NATIONAL SEMINAR

ON

DEVELOPMENTS IN SOIL SCIENCE – 2017

ABSTRACTS

82nd Annual Convention

Indian Society of Soil Science

11-14 December 2017

82nd ANNUAL CONVENTION

December 11-14, 2017
held at the
Amity University, Kolkata

Abstracts

Indian Society of Soil Science

National Agricultural Science Centre Complex
Dev Prakash Sastri Marg, Pusa, New Delhi -110 012
Phone : 0091-11-25841991; 25841529
Email: isss1934@gmail.com; isss.secretary@gmail.com
Web page : www.isss-india.org

ABSTRACTS: NATIONAL SEMINAR ON DEVELOPMENTS IN SOIL SCIENCE – 2017

December 2018

Edited by
D.R. Biswas
K.K. Bandyopadhyay
Sarvendra Kumar

Published on behalf of the Indian Society of Soil Science by:

Dr D.R. Biswas
Secretary, Indian Society of Soil Science
Ist Floor, National Societies Block
National Agricultural Science Centre Complex
Dev Prakash Sastri Marg, Pusa, New Delhi -110 012
Phone : 0091-11-25841991; 25841529
Email: isss1934@gmail.com; isss.secretary@gmail.com
Web page : www.isss-india.org

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Characterisation of Bilalgodu Micro-Watershed, Chikmagalur District, Karnataka

Kalaiselvi Beeman[1], Rajendra Hegde[1], R. Vasundhara[1], K.S. Anil Kumar, S. Dharmarajan [1], M. Lalitha[1] and S.K. Singh[2]

[1]ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Bangalore, 560 024, Karnataka

[2]ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur, 440 033, Maharashtra

A detailed soil survey at 1:10,000 scale was carried out in Bilalgodu micro-watershed of Kalasa block, Mudigere Taluk, Chikmagalur District in Karnataka, covering an area of 710 ha to understand the intrinsic pedogenic characteristics of soil representing mallenadu region of chikkamagaluru district. The major physiograpic units of the watershed are summit, undulating hills, side and foot slopes. Based on variation in landform, soil texture, colour, calcareousness and depth, five soil series were identified in the studied micro-watershed. Among the soil series identified, four soil series (S1 to S4) occur in the gently sloping to steep sloping upland areas (3-15% slope) and one soil series (S5) occur in the lowland area. In this watershed, S3 soil series (Moderately to strongly sloping (5-15%), very deep, reddish brown, gravelly, organic carbon rich) occurs extensively, occupying about 45.2 per cent area of the upland followed by S1 and S4. The series S1 and S4 combinly occupies about 367 ha of the watershed. The one lowland series (S5) occupy about 56.4 ha (7.9%) in the watershed. Five typifying pedons representing each soil series were analyzed for its physical, chemical and physico-chemical properties. The upland soils are developed over banded ferruginous quartzite schist and the lowland soils on colluvial parent material. They were deep to very deep, dark reddish brown to dark grayish brown, well drained, slightly acidic to very strongly acidic, medium to high in organic carbon and low to medium in cation exchange capacity with wide textural variations. Due to the variations in landform of the area, the soils have shown the difference in their development. The differentiated soils are grouped under 5 soil series and taxonomically classified into *Ustic Kanhaplohumults*, *Typic Kanhaplustults, Pachic Argiustolls, Ustic Haplohumults and Aquic Dystrustepts* respectively at sub group level.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Changes of Soil Properties under Different Land Uses in *Tarai* Region of West Bengal

D. Dutta[1], D.C. Nayak[1], S. Gupta Choudhury[1] and S.K. Singh[2]

[1]*ICAR- National Bureau of Soil Survey and Land Use Planning, Regional Centre, DK-Block, Sector-II, Salt Lake, Kolkata, 700091, West Bengal*

[2]*ICAR-National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur, 440033, Maharashtra*

The land use pattern in the study area has undergone a drastic change in recent past. In view of this, the present work has been carried out with the objectives of assessing the changes in total soil organic carbon (SOC) and nitrogen (N) induced by different land uses and correlation and regression between soil properties. The study area is situated between 88°102 to 88°452 E longitude and 26°352 to 26°552 N latitude with an elevation of 200 to 500 above MSL in the *tarai* area of Darjeeling district of West Bengal, India forming part of Teesta-Terai belt covering an area of 32000 ha. The climate of the area is warm per humid. Soil samples were collected from different sites under different land-use types: (i) dense forested area, (ii) tea (iii) natural fallow and (iv) cultivated area at the depths of 0–20 and 20–40 cm. The forest soils had the lowest bulk density value at the 0–20 cm soil depth followed by tea. Total soil organic carbon (SOC) in the surface soil (0 to 20 cm) varied from 4.45 g kg^{-1}in fallow to 22.60 g kg^{-1} in the forest and from 13.23 g kg^{-1} in tea to 14.70 g kg^{-1} in cultivated soils**.** At the soil depth of 20 to 40 cm forest soils also have the largest SOC (17.50 g kg^{-1}) followed by tea (10.62g kg^{-1}). Total soil N content increased from 0.37 g kg^{-1} in fallow to 1.91 g kg^{-1} in forest at the depth of 0 to 20 cm. The C: N ratio of different land use systems ranged from 8.1 to 13.3. The correlation data also showed that the bulk density was significantly and negatively correlated with clay content (r=-0.850**), silt (r=-0.613**).and positively and significantly correlated with sand (r=0.785**), medium sand (r=0.641**), fine sand (r=0.514**) and coarse sand (r=0.490**). Both SOC and total N contents in the upper 40 cm for all sites varied among different land uses. The largest SOC was observed in the top 20 cm soil layer within any land use which showed a decrease by 3% to 50% between 0-20 and 0-40 cm in depth. Agricultural land uses reduced C: N ratios, which usually ranged from 14 to 8**.** Regression study showed good relationship between SOC vs total N in the 0-20 cm and 20-40 cm depth. The study indicated that the land use pattern greatly affected the soil properties especially organic carbon, total nitrogen and C/N ratio.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Land Resource Inventory-based Land Use Plan Impact Assessment in Coastal Physiography of Eastern India, West Bengal

B.N. Ghosh*, Krishnendu Das, Siladitya Bandhyopadhyay, Subrata Mukhopadhyay and D.C. Nayak
ICAR-National Bureau of Soil Survey and Land Use Planning, Kolkata, 700091, West Bengal
**Email: bnghosh62@gmail.com*

Enormous constrains were found in coastal physiography for scientific land use plan preparation because of soils heterogeneity and biophysical factors. Concept of land management unit (LMU) was considered as important tools for land use plan owing to equal responses of similar management practices. Wide acceptability of soil resource mapping using soil series in a smaller scale is limited and also its impact assessment for crop suitability is controversial. To address these issues, land resource inventory (LRI) at large scale (1: 10,000 scale), crop suitability and impact assessment in different LMU for block level land use planning (LUP) were carried out in costal physiography of eastern India, Kuntali block of West Bengal. The impact assessment of LRI based LUP was exercised to develop efficient crop planning with best possible management practices. Details soil survey of the block indicated that the area was broadly under Inceptisols orders; two great groups of *Endoaquepts, Haplustepts,* eleven soil series and five land management units (LMU). LRI based LUP revealed that average annual net returns increased by 116.2%, irrespective of land use compared to traditional practices. Productivity and net returns can be increased several folds if customized recommended practices were adopted by the farmers. It has been concluded that customized recommended management practices played major role in boosting production and income in this ecosystem soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Characterization of Some Salt-affected Soils of Punjab for Reclamation and Management

A.K. Mandal
Central Soil Salinity Research institute, Zarifa Farm, Kachhwa Road, Karnal, 132001, Haryana

Salt affected soils in Punjab occupied large areas of south-west and central regions and vary widely in salt composition, internal drainage and pedogenic processes. The sodic (RSC) ground water enhanced salt enrichment and poor productivity. Ten soil profiles were collected from old and recent alluvial plains covering seven districts and analyzed to assess precise reclamation and management options. In the irrigated areas, waterlogging occurred in sandy alluvial plain (Pedon 1 and 2) showing loamy sand to sandy loam soil texture, low CEC and the significant contents of $CaCO_3$ calcretes (15.5%) at 0.5 m depth. The Na^+, Cl^-, $SO_4^{2-}$and at places Ca^{2+} and Mg^{2+} salts are dominant and indicated saline nature. Sodic soils (Pedon 3 and 4) were located in the recent alluvial plain that showed high pHs (9.3 to 9.9), ESP (72.1 to 81.0) and higher contents of Na^+, CO_3^{2-} and HCO_3^- salts. Sodic soils (Pedon 5 and 6) were also located in the old alluvial plain under canal irrigation, that showed high water table depth (2.0m), high pHs (8.8 to 9.1), surface salt content (ECe 20.8 dS m^{-1}), ESP (54.1 to 81.2). The blocky soil structure indicated impermeable soil strata and Na^+ saturation of soil matrix. At places, sodic soils were reclaimed (Pedon 7, 8 and 9) to low surface pHs (8.6) and used for rice-wheat. In the sub-surface layers these soils showed higher pHs (9.0 to 10.2) and higher contents of Na^+, CO_3^{2-} and HCO_3^-. Barren sodic soil (Pedon 10) was located in the old alluvial plain of central Punjab showing brackish ground water with high RSC. Sodic soils were also located in the Ghaggar plain of Patiala district showing moderately pHs (8.9 to 9.2), ESP (64 to 76), $NaHCO_3$ content (5.0 to 5.5 me L^{-1}) and SAR (46 to 52). Suitable management options and alternate land uses were suggested for growing salt tolerant crops, horticulture and forestry plantations with proper water management practices.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Land Characterization and Soil-site Suitability of Bidanagere Micro-watershed, Tumkur District, Karnataka for Horticultural and Plantation Crops

V.R. Ramakrishna Parama, G.P. Geetha, G.M. Veerendra Patel and A. Sathish
Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, GKVK, Bangalore, 560065, Karnataka

The study and understanding of soil physical and chemical properties and their distribution over an area has proved useful for the development of soil and crop management plan for efficient utilization of limited soil resources. Land resource inventory of Bidanagere micro watershed (649 ha) which is situated between 77°4′47.99″ to 77°6′35.94″ E longitude and 13°8′45.6″ to 13°10′40.8″ N Latitude, Tumkur district, Karnataka was made using geospatial techniques. Cadastral map at 1:7,920 scale was used as base map for the study. The satellite image (Cartosat-1, PAN 2.5 mts, Resourcesat-2 LISS-IV MX merged image) along with survey of India toposheet were used for delineation of land forms and physiographic units. Transects were identified in different landforms in which soil profiles were studied. Soil samples of horizons were analysed for various physical and chemical properties. Soil map indicating twenty nine phases were prepared. Soil analysis indicated that slightly acidic to alkaline pH (5.93 to 7.79), electrical conductivity was normal (0.10 to 0.86 dS m^{-1}), organic carbon was low to medium (0.11 to 0.71%). The exchangeable Ca (6.40-19.01 cmol(p^+)kg^{-1}), Mg (3.20-9.9 cmol(p^+)kg^{-1}), Na (0.16-0.93 cmol(p^+)kg^{-1}) and K (0.04-0.33 cmol (p^+) kg^{-1}) were in the descending order in upland and lowland profiles. The land suitability for horticultural crops like mango, sapota, guava, custard apple and jackfruit and plantation crop like coconut and areca nut was worked out. More than half (57.5%) 373 ha of the micro watershed is highly suitable (S1) for cultivation of mango, sapota, coconut, arecanut and jackfruit. Further, 63.53% and 61.55% of area is highly suitable (S1) for custard apple and guava respectively. The database on soils of Bidanagere can serve as a important advisory for suggesting appropriate crops and suitable intervention in order to increase production.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Impact of Land Management Variations on Soil Characteristics and Productivity

M.S. Kahlon and C.B. Singh
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab

Land management variations produces different impacts with passage of time on soil physical characteristics and crop productivity. This study was conducted to improve the understanding of these variations on rice-wheat productivity and soil water transmission characteristics. Three major tillage operations, namely, deep tillage before rice, deep tillage before wheat and conventional tillage in both rice and wheat were kept in main plots, while the secondary operations including both no-tillage with residue and conventional tillage in wheat and direct seeded rice and puddled transplanting in rice were kept in sub plots. Deep tillage showed positive effects on soil water transmission and crop yields. Among tillage practices deep tillage before rice and wheat results in 12% and 15% more yield than conventional tillage practice performed in both crops. The puddled transplanted rice out yielded direct seeder rice by 13% and conventional tillage in direct seeder rice produced 20% more yield than happy seeder in direct seeder rice. Maximum rice straw yield was recorded in conventional tillage - puddled transplanted rice combination, while that of wheat was recorded in happy seeder - puddled transplanted rice combination. Soil mechanical properties with respect to bulk density and penetration resistance showed significant decrease in both the deep tillage practices than conventional tillage. However, the infiltration rate showed significantly higher values by 17% in deep tillage before rice and 21% in deep tillage before wheat plots than conventional tillage plots.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Characterization of Flooded-Drained (FD) Potential Acid Sulfate Soils of Gosaba Island under Coastal Eco-system of Sundarbans, India

K.D. Sah[1], S. Pal[1], S.K. Reza[1], D.C. Nayak[1] and S.K. Singh[2]
[1]*ICAR- National Bureau of Soil Survey and Land Use Planning, Regional Centre, DK-Block, Sector-II, Salt Lake, Kolkata, 700091, West Bengal*
[2]*ICAR- National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur, 440033, Maharashtra*

Gosaba Island under under coastal ecosystem of Sundarbans is located in between 22°17′11″ to 21°32′13″ N latitude and 88°42′15″ to 89°6′15″ E longitude, converting an area of 1992.8 km^2 on an average elevation of 4 meter. Potential acid sulfate soils of Gosaba Island are flooded during monsoon and drained after 3 months possess serious problems of soil acidity, soil salinity and low productivity. During soil resource inventory of Gosaba Island on 1:10,000 scale five soil series namely Uttardanga, Pakhirala, Dayapur, Birajnagar and Bali were identified. The data revealed that all the soils are very deep, poorly drained, dark gray to gray in surface matrix and yellowish brown to olive yellow in subsurface mottles. Texture varied from silt loam to silty clay on the surface and clay loam to silty clay loam in the sub-surface having a distinet variation with respect to salinity, acidity and occurrence of acid sulfate layer in the subsurface soils. pH_w ranged from 4.5 to 6.6 on the surface and 3.3 to 5.4 in the sub-surface whereas the pH_{H202} varied from 3.5 to 5.5 on surface and 2.2 to 4.6 in the sub-surface sols reflecting the substantial amount of oxidizable sulfer in sub-surface soils. Acid sulfate layers were observed at the depth of 45 to 82 cm in Pakhirala, Birajnagar and Bali series. Cation exchange capacity of the soils varied from 11.2 to 17.6 cmol(p$^+$)kg^{-1} in all the soils. Exchangeable Ca^{2+} was the dominant cation in the exchange complex followed by Na^+, Mg^{2+} and K^+ in all the series. Available N and K ranged from 338 to 553 kg ha^{-1} and 342 to 513 kg ha^{-1} in surface and 146 to 599 kg ha^{-1} and 319 to 576 kg ha^{-1} in subsurface soils of Uttardanga, Pakhirala, Birajnagar and Bali series whereas lower values (147 to 282 kg ha^{-1}) of available N was observed in Dayapur series. Available P remained low and varied from 1.2 to 21.6 kg ha^{-1} in all the series. Available S and DTPA extractable Zn, Cu, Fe and Mn were found to be above critical limit varied from 0.87 to 3.20 mg kg^{-1}, 1.97 to 6.31 mg kg^{-1}, 18.6 to 314.7 mg kg^{-1} and 6.1 to 36.6 mg kg^{-1} respectively. The pH of soils was significantly correlated with exchangeable $A1^{3+}$ ($r = -0.74$), available S ($r = -0.73$) and available Fe^{2+} ($r = -0.58$). Availability of phosphorus with 120 days flooded-drained (FD) condition maintaining in laboratory by adding 50, 100, 150, 200, 250, 300, 400 and 500 mg kg^{-1} of phosphorus revealed that the availability of P was maximum with 100 mg kg^{-1} of phosphorus thereafter fixation of phosphorus increased with its higher doses and incubation period. The findings may be due to the high concentration of Fe increased the surface area of the soil facilitating the phosphorus absorption in flooded condition of soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Characterization and Mapping of Groundwater in Salt Affected Agroecosystems of Ghaghar Plains

Arijit Barman, P. Sheoran, S. Kumar, R.K. Singh, L.K. Tripathi and R.K. Yadav
ICAR- Central Soil Salinity Research Institute, Karnal, 132001, Haryana

Indiscriminate use of groundwater for exploiting harvestable potential in rice-wheat cropping system, negligible efforts for groundwater recharging and faculty agricultural practices in Ghaghar plains of Haryana is adversely impacting agricultural productivity and livelihood security. A total of 283 water samples were collected during 2016-17 on grid basis (500 m x 500 m) for quantification and characterization of water quality for its optimal irrigation usage and to prepare geo-referenced digital stratified thematic maps delineating poor quality groundwater problematic areas in the five villages (Mundri, Kathwar, Geong, Sampli Kheri and Bhaini Majra) of Kaithal district. The frequency distribution revealed 38.14% samples had pH more than 8.2, indicating potential alkali hazards upon use of available groundwater for irrigation purpose. About 91% of the collected water samples were confirmed with residual alkalinity (RSC>2.5 meq L^{-1}) in irrigation water while 11% samples are having salinity problems of varying nature (EC 2-4 dS m^{-1}). Village-wise frequency distribution for occurrence of alkali waters further highlighted 75% samples with high RSC (>4 meq L^{-1}) following the order of: Kathwar (84.5%)>Sampli Kheri (63.6%)>Geong (56.9%)>Mundri (56.3%)>Bhaini Majra (45.5%). Ordinary kriging map using Arc-GIS software at 1:50.000 scale considering water quality parameters (EC, pH, SAR and RSC) for irrigation purpose indicated only 8.18% area (R^2 = 0.99; $p<0.05$) having good quality water resources, further confirmed the ground truth data as defined by GPS based water sampling. Therefore, irrigation water management is the key management issue need to be strongly addressed by holding strong farmers-scientist interface, strengthening farmers participatory research and extension network, suggesting suitable adaptation (salt tolerance varieties) and mitigation (neutralization amendments) strategies to further control degradation (soil sodicity) trends and secure sustainable land management in salt affected agroecosystems.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Resources of Tangi Block, Khurda District, Odisha - Their Assessment for Formulating Agricultural Landuse Plan

K. Das*, S. Mukhopadhyay, B.N. Ghosh, Shreyasi Gupta Chaudhury, D.C. Nayak and S.K. Singh[1]

ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Sector-II, Block-DK, Salt Lake, Kolkata, 700091, West Bengal

[1]ICAR-National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur, 440010, Maharashtra

**Email: das_krishnendu@hotmail.com*

The Tangi block of Khurda district, Odisha covering 44169 ha occurring in the hot moist subhumid agroecological subregion (AESR 12.2) developed on gneissic complex of pre-cambrian origin with metamorphosed achaean formations comprising khondolites, charnokites forming the basement along with quaternary alluvium deposits was selected to develop block level Land Resource Information System (LRIS) in GIS environment. Visual interpretation of IRS LISS-IV data followed by digital terrain analysis using open source SRTM-DEM using spatial analyst tool lead to delineation of five major landforms in the block viz., hills, upland, valley, alluvial plain and coastal plains. The land use data of the block shows that forest lands occupied 11.4% of TGA of the study area while agricultural lands under single cropped lands are predominant in the study area, occupying 36.5% of TGA and double crops were only confined to 6.4% of TGA of the block.

Forty two Landscape Ecological units (LEU) were identified by interpreting various land uses with the landforms at different slope conditions. Based on detailed soil survey on 1:10,000 scale, fifteen soil series have been identified and they are mapped into eighteen soil phase units. Based on soil taxonomy, the soils are classified under loamy- skeletal, coarse loamy, fine loamy and fine textural classes under Ustorthents, Haplustepts, Endoaquepts and Rhodustalfs, Haplustalfs and Paleustalfs great groups. Chemical properties of the surface soils show that moderately acidic soils pH 4.5-5.5 occur in about 39% of TGA while soils having medium organic carbon content (0.5-0.75%) covers 54% of TGA. About 37% of TGA are having moderate to severe erosion constraints while soils with poor to imperfect drainage conditions occur in about 21% of TGA.The major constraints are soil acidity,low to medium organic matter, which along with erratic rainfall and undulating topography adversely affects the crop growth and productivity.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Resource Mapping of Dumka Block, Dumka District, Jharkhand for Perspective Land Use Plan

A.K. Sahoo*, D.C. Nayak, S.K. Gangopadhyay, S. Bandyopadhyay, S. Gupta Choudhury and S.K. Singh[1]

ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Block-DK, Sector-II, Salt Lake, Kolkata, 700091, West Bengal

[1]ICAR-National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur, 440 033, Maharashtra

**Email: sahooak2007@gmail.com*

The soils of Dumka block (37950 ha.) of Dumka district, Jharkhand developed on an undulating tract of granite-gneiss landscape of Chhotanagpur plateau are characterised, classified and mapped on 1:10,000 scale using IRS RESOURCESAT-II LISS IV image. The block is under sub humid sub tropical climate (AESR 12.3) with mean annual temperature of 24° and mean annual rainfall of 1350 mm. The soil moisture and temperature regimes are *Ustic* and *Hyperthermic* respectively.

Fifty Land Ecological Units (LEU) are identified in the block by integrating 17 landforms, 7 land use and 6 slope classes. The soils are mapped into 34 mapping units at phases of 14 soil series. The most extensive soil order identified is *Alfisols* (85.0%) followed by *Inceptisols* (10.8%) and *Entisols* (4.2%). The soils of hilly terrain are shallow to moderately deep, well to excessively drained, loamy skeletal to fine loamy in texture, strongly to very strongly acidic (pH 4.6 to 5.4) and are classified as *Lithic Ustorthens/ Haplustepts/Haplustalfs, Typic Haplustepts/Haplustalfs.* Soils occuring on undulating plateau and undulating uplands are shallow to very deep, well drained, loamy skeletal to fine (15.4 to 42.5% clay) in texture, moderate to strongly acidic (pH 5.2 to 6.0) and are classified as *Typic Haplustalfs/Paleustalfs/Rhodustalfs/ Haplustepts* and *Lithic Haplustepts/Haplustalfs.* Soils of low lands (*Don*) and depressed land are deep to very deep, imperfectly to poorly drained, fine loamy to fine in texture, (26.4 to 54.1% clay), neutral to slightly acidic (pH 6.0 to 7.1) in subsoil with strong to very strongly acidic surface (pH 4.6 to 5.3) and are classified as *Oxyaquic Haplustalfs*, *Aeric Epiaqualfs and Typic Haplustepts.*

Moderate to steep slope (29.1% TGA), moderately shallow to very shallow soil depth (16.1% TGA), sandy loam surface texture (68.5% TGA), severe to very severe erosion hazards (34.1% TGA) and strong to extremely acidic (pH <5.5) soils (68.9% TGA) are the major limitations for growing the crops. Majority area (54.6%) of the block is under land capability classes III and 40.8% area of the block are under land irrigability classes 3. Evaluation of soil site suitability data revealed that millets, citrus, cashew, ground nuts and cabbage are highly (S1) to moderately suitable (S2) and rainfed upland rice, maize, wheat, pea, pigeon pea, mustard/rapeseed, sesame, guava, mango, pineapple, potato and tomato are moderately (S2) to marginally (S3) suitable in majority area of the block except the soils of hilly terrain. Nine land management units (LMU) are identified based on the problems and potentials of the area. A suggested land use option is developed in different land management units towards increasing the productivity.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Spatial Distribution of Organic Carbon and Available Nutrients in the Soils of RRS Bawal, Haryana

Dinesh*, Mohammad Amin Bhat, K.S. Grewal, Anurag and Parmod Yadav
Department of Soil Science, CCS HAU, Hisar, 125004, Haryana
**Email: dineshtomarhau@gmail.com*

A detailed soil survey of Regional Research Station (Bawal) was carried out to study the spatial distribution of organic carbon and available nutrients. Fifty six surface soil samples were collected and analyzed for various properties. The locations of the samples were recorded by using handheld GPS. The soils were neutral to alkaline in reaction. The pH and EC (1:2) ranged from 7.0-8.6 and 0.03-0.24 dSm^{-1}, respectively. Organic carbon, available nitrogen, potassium and phosphorous varied from 0.13% - 0.78%, 63.0-112.0 kg ha^{-1}, 84.0-550.0 kg ha^{-1} and 6.0-34.0 kg ha^{-1}, respectively. Among the micronutrients, zinc, iron, manganese and copper varied from 0.42-2.92, 4.00-20.80, 4.46-16.22 and 0.40-4.80, respectively. The soils were low in available nitrogen and low to medium in organic carbon, potassium and phosphorus but exceeded in few samples. Among micronutrients, soils were low to high in zinc and moderate to high in other micronutrients. Therefore, the soils of the research station need fertilization in order to sustain the fertility of the soil. The soil analyses data were fed into GIS Software and spatial distribution maps were generated.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Erosion Probability Zone Mapping using Remote Sensing and GIS: A Case Study of Mahanadi River Basin

Sourav Roy, Bhabani S. Das and Somsubhra Chakraborty
Agriculture and Food Engineering Department, Indian Institute of Technology, Kharagpur, West Bengal

For planning and conservation works in agricultural management perspective, it is very important to assess the soil loss caused by rainfall. Environment and human sustainability also directly affected by Soil erosion. In this study, Revised Universal Soil Loss Equation (RUSLE) integrated with GIS has been used to estimate soil loss in Mahanadi river basin. The Mahanadi basin extends over states of Chhattisgarh and Odisha and comparatively smaller portions of Jharkhand, Maharashtra and Madhya Pradesh which is nearly 4.3% of the total geographical area of the country. The parameters of RUSLE model were estimated using remote sensing data and the erosion probability zones were determined using GIS. For identifying and mapping the vulnerable areas to soil erosion, various thematic maps were prepared and integrated into GIS. Major factors like land use-land cover, soil properties, rainfall, and slope that are considered to be influence soil erosion were included and finally, the probability zone map has been derived by the weighted overlay index method.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

An Appraisal of Sulphur and Micronutrient Fertility Status of Soils of Tiruchirappalli District of Tamil Nadu using GIS And GPS Techniques

Abhishek Amar and R. Shanmugasundaram
Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu

Micronutrients are as essential as macronutrients but required in smaller quantities by plants. Micronutrients deficiencies which were sparse and sporadic in early days are wide spread nowadays. It has been reported that the occurrence of Zn, Fe, Cu and Mn deficiencies was to an extent of 49%, 12%, 5% and 3%, respectively in India (Singh and Saha, 1995). The soil nutrient concentrations may be reported as index values. The concept of Soil Nutrient Index can be used to predict soil fertility levels or potential heavy metal toxicities. Also, the index provides a common scale for judging nutrient supply and balance in the soil (Hardy *et al.,*2008). Keeping the above points in view, a study was undertaken to assess the sulphur and micronutrient status in the soils of various blocks of Tiruchirappalli district of Tamil Nadu.

The district of Tiruchirappalli, extending over an area of 4,40,383 ha of land. A total of 1,584 geo-referenced surface soil samples from 14 blocks of Tiruchirappalii district were collected randomly at 0 - 15 cm depth by adopting the standard procedures of soil sample collection. Analytical results were used for calculation of percentage deficiency on sulphur and micronutrients, assessment of nutrient index and fertility rating.

The results revealed that the surface soil samples of Tiruchirappalli district were red loamy, acidic to alkaline in reaction with salinity level of harmless in condition, low to medium in organic carbon per cent and free calcium carbonate content of non calcareous to moderately calcareous in nature. The available sulphur content was low to high status with 11.59 percent of samples. Zinc deficiency was the predominant in majority of soil samples (63.82%) followed by Cu (40.11%), B (16.18%), Fe (4.99%) and Mn (3.82%). Regarding fertility rating class in Tiruchirappalli district, the available zinc and copper were very low. The available manganese, iron, sulphur and boron were found to be under high category.

The overall data on sulphur and micronutrient status of Tiruchirappalli district suggest that soils are severely deficient in available zinc and copper. To alleviate the deficiency, micronutrient fertilizers of these nutrients at recommended level could be adopted for maximizing the productivity of crops.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Geo-referenced Micro, Secondary and Pollutant Elements Status in Soils of Dumka District of Jharkhand

B.K. Agarwal, Manas Denre, Ruplal Prasad, D.K. Shahi and Arvind Kumar
Department of Soil Science and Agricultural Chemistry, Birsa Agricultural University, Kanke, Ranchi, 834006, Jharkhand

In recent year, adoption of high yielding varieties, imbalance use of nutrients coupled with limited use of organic manures, less recycling and burning of crop residues, soil erosion and undulating topography led decline the micro and secondary nutrients status in soil and adversely affected the productivity of crops. Therefore, present investigation was undertaken to delineate the status of micro (B, Zn, Cu, Mn and Fe), secondary (S, Ca and Mg) and pollutant (Pb, Ni, Co and Cd) elements in soils of Dumka district of Jharkhand.

Dumka is one of the oldest districts of Jharkhand state under Santhal Parganas region. It is bounded by Godda and Banka district in the north, Pakur in the east, West Bengal in the south and Jamtara and Deoghar in the west. Total geographical area of the district is about 4410 km^2 and population of 17,54,571 persons. The district comprises one subdivision namely Dumka and there are 10 blocks *viz.*, Dumka, Gopikander, Jama, Jarmundi, Kathikund, Maslia, Ramgarh, Raneshwar, Shikaripara and Saraiyahat. It has an agriculture based economy. Agriculture is characterized by mono cropping. The district has a total cultivated area of 1,97,124 ha. Net sown area is 1,28,126 ha. and only 11,532 ha. is irrigated (*i.e.*, 15% of the net cropped area). The average rainfall varies from 1300 to 1400 mm. The district experiences a prolonged dry period during January to May which keeps the soil dry for more than 90 days. Paddy based primary cropping system is in practice in the district, while vegetables, mustard and pulses also in practice as secondary cropping system near water resources.

Total 251 geo-referenced surface (0.0-15.0 cm) soil samples were collected from different blocks of Dumka district using GPS (Garmin Vista Cx). Soils were strongly acidic to neutral in reaction (pH 4.04-7.50) with electrical conductivity ranging from 0.03 to 0.80 dS m^{-1} and organic carbon content varied from 2.0 to 10.0 with mean value of 6.0 g kg^{-1}. About 46.6% soils were found medium status of soil organic carbon. DTPA extractable cationic Zn, Cu, Fe and Mn content were well sufficient in all analyzed soil samples. A wide variation of B (0.09 to 0.98 mg ka^{-1}) and S (1.01 to 31.00 mg kg^{-1}) contents were observed in soils of Dumka district with mean value of 0.45 and 9.05 mg kg^{-1}. On the basis of <0.50 and <10 mg kg^{-1} critical limit of B and S in soil 64.54% soils were found deficient in B and S. Calcium and magnesium contents in soils were varied from 0.34 to 4.35 and 0.047 to 0.262 with mean value of 1.65 and 0.208 cmol(p^+) kg^{-1}, respectively. Pb, Ni and Co contents in soil of Dumka district varied from 0.14 to 5.46, 0.84 to 5.60 and 1.40 to 5.92 mg kg^{-1}, respectively. Hence, deficiencies of B and S are most common in Dumka district soils. Straitening involving the soil/foliar application of B and S or use of organic manures can be adopted to sustain an optimum yield potential and enhanced their content in soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Characterization and Classification of Salt-affected Soils of South 24 Parganas, West Bengal using GIS and Remote Sensing Technique

Dolan Champa Sarkar[1]*, P.P. Mitranag[1], S. Roychowdhury[1] and V.S. Arya[2]
[1]Soil & Land Use Survey of India, Ministry of Agriculture & Farmers' Welfare, Government of India, Kolkata Centre, E. Block, BP Township, Kolkata, 700 094, West Bengal
[2]Soil & Land Use Survey of India, Ministry of Agriculture & Farmers' Welfare, Government of India, IARI Buildings, New Delhi, 110 012
**Email: sarkardolanchampa@gmail.com*

Soil is the basic natural resource for existence of mankind. Maintenance of soil health for higher productivity to feed the ever increasing population on sustainable basis is a herculean task in a country, like India, where the Landscape, Soil & agro-climate condition are extremely variable. The challenge is being faced not only of increasing productivity per unit area on sustainable basis but also of the preserving and maintaining of soil resources. It is desirable for any planning, management & monitoring at local, regional & national level, to have the scientific data base.

The South 24-Parganas district of West Bengal suffers salt affliction and water logging problem, so it is imperative to have information about location, extent and spatial distribution of different soils condition to mitigate these problems. To achieve this goal, identification & mapping of soil is prerequisite. Remote sensing & GIS has emerged a powerful tool in providing reliable has information on soil resources at different level of details. Monoscopic visual image interpretation technique has been followed to prepare Soil Resource map of 24 Parganas (South) District, West Bengal. The Indian Remote Sensing Satellite IRS-ID, LISS-III, gecoded False Colour Composite (FCC) on 1:50,000 scale of the month of February 2005 was used for image interpretation.The Survey of India toposheets on 1:50,000 scale had been used as a base map to prepare final soil map. Landscape boundaries had been drawn on the base map using SOI toposheet. The Land use/Land cover map was prepared by drawing broad land use / Land cover classes shown on topographical sheets and updated with the help of satellite imagery.

The morphological characteristics and physico-chemical properties associated with other land features like physiography, slope, land use / land cover, coastal salt affected land, calcareousness, erosion hazards are the basis of interpretation of soil into different interpretative groupings such as Land Capability Classification, Soil irrigability Classification, Land irrigability Classification, Hydrological grouping. Accordingly thematic maps are prepared using ARC GIS 10 software.

The objective of this study is to evaluate the available land resource as well as to assess the limitation and the potentialof the soilsof the study area. The parameters taken into consideration were 12 thematic maps i.e., physiography, soil, coastal salt affected land, waterlogging area land use/land cover, erosion, management, texture, land capability, soil irrigability, land irrigability and hydrological soil grouping maps. The study demonstrates that the area can be categorized into spatially distributed agriculture potential zones based on the soil properties, terrain characteristics and analyzing present land use. This approach has the potential as a useful tool for guiding policy decision on sustainable land resource management.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Mapping of Available Soil Nutrient Status in a Rainfed Area of Dhabani Village, Puruliya District, West Bengal using Remote Sensing and GIS Technique

S. Roychowdhury[1]*, Subhankar Tudu[2], DC Sarkar[1], PPM Nag[1] and VS Arya[3]

[1]*Soil & Land Use Survey of India, Ministry of Agriculture & Farmers' Welfare, Government of India, Kolkata Centre, E. Block, BP Township, Kolkata, 700 094, West Bengal*

[2]*Calcutta University, West Bengal*

[3]*Soil & Land Use Survey of India, Ministry of Agriculture & Farmers' Welfare, Government of India, IARI Buildings, New Delhi, 110 012*

**Email: roychowdhuryswapan8sr@gmail.com*

In India, about 60% of total net sown area comes under rainfed condition. Rainfed crops account for 48 percent area under food crops and 68 percent under non-food crops. Soil is the most vital and precious natural resource that sustains life on the earth. So, its systematic study is needed mostly with a vision to use it in a sustained manner. In India, out of the total cultivated land area of 142 million hectares (Mha), about 105 Mha suffers from different forms of degradation. So, maintenance of soil health is utmost necessary to protect the soil from any kind of further degradation.. Mapping of spatial variability of soil nutrients and its quality is important to assess the quality of soil. Remotely sensed database is beneficial for monitoring of agricultural production. It gives the accurate information of agricultural activities such as different crop identification and classification, crop condition monitoring, crop growth, crop area and yield estimation, mapping of soil characteristics and precision farming. Information from remotely sensed satellite imagery, geographic information system and global positioning system allows farmers to carry only affected areas of a field. The limitations and potentials of soils should be assessed using geo-informatics for sustained agriculture production. This study attempts to review applications of Geo- informatics on soil nutrient availability vis- a -vis soil fertility evaluation in soils of Rain fed area of Purulia, West Bengal for precision farming. Thus implementation of Remote sensing, GPS and GIS for soil nutrient assessment in soils of Rain fed area is imperative to increase sustainable agriculture production. The fertility maps are useful tools to know about land resources. These maps are essential to do a correct fertilizer recommendation, monitoring the changes of soil fertility level and to prediction of toxicity or deficiency of necessary plants nutritional elements in soil.

A study was conducted in the district of Purulia (Rainfed area) to map the soil nutrient availability using GIS software under different agricultural practices. The objective of this study was to prepare detailed maps using GIS for the soil fertility assessment of the region and to link the status of fertility with agricultural practices. Soil samples were analyzed for soil texture, electrical conductivity, pH, organic carbon, available NPK and micro nutrients (Zn, Cu, Fe, Mn). The data regarding fertilizer application, cropping pattern, crop rotation and irrigation practices were also collected from the farmers. Nine surface samples (GPS based) collected from the farmers' fields were analyzed to evaluate fertility status and mapping was done using geographic information system (GIS) technique. The pH of soil samples was strongly acidic to neutral. Soil organic carbon content was low to medium, Available NPK was low, and Sulphur was low to marginal. Regarding available micronutrients, zinc low to marginal whereas, copper was marginal to adequate, iron and manganese were adequate in these soils. The mapping of available nutrients using ArcGIS clearly shows that the availability of nutrients are location specific and nutrient management is imperative besides assured irrigation in this Rain fed area.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Multi-criteria Analysis for Area Prioritisation by Integrating Various Soil Parameters under GIS Environment

S. Mukhopadhyay[1]*, D.C. Nayak[1] and S.K.Singh[2]
[1]ICAR-National Bureau of Soil Survey and Land Use Planning, Sector-II, DK-Block, Salt Lake, Kolkata, West Bengal
[2]ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur, Maharashtra
**Email: subratajee@hotmail.com*

Multi-criteria analysis is a technique used in the present study to characterise the lands and identify the best suitable and also the most critical land so that appropriate conservation methods may be recommended. The parameters that are selected for analysis are present land use, erosion, land capability classification, storie index and soil productivity index (Riquier model). All the functional units (parameters) have been assigned with their influence and also their classes are ranked. These parameters are chosen because they are derived through analysis of several other parameters and encompass various attributes that influences the characterization of land. Soils have been mapped under nine physiographic divisions under which 16 soil series were identified and were demarcated in 22 mapping units. Each mapping unit contains association 2 or 3 soil series. Land capability classes for both dominant and the subdominant soils have been evaluated and are grouped as their associations into 12 classes where 51% of the area falls under class 1 and 2. More than 33% of area depicts high degree of erosion (>15 t ha^{-1} y^{-1}). Storie index reflected that all the very good to good quality lands are in the alluvial plains which comprises of nearly 44% of the study area. Land productivity index showed moderately good to good lands comprised of nearly 50% area. Scores are assigned to each class of the selected themes which ranged from 1 to 9. Since erosion is one of the prime controlling factors for prioritization, it has been assigned maximum weightage of 40 percent. Riquier model for productivity and Storie Index has been given a weightage of 20 percent each. Land capability class and slope were assigned 10 percent each. The analysis was run with the Arcinfo software and the results were clubbed into six priority classes based on the overall combined scoring.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of Land Degradation in Harve Sub-watershed, Chamarajanagar District using Geospatial Techniques

Sathish, A., Prabhudev Dhumgond, Shruti, Y. and Ramakrishna Parama V.R.
Department of Soil Science and Agricultural Chemistry, UAS, GKVK, Bangalore, 560065, Karnataka

Land degradation leads to alteration in ecological and economic functions further leads to decrease in productivity and quality of the land. The aim of the study is to assess land degradation with the help of geospatial technology - remote sensing (RS) and geographical information system (GIS) in Harve sub-watershed, Chamarajanagar district, Karnataka. Harve sub-watershed consists of six micro watersheds viz: Kumachalli-2, Kumachalli-1, Kuttegaudanahundi, Kengaki, Bettadapura and Sagde with the total area of 2680ha. Soil samples from Harve sub-watershed in southern dry zone of Karnataka were drawn at 250 m grid interval and assessed for their physico-chemical parameters. The severity of land degradation was estimated by analyzing the physico-chemical parameters in the laboratory and correlating them with interpretation of satellite imagery. Soil maps were prepared for each parameter under GIS environment using Arc GIS v 10.4. Four indicators were used for assessment such as soil erosion, soil slope, soil graveliness and soil pH. The assessment was done considering the area (ha) affected by individual parameter. Mapping of results on the GIS platform revealed that, 735 ha and 47 ha is subjected to moderate and severe erosion, respectively and 1610ha has very gently sloping land (1-3%) indicating immediate need for soil conservation measures to reduce the soil loss, 1331 ha has 35-60 per cent gravels reducing the choice of crops. Further, 914ha and 126ha of land has moderately and strongly alkalinity, respectively. These soils need immediate attention for their management to arrest further degradation. From the study it can be concluded that, the present scenario of land degradation in the area is very alarming and needs proper land use planning and management, thus providing the utility of geo- spatial technology for assessment of land degradation.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Combined Use of Legacy Data an Geospatial Tools for Upscaling Soil Resource Information-A Case Study of Digital Soil Type Mapping in Goa State

S. Chattaraj*, S.K. Singh, V. Ramamurthy, A. Daripa, G.P. Obi Reddy and R. Srivastava
ICAR-National Bureau of Soil Survey & Land use Planning, Nagpur, 440033, Maharashtra
**Email: Chattaraj.iari@gmail.com*

The critical function of soils being provision of food, fiber, and ecological support in an increasingly populous country are threatened as a result. To address manifold issue of climate change, soil degradation and nutrient depletion, the broad community of scientists, policy makers and farmers are intensely looking to the soil science community for relevant and comprehensive information about the type and status of spatial soil resources. However, the soil information available in India is at a smaller scale of 50K and 250k. The incompatibility largely stems from scale dissimilarity. That is why in recent period, there is a strong need being felt to update the existing soil information. The advancements in the emerging Remote Sensing and GIS and digital soil mapping (DSM) techniques are found to be handy to derive tools addressing the above mentioned problem. In this study, we propose a novel innovative approach to address the issues on evaluating the traditional soil map and updating existing small scale (50k) soil information to large scale (10k) based on the principles of DSM i.e. deriving objective soil information by reformulating the relationships between soil and its environmental co-variables using ancillary and minimal dataset approach.

The Pilot study is taken for the entire Goa state covering an area of 3702 sq km and its varied geology, landform and vegetation occurrence are reflected in the development of a variety of soils here. The approach for digital soil type mapping involves. 1. Mining of Legacy data 2. Digital terrain analysis 3. Upscaling of legacy information to 10k scale 4 Mono-series mapping through DSM on 10k scale (we adopt the digital soil mapping concept at this stage for deriving monoseries based soil information; The hypothesis in this case study is that in a given set of conditions i.e. state factors of climate, time and geology; had been already well taken into consideration while preparing 50k scale soil resource information and the soil type (series in pedological term) variability is largely governed by the remaining state factors of s,o r and n) 5.

Accuracy assessment, Cartosat-1 stereopair data were processed to generate the digital terrain model (DTM) of 10m spatial resolution using rigorous math model and incorporating sufficient ground control points (GCPs). The digital analysis of DTM layer were done to generate the maps of contour, drainage, slope and hillshade to be used as inputs for landform delineation. The DTM is also used for ortho-rectification of IRS-R2 LISS-IV data. The detection rate of more than 90% is observed while comparing 50k data to 10k scale. The degree of complexity in state factor minimum dataset based identification of monoseries occurrence in its ascending order is as follow: “o” factor > “r” factor > “n” factor > “s” factor. The pre and post field soil map displayed 75% accuracy based on the confusion matrix analysis. The soil forming factor based fuzzy membership function curve are also generated as an input for digital soil type mapping of respective series. In total 33 soil series were identified in the Goa state: Overall this is a Data Mining and Knowledge Discovery based method derived by fusing Remote Sensing. GIS and DSM techniques. The upscaling methodological framework developed for the state of Goa may be a model study for updating the soil resource information of other states of the country as well in a detailed, cost-effective, time bound and accurate manner.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Establishing Relationship between Plant Nutrient and Diseases Incidence by Spatial Analysis in Pomegranate

H.B. Raghupathi*, S. Srinivas and V.M. Shilpashree
ICAR- Indian Institute of Horticultural Research, Hessaraghatta, Bangalore, 560089, Karnataka
**Email: hbraghu@iihr.res.in*

Integrating nutrient levels in plant with the growth and health is important for realizing higher yield both at individual farm and regional level. The objective of the present investigation was to understand relationship between pant nutrient level in pomegranate with incidence of bacterial blight. Healthy and unhealthy samples were collected through grid sampling approach from around ten ha of land at *Chirtadurga* district of Northern Karnataka. Nutrient contour maps were superimposed with disease incidence. The geo-statistical parameters and semi-variogram models were developed. The mean N concentration was much higher in healthy plants when compared to the samples collected from unhealthy plants. Phosphorus concentration showed only marginal difference. Potassium concentration was marginally lower (1.68%) in unhealthy plants compared to the healthy plants (2.21%). Sulphur concentration showed no variation. Among the micronutrients, Fe and Zn Concentration was marginally higher compared to the established norms, while they showed only marginal difference between healthy and unhealthy plants. Molybdenum was marginally higher in healthy plants. The B/Ca ratio was lower in unhealthy plants when compared to the healthy plants. The degree of spatial dependence in the nutrient concentration variation was interpreted by the considering nugget % to sill ratio(poor when ratio is > 75%).The studies indicated that N concentration in leaf was positively related health of the plants. The nugget to sill ratio for N showed higher spatial dependence in healthy plants compared to the unhealthy plants. The mean concentration of N, K and that of Mo was higher in healthy plants while other (B) was lower. The nutrient contour maps exhibited relationship for some nutrient elements (for example N) with disease incidence. Since the nutrient buildup was having over whelming relationship with the growth of the plant, considering the nutrient composition of all the elements rather than any single nutrient elements in isolation with disease incidence was found necessary for developing a nutrient management strategy.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Loss Estimation Using Remote Sensing and GIS Techniques: A Case of Non-nadi Watershed of Gwalior District of Madhya Pradesh

U.P.S. Bhadouria, Sazia Khan, Akhilesh Singh, Avinash S. Tomar and H.S. Bhadauria
Department of Soil Science and Agricultural Chemistry, Rajmata Vijyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh

Soil loss by runoff is a severe and continuous ecological problem in Non-nadi watershed. Soil erosion is one of the most critical environmental hazards of recent times. A large area suffers from soil erosion, which in turn, reduces productivity. Methods such as the Universal Soil Loss Equation or Revised Universal Soil Loss Equation are widely used for the estimation of soil erosion from watershed areas. Thus, this study was aimed to estimate and map the mean annual soil loss by using GIS and Remote sensing techniques. The soil loss was estimated by using Revised Universal Soil Equation (RUSLE) model. Topographic map of 1:50,000 scale, CARTOSAT-II Digital Elevation Model (DEM) of 30 m spatial resolution, Soil map used in the study has been derived from soil map of M.P prepared by NBSS&LUP of 1:250,000 scale, ten years rainfall records of three stations, and Resource SAT-II LISS-III data of October / November 2013 with spatial resolution of 23.5 m was used to derive RUSLE's soil loss variables. The RUSLE parameters were analyzed and integrated using raster calculator in the geo-processing tools in ArcGIS 10.1 environment to estimate and map the annual soil loss of the study area. The result revealed that the annual soil loss of the watershed was estimated to be 10.05 t ha^{-1} yr^{-1}. The upper reaches of the watershed contributing the maximum soil loss. These area are degraded forest with high slope, while the middle reaches and lower reaches of the watershed contributing average (<1 t ha^{-1} yr^{-1}) and moderate (1-5 t ha^{-1} yr^{-1}) soil loss. The soil loss from different land use combination was calculated. Forest+ agriculture + fallow contributing maximum soil loss 8.75 ton/ha/yr. fallowed by forest + fallow 6.98 t ha^{-1} yr^{-1}. while maximum soil loss was found from the only Agriculture 0.47 t ha^{-1} yr^{-1}. Most of these soil erosion affected areas are spatially situated in the upper steepest slope part (inlet) and ravine type lands in lower part of the watershed. The Slope gradient and length followed by conservation practice and crop management factors were found to be the main factors of soil erosion. Thus, sustainable soil and water conservation practices should be adopted in steepest upper part and ravine lands in lower parts of the study area.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Delineation of Nutrient Deficiency in Soils of Chamarajanagar District, Karnataka

C.T. Subbarayappa*, V.N. Mahesh, P.N. Siva Prasad and Anand
Department of Soil Science and Agricultural Chemistry, UAS (B), GKVK, Bangalore, 560065, Karnataka
**Email: ctsubbarayappa@gmail.com*

A field survey was carried out to delineate the nutrient deficiencies in the soils of Chamarajanagar district, Karnataka, Geo referenced surface soils (350) were collected and were processed for various parameters viz., pH, EC, K, Ca, Mg, Zn, Fe, Mn, Cu and B by using standard methods. The soil were slightly acidic to alkaline in nature (6.0-9.37) with a mean of pH 7.78. All the soils are non saline in nature with a mean EC of 0.2 dS m^{-1}, available K_2O ranges from 58.8-630 with a mean of 360.89 kg ha^{-1}. Exchangeable calcium and magnesium ranges from 2.0-59.6 with a mean of 14.15 and 0.9-48.6 with a mean of 8.78 meq $100g^{-1}$ of soil respectively. Among the micronutrients, DTPA extractable Zn, Fe, Mn and Cu were ranges from 0.10-4.13, 0.69-31.76, 0.70-18.28 and 0.10-3.74 mg kg^{-1}, respectively. The available boron ranges from 0.15-2.43 with a mean of 0.41 mg kg^{-1}. Among the surveyed soils 49.14 per cent samples are deficient in zinc, 37.71 per cent are deficient in boron. On the basis of these data it is concluded that in general, the soils of the Chamarajanagar district showed maximum deficiency of micronutrients except copper. The nutrient index (N.1) of potassium (2.66) and copper is high (2.7), medium for zinc (1.73) and low for iron (1.3), Manganese (1.43) and boron (1.2).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Characterization, Classification and Evaluation of Soils in Semi-arid Agro-ecological Region of Puttur Mandal in Chittoor District, Andhra Pradesh

E. Purandhar and M.V.S. Naidu*
Department of Soil Science and Agricultural Chemistry, S.V. Agricultural College, Acharya N.G. Ranga Agricultural University, Tirupati, 517 502 Andhra Pradesh
**Email: venkata_naidu8888@yahoo.com*

Seven typical pedons representing major land forms in semi-arid ecosystem of Puttur mandal in Chittoor district of Andhra Pradesh *viz.,* plains and uplands developed from granite-gneiss parent material under varying land use were studied for their morphological characteristics, physical and physico-chemical properties and soil genesis. These soils were slightly acidic to moderately alkaline (pH 6.5 to 8.3) in reaction, non-saline, deep to very deep in depth and had isohyperthermic temperature and ustic soil moisture regime. Texture, organic carbon, CEC and base saturation were ranged from sand to clay, 0.15 to 0.49 per cent, 12.80 to 50.52 cmol$(p^+)kg^{-1}$ soil and 50.00 to 90.57 per cent, respectively. Soils were low to medium in available nitrogen (56.18 to 477.65 kg ha^{-1}), low to high in available phosphorus (8.08 to 90.76 kg ha^{-1}) , medium to high in available potassium (137.73 to 442.04 kg ha^{-1}) and deficient to sufficient in available sulphur (1.69 to 40.00 mg kg^{-1}). DTPA extractable Zn was deficient (except Ap horizon of pedons 1, 2, 3 and 5) whereas DTPA extractable Cu, Mn and Fe (except pedon 7) were sufficient. Pedons 4 and 5 were grouped under Entisols due to absence of sub-surface diagnostic horizon and classified as Typic Ustifluvents whereas pedons 1 and 7 were placed in Inceptisols due to presence of cambic (Bw) sub-surface diagnostic horizon and classified as Typic Haplustepts. However, pedons 1, 2 and 6 were grouped under Alfisols due to presence of argillic (Bt) sub-surface diagnostic horizon and classified as Ultic Haplustalfs. All the soils of the study area fall under agricultural land with land capability classes ranging from II to IV. Further, the lands have limitations of drainage and erosion. On the basis of major soil constraints, suitable land use plan for Puttur mandal was suggested for their sustainable management.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Characterisation and Evaluation of Rice Growing Soils in Jhal-Watershed of Bemetara Block, Chhattisgarh

Gopal M. Bedre, P. Chandran, P. Tiwary, B. Dash, R.P. Sharma, A. Jangir, G. Tiwari and S.K. Singh

Division of Soil Resource Studies, ICAR-NBSS&LUP, Amravati Road, Nagpur, 440033, Maharashtra

The present investigation was carried out to characterize and evaluate the rice growing soils of *Jhal* watershed in Bemetara block of Chhattisgarh. The detailed map with seven soils series and thirteen mapping units was prepared using remote sensing techniques, field survey and laboratory analysis. The soils belong to Vertisols (77%) Inceptisols (6%) and Entisols (2.4%), shallow to very deep; moderately to well drained with slight to severe erosion, clayey and bulk density ranged from 1.50 to 1.94 Mg m^{-3}. The saturated hydraulic conductivity of the soils is low and is negatively correlated with exchangeable Na^{+}. The soils are slightly to moderately alkaline (pH 7.4 to 8.5) and calcareous (0.4 to 4.9 per cent $CaCO_3$).The organic carbon is medium in surface soils due to rice cultivation with a decreasing trend with depth. The cation exchange capacity is high indicating the dominance of smectite clay and high base saturation of some soils (63.8 to 138.9%) may be due to presence of soil modifiers like zeolites.

The land productivity index (LPI) by Riquier method indicated that 65% area is rated as good for rice, pigeonpea, gram and soybean crops. Soil-site suitability evaluation indicated that majority of the area (81%) is moderately suitable for rice, wheat and gram but for pigeonpea and soybean areas under this suitability class are less.

Comparison of the land evaluation results indicated that the quantitative method performed better than the qualitative methods. Except for a few soil, both the methods of land evaluation performed at par for rice, gram and soybean, but for wheat and pigeonpea crops, there was no agreement.

The information generated through this study will be useful for sustainable development and management of land resources to enhance the crop productivity in Bemetara taluka of Chhattisgarh in general and similar soils occurring elsewhere under similar agro-eco regions.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Land Capabality Classification and Soil-Site Suitability of Gollarahatti Micro Watershed, Tumkur District for Major Crops-aided by GIS and Remote Sensing

V.R. Ramakrishna Parama, A. Sathish, Veerendra Patel and Prabhudev Dhumgond
Department of Soil Science and Agricultural Chemistry, University of Agricultural Science, Bengaluru, Karnataka

The present study was undertaken to characterize soils in Gollarahatti micro watershed located at North latitude 13°55′30.81″ and 13°54′34.03″ and East longitude 76°46′45.81″ and 76°45′40.61″ covering an area of 444 ha, Tumkur District, located in the Southern dry zone of Karnataka. Cadastral map at 1:7920 scale was used as base map. The satellite image along with toposheet was used for delineation of land forms and physiographic units. Horizon wise soil samples were collected from twenty six pedon and analyzed for important physical and chemical properties. The detailed soil characterization resulted in seventeen soil series and twenty eight soil phases, which were described for land capability classification and land suitability. Land capability classification was determined for these twenty eight soil phases which indicated LCC II and LCC III classes with erosion and soil limitation. These soils had none to slight limitations with respect to slope, erosion, drainage, depth, texture, coarse fragments, $CaCO_3$, pH and organic carbon. The soil pH ranged from neutral to slightly alkaline. The soils were non saline and all pedon exhibited irregular electrical conductivity. The organic carbon content ranged from medium to high. The distribution of exchangeable bases on soil exchange complex were in the order of Ca > Mg > Na> K *viz*. The cation exchange capacity in this micro watershed varied from 10 to 54 cmol(p^+)kg^{-1}. The land suitability for major agriculture crops like chilly, red gram, groundnut, cotton, sunflower, arecanut and coconut was prepared. The database was used for suggesting appropriate crops suitable for the location. Red gram, sunflower, groundnut and cotton are highly suitable for major part of *Gollarahatti* Micro watershed

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Characteristics and Nutrient Status of the Soils of Middle Indo-Gangetic Plain of North Bihar for Increasing Productivity

S.K. Gangopadhyay*, A.K. Sahoo, S. Mukhopadhyay, D.C. Nayak and S.K. Singh[1]
ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Sector-II, Block DK, Salt Lake, Kolkata, 700 091, West Bengal
[1]ICAR-National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur, 440 033, Maharashtra
**Email: samarskg@gmail.com*

Soils of Middle Indo-Gangetic plain in north Bihar (AESR – 13.1) developed from alluvium carried out by the river Ganga in the south and the Nepal Himalayas in the north on nearly level to very gently sloping plain. The major crops grown in this area are rice, wheat, maize, pulses, oilseeds and sugarcane with poor crop yield. The soils suffer from water logging, frequent flooding, drainage congestion, calcareousness, salinity and multinutrient deficiency, affecting the crop yield. The study is an attempt to find out the nutritional deficiency in soils affecting the poor performance of crop.

During the soil resource inventory of the Piprakothi block, east Champaran district of north Bihar, grid soil samples were collected at an interval of 2.5 ha and total 1700 samples were collected in the block. Total 12 soil parameters viz., pH, EC, OC, available macronutrients like N, P, K, S and micronutrients like Fe, Mn, Zn, Cu and B were determined to identify the nutrient status of soil. Soils were very deep, moderately well to imperfectly drained, mostly alkaline (pH 7.1 to 9.9), low in EC (0.1 to 0.97 dS m^{-1}), low to high in organic carbon (1.0 to 14.0 g kg^{-1}) with 35 to 40 per cent calcium carbonate. The soils are low to medium in N , low in P, S and are deficient in Mn and Zn. Soils are mostly Inceptisols with redoximorhic features.

To improve the soil nutrient status and to enhance the productivity of crops, judicial management of fertilizers including organic manures in proper dose were suggested with proper soil and water management practices. The result suggests that application of 15-20 kg ha^{-1} of sulphur for the soils low in sulphur and 25 kg ha^{-1} of Zn SO_4 where both sulphur and zinc are low will enhance the crop yield. Application of 0.5% $MnSO_4$ as foliar spray is also recommended where Mn is deficient. Besides these, FYM @ 5-10 t ha^{-1} and Azospirilllum sp. Plus Phosphate Solubilizing Bacteria (PSB) @ 5 kg ha^{-1} at the time of sowing is recommended. Based on these recommendations and employing the soil and water conservation measures, the soil fertility may be improved and at the same time the stored water from the water harvesting structure will reduce the soil salinity.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Land Management Unit based Agricultural Land Use Planning for Rajnagar Block, Birbhum District, West Bengal

Shreyasi Gupta Choudhury[1]*, Krishnendu Das[1], A.K. Sahoo[1], Tapati Banerjee[1], S. Mukhopadhyay[1], D.C. Nayak[1], S.C. Ramesh Kumar[2] and S.K. Singh[3]

[1]ICAR- National Bureau of Soil Survey and Land Use Planning, Regional Centre, Kolkata, 700091, West Bengal

[2]ICAR- National Bureau of Soil Survey and Land Use Planning, Regional Centre, Bangalore, 560024, Karnataka

[3]ICAR- National Bureau of Soil Survey and Land Use Planning, Nagpur, 440033, Maharashtra

**Email: shreyasi.acss@gmail.com*

Agricultural land use planning is a function of soil characteristics, landscape ecology, socio-economic information and climate. The aim of the present study is to develop a judicious agricultural land use plan (considering all the above mentioned components) for Rajnagar block of Birbhum district, West Bengal situated in hot sub-humid ecological sub- region (AESR 12.3) of extended Chhotanagpur plateau. The area belongs to subhumid, subtropical climate with nine defined landform units (Hillock, Plateau top, plateau fringe, dissected plateau, gently sloping undulating upland, very gently sloping undulating upland, gently sloping undulating plain, very gently sloping alluvial plains and valley fill). Land resource inventory of the block (area 22147 ha) at 1:10000 scale has been done for farm planning. Thirteen soil mapping units have been identified and subsequently clubbed into five land management units (LMUs) based on the problems and potentials of the soils with respect to drainage, depth of soil, soil reaction, texture, erosion etc. Soil site suitability for 20 different field and horticultural crops has been evaluated. Among the field crops *kharif* rice, cowpea and chickpea were found to be moderately suitable in 67.6%, 61.5% and 60.8% of the total geographical area (TGA), respectively. A detail socio-economic survey has been accomplished considering 15 farmers (5 from each of small, medium and large category) from each of the five land management units for the purpose of preparing land use plan at farm level. The soil and socio-economic database has been integrated and analysed through Automated Land Potential Evaluation System (ALPES). The economic analysis of the dominated crops like kharif rice, potato and mustard showed B:C ratio of 2.63, 3.35 and 1.82, respectively. The LMU based crop economics revealed that rice, mustard and potato had the highest B:C ratio in LMU II, V and V, respectively. Considering all probable components, suitable land use options have been developed for each LMUs for optimal land use plan.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Land Resource Inventory Approach towards Agricultural Land Use Planning of Chhotanagpur Plateau Regions of India

Siladitya Bandyopadhyay*, B.N. Ghosh, S. Mukhopadhyay, K. Das, A.K. Sahoo, D.C. Nayak and S.K. Singh[1]

ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Kolkata, 700091, West Bengal

[1]National Bureau of Soil Survey and Land Use Planning, Nagpur, 440033, Maharashtra

**Email: siladitya_555@yahoo.co.in*

The Chhotanagpur plateau region has been regarded as one of the oldest landscape and geological hotspot, having very limited systematic information on soil resources. In this backdrop, an attempt was taken to conduct land resource inventory towards developing site specific agricultural land use plan. The study area has been selected at Katkamdag block of Hazaribagh district of Jharkhand, India. The block is situated between 23°52′24″N to 24°01′14″N latitude 85°14′52″E to 85°23′51″E longitude and covering an area of 12834 hectare. The climate is dry-sub humid representing the agro-ecological sub region of 11.0. Detailed land resource inventory on 1: 10,000 scale has been conducted with Resourcesat-2 IRS LISS-IV cloud free multispectral images as base maps. 26 LEUs were obtained by GIS based overlay of 6 landforms and 6 land use land covers. Gently sloping undulating plains under single crop is the most prevailing LEU occupied 19.6% of TGA of the block. In the block, 11 soil series were identified with 13 phases as mapping units. Soils on isolated hillocks were classified in the sub groups of *Haplustalfs* and *Ustorthents*, whereas, Soils on gullied lands, plateaus, undulating uplands and undulating plains were classified in the sub groups of as *Paleustalfs, Rhodustalfs* and *Haplustalfs*, respectively. Dhengura and Marhand series were moderately suitable to upland rice, maize and black gram and marginally to vegetables. Kusumba, Luta, Meyatu and Sisoi series were moderately suitable to maize, groundnut, cowpea, black gram and pigeon pea and marginally to vegetables. Tilayia series was moderately suitable to ground nut only and marginally to cow pea, pigeon pea and black gram. Insufficient ground water recharge due to regular droughts, steepness of the slope, severe soil erosion and low organic carbon content of soils were found to be the major limitations for crop growth. Restoration of forest is recommended with social/ agro-forestry and plantation of local deciduous species are recommended in Banadag, Chirua and Rajhar series. In Tilayia series, appropriate soil and water conservation measures were suggested for adopting dry-land agriculture with groundnut, cowpea, pigeonpea, *etc.* Maize, groundnut, cowpea and black gram may be cultivated as rain-fed crops in *Kharif* season in Kusumba, Meyatu and Sisoi series. In Luta, Dhengura and Marhand series, upland rice and maize may be cultivated as rain-fed *Kharif* crops with crop rotation with cowpea and black gram. Vegetables may be grown in *Rabi* season with life saving drip or sprinkler irrigations provided with suitable water harvesting units.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Intensively Mechanized Farming on Physical Health of Rice Soil of Cauvery Delta Zone of Tamil Nadu

N. Chandra Sekaran
Department of Soil Science and Agricultural Chemistry,
Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu

Mechanization especially mechanical transplanting and combined harvester are common practices which was very promising in rice-rice cropping system in Tamil Nadu. Hence effect of mechanization on the soil physical health need to be studied in the perspective of the rice soils of Tamil Nadu. In the light of the above, field experiments were conducted at Tamil Nadu Rice Research Institute, Aduthurai in a non-saline neutral clay soil having low organic carbon status (1.21 g kg^{-1} of soil) with available N, P and K status of Medium, Medium and Low under Rice - Rice cropping system during 2011-14 to compare the effect of farm mechanization with farmers practice. There was a mechanization induced soil compaction development in the soil under rice–rice cropping system compared to farmers practice. This was evidenced from poor soil physical condition induced by mechanization *viz.,* increased the bulk density from 1.32, 1.34 and 1.35 to 1.33, 1.37 and 1.38, decreased the particle density from 2.43, 2.42 and 2.41 to 2.40, 2.38 and 2.38 Mg m^{-1} and also decreased the porosity from 45.68, 44.63 and 43.98 to 44.58, 42.43 and 42.07% at 0-15, 15-30 and 30-45 cm depth, respectively. Further the hydraulic conductivity was also decreased from 1.00, 1.00 and 0.96 to 0.96, 0.93 and 0.91 cm hr^{-1} at 0-15, 15-30 and 30-45 cm depth respectively. The initial infiltration rate of 0.56 cm hr^{-1} was decreased to 0.49 after two rice - rice cropping system in post harvest soils. The effect was well pronounced at lower depth (15-45 cm) than surface soil (0-15 cm), which is a favourable condition required for rice cultivation. Consequently there was a comparable yield increase of both rice grain and straw under mechanized cultivation than farmers practice during 2012-14 in Kuruvai and Thaladi seasons.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Organic Carbon, Aggregate Stability and Microbial Attributes under Conservation Tillage with Crop Residue in Jute-based Cropping Systems

R. Saha*, M.S. Behera, Alka Paswan, S.P. Mazumdar, D. Barman and B. Majumdar
ICAR-Central Research Institute for Jute and Allied Fibres, Barrackpore, Kolkata, 700120, West Bengal
**Email: saharitesh74@rediffmail.com*

Conservation agriculture (CA) is based on principles of minimum soil disturbance, residue retention on soil surface and crop diversification, which not only improves healthy functioning of soil but also enhances soil organic carbon build up, nutrient availability, its biological quality and aggregate formation. Therefore, study was conducted to evaluate the impact of tillage practices and jute based cropping systems on soil organic carbon, aggregate stability along with indicator of soil biological health like soil microbial biomass carbon (SMB-C) in sandy loam soil of eastern Indo-Gangetic plains. The experiment was laid out in a split-plot design with 3 tillage practices *i.e.* conservation tillage (without tillage), conservation tillage with residue along with conventional tillage (with traditional tillage) in main plots and 3 jute based cropping systems *i.e.* jute-rice-wheat, jute-rice-lentil and jute-rice-potato in sub-plots. Results showed that SOC contents under conservation tillage with residue incorporated plots were much higher, maximum being in jute-rice-lentil (0.73 and 0.60%, respectively in 0-15 and 15-30 cm soil depth) followed by jute-rice-wheat (0.70 and 0.56%, respectively) and jute-rice-potato (0.67 and 0.59%, respectively). Soil aggregation represented by mean weight diameter (MWD) and percent water stable macro-aggregates (% WSMA) was significantly affected by tillage practices and crop residue incorporation. Conservation tillage with residue incorporated plots showed higher aggregate stability (MWD: range- 0.51-0.83 mm and WSMA: range 41.1-62.8%) as compared to other tillage treatments. The trend is almost similar to soil organic carbon content, which implied that soil organic carbon was the major contributor to soil aggregate formation. Soil microbial biomass carbon (SMBC) and soil moisture contents at surface soil (0-15 cm) were high under conservation tillage with residue incorporated plots as compared to conventional tillage practice. However, the crop yield in conventional tillage practice was higher than conservation tillage practice, which is common during initial years of conservation tillage experiments.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Irrigation Regimes and Fertigation Levels on Yield and Physico-Chemical Properties of Soil under Summer Chilli with Plastic Mulching

B.D. Bhakare* and S.Q. Khan
AICRP on Irrigation Water management,
Mahatma Phule Krishi Vidyapeeth, Rahuri, 413722, Maharashtra
**Email: bapusaheb1661@gmail.com*

A field investigation was conducted at the AICRP on Irrigation Water Management, M.P.K.V., Rahuri (M.S.) during the year 2015. The soil was well drained and clayey in texture, low in available nitrogen, medium in available phosphorus and high in potassium. The experiment was laid out in split plot design with three replications. The main plot treatments comprised of four irrigation regimes *viz.,* 70, 80, 90 and 100 per cent of ETc. Sub plot treatments consisted of three fertigation levels *viz.,* 75, 100 and 125 per cent of RDF in weekly 16 splits according to growth stages. The control treatment i.e. surface irrigation with RDF through conventional fertilizers without mulch and absolute control. Irrigation regime of 100 per cent ETc and fertigation level of 125 per cent RDF periodically exhibited significantly higher plant height, branches plant^{-1}, dry matter and fruit yield at harvesting stage. However, irrigation regime 100 per cent ETc was at par with 90 and 80 per cent ETc. The yield and yield contributing characters were higher in irrigation regime of 100 percent ETc being at par with 90 and 80 percent ETc while, fertigation level of 125 per cent RDF recorded higher yield and yield contributing characters of chilli and was at par with 100 per cent RDF. Irrigation regimes of 100 per cent ETc recorded significantly higher nutrient uptake than those under 70 per cent ETc followed by 90 per cent ETc. Fertigation levels of 125 RDF recorded higher nutrient uptake than those under 75 RDF. Higher fertilizer use efficiency was recorded by chilli crop at 100 per cent ETc being at par with irrigation regimes of 90 and 80 per cent ETc. Fertigation with 125 per cent RDF recorded lower fertilizer use efficiency than 75 per cent RDF. Irrigation regimes of 70 and 100 per cent ETc registered numerically maximum and minimum water use efficiency and water saving, respectively. Fertigation levels of 125 per cent RDF recorded numerically maximum water use efficiency. Irrigation regimes of 100 per cent ETc and fertigation levels of 125 per cent RDF recorded maximum availability of soil moisture among other treatments and control plots. It could be concluded that maximum fruit yield and quality, irrigation regime of 90 per cent ETc and fertigation level of 100 per cent recommended dose (100:50:50 N, P_2O_5, K_2O kg ha^{-1}) in 16 splits was found most suitable for summer chilli under silver black polyethylene mulch.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Physical Conditions as Affected by Fertigation in Rice Based Cropping Systems under Zero Tilled Conditions

Piu Basak and Anshuman Kohli*
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, 813210, Bihar
**Email: anshuman_kohli@hotmail.com*

In rainfed low land areas of several districts of south Bihar, farmers grow a rainfed rice crop and are usually inclined to leave their land fallow during the *rabi* season because of the unavailability of ample soil moisture. Such a situation can be overcome if the farmers are able to grow *rabi* season crops just after the harvesting of rainfed rice for making optimum use of the residual soil moisture using zero tillage. Further, if some water can be made available during the *rabi* season through rainwater harvesting or otherwise, this can be used for supplemental irrigation in the post rice crops and there will be incentive in applying this irrigation through efficient mechanisms like fertigation. Differential rates of fertilizer and irrigation water application can possibly modify the soil physical conditions. Hence, a zero tilled fertigation experiment in split plot design was laid out at the farm of BAC, Sabour in 2014 with three levels of fertigation in main plots (nitrogen levels as fertigation @ 20, 40, and 60 kg ha^{-1} in *kharif* season and irrigation levels @ 200, 300 and 400 mm in post rice crops, designated as W_1, W_2 and W_3 respectively) and four rice based cropping systems as sub plot treatments (rice followed by durum wheat, barley, lentil and chickpea). This presentation discusses the data from ex-ante and ex-post analysis with the third year rice crop in the system. Rice grain yield was significantly greater under W_2 and W_3 fertigation regimes. Steady state infiltration rate measured after the harvest of the rice crop was found higher under rice-legume cropping systems in comparison to rice-cereal cropping systems. No significant influences of fertigation and cropping systems were found on soil bulk density. Maximum water holding capacity of surface soil after the harvest of *rabi* season crops was significantly greater under the higher fertigation regimes. Water stable aggregation after the harvest of third rice crop was found to be significantly greater under higher fertigation regimes. Various fertigation regimes and cropping systems had a significant influence on the soil penetration resistance before the establishment of the rice crop which was strikingly nullified by the time of its harvest.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Tillage Practices and Cropping Sequence on Properties of a Vertisol

H.K. Rai*, Deepanshu Jain and Arpit Suryawanshi
Department of Soil Science and Agricultural Chemistry
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 482004, Madhya Pradesh
**Email: rai.hkr.hitendra@gmail.com*

Soil properties are interdependent and directly influence the availability of water and nutrients to plants and regulate crop growth and productivity. To the great extent soil properties are altered by tillage practices and crops grown in long term. Present study was carried out under soybean-wheat and rice-wheat cropping sequences during successive *kharif* and *rabi* seasons of 2014-15 at BISA Research Farm Jabalpur (23^0 33' N Lat, $80^0$04' E Long and at an altitude of 407.0 amsl.) to evaluate the effect of tillage practices and cropping sequence on key physico-chemical properties of a Vertisol. The study was composed of six treatments which included rice-wheat sequence in zero tillage (ZT) for one year (T_1), rice-wheat sequence in ZT for 2 years (T_2), rice-wheat sequence in ZT for 4 years (T_3), soybean-wheat sequence in conventional tillage (CT) for one year (T_4), soybean-wheat sequence in CT for 2 years (T_5) and soybean-wheat sequence in CT for 4 years (T_6) with three replications under randomized block design. Under zero tillage (ZT) system crop residues were retained on soil surface, while under conventional tillage (CT) system residue was removed. The results clearly indicated that bulk density, penetration resistance, soil moisture content, infiltration rate, fractions of different sized aggregates and mean weight diameter of aggregates of soil were significantly altered by different treatments of tillage practices and cropping sequences. The results also transpired that adoption of conservation tillage improved all the physical properties with the time. Bulk density and penetration resistance in soil were significantly reduced, while infiltration rate, fractions of larger soil aggregates and mean weight diameter of soil aggregate were increased significantly under the treatment of 4 years adoption of ZT practice irrespective of cropping sequences. Effect of tillage practices and cropping sequence on pH and electrical conductivity of soil was statistically not significant but organic carbon content and cation exchange capacity of soil was significantly influenced by tillage practice. Correlation study showed that relationship between bulk density and organic carbon (R^2= 0.784) and bulk density and infiltration rate (R^2=0.91) were inverse and linear. However, relationships between organic carbon content and cation exchange capacity (R^2=0.916) and bulk density and penetration resistance (R^2=0.843) were proportional and linear.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Simulation of Soil Water Dynamics and Root Water Uptake in Wheat under Different Tillage and Irrigation Management using HYDRUS-2D Model

K.K. Bandyopadhyay*, Madanmohan Meena, P. Aggarwal, A. Sarangi and D.R. Biswas
ICAR-Indian Agricultural Research Institute, New Delhi, 110012
**Email: kk.bandyopadhyay@gmail.com*

Simulation models can serve as powerful tools in understanding the soil water dynamics and root water uptake within the crop root zone, which will assist in judicious scheduling of irrigation in different crops under diverse soil types. HYDRUS-2D is a well-known Windows-based computer software package for simulating water, heat, and/or solute movement in two dimensional, variably saturated porous media. Field experiments were conducted during the years 2015-16 and 2016-17 on wheat (cv HD2967) in a sandy loam soil at Indian Agricultural Research Institute, New Delhi to calibrate and validate HYDRUS-2D v 2.05 model for simulation of soil water dynamics and root water uptake in wheat under different tillage and irrigation management. The treatments comprised of three levels of tillage as main plot factor (Conventional tillage (CT), Deep tillage (DT) and No tillage with residue (NT)) and three levels of irrigation as subplot factor (I_1: 1 irrigation (CRI), I_3: 3 Irrigations (CRI, Tillering, Flowering) and I_5: 5 Irrigations (CRI, Tillering, Jointing, Flowering, Milk)), which were evaluated in a split plot design with three replications. HYDRUS-2D v 2.05 model was calibrated with the field experiment generated soil moisture and root growth data for the year 2015-16. van Genuchten parameters (θ_r, θ_s, K_s, α, η, l), input parameters for HYDRUS-2D model, were computed using Rosetta v 1.2 model for three soil layers (0-15, 15-30 and 30-45 cm) at the beginning of experiment. Then Inverse modeling option was employed to optimize van Genuchten parameters (K_s, α and n) for these thee soil layers. The initial soil moisture condition at the beginning of simulation at these three layers was used as initial condition. The upper boundary condition of soil was set to be atmospheric boundary and lower boundary as free drainage boundary and vertical side of domain were used as no flux boundary. Potential evaporation and potential transpiration were the atmospheric boundary condition for the model. The daily rainfall and irrigation practices during the simulation period were also used as input parameter for this model. Various root growth parameters like maximum root depth, maximum rooting intensity both in horizontal and vertical direction were also used as input parameters for root water uptake model. Then the performance of this model was evaluated with independent data set for limited period of simulation of 78 to 112 DAS during the 2016-17 using the optimized van Genuchten parameters. It was observed that there was significant improvement in the predictability of soil moisture content by HYDRUS 2D model after imposition of Inverse modeling option. When the model was run with the optimized van Genuchten parameters, the model could account for 33.4, 67.7, 53.3% and 59.3% variations in the observed soil moisture content at 0-15, 15-30, 30-45 and 0-45 cm soil depths. HYDRUS 2D model could also account for 66.4% variation in mean transpiration rate/ root water uptake with RMSE of 0.039 during the year 2015-16 and 56.4% variation in the observed transpiration rate with RMSE of 0.114 during the year 2016-17. Soil water balance studies in both the years showed that cumulative root water uptake was highest in DT followed by CT and NT whereas cumulative evaporation under NT was higher than that of DT and CT. With increasing irrigation level, cumulative root water uptake increased but cumulative evaporation decreased in both the years. The deep percolation loss increased in both the years with the increase in irrigation level.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Soil Texture, Organic Carbon and Soluble Salts on Hydraulic Properties of Soils of Haryana State

Seema, Rita Dahiya* and V.K. Phogat
Department of Soil Science, CCS Haryana Agricultural University, Hisar, 125004, Haryana
**Email: ritajbd@yahoo.com*

Hydraulic properties of soils play a vital role in adoption of proper irrigation methods for enhancing input use efficiency of soils. Keeping in view the importance of hydraulic properties, the study was carried out by collecting the soil samples from 0-15 and 15-30 cm depths at farmers' field in different villages spread over nine districts of the State during 2016-17. The experimental soils were found to belong to six textural classes i.e., sand, loamy sand, sandy loam, loam, silty loam and sandy clay loam. The organic carbon (OC) content, electrical conductivity (EC), pH, saturated hydraulic conductivity (Ksat), moisture at filed capacity and permanent wilting point, water stable aggregates of the soils were determined using standard methods. The pH, EC and OC of soils were found ranging from 6.69 to 8.08, 0.11to 3.68 dS m^{-1} and 0.14 to 0.72%, respectively. The Ksat of the soils was found significantly correlated with bulk density, silt+clay content, OC and water stable aggregates of the soils. The soil moisture at field capacity and permanent wilting point were also found significantly and positively correlated with silt+clay content, soil organic carbon and water stable aggregates, however, significantly and negatively correlated with bulk density. In the present study, no significant correlation was found between hydraulic properties and soluble salt concentration of the soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Evaluation of Spatial Distribution and Management Zone Delineation for Micronutrients in Semi-arid Deccan Plateau Region of India

Sanjib Kumar Behera[1], M.C. Patnaik[2], P. Surendra Babu[2], Arvind Kumar Shukla[1] and Ashok Kumar Patra[1]

[1]*ICAR-Indian Institute of Soil Science, Nabibagh, Berasia Road, Bhopal, 462038, Madhya Pradesh*
[2]*PJTS Agricultural University, Rajendranagar, Hyderabad, 500030, Telangana*

Emerging micronutrient deficiencies in different soils of world is a threat to agricultural sustainability. Since distribution of micronutrients in soil varies spatially, site-specific management of micronutrient is possible by delineation of management zones (MZs) according to their spatial distribution. The current investigation was performed to delineate MZs in Deccan Plateau Region (DPR) of India based on spatial distribution of soil parameters and micronutrients for efficient micronutrient management. A total of 4939 geo-referenced representative soil samples (from 0-0.15 m soil depth) were collected from Telangana state in DPR of India. Collected soil samples were processed and analysed for soil parameters like pH, electrical conductivity (EC), soil organic carbon (SOC), and available zinc (Zn), iron (Fe), copper (Cu), and manganese (Mn) concentrations. The values of soil properties including micronutrients varied widely with low (8.9%) to moderate (29.1 to 47.2%) values for coefficient of variations. Semivariogram analysis and ordinary kriging revealed varied spatial distribution with moderate to strong spatial dependence for soil properties including micronutrient in the region. Development of the MZs was carried out by principal component (PC) analysis and fuzzy-c- mean clustering. Four PCs with eigen values greater than 1 and accounting 73% of total variance were used for further analysis. On the basis of fuzzy performance index and normalized classification entropy, six potential MZs were identified. There was heterogeneity of the studied soil parameters in the MZs. Thus, study emphasized that the methodology for delineating MZs could be effectively used for site specific micronutrients management in DPR of India.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Mapping Using Diffuse Reflectance Spectroscopy Based Variable Indicators

Anukool Raj, Somsubhra Chakraborty and Bhabani Sankar Das
Agriculture and Food Engineering Department, Indian Institute of Technology, Kharagpur, West Bengal

Diffuse reflectance spectroscopy (DRS) has shown its potential as a feasible, rapid and non-invasive soil characterization tool. Nevertheless, the use of whole VisNIR spectra in DRS models often incorporates surplus information, eventually producing inefficient model predictions. Thus the careful choice of informative spectral variables is a significant step towards producing robust and useful DRS-based models. This study evaluated the feasibility of combining variable indicator-based DRS outputs and geostatistical interpolations to rapidly produce soil spatial variability maps for six soil properties [sand, clay, silt, total carbon (TC), total nitrogen (TN) and loss-on-ignition organic matter (LOI)]. A total of 300 samples were collected from three catenas of Transylvanian Plain, Romania. First derivative spectra were used to calculate Pearson's correlation coefficient (*r*), biweight midcorrelation (*bicor*), mutual information based adjacency (AMI), variable importance in the projection (VIP),and their combinations. This variable indicator suite was combined with an ordered predictor selection (OPS) method to choose the optimum number of spectral variables. Summarily, the results indicated that a successful combination of OPS-based variable indicators and their subsequent incorporation into DRS-based chemometric models can potentially improve model predictions that can be further combined with geostatistical interpolation methods to produce spatial maps of soil properties.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Long-Term Use of Fertilizer and Organic Manure on Soil Aggregate Strength and Stability, and Clay Dispersibility

Paulson Thomas[1], M.C. Meena[2], B.K. Aggarwal[3], Shri Ram[4], A.K. Mishra, S. Singh[1] and D. Chakraborty[1]*

[1]Division of Agricultural Physics, [2]Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi, 110012
[3]Department of Soil Science and Agricultural Chemistry, Birsa Agricultural University, Ranchi, 834006, Jharkhand
[4]Department of Soil Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar 263145, Uttarakhand
**Email: debashisiari@gmail.com*

Effect of long-term fertilizer and manure applications on soil aggregate strength and water stability, and dispersibility of clay, and their relation with soil organic C were evaluated on three different Indian soils under long-term fertilizer experimentation. Although the aggregate parameters showed significant variations under the recommended and 50% higher that the recommended NPK fertilizer and fertilizer plus manure applications, tensile strength and friability of aggregates were identified as the most sensitive to either particulate organic C (POC) or total organic C (TOC) content change in soil. Fertilizers and manure had distinct effect in POC, which could be taken as the most reactive form of soil organic C, and highly responsive to soil management practice. In a quest to identify the best agri-management option to sustain the soil quality, the micro- or aggregate-scale soil response required close monitoring. Role of fertilizer alone or in combination with manure in maintaining soil physical condition through the modification in soil aggregate properties and clay dispersibility was clearly evident.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Modelling Soil Water Dynamics and Crop Water Use in a Soybean-Wheat Rotation Under Chisel Tillage in a Sandy Clay Loam Soil

Mukhtar Ahmed[1], D. Chakraborty[1]*, Pramila Aggarwal[1], R. Bhattacharya[2] and Ravender Singh[1]

[1]Division of Agricultural Physics, [2]Centre for Climate Resilient Agriculture, ICAR-Indian Agricultural Research Institute, New Delhi, 110012

**Email: debashisiari@gmail.com*

Mechanical chiseling disrupts the sub-surface compaction often found in agricultural soils, and modifies soil physical condition conducive to root growth. However, the effect is transitory and therefore, the impact on soil hydraulic characteristics and consequently on water dynamics must be precisely quantified for effective technology-targeting. In this study, Hydrus-2D was used to describe the soil water change, root water uptake and profile water balance components under different time lags after chiseling. The input parameters were collected from a 2-year field experiment with soybean-wheat crops in rotation on a sandy loam soil in the experimental farm of the ICAR-Indian Agricultural Research Institute, New Delhi. The chisel treatments were residual chisel (RS), repeated chisel (RC) and no chisel (NC). Greater root water uptake in RS and RC compared to the NC could be attributed to marginally higher leaf area index and fIPAR in chiseled plots along with greater depth and spread of roots. Model simulated soil water content was in good agreement with observed data in the first year of rotation. The model was further validated by comparing the simulated and observed values of crop transpiration with R^2=0.85 and 0.72 ($p<0.001$) in soybean and wheat crop, respectively in the following year. Simulated field water valance components indicated 50-70 mm higher seasonal transpiration by the crops. Chisel plots had significantly higher yield and water use in 1st year soybean-wheat rotation, but the effect of chisel became marginal in the 2nd year rotation. Soil water content in the profile indicates higher plant-available water in chiselled plots. In view of the cost of chiseling and the marginal benefits obtained till 2nd year of crop rotation, chiseling once in 2-3 years may be recommended for the sandy loam soils under the semi-arid climate condition.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Pedological Perspective of Ravine Erosion Sites within Gird Region of Madhya Pradesh

Akhilesh Singh, Bharat Meena, Shashi S. Yadav, S.K. Verma, S.S. Bhadauria and U.P.S. Bhadauria
Rajmata Vijyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, 474002, Madhya Pradesh

Erosion is a common feature in Gird region of Madhya Pradesh, rendering large expanses of arable land, uncultivable and uninhabitable. Erosion in the area was classified into two types: Deep erosion (Chambal Ravine), medium (Kunwari and other tributaries of Chambal and Yamuna) and minimum erosion (Agriculture field). The current study aimed at providing insight into physical and chemical properties of soil that promote soil erosion and determine the ravine/gully formation type. Field studies were conducted at 3 sites (2 eroded and 1 Minimum- eroded). Physical (particle size distribution, structure stability, infiltration rate, and dispersibility), and chemical (pH, exchangeable cations, total-C, and total-N) properties of soil samples collected from the sites were analyzed in the laboratory. The results showed that high infiltration rate and higher soil dispensability resulted to loss of heavy soil mass due to fragile soil structure and hollow out at the soil layer of stream floor might induce the fall down of the above soil mass successively. These are major factors contributing to the formation of deep and medium type of ravine erosion. Soils of the eroded sites and the non-eroded sites differed mainly on the basis of soil structure stability, water infiltration rate, and soil dispersibility and low organic carbon content in eroded soil. Susceptibility of soil layers to erosion also depended on the magnitude of ESP and sand content.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Variation of Soil Hydrothermal Regimes in Zero and Conventional Tillage with Residue Treatments

P. Pramanik, K.K. Bandyopadhyay, P. Aggarwal, P. Krishnan and Vikas Rai
Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi, 110012

Thermal properties of soils play an important role in influencing microclimate, which influences seed germination, seedling emergence, and subsequent crop stand establishment. These are required for modelling energy, water and nutrient movement in soils. Soil physical properties affecting soil thermal regimes include texture and mineralogical composition of the soil (static properties), organic matter, soil water content, compaction, porosity, etc. (dynamic properties). Most of these dynamic properties which show large temporal variation due to various agronomical operations carried out during crop raising, can be controlled by appropriate soil and crop management practices. Objective of this study was to assess the effect of tillage and residue on soil hydrothermal regimes. From the experiment, four treatments i.e conventional tillage (CT), conventional tillage +residue (Ct+R), zero tillage (ZT) and zero tillage +residue (ZT+R) were selected. Soil temperature reading was recorded from 0, 5, 10, 15, 20,25 cm of soil depth during 10 AM to 5 PM at one hour interval. Soil water content (SWC) was also determined gravimetrically at 0-15, 15-30, 30-45 and 45-60 cm soil depth at regular intervals. Results showed that Zero tillage (ZT) had 10-13% more SWC in 0-15 cm soil layer than conventional tillage (CT). Residue application had improved SWC both in ZT and CT. ZT +R had 12-17% more SWC than ZT and CT+R had 11% more SWC than CT in surface layer. Conventional tillage + residue showed maximum soil temperature in most of the soil depths throughout the day time. Fluctuation of soil temperature was more upto 10-15 cm of soil depth and reduced as the soil depth increased. Zero tillage had 0.6–0.9°C lower temperature compared to conventional tillage. Application of residue increased soil temperature by 0.5°C–0.6°C in zero tillage and by 0.6 °C–0.7 °C in conventional tillage. Volumetric heat capacity (Cv) followed the order: ZT+R> CT+R> ZT>CT because of higher moisture content of residue applied plot. Thermal diffusivity (D) was maximum for CT (0.15 m^2d^{-1}) and minimum was in CT+R (0.05 m^2d^{-1}). In CT, damping depth was 28.21 cm and in ZT, damping depths were 21.85 cm. Application of residue had reduced damping depth by 15.41 cm in CT and 5.89 cm as compared to ZT. Thermal conductivity (k) was maximum (0.51 MJ/m/°C/ day) for CT and minimum for (0.11 MJ/m/°C/ day) for CT+R. ZT+R and ZT had k value of 0.32 MJ/m/°C/ day and 0.14 MJ/m/°C/ day, respectively. From the results it can be concluded that application of crop residue has beneficial effect in moderating soil hydrothermal regimes depending on the season of crop growth.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Determination of the Most Sensitive Spectral Bands for assessing Soil Fertility Status of a Potato Field

Sukhpreet Singh and B.S. Sekhon*
Department of Soil Science, Panjab Agricultural University, Ludhiana, 141004, Punjab
**Email: bsekhon@pau.edu*

Potato with an estimated acreage of 2.15 million thousand hectares and a production of 48.2 million tons is the predominant vegetable crop of India (Third advanced Estimates, Govt. of India, 2017). Similarly, in Punjab with a more than 40% share in acreage under vegetable crops, potato remains the predominant vegetable crop of the state. Shallow root system of the crop and scant adoption of soil test based fertilizer recommendations have made the crop share significantly the nutrient consumption in the state. As per a survey conducted by Sekhon et al. (2015, personal communication), potato growers in Punjab use on an average 241 kg N ha^{-1}, 183 kg P_2O_5, and 101 kg ha^{-1} K_2O (as against the general recommendation of N 190 kg ha^{-1}, fertilizer P 60 kg ha^{-1}, and fertilizer K 60 kg ha^{-1}). Soil test based fertilizer use holds a huge promise in curtailing irrational fertilizer use in this crop and thus can benefit financially both the farmers and the government. However, timely availability of soil test results and comprehensive sampling are two important prerequisites for successful adoption of soil test based fertilizer recommendations. Conventional chemical-based soil test methods may not match up to these prerequisites. Diffuse reflectance based spectroscopic methods can, however, help meet these prerequisites. With this objective, a potato field in Mohie village of Ludhiana district was sampled (0-15 cm) at 70 nodes in 10m×20m grid pattern. The samples were divided into two parts and prepared for both chemical and spectral analyses. Reflectance of soil samples was recorded in dark chamber by using ASD FieldSpec Pro ® spectroradiometer (350-2500 nm reflectance spectra collected at every 1nm width and then resampled after every 10nm).The raw spectra were further transformed into first derivative to eliminate noise. Partial least squares regression (PLSR) procedure was used to develop models for predicting soil fertility variables by using reflectance values by employing SAS 9.3 statistical package. Variable importance plots (VIPs) were developed to identify spectral bands that correlate well with a given soil fertility variable. Results showed that for sand, silt, and clay content prediction most sensitive band occurred around 420, 2070, and 440 nm, respectively. The band around 1800 nm was most relevant to pH prediction and for soil organic carbon it was around 2210 nm. Olsen-P measurements correlated well with band around 390 nm. However, Mehlich-3 P predictions were related with 1820 nm band. Available K predictions were weighed heavily on band around 2350nm. Thus, soil reflectance properties due to their rapid assessment hold good promise in providing timely soil test results and can ensure wider coverage of acreage to override spatial variability.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Validation of NST 3.0 Model for Predicting Phosphorus Influx in Maize and Groundnut

A.A.S. Gill[1]* and P.B.S. Bhadoria[2]
[1]Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab
[2]Department of Agricultural and Food Engineering, IIT, Kharagpur, 721302, West Bengal
**Email: arsh@pau.edu*

The applicability of nutrient uptake model (NST 3.0) to predict phosphorus (P) influx at different growth stages was studied through field experiment. The maize (Paras and JH 3459) and groundnut (M 522 and SG 99) cultivars were grown on a sandy loam soil having pH 5.1, OC 4.1 g kg^{-1} soil and available P 11.2 kg ha^{-1} in the presence and absence of benomyl fungicide [applied for eradication of arbuscular mycorrhizae (AM)]. Crop plants were harvested at 24, 48, 74 days after sowing (DAS) and final harvest was taken at maturity to cover the whole growing season. At each harvest, soil solution P, shoot yield, shoot P content, root length and root infection by AM were determined. Comparison of the P influx of the maize plots treated with and without benomyl revealed that the relative contribution of AM to P influx in maize cultivars was 47-49% at first harvest interval (24-48 DAS) and 25-27% at second harvest interval (48-74 DAS). Similarly, for groundnut this corresponded to 37% and 23%. Model calculated influx was 26-36% of the observed P influx in maize cultivars while in groundnut cultivars model predicted 7-13% of the observed P influx. Thus, the model under predicted the P influx in maize and groundnut cultivars. This suggests that contribution of AM and additional soil factors that may affect P influx in maize and groundnut (i.e. root exudates or rhizosphere chemistry which increase or decrease rhizosphere pH) should be included in a simulation model to improve P influx predictability. The most sensitive parameter controlling P influx was initial soil solution P concentration irrespective of harvest intervals in cultivars of both the crops. Uptake kinetic parameters maximum influx (lmax), Michaelis-Menton constant (km) and minimum soil solution concentration (Cmin) was found to play negligible role in calculated P influx.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

IR spectroscopy as a Tool to Evaluate Adsorption of Phosphatase on Nano Size Fractions of Soil Clays

Ranjan Paul*[1], S.C. Datta[2], K.M. Manjaiah[2], Anil Dahuja[3] and Ranjan Bhattacharyya[4]
[1]Division of Soil Resource Studies, ICAR-NBSS&LUP, Nagpur, 440033, Maharashtra
[2]Division of Soil Science and Agricultural Chemistry, [3]Division of Biochemistry, [4]Centre for Environmental Science and Climate Resilient Agriculture,
ICAR-Indian Agricultural Research Institute, New Delhi, 110012

Soil enzymes can easily be adsorbed in solid phases of soil and do not remain free in solution. Extent of adsorption will depend upon the type of the colloid present in soil and the structure of the enzyme (shape, size and functional group). Phosphatase is very common and important in the biogeochemical cycle in soil which catalyses the conversion of organic phosphorus substrates into inorganic form. Adsorption and activity of phosphatase were considerably influenced by several minerals and clay fractions present in soil. Clays having at least one dimension in less than 100 nm range are referred to nanoclays. Nanoclays are superior in terms of specific surface area, CEC, surface charge density and surface reactivity than non-nano clay fraction. Nanoclays are most reactive part of soil clays. These nanoclays can interact with phosphatase and bring conformational change in it. In the present research different types of nanoclays isolated from Inceptisol, Vertisol and Alfisol and their complexes with acid and alkaline phosphatase were characterized by Fourier-transform infrared reflectance spectroscopy (FTIR).Nano fractions from genetically different soils (i.e. Inceptisol, Vertisol and Alfisol) were separated by ordinary centrifugation in the laboratory. An *In-situ* experiment was done by adsorbing commercial phosphatase enzyme (acid and alkaline) onto different nanoclays. Nano clays and their complexes with phosphatase were characterized by FTIR spectroscopy. Peaks with varying intensities were observed for all nanoclays. Si-O stretching and Al-O-H bending resulted peak at 1003 and 911 cm^{-1}, respectively for all nanoclays. Disturbance in secondary structures due to its adsorption on mineral surfaces can be monitored by FTIR spectra. FTIR spectra of acid and alkaline phosphatase demonstrated characteristic peaks of proteins appeared at wave numbers of 1635, 1540 and 1574 cm^{-1}. These peaks were due to absorption by functional groups of amide I (C=O stretching vibration), amide II (N-H bending and C-N stretching modes) and amide III (C-N stretching and N-H bending), respectively. Alkaline phosphatase showed band at 699 cm^{-1} due to amine. Peaks observed at 600-800 cm^{-1} range were due to C-H bending vibration. The presence of peaks corresponding to wavenumbers similar to free enzymes were also observed in nanoclays after enzyme immobilization but peak position either shifted to higher/lower frequency, remain in same position or absent. Shifting of 614, 699, 1280, 1405, 1540 and 2921 cm^{-1} frequencies to the higher value in all nanoclays suggest that functional group present in these regions did not take part in adsorption and became more free. In the contrary shifting of 963, 1013, 1059, 1107, 1574, 1635 and 3662 cm^{-1} to lower values in all nanoclays indicates that these functional groups are involved in adsorption of enzyme molecules to the mineral surface. Peaks at 619, 646, 801,923, 1396 and 1457 cm^{-1} remained at same position as these functional groups were not involved in adsorption process. Peaks showed by pure enzymes at 842, 892, 1068 and 3000-3400 cm^{-1} region were absent after its immobilization on different supports, which implyed that secondary conformational changes in proteins occurred by adsorption on mineral surfaces.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

In-situ Moisture Conservation Technologies to Cope with Moisture Stress Situation for Augmenting Yield Productivity in NICRA Adopted Villages of Eastern India

F. H. Rahman*, S. Nath and S.S. Singh
ICAR-Agricultural Technology Application Research Institute Kolkata
Bhumi Vihar Complex, Sector III, Salt Lake, Kolkata, 700097, West Bengal
**Email: fhrahmancal@gmail.com*

Enhancing resilience of agriculture to climate risk is of paramount importance for protecting livelihoods of small and marginal farmers. Traditionally, technology transfer in agriculture has aimed at enhancing farm productivity. Farmers need to adapt quickly to enhance their resilience to increasing threats of climatic variability such as droughts, floods and other extreme climatic events. Over the years, an array of practices and technologies has been developed by researchers towards fostering stability in agricultural production against the onslaught of seasonal variations. Adoption of such resilient practices and technologies by farmers appears to be more a necessity than an option. To reorient the whole gamut of technology transfer in Indian perspective, a national-wide initiative, namely, National Innovations in Climate Resilient Agriculture (NICRA) was taken up during the year 2011-12 and constant and critical reviewing of one of its important components *i.e.*, Technology Demonstration Component (TDC) brought out some salient effects of technology demonstration, which can lead to more resilience of Indian agriculture to the climatic vagaries. Out of 16 NICRA KVKs, Bihar (7 KVKs), Jharkhand (6 KVKs) and West Bengal (3 KVKs) selected a village and after preliminary baseline works, the agro-climatic characteristics were outlined for the purpose of future improvement of their livelihood. Natural Resource Management is the major activities to change the cropping intensity in these villages. In the module *in-situ* moisture conservation in different villages of the NICRA project have a tremendous impact on increasing productivity of various crops. *In-situ* moisture conservation includes different technologies like Summer ploughing, Green manuaring, Brown manuring, Azolla application, Zero Tillage, Repair of bund, land embankment development, Organic and plastic mulching in vegetables etc. These conservation technologies have been demonstrated in 16 NICRA adopted villages covering 412 demonstrations in various crops in 66 ha during 2016-17. The yield increment of various demonstrations over farmers practice was recorded in the range of 25 to 65%.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soils and Climate Variability Effects on Soybean and Wheat Yield under Soybean-Wheat Cropping System of Central India

M. Mohanty[1]*, Nishant K. Sinha[1], Pramod Jha[1], S. Lenka[1], Anil Dwivedi[2], Rohit Patidar[1], A. Rajput[1], R.S. Chaudhary[1], Muneshwar Singh[1] and A.K. Patra[1]

[1]*ICAR-Indian Institute of Soil Science, Nabi Bagh, Berasia Road, Bhopal, 462038, Madhya Pradesh*
[2]*Department of Soil Science and Agricultural Chemistry, JNKVV, Jabalpur, Madhya Pradesh*
**Email: mmohanty_bpl@yahoo.co.in*

Soybean [*Glycine max* (L.) Merrill] is one of the major rainy season cash crops in central India. The state of Madhya Pradesh has been identified as a 'Soya State' on account of its share in area (>70%) and production (72%) in India. The crop is predominantly grown on Vertisols and associated soils with an average crop season rainfall of about 900 mm, but varying greatly across locations and years. Soybean–wheat is the dominant cropping system of central India. This has resulted in an increase in the cropping intensity and resultant increase in the profitability per unit land area. Despite its phenomenal growth in area, the average productivity of soybean has remained more or less at 1000 kg ha^{-1} due to several abiotic, biotic and socio-economic factors. However, apart from other factors soils and climate play important role in this cropping system. Therefore, a simulation study was conducted using a well calibrated and validated Agricultural Production System Simulator (APSIM) model to study the soil and climate variability effects on soybean and wheat yield in Vertisols and associated soils of central India. The study revealed that the regional yield estimate of soybean ranged from 1.4 to 1.9 t ha^{-1} with a temporal yield variation of about 15%, which is accounted by the change in weather patterns in the growing season. Spatial variability of 25% was observed in soybean yield, which was accounted due to change in soil properties. Similarly, the regional yield estimate of wheat ranged from 2.3 to 4.5 t ha^{-1} with a temporal yield variation of about 10% and spatial variability of 16%. The variability in crop yield include crop management factors such as suboptimal use of nutrients, suboptimal planting time, poor plant population, and infestation with weeds, pests and diseases that limit productivity. Proper management of inputs particularly nitrogen (N) and irrigation water using modern technology is essential for maximizing production and for providing high returns to farmers. With efficient use of available resources, farmers can harvest 10-40% additional yield.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Nutrient Management Practices on Soil Aggregation and Aggregate-associated Carbon in Jute-Rice-Wheat System

S.P. Mazumdar*, D.K. Kundu, S. Sasmal, A.R. Saha, B. Majumdar, A.K. Ghorai, M.S. Behera, R. Saha and D. Barman
Crop Production Division, ICAR-Central Research Institute for Jute and Allied Fibres
Barrackpore, Kolkata, 700120, West Bengal
**Email: sonalimazumdar110@gmail.com*

Impact of continuous application of fertilizers either alone or in conjunction with farmyard manure (FYM) on aggregate stability and distribution of carbon in different aggregate fractions after 43 years of jute-rice-wheat system was studied. Application of NPK either through inorganic fertilizers or through combination of inorganic fertilizers and organics such as farmyard manure (FYM) significantly increased the amount of water stable aggregates, aggregate ratio, Mean Weight Diameter (MWD) and Geometric Mean Diameter (GMD). Macro-aggregates (>0.25 mm) constituted 35-59% of water stable aggregates and varied significantly among treatments.The amount of macro-aggregates was lowest in the control plot and it was highest in the plots treated with organics Addition of farm yard manure (FYM) significantly improved the formation of macro aggregates, decreased the proportion of micro aggregates. The mean weight diameter (MWD) and geometric mean diameter (GMD) were significantly higher in plots receiving FYM in combination with inorganic fertilizers. Incorporation of organic materials not only improved soil aggregation but also resulted in higher carbon in macro aggregatesas compared to microaggregates and application of organics resulted in the greatest increase in C concentration in various aggregate size fractions over control. It was concluded that combination of organic- inorganics provide greater scope in improving soil quality and long term carbon accumulation and also helps in sustaining the system productivity.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Study of Some Salient Physical and Chemical Characteristics of Coastal Saline Soil

Pranay Kumar Roy Barman
IBRAD School of Management and Sustainable Development, Kolkata

An investigation was carried out to study the salient physical and chemical characteristics of some coastal saline soils of Bangladesh located in the district of Barisal covering parts of Sundarbans continuous with the Sundarbans in West Bengal of India. A large portion of the areas in Kuakata and Khepupara and adjoining areas situated at about 1 mile from the river Andhermanik and about 10-11 miles away from the Bay of Bengal. The water of the river Andhermanik owes its salinity to the Bay of Bengal.The flow tide and tidal bore are two main factors causing soil salinity. The salt incrustations were observed in different areas of the localities. The soil salinity was noticed down to a depth of 40-90 cm. In Kuakata and to a depth of 25-65 cm. In Khepupara. The field study was carried out during dry season while crusts of the salts were found on the soil surface. The surface and subsurface soils at Kuakata were greyish white ; the surface soil of Khepupara was brownish grey and the subsurface soil was grey in colour. Texture of the soils of the two localities varied ;Kuakata soil was silty clay loam and that of Khepupara was sandy clay loam. The soils of both the areas were friable when dry. The soils sampled from the surface and subsurface areas showed dense and blocky structure. The soils were generally flocculated. The soils studied were having no distinctly developed profile characteristics but were having undifferentiated soil materials. The particle size distribution in the soils varied from the surface to sub surface layer. Of the different fractions of particle size distribution in Kuakata silty clay loam soil, sand increases with depth while silt and clay fractions decrease with depth. It was observed that in surface soil silt percent is the highest and in subsurface sand percent is the highest. In Khepupara sandy clay loam soil the sand and silt fractions increase with depth and clay fraction decreases with depth. The pH of the soil samples varied from 7.1to 7.6. The electrical conductivity of the soils varied from 9.20 mhos/cm. at 25°C to 13.60 mhos cm^{-1} at 25°C; the exchangeable sodium percentage of the soils varied from 11.03 to 13.56; the salinity concentration of the soils varied from 0.60 to 0.87 percent. It was observed that organic matter and total nitrogen content decrease with depth in both Kuakata and Khepupara soils. The organic matter content of the soils were deduced from organic carbon values; the C/N ratio of Kuakata soil decreased with depth and that of Khepupara soil increased with depth. It varied from 9.70 to 10.00. It was also observed that the NH_4-N content of both Kuakata and Khepupara soils decreased with depth. The available phosphorus content of both Kuakata and Khepupara soils decreased with depth; the same was the observation in case of potassium. These observations are comparable to that of non saline soil of the State. On the basis of the characteristics observed , it appears that the soil belongs to the group of hydrohalogenic soil and the soils may specifically termed as "saline soils".

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Tillage and Irrigation on Water Use Efficiency of Wheat in the Indo-Gangetic Plain Region

Madanmohan Meena, K.K. Bandyopadhyay, P. Aggarwal, A. Sarangi and D.R. Biswas
ICAR-Indian Agricultural Research Institute, New Delhi, 110012

Due to growing competition for water among the domestic and industrial sectors, there is a greater challenge in the agricultural sector to produce more food from less water, which can be achieved by increasing crop water productivity. Wheat is grown in an area of about 30-31 million hectares in India and water is the most limiting factor for wheat production. So there is an urgent need to improve water use efficiency in wheat. Field experiments were conducted during the year 2015-16 and 2016-17 on wheat (cv HD 2967) in a sandy loam soil at Indian Agricultural Research Institute, New Delhi to study the effect of tillage and irrigation management on water use efficiency of wheat in a maize-wheat system. The treatments comprised of three levels of tillage as main plot factor (Conventional tillage (CT), Deep tillage (DT) at alternate years and No tillage with residue (NT) and three levels of irrigation as subplot factor (I_1: 1 irrigation (CRI), I_3:3 Irrigation (CRI, Tillering, Flowering) and I_5: 5 Irrigations (CRI, Tillering, Joining, Flowering, Milk) were evaluated in a split plot design with three replications. It was observed that soil moisture content at 0-15 and 15-30 cm depth was higher under NT with residue retention than that of CT and DT whereas moisture content in the lower 45-120 cm soil depth was higher in DT followed by NT and CT. Both upward (evaporative and root water uptake) and downward flux (deep percolation) was higher in DT indicating better transmission properties of soil. The root length density (RLD) under DT was significantly higher than that of NT and CT by 12.5 and 40.7%, respectively at 0-15 cm soil depth. The RLD increased significantly with increasing irrigation level at 0-15 cm soil depth. RLD under NT was higher than CT by 25.1% at 0-15cm soil depth. Seasonal ET during the year 2016-17 was higher than that of the year 2015-16 by 32.9% due to higher rainfall received during the year 2016-17 than that of the year 2015-16. In both the years, seasonal ET under DT was higher than that of CT followed by NT. Grain and biomass yield of wheat during the year 2016-17 was higher than that of the year 2015-16 by 39.2 and 24.4%, respectively. In both the years, there was no significant difference in DT, CT and NT tillage treatments with respect to grain and biomass yield of wheat. During the year 2015-16, there was no significant difference in grain yield of wheat due to I_3 and I_s , treatment, but these treatments were superior to I_1 treatment. However, during the year 2016-17, grain yield under I_5 was significantly higher than that of I_1 and I_3, treatments but there was no significant difference between I_1 and I_3 treatments with respect to grain yield of wheat. There was no significant difference among DT, CT and NT with respect to WUE of wheat in the year 2015-16. However, during the year 2016-17, WUE of wheat under DT was significantly higher than that of NT, but there was no significant difference between DT and CT or CT and NT with respect to WUE. The WUE of wheat decreased significantly with increasing irrigation level during the year 2015-16 but effect of irrigation was not significant on WUE of wheat during the year 2016-17. So in low rainfall years, wheat grown under deep tillage at alternate years with three irrigations resulted in higher yield and WUE in the Indogangetic plain region.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Mitigating Abiotic Stresses Through Tillage, Potassium Fertilizer and Sowing Time Management in Lentil

Ramprosad Nandi*, Koustav Mondal, Madhurima Mondal, Kabita Chowdhury, Tapas Biswas and P.K. Bandyopadhyay

Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, 741 252, West Bengal

**Email: ramprosadnandi95@gmail.com*

Lentil (*Lens culinaris* Medik), an annual pulse crop is grown mostly in the rice-fallows of mid and eastern India, sharing 27 per cent of annual production of the world. But a number of abiotic factors related to soil and water lead to low or stagnant production of lentil in rice-fallows. Farmers usually practice puddled and transplanted long duration *kharif* rice, followed by ploughing to sow lentil seeds, leading to abrupt soil moisture depletion which results in immature flower drop, improper grain filling, lack of plant stand and ultimately low productivity. The introduction of short duration rice variety vis-a-vis water efficient short duration lentil variety with low cost resource conservation technology (RCT) in rice soils could be proved to be an appropriate approach to address the problems. Additionally potassium (K) fertilizer management in lentil growth periods could also reduce the intensity of stress through physiological modifications in lentil plants. Viewing all these a field experiment was conducted in rice-fallows of the University research farm, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal in split plot design with three replications. The main plot was of two dates of sowing of lentil [early (E) and late (L)] and the sub-plots consisted of three tillage practices viz. no tillage (NT), minimum tillage (MT) and conventional tillage (CT) with varying rice residues. The sub-sub-plots contain four K fertilizer levels viz. no K (K0) i.e. control, K as basal (Kb), K as foliar (Kf) and K both as basal and foliar(Kb+f). Initial root zone soil moisture storage was more in early sown lentil in an order of MT>ZT>CT (152-168 mm). Late sowing of lentil experienced less moisture storage irrespective of all the treatments (138-154 mm). CT faced faster decline below the water available range early (68-75 DAS) as compared to NT and MT (78-85 DAS).The leaf area index (LAI) was maximum at peak vegetative stage and the highest value was under E-CT-Kb+f followed by E-NT-Kb+f and the least for L-CT irrespective of all K treatments. Relative leaf water content (RLWC) at peak vegetative to flowering was maximum for E-NT followed by E-MT and L-MT but it went down below the critical limit (70%) shortly in L-CT. Leaf chlorophyll content was more in E-CT-Kb+f followed by E-NT-Kb+f at flowering period. Though plant height was more in NT plots but E-CT experienced maximum total plant biomass as well as root biomass. Pods per plant, leaf expansion rate, crop growth rate were significantly higher under CT than MT and NT in E; however, for L it was higher under treatment MT. Treatment E-CT-Kb+f showed the maximum grain yield followed by E-MT-Kb+f and the least under L-CT-K0. Result thus concluded that early sowing of CT and MT followed by K fertilizer management could be appeared to be a solution for moisture stress management.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Three-dimensional Digital Soil Mapping of Multiple Soil properties at a field- scale using 3D regression kriging

Asim Biswas*, Yakun Zhang, Wenjun Ji and Viacheslav I. Adamchuk
**Email:* *asimbiswas@gmail.com*

With technological advancements and development of computational facilities, 3D digital soil mapping (DSM) is becoming popular for its information on both the horizontal and the vertical variability in soil properties. Most current studies are based on either, one-dimensional profile depth functions, or two-dimensional horizontal interpolation techniques, which do not allow true 3D visualization of spatial soil heterogeneity. Only few studies have utilized the 3D variograms for mapping. Recent advances in proximal soil sensing technologies allowed measurement and prediction of soil properties rapidly at multiple depths and has potential as input for DSM. Various soil physical and chemical properties have already shown either direct or indirect relationships with the proximal soil sensing data, including volumetric water content (VWC), gravimetric water content (GWC), bulk density (BD), soil organic matter (SOM), soil pH, electrical conductivity (EC), sand content, clay content, available phosphorus (P), and available soil cations (potassium (K), sodium (Na), magnesium (Mg), zinc (Zn), and manganese (Mn)). This study aims to test the methodology of 3D-DSM using a 3D geostatistical approach with predicted soil properties from proximal soil sensing. In this study, 32 soil cores (1-m maximum depth) were collected and sectioned at 10-cm depth intervals from Field 26 of Macdonald Farm, McGill University. A total of 251 samples were analyzed for multiple soil properties in the laboratory. Additionally, vis-NIR spectra data were collected to about 1-m depth *in-situ* at 148 sites (including these 32 cores) using the Veris® P4000 soil profiler. Predicted soil properties by partial least square regression (PLSR) models from vis-NIR spectra at 148 sites were separated into calibration dataset (70%) and validation dataset (30%). The spatial relationship of soil properties from calibration dataset and environmental covariates (including field topography, gamma radiomatrics, and apparent soil electrical conductivity) was used to estimate 3D variograms and pursue regression kriging. Generalized linear model, regression tree, and random forest were compared for the trend prediction. As a result, complete three-dimensional digital soil maps were developed.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Predicting Water Retention using Parametric Functions

Asim Biswas* and Amiya Biswas
**Email: asimbiswas@gmail.com*

The soil water characteristic (SWC) is a fundamental property which controls soil water storage and movement. Various analytical functions are often used to describe SWC because they are convenient in the solution of numerical flow equations as well as the implementation of closed form methods of predicting unsaturated hydraulic conductivity. These applications will only be successful provided the analytical functions adequately describe the measured SWC data. Two large datasets from New Zealand and United Kingdom was used to evaluate analytical functions on the basis of how well they describe the measured data. Among the various analytical functions, simpler power law equation described measured SWC well and was only reported. Most of the errors with the power-law functions occurred at water contents near saturation. This may be from physically unrealistic equation discontinuity around the air entry potential. The good performance of the power-law form of equation enabled development of a method to predict SWC data from only two measured SWC points and a knowledge of soil bulk density. The power law equation was used in association with parabolic smoothing to obtain the parameters using just two measured SWC points. A very good prediction was obtained within the range of 0 to -150 m matric potential. The prediction based on two-point measurement significantly reduced the cost of obtaining SWC data and provided an opportunity to overcome the constraint of widespread application of soil water simulation models based on Richard's equation.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Distribution of Soil Organic Carbon Pools in Aggregate Size Fractions under Rice-based Cropping System

Kabita Chowdhury*, Ramprosad Nandi, Sonu Kumar and P.K. Bandyopadhyay
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, 741252, West Bengal
**Email:chowdhurykabita1@gmail.com*

The type of crops grown or the cropping systems determine the soil organic carbon (SOC) storage and different pools associated with it. Soils having continuous short term (7 years) cropping systems *viz*. rice-fallow and rice-lentil, collected from the Block Seed Farm, Kalyani, West Bengal to study the distribution of SOC in different aggregate sized fractions (i.e. Coarse macroaggregate,>2 mm; Mesoaggregate, 2-0.25 mm; Coarse microaggregate, 0.25-0.05 mm and silt+clay <0.05 mm and to assess the array of different pools of SOC (labile, non labile and active or passive pools) at different size fractions. Rice-fallow system had more stable aggregates than rice-lentil. Oxidizable organic carbon (OC) and total organic carbon (TOC) were higher in smaller aggregate size fractions in rice-fallow, however, the distribution was reversed in rice-lentil system. Pool I (very labile) and pool II (labile) of SOC were higher in >2mm for rice fallow, however, they were in 2-0.25mm fraction for rice-lentil cropping system. Pool III (less labile) was more in 0.2-0.25mm in rice fallow but was more in>2mm in rice-lentil. Pool IV (non-labile) showed linear distribution among aggregates in both rice-fallow and rice-lentil, however, rice-fallow showed more pool IV than rice-lentil. Results revealed that the passive pool (pool III+IV) was higher than active pool (pool I+II) in rice-fallow system but were at par in rice-lentil system. Macroaggregates (>0.25mm) contained 38 and 45% of active pools and 62 and 55% passive pools from rice-faloow and rice-lentil cropping systems, respectively. Microaggregates (<0.25mm) of rice-fallow stored 30% more passive pool as compared to rice-lentil. The relative preponderance of different pools of rice-fallow and rice-lentil were pool III>pool IV>pool I>pool II and pool I>pool IV>pool II> pool III, respectively. Lability index was found higher in rice-lentil than rice-fallow in each aggregate size fraction.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Comparison of Soil Carbon within Aggregation under Three District Ecological of Northern Part of West Bengal, India

Parijat De[1], Shovik Deb[1], Somsubhra Chakraborty[2], Deo Kumar[1] and Ashok Choudhury[1]

[1]Department of Soil Science and Agricultural Chemistry,
Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, 736165, West Bengal
[2]Agricultural and Food Engineering Department,
Indian Institute of Technology, Kharagpur, 721302, West Bengal

Diversity of land use land cover (LULC) in Northern part of West Bengal, India is very unique. The Himalayan terai region within this part of state is home for several national parks. Due to rapid increase of anthropogenic pressure and agricultural intensification this region is facing some challenges. It results in shifting of unprotected forest to agricultural land. The change of LULC also affects soil properties including soil aggregation and aggregate occluded carbon dynamics. In this regard, this study has been taken up with the objectives to find out the impact of land use change on soil aggregation and qualitative aggregate occluded Carbon. There is similar trend of basic physico-chemical properties in all the soils in terms of mean weight diameter and geometric mean diameter. Further, forest soil also experienced formation of highest number of microaggregate as well as microaggregates within macroaggregates. This indicated the overall better aggregation of forest soils and possible better physical protection of organic Carbon inside these aggregates. Higher aggregate associated Carbon in forest soils further confirmed the fact. Spectral analysis of bulk soil Carbon as well as aggregate occulated Carbon revealed qualitative changes of Carbon with change in land use ecology as well as with aggregate size classes.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Contrasting Tillage Practices on Soil Physical Parameters under Rice-Lentil Cropping System

Madhurima Mondal, Ramprasad Nandi, Kabita Chowdhury and P.K. Bandyopadhyay
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, 741252, West Bengal
**Email: madhurima.m23@gmail.com*

Lentil (Lens culinaris Medik) predominantly grows under rainfed condition in puddle transplanted rice soils using residual soil moisture in the Gangetic alluvium of West Bengal. Low yield of lentil are commonly associated with the adverse effect of soil physical conditions induced by puddling for the rice crop. With the hypothesis to counteract these problems five short-term (2011-12 to 2015-16 cropping seasons) tillage practices viz., one conventional tillage (CT) and four conservation tillage, e.g. minimum tillage (MT), no tillage (NT), conventional tillage with straw mulch (CT+M) and minimum tillage with straw mulch (MT+M) were imposed after rice crop. The objective was to evaluate the effects of tillage practices on soil physical properties. Results indicated that for short term tillage, the mean bulk density (BD) value of CT was 2.6% higher than other conservation tillage practices. Total porosity values of NT, CT+M and MT+M were statistically at par and increased by 5.3% more than CT. Conservation tillage recorded 18.5% higher maximum water holding capacity (MWHC) than CT. A significant relationship ($p<0.001$) between saturated hydraulic conductivity (Ks) and bulk density (BD) depicts 67% and 64% variability due to differences in pore variation created by bulk density and soil organic carbon (SOC) with depth. Conservation tillage practices improved the basic infiltration rate from 4 to 6 mm h^{-1} over CT and water stable aggregates (WSA) by 6.8%. A significant correlation ($p<0.001$) between WSA and SOC explained 50% variability indicating that 2% WSA could be achieved by increasing 0.1% SOC. Conservation tillage practices modified 4% more pore space through improving 5% macroaggregate size diameter that increased 19% and 11% more water holding capacity and infiltration rate. The reduction in aggregate stability with five years of CT significantly reduced both macroporosity and pore continuity, thereby decreasing water infiltration, maximum water holding capacity and saturated hydraulic conductivity. The relative performance of the tillage on physical parameters in puddled rice soil was as: MT+M>CT+M>NT>MT>CT.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Modelling of Soil Water Balance and Root Water Uptake in Bed-Planted Pigeon pea using HYDRUS-2D

Vikas Rai[1], P. Pramanik[1], P. Aggarwal[1], P. Krishnan[1], K.K. Bandyopadhyay[1], Ranjan Bhattacharyya[2] and T.K. Das[3]

[1]Division of Agricultural Physics, [2]Centre for Environment Science and Climate Resilient Agriculture, [3]Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi, 110012

Although conservation agricultural practices are superior to traditional farming practices, very limited information is available on effects of these practices in moderating soil temperature and distribution of profile soil water during crop growth period for understanding the water and energy balance. In current study, both soil water balance and root water uptake of pigeon pea (*Cajanas cajan*) grown under permanent raised bed with residue (PBB+R) and conventional tillage (CT) system in a pigeonpea-wheat (*Triticum aestivum*) cropping system were analyzed using the Hydrus-2D model. Results in the seventh year of the pigeonpea crop indicated that soil bulk density (BD) decreased, field saturated hydraulic conductivity (K_{sat}) increased and soil water retention was improved in PBB+R over CT plots. For calibration of Hydrus-2D model, experimentally measured saturated hydraulic conductivity (K_{sat}) values along with α and n parameters obtained as output of Rosetta Lite model were optimized through inverse modeling and were used as hydraulic inputs of the model which, predicted daily changes in profile SWC with reasonable accuracy ($r^{2=}$ 0.78). The peak values of leaf area index (LAI) and fractional intercepted photosynthetically active radiations (fiPAR) for PBB+R treatment (occurred at 100 DAS) ranged between 2.57-2.96 and 0.92-0.96 respectively, whereas the peak value for CT (occurred at 115DAS) and its magnitude was 2.25 with a range of 1.96-2.25 and 0.86 (range 0.82-0.86). Computed potential transpiration rate (T_p) under CT were lower than PBB+R, due to less radiation interception and lower LAI. It has been also observed that under low soil moisture condition in root zone, soil stress factor (K_s) significantly reduced RWU whereas when root zone is sufficiently wet, Ks have very negligible effect. Soil water balance simulated (100-125 DAS) from the model showed higher cumulative root water uptake (CRWU) (1.72 cm), lower cumulative evaporation (CE) (0.34 cm) and higher soil water retention in PBB+R than in CT.

Hence, it can be concluded that PBB+R practices should be adopted for pigeon pea cultivation, as it improved sol water balance, enhanced root growth and improved radiation interception, LAI and biomass production. The HYDRUS-2D could satisfactorily simulate the temporal changes in soil water balance and root water uptake during the crop period. So, this model may be adopted for evaluating different management practices in terms of improvement in water and radiation use by crop plants.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effects of Conservation Agriculture on Soil Carbon Pools in Maize-Wheat-Mungbean Cropping System

Priti Tigga, Mahesh C. Meena, B.S. Dwivedi, S.P. Datta, R. Singh, H.S. Jat[1] and Gordhan Gena
ICAR-Indian Agricultural Research Institute, New Delhi, 110012
[1]ICAR-Central Soil Salinity Research Institute, Karnal, Haryana

Conservation agriculture (CA) involving zero-till permanent beds (PB), crop residue retention on soil surface and inclusion of legumes has potential to enhance soil organic carbon (SOC) pools and maintaining soil quality. In view of this, a field experiment was initiated in the year 2012 to assess the impact of tillage practices and nutrient management options on various SOC pools and soil microbial biomass C (MBC) in a clay loam soil of north-west Indo-Gangetic plain under maize-wheat-mungbean cropping system. The experiment was laid out in a split-plot design with four combination of tillage and residue management practices as main-plots *i.e.* conventional tillage with residue removal (CT-RR), conventional tillage with incorporation of maize, wheat and mungbean residue (CT+RI+GI), PB with retention of maize and wheat residue (PB+RR) and PB with retention of maize, wheat and mungbean residue (PB+RR+GR), and the sub-plots consisted of nutrient management options, *i.e.* farmer's fertilizer practice (FFP), recommended dose of fertilizers (RDF) and site-specific nutrient management using 'nutrient expert' (SSNM-NE). The soil samples were collected at physiological maturity of wheat in the year 2016. The results revealed that total organic C (TOC) was 38.3 and 18.8% higher under PB+RR+GR than CT-RR in 0-5 and 5-15 cm depths, respectively. The nutrient management options *i.e.* SSNM and RDF were equally effective in enhancing TOC in both soil depths. In 5-15 cm depth, the interaction effect of tillage and nutrient management options was also noted on TOC content and maximum was under PB+RR+GR × FFP (7.97 g kg^{-1}). The Walkley-Black C (WBC) content followed the trend as obtained with TOC under varying treatments and showed increase over the initial WBC (5.70 g kg^{-1}). There was a significant difference in the SOC fractions *viz.* very labile C (C_{VL}), labile C (C_L) and less labile C (C_{LL}) under 5-15 cm depth, where higher values were recorded under PB compared to CT treatments. Similarly, the non-labile C (C_{NL}) was also higher under PB (2.93- 2.97 g kg^{-1}) than CT (1.15-2.35 g kg^{-1}) in the surface soil depth, which otherwise was non-significant in 5-15 cm soil depth. The highest values for $KMnO_4$-C and HWEC were recorded under PB+RR+GR *i.e.* 1.70 and 0.32 g kg^{-1}, respectively in the surface depth. Among the nutrient management options, $KMnO_4$-C as well as HWEC higher under RDF were significantly. Among microbial parameters, the highest MBC was observed under PB+RR+GR (310 mg kg^{-1}) while, the lowest was recorded under CT-RR (183 mg kg^{-1}) in surface soil and decreased with the increasing soil depth. Overall, the highest SOC content was recorded in PB+RR+GR compared to other tillage practices. Balanced fertilization (RDF and SSNM) also helped in improving SOC pools under CA. Thus, the present study suggested that PB+RR+GR along with RDF or SSNM were best for sustainable crop production and restoration of soil health in maize-wheat-mungbean cropping system.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Long-term Fertilization on Allocation of Labile Pools of Soil Organic Carbon in an Inceptisol under Rice-Rice Cropping System in Subtropical India

Ritesh Kundu[1]*, Ashim Datta[2], Dibakar Roy[3], Dhaneshwar Padhan[1], Samrat Adhikary[1], A.K. Nayak[4] and Biswapati Mandal[1]

[1]*Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, 741252, West Bengal*

[2]*Division of Soil and Crop Management, ICAR-Central Soil Salinity Research Institute, Karnal, 132001, Haryana*

[3]*Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, New Delhi, 110012*

[4]*Division of Crop Production, ICAR-National Rice Research Institute, Cuttack, 753006, Odisha*

**Email: riteshubkv@gmail.com*

Soil is a brilliant sink for carbon and it remains in soils in different pools with varying residence time. Labile C fractions are the most active part of soil organic carbon that fuel the soil food web and greatly influence nutrient cycles and many biologically related soil properties. Permanganate oxidizable C responds more quickly to changes in management practices than SOC, and is thus used as an early and sensitive indicator of SOC changes. Long-term application of organic and inorganic fertilizers with intensive cropping has an influence on allocation of carbon into such active pools. An attempt was made to study the effect of management practices on distribution of carbon into active pools in an Inceptisol under rice-rice cropping system for last 48 years in humid subtropical India. Two management practices viz., 100% recommended doses of fertilizer NPK and 50% NPK + FYM along with a fallow and an absolute control were considered for comparison. Soil samples at three depths (0-0.15 m, 0.15-0.30 m, 0.30-0.45 m) were collected and analyzed for the present study. $KMnO_4$(0.02M) oxidizable carbon was found higher in soils fertilized with inorganic fertilizer irrespective of depth and along depth it decreased gradually irrespective of treatments. POX-C (0.02M $KMnO_4$) as percent of OC (Walkley and Black, 1934) and TOC (Tiessen and Moir, 1993) varied from 2.8 to 4.7 and 2.2 to 3.4%, respectively in surface layer. Also we have got significant positive correlation (R^2=0.95) between POX-C and oxidizable organic carbon (Modified Walkley and Black using 12*N* H_2SO_4) at surface layer (0-0.15m), whereas the relationship is insignificant at lower depths.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Potassium Supplying Capacity of Soils in Relation to Mineralogy under Mulberry Land Use System in North-Eastern Himalayan Region

Anshuman Das*, D.R. Biswas, Debarup Das, Ruma Das, Prasenjit Ray[1], Avijit Ghosh, Siddhartha Sankar Biswas and Khushboo Rani

Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi, 110012

[1]ICAR-NBSS&LUP, Regional Centre, Jorhat, 785 004, Assam

**Email: anshumandasiarissac@gmail.com*

Potassium (K) is the most neglected nutrient as it is believed that K availability in most of the Indian soils is high. Thus, intensive cropping system is skewed towards use of nitrogen (N) or N and phosphorus (P) which led to imbalance of nutrients and mining of K from soils. India ranks second in the world in silk production which is dependent on the mulberry leaves as the sole food for silk worm. The livelihood of people of north-eastern region especially in Assam, rely upon mulberry land use system for production of silk. Mulberry is an exhaustive crop, but no fertilizer management, particularly potassium (K) is taken into consideration for several years which would likely to be unproductive in near future, if no measure is taken. It is assumed that non-exchangeable K which constitutes a slowly available pool of K might significantly influence K fertility in soils of mulberry land use system. Therefore, the present investigation was carried out to see the K supplying capacity of soils in relation to mineralogy and different pools of K under mulberry land use system in north-eastern Himalayan region of Assam in two different soil orders. Soil samples were collected from three different depths (0-15, 15-30 and 30-60 cm) under two different soil orders namely, inceptisol and entisol from Jorhat and Golaghat districts of Assam, respectively. The different pools of K and release kinetics were determined throughout its depth and the clay minerals were identified by X-ray diffraction method. The release kinetics was fitted with several equations and best fitted with the power function. All the pools of K namely, water soluble, exchangeable and non-exchangeable K was higher in Inceptisol than the Entisol. Percentage of available K was also higher in inceptisol (2.26%) than the entisol (0.33%). The apparent release rate coefficient of K in soil was higher in entisol than the inceptisol. Both the soil orders were dominated with kaolinite and micaceous minerals. However, the amounts of micaceous minerals are relatively higher in entisol than inceptisol.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Residual Effect of Integrated Nutrient Management on *Rajgira* Yield and Nitrogen Fractions in Soil under Maize-*Rajgira* Crop Sequence

K.C. Patel and Rukshmani S. Bhoye
Department of Soil Science and Agricultural Chemistry, B.A. College of Agriculture, Anand Agricultural University, Anand, 388 110, Gujarat

A field experiment was conducted at the Regional Research Station, Anand Agricultural University, Anand on loamy sand soil to study the residual effect of integrated nutrient management on *rajgira* yield and nitrogen fractions in soil under maize–*rajgira* crop sequence. The *rabi rajgira* (var. Gujarat Amaranths–1) was grown and treatments were replicated four times in a split plot design. The treatments comprised *viz.* main plot - M_1: 100 % RDF + 10.0 t FYM ha^{-1}, M_2: 100 % RDF + 3.0 t vermicompost ha^{-1}, M_3: 100 % RDF + 1.0 t castor cake ha^{-1}, M_4: 75 % RDF + 10.0 t FYM ha^{-1}, M_5: 75 % RDF + 3.0 t vermicompost ha^{-1}, M_6: 75 % RDF + 1.0 t castor cake ha^{-1} and in sub plot R_1: 50% RDF and R_2: 100% RDF. The treatments (M_1 to M_6) were applied to maize (*kharif*) only and residual effect was studied on *rajgira* (*rabi*), where as RDF treatments (R_1 & R_2) were applied to both maize and *rajgira* crops. The recommended dose of NP for maize was 60 kg N + 40 kg P_2O_5 ha^{-1} and for *rajgira* @ 40 kg N + 20 kg P_2O_5 ha^{-1}.

The integrated nutrient management treatments applied to preceding crop of maize showed significant residual effect of INM treatments on grain and straw yield of *rajgira*. The significantly highest grain (2.3 t ha^{-1}) and straw (4.0 t ha^{-1}) yields were recorded under treatment M_1 (100 % RDF + 10.0 t FYM ha^{-1}). The direct effect of 100% RDF (R_2) recorded significantly the highest grain yield (2.1 t ha^{-1}) and straw yield (3932 kg ha^{-1}). The significantly highest soil organic carbon (0.43 %), available P_2O_5 (42.79 kg ha^{-1}) and available K_2O (235.29 kg ha^{-1}) was recorded under treatment M_1 (100 % RDF + 10.0 t FYM ha^{-1}). Among different nitrogen fractions, total nitrogen, available N and NO_3^- - N of soil were significantly increased due to residual effect of integrated nutrient management after harvest of *rajgira*. The significantly higher total nitrogen (823.76 kg ha^{-1}), available N (371.17 kg ha^{-1}) and NO_3^- - N (100.17 kg ha^{-1}) was recorded under treatment M_1 (100 % RDF + 10.0 t FYM ha^{-1}). The per cent improvement of available N and nitrate nitrogen was 13.11 and 21.55 under M_1 over M_5 treatment. The residual effect of INM on nitrogen fractions indicated that due to addition of 10 t FYM over the seasons enriched nitrogen fractions in order of available N > NO_3 – N in soil. The direct effect of fertilizer applied to *rajgira* crop did not significantly influence on total nitrogen, available N and nitrate nitrogen content in soil. Among different combinations, M_3R_1 treatment combination recorded significantly higher total nitrogen (872.28 kg ha^{-1}) and available N (373.85 kg ha^{-1}) in soil. Whereas, treatment combination M_1R_2 (46.22 kg ha^{-1}) recorded maximum nitrate nitrogen content in soil. The results indicated that among the different INM treatments, the residual effect of 100 % RDF + 10.0 t FYM ha^{-1}) gave better performance in increasing grain and straw yield and also improved chemical composition of *rajgira*. The nutrients status in soil was also maintained under residual effect of 100% RDF + 10 t FYM ha^{-1} after harvest of *rajgira*. The direct application of 100% rate of fertilizer application to *rajgira* was found beneficial in improving *rajgira* yield, nutrient content and nutrient status in soil over 50% RDF application. The addition of castor cake @ 1.0 t ha^{-1} and FYM @ 10 t ha^{-1} along with chemical fertilizer to preceding crop of maize had better residual effect in enriching available N and nitrate-N in soil under maize – *rajgira* cropping system. Therefore, residual effect of integrated nutrient management practices help in increasing *rajgira* yields and also maintain soil health under maize – *rajgira* crop sequence.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Characterization of Soil Acidity in Soils of Manipur

L. Devarishi Sharma and Indira Sarangthem*
College of Agriculture, Central Agricultural Chemistry, Imphal, Manipur
**Email: indira_sarangthem@yahoo.co.in*

In India, acid soils constitute nearly one-third of the area under cultivation. The North-Eastern region of India with alpine to humid tropical climate possesses the problem of soil acidity which is the major limiting factors for low productivity potential. In Manipur about 90% of soils are acidic. The conditions conducive for the formation of acid soils in Manipur high rainfall, high temperature and hilly topography. The rapid weather in and intense leaching under high rainfall conditions favors the development of soil acidity. The study on characterization of soil acidity in Manipur was undertaken with the characterization of nature of soil acidity and the relationship between the different forms of acidity with the soil properties.

Total acidity, pH dependent acidity and exchange acidity of surface soil of i) Senapati district range from 15.02-22.48 cmol(p^+)kg^{-1}, 13.83-18.47 cmol(p^+)kg^{-1} and 0.55-6.02 cmol(p^+)kg^{-1}, ii) Churachandpur district (9.46-16.89 cmol(p^+)kg^{-1}, 7.34-14.37 cmol(p^+)kg^{-1}, and 0.90-3.22 cmol(p^+)kg^{-1}), iii) Imphal East district (4.75-17.32 cmol(p^+)kg^{-1}, 4.53-16.82 cmol(p^+)kg^{-1}, and 0.10-0.70 cmol(p^+)kg^{-1}), iv) Imphal West district (2.82-17.40 cmol(p^+)kg^{-1}, 2.72-16.30 cmol(p^+)kg^{-1}, and 0.10-1.80 cmol(p^+)kg^{-1}), v) Bishnupur district (3.73-6.71 cmol(p^+)kg^{-1}, 3.65-6.56 cmol(p^+)kg^{-1}, and 0.08-0.32 cmol(p^+)kg^{-1}) and vi) Thoubal district (4.56-12.00 cmol(p^+)kg^{-1}, 2.81-9.23 cmol(p^+)kg^{-1}, and 0.90-2.97 cmol(p^+)kg^{-1}). Similarly total acidity, pH dependent acidity and exchange acidity of sub-surface soil of i) Senapati district (12.19-23.33 cmol(p^+)kg^{-1}, 7.60-16.84 cmol(p^+)kg^{-1} and 1.17-8.10 cmol(p^+)kg^{-1}), ii) Churachandpur district (9.46-16.89 cmol(p^+)kg^{-1}, 7.34-14.37 cmol(p^+)kg^{-1} and 0.90-3.22 cmol(p^+)kg^{-1}), iii) Imphal East district (5.62-18.03 cmol(p^+)kg^{-1}, 5.52-17.79 cmol(p^+)kg^{-1} and 0.10-0.24 cmol(p^+)kg^{-1}), iv) Imphal West district (3.55-19.53 cmol(p^+)kg^{-1}, 3.44-18.89 cmol(p^+)kg^{-1} and 0.07-0.84 cmol(p^+)kg^{-1}), v) Bishnupur district (3.54-11.42 cmol(p^+)kg^{-1}, 3.48-11.31 cmol(p^+)kg^{-1} and 0.06-0.30 cmol(p^+)kg^{-1}) and vi) Thoubal district (4.56-12.00 cmol(p^+)kg^{-1}, 2.81-9.23 cmol(p^+)kg^{-1} and 0.90-2.97 cmol(p^+)kg^{-1}).

Correlations among different forms of acidity and soil properties were studied. The soils of hill districts of Senapati, & Churachandpur have a negative correlation with pH and different forms of acidities. Organic carbon had significant positive correlation with pH dependent acidity and total acidity. Available Ca & Mg had significant negative correlation with exchange acidity. Both forms of aluminium (exchangeable Al & extractable Al) have contributed significantly to exchange acidity & total acidity forms of acidities. Cation exchange capacity (CEC) have positive correlation in all forms of acidities, except exchange acidity. Clay had positive significant influence on exchange acidity & total acidity. Likewise the soils of Imphal East, Imphal West, Bishnupur & Thoubal shows that pH, organic carbon, exchangeable-Al, extractable-Al & clay had significant influence on different forms of acidities to a varying degrees. pH had a negative correlation with all kinds of acidities. Organic carbon had significant positive correlation with pH dependent acidity and total acidity. Likewise both forms of aluminium (exchangeable Al & extractable Al) have contributed significantly to different forms of acidities. CEC have positive correlation in all forms of acidities, except exchange acidity. Available Ca & Mg had significant negative correlation with exchange acidity. Clay had positive significant influence on exchange acidity, pH Dependent acidity & total acidity except pH-dependent acidity in sub-surface of Thoubal district . It is observed that Imphal East, Imphal West, Bishnupur & ThoubalI the major contributing factors for producing exchange acidity are pH, exchangeable Al, extractable aluminium and clay whereas soil properties responsible for pH- dependent acidity are organic matter, extractable aluminium and clay.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Zinc Fractions and Their Availability to Transplanted Paddy Soils of Manipur

Nivedita Oinam, R.K. Kumarjit and Indira Sarangthem
Department of Soil Science and Agricultural Chemistry, Central Agricultural University, Imphal, Manipur

Distribution of various fractions of zinc and their relationship with different soil properties in rice growing valley soils of Manipur were studied. Thirty six surface soil samples (0-20cm) were collected from different paddy fields of four valley districts of Manipur (Imphal-east, Thoubal, Imphal-west and Bisnupur) under Stratified Random Sampling. Fractionation of zinc was as per the sequential extraction procedure of Murthy (1982) modified by Mandal and Mandal (1986). All the soil samples were acidic in reaction (pH 4.9-6). The DTPA-Zn content ranged from 0.55 to 1.26 mg kg^{-1} with mean value of 0.89 mg kg^{-1} in the soils. The distribution of different zinc fractions in paddy soils revealed that water soluble and exchangeable zinc fractions (WSEX-Zn) in the soils varied from 0.05 to 0.56 mg kg^{-1}, organically bound zinc fraction (OC-Zn) 4.71 to 7.76 mg kg^{-1},amorphous sesquioxide bound zinc (AMOX-Zn) 1.96 to 4.96 mg kg^{-1}, crystalline sesquioxide bound zinc (CRYOX-Zn) 0.96 to 3.2 mg kg^{-1}, manganese oxide bound zinc (MN-Zn) in the soils varied from 1.18 to 4.26 mg kg^{-1}. The major proportion of soil zinc was in the residual zinc form ranging from 58.37 to 110.71 mg kg-1 and total zinc content73 to 126 mg kg^{-1}. The per cent contribution of WSEX-Zn, OC-Zn, AMOX-Zn, CRYOX-Zn, MN-Zn and Residual zinc constituted 0.32%, 6.7%, 3.63%, 1.78%, 2.53% and 84.99 per cent of the total zinc content in the soils respectively. Correlation studies of different Zn-fractions with soil properties showed highest correlation between organically bound zinc fraction and organic carbon (r = 0.736**). Water soluble and exchangeable zinc fractions had significantly negative relationship with soil pH (r = -0.394*).Organically bound zinc fraction also showed significant and positive correlation with clay (r = 0.340*). Manganese oxide bound form had a negative significant relationship with organic carbon (r = -0.358). Residual Zinc had significant and negative correlation with pH (r = -0.425**) but significant and positive correlation with soil organic carbon (r = 0.696**),total zinc with pH (r = -0.444**) and soil organic carbon (r = 0.673**) suggesting that water soluble and exchangeable zinc fraction is of great importance in Zn nutrition of lowland rice. Major portion of Zn was in the residual fraction which contributed very little to plant uptake.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Distribution of Secondary and Micronutrients in Paddy Soils of Manipur

Indira Sarangthem, Nivedita Oinam, L. Devarishi Sharma and L. Punilkumar Singh
Department of Soil Science and Agricultural Chemistry, Central Agricultural University, Imphal, Manipur

Distribution of micro-secondary nutrients in Manipur from three hundred thirty GPS soil samples of different paddy growing fields of Churachandpur, Thoubal and Bishnupur district under stratified random sampling were studied. Micronutrients content in 5 blocks of Churachandpur district (Churachandpur, Singhat, Thanlon, Tipaimukh and Churachandpur north) showed 58 % Zn sufficiency, Fe and 100% Mn sufficiency while Cu is found 62% sufficient. High content of available Fe may be attributed to higher organic matter because it acts as chelating agent and Mn sufficiency might be due to higher biological activity and organic carbon content in the surface layers. Thoubal district (Thoubal, Lilong and Kakching blocks) showed Zn and Cu to be 43.3 % and Cu 96.7% sufficiency respectively while Fe and Mn are found 100% sufficient. The soil samples analyzed from 3 (three) blocks of Bishnupur district i.e.(Moirang, Bishnupur and Nambol) showed 93.3% Zn sufficiency, 86.7% Cu sufficiency while Fe and Mn are found 100% sufficient in all blocks. Analysis of Sulphur content of different soil samples shows deficiency of 84% in Churachandpur (5.47-11.95 mg kg^{-1}), 85.5% in Bishnupur (5.32-11.43 mg kg^{-1}) and 76.7% in Thoubal (3.63-11.70 mg kg^{-1}) Districts. The fact that sulphur is readily leached from the soil and weathered soil in high rainfall areas frquently have a low satus may contribute to the factors. Regular high level of phosphorus may replace sulphur from soil matrix and lead to sulphur depletion.In Churachandpur district, deficiency of sulphur may also be attributed to the burning of vegetation that results in gaseous losses of sulpur from the farming system.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Evaluation of Quantity-Intensity Relationship of Potassium in Some Selected Indian Agricultural Soil

Rejaul Mallick, Sourav Kumar khan and Sanjib Kar
Department of Agricultural Chemistry and Soil Science, Institute of Agricultural Science, University of Calcutta, 35, Ballygunge Circular Road, Kolkata, 700019, West Bengal
Email: rejaulmollick760@gmail.com, souravkhan.90@gmail.com, sanjib_cu@yahoo.co.in

The potassium (K) supplying capacity of some selected agricultural soil was investigated by employing the quantity-intensity (Q/I) approach. The values of potential buffering capacity (PBC^K), labile K (K_L), specific K (K_0), specific K sites (K_X), equilibrium activity ratio (AR^K) and free energy change (-”G) were estimated from the quantity-intensity curve. Higher cation exchange capacity and lower organic carbon favours labile K pool. All Q/I parameters has a direct relationship with chemical characteristics and clay mineralogy of the soil. The changes of Q/I parameters is associated with contents of clay, organic matter and clay mineralogy of the soil. High exchangeable cation in the soil matrix and higher CEC favours labile K, specific K and specific K sites. Equilibrium activity ratio of potassium increases with decreasing free energy change as well as increasing CEC and exchangeable cations.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Transformation of Different Fractions of K in a Limed and the Corresponding Unlimed Waterlogged Soil Subjected to a Wetting and Drying Cycle

Sayan Majumder*, Tapa Debnath and Dipankar Saha
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, 741252, West Bengal

A laboratory investigation was carried out to study the changes in different K fractions in a limed and the corresponding unlimed soil maintained under waterlogged condition subjected to a wetting and drying cycle. A Typichaplustalf soil is used for the present investigation which was collected from Regional Research Station, Jhargram, West Bengal. Limed soil was prepared by treating acid soil with liming material ($CaCO_3$) equivalent to the lime requirement followed by wetting and drying for 3 months. Waterlogging is maintained in limed and unlimed soil for 90 days. Another set of both the soils were waterlogged upto 45th day, then a drying phase was given and again remoistened to waterlogged situation on 60th day and maintained upto 90 days. Both limed and unlimed soils were treated either with K fertilizer or both N and K fertilizers. Soil samples were periodically collected on 0, 30, 45, 60, 75 and 90th day of the incubation study. Soil samples were analysed for different fractions of K flame photometrically following standard methods.

Results revealed that, irrespective of moisture regimes and liming, water soluble K significantly decreased over 90 day period of incubation. Furthermore, comparatively higher amount of decrease in water soluble K is recorded in limed than unlimed soils over 90 day period of investigation. Again, in general, exchangeable K decreased in limed over unlimed system upto 45th day of incubation. However, a completely reverse trend of results was observed from 45th to 90th day of study. On the other hand, comparatively lower amount of available K is accumulated in limed over unlimed soil upto 60th day of incubation. However,75th day onwards, a reverse trend is observed in both the fertilizer treated and untreated systems. Furthermore, irrespective of treatments, in general, non-exchangeable K decreased over 90 day period of incubation. The decrease in non-exchangeable K is more marked in limed over that of unlimed systems. The increase in exchangeable K and the concomitant decrease in non-exchangeable K in limed soil over 90 day period of incubation suggests that there exists an equilibrium between these two forms of K in soil. Maintenance of a drying phase in a continuously flooded system released non-exchangeable K and the intensity of K release is more in limed over that of unlimed soil over 90 day period of investigation. Comparatively higher amount of 1 N boiling HNO_3 extractable K is accumulated in limed over unlimed systems. The increase in 1 N boiling HNO_3 extractable K is due to increase in non-exchangeable K. Boiling of soils with 1 N HNO_3 released K not only from the wedge sites but freed non-exchangeable positions occupied by NH_4^+ ions and hence the amount of available K increased. Changes in lattice K followed exactly an opposite trend of results compared to non-exchangeable and 1 N boiling HNO_3 extractable K throughout the whole period of investigation. Liming had a positive effect on increasing total K in soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Carbon Sequestration in Shrub-based Agroforestry Systems in Arid Rajasthan

M.L. Soni* and V. Subbulakshmi
ICAR-Central Arid Zone Research Institute, Regional Research Station, Bikaner, 334004, Rajasthan
**Email: soni_ml2002@yahoo.co.in*

Shrubs are integral part of traditional agroforestry of arid zone ecosystems. Efforts are being done to incorporate the important shrubs in system approach through strip cropping. We developed improved shrub based agroforestry systems in strips of 1: 3 shrub: crop ratio. The present study was undertaken to estimate the standing biomass and carbon build up in the shrub based improved agroforestry systems in arid zone of Bikaner, India. We studied productivity and carbon storage capacity of shrub based agroforestry systems in arid areas of Bikaner, India. For estimation of shrub biomass, representative plants of average height, crown and collar diameters from each strip was harvested and fresh weight of the aboveground biomass of individual plant was recorded. Similarly, the roots of individual plant were also excavated and fresh weight was recorded immediately after excavation. Dry biomass weight of the shoot and root was recorded after oven drying (80 ºC) the sample. The average grain yield and total biomass of clusterbean and mothbean in terms of productivity was significantly higher in shrub based cropping system as compared to their sole crops. Root: shoot ratio of both the shrubs were >0.70. Between the two shrubs, root: shoot ratio of *Calligonum polygonoides* were higher as compared to *H. salicornicum*. High root: shoot dry weight ratio of *C. polygonoides* suggests that it tends more to the carbon allocation to root system and support its better survival in hot arid areas. In shrub based agri-silvi systems, *Calligonum polygonoides* proved more useful for inclusion as compared to *Haloxylon salicornicum*. Biomass accumulation in *C. polygonoides* based agroforestry system was significantly higher as compared to H. *salicornicum* based agroforestry systems. Higher CO_2-eq. mitigation potential through vegetative biomass was observed in *C. polygonoides* based agroforestry systems (1.1-1.3 t/ha/yr) as compared to *H. salicornicum* based agroforestry systems (0.6-0.7 t/ha/yr). Soil accounts for 76-81 % carbon stock in shrub based agroforestry systems.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Rice Residue Biochar Influences P Availability in Soils with Contrasting pH

Subham Mukherjee* and Manpreet Singh Mavi
Punjab Agricultural University, Ludhiana, 141004, Punjab
**Email: subham.mukherjee07@gmail.com*

P deficiency is being considered as one of the most limiting factor in modern system of agricultural crop production. Low soil solution concentration and high fixation/precipitation of P under various soil ecosystems resulted in introduction of various alternative ameliorating strategies. Biochar, a product of thermo-chemical conversion of biomass, has received immense global importance for sequestering C but its impact on alleviating phosphorous demand remains largely unexplored. Therefore, an incubation experiment to study the interactive effect of rice residue biochar and inorganic-P on phosphorous dynamics in soils with contrasting pH (acidic, neutral and alkali soil), was conducted for 60 days. Treatments comprised of 20 g kg^{-1}(w/w) rice residue biochar added to the experimental soils with three rates of inorganic-P (KH_2PO_4) (0, 25, 50 mg kg^{-1}). Biochar application alone or in combination with inorganic-P resulted in significant increase in a range of organic and inorganic P pools (microbial biomass-P, plant available olsen-P and mineral bound inorganic-P fractions). This was probably due to : i) high available P content in biochar itself and; ii) biochar induced decrease in P sorption in all the experimental soils, due to increase in competition for the P sorption sites by the surface functional groups present in the biochar. Increase in available P and microbial biomass P content due to incorporation of biochar followed the order neutral soil > alkali soil > acid soil, whereas the contents of P fractions irrespective of biochar and inorganic-P treatments followed the order Fe-P > Al-P > reductant soluble-P > Ca-P > loosely held/ soluble-P in acidic soil, Ca-P > Al-P > Fe-P > loosely held/ soluble –P > reductant soluble-P in case of neutral soil and Ca-P > loosely held/soluble-P > Al-P > Fe-P > reductant soluble-P in alkali soils respectively. Further, P rich biochar's ability to decrease phosphomonoesterase activity was also indicative of its value to act as both source and sink of P. Thus, biochar can be used as a potential ameliorating strategy in the context of sustainable P management under various soil ecosystems.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Long-Term Soil Carbon Changes in Different Fertilizer Treatments under Jute-based Agro-Ecosystem

A.K. Singh, M.S. Behera, D. Barman, A.R. Saha, S.P. Mazumdar and D.K. Kundu
Crop Production Division, ICAR-Central Research Institute for Jute and Allied Fibres, Barrackpore, Kolkata, 700120, West Bengal
**Email: singhak30@gmail.com*

Accumulation of soil organic carbon (SOC) is a function of ecosystem process that, in turn, is influenced by long-term land management practices. Changes over time in the amount and distribution of SOC fractions with different turnover rates can be estimated by means of soil SOC models. A study on carbon sequestration under jute based agro-ecosystem was carried out with an objective to see resulting change in soil organic carbon (SOC) due to continuous application of chemical fertilizer and manures. To simulate the SOC changes as influenced by different combination of fertilizer uses on jute based cropping system, RothC model was used. Average climate data and plant residues and manure input from the year 1973 to 2012 were used. It was also assessed that how many years is required to reach the equilibrium point of SOC with the amount of plant residues and manure inputs which were supplied until the year 1972. Under NPK_{000} and NPK_{100} treatments, simulation of 40 years data indicates that the SOC content increases slightly at the beginning (year 1973-1985), then it decreases gradually afterwards. Whereas in case of $NPK_{100+FYM}$ treatment, SOC contents was slightly increased from its initial value and maintained the increased value till the year 2012. To arrive equilibrium point of SOC (18.18 t C/ha), NPK_{000} and NPK_{100} treatments took almost 35 years and 39 years, respectively. $NPK_{100+FYM}$ treatment took about 27 years to reach the equilibrium point. The yearly contribution of plant residues from jute plants was about 1.03 t C/ha, followed by wheat (0.68 t C/ha) and rice (0.49 t C/ha). The result shows that fertilizer management systems, which include FYM, have more capacity to recover the soil carbon. The initial SOC content had a large effect on the SOC recovery capacity.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of Anions from Ground Water in Katepurna Command Area of Akola District of Maharashtra

S.M. Jadhao, C.G. Wadal, S.P. Nandapure, P.R. Kadu and N.M. Konde
Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra

The study was conducted during 2015-2016 to assess the anions from ground water in Katepurna command area of Akola district of Maharashtra. The ten open well water samples were collected during pre monsoon (summer), monsoon (rainy), post monsoon (winter) season from the Salpi, Walpi, Nimbhara, Hatola, Botha, Zodga, Wagha, Mahan, Chichkhed, Shelu Bk. village in Katepurna command area of Akola district of Maharashtra and analyzed by using standard procedures for bi-carbonate, chloride, sulphate, boron and fluoride.

The result shows that the bicarbonate content in ground water was in the range of 2.90 to 4.75, 2.65 to 4.55 and 2.65 to 4.00 me L^{-1} during pre monsoon, monsoon and post monsoon season respectively, which was high during pre monsoon and low during post monsoon season. Most of the values of water sample of all three seasons fall into below the degree of restriction to use. The chloride content of ground water varies from 2.5 to 3.8, 2.2 to 3.4 and 0.8 to 3.0 me L^{-1} in pre monsoon, monsoon and post monsoon season respectively, it was high during in pre monsoon and low during post monsoon. The sulphate content of ground water was recorded in the range of 2.20 to 4.25, 1.27 to 2.80 and 1.13 to 2.60 me L^{-1} during pre monsoon, monsoon and post monsoon season respectively, which was within the normal permissible limit for irrigation. The boron content in ground water was in the range of 0.45 to 1.12, 0.40 to 1.13, 0.44 to 0.57 mg L^{-1} during pre monsoon, monsoon and post monsoon season respectively. Most of the values of water sample from all the seasons fall into “Slight to moderate” degree of restriction to use. The fluoride content in ground water was found in the range of 0.34 to 0.50, 0.35 to 0.46 and 0.31 to 0.42 mg L^{-1} during pre monsoon, monsoon and post monsoon season respectively. Most of the samples of fluoride content in all seasons are below the permissible limit.

Hence, from the results it can be concluded that, the anions *i.e.* bi-carbonate, chloride, sulphate, boron and fluoride are noticeable within permissible limit during pre monsoon, monsoon and post monsoon season. The ground water in pre monsoon and monsoon season is suitable for irrigation as compared to the post monsoon season.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Manganese Release by Organic Ligands and Bio-availability to Wheat (*Triticum aestivum*)

R.N. Pandey* and Suresh Chandra
Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, New Delhi, 110012
**Email: rnpandeyssaciari@rediffmail.com*

Plant available manganese deficiency in Indian soils is increasing in spite of high content of total Mn in soil due to which frequent application of Mn fertilizer is required. In an incubation experiment the release kinetics of soil Mn was studied in the presence of organic ligands to find out the feasibility of mobilization of native soil Mn and the bio-availability of Mn to wheat in a green house experiment. In an incubation study Mn deficient soil (Inceptisol) was incubated with Mn levels (0 and 25.0 mg Mn kg^{-1} soil as $MnSO_4.H_2O$), oxalic acid (10 and 20 mg kg^{-1} soil), citric acid (10 and 20 mg kg^{-1} soil) and farm yard manure (0 and 2.5 g kg^{-1} soil). Released Mn contents at 1, 10, 20, 30, 45, 60 and 90 days intervals were extracted by using 0.005M DTPA and estimated on AAS. The results of incubation study showed that organic ligands were effective in mobilizing and maintaining sufficient soil Mn for 90 days over control. Organic acids along with the recommended dose of Mn were more effective in maintaining higher concentration of Mn up to 90 days as compared to organic acids without Mn.

To test the result obtained in the incubation study a greenhouse experiment was conducted in Mn deficient inceptisol using wheat (var. HD 2967) as a test crop. The treatments were oxalic acid (0, 5 and 10 mg kg^{-1} soil) with different doses of Mn (0, 5, 10 and 20 mg Mn kg^{-1} soil as $MnSO_4$), 1% Mn sprayed twice and 0.5% Mn sprayed thrice. Wheat grain and straw yields in all the treatments were significantly increased over control (0 mg kg^{-1}soil). Wheat grain and straw yield was significantly higher under treatment 1% Mn sprayed twice over 0.5% Mn sprayed thrice and was statistically at par with the recommended dose of soil applied Mn (20 mg kg^{-1}) except for straw yield. The most effective treatment was oxalic acid (5 mg kg^{-1}) + Mn (5 mg kg^{-1}) which was statistically at par with the recommended dose of Mn (20 mg kg^{-1}). Result showed that oxalic acid could be used for increasing the bioavailability of soil native Mn under Mn deficiency condition; however, field experimentations with many crops and different combination of oxalic acid and Mn treatments are required.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Organic Carbon and Productivity as Influenced by Rainfall and Temperature Pattern at Various Growth Stages of Sorghum and Wheat under Long Term Fertilizer Experiment in Vertisol

S.D. Jadhao, B.A. Sonune, D.V. Mali, V.K. Kharche, N.M. Konde and R.N. Katkar
Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, 444104, Maharashtra

The experiment was initiated in the year 1988-89 to study the effect of long term manuring and fertilization on soil quality, crop productivity and sustainability under sorghum – wheat cropping sequence in Vertisol. The experiment comprised various manurial and fertilizer treatments laid out in Randomized Block Design with four replications. The data generated on yield and soil organic carbon were correlated various weather parameters. The yield data, rainfall received during various growth stages of sorghum and temperature recorded at various growth stages of wheat were fitted in polynomial equation of varying degree ($y=a+bx+cx^2+dx^3$...). The results of the present experiment revealed that, the highest r^2 value was obtained when the data was fitted with 9th degree polynomial equation indicating best fit. The highest r^2 value was obtained when the grain yield data was regressed with rainfall received during panicle initiation stage as compared to other two stages under 100% NPK + FYM. The wheat yield and temperature during 5-14 meteorological week (grain filling stage of wheat) was fitted in the 9th degree polynomial equation i.e. $y=a+bx+cx^2+dx^3$...The highest r^2 value i.e. 0.61* (100% NPK) and 0.76* (FYM) was obtained when the grain yield data was regressed with temperature recorded at grain filling stage of wheat (5-14 meteorological weeks). The soil organic carbon stock was increased with the continuous application of fertilizers and manures over the initial status. Continuous cropping with 100% NPK along with FYM recorded highest SOC to the extent of 15.25 Mg ha^{-1} followed by FYM alone and 150% NPK. The increase in the SOC over initial was recorded to the extent of 6.56 Mg ha^{-1} in 28 years.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Applied Phosphorus on Zinc Adsorption-Desorption, Kinetics in Soils

S.P. Saini* and Parminder Singh
Department of Soil Science, Punjab Agricultural University, Ludhiana. 141004, Punjab
**Email: satpalsaini@pau.edu*

Zinc (Zn) adsorption-desorption, the release of Zn from soil, crystalline minerals and other precipitates into the solution phase, is the process that controls Zn mobility in soils. An experiment was conducted in laboratory to determine the pattern of Zn adsorption-desorption from the different soils of long term wheat-maize cropping system (100% N) Soil I, (50% NPK) Soil II and (100% NPK) as Soil III. Two gram soil was equilibrated with 20 ml 0.01 M $NaNO_3$ solution containing 5, 10, 20, 40, 60, 80, 100 and 200 mg L^{-1} Zn (zinc nitrate) and 0 and 100 mg L^{-1} P (di-hydrogen sodium mono phosphate) for 24 hours incubated at 25°C and desorbed with 20 ml DTPA, by replacing supernatant at different periods 5, 15, 30 60, 120, 240, 360, 480, 960 minutes in a temperature controlled shaker (25 °C ±1). Maximum Zn adsorption was found in Soil III with applied P at 100 mg L^{-1} and this is due to higher P content and increased negative sites for Zn adsorption. Four kinetic models (First order, Power function equation, Parabolic diffusion and Elovich) were evaluated to describe the rate of Zn desorption of soil extracted with DTPA for periods from 5 to 960 min. The R^2 values obtained from Elovich model ranging from 0.93 to 0.97 with standard error (SE) 0.172 to 0.256 It was characterized by a rapid initial desorption during the first 4h of shaking followed by a slower desorption, which was still proceeding after 16h. Elovich model was determined as the best models describing Zn desorption kinetics with least standard error. Zinc desorption increased as Zn was applied, whereas it decreased with applied phosphorus level.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Fractions of Cadmium as Influenced by Cd-EDTA and *Brassica* Species for Amelioration of Cd Toxicity in Soil

P.K. Taneja, S.S. Dhaliwal* and J.S. Manchanda
Department of Soil Science, Punjab Agricultural University, Ludhiana, Punjab
**Email: drdhaliwalss@yahoo.co.in*

Degree of soil pollution with heavy metals is monitored with sequential extraction procedures. A large number of available extraction techniques developed which inquiry as to which technique is preferable over other technique. Technique adaptable by Tessier is most acceptable. The main principle behind the procedure is replacement of the particular carriers of heavy metal with selective hydroxylamine, for oxidative action hydrogen peroxide & ionic exchange & acidic dissolution by acetic acid. The most mobile metal element is removed in the first fraction and continues in order of decreasing of mobility. Metals of anthropogenic input tend to get extracted in first six fractions and metal found in residual fraction are of natural occurrence in the parent rocks. In this sequential extraction technique, salt solution is used to remove the exchangeable fraction. The carbonate-bound fraction is susceptible to change in pH, acid solution is used in second step of extraction technique. Metal bound to Fe & Mn oxides are susceptible to anoxic condition so as solution capable of dissolving insoluble sulphide salt is used in third step. In the fourth step, to remove metals bound in the organic phase, organic material must be oxidised. The residual fraction consists of metals incorporated into the crystal structure of primary and secondary minerals. This fraction is the hardest to remove and require the use of strong acid to break down silicate structure.

A screen house experiment was conducted on sandy loam soil to assess the effect of six levels of Cd (0, 5, 10, 20, 40 and 80 mg kg^{-1}) and three levels of EDTA (0, 1 and 2 g kg^{-1}) in a factorial randomized design on the growth of three *Brassica* species (*Brassica juncea, Brassica compestris and Brassica napus*). Fractions of cadmium were analysed at two stages i.e. at equilibrium and after harvest of crop. At equilibrium, the contents of Cd in different fractions in experimental soil at different rates of Cd and EDTA application did not differ much on which different *Brassica species* were grown and later on were not distinctly different from each other. The small differences in the contents of different fractions may have resulted from inherent spatial variability in sampling of experimental soil. The results revealed that with increasing Cd levels, all fractions of Cd increased. Application of EDTA in soil substantially increased exchangeable + water soluble (EX+WS) fraction, indicating its usefulness in enhancing the solubility of this element. The amount of EX+WS fraction left in soil after the crop harvest with the application of EDTA was significantly lower as compared to without EDTA. The amount of EX+WS fraction left in soil after the harvest of *Brassica juncea* was minimum at all levels of Cd application because of higher removal of Cd from soil. In the present study three *Brassica species* viz. *Brassica juncea*, *Brassica compestris* and *Brassica napus* were taken and experimental results indicated that *Brassica juncea* could be considered as the best hyper accumulator among the three species of Cd in Cd contaminated soils. Cropping with hyper accumulator plants may prove to be an effective means for extraction of Cd from contaminated soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Zinc-induced Phosphorus Deficiency in Lentil

J.S. Manchanda, D.S. Bhatti, S.S. Dhaliwal and Amanpreet Kaur
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab

A screen house experiment was conducted using a loamy sand soil (Typic Haplustept) having pH (1:2) 7.8, electrical conductivity (1:2) 0.15 dS m^{-1}, organic carbon 0.27%, available P_2O_5 12.8 kg ha^{-1} and K_2O 170 kg ha^{-1} and DTPA extractable Zn, 1.65, mg kg^{-1} soil to study the effect of Zn fertilization (0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5, 20.0, 22.5, 25.0, 27.5, 30.0 mg Zn kg^{-1} soil) on yield and mineral composition of lentil. Five kg of well processed soil was filled in each pot lined with polyethylene sheet. A basal dose of 5 mg N kg^{-1} soil and 8 mg P_2O_5 kg^{-1} soil was applied through urea and potassium dihydrogen orthophosphate, respectively. Five seeds of lentil were sown in each pot. Every treatment was replicated thrice in completely randomized design. The crop was grown for 90 days, soil samples were collected at harvest. The plant samples were processed and analyzed for micronutrients and P.

Plant height significantly decreased from 27.3 cm in control to 23.8 cm when Zn was applied @ 30 mg kg^{-1} soil. The dry matter yield (DMY) was not significantly affected up to a level of 17.5 mg Zn kg^{-1} soil but thereafter the DMY declined significantly over control. A maximum decline of 45.3 per cent over control was observed with the highest level of applied Zn. Phosphorus deficiency symptoms were observed when Zn was applied in excess of 12.5 mg Zn kg^{-1} soil. A significant decline in P concentration in shoot was observed beyond a level of 15 mg Zn kg^{-1} soil and it decreased significantly from 0.22 per cent in control to 0.14 per cent with the highest level of applied Zn. Similarly, P uptake decreased significantly from 4.95 to 1.72 mg pot^{-1} with an application of 30 mg Zn kg^{-1} soil. Zinc concentration in shoot increased from 52 mg kg^{-1} in control to 598 mg kg^{-1} dry matter whereas its uptake increased from 0.12 to 0.74 mg pot^{-1} when Zn was applied @ 30 mg kg^{-1} soil. Sulphur uptake decreased from 3.15 to 2.09 mg pot^{-1} with the highest level of applied Zn. Concentration ratio of P: Zn in the shoot dry matter decreased from 42.3 in control to 2.3 with graded levels of applied Zn. Phosphorus deficiency symptoms were observed when P: Zn ratio in dry matter was >7. DTPA-Zn in soil increased from 1.6 to 12.9 mg kg^{-1} soil with zinc application. The results of this study indicated that excessive application of Zn may cause P deficiency in lentil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Ameliorating Effect of Rice-Residue Biochar under Varying EC Levels

Manpreet S. Mavi, Rajanbeer Singh and O.P. Choudhary
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141 004, Punjab

**Corresponding author; email: mavims16@pau.edu*

Although increasing data have shown beneficial effects of biochar on physicochemical properties in the non-saline and non-sodic soils, information is limited about the potential of using biochar as an organic matter-rich material to ameliorate salt-affected soils. An incubation study was conducted to evaluate the effect of addition of increasing rates of rice-residue biochar (0, 1%, 2%, 4%) in soils varying in EC levels. Bulk soil samples (sandy loam; 0-30 cm soil layer) were collected from different plots varying in salinity (EC2, EC8, EC16) from an ongoing field experiment (since 2007) at Punjab Agricultural University (30°562 N, 75° 522 E) after harvest of wheat in 2014-15 season. After sieving the air dried samples to 2 mm, different rates of rice-residue biochar were added to soils with varying EC levels and incubated at 25ºC in the laboratory for 8 weeks. Soil respiration was measured throughout the incubation period, microbial biomass carbon (MBC), dissolved organic carbon (DOC), ammonical and nitrate-N were analysed at day 14 and 56 of the incubation, whereas, pH and EC was measured at the end of incubation period. Specifically, we hypothesized that increasing rate of rice residue biochar will improve soil properties under varying EC levels. Irrespective of salinity, both EC and pH increased with increase in rate of biochar application. Compared to unamended control soil(EC2), cumulative respiration (CR) and MBC in EC8 or EC16 soil was lower by 39-63% and 51-71%, respectively. However, addition of biochar at the rate 2-4% in EC8 soil reduced the decrease in CR and MBC either to 21% or similar to unamended non-saline treatment whereas; it was reduced to 47% or 21%in EC16 soil respectively. Contrarily, addition of biochar at the rate 1% did not significantly affect CR and MBC in EC8 or EC16 soil both on day14 and 56 of incubation. Irrespective of salinity, DOC concentration increased in the order: B0% > B1% > B2% >B4%. Further, at all salinity levels, NO_3^--N concentrations increased with increase in period of incubation and biochar rates whereas, NH_4^+-N concentration was higher upto day 14 but were lower on day 56 of the incubation. The study confirmed that the availability of labile substrates from biochar can help the microbes to override the negative effects of salinity. In addition, the study also showed that the higher rates of biochar application (2-4%) will be more effective in ameliorating the adverse the salt-affected soils whereas lower addition rates may contribute greater towards C sequestration. Further, biochar addition to the salt-affected soils had a positive influence on mineral N thereby, increasing soil N availability to the plants or increasing potential risk of leaching losses of nitrate-N in the stressed environment.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Balanced and Imbalanced Application of Fertilizer Nutrients on Organic Carbon Pools in Soil under Rice-Wheat Cropping System

Pritpal-Singh*, D.K. Benbi and A.S. Toor
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab
**Email:jasppsingh@gmail.com, jasppsingh@yahoo.co.in*

A field experiment was conducted to study the impact of balanced and imbalanced application of fertilizer nutrients (N, NP, NK, PK, NPK) without and with farmyard manure (FYM), and an unfertilized control (UF) on organic carbon and its pools in soil under rice-wheat cropping system. Conjoint application of NPK and FYM significantly increased TOC and its pools *viz*. water extractable organic C (WEOC), microbial biomass C (MBC) and organic C fractions of varying oxidizability viz. very labile, labile, less labile and recalcitrant C. Four fractions of TOC extracted under a gradient of oxidizing conditions represented 15.2, 13.4, 30.9 and 41.0%, respectively in a soil plough (0-15 cm) layer. Conjoint application of NPK and FYM significantly increased the recalcitrant C fraction, while imbalanced application of fertilizer nutrients, had negative impact on this fraction. Farmyard manure application significantly increased $KMnO_4$-C by 229% in the surface, and 180% in the sub-surface soil, than the UF. Averaged across treatments, surface soil had 25.6% higher $KMnO_4$-C than the sub-surface soil. The CMI exceeded 100 even with imbalanced application of fertilizer nutrients (except for N application), but increased significantly with NPK application. Balanced fertilizer application along with FYM (NPK+FYM) further increased CMI, compared with imbalanced application of fertilizer nutrient (N+FYM). A correlation matrix developed among different organic C pools showed that WEOC, MBC, $KMnO_4$-C, very labile C, labile C and less labile C were significantly related to TOC.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Organic Carbon, Nutrient Uptake and Productivity of Maize-Wheat as Affected by Long-term Use of Fertilizers and Farmyard Manure

G.S. Dheri*, B.S. Brar and H.S. Uppal
Department of Soil Science, Punjab Agricultural University, Ludhiana, Punjab
**Email: gsdheri@pau.edu*

Balanced fertilization (NPK) is essential for maintaining soil health and productivity of maize-wheat cropping system. Long-term fertilizer experiments are vital tools for assessing the sustainability of any fertilizer practice. The present study described the effect of long-term application of fertilizers on soil properties, nutrient uptake and productivity of maize-wheat cropping system. Continuous use of balanced fertilizer and farmyard manure (FYM@15t ha^{-1}) decreased pH from 8.2 to 7.29. The accretion of soil organic carbon, available phosphorous (P) and potassium (K) emphasized the advantage of the use of balanced fertilization. The reduction of 0.9 unit of pH maintained the concentration of micronutrients in sufficiency range even after their removal by 45 crop cycles. The omission of the application of K resulted in the reduction in soil K indicates its mining which is not sustainable on a long-term basis.

The productivity of maize-wheat cropping system was maximum using the recommended dose of NPK fertilizers and FYM. The grain yield of wheat increased from 3.53 t ha^{-1} under N to 4.76 t ha^{-1} under NPK treatment. The improvement in the grain yield of maize under balanced fertilization (NPK) as compared to the imbalanced fertilization (N) was 41.3%. Maize responded to the application of K (0.84 t ha^{-1}), however, the use of K in wheat had a non-significant effect on grain yield. The productivity of maize-wheat cropping system was highest with the conjoint use of balanced fertilizers and FYM. The additional dose of NPK (150% NPK) than recommended (100% NPK) is not the substitute of FYM. An inclusion of P and K along with N resulted in higher N uptake (39%) by maize and wheat (40%). The raised uptake of N, P and K by grains of maize and wheat under balanced fertilization improve the nutritional value of crops. In conclusion, balanced fertilizer is essential for maximizing the productivity of maize-wheat cropping system and maintaining the fertility of the soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Phosphorus Fertilization on Zinc Nutrition in Rice and Transformation of Zinc Fraction in Soil

Sudeshna Mondal, G.C. Hazra and Pabitra Kumar Mani
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, 741252, West Bengal

A field experiment was carried out in new alluvial soil (*Aeric Haplaquept*) at Central Research Farm, Bidhan Chandra Krishi Viswavidyalaya to study the interactive effect of combined P and Zn fertilization on the Zn nutrition of rice and transformation of both native and applied zinc fraction in soil. It was found that P application up to 80 kg ha^{-1} did not affect the yield of rice grain as well straw. Moreover, the yield of both grain and straw of rice was increased with the combined application of P and Zn and the highest yield was recorded (12.13% and 14.17%, respectively over the control) when P and Zn were combined with each other at their respective highest levels. But the availability of Zn, both native and applied, in soil was reduced with P fertilization and the effect was more pronounced in case of applied Zn. A declining trend of Zn content in plant as well as uptake by plant was recorded both in grain and straw, with the application of P at higher dose and it was least when combined application of P and Zn was done @ 80 kg ha^{-1} and 5 kg ha^{-1}, respectively. Application of P caused a decrease in the transformation of Zn, both native and applied, in soil into the water soluble plus exchangeable, MnO bound, carbonate bound, organic complexed and residual form with a concomitant increase in the amorphous and crystalline sesquioxide bound forms. The Zn concentration in grain and straw was progressively decreased with a decrease in Zn content in all the fractions but with a increase in amorphous and crystalline sesquioxide bound forms of Zn.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Soil pH on the Growth of Natural Rubber Plants

K.K. Ambily and Mercykutty Joseph
Rubber Research Institute of India, Kottayam, 686009, Kerala

In India, natural rubber (*Hevea brasiliensis*) is cultivated in around 8,27,000 hectares of arable land. Major share of the rubber growing regions is experiencing tropical humid climate and the soils are mainly ultisols with low base saturation, high exchangeable Al and acidic pH. Each planting cycle ranges from 25-30 years and in its traditional belt of cultivation, it is in the fourth cycle of planting. Our studies indicated shift in the soil pH from strongly acidic to extremely acidic with continuous cultivation of rubber warranting a close monitoring of the changes in soil properties and growth of plants under extremely acidic soil conditions. Hence, the study was conducted in rubber seedlings grown in the glass house of RRII in polythene bags filled with soil collected from fields having three distinct pH *viz.* 4.4, 5.5 and 7.4. Growth of the plants in terms of shoot diameter, root length, shoots and root biomass were monitored at periodic interval. Nutrient concentration and uptake of nutrients, concentration of Al in the root and shoot were also monitored. Growth measurements at the 45th day indicated no difference between plants grown at three pH. However, at the third month (90th day) and eight month (240th day) significantly lower growth was recorded by plants grown in extremely acidic pH (pH 4.4). Highest growth was recorded by plants grown at 7.4 pH. Shoot and root biomass also recorded similar trend. Root length recorded the same trend in the initial stage but was significantly high at 5.5 pH and was on par with 7.4 pH. The Al concentration in the root at the 45th day was 3114, 3057 and 1800 mg kg^{-1}, respectively at pH 4.4, 5.5 and 7.4. Though, high Al concentration was recorded in root, shoot concentration was low at pH 5.5 and 7.4 . At extremely acidic pH, the high Al to cation ratio may be the reason for the accumulation of high Al in root as well as the shoot. Growth of plants were reduced at extremely acidic pH which may be due to the combined effect of extreme acidity coupled with the low availability of nutrients warranting soil acidity management and specific nutrient management for maintaining soil productivity and good growth of rubber plants.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Dynamics of Soil Organic Carbon under Conservation Agriculture: A Case Study from a Rice-Wheat System on a Calcareous Soil of Eastern Indo-Gangetic Plains

Abir Dey, Brahma S. Dwivedi, Mahesh C. Meena, Siba P. Datta, Ranjan Bhattacharyya, Raj K. Jat[1] and Ashok Kumar
ICAR-Indian Agricultural Research Institute, New Delhi
[1]Borlaug Institute for South Asia, CIMMYT, Pusa, Bihar

Improving soil organic carbon (SOC) in arable soils continues to be a major challenge to restore soil health and achieve sustainable crop production. The present investigation was, therefore, undertaken to study the effect of conservation agriculture (CA) practices on distribution of SOC pools and their mineralization pattern under rice-wheat (RW) cropping system. Surface (0-15 cm) soil samples were collected (after 6 crop cycles) from an ongoing experiment on a calciorthent at CIMMYT- Borlaug Institute for South Asia (CIMMYT-BISA) Samastipur, Bihar representing eastern part of the Indo-Gangetic Plains (E-IGP). The treatments were: conventional-till transplanted rice followed by conventional-till wheat (CTR-CTW), CTR followed by zero-till wheat (CTR-ZTW), ZT direct seeded rice followed by CTW (ZTDSR-CTW), ZTDSR followed by ZTW without residue retention (ZTDSR-ZTW), ZTDSR-ZTW with residue retention of both cereal crops (ZTDSR-ZTW+R) and ZTDSR followed by wheat both on permanent raised beds with residue retention (PBDSR-PBW+R).Total SOC along with its different fractions in soil were measured. In order to study the mineralization behaviour of SOC as effected by CA and conventional practices in a RW system, an incubation study was undertaken under two conditions separately, one simulating field condition during rice cultivation (submergence, temperature 35 ºC) and another simulating field condition during wheat cultivation (field capacity, temperature 25 ºC). Results indicated significant improvement in SOC consequent to tillage reduction, crop residue retention and green manuring over conventional practice. Treatment ZTDSR-ZTW+R had 20% higher total SOC compared with CTR-CTW. Effect of CA was spectacular on the relatively labile pools of SOC. Under ZTDSR-CTW and ZTDSR-ZTW plots, very labile SOC was 17 and 37% higher compared with CTR-CTW. Double residue retention (ZTDSR-ZTW+R) resulted in an additional ~10% increase in very labile SOC over ZTDSR-ZTW. Beneficial effect of tillage intensity reduction was more prominent on improvement of particulate organic matter associated C, whereas that of residue retention was more prominent on microbial biomass C. Treatments ZTDSR-ZTW and ZTDSR-ZTW+R registered similar SOC mineralization which was significantly higher compared with CTR-CTW, especially at later intervals. Under ZTDSR-ZTW+R, the amounts of CO_2-C evolved were 13, 24 and 11% higher compared with that under CTR-CTW on day 16, 32 and 64 after initiation of incubation in the conditions simulating rice cultivation. Interestingly, the cumulative SOC mineralisation under PBDSR-PBW+R was similar to that under CTR-CTW, and are significantly less compared with ZTDSR-ZTW and ZTDSR-ZTW+R. Cumulative CO_2-C emission from different plots was lesser in conditions simulating monsoon rice (temperature 35ÚC, submergence) compared with conditions simulating winter wheat (temperature 25ÚC, field capacity) up to 16 days after initiation of incubation. At the later sampling intervals the trend reversed completely. First-order kinetic model provided a good fit to these mineralization data. Under the rice growing condition, the decay rates of SOC were higher as compared to those under condition simulating winter wheat environments of E-IGP. The treatment PBDSR-PBW+R registered the lowest SOC decay rates irrespective of prevailing hydro-thermal conditions. Treatment ZTDSR-ZTW+R had significantly lower decay rates of SOC mineralisation compared to CTR-CTW.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Synchronization of Nitrogen Supply with Demand of Wheat using Farmyard Manure as an Organic Amendment

S.S. Biswas*, S.K. Singhal, D.R. Biswas, T. Roy, A. Sarkar, A. Ghosh and A. Das
Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, New Delhi, 110 012
**Email: siddssac20475@gmail.com*

Integrated use of fertilizer nitrogen (N) along with organic amendments is one of the best ways to enhance N use efficiency (NUE). Freshly added organic amendments enhance microbial activities. The microbes utilize available mineral N and bind them in their bodies, preventing their losses. After their death, due to decomposition of these microbes, N becomes available to plant. Thus, integrated use of organic amendments along with fertilizer N mimics the nature of slow release fertilizer N to some extent. In this study, we used farmyard manure (FYM) as an organic amendment along with fertilizer N for synchronizing N supply with demand of wheat crop. An incubation experiment was conducted to study the release kinetics of mineral N from FYM treated soils for deciding the rate of FYM for crop growth using an Inceptisol from IARI Research farm, New Delhi. The treatments consisted of four levels of FYM (0, 2, 4 and 6 g kg^{-1} soil) along with 3 levels of fertilizer N (0, 50 and 100 mg kg^{-1} soil). Results showed that when soil was treated with FYM_4N_{100} (4 g FYM + 100 mg fertilizer N kg^{-1}soil) released significantly higher amount of mineral N than that obtained from FYM_2N_{100}(2 g FYM + 100 mg fertilizer N kg^{-1}soil) treatment. But when FYM level was increased from 4g kg^{-1} soil to 6 g kg^{-1} soil there was no significant increase in release of mineral N. Maximum amount of NH_4^+ as well as NO_3^- -N (74.8 and 119.3 mg kg^{-1} soil, respectively) was released from the soils treated with FYM_6N_{100} (6 g FYM kg^{-1} soil along fertilizer N 100 mg kg^{-1} soil) treatment, which was statistically at par with those (73.9 and 117.6 mg kg^{-1} soil, respectively) obtained from FYM_4N_{100} treatment. Based on the results emanated from incubation study, the level of FYM was selected as 4g kg^{-1} soil for pot culture experiment. Two levels of FYM (0and 4 g kg^{-1} soil) along with three levels of fertilizer N (0, 50 and 100 mg kg^{-1} soil) were used for pot culture experiment. Results showed that maximum straw and grain yield and N uptake were obtained in FYM_4N_{100} treatment. However, FYM_4N_{100} and FYM_4N_{50} treatments were statistically at par. Thus, the results demonstrated that by treating the soil with 4 g FYM + 50 mg fertilizer N kg^{-1} soil, it is possible to reduce the requirement of fertilizer N by 50% without affecting the crop yield and crop N uptake, indicating a better synchronization of N supply and demand for crop production.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Vertical Distribution of Soil Organic Carbon Density in Relation to Land Use Systems in Humid Subtropical Northeastern India

S.K. Reza*[1], P. Ray[2], S. Ramachandran[2], S. Bandyopadhyay[1], S. Mukhopadhyay[1], K.D. Sah[1], D.C. Nayak[1], Niladri Paul[3], S.K. Singh[4] and S.K. Ray[2]

[1] ICAR-National Bureau of Soil Survey and Land Use Planning, Sector-II, DK-Block, Salt Lake, Kolkata, West Bengal

[2] ICAR-National Bureau of Soil Survey and Land Use Planning, Jamuguri Road, Jorhat, Assam

[3]College of Agriculture, Tripura, Lembucherra, West Tripura

[4] ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur, Maharashtra

**Email: reza_ssac@yahoo.co.in*

Globally, agricultural mineral soils can be either sources or sinks of carbon (C) depending on the land use, environmental conditions and management activities. The scope of the study is to evaluate organic carbon (OC) stock in mineral soil in cropland, tea plantation and rubber plantation in Bishalgarh block, Sepahijala district, Tripura. For this purpose soil samples were collected from three representative sites of each of the three selected land uses. Soil sampling was done up to a depth of 100 cm taking three soil layers (0–25 cm, 25–50 cm and 50-100 cm) following standard procedure. Soil samples were analyzed for physical and chemical properties. The result indicates that the mean BD values at all depths were higher under cropland (1.64–1.71 g cm^{-3}) than under tea plantation (1.54–1.64 g cm^{-3}) and rubber plantation (1.29–1.50 g cm^{-3}). This is possibly due to low organic manure (OM) inputs and moderate soil compaction under agricultural lands due to tillage (ploughing and puddling) and livestock trampling. As expected, the mean bulk density under all land use systems slightly increased with soil depth. The pH values at all depths were relatively low under tea plantation (pH 4.6–4.6) compared to rubber plantation (pH 4.8–5.1) and cropland (pH 5.1–5.2). This suggests that soils under tea plantation are more acidic than other land use systems and this could be attributed to more leaching of bases. On the other hand, the mean soil pH increased with depth under all the land use systems. The surface soils had low clay and high sand content in all the land use systems and then decreased in the subsurface layers while, exchangeable Al^{3+} and H^+ increased with increasing soil depth. OC concentration decreased with increasing soil depth under all land use systems with significant difference across different soil depth ($P<0.01$). At the surface layer (0–25 cm), OC was variably distributed under three land use systems. OC of rubber plantation was significantly different from those under cropland except for tea plantation ($P<0.05$). This indicated that rubber and tea plantations are more effective in OC accumulation than cropland. The mean OC stock in different (0–25, 25–50 and 50–100 cm depth) soil layers in different land use systems indicate that the 0–25 cm layer stores largest amount of OC except 50-100 cm soil layer of cropland. There are no statistically significant differences between rubber and tea plantation. OC distribution in the soil profile is not homogeneous and is affected by type of vegetation (change in crop rotation and composition), land use and other factors like increase in ploughing depth, manure application. The study indicates that relative distribution of OC stocks as a function of depth and found that on average, 65% in rubber plantation, 68% in tea plantation and 57% in cropland OC stored in the upper 50 cm of mineral soil in 100 cm soil profile. The correlation study showed that OC density was significantly influenced by solution pH, clay content, q_g and CEC of the soils in the study area.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Transformation of Clay Minerals in a 47-Year-Old Rice-Rice Cropping System

Dibyendu Chatterjee, A.K. Nayak, S.C. Datta, Anjani Kumar, M. Shahid, S. Mohanty, R. Tripathi, B. Lal, P. Gautam and J. Panigrahi
Crop Production Division, ICAR- National Rice Research Institute, Cuttack, 753 006, Odisha

The effect of long-term fertilizer treatment (47 years) on puddle rice-rice cropping was studied. The treatments were unfertilized control (CTRL), farmyard manure (FYM), N, NP, NK, NPK, N + FYM, NP + FYM, NK + FYM and NPK + FYM. The application of inorganic fertilizer was done @ 60-40-40 and 80-40-40 N-P_2O_5-K_2O kg ha^{-1} for wet and dry seasons, respectively as per the requirement of the respective treatment. The FYM was applied @ 5 tha^{-1} in the treatments receiving FYM during the last week of May every year. In the laboratory, fractionation soil samples were done in two ways: one with removal of all binding agents (humus free clay) and another without removal of binding agents (clay-humus complex). Humus free clay (<2 µm) was separated by removing organic matter, sesquioxides and free cations by treating with H_2O_2, citrate-bicarbonate-dithionite (CBD) treatment and sodium acetate. Ultrasonic vibration technique for dispersion was followed for separating clay-humus complex. Silt fraction was kept for further analysis. Basally oriented clay samples (Mg-air, Mg-glycerol, K-air dried, K-550°C heated) were X-rayed. The X-ray diffractograms were recorded in Philips diffractometer (Model PW 1710) using Ni-filtered Cu-Ká radiation at a scanning speed of 1.5° 2è per minute. The peak area was measured using automated powder diffraction (APD) software and the quantities of minerals were estimated using standard procedure. Selective dissolution of short range order minerals were performed by four extraction methods: (a) Boiling with 0.5 N NaOH, (b) 0.2 M acid ammonium oxalate pH 3, (c) dithionite-citrate-bicarbonate extraction and (d) 0.1 M sodium pyrophosphate pH 10.The experimental soils of NRRI long-term fertility experiment were composed of three major minerals, *viz.* kaolinite (49.6-54.4%) mica (32.7-39.0%) and smectite (10.6-17.0%). The smectite content was decreased (taking control as reference) in all the treated soils, for *e.g.* FYM (-1.6%), fertilizer with FYM (-5.1%) and fertilizer without FYM (-6.4%). On the contrary, kaolinite content was increased by 2.3% in FYM, 4.8% in fertilizer with FYM and 0.8% in fertilizer without FYM. The result clearly showed the weathering and transformation of 2:1 mineral (smectite) with respect to control and more formation of 1:1 mineral (kaolinite).Total oxalate extractable oxides (TOX) were highest in NP+FYM treated plots in both clay and silt. The content of TOX was 1.5-2 times higher in clay than TOX content in silt. Application of FYM increased the production ferrihydrite in both clay and silt. Potassium fixation capacity was more in K skipped and NP applied plots. Clay-humus complex showed less K fixation than the clay at the same treatment. Application of FYM reduced fixation capacity of potassium.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Integrated Phosphorus Management on the Changes in Different Fractions of Phosphorus in Soil in relation to Yield and Nutrition of Rice (*Oryza sativa* L.)

Priyanka Naskar[1]*, R.B.Mallick[2] and Debashis Ghosh[3], A.K. Dolui[1] and D.K.Das[1]
[1]Department of Agricultural Chemistry and Soil Science, [2]Department of Agronomy
Institute of Agricultural Science, University of Calcutta, 51 /2, Hazra Road, Kolkata, West Bengal
[3]Department of Agricultural Chemistry and Soil Science, BCKV, Mohanpur, West Bengal
**Email: priyankanaskar22@gmail.com*

Field experiment was conducted during the *Kharif* season of 2015 in an inceptisol using rice (Cv. IET-4786) as a test crop with six different treatment combinations in a randomised block design (RBD) replicated four. The objective of the study was to evaluate different fractions of P in soil in relation to yield and nutrition of rice. For the determination of different fractions of P in soil , the sequential phosphorus extraction procedure, originally developed by Chang and Jackson (1957) and subsequently modified by Kuo (1996) was used. The results reveal that the periodic changes of different fractions of phosphorus namely water soluble and loosely bound, Al-P , Fe-P, reductant soluble-P and Ca-P bound have been found to be increased initially and thereafter, the amount of the same decreased with the progress of crop growth irrespective of treatments. However, the magnitude of such changes has been found to be varied with treatments, being recorded highest amount of calcium bound phosphorus compared to other fractions. The water soluble and loosely bound phosphorus was recorded lowest amount. The results further show that the amount of P content has been found to be increased initially and decreased at the later period of rice growth, being recorded highest amount in the treatment where 50% NPK Recommended + organic matter at 5 t ha^{-1} + Zn at 5 kg ha^{-1} + PSB (@10kg ha^{-1}) were applied togetherly. As regards to the yield of rice it was observed that the highest yield was also recorded in the treatment where 50% NPK Recommended + organic matter at 5 t ha^{-1} + Zn at 5 kg ha^{-1} + PSB (@10kg ha^{-1}) were applied togetherly.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Accuracy of Pedo-Transfer Functions as Affected by Clustering of Soils

Poulamee Chakraborty and Bhabani Sankar Das
Agriculture and Food Engineering Department, Indian Institute of Technology, Kharagpur, West Bengal

Pedo-Transfer functions (PTFs) are very effective in estimating difficult-to-measure and cost intensive soil properties from readily available basic soil data. However, PTFs lacks portability and accuracy when developed or utilized for large soil dataset. In the present study, therefore, we evaluated the effect of clustering on PTFs developed to estimate cation exchange capacity (CEC) for 3707 soil data belonging to a wide geographical area. 10 K-mean clusters were developed for the soils on the basis of Clay content, pH and organic carbon content. Support Vector regression based PTFs were then developed for each of this clusters. The highest performing and lowest performing PTFs shows R^2 and RMSE values of (0.84, 5.603 & 0.38, 9.458) respectively. The clusters were then added one at a time and PTFs were developed for these cluster additions. We observed a decrease in the performance statistics for the Cluster additions with each subsequent cluster added. With all the clusters added the $R^2$and RMSE values are 0.66 and 8.333 respectively. We plotted the cluster mean clay content vs the cluster mean CEC value and observed a straight line relationship between the two except for three clusters. Removing those three clusters from the entire dataset and developing a PTF with rest of the data we obtained a R^2 and RMSE value of 0.72 and 5.673 respectively showing a moderate prediction of CEC value for such a huge dataset (N=2726). The present study therefore, provides a procedure that could be utilized in developing PTFs for large soil datasets.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Soil Types on Adsorption and Dissipation of Pyrithiobac Sodium

T. Ramprakash*, M. Madhavi and J.S. Sudha Rani
AICRP on Weed Management, PJTSAU, Rajendranagar, Hyderabad, 500030, Telangana
**Email: trapkash@gmail.com*

Experiments were conducted to evaluate the sorption and dissipation behavior of pyrithiobac sodium in red and black cotton growing soils of Telangana state in India. Freundlich equation has been used effectively to determine the adsorption of herbicides on soil, where the fraction of adsorbed herbicide is low. The values of 1/n suggest the existence of non-linear adsorption. There could be a decrease in available sites as the adsorption increases. This is particularly true in soils with low organic matter and clay content.

Adsorption was not linear (1/n <1) and the shape of the isotherms showed that adsorption decreased at higher concentrations which could be explained by a decrease in affinity of adsorption sites or competition with water molecules for the same adsorption sites. The Freundlich constants $K_{f,}$ 'n'and other adsorption parameters (K_d, K_{doc}, K_{foc}) for the red and black soils are presented in the table. K_d and K_{doc} values for the red and black soils were 0.17 and 39.41; 0.38 and 71.45 respectively. The K_f values for the red soil was 0.260 and for the black soil 0.542. The lower K_d / K_{df} values indicate lower sorption tendency of pyrithiobac sodium. The lower K_{doc} value in case of red soil (39.4) and higher K_{doc} value in black soils (71.45) indicate the higher affinity of the pyrithiobac towards organic matter and clay-humus complexes, which are more readily formed in black soils due to the presence higher amount of clay and high-active (smectitic) clay compared to the red soils.

DT_{50} calculated for the red soil at field capacity was 46.2 days and at 50 % field capacity was 49.5 days, where as in black soil the persistence half-life was 53.30 days in case of both moisture levels (field capacity and 50 % field capacity). Prolonged half life of pyrithiobac in experimental conditions reveals the herbicide's carryover capacity and probability for damage to crop grown in rotational sequence.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Synthesis and Evaluation of Natural Polymer-coated DAP in Enhancing Phosphorus Availability to Crops

Mandira Barman*, S.C. Data and K.A. Chobhe
Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi, 110012
**Email: mandira.ssaciari@gmail.com*

Developing a controlled release technology to reduce phosphorus (P) fixation and loss through run-off may be helpful in enhancing P use efficiency in crops. For that a natural oil and clay mixture coated di-ammonium phosphate (DAP) fertilizer was prepared. A field experiment was conducted to evaluate the efficacy of this polymer coated DAP in increasing P availability in alluvial soil using wheat as a test crop. Yield of wheat was improved significantly when recommended dose of P (RDP) applied through polymer coated DAP. Maximum yield was obtained when full RDP was applied through polymer coated DAP. But, yield (5.13 t ha^{-1}) at 75% RDP applied through polymer coated DAP were statistically at par with full RDP applied through un-coated DAP (4.93 t ha^{-1}). This polymer coating on DAP fertilizer granule imparts slow release property in fertilizer; therefore, it can maintain higher available P in soil for long duration, which helps in yield improvement.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Spatiotemporal Evaluation of Soil Salinity using Electromagnetic Induction Techniques

Bhaskar Narjary, M.D. Meena, Satyendra Kumar, S.K. Kamra and D.K. Sharma
ICAR-Central Soil Salinity Research Institute, Karnal, 132001, Haryana

Soil salinity is a serious ecological threat and adversely affecting crop yield and soil health in Indo-Gangetic plain. Spatio-temporal information on salinity is required at the farm level to enable determination of suitable soil, crop and water management. In order to provide a cost-effective, rapid, easy and less labor intensive assessment of salinity we describe herein the use of a geophysical electromagnetic induction instrument (EM-38) to map the soil electrical conductivity of a saturated soil paste extract (ECe – dS/m) to an average depth of 0.90 m. We carried out a farm scale EM38 grid survey (i.e. ~ 20 x 20 m grid) during summer season of 2013 and 2016 across 12 ha in the Central Soil Salinity Research Institute (CSSRI) experimental farm at Nain, Haryana, India. The soil samples were analyzed for electrical conductivity of saturated extract (EC_e), pH, cations (Ca^{2+}, $Mg^{2+}$and Na^+) and anions (CO_3^{-2}, HCO_3^-, Cl^-) using wet chemistry procedures. Significant correlation relationship between EM-38 readings and ECe (r^2- 0.84) allowed us to use EM-38 data to characterize the spatial variability of soil salinity. Geostatistical method (Krigging) was used to determine the horizontal spatio-temporal variability of soil salinity over the years. High positive correlation of more than 0.76 with EM-38 readings with Na^+ and Cl^{-1}ion indicated sodium chloride (NaCl) as the major constituent responsible for soil salinity (EC_e) in the study area. Among soil properties, soil salinity (EC_e) was correlated strongly with sodium (r = 0.93) and chloride (r = 0.83); both also positively correlated strongly (r = 0.81) with each. Observation on soil salinity over a period of three years between (2013 to 2016) revealed that area under low soil salinity (4-8 dS m^{-1}) increased from 4% to 17%, conversely, area under very high soil salinity (>16 dS/m) reduced to 30% from 74 %. The sharp change of salinity within the field may be due to the improved agricultural management practices within the field where large amounts of rain and fresh drainage water made available to leach salts into deeper soil layers

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Surface Charge is an Inherent Property of Soil Chemical Constituents

Sourav Kumar Khan and Sanjib Kar
Department of Agricultural Chemistry and Soil Science, Institute of Agricultural Science, University of Calcutta, Kolkata, 700019, West Bengal
Email: souravkhan.90@gmail.com, sanjib_cu@yahoo.co.in

To investigate the distribution of the electric charges on some tropical soil of India was made by direct measurement of adsorption of ions in the presence of varying concentration of electrolyte. The results show the pristine point of zero charge varies with soil according to the variation of organic matter and sesquioxide content. The pH value is presented as a measure of pedogenic development. The decrease in this pH value is interpreted as indicating that the soils are approaching a steady- state with time. Net charge also varies with organic carbon, composition of clay and chemical component of soil. Variability in the magnitude of this charge was attributed to the effect of Al or Fe blocked exchange sites or contribution from dissociated organic functional groups. Organic carbon strongly affects the variation of negative charge with pH, but sesquioxide/allophone is responsible for positive charge variation.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Development of Protocols for Assessment of Plant Available Sulphur in Soils under Organic Production Systems

Dhaneshwar Padhan[1]*, Dibyendu Sarkar[1], Ashim Datta[2], Mahasweta Chakraborty[1], Susmit Saha[3], Ritesh Kundu[1], Pragyan Paramita Rout[4], Biplab Pal[1], Gora Chand Hazra[1] and Biswapati Mandal[1]

[1]*Department of Agricultural Chemistry and Soil Science, BCKV, Mohanpur, 741252, West Bengal*
[2]*Division of Soil and Crop Management, ICAR-CSSRI, Karnal, 132001, Haryana*
[3]*College of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Burdwan Sadar, 713101, West Bengal*
[4]*Department of Soil Science and Agricultural Chemistry, TNAU, Coimbatore, 641003, Tamil Nadu*
**Email: dhaneshwar.padhan@gmail.com*

Many extractants for the determination of plant available sulphur (S) in soil have been tested for conventional methods of crop production, but hardly any extractants were tested for assessing the plant available S in soils under organic production systems. We hypothesized that the extractants normally used in conventional soil testing methods for extracting available S cannot be applied equally in organic production systems. Four extractants viz., 0.15% $CaCl_2$, 0.5M $NaHCO_3$, 1M NH_4HCO_3+ 0.005MDTPA and 1N NaOH+ 0.05M EDTA with different mode of actions were evaluated for their extractability in Aridisol, Entisol, Alfisol, Inceptisol and Vertisol under regimes of organic manure application (viz., FYM0, FYM2.5, FYM5.0, FYM10, FYM20, and FYM40) with spinach as the test crop. The relative efficiency of the S extractants followed the order 0.5M $NaHCO_3$ > 1M NH_4HCO_3+ 0.005MDTPA > 1N NaOH+ 0.05M EDTA > 0.15% $CaCl_2$ for all the soil orders. The extractable soil S was significantly correlated with dry matter yield, plant tissue S concentration and uptake. On average, the relationship was greater with 0.5 M $NaHCO_3$ in all the soil orders, indicating its superiority over 0.15% $CaCl_2$, 1M NH_4HCO_3+ 0.005MDTPA and 1N NaOH+ 0.05M EDTA. Amongst the soil orders, Alfisol could maintain stronger relationships between plant tissue concentrations and S extracted by the four extractants. Of the four extractants tested, 0.5M $NaHCO_3$ was the best for assessing the plant available S contents in soils for nutrition of spinach.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Studies on Potassium Release Characteristics in Selected Soils of Nalgonda District of Telangana

Meraj Siddiqua[1]*, S.H.K. Sharma[1], A. Aziz Qureshi[2] and P. Laxminarayana

[1]Department of Soil Science and Agricultural Chemistry, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, 500030, Telangana

[2]ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad, Telangana

The knowledge of the rate of release of potassium (K) from soil plays an important role in understanding the K supplying capacity of soils to plants. The release of non-exchangeable K occurs when the levels of exchangeable and soil solution K are decreased by its crop removal and leaching. The phenomenon how K is released into solution and the rate of release is of great importance to plant availability and crop production. In intensive cropping without K fertilization, initially, the exchangeable K in soil contributes to plant K nutrition, with further cropping, exchangeable K attains a certain minimal level. Afterwards, contribution from non-exchangeable pool (i.e., K from inter layers of the major minerals in the clay fraction) to meet K requirement of crop and it accounts for up to 90–95% of the total plant K uptake. Initial soil properties and K release characteristics were also studied in 20 soil samples representing Nalongda distirct of Telangana.The texture of soils varied from sandy clay loam to clay, all the soils were found to be non saline, slightly acidic to alkaline in reaction. Most of the soils had low to medium organic carbon content. The value for available potassium in soils ranged from low (<120 kg K ha^{-1}) to high (>240 kg K ha^{-1}). Distinct variability in the status for available potassium in these soils was observed and the values ranged from 102 to 790 kg K ha^{-1}. Among the various approaches to study the K-release characteristics of soils, non exchangeable K release with boiling 1*M* HNO_3 was found to be a more appropriate method to categorize soils for K availability to plants. Introduction of the concepts of step K and constant-rate K (CR-K) as measures of plant-utilizable non-exchangeable K release in soil by repeated extractions with boiling 1.0*M* HNO_3 therefore provides some useful information on the K-supplying capacity of the soils under continuous cropping. However, amount of K extracted in the step K extraction with HNO_3 ranged from 244 to 556 mg kg^{-1} with an average value of 333.2 mg kg^{-1} .The maximum amount being recorded in the soils of Ammanbole and minimum amount in the soils of Khairthpur. The amount of step K from non exchangeable sites in the soils under study ranged from 196 to 652 mg kg^{-1} with mean value of 320.3 mg kg^{-1} .The highest value being recorded in Ammanbole and lowest in Kolanupaka. The constant rate K value is a measure of the less-available K from the mineral lattice sources. CR-K ranged from 92 to 172 mg kg^{-1} with an average value of 119.6 mg kg^{-1}. The highest value being recorded in Ammanbole and the lowest value in Deshmukhi. The higher values of CR-K in the soils of Ammanbole indicate that these soils may supply K at a higher rate for a longer period than the others.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Evaluating the Contribution of Non-Exchangeable Potassium to Yield and Uptake By Crops

A. Madhavi, T. Srijaya, P. Surendra Babu, D.V. Ramana Reddy and Pradip Dey
AICRP on Soil Test Crop Response, Professor Jayashankar Telangana State Agricultural University, Agricultural Research Institute, Rajendranagar, Hyderabad, Telangana

Survey was conducted in different districts of Telangana and Andhra Pradesh to collect the soil samples from different types of soils. A total 186 soil samples were collected comprising 66 vertisols, 42 inceptisols, 42 Entisols and 36 Alfisols. The range of non exchangeable K in these soils was found to be 666 to 3905 kg ha^{-1} in vertisols, 692 to 4179 kg ha^{-1} in inceptisols, 645 to 2414 kg ha^{-1} in alfisols and 412 to 3781 kg ha^{-1} in entisols. The ratio of average non exchangeable and exchangeable potassium content in these soils was found to be 3.2, 4.5, 4.4 and 6.4 times in vertisols, inceptisols, alfisols and entisols, respectively.

An attempt was made to find out the response of applied potassium by rice crop under controlled conditions and with increased non exchangeable potassium content in four different types of soils. The range of non exchangeable potassium in soils that was employed was 649 to 1176 kg ha^{-1}in Vertisols, 818 to 1109 kg ha^{-1} in inceptisols, 652 to 1642 kg ha^{-1} in entisols and 560 to 1789 kg ha^{-1} in alfisols. The available potassium in these soils was in the range of 314 to 629 kg ha^{-1} in vertisols, 269 to 663 kg ha^{-1} in Inceptisols, 144 to 720 kg ha^{-1} in Entisols and 114 to 596 kg ha^{-1} in Alfisols. The ratio of average non exchangeable and exchangeable potassium content in these soils was found to be 2.24, 2.15, 2.26 and 3.22 in vertisols, inceptisols, entisols and alfisols, respectively. Irrespective of type of soil, under high non exchangeable potassium content conditions, the response to potassium application by rice crop was found to be only up to 25% of recommended dose of potassium. This dose of 25% RDK (15 kg K_2O ha^{-1}) resulted in percent response of drymatter yield to an extent of 12.5, 31.9, 16.36 and 8.30% in vertisols, entisols, inceptisols and alfisols, respectively. As such no correlations could be drawn between non exchangeable potassium and yield / K content of crop.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Evaluation Of Multinutrient Extractant In Comparision With Existing Soil Test Methods For Available Nutrients

T. Srijaya, A. Madhavi, P. Surendra Babu, D.V. Ramana Reddy and Pradip Dey
AICRP on Soil Test Crop Response, Professor Jayashankar Telangana State Agricultural University, Agricultural Research Institute, Rajendranagar, Hyderabad, Telangana

AB-DTPA was compared with existing soil testing methods of available P_2O_5 (Olsen's-P), K_2O (Neutral Normal Ammonium acetate-K) in 186 soils employing 66 Vertisols, 42 Inceptisols, 42 Entisols and 36 Alfisols for their extractability. The available phosphorus extraction by AB-DTPA and olsen's method was found to have high correlation in all four types of soils. In general, the mean amount of P_2O_5 extracted by AB-DTPA and Olsen extractant was almost similar with a meager variation of +/- 2% in Vertisols and Alfisols. The maximum variation in mean P_2O_5-extractability was observed in inceptisols when olsen extractant extracted 11.71% more of P_2O_5 and in Entisols the same extractant extracted 3.39% more of P_2O_5 than that of AB-DTPA.

The available potassium content extracted by neutral normal ammonium acetate method was 5.39 to 16.33 per cent higher over AB-DTPA method in Vertisols, Inceptisols and Alfisols. In Entisols, AB-DTPA extracted more (7.85%) available K_2O than that of ammonium acetate method. The available potassium extraction by AB-DTPA and ammonium acetate method was found to have high correlation in all four types of soils. The overall study indicated that in general, across all four types of soils, AB-DTPA extraction almost agrees with those of Olsen's phosphorus and ammonium acetate potassium.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Computation of Geo-accumulation Indices for Tannery Contaminated area of Kanpur

M.L. Dotaniya*, S. Rajendiran, V.D. Meena, M. Vassanda Coumar, J.K. Saha, S. Kundu and A.K. Patra
ICAR-Indian Institute of Soil Science, Nabi Bagh, Berasia Road, Bhopal, 462 038, Madhya Pradesh

An Indian agricultural production system is much affected by the use, type and availability of the natural resources. Deterioration in natural resources health is limiting the production and the productivity of agricultural systems. Growing population with higher pace put a pressure on limited resources to produce more amount of food to mitigate the food demand. Due to progressive industrial developmental activities and increasing population growth, huge volume of domestic sewage water is being produced in mega cities. Use of waste water for irrigation of agricultural lands in urban and rural areas across the globe is a common practice, due to the scarcity and unavailability of quality irrigation water. Wastewater use in urban and rural agriculture is increasing where such use derives significant economic activity and supports the livelihood of resource poor farmers. With this backdrop, tannery effluent and tannery effluent irrigated and non-irrigated samples were collected by adopting Simple Random Sampling (SRS) technique in and around tannery industrial areas of Kanpur city. After collection, soils were air dried under shade and stored in polythene bags. The groundwater samples were collected from the tube wells and stored in thoroughly rinsed plastic bottles. Physico-chemical properties of effluent and soil were calculated with the help of standard analysis methods. After the analysis, Geoaccumulation index (I_{geo}) was calculated with the help of formula described by Muller (1969). From the result, the tannery effluents contained 1.53-57.3 ppm Cr, 0-0.12 ppm Ni, 0-0.02 ppm Cd, 0-0.07 ppm Pb, 0-0.48 ppm Zn and 0-0.03 ppm As. The study revealed that the use of tannery effluent for crop production has led to built up of Cr in the soil by 28 to 30 times. The I_{geo} revealed that soil samples were unpolluted to moderately polluted with Cu, Ni, Zn, Pb and As; moderately polluted in case of Cd; and heavily to extremely polluted by Cr. The increased pollution level may adversely affect the soil health and likely to contaminate the food chain. Therefore, the government should take initiatives to strictly monitor the effluent treatment plants regularly and also spread the awareness among the public on the impact of tannery effluents on soil–plant-human systems through government and nongovernmental organizations (NGOs) in the tannery effluent irrigated areas.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Long-term Integrated Nutrient Management on Zinc fractions in relation to Rice Productivity in a *Typic Ustochrept* Soil of Punjab

Navdeep Singh, R S Gill* and G S Dheri
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab
**Email-rsgill79@pau.edu*

Micronutrient deficiencies have become one of the major constraints in sustaining crop production in the present day agriculture. In Punjab, currently 15 percent soils are deficient in Zn and 11 percent soils are deficient in Fe. In soils, Zn and Fe occur in various forms associated with inorganic and organic components and in a number of discrete chemical forms differing in their solubility and thus availability to plants. An experimental study was carried out on from an ongoing long-term integrated nutrient management experiment under rice-wheat cropping system. The soils receiving different treatments were designated as T_1 (Control), T_2 (50%NPK), T_3 (75%NPK), T_4 (100%NPK), T_5 [50%NPK+50%NPK (FYM)], T_6 [75%NPK+25%NPK (FYM)], T_7 [50%NPK+50%NPK (WCS)], T_8 [75%NPK+25%NPK (WCS)], T_9 [50%NPK+50%NPK (GM)] and T_{10} [75%NPK+25%NPK (GM)]. The results revealed that the highest content of Zn (ranged between 2.64 and 3.08 mg kg^{-1}) were found in the form of crystalline iron oxide bound fraction (CFeOX). The highest amount of CFeOX, amorphous iron oxide (AfeOX), exchangeable (EXCH), carbonate (CARB) and organic matter (OM) bound Zn was found in the treatments where 50 and 25% of the recommended NPK were applied through FYM, WCS and GM respectively. The EXCH-Zn in the treatment where 50% of the recommended NPK was supplied through FYM, WCS and GM was 52.7, 20.0 and 34.5 % higher than the treatment where 100% of the recommended NPK were supplied through inorganic fertilizers alone. The uptake of Zn was higher in the integrated nutrient management plots. The positive and significant correlation of EXCH (r = 0.714*), CARB (r = 0.601*) & OM(r = 0.648*) fractions of Zn with uptake Zn uptake by paddy grains showed that the availability of Zn to plant depends upon these fractions of Fe & Zn in soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of Soil-humus Stability in a Rice-Wheat Cropping System

Nayan Ahmed, T.J. Purakaystha, Ruma Das, Sunanda Biswas, S.C. Datta and R. K. Sharma
Division of Soil Science and Agricultural Chemistry, IARI, New Delhi, 110012

Soil humus stability has been quantified for three depths (0-15 cm, 15-30 cm and 30-60 cm) in five different treatments in the rice-wheat cropping system of a long term integrated nutrient management experiment being carried out at PAU, Ludhiana. The stability of soil –humus was determined by sequential extraction of humus using sodium pyrophosphate and estimating the carbon extracted. This was a batch technique, where the desorbed humus was removed every two hours to avoid back ward reaction, if any, so that the rate of release remained unaffected wherein re-adsorption of humus on the clay surface was avoided. The carbon concentration in the extracts was measured by Schollenberger method. From the carbon concentration of the extract at different times, the cumulative desorption of humus carbon per unit amount of soil-humus complex was determined and subtracted from the original soil-humus carbon content to get remaining carbon, C_t at time t. Carbon content of a soil humus complex, C_t, at a time t, after desorption of humus from soil-humus complex was fitted to a simple first order equation

$$C_t = C_o \exp(-kt)$$

Where, C_o is the initial carbon content and k is the humus desorption rate constant. The inverse of k will give the retention time i.e. stability of soil humus carbon. It was observed that soil humus stability in Ludhiana soils are generally low due to its sandy loam texture, but stability increased with depth of soil in all treatments. The c-desorption data fitted more suitably to linear sum of more than two 1st order equation than only one 1st order equation as indicated by the r^2 value, which indicates more than one C-pool having two desorption rate constants. To make comparison of the stability of individual treatments, it was observed that in long term, GM treated soils had highest humus stability followed by straw incorporation. FYM addition and only NPK also resulted in moderate stability, which was higher in comparison to control. Higher humus stability in case of GM and straw may be due to more reactive and labile components released during fast decomposition of GM, which helps in stronger bonding with the mineral fraction of soil. FYM shows lesser stability than GM or straw because FYM is relatively more stable product and further reaction with inorganic components is less. The labile components in FYM, although small are loosely adsorbed on clay minerals, which desorbs easily leading to its lower humus stability.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Distribution of Micronutrients in Paddy Fields of Thoubal and Bishnupur Districts of Manipur

Laishram Punilkumar, R.K. Kumarjit and Indira Sarangthem
Department of Soil Science and Agricultural Chemistry, Central Agricultural University, Imphal, Manipur

An investigation was carried out to study the vertical distribution of micronutrients upto 60 cm depth with an interval of 20 cm (0-20, 20-40, 40-60 cm) from twenty eight paddy growing fields of Thoubal and Bishnupur districts of Manipur and its correlation with soil chemical parameters of soils. SoilS of Thoubal and Bishnupur were moderately acidic to neutral in reaction (4.67–7.29) and heavy in texture, rich in organic carbon (0.30 – 2.70%), low in electrical conductivity (0.04 – 0.19 dSm^{-1}) and exchangeable bases (Ca^{++} and Mg^{++}). Available nitrogen(N), phosphorus (P) and potassium (K) content varied from 62.72 to 376.32 kgha^{-1}, 5.23 to 18.78 kg ha^{-1} and 61.49 to 343.39 kg ha^{-1} respectively. DTPA-extractable micronutrients (Fe, Mn, Cu and Zn) ranged from 17.0 to 287.0 mgkg^{-1}, 4.4 to 141.0 mg kg^{-1}, 1.0 to 7.75 mg kg^{-1} and 0.27 to 1.65 mg kg^{-1} respectively. At different depths viz. 0-20cm, 20-40cm and 40-60cm, distribution of DTPA-Fe varied from 20.0 to 283.0, 17.0 to 287.0 and 18.0 to 175.0 mg kg^{-1} soil; DTPA-Mn varied from 7.5 to 139.0, 4.4 to 141.0 and 5.7 to 99.0 mgkg^{-1} soil ; DTPA-Cu availability ranged from 1.5 to 7.75, 1.25 to 6.75 and 1.0 to 7.0 mgkg^{-1} soil and DTPA-Zn varied from 0.58 to 1.65, 0.38 to 1.03 and 0.27 to 0.82 mgkg^{-1} soil respectively. The availability of micronutrient showed decreasing pattern with increase in soil depth except Cu showing irregular distribution. Further, DTPA-extractable micronutrients showed positive correlation with EC, OC, CEC, clay but negative correlation with pH and sand content. There was a negative and significant correlation between DTPA-Fe and pH in different depths with r value -0.715**, -0.857** and -0.831** respectively. However, DTPA-Fe showed positive and significant correlation with OC in first and second depth (r=0.582** and 0.568**). The surface layer soils were adequate in all the micronutrient content. But all the macronutrient content varied from low to medium in the surface layer. Therefore, it is advisable to supply the required macronutrients to the crop to sustain the fertility of the soils as well as productivity of crop especially rice to increase the income of the farming community.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Acknowledge the Behavioural Changes of Permanent and Variable Charges in Different Surface Soils in Tropical India

Tanushri Saha, Sanjib Kar and Sourav Kumar Khan
Department of Agricultural Chemistry and Soil Science, Institute of Agricultural Science, University of Calcutta, 35, B.C. Road, Kolkata, 700019, West Bengal
Email: souravkhan.90@gmail.com, sanjib_cu@yahoo.co.in

The surface electric charges in soil particles are classified into structural or permanent and pH-dependent or variable charges. The aim of the present study was to acknowledge the behavioural changes of permanent and variable charges in different surface and subsurface soils in tropical India. Eight surface and subsurface soils were collected from different states of India. Determination was made of the experiments through selective ion exchange of Cs^+ by Li^+ and Cs^+ by NH_4^+ respectively. Results reveals that the variable and total charge ratio of 0-12cm layer exhibited maximum proportion of electric charges with respect to 12-22cm layer profile. With increasing organic matter CEC and surface charge increases. Numerical data also supported by statistical interpretation by 0.5% level of significance in relation with cation exchange capacity ($p<0.05$; 0.99942). The total surface electric charges vary with several depths that have direct relation with cation exchange capacity of the soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Quality for Crop Productivity and Yield Sustainability of a Continuously Manured Rice Soil of Eastren India

Pradipta Majhi[1] ; K.K. Rout[2], S. Mondal[3], M. Mandal[4] and F.H. Rahman[5]*
[1]Krishi Vigyan Kendra, Puri, OUAT, 752014, Odisha
[2,4]Department of Soil Science and Agricultural Chemistry, OUAT, Bhubaneswar, 751003, Odisha
[3]Department of Soil Science and Agricultural Chemistry, Santineketan, Visva-Bharati, West Bengal
[5] ICAR- Agricultural Technology Application Research Institute, Salt Lake, Kolkata, 700097, West Bengal
**Email: fhrahmancal@gmail.com*

In order to study the crop response and impact on soil health of some secondary (S) and micronutrients (Zn and B) *vis-a-vis* FYM or addition of extra 50% NPK a nine years old Long term Fertilizer Experiment on rice-rice conducted on an acid soil under a sub tropical condition was used. For the study, crop and soil data of seven treatments (T_1: Control, T_2: 100% NPK, T_3: 150% NPK, T_4: 100% NPK + Zn, T_5: 100%NPK + FYM, T_6: 100% NPK + Zn + B, T_7: 100% NPK + Zn + S) were collected. FYM was applied @5t ha^{-1} in each season through incorporation before final land preparation. Sulphur 30 kg S ha^{-1} through gypsum, Zinc as seedling root dipping in 0.4% ZnO solution and boron through 2 foliar sprays of borax (0.25%) at 15days interval at flowering. Altogether 30 numbers of surface soil attributes of the post wet season (2014) was used for assessment of soil quality through standardised statistical framework two goal functions, crop productivity and its sustainability. After nine years, best quality of soil was found in 100% NPK + FYM (SQI, 0.941) treatment followed by 150% NPK (SQI, 0.826) and CEC was found to be the only key indicator for dry season rice with productivity as goal function. Soil quality deterioration was highest (SQI, 0.038) in unmanured control. Combination of B to Zn failed to bring any soil quality improvement for dry season rice yield. On the other hand combination of S improved soil quality by 14.92%. Combined application of B and Zn had negative impact on soil CEC that caused lower SQI (0.484) than 100% NPK (0.610). Nine years of combination applied at of 150% NPK was significantly superior to 100% NPK but was at par with 100% NPK + 10 t FYM/ha/year giving no indication of deficiency of any of the secondary and micronutrients under such situation. This clearly demonstrates the inadequacy of 100% NPK to meet the crop requirement. One or more of the three primary nutrients thus fall short to meet the crop requirement and with additional 50% NPK or 10 t FYM this could be compensated which needs for the study.

In contrast, yield sustainability in dry season crop as another goal function two soil attributes, 1N HNO_3-K (reserve K) and total N were found to be important with relative percentage contributions of 88 and 12, respectively, to soil quality demonstrating reserve K of surface soil to be the key soil attribute for sustainability of rice in dry season. There was no difference in soil quality of 150% NPK and 100% NPK + FYM treatments.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Boron Fractionation in Alkaline Calcareous Soils of Punjab

A.K. Boparai and J.S. Manchanda
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab

The deficiency of B is expected to be high in coarse-textured soils having low organic matter, high $CaCO_3$ and high pH. Calcareous and coarse textured soils which are highly leached exhibited boron deficiency to a greater extent as compared to other soils. Soil B can be found in various chemical pools. All these pools are not available to plants. Hot-water-extractable B has been regarded as a suitable index for B availability to plants. But, according to some authors, no significant correlation of HWS-B with the plant available form was observed. For understanding the soil chemistry and plant nutrition, elemental distribution of different forms of B is essential. Twenty one soil samples were selected based on their properties and were analyzed for different chemical pools of B. The sequential B fractionation scheme included fractions readily available B, specifically adsorbed B, oxide bound B, organically bound B, residual/occluded and total B. Readily soluble B ranged from 0.28 to 4.55 with a mean value of 1.49±0.37 mg kg^{-1} soil. The specifically adsorbed B ranged from 0.24 mg kg^{-1} to 2.96 mg kg^{-1} with a mean value of 1.06±0.22 mg kg^{-1} soil. The oxide bound B ranged from 0.52 mg kg^{-1} to 9.86 mg kg^{-1} with a mean value of 5.30±0.95 mg kg^{-1} soil. The organically bound B ranged from 0.94 mg kg^{-1} to a maximum of 12.43 mg kg^{-1} in soil having a maximum per cent SOC (1.07) with a mean of 7.18±1.27 mg kg^{-1} soil. The major portion of the soil B existed in the form of residual mineral fraction. It ranged from 46.85 mg kg^{-1} to 152.60 mg kg^{-1} with a mean of 71.21±9.85 mg kg^{-1} soil. The maximum content of residual B was observed in the soil having a $CaCO_3$ content of 9.0 per cent. The total B in these soils ranged from 55.5 mg kg^{-1} to 167.67 mg kg^{-1} with a mean of 86.25±9.81 mg kg^{-1} soil. The amount of B in readily soluble, specifically adsorbed, oxide bound, organically bound and residual mineral fraction varied from 0.17 to 2.71, 0.14 to 1.77, 0.31 to 5.88, 0.56 to 7.42 and 0.17 to 2.71 as a per cent of total B in soils, respectively. Readily soluble B was significantly positively correlated with soil pH (r= 0.535*), EC (r=0.661*) and ESP (r=0.698**). Specifically adsorbed B was also significantly positively correlated with soil pH (r= 0.574*), EC (r=0.682*) and ESP (r=0.716**). The oxide bound B was significantly positively correlated with clay content (r=0.512*). Organically bound B was significantly positively correlated with soil organic carbon (r=0.964**), CEC (r=0.563*), and clay content (r=0.470*) but significantly negatively with sand (r=-0.475*). Both residual mineral B (r= 0.953**) and total soil B (r=0.982**) were significantly positively correlated with $CaCO_3$ content in soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Quantity-Intensity (Q/I) Relations in Inceptisols as Influenced by Graded Levels of Potash for Banana

V.P. Bhalerao[1]*, A.N. Deshpande[2] and C.A. Nimbalkar[3]
[1]Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dhule, 424004, Maharashtra
[2]Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra
[3]Mahatma Phule Krishi Vidyapeeth, Rahuri, , Maharashtra
**Email: bhaleraovp@gmail.com*

Quantity-intensity (Q/I) relationships of K are useful in understanding the nature of K equilibrium and serve as a better index of K supplying power of soil. Two field experiments were conducted simultaneously at the research farm of Mahatma Phule Krishi Vidyapeeth, Rahuri on *Vertic Haplustept* soil to study the effect of graded levels of potash application to banana quantity-intensity (Q/I) relations. The soil had a pH 8.30, EC 0.17 dSm^{-1}, organic carbon 6.8 g kg^{-1}, whereas available N (alkaline $KMnO_4$), P (Olsen's P) and K (NH_4OAc) contents were 189, 18.3 and 443 kg ha^{-1}, respectively. Experiments were laid out in randomized block design comprising of six treatments of potash levels and four replications. Tissue cultured plantlets of banana (*cv.* Grand Naine) were planted at 1.5 m x 1.5 m with inline drip irrigation system. The treatments were K_2O @ 0, 100, 200, 300, 400 and 500 g $plant^{-1}$ applied through fertigation at 7 days interval in 44 splits up to 300 days. Fertilizer dose of 200 g N through fertigation and 40 g P_2O_5 with 10 kg FYM per plant was uniformly applied in all the treatments as per MPKV recommendation.

The highest AR_0^k value was observed in the treatment of 500 g K_2O $plant^{-1}$ [13.74×10^{-3} (mol $l^{-1})^{1/2}$], which indicates that soils have higher K^+ ion strength in the solution so that the immediate availability of K will be more in this treatment and having enough K so as to maintain intensity values as compared to rest of the treatments.

Labile potassium (K_L) was higher (1.14 me 100 g^{-1}) in the treatment of 500 g K_2O $plant^{-1}$ than in the treatment of no potash (0.88 me 100 g^{-1}), which indicated that under intensive cropping the K_2O treatments has the higher potential to replenish the K concentration in the soil solution for a longer period than the treatment of no potassium. Potassium held at non-specific site (ÄK_0) was in the range of 0.37 to 0.43 me 100 g^{-1} and tended to increase with increasing K fertilization. The ÄK_0 values obtained in all the treatments were well below the amount of exchangeable K in all the treatments, which indicated that a part of exchangeable K does not contribute to ÄK_0 value.

Potassium held at specific sites (K_X) tended to increase with increasing K fertilization. The higher K_X values indicated higher exchange surface offering a selective or specific binding for potassium and not for Ca and Mg. As the levels of potash increased there was decrease in PBC^K values. The lower PBC^K values 31.3 cmol kg^{-1}/(mol $l^{-1})^{1/2}$ was observed in the 500 g K_2O $plant^{-1}$. Higher K intensity and activity lead to a lower PBC^K which is a better indicator of the ability of soil to maintain K intensity.

As per the threshold values of free energy exchange (ÄG) the soil appeared to possess optimum amount of available K (-2500 to -3000 cal mol^{-1}).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Impact of Amount and Source of Phosphorus Application on Soil P Fractions and Release Kinetics under Rice-Wheat System

Dhram Prakash*, D.K. Benbi and G.S. Saroa
Krishi Vigyan Kendra, Rauni, Patiala, 147001, Punjab
**Email: dhramprakashteotia@gmail.com*

A field experiment was conducted to study the effect of rate and source of phosphorus (P) application on soil P fractions and release kinetics in rice-wheat system. The treatments included two rates of P viz. 0 and 30 kg P_2O_5 ha^{-1} applied to rice through single super phosphate (SSP) and rock phosphate (RP) both in the presence and absence of farmyard manure (FYM) application. The following wheat was fertilized at 60 kg P_2O_5 ha^{-1} through SSP. Application of fertilizer P to rice through SSP (F_0P_{30SSP}) significantly increased organic P (Po) compared to the same amount applied through RP (F_0P_{30RP}). Increase in organic, inorganic and total P was higher in plots receiving both fertilizer P and FYM (F_1P_{30RP}) compared to the soils receiving FYM alone (F_1P_0). Highest amount (1.95 mg P kg^{-1}) of water soluble P (H_2O-Po) was observed in plots receiving fertilizer P in conjunction with FYM (F_1P_{30RP}) and the lowest (0.86 mg P kg^{-1}) in unfertilized control. Plots treated with SSP (F_0P_{30SSP}) showed significant increase in H_2O-Po than plots receiving fertilizer P through RP (F_0P_{30RP}). Averaged across treatments, organic P concentration followed the order NaOH-Po>Ca-Al Po>$_C$TCA-Po>H_2SO_4-Po>Fe-Po>$_H$TCA-Po>H_2O-Po. The NaOH-Po and Ca-Al Po fractions constituted major proportion (55.3%) of organic P. Phosphorus release was best described by Elovich and power functions (R^2 = 0.98). The results showed that after 7 cycles of rice-wheat cropping soil P fractions as well as P release were higher under conjoint application of FYM and RP compared to their individual applications, emphasizing the need for integrated use of these sources for improved P use efficiency in these soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Relationship between Soil Characteristics and DTPA-extractable Micronutrients Cations in Soil of Gwalior District

S.K. Singh, Naresh Gupta, R.S. Kushwah and Rakesh Kumar
Krishi Vigyan Kendra, RVSKVV, Gwalior, 474002, Madhya Pradesh

Micronutrients are very much essential for the growth, development and reproduction of plants. Different crops require varied quantities of micronutrients in their different stages of growth. Thus, they become more important as regards to increase and conserve fertility and productivity of soil. Deficiency of micronutrients may either be primary, due to their low total content of elements or secondary, caused by soil factors reducing their availability to plants. The emergence of micronutrients deficiency has generally been considered as secondary. Now a days use of only nitrogenous and phosphatic fertilizers is also creating nutrient imbalance in soil, particularly that of micronutrients. Although, the requirement of micronutrient is very low, their effects on crop yield are very significant. Under present study more than One thousand five hundred soil samples were analyzed of various cropping system in the year 2016 for the preparation of soil health card.

Results indicate that the available Zn ranged from 0.14-1.29 mg kg^{1} with a average value of 0.68 mg kg^{1}. The range of Cu was 0.44 - 4.22 (mean 1.80) mg kg^{1}. The average value of Fe was 6.88. It ranged from 1.98 - 18.52 mg kg^{1}. Such values for Mn were 8.44 and it ranged from 2.80-30.32 mg kg^{1}. Considering the critical level of Zn and Fe as 0.6 and 4.5 mg kg^{1}, the zinc deficiency ranged from 52 to 70% with mean value of 58.4 percent. The deficiency of Fe varied from 14.0 to 38.0% (mean 18.0%) under different cropping sequences in Gwalior district of Madhya Pradesh. Based on linear coefficient of correlation, available zinc, copper, manganese and Iron showed positive correlation with organic carbon and negative relationship with pH content.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Tillage Practices and Weed Control Methods on Soil Properties and Organic Carbon Pools in Alluvial Soils of Madhya Pradesh

Manoj Kumar[1], S.K. Verma[2], A.K. Priyadarshani[3]*, D.S. Bhadoriya [4], Asha Arora[5] and Narendra Singh[6]
RVSKVV, College of Agriculture, Gwalior, Madhya Pradesh
**Email: murlipriya245@gmail.com*

The experiment was conducted during *rabi* season of 2016-17 at the research farm, RVSKVV, College of Agriculture, Gwalior (M.P.) was a part of ongoing long term (2013) experiment of weed management and tillage practices; to study Impact of different tillage practices and weed control methods on organic carbon pools and soil physical properties at 0-15 and 15-30 cm soil depth. The trial was laid out under strip plot design replicated three times with 15 treatments including 5 tillage practices viz.T_1 [Conventional tillage (CT) operation followed by Conventional Tillage (CT)], T_2 [Conventional Tillage (CT) in *kharif* followed by Zero Tillage (ZT) in *rabi*], T_3 [Zero Tillage (ZT) followed by Zero Tillage (ZT)], T_4 [Zero Tillage (ZT) followed by Zero Tillage and residue retained (ZT+R) (at least 30%) on the field, direct sowing during *rabi*, weed management through herbicides (Pre and post emergence)] & T_5 [Zero Tillage and residue retained (ZT+R) followed by Zero Tillage and residue retained (ZT+R)] as horizontal plots and W_1 [Pendimethalin @ 1.0 kg/ha as PE (Pre-Emergence)], W_2 [Oxyflourfen @ 0.230kg/ha as PE + 1 HW at 25-30 DAS (IWM)] & W_3 [One hand weeding] as vertical plots. The study indicates that active pool of carbon showed more variation as compare to passive pool at both depths. The treatment combination recorded higher value of active pool for T_4W_2 (0-15 cm) and T_3W_2 (15-30 cm); where as passive pool for T_5W_1 at both depths. The active to passive pool ratio was highest for T_2W_1 (0-15 cm) and T_3W_2 (15-30 cm) over rest of the combinations. The BD was increased in zero tillage treatment as compared to conventional tillage at 15-30 cm depth. The highest MWD recorded in T_5W_3 (1.04 mm) at 15-30 cm. The no tillage system provides for greater stability to soil aggregates compared to the fallow plus CTS.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of Soil Quality Index, Sustainable Yield Index and Carbon Management Index in a Long-term Integrated Nutrient Management on Rice in an Inceptisol of Assam

Smrita Buragohain*, Dhruba Jyoti Nath, Anjuma Gayan, Yumnam Bijilaxmi Devi and Ipsita Ojah
Department of Soil Science, Assam Agricultural University, Jorhat, 785013, Assam
** Email: smrita40@gmail.com*

Soil quality index (SQI), sustainable yield index (SYI) and carbon management index (CMI) were evaluated in a field experiment involving integrated nutrient management (INM) for eleven years (2006-2016) of rice cultivation in an Inceptisol of Assam. Experiments were conducted in a randomized block design (RBD) with four replications and five treatments: unfertilized control (T_1), recommended doses of inorganic fertilizer (T_2), bio-fertilizer with reduced (50%) inorganic N and P (T_3), reduced (50%) inorganic N and P with 1 t ha^{-1} of enriched bio-compost (T_4) and reduced (75%) inorganic N and P with 2 t ha^{-1} enriched bio-compost (T_5). The results of long term integrated nutrient management (INM) on rice for eleven years demonstrated the impact of enriched compost with reduction in chemical fertilizer even upto 75% of RD(NP). The treatment consisted of 25% RD of NP(T_5) with 100% K along with enriched compost (2 t ha^{-1}) could sustain the rice production at 4.18 t ha^{-1} which was comparable with total inorganic fertilizer (4.03t ha^{-1}). Likewise, the computed SYI after eleven years of the experiment resulted the values between 0.99-1.07 as against the control value of 0.77. The treatment T5 contributed highest SYI (1.07) in the experiment. The soil quality index (SQI) computed through principal component analysis (PCA) after eleven years of INM in paddy showed the SQI ranges from 0.75 to 1.00. The calculated SQIs were in the order of T_5 (1.00) > T_4 (0.98) > T_3 (0.96) > T_2 (0.87) > T_1 (0.75). The low SQI (0.75) was observed in soil receiving no inputs in the treatment. Reducing chemical fertilizer (NP) by 75% improved the SQI with a value of 1.00 in treatment that received enriched compost (2.0t ha^{-1}). Carbon management index (CMI) was calculated as per the procedure described by Blair *et al.*, (1995) using control soil as a reference. The CMI index computed by utilizing various carbon fractions illustrated the CMI ranges from 100 in control to 170.61 in the treatment received enriched compost @2t/ha for eleven years. Higher value of CMI indicates that the system is being rehabilitated, improved and sustained as compared to lower CMI, which depicts that the system is declining. Persistent application of biofertilizers also illustrated the clear increase in fluorescein di-acetate (FDA) hydrolase (10.51 µg fluorescein g^{-1}h^{-1}) and arylsulfatase (ARS) (43.88 µg *p*-nitrophenol g^{-1}h^{-1}) activities with 50% of NP fertilizer. Application of enriched compost (EC) (2 t ha^{-1}) demonstrated clear increase in dehydrogenase (DH) (220.0 µg TPFg^{-1}24h^{-1}) and phosphomonoesterase (PME) (388.8 µg *p*-nitrophenol g^{-1}h^{-1}) activities with only 25% of recommended nitrogenous (N) and phosphatic (P) fertilizer. The integration of biofertilizers or EC with reduction of 75 to 50% NP fertilizers resulted the higher microbial biomass carbon (MBC) in between 270.64 and 323.35 µg g^{-1} compared to chemical fertilizer alone. Application of enriched bio-compost at the rate of 2 t ha^{-1} with a substitution of 75% of recommended inorganic N and P fertilizers for rice cultivation, documented significant improvements in soil quality.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Transformation of Different Fractions of K in a Limed and the Corresponding Unlimed Waterlogged Soil Subjected to a Wetting and Drying Cycle

Sayan Majumder, Tapa Debnath and Dipankar Saha
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, 741252, West Bengal

A laboratory investigation was carried out to study the changes in different K fractions in a limed and the corresponding unlimed soil maintained under waterlogged condition subjected to a wetting and drying cycle. A Typic Haplustalf soil is used for the present investigation which was collected from Regional Research Station, Jhargram, West Bengal. Limed soil was prepared by treating acid soil with liming material ($CaCO_3$) equivalent to the lime requirement followed by wetting and drying for 3 months. Waterlogging is maintained in limed and unlimed soil for 90 days. Another set of both the soils were waterlogged upto 45th day, then a drying phase was given and again remoistened to waterlogged situation on 60th day and maintained upto 90 days. Both limed and unlimed soils were treated either with K fertilizer or both N and K fertilizers. Soil samples were periodically collected on 0, 30, 45, 60, 75 and 90th day of the incubation study. Soil samples were analysed for different fractions of K flame photometrically following standard methods.

Results revealed that, irrespective of moisture regimes and liming, water soluble K significantly decreased over 90 day period of incubation. Furthermore, comparatively higher amount of decrease in water soluble K is recorded in limed than unlimed soils over 90 day period of investigation. Again, in general, exchangeable K decreased in limed over unlimed system upto 45th day of incubation. However, a completely reverse trend of results was observed from 45th to 90th day of study. On the other hand, comparatively lower amount of available K is accumulated in limed over unlimed soil upto 60th day of incubation. However,75th day onwards, a reverse trend is observed in both the fertilizer treated and untreated systems. Furthermore, irrespective of treatments, in general, non-exchangeable K decreased over 90 day period of incubation. The decrease in non-exchangeable K is more marked in limed over that of unlimed systems. The increase in exchangeable K and the concomitant decrease in non-exchangeable K in limed soil over 90 day period of incubation suggests that there exists an equilibrium between these two forms of K in soil. Maintenance of a drying phase in a continuously flooded system released non-exchangeable K and the intensity of K release is more in limed over that of unlimed soil over 90 day period of investigation. Comparatively higher amount of 1 N boiling HNO_3 extractable K is accumulated in limed over unlimed systems. The increase in 1 N boiling HNO_3 extractable K is due to increase in non-exchangeable K. Boiling of soils with 1 N HNO_3 released K not only from the wedge sites but freed non-exchangeable positions occupied by NH_4^+ ions and hence the amount of available K increased. Changes in lattice K followed exactly an opposite trend of results compared to non-exchangeable and 1 N boiling HNO_3 extractable K throughout the whole period of investigation. Liming had a positive effect on increasing total K in soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Submergence on Different Boron Fractions in Soils of Konkan

D.P. Kalokhe, M.C. Kasture and S.B. Dodake
Department of Soil Science and Agricultural Chemistry, College of Agriculture, DBSKKV, Dapoli, Maharashtra

A soil submergence study was conducted during July 2016 to November 2016 in the laboratory of Soil Science Department of College of Agriculture, Dapoli. The experiment was laid out in Completely Randomized Design (CBD) comprising of eight treatments replicated thrice and observations were recorded at 30, 60, 90 and 120 days of submergence. The effect of submergence on boron fractions in lateritic, medium black, Manat, coarse shallow, coastal saline, coastal alluvial, reddish brown and acid sulphate soils was studied and also correlations between boron fractions and soil properties as well as amongst boron fractions were analysed.

The readily available B, important from plant nutrition point of view was found to be deficient initially but after submergence of the soils it ranged between the sufficiency levels. Organically bound boron, residual boron and total boron correlate positively with the readily available fraction of the boron in submerged condition. Availability of N, P, K and micronutrients was also found to be increased with the advancement of the submergence period. Residual boron fraction contributed maximum in the total boron pool and it was also found highly significant with total boron in the soils of Konkan. During the submergence period, most soil B existed in the residual or occluded form, while the fractions readily soluble B, specifically adsorbed B and organically bound B represented only a small proportion of the total B content. Correlations between boron pools and soil properties indicated that under different periods of submergence specifically adsorbed B, residual B and total B can participate in boron nutrition of plants like rice. In the regions like Konkan, where high rainfall prevails, this study can be useful to delineate the benchmark for boron fractions.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of pH on Inorganic Phosphorus Sorption/ Desorption Characteristics in Soils

B. Bhabai and D. Mukhopadhyay
Department of Soil Science and Agricultural Chemistry, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, 736165, West Bengal

A laboratory experiment was conducted to study the adsorption envelopes at the pH 4.0, pH 6.0 and pH 8.0 on the changes of the sorption capacity of phosphorus (P) in the soils treated with graded doses of P solutions. The phosphorus sorption was lowered down to 19.03% in soils due to the change in pH from 4.0 to 6.0 and decreased upto 17.04% when the pH was raised from 4.0 to 8.0 at 35^0C during the given sorption run. The Langmuir parameters (K_1 and K_2) were affected by the pH levels (*i.e.* pH-4.0, pH-6.0 and pH-8.0). During the desorption run, the percentage of P desorbed to the initially sorbed P was increased (upto 40%) with the increasing pH (at pH 8.0) of the solution, suggesting the greater desorbability of P at the higher pH in soil. In general, the K_1 values decreased at pH 6.0 in comparison to that at pH 4.0 during the desorption run. The trend in increase of the K_2 values with the increasing pH was apparent. During the sorption run, the average values of the partition coefficient (K_d) in soil at pH 8.0 were lower (K_d =812) in general than at the pH 4 (K_d =1171).The calculated K_d values during the desorption run were decreased with the increasing pH (K_d = 4385 at pH 6.0 and K_d =4153 at pH 8.0) over that of the initial solution - pH of 4.0 (K_d = 4727). Hence, the decreasing K_d with the increasing pH signified the lower rates of change in the amount of sorbed P, rendering more availability of the given P in the solution phase.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Distribution of Active Carbon Fractions under Different Land Use Systems of a Micro-watershed in Northern Transition Zone of Karnataka

Sabyasachi Majumdar[1]*, P.L. Patil[2], G.S. Dasog[2] and C.R. Patil[3]
[1]*Department of Soil Science and Agricultural Chemistry, UAS, GKVK, Bangalore, 560065, Karnataka*
[2]*Department of Soil Science and Agricultural Chemistry, UAS, Dharwad, 580005, Karnataka*
[3]*Department of Agricultural Microbiology, UAS, Dharwad, 580005, Karnataka*
**Email: sabyasachiuasd@gmail.com*

An investigation was undertaken during 2013-14 in northern transition zone of Karnataka to study the active fractions of carbon under different land use systems of Shinganhalli-Bogur micro-watershed. Three land use systems [agriculture (paddy land and non paddy land), forest and horticulture] were selected for the study. From each land use system, fifteen surface (0-20 cm) soil samples were collected randomly and exact geographical location of the sample site was recorded using a GPS device. Water soluble carbon and active carbon were estimated by following procedure given by McGill *et al.*(1986) and modified method of Blair *et al.* (1995) as outlined by Weil *et al*. (2003), respectively. The soil organic carbon content [estimated by Walkley and Black's wet oxidation method as described by sparks (1996)] in forest land use system recorded the highest (15.9 g kg^{-1})and could be attributed to greater turnover of above and below ground biomass through leaf litter and fine root biomass. The horticulture system recorded lower organic carbon content (9.2 g kg^{-1})as compared to agriculture (paddy land) system. This was attributed to the young age of the system as horticulture plantation was done only four years earlier. Hence the organic matter addition through leaf fall, root exudates and root activity was poor. The increase in soil organic carbon content in the paddy land use could be a result of continuous fertilization, incorporation of plant residue and addition of green manure. The highest water soluble carbon (WSC) was recorded under forest land use system (68.49 mg kg^{-1}) due to high level of organic carbon input as a result of higher biomass addition over a long period of time. Among agriculture land use system, paddy land had the higher water soluble carbon fraction over non-paddy land. The lower water soluble carbon content (36.59 mg kg^{-1}) under non-paddy land use system might be attributed to the poor management practices such as lack of addition of crop residues and organic manures. Active carbon (AC) under the different land use ranged from 325.00 to 1850.00 mg kg^{-1}. Active carbon which is an excellent indicator of soil quality was found to be in direct proportion of soil organic carbon. Higher value of active carbon (1420.69 mg kg^{-1}) under the forest land use is an indication of good soil health. Boththe active fractions of carbon exhibited significant positive relationship with organic carbon and clay content. It clearly indicated that with increase in organic carbon content water soluble carbon and active carbon content will also increase. Significant and positive correlations was found between these soil organic carbon pools, under different land use systems, suggesting that the water soluble carbon and active carbon were derived from soil organic carbon stocks.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Forms and Distribution of Sulphur as Influenced by Various Land Use Systems of a Micro-watershed in Northern Transition Zone of Karnataka

Sabyasachi Majumdar[1]*, P.L. Patil[2], G.S. Dasog[2] and C.R. Patil[3]
[1]Department of Soil Science and Agricultural Chemistry, UAS, GKVK, Bangalore, 560065, Karnataka
[2]Department of Soil Science and Agricultural Chemistry, UAS, Dharwad, 580005, Karnataka
[3]Department of Agricultural Microbiology, UAS, Dharwad, 580005, Karnataka
**Email: sabyasachiuasd@gmail.com*

A study was carried out during 2013-14 in northern transition zone of Karnataka to study the forms and distribution of sulphur under different land use systems in Shinganhalli-Bogur micro-watershed. Three land use systems [agriculture (paddy land and non paddy land), forest and horticulture] were selected for the study. From each land use system, fifteen surface (0-20 cm) soil samples were collected and analysed for various forms of sulphur. The occurrence of forms of sulphur under different land use system followed the order: Organic-S > Heat soluble S > Available sulphur > Water soluble sulphur. The water soluble sulphur in surface soil samples of different land use systems ranged from 3.0 to 25.5 mg kg^{-1}. The water soluble sulphur on an average constituted 1.19 to 1.91 per cent of total sulphur. The amount of available sulphur in surface samples under different land use systems ranged from 2.8 to 35.7 mg kg^{-1}.The available sulphur in surface samples constituted on an average 1.27 to 2.25 per cent. The lower values of available sulphur might be due to nature and properties of soils and environmental conditions that is rainfall and topography which did not allow the sulphate sulphur to accumulate on soil surface. The heat soluble sulphur content of surface samples under different land use systems ranged between 7.7 to 43.4 mg kg^{-1}. Heat soluble sulphur, also referred to as mineralizable sulphur, was relatively higher than the water soluble sulphur and available sulphur. Higher amount of heat soluble sulphur is attributed to release of additional amount of sulphur from organic pool on wet and dry heating of soil during extraction. The increased solubility by heating may be attributed to the liberation of sulphate sulphur covalently held by organic matter. Heat soluble S showed significant positive correlation with almost all the soil properties viz., pH, OC, $CaCO_3$ and clay, which revealed that heat soluble-S had direct bearing with these properties. The total sulphur content of surface samples under different land use system ranged from 428 to 1275 mg kg^{-1}. Total sulphur was negatively correlated with pH and positively correlated with clay and organic carbon under all the land use systems. This suggests that total S content of these soils under different land use systems increased with an increase in organic carbon and finer fractions of the soil. The content of organic sulphur of surface samples varied from 185 to 875 mg kg^{-1}under different land use system. On an average, the organic sulphur constituted 47.57 to 72.07 per cent under various land use systems. The higher content of organic sulphur in surface samples was due to higher organic matter content. Total sulphur and organic sulphur maintained a significant positive correlation with organic carbon and clay content. Thus, it can concluded that the organic carbon and clay play an overwhelming role in regulating forms of sulphur in soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Land Use Systems on Vertical Distribution of Active Soil Carbon Pools in Northern Transition Zone of Karnataka

Sabyasachi Majumdar[1]*, P.L. Patil[2], G.S. Dasog[2] and C.R. Patil[3]
[1]*Department of Soil Science and Agricultural Chemistry, UAS, GKVK, Bangalore, 560065, Karnataka*
[2]*Department of Soil Science and Agricultural Chemistry, UAS, Dharwad, 580005, Karnataka*
[3]*Department of Agricultural Microbiology, UAS, Dharwad, 580005, Karnataka*
**Email: sabyasachiuasd@gmail.com*

An investigation was undertaken during 2013-14 in northern transition zone of Karnataka to study the forms and distribution of soil carbon fractions of Singhanhalli-Bogur micro-watershed. Three land use systems [agriculture (paddy land and non paddy land), forest and horticulture] were selected for the study. The area is represented by semi-arid climate with annual precipitation of 755.2 mm. One representative soil profile was sampled from each land use system for studying the vertical distribution of different carbon fractions. We measured active soil carbon pools (organic carbon, water soluble carbon and active carbon) for various land use systems. Soil organic carbon (SOC) varied from 2.3 to 12.1 g kg^{-1} under different land use systems. Soil organic carbon was found to decrease in the order forest > horticulture > agriculture land use system. The higher SOC content was recorded under surface soils compared to subsurface soils irrespective of the land use systems. The SOC content in forest land use was higher than the horticulture and agriculture land use system. The higher SOC content under the forest land use system could be the result of high above (leaf litter) and below ground (root biomass) input to the system. The soil organic carbon content of 12.1 g kg^{-1} could be possible in forest land use of vertisols because these soils contain appreciable amount of silt and clay, which is the major determinant of soil carbon saturation limit and stabilization of soil organic matter. Among all the land uses, the minimum organic carbon was recorded under non-paddy land which might be due to higher physical disturbance and low organic carbon input. The water soluble carbon content under different land use systems ranged from 12.40 to 64.29 mg kg^{-1}. Among agriculture land use system, paddy land improved the carbon fractions over non-paddy land. Active carbon under the different land use ranged from 210.40 to 670.49 mg kg^{-}1. Water soluble carbon and active carbon were recorded the highest under forest land use system. The water soluble carbon and active carbon content decreased depth wise which could be attributed to decrease in organic carbon content down the depth. The present study revealed that different land use systems influenced the soil organic carbon and its active pools. Soil organic carbon, water soluble carbon and active carbon were significantly increased under forest land use system. This gave an insight that soil carbon build-up could be possible in agricultural land use provided if it is managed properly.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Status of Forms of Potassium in soils of Gwalior District of M.P., India

Hemlata Dhakad[1]*, Shashi S. Yadav[2], Shweta Jamra[3] and Vinay Arya[4]

[1,2,4]College of Agriculture, Gwalior, Madhya Pradesh

Department of Soil Science and Agricultural Chemistry, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, 474002, Madhya Pradesh

**Email: hemlatadhakad3@gmail.com*

Potassium is a major constitute of the earth crust contained more in igneous rocks than in sedimentary rocks. Potassium comprise on an average of 2.6% of the earth crust making it the seventh most abundant element and fourth most abundant mineral nutrient in lithosphere. The present study was carried out during 2015-16 with One hundred twenty GPS based ((Latitude $26^0$00'02.19"- $26^0$59'58.39" and longitude $78^0$01'40.11.4"- $78^0$24'10.70") surface soil samples (0-15 cm) were collected from twenty three villages of four blocks (Namely Dabra, Bhitarwar, Ghatigoan and Morar) of Gwalior district (M.P.). The samples were prepared and analyzed for different forms of potassium. Status of water soluble- K in studied area was ranged from 7.2 – 26.4 mg kg^{-1} under different blocks with an average value of 15.1 mg kg^{-1} and contributes only 0.102% of total-K. Maximum average value of water soluble K (16.4 mg kg^{-1}) was observed in Ghatigoan block whereas minimum value (13.0 mg kg^{-1}) was found in Bhitarwar block of Gwalior district. Exchangeable- K content was found in the range of 115.2 – 330.2 mg kg^{-1} with an average value of 230.5 mg kg^{-1} which accounted1.55% of total-K. Maximum average value of exchangeable- K (251.5 mg kg^{-1}) was observed in Bhitarwar block whereas minimum value (210.7 mg kg^{-1}) was found in Morar block of Gwalior district. Status of non-exchangeable- K ranged from 290.4 – 965.4 mg kg^{-1} with an average value of 548.4 mg kg^{-1} and contributing to 3.70% of total-K. Maximum average value of non-exchangeable-K (623.9 mg kg^{-1}) was observed in Bhitarwar block whereas minimum value (496.5 mg kg^{-1}) was found inMorar. Lattice-K was found in the range of 1.072 – 1.729 % with an average value of 1.403%and contributed 94.67% of the total K. Maximum average value of lattice- K (1.421%) was observed in Ghatigoan block whereas minimum value (1.381%) found in Morar block. Total-K status of Gwalior district was found in the range of 1.127 – 1.859% under different villages with the average value of 1.482%. Maximum average value of total-K (1.499%) was observed in Ghatigoan block whereas minimum value (1.453 %) found in Morar block of Gwalior district.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Impact of Contrasting Tillage on N Mineralization under Rice and Maize-based Cropping System

Shweta Shambhavi, Rakesh Kumar, Rakhi Kumari and Priti Kumari
Department of Soil Science and Agricultural Chemistry, BAU, Sabour, Bihar

The influence of contrasting tillage and cropping system on nutrient cycling processes in soil have substantial implications for environmentally sound practices regarding their use. An attempt had been made to study the effect of different tillage and crop rotation practices and soil environment (soil moisture and temperature) on dynamics as well as the net amounts of N mineralized. For this purpose, soils were collected from the field trial laid in split plot design with three replications having three tillage systems as main plot and cropping systems as sub-plots. The soil samples were collected at 0, 10, 20, 30 and 40 days after fertilization of the crop. An incubation study was conducted simultaneously to study the effect of temperature and moisture on net N mineralization. The results revealed that potentially mineralizable N (No) was around 40 and 50 mg kg^{-1} of soil under maize and rice based cropping systems, respectively. The mineralized N (Nm) was found to be lowest at 0 days after fertilization and highest at 10 days after fertilization. In both the cropping systems, rate of N mineralization (k_N) was found to be minimum under zero tillage while maximum under conventional tillage system. With regards to cropping system, lowest rate of N mineralization was found under rice-lentil (5.32 mg N/kg/day) and maize-maize (5.51 mg N/kg/day). Lower rate of N mineralization depicts availability of mineral N for a longer period of time. Incubation study carried out at 25 and 35^0C and 20 and 40 per cent moisture (v/v) revealed that at constant temperature with increase in moisture there was decrease in rate of N mineralization.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Acidity Components under Organic and Conventional Tea Cultivation of Assam

S. Bhuyan*, G.G. Kandali, R.M. Karmakar, M.C. Talukdar, M. Choudhary, K. Borah and N. Borah
Department of Soil Science, Assam Agricultural University, Jorhat, 785013, Assam
**Email: Sami4bhuyan@gmail.com*

Attempts have been made in the present study to compare two management systems *viz.*, organic (Hatikhuli Tea Estate) and conventional (Difflo Tea Estate) to see the effect of management practices on soil acidity components and its variation with respect to depth and age of tea plantations. For this study four composite soil samples were collected from five age groups (<15 years, 15-30 years, 30-45 years, 45-60 years and >60 years) of plantations and three depths (0-20 cm), (20-40 cm) and (40-60) cm. Altogether 120 numbers of soil samples were collected sixty from two management systems. Samples were analyzed for important soil physico-chemical properties and different forms of acidity components using standard procedures. Conventional system was found to be more acidic than organic system although the pH was maintained at a favourable range for tea production. The Organic system was found to maintain higher levels of organic carbon than conventional system. The pH of the soil increased with depth and organic carbon decreased with depth in both the management systems. The value of total acidity was lower as compared to total potential acidity. Irrespective of depth all the acidity component were higher in conventional management system as compared to organic management, except pH dependent acidity which was higher in organic management. All the acidity components were found to decrease with depth and increase with age of plantations. pH was negatively correlated with exchange acidity (r=-0.502**) under organic system and (r=0.301**) under conventional system indicating that most of the exchange acidity is responsible for lowering the soil pH. Exchangeable Al was positively correlated with organic carbon (r=0.340**) under organic and (r=0.283*) under conventional. Exchangeable acidity showed highly significant positive correlation with exchangeable Al both in organic (r=0.983**) and conventional (r=0.990. Highly significant positive correlation was found in between total potential acidity and pH dependant acidity under organic (r= 0.856**) and conventional (r=0.730**) management. The study showed that variation of acidity components were higher under conventional management which may be due to the dominant role of Al in these soils. Total acidity was found to increase significantly with age of plantations under conventional system and highest was found in the age group 45-60 yrs. Thereafter, it declined in > 60 yrs. In case of organic management, total acidity increased with age of plantations till 45-60 years and thereafter declined in >60 years, although the decrease was non-significant. The study provided relative understanding of both the systems of cultivations to formulate or select beneficial tea cultivation practice to increase production, maintain productivity for long term sustainability without deteriorating soil health and soil fertility.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Role of Organic Matter on Charge Behaviour of Some Tropical Soils of India

Neepa Dey, Sourav Kumar Khan and Sanjib Kar
Department of Agricultural Chemistry and Soil Science, Institute of Agricultural Sciences, University of Calcutta,35, Ballygunge Circular Road, Kolkata, 700019, West Bengal
Email: souravkhan.90@gmail.com sanjib_cu@yahoo.co.in

Organic matter is known to play a role in maintaining soil fertility through its influence on surface charges. In this study, eight soil samples collected from Ap layer of highly weathered haplaquent and fluvaquent for the analysis of soil properties and surface charge characteristics. The pH of point zero charge is fundamentally important property used in modeling the interaction of solid surfaces with aqueous solutions and solute. The pHo' is measured by acid base titration of solid suspensions. Results of the study revealed that soil's charge behavior was dominated by variable charge for both haplaquept and fluvaquents, and that the negative surface charge increased with increasing pH. Both negative and positive surface charges were high in top soils of haplaquept. Negative surface charge increases with added organic manures on these surface sols. Among the added organic matter humic acid contribute highest surface charge on soil systems. Inorganic fertilizer play minor role on soil surface charge. Among the organic compost surface charge decreases in the following order: humic acid>fulvic acid> vermicompost> cow dung> oil cake> neem cake.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Study of Nutrient Release Pattern of Nutriseed Pack and Standardization for Tomato Crop

Surabhi Hota[1]* and K Arulmozhiselvan[2]

[1]*Department of Soil Science and Agricultural Chemistry, Indira Gandhi Agriculture University, Raipur, 492012, Chhatisgarh*

[2]*Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu*

**Email: surabhi.hota@gmail.com*

A method of crop production of tomato was attempted in field Nutriseed Packs. Nutriseed Pack is a tubular assembly composed of fertilizer pellet and manure pellet for placing in the root zone soil of seedling at the time of transplanting. Before applying it in the field, A Laboratory experiment was conducted to record the amount of nutrient released through polymer coated paper of fertilizer pellet pack with paper wrap and gel additives to standardize the most suitable pellet combination to be applied in field. During the period of 12 weeks, release of electrolytes in soil from fertilizer pellet pack containing single layer of polymer coated paper, was 502.1 mg and Double layer + Wrap + *Maida* gel was 94.0 mg. The highest release occurred in pack with no additive (306.1 mg) followed by *Maida* (254.3 mg), corn flour (217.6 mg) and sago granule (187.5 mg) indicating that hygroscopic gel additives reduced release of electrolytes substantially. High available N was estimated in soil, placed with fertilizer pellet pack having single layer (214.2 mg) and single layer+wrap+*Maida* (209.4 mg). Available N release was highest without additive (107.5 mg) followed by Maida (93.6 mg), Cornflour (84.1 mg) and sago (49.9 mg). High available P was found with Single Layer + No gel (7.28 mg) and low in Double Layer + Wrap (1.98 mg). High available K was observed in pack with Single Layer (239.7 mg) and low K with Double Layer + wrap+ Corn Flour (53.9 mg). Over all, pack with Single layer + Warp +Maida showed a steady release pattern for N, P and K. Hence this treatment was taken to field study.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Iron Slime on DTPA-extractable Cationic Micronutrients and Heavy Metals of Soils under Different Land Use Systems: An Incubation Study

Souvik Roy Chowdhury, Pravat Utpal Acharjee, Debashis Ghosh, Swarbinay Mahanta, Sajal Saha, Sandip Hembram and Prasanta Kumar Patra
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, P.O. Krishi viswavidyalaya, Mohanpur, 741252, Nadia, West Bengal

Disposal of by-products generated during steel making require substantial monetary involvement in one hand and loss of valuable resource on the other. Application of iron slime with soil has been found to increase the organic carbon, available and total nitrogen, available P and available potassium content of soil. To examine whether it has some detrimental effect, a laboratory based pot culture experiment was carried out for a period of 180 days on addition of graded dose of iron slime on the availability of some micronutrients and heavy-metals in soils collected from 14 agro ecosystem across different locations in West Bengal. Irrespective of ecosystem and level of iron slime application, while a progressive increase, with time of incubation, was observed in extractable Fe, Cu, Zn, Cd and Ni content, extractable Mn and Pb content recorded a decreasing trend. Higher levels of iron slime application resulted in higher levels of extractable Cu (2.04 mg kg^{-1}), Zn (2.37 mg kg^{-1}), Cd (0.11 mg kg^{-1}) but lower levels of extractable Mn, Ni and Cr. At the end of 180 days of incubation, irrespective of iron slime application, maximum change (%) with respect to their initial level was observed in Fe, Mn and Zn in eucalyptus plantation, that of Cu in rubber, of Pb in guava and of Cr in the fallow soil and that of Cd and Ni in rice ecosystem. Maximum % decrease in the available Cu, Mn, Zn and Cr were observed in soils collected from fallow, okra, and jute and litchi ecosystems, respectively. Little response with respect to available Fe, Cu, Mn, and Zn content was observed in soils collected from rice, eucalyptus, litchi and okra ecosystem, respectively, due to application of iron slime. Correlation study revealed strong negative correlation of Mn content with Fe (-0.615**) and positive correlation with Pb (0.654**). Extractable Cd and Ni were found to be in strong correlation with Cu. At the end of 180 days of incubation, Fe concentration of soils ranged from 15.67 mg kg^{-1} in brinjal to 65.82 mg kg^{-1} in eucalyptus with a mean of 41.5 mg kg^{-1}; that of Cu ranged from 0.86 mg kg^{-1} in tea soils of North Bengal to 5.10 $mgkg^{-1}$ in rice soils with a mean of 5.10 mg kg^{-1}; for Mn, these values ranged from 6.15 mg kg^{-1} in Sal to 26.31 mg kg^{-1} in eucalyptus with a mean of 11.67 $mgkg^{-1}$ and for Zn, it ranged from 1.28 mg kg^{-1} in Jute to 5.83 mg kg^{-1} in *sal* with a mean of 2.35 mg kg^{-1}.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Residence Time Effect on Arsenate Desorption Behaviour in Two in Two Soils of North India

Jyoti, Dhanwinder Singh* and R. Sikka
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab
**Email: dhanwinder@pau.edu*

The occurrence of arsenic in natural environments depends both on geogenic as well as on anthropogenic activities. The contamination of ground water by arsenic has become a critical water quality problem both for irrigation and drinking in many parts of world including India. In the arid south-western zone of Punjab comprising Sangrur, Mansa, Faridkot,Muktsar, Bathinda and Ferozpur districts arsenic has been found to be in the range of 4-688 µg L^{-1} (maximum WHO permissible limit 10 µg L^{-1}). The availability, mobility and toxicity of arsenate in soil is controlled by sorption-desorption process. A sandy loam (Typic Ustochrept) and a clayey (Typic Hapludalf) soil from two north Indian states, Punjab and Himachal Pradesh, respectively, were used to study sorption-desorption behavior of arsenate. Arsenate sorption by the soils was studied from a range of added conentrations (50 to 100) mg arsenate kg^{-1}) in the presence of background electrolyte, 0.01M KNO_3 for time period ranging from 2 to 512 hours. Desorption of arsenate was carried out by six successive washing with arsenate free 0.01 M KNO_3 solution. Results revealed that in both soils the cumulative desorption of sorbed arsenate over a period of six desorption increased with the increase in the number of successive desorptions irrespective of the initial concentration of arsenate added to the soil, but the amount of arsenate desorbed decreased in every successive desorption. The amount of arsenate desorbed was higher where higher levels of arsenate were added for lesser reaction period than where lower doses of arsenate were added for longer reaction period. However, percent desorption with respect to sorption was always relatively lower in Palampur soil as compared to Ludhiana soil at all the levels of added arsenate and at all sorption reaction period, which could be due to difference in their pH, AEC, organic matter, Fe and Mn oxide content.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Conservation Technologies on Soil Aggregation and Aggregate-associated Carbon Pools in Rice-Mustard Cropping System of Western Indo-Gangetic Plains

Shrila Das[1]*, R. Bhattacharyya[2], M.C. Meena[1], B.S. Dwivedi[1] and T.K. Das[3]
[1]Division of Soil Science and Agricultural Chemistry, [2]Centre for Environment Science and Climate Resilient Agriculture, [3]Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi, 110012
**Email: shrila34040@gmail.com*

Soil degradation is now a burning issue as Indian agriculture is fully dependent on soil to meet the challenge of food security of the over growing population. Inappropriate agricultural practices have a direct and adverse impact on widespread land degradation inrecent years which reflects on increased soil erosion, soil quality deterioration due to decline in the groundwater table, increased sub-soil compaction, atmospheric pollution, multi-nutrient deficiencies and decline in quantity and quality of soil organic matter (SOM).Therefore there is a need of such a management system, which aims at higher productivity and profitability through rational and sustainable use of available resources on a long-term basis. Here comes the importance of conservation agriculture (CA)-based technologies which increase the SOC content, improve nutrient cycling and soil aggregation and nutrient storage through zero tillage practices along with retention of crop residues. But the information on impact of CA on soil aggregation and distribution of C pools within aggregates the north-western Indo- Gangetic Plains (IGP) is meagre. Therefore, the present study was undertaken with different combination of conservation technologies with double and triple zero tillage and conventional technologies with or without residue in an on-going 6-year old experiment with the objectives of understanding the effect of CA practices on (i) soil aggregation, and (ii) distribution of aggregate associated SOC into different pools of varying lability in rice-mustard cropping system of the western IGP. Result showed that conservation agriculture (CA) plots have significant impact on soil aggregation as well as on aggregate associated SOC accumulation under rice-mustard system after 6 years. Total SOC nonsignificantly varies from 0.75% to 0.87% in top soil, but in lower depth, it significantly varies from 0.74 to 0.84%. There was also significant effect of CA treatments on macro aggregate associated very labile and labile pools of C but non significant with recalcitrant pools. But interestingly, microaggregate associated C pools showed significant effect on both labile and recalcitrant C pools. Residue amended plots have significantly higher microaggregate associated labile C pools than non residue plots. The effect of CA on total SOC stock were more pronounced in macro aggregates , than micro aggregate, indicating a greater sensitivity of macro aggregates to these management practices and finally treatment with Moong Bean Residue (MBR) + Zero- Till Direct Seeded Rice (ZTDSR)-Rice Residue (RR)+ Zero-Till Mustard (ZTM)+ Zero-Till Moong Bean (ZTMB) is so far the most effective treatment from carbon sequestration point of view.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Long-term Zero Tillage in Wheat on C and N Fractions of Different Textured Soils under Rice-Wheat Cropping System

Meenakshi, V.K. Phogat, Kiran Khokhar and Rita Dahiya
CCS Haryana Agricultural University, Hisar, 125004, Haryana

Information about soil organic carbon and nitrogen fractions under different tillage system is essential for sustainability of agricultural systems. The long-term impact of zero tillage in wheat under rice-wheat cropping system at farmers' fields was evaluated during 2015-2016 for monitoring changes in different fractions of soil organic carbon and nitrogen, and wheat productivity parameters in three texturally different soils. The zero tillage practice in wheat increased the organic carbon content and carbon stock as compared to conventional tillage in soils. Reduction in the intensity of tillage from conventional to zero resulted in decrease in bulk density of sub-surface soil. The zero tillage increased dissolved organic carbon, microbial biomass carbon light and heavy fractions of carbon in soils at both the depths. The light and heavy fraction carbon values were observed to be lower in lighter textured soil which increased with increase in fineness of the texture. The total nitrogen was highest in clay loam under zero tillage at 0-15 cm depth as compared to conventional tillage. Total hydrolysable nitrogen was found- highest in clay loam followed by loam and sandy loam soils. Highest value of non-hydrolysable nitrogen, amino acid nitrogen, hydrolysable ammonium nitrogen were observed in zero tillage practice as compared to conventional practice. The practice of zero tillage found to be more effective in increasing yield of wheat in fine as compared to coarse textured soils. The results of the study indicated that the practice of zero tillage in wheat under rice-wheat cropping system may be adopted for sustaining the productivity of the cropping system.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Phosphate Sparing Effect of Previous Phosphate Applications

Prashanta Barman and Abhijit Debnath
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalya Mohanpur, 741252, Nadia, West Bengal

Enormous phosphate has been applied in world's soils with the perception that soluble ferilizers are inefficient. The aim of this work was to show that prior application of phosphate increases the effectiveness of subsequent application so that the levels of application decreased. Phosphate sorption-desorption study was conducted in one acid soil (alfisol) of West Bengal, having low inherent phosphorus (P), Sorption-desorption studies were also conducted in the soil after incubation with various levels of P at 60^{o}C for 35 days. To describe sorption, data were fitted to Freundlich equation, S- ac^b– q, where, S indicates sorption of phosphate P (mg kg^{-1}), C, the observed solution concentration (mg P L^{-1}), and a, b, q $_,$ are parameters. The Frendlich equation has been modified by adding on intercept term (q). For the desorption step, sorption was calculated from: S_d -S-c S_r, where S_d, is the amount of phosphate retained by soil and S_r is the solution soil ratio. The simultaneous solution of equations was done following the method of Barrow (2008). The amount of phosphate sorbed at a given phosphate concentration was always higher than that during desorption run, showing low desorptivity of sorbed phosphate indicating high hysteresis and buffering capacity. Sorption of P in soil decreased gradually with increasing levels of phosphate added to soil for incubation. Incubation with gradual higher levels of added Phosphorus reduced the hysteresis ratio. This occurred because high phosphate status made the surface charge on the reacting surfaces more negative and caused eventual cessation of the diffusive movement of phosphate into the adsorbingparticle. The effectiveness of incubated P as well as freshly applied P in soil was measured in terms of yields of Mustard (Brassica juncea-var. Benoy) grown in pots. One set of pots contained graded levels of P incubated for the time period and temperature indicated above and the other set received fresh P. Both these sets of pots were then subjected to crop growing for 30 days with mustard. The (dry-matter) yield response curves were generated using the Mitscherlich equation of the form, Y=a(1-q*exp(-dx)), where Y is yield corresponding to the value of 'x', a is the maximum yield and q, d are parameters. The value of 'd' is a measure of the effectiveness of fresh and incubated P. In order to obtain two values of d we used same values of a and q for both the cases. The results revealed that there was a general decrease in the effectiveness of the applied P to the tune of 0.58 times due to incubation. This was due to continuing reaction of phosphate that leads to its penetration into the adsorbing particle following sorption. However, this penetrated phosphate blocks subsequent penetration thus leading to low phosphate requirement thereafter. This has become evident from the findings of sorption study. Thus when low-phosphate soils are fertilized, it is necessary to supply more phosphate than is removed in produce, however, after long term phosphate fertilization, it is sufficient to only replace phosphate lost in produce.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Long-term Nutrient Management Practices on Clay-Humus Stability in Different Soil Orders

Ruma Das*, Nayan Ahmed, T.J. Purakayastha, Debarup Das, Sunanda Biswas and S.C. Datta
ICAR-Indian Agricultural Research Institute, New Delhi, 110012
**Email: rumadas13@gmail.com*

Organic matter plays a very important role in maintaining soil health and sequestering carbon (C) in soil. The humus part of soil organic matter is mainly present in association with clay minerals as clay-humus complexes. Such association largely protects the humus from microbial attack and thus plays a pivotal role in stabilizing the soil organic C. the type and amount of clay minerals present in a soil and the nature of organics added to it can be considered as the most important factors affecting the stability of clay-humus complexes. Hence, long-term application of inorganic fertilizers in combination with different organic sources are likely to have different impacts on clay humus stability in soils of different orders. The present investigation was conducted to study the long-term effect of fertilization and manuring with different organic sources on clay-humus stability in four different soil orders of India. Surface soil (0-15cm) samples were collected from four long-term experiments located in Pantnagar (Mollisols), Ludhiana (Inceptisols) and Jabalpur (Vertisols) with rice-wheat system, and Ranchi (Alfisols) with maize wheat system. The treatment chosen for the study were control (no fertilization), 100% NPK (100% of recommended dose), 50% NPK + farmyard manure (FYM), 50% NPK + wheat straw (WS) and 50% NPK + green manure (GM). Irrespective of soil orders, clay-humus stability was significantly higher in each of the treatments having an organic source in combination with (50% NPK+FYM, 50% NPK+WS and 50% NPK+GM) than the sole fertilization treatment (100% NPK) and control. In the rice wheat cropping system, FYM and GM application showed higher stability than straw. Whereas in maize wheat system of Ranchi, application of GM and straw showed higher stability than FYM. The soils of Jabalpur showed the highest clay-humus stability followed by Pantnagar, Ranchi and Ludhiana.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Different Biofertilizers on Pulses and Oilseeds Frontline Demonstration in Eastern Region of India

Bani Ghosh, Jhumur Basak, F.H. Rahman, P.P. Pal, S.K. Roy and S.S. Singh
ICAR-Agricultural Technology Application Research Institute Kolkata, Bhumi Vihar Complex, Sector III, Salt Lake, Kolkata, 700097, West Bengal
**Email: fhrahmancal@gmail.com*

A field experiment was conducted on Pulses and Oilseeds during *rabi* 2015-16 and *kharif* 2016 in eastern region of India (Bihar, Jharkhand and West Bengal) to study the effect of different biofertilizers application on yield and economics of pulses and oilseeds crops. It is observed that the application of biofertilizers *viz*. PSB, PMB, *Rhizobium sp*, *Pseudomonas sp* responded better in yield than the other conventional practices. In *rabi* 2015-16, total 351 ha area covered in oilseeds and 422 ha in pulses were demonstrated whereas in *kharif* and *rabi* seasons of 2016-17, a total of 475 ha in oilseeds and 389 ha in pulses were demonstrated under bio fertilizer application. Due to biofertilizer applications, yield gap was minimized 23-25% in oilseeds and 22-27% in pulses in compare to district average yield. For sesame, *Pseudomonas fluorescence* @ 1.2 kg ha^{-1}, PSB and PMB @ 2.0 kg ha^{-1} each gives higher yield average by 17-22%. In Groundnut, inoculation of the kernels with *Rhizobium* culture @ 200 g kg^{-1}, showed significant increase in yield. For rapeseed and mustard, PSB @ 2 kg ha^{-1} and PMB @ 4 kg ha^{-1} augment the yield by 20-23%. The BC ratio of demonstrations was found 2.5 against BC ratio of farmers' plot 1.8. In chick pea, with application of PSB @ 2 kg ha^{-1} gave a substantial increase in yield (20-25%). Lentil yield was higher (10-15%) with the application of *Rhizobium* @ 4 kg ha^{-1}, PSB and PMB @ 2 kg ha^{-1} each as soil application when compared with farmers practice. In green gram, seed treatment with *Rhizobium* and PSB @ 2 kg ha^{-1} gave more yield (22-27%). The economic return of the demonstrations was significantly higher (B:C::2.90) than the farmers' practice (B:C::2.10).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Sulphur and Biofertilizers on Growth, Yield and Oil Content of Sesame (*Sesamum indicum* L.) in Lateritic Soil of West Bengal

Anamika Das, Soumi Mukhopadhay, P.K. Biswas*, M.C. Kundu, Suchhanada Mondal and G.K. Ghosh
Department of Soil Science and Agricultural Chemistry, Institute of Agriculture, Visva-Bharati, Sriniketan, 731236, West Bengal
**Email: ppabitra07@rediffmail.com*

A field experiment was conducted during *kharif* season of 2016 at Agricultural Research Farm, Institute of Agriculture, Visva-Bharati, West Bengal to study the effect of sulphur and biofertilizer on growth, yield and oil content of sesame (variety Tilottoma) in lateritic soil of West Bengal. The experiment was laid out in RBD with twelve treatments (sulphur @ 0 kg ha^{-1} + PSB, sulphur @ 0 kg ha^{-1} + *Azotobacter*, sulphur @ 0 kg ha^{-1} + PSB + *Azotobacte*r, sulphur @ 15 kg ha^{-1} + PSB, sulphur @ 15 kg ha^{-1} + *Azotobacter*, sulphur @ 15 kg ha^{-1} + PSB + *Azotobacte*r, sulphur @ 30 kg ha^{-1} + PSB, sulphur @ 30 kg ha^{-1}+ *Azotobacter*, sulphur @ 30 kg ha^{-1} + PSB+ *Azotobacte*r, sulphur @ 45 kg ha^{-1}+ PSB, sulphur @ 45 kg ha^{-1} + *Azotobacter* and sulphur @ 45 kg ha^{-1} + PSB+ *Azotobacte*r) with an untreated control. The crop was fertilized with a uniform basal dose of N, P_2O_5 and K_2O at 60:40:40 kg ha^{-1} applied through urea, diammonium phosphate and muriate of potash, respectively in all the plots except control. The crop was also fertilized with sulphur as per treatments through zinc sulphate monohydrate. Seed were inoculated with *Azotobacter* and PSB prior to sowing as per treatments using 60 g culture kg^{-1} seed. The results showed that the highest plant height (77.7 cm) was observed in treatments of application of 45 kg sulphur along with dual inoculation of *Azotobacter* and PSB as compared to untreated control (47.7 cm) at harvest of the crop. The results also showed that the application of 45 kg sulphur along with dual seed inoculation of *Azotobacter* and PSB being at par with 45 kg sulphur + single inoculation of *Azotobacter* ha^{-1} recorded the maximum dry matter accumulation (346 g m^{-3}) and highest seed yield (813 kg ha^{-1}). Yield advantages were obtained due to 45 kg sulphur along with duel seed inoculation with *Azotobacter* and PSB ha^{-1} (300, 34.5, 37.7 and 28.3%), 30 kg sulphur along with dual seed inoculation with *Azotobacter* and PSB (295, 55.7, 59.4 and 48.5%), 30 kg sulphur along with *Azotobacter* only (268, 45.2, 48.7 and 38.5%), 45 kg sulphur along with single seed inoculation of *Azotobacter* (251.2, 38.4, 41.7 and 32.0%) and 15 kg sulphur along with PSB only (244.8, 35.9, 39.1 and 29.6%) against untreated control (203 kg ha^{-1}) , seed inoculation with PSB only (515 kg ha^{-1}), seed inoculation with *Azotobacter* only (503 kg ha^{-1}) and dual seed inoculation with PSB+ *Azotobacter* (540 kg ha^{-1}), respectively. Similarly, oil content were increased due to 45 kg sulphur along with duel seed inoculation with *Azotobacter* and PSB ha^{-1} (25, 23, 23 and 23%) and 45 kg sulphur along with single seed inoculation of *Azotobacter* (23.85, 22.47, 21.81 and 22.10%) as against untreated control (41.8%), seed inoculation with PSB only (42.2%), seed inoculation with *Azotobacte*r only (42.5%) and dual seed inoculation with PSB+ *Azotobacter* (42.4%), respectively.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Dynamic of Soil Bio-chemical Properties during Decomposition of Various Organic Manures in a Sandy Loam Soil: A Laboratory Study

Sandeep Sharma*, Monika and Neemisha
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141 004, Punjab
**Email: sandyagro@rediffmail.com*

Addition of organic manures to soil is an important management strategy to improve organic matter status and to provide better soil conditions for soil microbial compositions. Monitoring soil biochemical changes with organic amendments may prove useful for sustainable management of soils. Laboratory incubation study was undertaken to examine the influence of organic manures widely varying in chemical composition on the periodic changes in soil biochemical properties over a 28 day period in a sandy loam soil. Significant changes in soil biochemical properties (pH, EC, available-P, available K, N- mineralization, dehydrogenase and alkaline phosphatase activities) due to incorporation of different organic manures were observed and compared to control. The soil biochemical properties substantially enhanced after the addition of different organic manures during first few days of incubation. The release of NH_4-N was highest at day 7 with goat manure amended soils (37.42 mg NH_4-N kg^{-1} soil) and lowest with pig manure (8.25 mg NH_4-N kg^{-1} soil). With the passage of time the NO_{3-} N mineralization increased progressively and reached its peak within 2 weeks and thereafter it showed decreasing trend. Among various biochemical properties, highest dehydrogenase and alkaline phosphates activities were shown by non-broiler manure followed by pig manure. The decline in NH_4-N and increase in NO_3-N was observed with the application of goat manure than other treatments indicating more nitrification in soil. The present study concluded that organic manures varying in different nutrients content may be useful for quantifying the return of organic matter and nutrients in soil. However, these needs to be tested under field conditions with different soil types and climatic conditions.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Potassium Solubilizing Bacteria and Waste Mica on Potassium Uptake and Dynamics in Maize Rhizosphere

Afzal Ahmed, Nilanjan Chattopadhyaya, Jajati Mandal* and Nintu Mandal
Department of Soil and Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, 813210, Bihar
**Email: jajati.bckv@gmail.com*

Indian soil has not been deficient in Potassium since long. Non judicious application of inorganic nitrogenous fertilizer and omission of providing phosphatic and potassic fertilizers by peasant community due to inordinate price hike as well as preference to high yielding cultivars put the soil health at stake. To combat with this warning situation, resident microflora, present in the plant rhizosphere should be brought in to use to provide the bio-available potassium from fixed and unavailable pool of potassium by various mechanisms in acidolysis, chelation, exchange reactions, complexolysis, and production of organic acids. Therefore, the objective of this research is to study the effect of potassium solubilizing bacteria and waste mica on potassium uptake and dynamics in maize rhizosphere. A pot experiment having 10 treatments {T1: Control, T2: Recommended dose of Fertilizer (RDF), T3: Full N and P+75% K and rest 25% by waste mica, T4: Full N and P+50% K and rest 50% by waste mica, T5:T3+KSB1*(Fraturia aurantia),* T6: T4+KSB1, T7: T3+KSB2 *(Bacillus edaphicus),*T8: T4+KSB2, T9: T3+KSB1+KSB2 and T10: T4+KSB1+KSB2 } was conducted using maize (Var: SHM 1) as the test crop during *kharif* season 2015-16. The K solubilising power of the microorganisms showed a promising result (co-inoculation of two bacteria) in laboratory incubation and that was also observed in the results obtained from pot experiment. The observations were recorded at three different stages *viz*, knee high stage, silking stage and harvesting stage. The results revealed that the water soluble, exchangeable and non-exchangeable pools of K over different stages ranged from 3-5%, 9-10% and 85-88% respectively. Correlation studies among biomass yield, K uptake and different pools of K showed a significant relationship. T10 (T4+ KSB1+KSB2) has been found to be the best. It is observed that application of waste mica co-inoculated with potassium solubilizing microorganisms *(Fraturia aurantia & Bacillus edaphicus)* have a significant effect on biomass yield. Similarly, bacterial intervention of mica improves the water-soluble, exchangeable and nonexchangeable K pools in soils, thereby influences the K dynamics in a positive manner upon those pools and thus increased the bioavailability. Thus, bio-intervention of waste mica could be an alternative and viable technology to solubilize insoluble K into bio available form and could be used efficiently as a source of potassium bio-fertilizer for sustaining crop production.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Faster Retting of Jute by using Bacterial Endospores for Quality Fibre Production

B. Majumdar*, **Lipi Chattopadhyay, Sonali P. Mazumdar, A.R. Saha and R. Saha**
Division of Crop Production, ICAR-Central Research Institute for Jute and Allied Fibres, Barrackpore, Kolkata, 700 120, West Bengal
**Email: bijju5@rediffmail.com*

A talc-based microbial formulation developed by ICAR-CRIJAF consisting of three strains of *Bacillus pumilus* (MTCC5573, MTCC5574 and MTCC5575) in a consortium mode were found very efficient in retting of Jute (*Corchorus olitorius* L. and *C. capsularis* L.). But, it has been found that like many other carrier-based formulations, the shelf-life of microorganisms is low and cannot tolerate environmental stresses during storage and transportation. Hence, retting of jute by using endospores of these bacteria with extended shelf-life was attempted for quality fibre production. Endospores of these strains of *Bacillus Pumilus* were prepared by using sporulation broth media and preserved for six months. The viability of endospore was tested by introducing into different temperature, pH, UV treatment and antibiotic sensitivity test. Then spores were used for retting of raw jute in laboratory scale study. Polygalacturonase and xylanase activities were measured along with CFU count throughout the process. After six months of preparation, endospore count was maintained the initial status (10^9 ml^{-1}) whereas cfu count of talc-based microbial formulation decreased from 10^{10} to 10^6 ml^{-1}. Endospores showed higher resistance to temperature, pH, UV irradiation and antibiotic sensitivity than their vegetative forms. The six months old spores when used for jute retting were found to release pectinolytic and xylanolytic enzymes which in turn helped in the completion of retting of jute within very short period (10 days) and yielded good quality jute fibre (fibre strength 27.8 g tex^{-1}) compared to talc based formulation, where retting was completed in 15 days and the resultant fibre had strength of 25.11 g tex^{-1}. It can be concluded from the study that endospores of *Bacillus pumilus* can be used in place of talc based microbial formulation for higher shelf life of the product, faster retting and better fibre quality of jute in future.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Waste Mica as Potassium Source: Evaluation of Chemical and Biological Interventions

B.B. Basak*
ICAR-Directorate of Medicinal and Aromatic Plants Research, Boriavi, 387310, Anand, Gujarat
**Email: biraj.ssac@gmail.com*

A study was conducted to evaluate waste mica powder collected from surroundings of mica mines located at Koderma district of Jharkhand and Nellore district of Andhra Pradesh, as a source of potassium (K) in soil. The total potassium content in ground waste mica sample (2 mm size) varies 8-10% as K_2O. K supplying capacity of different size fractions of the mineral powder was evaluated through different chemical extractants namely water, 0.01 *M* calcium chloride ($CaCl_2$), 0.01 *M* citric acid, neutral 1*N* ammonium acetate (NH_4OAc) and boiling 1*N* nitric acid (HNO_3) as per the standard procedure. To study the K uptake from different size fractions of mica powder, a pot culture experiment was conducted with K deficient soil (Alfisols from Bhubaneswar) by growing aromatic grass (Palmarosa, *Cymbopogon martini* var. *motia*). The K released by chemical extractants from the mineral powder followed an increasing trend with an increase in the fineness of particles. The amount of K released by different extractants followed the order: water < 0.01 *M* calcium chloride < 0.01 *M* citric acid < 1 *N* ammonium acetate < 1 *N* boiling nitric acid. The lowest K release (30 to 110 mg kg^{-1}) recorded by distilled water while highest K released (1820 to 1975 mg kg^{-1}) was recorded by boiling 1 N HNO_3 solution irrespective of the various size fractions. The cumulative K release from the mica powder in successive extraction procedure was recorded higher with organic and mineral acid, which suggested that the material was a slow release K source. A significant positive correlation was observed between K release by different chemical extractants and the biomass yield as well as K uptake by plants. Among the different chemical extractants, 1 *N* NH_4OAc and 1 *N* boiling HNO_3 showed higher correlations with plant K uptake. The study also revealed that both the chemical and biological methods were able to extract only a portion of total K present in the waste mica powder. The results indicated that the waste mica could be used as a slow release K fertilizer in K deficient soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Potassium Solubilizing Microorganism with Waste Mica and Rice Husk on Release of Potassium in an Inceptisol

N.P.S. Yaduvanshi and D.R. Biswas
Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, New Delhi, 110012

Potassium (K) is the third major essential nutrient for plant growth. There are many reports in recent past that Indian soils do show K deficiency as available soil K levels have dropped due to rapid development of agriculture. Some microorganisms in the soil are able to solubilize unavailable form of K-bearing minerals, such as micas, illite and orthoclase. The rice husk is high content of K. In India, rice production was 103 million tonnes during 2015-16 and each kg of white rice produce 0.28 kg of rice husk. The objective of this study was to evaluate the dynamics of K released from rice husk and waste mica as influenced by K solubilizing bacteria (KSB) in an Inceptisol. A laboratory incubation study was carried out at Division of Soil Science and Agricultural Chemistry, IARI, New Delhi during 2016-17 to see the release pattern of K from waste mica and rice husk under ambient condition. The treatments consisted of T_1 : Control; T_2 : 0.223 g K kg^{-1} soil through 7.43 g rice husk (RH); T_3: 0.446 g K kg^{-1} soil through 14.86 g RH; T_4 : 0.892 g K kg^{-1} soil through 29.72 g RH; T_5: T2 + 8 g waste mica (WM) kg^{-1} soil + KSB-1; T_6: T3 + 8 g WM kg^{-1} soil + KSB-1; T_7 : T4 + 8 g WM kg^{-1} soil +KSB-1; T_8: T2 + 8 g WM kg^{-1} soil + KSB-2; T_9: T3 + 8 g WM kg^{-1} soil 8 g WM kg^{-1} soil + KSB-2 and T_{10} : T4 + 8 g WM kg^{-1} soil + KSB-2. Soil samples were collected at 0, 15, 30, 45 and 60 days after incubation and available K was determined by extracting soil with ammonium acetate. The results showed that addition of RH combined with WM and microorganism decreased soil pH and increased EC during the incubation period in comparison to RH alone. Soil pH decreased with increasing incubation period. Addition of RH combined with WM and both KSB increased significantly over control and RH alone treatment. Available K content increased with increasing level of rice husk combined with WM and both KSB during incubation period. The maximum ammonium acetate extractable K was obtained with the addition of RH with WM and KSB-1 which was at par with KSB-2. Maximum release of ammonium acetate soluble K was obtained in rice husk combined with WM and both KSB up to 45 days of incubation period. Both the potassium solubilizing microorganisms were equally affected in solubilizing the K in treatments.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Nanoparticles-induced Resilience and Resistance of Microbial Systems towards Heat Stress

Abhishek Kumar, Rajiv Rakshit, Nintu Mandal and Anupam Das*
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, 813210, Bihar
**Email: anusoil22@gmail.com*

In the present climatic scenario, the mean annual temperature is increasing gradually at a rate of 0.69-1.08 ºC $year^{-1}$ ands oil functions are increasingly under environmental pressure most often related to the intensification of anthropogenic activities. Applications of nanoparticles are getting popularized now a day owing to their crucial use in the field of agriculture and they are known to modulate the crucial soil functions. Thus, it seems essential to know how nano particles influence the response of soil microorganisms to disturbances or environmental changes. Keeping this hypothesis in view, an incubation experiment was conducted with two objectives: (i) to assess the impact of fertilization and nanomaterials on changes in enzyme activities in relation to heat stress (48ºC for 24 hours) and(ii) to estimate the resistance and resilience indices of soils with added nanomaterials. To test the effect of nanomaterials on the resistance and resilience of the microbial parameters, five treatments were taken: T_1-control; T_2-Zn nanomaterials @10 ppm; T_3- Zn nanomaterials @40 ppm; T_4- Fe nanomaterials @10 ppm; T_5- Fe nanomaterials @40 ppm. Results from this experiment showed the declining trends in soil enzyme activities (27-75% decrease in FDA, 11-63% decrease in acid phosphatase activity, 12-105% decrease in alkaline phosphatase activity, 20-38% decrease in dehydrogenase activity) at zero days i.e. immediately after heat stress. For FDA, it was observed that the T_2 (nano Zn @ 10 ppm) and T_4 (nano Fe @ 10 ppm) treatment had the greatest stress resistance, with an index rating of 0.48 and 0.43 respectively and resilience indices of all the treatments varies from -0.01 to 0.16 after 90 days of incubation. Resistance indices for acid phosphatase activity varied from as low as 0.25 in control treatment to as much as 0.73 in nano Zn @ 40 ppm treatment (T_3). Recovery of alkaline phosphatase was clearly observed after 90 days, the higher resilience index being observed in T_2 (nano Zn@ 10 ppm) and lower being in T_1 (control). With respect to resistance indices of dehydrogenase activity against heat stress, it was observed that the T_3 (nano Zn @ 40 ppm) treatment had the greatest resistance with an index rating of 0.70. The control system showed an index rating of 0.56 which was statistically comparable to T_4 (resistance index rating of 0.58) and T_5 (resistance index rating of 0.55) at $P < 0.05$. The resilience index showed that the rate of recovery of the dehydrogenase activity was initially rapid (0.32 on 28 days) in control and then decreased at 70 days (-0.36) after incubation. Resistance and resilience pattern showed that the nanomaterial supplemented system had higher resistance than control; whereas the recovery of these systems are slow but improved as reflected after 90 days of incubation.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Biofertilizers on Productivity, Soil Properties and Phosphatases Activity under Groundnut Monocropping System in an Alfisols of Andhra Pradesh, India

M. Vijay Sankar Babu*, K.C. Nataraj and B. Ravindranatha Reddy
Department of Soil Science and Agricultural Chemistry, Agricultural Research Station,
Acharya N.G. Ranga Agricultural University, Anantapuramu, 515001, Andhra Pradesh
**Email: vijay7970@rediffmail.com*

In the past decade, there has been increased scientific interest not only in enhancement of applied nutrients but also to utilize the native soil nutrients by different ways and means. One among them is usage of bio fertilizer consortia. A field experiment was conducted during *kharif* 2012-13 to 2016-17 to study the native soil phosphorus solubilisation and enhancement of nutrient use efficiency using bio fertilizer consortia in rainfed groundnut at Agricultural Research Station, Anantapur with three replications and ten treatments *viz*., T_1: control, T_2: half of recommended fertilizer dose (10-20-20), T_3: T_2 with PSB + AM fungi, T_4 : T_2 with PSF + AM fungi, T_5 : T_2 with PSB + PSF + AM fungi, T_6 : soil test based fertilizer application, T_7 :$T_6$with PSB + AM fungi, T_8 : T_6 with PSF +AM fungi, T_9 : $T_6$with PSB + PSF + AM fungi, T_{10} : PSB + PSF + AM fungi alone. Significantly differed yields were observed in all the treatments. The highest mean (five years) pod yield was recorded (1013 kg ha^{-1}) in the treatment received fertilizer application based on soil test values along with consortia of PSB+PSF+AM fungi and was closely followed by half the recommended fertilizer (10:20:20 kg N,P_2O_5, K_2O ha^{-1}) along with consortia of PSB+PSF+AM fungi (1007 kg ha^{-1}). Control recorded the lowest mean pod yield (709 kg ha^{-1}). There were no significant differences observed in soil parameters across the treatments. Higher phosphatases enzyme activity observed in the treatment received fertilizer application based on soil test values along with consortia of PSB+PSF+AM fungi and treatment with half the recommended fertilizer along with consortia of PSB+PSF+AM fungi.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Integrated Use of Liquid Biofertilizers and Fertilizers on Seed Cotton Yield and Macronutrient Status in Soil

P. Madhu Vani, I. Usha Rani, G. Kishore Babu and A. Lalitha Kumari
Regional Agricultural Research Station, Lam, Guntur, ANGRAU, Andhra Pradesh

In view of the advantages of liquid biofertilizers over carrier based formulations, a study was conducted during *kharif*, 2016 in black cotton soils at Regional Agricultural Research Station, Lam, Andhra Pradesh to evaluate the liquid biofertilizers along with inorganic fertilizers on seed cotton yield and soil nutrient status. The experiment was laid out in a randomized block design with nine treatments consisting of 100% RDF, 100% RDF+LBF at sowing, 100% RDF+LBF at sowing and 45 DAS, 100% RDF+LBF at sowing +FYM @10 t ha^{-1}, 100% RDF+LBFs at sowing + FYM @ 10 t ha^{-1} and 45 DAS, 75% RDF+LBF at sowing, 75% RDF+LBF at sowing and 45 DAS, 75% RDF+LBF at sowing + FYM @ 10 t ha^{-1}, 75% RDF+LBF at sowing + FYM @ 10 t ha^{-1} and 45 DAS were replicated thrice. The experimental soil was non saline, clayey in texture with slightly alkaline in reaction. The soil was low in organic carbon and available nitrogen and high in phosphorus and potassium. Application of liquid N, P and K biofertilizers + FYM @ 10 t ha^{-1} either with 100% RDF or 75% RDF showed significant influence on seed cotton yield and macronutrient status in soil at harvest. Among the treatments highest seed cotton yield (4376 kg ha^{-1}) was recorded in the treatment which received 100% RDF + liquid N, P and K biofertilizers at sowing and 45 DAS+FYM @ 10 t ha^{-1} while the lowest was recorded in T_1 which received RDF only (3506 kg ha^{-1}). Further observed that the treatments which received either 75% RDF or 100% RDF along with liquid biofertilizers at sowing and at 45 DAS and FYM @ 10 t ha^{-1} recorded on par yields. The available N, P_2O_5 and K_2O contents were higher in treatments which received liquid N, P and K bio fertilizer sat sowing and 45 DAS and FYM @10 t ha^{-1} (271, 169, 1124 kg/ha). Except nitrogen, organic carbon, available phosphorus and potassium contents were increased in soils over the initial status at harvest. This indicated that the use of liquid biofertilizers along with FYM can substitute 25 per cent of recommended dose of chemical fertilizers and also offers economic and ecological benefits by way of soil health and fertility to farmers.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Four Types of Biochars on Microbial Activity, Nutrient Availability and Nature of Acidity in Soil

Awtar Singh[1]*, A.P. Singh and Arghya Chattopadhyay
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, 221005, Uttar Pradesh
[1]Present address; Division of Soil and Crop Management, ICAR-Central Soil Salinity Research Institute, Karnal, 132001, Haryana
**Email: awtar.singh@icar.gov.in*

Application of biochar to soil has increased considerably during recent years because of its effectiveness as a soil amendment causing favorable effect on soil health. However, the effects have been reported to vary and depend upon types of feedstocks and pyrolysis conditions used for biochar preparation. In the present study, biochar was prepared from rice husk, sugarcane bagasse, *Parthenium* and *Lantana* in a pyrolysis kiln at the temperature of around 400 °C for 2h. Soil for experimentation was collected from Naugarh, district Chaundali, India. The soil has sandy clay loam texture with pH (1:2.5) 5.5, electrical conductivity (1:2.5), 0.030 dS m^{-1}, cation exchange capacity 8.83 cmol (p^+) kg^{-1}, soil organic carbon 0.50%, mineralizable nitrogen 147 (kg ha^{-1}), available P 17.5 (kg ha^{-1}), available K 121 (kg ha^{-1}), exchangeable Ca 9.4 (meq 100 g^{-1}), exchangeable Mg 7.3 (meq 100 g^{-1}). To assess the impact of different types of biochar on microbial activity and nutrient availability, soil sample was treated with all the four types of biochar at different doses *viz.* 0, 225, 450 and 900 mg 100 g^{-1} of soil under controlled conditions. All the biochar treated soils showed significantly higher microbial activity with variability occurring among all the biochars. The increasing trend was first recorded after 15 days of incubation and it continued up to 120 days. Among the biochars, *Lantana* biochar treated soils showed significantly higher microbial biomass carbon, dehydrogenase activity and acid phosphatase activity over other types of biochar at similar application rates. In case of cellulase activity, *Lantana* and *Parthenium* biochar treated soil showed significantly higher value compared with sugarcane bagasse biochar and rice husk biochar at similar dose of biochar application after 15, 30 and 60 days of incubation, but at later stage (after 90 and 120 days of incubation) all the biochars, produced similar activity. In case of nutrient availability, biochar amended soil did not show significant effect. However, higher K availability was recorded due to application of higher dose of *Lantana* and *Parthenium* biochar. Exchangeable acidity, total acidity and total potential acidity were not affected significantly by any biochar application.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Microbial Biomass and Enzyme Activities in Semi Arid Agroforestry System

Garima Gupta[1]*, R.S. Yadav[2], Deeapk Maurya[3] and Ram Newaj[4]
[1]Maya College of Agriculture and Technology, Selaqui, 248011, Dehradun, Uttarakhand
[2]ICAR- Indian Institute of Soil and Water Conservation, Regional Centre, Datia, 475 661 Madhya Pradesh
[3]ICAR-NBSSLUP, Regional Centre, Kolkata, 700091, West Bengal
[4]ICAR- Central Agroforestry Research Institute, Jhansi, 284003, Uttar Pradesh
**Email: garima811@gmail.com*

Research over the past 25 years has confirmed that agroforestry can be more biologically productive, profitable, and sustainable than forestry or agricultural monocultures. Microbial biomass plays a key role in the processes of soil organic matter dynamics and soil nutrient availability in the agricultural ecosystems. Present investigation was carried out for evaluate the impact of *Albizia procera* based different land uses on soil microbial activities. The study was carried out on six year old *Albizia procera* based land uses at research farm of Central Agroforestry Research Institute, Jhansi. We investigated the soil microbial biomass C (MBC), soil microbial biomass N (MBN), dehydrogenase activity and alkaline phosphatase activity. Soil samples were taken at 0-5 and 5-15 cm soil depth and 1m, 2m, 4m distance from tree trunk. Study revealed that land use system with unpruned *A. procera* was found to have significantly higher soil enzyme activity, microbial biomass C and N. These variations among *A. procera* based different systems and pruning regimes therein could be attributed to differential addition of these nutrients by *A. procera* litter. Lower soil enzyme activity, microbial biomass C and N below the crown of *A. procera* pruned is attributable to low input of carbonaceous material and nutrients retrieved through its litter. The results indicate that adoption of the agroforestry practices led to an improved organic matter status of the soil, which is also reflected in the increased nutrient pool and microbial activities necessary for long-term productivity of the soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Development of Multifaceted Plant Growth Promoting Microbial Consortium for Acid Soils

Anandkumar Naorem[1], Dwipendra Thakuria[2], Shiva Kumar Udayana[1], Sidhu Murmu[1] and Biswapati Mandal[1]

[1]Department of Agricultural Chemistry and Soil Science, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal

[2]College of Post Graduate Studies, Central Agricultural University Umroi Road, Umiam, 793103, Meghalaya

Soil acidity related constraints are major problems in crop production systems world-wide. In an effort to develop a microbial consortium (MC), which can exhibit multifaceted plant growth promoting (PGP) traits relevant to acid soils, this study was formulated with 3 aims: (i) screening of bacteria for PGP traits, (ii) assessment of compatibility among PGPB isolates for formulation of MC and (iii) to test the suitable carrier materials. From a repository of 300 pure culture bacteria (inhabitants of root and rhizosphere soils of wild and cultivated rice species) maintained in the Microbial Ecology Laboratory, CPGS, (CAU-Imphal), five PGPB isolates were picked-up from each of the four functional groups *viz.* cellulose decomposing bacteria (C-group), nitrogen fixing bacteria (N-group), IAA producing bacteria (I-group), and phosphorus solubilising bacteria (P-group). Further, one bio-control agent (B-group) was chosen from Plant Pathology Laboratory, CPGS (CAU-Imphal).Five isolates from each of 4 groups including isolate B1 were screened for quantitative determination of IAA-like substances, dissolution of insoluble inorganic ($AlPO_4$ and $FePO_4$) and organic (Na-phytate) phosphates, phosphatase activity, exopolysaccharides secretion and ACC-deaminase activity. The highest scorer PGPB isolates based on multifaceted PGP traits were C4 (25), I3 (24), N3 (22) and P5 (24) for C-, I-, N- and P-groups, respectively and B1 isolate from B-group scored 24. Dual cross streaking and mixed culture broth assays indicated that above 5 consortium isolates were compatible to each other. The taxonomic identities of 21 PGPB isolates were belong to genera *Pseudomonas, Klebsiella, Pantoea, Serratia, Lysinibacillus,* Uncultured *Rhizobium*, *Bacillus* and *Enterobacter*. Values of PGP traits in consortium mode were significantly higher than that in individual PGPB broth. The test for shelf-life of 5 consortium isolates in compost or biochar solid carriers indicated that population of each of consortium isolates kept on increasing during storage till 60 days. MC-compost supported higher viable counts of each of five consortium isolates during storage compared to MC-biochar. In micro-plot field experiment, rice (var. CAUR3) was used as test crop. Results indicated that MC-compost produced significantly higher root volume compared to that in MC-biochar and 100% RDF at 30, 60 and 90 DAT (P<0.05). The harvest index of rice was found to be 12.8% higher in MC-compost over 100% RDF and 7.6% over MC-biochar. The grain yield of rice was found to be higher in MC-compost (4.5 t ha^{-1}) than RDF (3.6 t ha^{-1}) and MC-biochar (3.5 t ha^{-1}) i.e. MC-compost enhanced grain yield of rice by 25% and 28.6% over 100% RDF and MC-biochar, respectively. The grain nutrient (N and P) uptake in MC-compost was significantly higher than that in 100%RDF and MC-Biochar. In conclusion, this study has generated a compost based MC having multifaceted PGP traits. The performance of MC-compost needs to be validated through multi-locational trials in farmers' fields.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Seed Inoculation of Zinc and Iron Solubilizing Microorganisms on Yield and Nutrient Uptake of Maize in Inceptisol

P.P. Kadu, S.S. Chavan and S.R. Shelke
Department of Soil Science and Agricultural Chemistry, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra

A field experiment was conducted during the year 2015-16 at research farm of MPKV, Rahuri, to study the effect of seed inoculation of zinc and iron solubilizing microorganisms on yield and nutrient uptake by maize in Inceptisol. The results of the experiment revealed that application of GRDF + 20 kg $ZnSO_4$ + 25 kg $FeSO_4$ + seed inoculation of Zn and Fe solubilizers (T_7) at maize significantly increased the soil available N, P and K content at tasseling stage. Same trend was observed with slight decrease of available N, P and K content at harvest stage of maize. The highest maize grain yield (59.7 q ha^{-1}) was observed in treatment T_7 i.e. GRDF + 20 kg $ZnSO_4$ + 25 kg $FeSO_4$ + seed inoculation of Fe and Zn solubilizers which was superior over all other treatments. The highest microbial population was also observed in treatment T_7, followed by treatment T_6. Same trend was observed in both the crop stages with a slight decline at the harvest stage of maize. It can be concluded from the present investigation that, seed inoculation of Fe and Zn solubilizers to maize and application of recommended dose of nutrient (120:60:40 kg ha^{-1} N: P_2O_5: K_2O +10 t FYM ha^{-1}) with zinc sulphate @ 20 kg + ferrous sulphate @ 25 kg ha^{-1} to maize crop was found beneficial for obtaining higher grain and stover yield of hybrid maize, total uptake of macro and micronutrients besides maintaining fertility of soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Phosphorus Availability as Influenced by Soil Inoculation of Phosphorus Solubilizing Microorganisms in Calcareous and Non Calcareous Soils

P.P. Kadu, A.D. Deshmukh and S.R. Shelke
Department of Soil Science and Agricultural Chemistry,
Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra

A pot culture experiment entitled, "phosphorus availability as influenced by soil inoculation of phosphorus solubilizing microorganisms in calcareous and non calcareous soils" was conducted at the Department of Soil Science and Agricultural Chemistry, MPKV, Rahuri. The results of investigation revealed that the highest soil available phosphorus was observed in moderate calcareous soil in treatment of *Aspergillus awamori* soil inoculation. The efficacy of phosphate solubilizing microorganisms for solubilizing the inorganic soil phosphate was observed to be in the order of *Aspergillus awamori*>*Bacillus megatarium*>*All PSM* >*Pseudomonas striata*>*Penicillium digitatum*. *Aspergillus awamori*, the fungal strain was the most efficient phosphate solubilizing microbial strain among all the strains, in all the soils with varying levels of $CaCO_3$. *Bacillus megatarium* was observed to be the most efficient phosphate solubilizing bacterial strain. The fungal and bacterial population was also increased with soil inoculation of phosphate solubilizing microorganism in all the soils with varying levels of $CaCO_3$. The bacterial population was almost 2 folds higher than the fungal population. The soil pH and $CaCO_3$ content decreased in all the treatments of soil inoculation with phosphate solubilizing microorganisms. It is therefore concluded that the soil inoculation by phosphate solubilizing microorganisms was observed to be very beneficial for solubilizing the soil native fixed phosphates in moderate and highly calcareous soils. The phosphorus solubilization in all the three soils by the various PSM strains was in the order of *Aspergillus awamori*>*Bacillus megatarium*>*All PSM* >*Pseudomonas striata*>*Penicillium digitatum*.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Long-term Effect of Crop Residue Incorporation *in situ* on Yield and Bio-chemical Activities of Groundnut in an Acid Soil

N.C. Gupta and Nirmala Kumari
Department of Soil Science and Agricultural Chemistry, Birsa Agriucltural Uiverity, Ranchi, Jharkhand

The present investigation entitled long-term effect of crop residue incorporation *in-situ* was conducted during 2014-15. The objective was to study the enzymatic activity and grain yield on the long term experiment in situ crop residue incorporation. Soil of the experimental field was loam in texture, acidic in reaction (pH-5.4), low in organic carbon (0.41%) with medium in fertility status of available N, P and K. The crop residue incorporated @ 5.0 t ha^{-1} in *Rabi* and *Kharif* crops. The experimentation after 24 years results indicate that grain yield of groundnut and wheat was increased from 9.67 (T1) to 20.3 q ha^{-1} (T5) in Groundnut and 10.4 (T1) to 42.3 q ha^{-1} (T5), respectively, to application of chemical fertilizers along with crop residue incorporation in soil. The beneficial effect of crop residue was noticed with RDF on grain yield and rhizospheric microbial population. Total nutrient uptake of N,P and K was recorded 51.4 to 102 kg ha^{-1}, 12.9 to 22.2 kg ha^{-1}, 47.5 to 94.1 kg ha^{-1}, respectively, for groundnut while for wheat uptake of N,P and K was 25.54 to 78.29 kg ha^{-1}, 4.20 to 14.63 kg ha^{-1}, 23.59 to 66.9 kg ha^{-1}, respectively.

Analysis of post-harvest soil samples revealed that integrated use of crop residue along with chemical fertilizers recorded not only better physico-chemical properties of soil but also, improved the microbial population as well as enzymetic activity in soil. The highest microbial count of bacteria (21.2 × 10^6 CFU g^{-1} soil), fungi (47 × 10^4 propagules g^{-1} soil) and Actinomycetes (10.9 × 10^6 CFU g^{-1} soil), soil respiration (6.2 mg CO_2/100g soil after 3 day), SMBC (14.1 mg kg^{-1} soil), phosphatase activity (193.9 µ p-nitrophenol released g^{-1} soil hr^{-1}), dehydrogenase activity (5.9 µg TPF g hr^{-1}) and cellulose activity (1.04 mg glucose g^{-1} soil 24^{-1} hrs) were recorded with treatments where crop residue incorporated along with recommended dose of fertilizers were in practiced.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Phosphorus Solublizing Bacteria on Yield Components and Productivity of in Rice-Wheat System

Sukhwinder Singh* and Jagdish Grover
Krishi Vigyan Kendra (Punjab Agricultural University, Ludhiana), Faridkot, Punjab
**Email: sjeeda420@pau.edu*

Farmers' field experiments were conducted at three different locations during *rabi* 2015-16 to assess the effect of phosphorus solublizing bacteria (PSB) on yield components viz. plant height, effective no. of tillers m^{-1}, ear length, 1000-grain weight and grain yield of wheat sown in rotation with rice. Soils at three experimental locations were loam to sandy loam in texture, slightly alkaline, non-saline (E.C.<0.23 d S m^{-1}), medium in organic C (0.48-0.58%) and available-P (5.4-6.8 mg kg^{-1}), and high in available-K (95 mg kg^{-1}). Three treatments viz. recommended fertilizer-P as DAP @ 137 kg ha^{-1} (T_1), 75% recommended P+PSB @ 2.5 kg ha^{-1} (T_2), and a farmers practice (~25% higher P than recommended rate) were compared to assess their effect on wheat productivity. At all study sites, effective no. of tillers m^{-1}, ear length, and 1000-grain weight was considerably higher with phosphorus solublizing bacteria application, compared with other two treatments. Wheat grain yield varied between 43.5 and 47.3 q ha^{-1}, and increased by 3.8 to 5.2% with PSB inoculation, compared with farmer's practice of P application. Thus, it could be concluded that PSB inoculation could lead to substantial saving of fertilizer-P in wheat.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Phosphorus and Bioinoculants on Soil Fertility and Yield of Summer Mungbean (*Vigna radiata* L.)

D.P. Singh, Vinod Yadav and S.C. Meena
Department of Agricultural Chemistry and Soil Science,
Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan

A field experiment entitled "Effect of phosphorus and bioinoculants on soil fertility and tield of *summer* mungbean [*Vigna radiata* (L.) Wilczek]" was conducted during *Summer* season 2016 at Agronomy farm, Rajasthan College of Agriculture, Udaipur. The experiment consisted 16 treatments combination of four levels of phosphorus *viz.,* control, 20, 40 and 60 kg P_2O_5 ha^{-1} and four treatments of bio-inoculants *viz.,* control, PSB*, Aspergillus awamori* and PSB + *Aspergillus awamori,* replicated thrice. Mungbean var. SML-668 was taken as test crop. Results indicated that the total and effective number of nodules per plant, leaf area index, total chlorophyll content, number of pods per plant, number of seeds per pod, test weight, seed and straw yield, nitrogen, phosphorus and potassium content in seed and straw and their uptake, protein content in seed, organic carbon, available nitrogen, available potassium, dehydrogenase enzyme activity and alkaline phosphatase activity in soil after harvest, net return and B : C ratio were significantly maximum in 40 kg P_2O_5 ha^{-1} level of phosphate application over control, whereas, available phosphorus status of soil was recorded significantly maximum with the application of 60 kg P_2O_5 ha^{-1}. Among the treatments of different bio-inoculants, PSB + *Aspergillus awamori* resulted in significantly maximum increase in total and effective nodules per plant, leaf area index, total chlorophyll content, number of pods per plant, number of seeds per pod, test weight, seed and straw yield, nitrogen, phosphorus and potassium content in seed and straw and their uptake, protein content in seed, organic carbon, available nitrogen, available phosphorus, available potassium, dehydrogenase enzyme activity and alkaline phosphatase activity in soil at harvest, net return and B:C ratio as compared to control, individual inoculation of PSB and *Aspergillus awamori* treatments.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Integration of Different Sources of Plant Nutrients on Yield of Transplanted Rice in Sahibganj, Jharkhand

Amrit Kumar Jha, Birendra Kumar Mehta and Kaushik Chatterjee
Krishi Vigyan Kendra (Birsa Agricultural Unuversity), Sahibganj, 816 109, Jharkhand

Rice is the main crop of Sahibganj district cultivated during *kharif* season and occupies nearly 49% of the net sown area. The average production of rice in the district is below the state and national average. This might be due to unscientific and imbalanced use of plant nutrients in rice cultivation. Hence, an on farm trial (OFT) was conducted during 2015-17 to evaluate the effect of integration of different sources of plant nutrients on yield of rice as well as soil nutrient status. The trial was conducted at ten locations with three treatments namely (i) Farmer's Practice: Application of 60-25 kg NP ha^{-1}, (ii) Technology Option 1: Application of 100% recommended dose of fertilizers (RDF) i.e. 80-60-40 kg NPK ha^{-1} and (iii) Technology Option 2: Application of 75% + vermicompost @ 20 q ha^{-1} + blue green algae @ 10 kg ha^{-1} + *Azospirillum* @ 2 kg ha^{-1}. The trial was conducted in randomized block design (RBD) considering each location (farmer) as one block (replication). Results of the trial indicated that application of 100% RDF and integration of 75% RDF with vermicompost, blue green algae and *Azospirillum* significantly increased the number of effective tillers per hill, number of spikelet per panicle, test weight of grains and grain yield as compared to farmer's Practice. However, significantly highest yield of rice grain (41.2 q ha^{-1}) was recorded with technology option 2. The data on available N, P and K status of soil after harvest of rice crop was significantly higher under technology option 2 as compared to farmer's practice.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Response of Biofertilizer on Chickpea, Wheat and Lintil in Tribal Area of Dindori, Madhya Pradesh

S.S. Baghel*, A.K. Upadhyay, B. Sachidanand, Pradip Dey and P.L. Ambulkar
Department of Soil Science and Agricultural Chemistry, J.N. Krishi Vishwa Vidyalaya, Jabalpur, 482004, Madhya Pradesh
**Email: ssbatic@rediffmail.com*

Organic farming system receive considerable attention these days concern much about pollution free environment. Tribal farming of the district Dindori are practicing default organic farming. The major cropping system of the tribes are kodo↔fallow, pegion pea↔fallow, fallow↔niger, kutki↔fallow, maize↔toria, paddy↔wheat, paddy↔gram, paddy↔lentil, paddy↔linseed. The productivity of this area is very low, however the district Dindori was selected to carry experiment on farmers field. Ten farmers of different villages were selected to test the incorporation of biofertilizer in different crops. The soil was normal in pH, EC with low available N (150-180 kg ha^{-1}), phosphorus from (7-9 kg ha^{-1}) and medium in potassium (335 kg ha^{-1}). For legumes crops seed were treated with *Rhizobium* and for non-legume crops seed were treated with *Azotobacter* and PSB. Study revealed that incorporation of biofertilizer enhanced the yield of chickpea and wheat. The average yield of lintil was 3.93 q ha^{-1} and 6.82 q ha^{-1} under FP and RP respectively.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of Soil Microbiological Properties in Relation to Tree-based Cropping Systems in Typic Ustochrepts

Jeevanjot Dhaliwal*, S.S. Kukal and Sandeep Sharma
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab
**Email: jdhaliwal-coasoil@pau.edu*

The purpose of this study was to investigate the impact of tree based cropping systems on soil microbiological properties in Shiwalik region of lower Himalayas. A study was conducted in a mixed watershed comprising of agroforestry, agrohorticulture (tree-based) and maize-wheat (sole agriculture) cropping systems. The soil samples were collected from three cropping systems and were analyzed for soil microbiological properties. The soil microbiological properties were significantly higher in agroforestry systems followed by agrohorticulture and lowest in maize-wheat cropping system. The dehydrogenase activity (DHA) was significantly higher in soils under agroforestry (49.9 μg TPF g^{-1} h^{-1}) followed by soils under agrohorticulture (27.8 μg TPF g^{-1} h^{-1}) and maize-wheat (21.5 μg TPF g^{-1} h^{-1}) in surface (0-15 cm) soil layer. The DHA decreases with the depth; the decrease was more in maize-wheat (49.3%) than in agrohorticulture (41.7%) and was lowest in agroforestry system (15.0%) in the sub-surface (15-30 cm) soil layer. The alkaline phosphatase activity in the surface soil layer was significantly higher in soils under agroforestry (42.2 μg PNP g^{-1} soil h^{-1}) and decreased by 37.2 and 71.8% in soils under agrohorticulture and maize-wheat, respectively. The acid phosphatase activity in surface soil layer was statistically non-significant. The urease activity was significantly higher in agroforestry (5.16 ppm of urea-N hydrolysed g^{-1} h^{-1}) than in agrohorticulture (3.47 ppm of urea-N hydrolysed g^{-1} h^{-1}) and maize-wheat (2.7 ppm of urea-N hydrolysed g^{-1} h^{-1}) cropping system in surface soil layer. In surface soil layer, the soil respiration rate was 86.8 and 34.3 percent higher under agroforestry and agrohorticulture as compared to maize-wheat system. There was a significant difference in the polysaccharide carbon in surface soil layer under different cropping systems, and it was higher in tree based cropping system. Soil respiration and polysaccharide carbon was also higher in soils under tree based cropping system than the sole agriculture. The higher soil enzyme activity under tree-based cropping system as compared with maize-wheat cropping systems shows the effect of land use management, soil sustainability and consequently ecosystem functioning in northwest region of India.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Long-term Fertilization and Manuring on Activity and Diversity of Bacteria in a New Gangetic Alluvial Soil under Jute-Rice-Wheat Cropping System

Sunanda Biswas[1,2*], D.K. Kundu [2], S.P. Mazumdar[2], A.R. Saha[2], B. Majumdar[2], A.K. Ghorai[2] and A.K. Saxena[3]

[1]*Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi, 110012*

[2]*Crop Production Division, ICAR-Central Research Institute for Jute and Allied Fibres, Barrackpore, Kolkata, 700 120, West Bengal*

[3]*Division of Microbiology, ICAR-Indian Agricultural Research Institute, New Delhi, 110012*

Soil microorganisms play an important role in sustaining the soil health and long term productivity. The main objective of the present investigation was to study the long term effect of different management practices on the activity and diversity of bacteria isolated from a New Gangetic alluvial soil with jute-rice-wheat cropping system. Soil samples were collected from the five different management practices viz. fallow, control, 100% recommended dose of NPK, 150% of recommended dose of NPK and 100 % recommended dose of NPK plus farmyard manure under long term fertilizer experiment with jute-rice-wheat cropping system at Central Research Institute for Jute and Allied Fibres, Barrackpore, West Bengal. Soil samples were analysed for microbial populations, microbial biomass carbon, dehydrogenase, FDA hydrolase, acid and alkaline phosphatase activity of soil. Bacterial diversity was analysed by PCR-RFLP of genomic DNA of isolates using Hae III restriction enzyme. Highest bacterial population was found with 100% NPK+FYM treatment. Microbial biomass carbon content under different management practices varied from 221 to 447 mg kg^{-1} soil and highest was found with 100% NPK+FYM treatment. For all the four enzyme activities, highest value was found with integrated treatment and lowest was with control treatment. Dendrogram derived from the distance matrix by UPGMA, a total of 35 clusters were recorded for 59 bacterial isolates. Integrated management practices with balanced use of mineral fertilizers and organic manures sustain the microbial activity and diversity and maintain soil health.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Exploitation of Zinc Solubilizing Bacteria for Zn Nutrition in Rice

**Smrita Buragohain*, Dhruba Jyoti Nath, Anjuma Gayan,
Yumnam Bijilaxmi Devi and Ipsita Ojah**
Department of Soil Science, Assam Agricultural University, Jorhat, 785013, Assam
**Email: smrita40@gmail.com*

Based on the formation of clearing zone on media containing insoluble Zinc (ZnO), fourteen bacteria of zinc solubilizing abilities have been isolated from paddy rhizosphere. Subsequently, secondary screening was carried out for the isolates for assessing their solubilisation capacity using Khandeparkar's ratio (solubilization index, >1.0). The potentiality of solubilization of insoluble Zn were tested using five best screened isolates (*viz.* ZSBK1, ZSBN2, ZSBT2, ZSBM1 and ZSBS1) in broth containing 0.12g ZnO/100mL (1% as Zn). It was observed that the isolated bacteria could solubilize the insoluble Zn over 70% in 30 days. Similarly, the solubilization abilities of the isolates were also assessed in soil for DTPA extractable native Zn. The results ascertained that the DTPA-Zn were at about 10-30 mg/kg in between 20 to 30 days of time. The potentiality of above tested isolates were also assessed in the field experiment of rice (having the soil Zn status less than 0.6ppm) in comparison with application of recommended doses(RD) of $ZnSO_4$ (25 kg ha^{-1}).The treatments selected for this experiments were : (RD) of NPK(40:20:20 kg ha^{-1}) (T_1), RD of NPK+ $ZSBN_2$ (T_2), RD of NPK+ $ZSBK_1$ (T_3), RD of NPK+ $ZSBT_1$ (T_4), RD of NPK+ $ZSBS_1$ (T_5), RD of NPK+ $ZSBM_1$ (T_6) and RD of NPK+ZnSO4 @ 25Kg/ha (T_7) . The isolate ZSBS1 from rice rhizosphere increased significantly higher concentration of Zn (43.14 mg kg^{-1}) in rice grain compared to application of $ZnSO_4$ (39.18 mg kg^{-1}). Subsequently, compared to the sole recommended application doses of N P K, significantly higher concentration of DTPA-Zn was observed in other treatments contained the ZSB. Further two isolates ZSBS1 and ZSBT1 were tested for Zn nutrition in three widely grown varieties of rice (*viz. Bahadur*, *Ranjit* and aromatic *Joha*) in Assam (2015-16). Results showed that the isolates ZSBS1 and ZSBT1 could increase the Zn concentration (39.19 and 38.38 mg kg^{-1} respectively) in rice grain which was comparable with the application of $ZnSO_4$ (41.71 mg kg^{-1}). Among the varieties, significantly highest Zn concentration (36.88 mg kg^{-1}) was recorded in rice variety *Ranjit*. Finally, the on farm trial was conducted at nine different sites under the KVK Golaghat, Nalbari and Sonitpur in Zn deficient soils (<0.6 ppm). The results exhibited the comparable performances of ZSB with that of inorganic Zn sources ($ZnSO_4$ @ 25kg/ha). The average rice yield, Zn concentration in grain and the Zn status in the rhizosphere after harvest of rice illustrated the importance of ZSB instead of sole ZnSO4 application in Zn deficient soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Elevated Atmospheric CO_2 Concentration on Water Productivity, Plant Water Status and Antioxidant Enzyme Activities of Rice Plant

Anjani Kumar[1,2*], A.K. Nayak[2] and B.S. Das[1]
[1]Agricultural and Food Engineering Department, Indian Institute of Technology, Kharagpur, 721302, West Bengal
[2]Crop Production Division, Central Rice Research Institute, Cuttack, 753 006, Odisha
**Email: anjaniias@gmail.com*

The present experiment was conducted for two years under open top chambers (OTCs) to elucidate the effects of ambient CO_2 (390 ± 10 μmol mol^{-1}) and two levels of elevated CO_2 (ECO_2;550 ± 20 μmol mol^{-1} and 700 ± 20 μmol mol^{-1}) under two soil water levels (well watered and water stressed to -60 kPa) on water productivity (WP) and physiological changes in rice. In water deficit treatments, measured amount of water was applied as surface irrigation, each time the soil water potential measured by tensiometers (-60 kPa). Under well watered (WW) condition, we observed a significant increase in plant height, ear bearing tillers, grain and straw yield over ambient CO_2 by 15, 37, 18 and 14% respectively under ECO_2 (550 ± 20 μmol mol^{-1}) condition. However, the increase over ambient CO_2 was 17, 21, 43 and 6% respectively under water deficit stress (WDS) and ECO_2(550 ± 20 μmol mol$^{"1}$) condition. Both levels of ECO_2 decreased the irrigation water input by 11-14% under well watered condition, whereas the decrease under WDS was approximately 5% over ambient CO_2.Our results suggested that irrigation water requirement for rice will decrease under future ECO_2 environment. WP increased with WDS, particularly at ECO_2 (550 ± 20 μmol mol$^{"1}$; 35 and 49% under well watered and WDS respectively). WDS coupled with ECO_2induced changes in the response of antioxidant metabolites (proline, catalase and peroxidase) and plant water status at the leaf level like relative water content, electrolyte leakage and leaf water potential. This study suggests that physiological changes occurring under ECO_2 helped the rice plant in partially mitigating the negative effects of WDS.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Physico-chemical Properties on Alkaline Phosphatase Activity in Soils of Ranga Reddy District of Telangana

J. Aruna Kumari[1], P.C. Rao[2], G. Padmaja[3] and M. Madhavi[4]
[1]Department of Biochemistry, College of Agriculture, PJTSAU, Rajendranagar
[2]Dean of Agriculture (Retd), PJTSAU
[3]Agricultural College, Jagital
[4]ACRPP, Weed control, Rajendranagar

Physico- chemical properties of soil have profound influence on soil enzyme alkaline phosphatases activity. To study the distribution of influence of physico- chemical properties on alkaline phosphatases activity forty soil samples were collected from different villages of Ranga Reddy district of Telangana. These samples were analysed for the soil properties like pH, EC, available nutrients, texture, organic carbon and soil enzyme activity. Alkaline phosphatase activities of the soil ranged from 37.0 to 75.2 with an average of 50.52 µg PNP g^{-1} soil hr^{-1}. The pH ranged from 5.7 to 8.9, electrical conductivity from 0.1 to 1.23 dSm^{-1} and organic carbon from 0.13 to 1.48 %. The available Nitrogen varied from 201 to 472 kg ha^{-1}. The available P_2O_5 status in the soils varied from 11.6 to 79.1 kg ha^{-1}. The available K_2O ranged from 118 to 411 kg ha^{-1}. Alkaline phosphatase was positively correlated with organic carbon (r = 0.726) and available P (r = 0.720) but did not show any significant correlation either with silt, clay and pH. The higher correlation of phosphatase activity with organic carbon content could be due to the fact that the organic matter is the seat of microbial population and activity.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Nodulation, Nutrient Uptake and Yield of Summer Green Gram [*Vigna radiata* L.] as Influenced by Seed Treatment with Molybdenum, Cobalt and *Rhizobium*

V.J. Zinzala* and S.R. Chaudhari
Department of Soil Science and Agricultural Chemistry, N.M. College of Agriculture, Navsari Agricultural University, Navsari, 396 450, Gujarat
**Email: kvzinzala@gmail.com*

A field experiment was undertaken in Inceptisols during summer 2015 at the KVK farm, Navsari Agricultural University, Waghai (Dangs) to evaluate the nodulation, nutrient uptake and yield of summer green gram [*Vigna radiata* L.] as influenced by seed treatments with molybdenum and cobalt, subsequently with *rhizobium.* Experiment comprised 8 treatments *viz.,* control (T_1), 10 ml *rhizobium* kg^{-1} seed (T_2), 8.0 mg Co kg^{-1} seed (T_2), 16.0 mg Mo kg^{-1} seed (T_4), 8.0 mg Co kg^{-1} seed + 16.0 mg Mo kg^{-1} seed (T_5), 10 ml *rhizobium* kg^{-1}seed + 8.0 mg Co kg^{-1} seed (T_6), 10 ml *rhizobium* kg^{-1} seed + 16.0 mg Mo kg^{-1} seed (T_7) and 10 ml *rhizobium* kg^{-1}seed + 8.0 mg Co kg^{-1} seed +16.0 mg + Mo kg^{-1} seed (T_8) with three replications. The experimental soil was clay loam in texture, $pH_{1:2.5}$ (6.4), $EC_{1:2.5}$ (0.21 dS m^{-1}), high in organic carbon (0.95%) and available K (312 kg ha^{-1}), Low in available N (233 kg ha^{-1}), P_2O_5 (24 kg ha^{-1}) and Mo (0.011 mg kg^{-1}) and medium in Co (0.243 mg kg^{-1}). The results revealed that seed treatment with Mo and Co, subsequently with *rhizobium*, significantly recorded higher nodulation, nutrient uptake and yield of summer green gram. The treatment T_8 recorded significantly the higher number of nodules plant^{-1} (21.2), seed yield (762 kg ha^{-1}), stover yield (1366 kg ha^{-1}), nutrients uptake by seed (27.1 N kg ha^{-1}, 2.81 Mo g ha^{-1} and 2.69 Co g ha^{-1}), and nutrients uptake by stover (32.4 N kg ha^{-1}, 5.04 Mo g ha^{-1} and 4.35 Co g ha^{-1}) of summer green gram over control, but it remained at par with T_6 and T_7. The enhancement in these parameters could be ascribed to better activity of nitrogenase enzyme which might have arisen by the combined effect of molybdenum and cobalt and thus increased nodulation and nitrogen fixation in green gram and as a result improved available soil nitrogen which might have boosted crop growth and yield.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Different Rice Establishment Methods on Soil Enzyme Activity, Nutrient Status and Grain Yield of Rice in North Coastal Zone of Andhra Pradesh

Ch. S. Rama Lakshmi, T. Sreelatha, D.V. Ramana Reddy, M.B.G.S. Kumari and N. Venugopala Rao
Regional Agricultural Research Station, Anakapalle, Andhra Pradesh

Present study has been taken up to evaluate the effect of different rice establishment systems and nutrient management practices on soil and crop productivity of rice under clay loam soils of North Coastal Zone of Andhra Pradesh. Field experiment was conducted at Regional Agricultural Research Station, Anakapalle during *kharif*, 2012 to 2014 in split plot design with seven planting methods as main plots and 4 nutrient management practices as sub plots. Seven planting methods viz., transplanted rice, sprouted seed broad costing under puddled condition, drum seeding, dry seeding by broad casting, dry seeding in lines, mechanical planting and SRI method of planting. Sub plots includes 100 % recommended dose of fertilizers (RD), 100% RD+foliar spray of potassium nitrate at 10 days after panicle initiation and panicle emergence, 150% RD, 150% RD+foliar spray of potassium nitrate at 10 days after panicle initiation and panicle emergence. All the treatments received 10 t farm yard manure per ha. Results revealed that among different rice planting methods, highest dehydrogenase activity of 4.9 mg TPF g^{-1} d^{-1} was recorded in SRI method of cultivation with 100% RD+foliar spray of potassium nitrate at 10 days after panicle initiation and panicle emergence followed by normal transplanting with 150% RD+foliar spray of potassium nitrate at 10 days after panicle initiation and panicle emergence. Highest available nitrogen was observed in normal transplanting method with 150% RD whereas lowest status was observed in dry seed in lines with 100 % chemical fertilizers. Highest available phosphorus and potassium status was observed in SRI method of planting with 150% RD+foliar spray of potassium nitrate at 10 days after panicle initiation and panicle emergence. Highest grain yield of 5.75 t ha^{-1} was observed in SRI method of planting. It was closely followed by drum seeding (5.30 t ha^{-1}) and normal method of transplanting (5.23 t ha^{-1}) with 150% RD+foliar spray of potassium nitrate at 10 days after panicle initiation and panicle emergence. It can concluded that the soil and crop productivity was more under SRI method of cultivation which was closely followed the normal transplanting and drum seeding methods.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Isolation and Characterization of Arbuscular Mycorrhizae from Rice Rhizosphere in Acid Soils

Ipsita Ojah*, Dhruba Jyoti Nath, Anjuma Gayan, Smrita Buragohain
Department of Soil Science, Assam Agricultural University, Jorhat, 785013, Assam
**Email: ipsita20ojah@gmail.com*

In the present study, attempts have been made to isolate and characterize AMF in the rhizosphere of seven rice varieties widely grown in Assam. The results exhibited the occurrence of AMF spores in the rhizosphere of wet land rice varieties in between 209 to 397 100^{-1} g soil of which highest value was observed in Joha rhizosphere (397 100^{-1} g). Root samples of the seven rice varieties examined, four varieties (Bora, Joha, Bahadur and Badsahbhog) depicted more than 40% of root colonization with the highest value in Bora (48.8%). The AMF spores occurred in the rhizosphere were negatively influenced by available P_2O_5 (r = -0.43**). However the available P_2O_5 in the rhizosphere clearly correlated with phosphomonoesterase enzyme (0.64**) which in turn showed correlation with bacteria (r=0.30*) and fungi (r=0.37**). The AMF spores also showed significant correlations with easily extractable glomalin (EEG) (r=0.48**) and total glomalin (TG) (r=0.63**) respectively, determined in the rice rhizosphere. Morphological characterization of the isolated AMF spores, revealed the prevalence of two genera *Glomus* and *Gigaspora* which were successfully mass multiplied in maize root as host crop. The effectiveness of mass-multiplied spores were tested in a pot experiment in rice with three levels of P_2O_5 (0, 20 and 40 kg ha^{-1}) under submerged condition. With reduced levels of P_2O_5 (20 kg ha^{-1}) comparable plant biomasses were recorded ($P<0.05$) under AMF inoculation with that of highest level of P_2O_5 (40 kg ha^{-1}) with or without AMF inoculation. By reducing the P supply (20 kg ha^{-1}), the measurable effect of AMF ($P<0.05$) was obtained for P and N concentration (1.27 and 7.88 mg g^{-1} respectively) and their uptake (20.63 and 127.50 mg $plant^{-1}$, respectively) in rice plants which were comparable with un-inoculated plants at 40 kg P_2O_5 ha^{-1}. AMF spores and root colonization were found at all levels of P supply, although decreased with increasing P under AMF inoculation which implies that saturation or inundation does not necessarily prevent the development of AMF association.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Microbial Biomass Carbon and NH_4-N Content as affected by Application of Pyrazosulfuron-Ethyl in a Lateritic Soil of West Bengal

Suchhanda Mondal, P.K. Biswas, M.C. Kundu and G.K. Ghosh
Department of Soil Science and Agricultural Chemistry, Institute of Agriculture, Visva-Bharati, Sriniketan, 731236, West Bangal

A laboratory experiment was conducted in the Department of ASEPAN, Palli Siksha Bhavana, Siriniketan (West Bengal) to study the effect of pyrazosulfuron-ethyl on microbial biomass carbon (MBC) and ammonification. The treatments comprised of two levels of pyrazosulfuron-ethyl (0 and 20 g a.i. ha^{-1}), two nitrogen sources (urea and vermicompost). A control was also there for both the levels of pyrazosulfuron-ethyl. The soil was incubated for 50 days in test tubes maintaining the soil moisture level at saturation. The soil was taken out and was analyzed for microbial biomass carbon and NH_4-N, contents on 0, 5, 10, 15, 20, 30, 40 and 50 days of incubation. Soil MBC contents were increased with time. Vermicompost treated soils maintained much higher values of MBC than urea and control. Pyrazosulfuron-ethyl caused reduction in MBC. The contents of NH_4-N were initially increased, reached maximum values at 30 days and decreased afterwards. Urea treatments contained higher amounts of NH_4-N compared to others. Application of pyrazosulfuron-ethyl caused reduction in NH_4-N contents. There was a net mineralization of nitrogen in soil received urea. In soils receiving vermicompost as nitrogen source, there was a net immobilization of nitrogen.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Organophosphate Insecticides on the Dynamics of Microorganisms in Soil

Jayanta Sarma, Partha Sarathi Mahato and Amal Chandra Das*
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, 741252, West Bengal
**Email: acdas2@rediffmail.com*

An experiment was conducted under laboratory conditions to investigate the effect of two organophosphate insecticides, viz. monocrotophos and profenofos, at their recommended field applications rates (750 g and 1.0 kg a.i. ha^{-1}, respectively) on the growth and multiplication of total bacteria, actinomycetes and fungi including their effects on the activities of some soil enzymes in an alluvial soil collected from the university farm of Bidhan Chandra Krishi Viswavidyalaya, West Bengal. Application of organophosphate insecticides, in general augmented the microbial proliferation as well as the enzymatic activities of soil leading to greater mineralization and availability of carbon, nitrogen and phosphorus in soil. Among the treatments, it was revealed that the stimulation was more conspicuous when both the insecticides were applied in combination followed by monocrotophos and profenofos, respectively. Comparing the single incorporation of the cited insecticides, it was also investigated that monocrotophos was more stimulative than profenofos in harbouring the microbial population, while the later insecticide was more effective in inducing the enzymatic activities of soil. The greater retention and availability of the plant nutrients was highly induced when both the insecticides were incorporated into the soil separately rather than their combined application.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Different Forms of Potassium and Enzyme Activities in Mica-enriched Soils of Giridih District, Jharkhand

Saibal Ghosh, Abhishek Mukherjee* and Pradip Bhattacharyya
Agricultural and Ecological Research Unit, Indian Statistical Institute, Giridih, Jharkhand
**Email: abhi.mukh@yahoo.com*

A study was conducted to examine the different forms of potassium (K) and soil enzyme activities in mica enriched soils of Giridih district, Jharkhand. In total, 76 soil samples were collected from the Tisri and Gawan blocks of Giridih district. Most of the studied soils were found to be acidic in nature. The average pH (water), pH (KCl) and total organic C were 5.98, 4.56 and 6.2 g kg^{-1}, respectively. Different enzyme activities like urease (UA), acid phosphatase (PA), dehydrogenase and fluorescein di acetate hydrolyzing activity were studies. The studies enzyme activities (mg kg^{-1}) were varied from 13.5-84.4, 104-752, 17.5-57.2 and 8.5-45.9 respectively. All the parameters were negatively correlated with both the pH. The average water soluble, exchangeable, non-exchangeable, lattice and total K varied from 4-53 mg kg^{-1}, 18-195 mg kg^{-1}, 422-2825 mg kg^{-1}, 471-2207 mg kg^{-1}, 734-4161 mg kg^{-1}, respectively. The average percentage contribution of water soluble, exchangeable, non-exchangeable, lattice K towards total K constitute 0.8%, 68.2%, 28.2% respectively. Most of the K in these soils was in non-exchangeable form. The reserves of step-K and constant rate k (CR-K) were evaluated by repeated extraction of soils with boiling molar nitric acid. The reserves of step-K content were, in general, related to the content of the clay fraction of the soils. The cumulative release of no-exchangeable K by repeated extraction with boiling 1(M) HNO_3, suggesting that the release of non- exchangeable K decreased with successive number of extractions. Constant rate K and step K varied from 0.24-0.83 cmol(p^+)kg^{-1} and 4.63-59.0 cmol(p^+)kg^{-1}. The ratio of step-K to non exchangeable K (NEK) may reflect the mobilizable NEK reserves in soil. The ratio of step-K to NEK in the studied soils was 0.004 to 0.039, which indicates the low mobilizable NEK reserves in soil. Both water soluble and exchangeable K were low with respect total K. Different forms of potassium were significantly and positively correlated with each other indicated existence of equilibrium between different forms of K in these soils. The degrees of correlation between water soluble K and exchangeable K was generally of the higher order. There soils showed a wider ratio of non-exchangeable to exchangeable K, indicating the dominance of illite in clay fraction. Low available K emphasizes the need for future research to optimize K fertility management to increase productivity of intensive rice based copping systems in these soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Tannery Waste Sludge on Microbiological and Biochemical Soil Quality Indicators

Priyanka Chakraborty, Sampad Sarkar and Pradip Bhattacharyya
Agricultural and Ecological Research Unit, Indian Statistical Institute, Giridih, Jharkhand
**Email: pradip.bhattacharyya@gmail.com*

An incubation study was conducted to evaluate the effect tannery waste sludge (TWS) as a soil amendment on soil quality indicators, such as microbial biomass, and their activities. The TWS was compared against cow dung manure (CDM), a traditional organic supplement. The comparative study was carried out in water regimes at 60% of water holding capacity (WH) of soil and under waterlogged (WL) condition, TWS was applied to red and lateritic soil at the rates of 0, 2.5, 10, 20 and 40 and CDM at 0.20 and 40 t ha^{-1}. Microbial biomass-C (MBC), glucose induced soil respiration (SR), urease and acid phosphate activities in soil were analyzed following 15, 30, 45,60,90 and 120 days of incubation. The parameters studied were significantly higher in CDM-treated than in TWS- treated soils. Increase in graded doses of TWS from 2.5 to 40 t/ha substantially increased the MBC, SR, urease and phosphatase activities in the soil. In 60% WH regime, MBC and SR increased for the first 30days of incubation and then declined. Under the WL regime, the MBC declined while SR increased from 15 days till 120 days of incubation. Urease and phosphatase activities of soil increased for up to 60 days during incubation in 60% WH and then decreased. Activities of both the enzymes under WL regime decreased progressively during incubation. There were no negative impacts on the soil quality indicators from high application rates of TWS.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

A Study on Soil Arsenic Bioremediation with Bacterial Inoculation

Sudipa Mal* and Tapas Biswas
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal
**Email: sudipaurs7@gmail.com*

Arsenic (As) is ubiquitous in the environment, posing risks to human health in many parts of the world, particularly West Bengal of India and Bangladesh, bio-volatilization of As has been suggested to play an important role in arsenic toxicity remediation. The present study aimed to determine total soil As loss through volatilization mechanism by bacteria. Arsenic bio-volatilization efficacy of bacterial inoculations with organic amendment (vermicompost) was tested in an incubation study using. As polluted rice soil from three different locations. Two As resistant and volatilizing bacteria collected from NAIP-arsenic laboratory, BCKV, were used in the experiment. Physicochemical and microbiological properties of the soil were studied. The As contaminated soils were silty clay, neutral in reaction (pH 6.9 to 7.6), medium to high in organic C (0.58% to 0.90%) content. Total arsenic contents of the soils ranged between 11 to 23 mg kg^{-1}. Change in organic carbon of treated soils was determined. Loss of total soil As upon inoculation in presence and absence of organic matter (vermicompost) was measured. Addition of vermicompost in soil @ 10 t ha^{-1} was found to have significantly increased soil organic carbon (1.02%). There was no appreciable change in soil oxidizable organic carbon upon microbial inoculation. The microbial inoculations significantly decreases total soil arsenic concentration of all three soils. In Baruipur soil, *R. spheroides* was better in reducing total soil arsenic (10.9%). In Gontra soil, *B. clausii* was greater reducer of total soil arsenic with reduction of 6.1% over *R. spheroides* with 5.2% reduction of soil arsenic loading. Addition of vermicompost @ 10 t ha^{-1} resulted decrease soil arsenic (by 3.0%). A gradual decrease in soil arsenic was observed with increase of incubation days from 15 to 60 days in soil with and without vermicompost addition. In Nonaghata soil, the treatment with *Rhodobacterspheroides* (17.3 mg kg^{-1}) was significantly better in reducing total soil arsenic with 10.2% over *B. clausii* with reducing 8.9%. A comparison of the outcome of arsenic volatilizing bacterial inoculations on total arsenic in three different soils from different locations revealed that inoculation of arsenic volatilizing bacterial strains reduced total arsenic load in all the soil irrespective of the gravity of the metalloid toxicity. *Rhodobacterspheroids* performed better in Baruipur and Nonaghata soil whereas *Bacillus clausii* was more effective in soil from Gontra region. Complex soil-biota relationship may also be responsible for their efficacy. A synergistic effect between these two strains was observed as their co-inoculation reduced soil arsenic load significantly.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Determination of Arsenic Tolerance Limit for Soil Bacteria

Animesh Ghosh Bag*, Nitin Chatterjee, Gayatri Sahu, Aritra Mukherjee and G.C. Hazra
Department of Agricultual Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, 741252, West Bengal
**Email: ghoshbagainimesh610@gmail.com*

Arsenic considered as a toxic element becomes the most important issue worldwide in ground water as well as soil pollution. Seventy countries including China, Brazil and USA are suffering from this chromic disease named Arsenic. But the magnitude of toxicity is highest in Bangladesh followed by lower Gangetic plain of India mainly West Bengal. Indiscriminate use of arsenic contaminated ground water may result arsenic in our daily diets also via water-soil-plant continuum. Along with human and plant arsenic has an adverse effect on micro organisms which can be considered as most important component of soil. Some of the bacteria can tolerance high level of arsenic toxicity and can be use to remediate arsenic toxicity in soil. To determine tolerance limit of arsenic for different bacteria inhabited in the soil, an experiment was conducted in BCKV research complex, Kalyani.

Soil samples were collected from four blocks of Nadia district (Ranaghat, Chakda, Haringhata and Krishnanagar) to check bacterial status and tolerance levels of bacteria. After analyzing the physiochemical and microbial properties of soil, it may be concluded that there is a high negative correlation between bacterial population and arsenic concentration in soil with R^2 value 0.93. These means bacteria cannot tolerate arsenic toxicity after a certain level which is known as arsenic tolerance limit of bacteria. Tolerance limit of bacteria was estimated by growing those bacteria in arsenite broth upto 5000 ppm. Results showed that soil bacteria isolated from C4 and C5 soil sample which were collected from certain places of Chakda block (Nadia) have highest tolerance limit, upto 4000 ppm. Other isolates have less arsenic tolerance capacity than that of the bacteria got from C4 and C5 soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Long-term Application of Manures and Fertilizers on Organic Carbon Build-up and Enzyme Activities in Godavari Alluvial Soils under Rice-Rice Cropping System

D. Srinivas* and Ch. Sreenivas

Andhra Pradesh Rice Research Institute and RARS, Maruteru, Andhra Pradesh
**Present address: Department of Soil Science and Agricultural Chemistry, Agricultural College, Rajahmundry, 533103, East Godavari District, Andhra Pradesh, Email: drd_srinivas@yahoo.com*

Rice-Rice cropping system is the most prevalent and dominant cropping system adopted by the farmers in the southern part of the peninsular India. The effect of long-term (23years) fertilizer application on soil organic carbon and enzyme activities were investigated in Godavari alluvial soils during *rabi* at A.P. Rice Research Institute, Maruteru, West Godavari District, Andhra Pradesh, India. The treatments T1: control; T2: 100% N; T3: 100% NPK; T4: FYM @ 10 t ha^{-1}; T5: FYM @ 5 t ha^{-1} + NPK (N: 180: 90 P_2O_5: 60 K_2O kg ha^{-1}) were laid out in permanent plots and data were recorded in triplicate and analyzed using RBD design after harvesting of rice crop. 100% NPK + FYM treated plots recorded significantly highest grain yield (5807 kg/ha) and organic carbon content (1.28%) over control. Enzyme activity was also assessed as per the standard analytical procedures indifferent stages of crop growth. Combined application of FYM along with inorganic fertilizers significantly registered highest dehydrogenase (8.74 mg TPF g^{-1} d^{-1}), urease (74.5 mg NH_4^+ - N 5 g^{-1} $2h^{-1}$) and alkaline phosphatase activity (93.11 µg PNP g^{-1} hr^{-1}) at panicle initiation stage of the rice crop. Soil organic carbon and enzymatic properties were also closely related with the C inputs and crop growth stages.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Different Forms of Acidities on Microbial Biomass and Enzyme Activities in Tea Garden Soils of Upper Assam

Kasturi Charan[1], Tanmoy Karak[2*], Romesh Kumar Boruah, Pradip Bhattacharyya[1*]
[1]Agricultural and Ecological Research Unit, Indian Statistical Institute, Giridih, Jharkhand
[2]Tea Research Association, Upper Assam Advisory Centre, Dibrugarh, Assam
**Email: tanmay.karak@gmail.com*

Assessment of microbial parameters, viz. microbial biomass, urease, acid phosphatase, β-glucosidase and sulphatase with respect to acidity helps in evaluating the quality of soils. This study was conducted to investigate the effect of different forms of acidities on soil microbial parameters of some tea-growing soils of upper Assam. In total, sixty soil samples were collected from Dibrugarh and Tinsukia districts of upper Assam. Microbial biomass C, urease, acid phosphatase, β-glucosidase and sulphatase activities (mg kg^{-1}) were varied from 41.2-218, 16.8-47.9, 431.8-1417.6, 2.4-39.3 and 6.5-27.3 respectively. Different forms of acidities like total potential, exchangeable and total acidity were significantly and positively correlated with each other. Significant positive correlations were observed between the microbial parameters and organic carbon content of the studied soil. All microbial parameters in soils were significantly affected by different forms of acidities. Microbial biomass and different enzyme activities were positively correlated with pH but negatively correlated with different forms of acidities indicated that inhibition of microbial growth and activities had occurred because of acidity stress.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Microbial Inoculants with Different Levels of Plant Nutrients on Soil Health and Grain Yield of Maize (*Zea mays* L.)

D.K. Shahi*, V. Kumar, C.S. Singh[1], N.C. Gupta and S.B. Kumar
Department of Soil Science and Agricultural Chemistry, [1]Department of Agronomy,
Birsa Agricultural University, Ranchi, 834006, Jharkhand
**Email: dksbau@gmail.com*

A field experiment was conducted at Soil Science and Agricultural Chemistry, BAU, Ranchi experimental farm, during *rabi* season 2015-16 in sandy clay loam soil. The experiment was laid out in a factorial randomized block design with 12 treatments: 50% NPK + AM, 50% NPK + *Azotobacter, 50%* NPK + AM + *Azotobacter,* 75% NPK + AM, 75% NPK + *Azotobacter*, 75% NPK +AM + *Azotobacter*, 75% NPK + AM + Azotobacter, 100% NPK +AM, 100% NPK + *Azotobacter*, 100% NPK + AM + *Azotobacter*, AM alone, *Azotobacter* alone and AM + *Azotobacter*, replicated thrice. The results revealed that yield and microbial properties (Bacteria (44.6×10^6 cell g^{-1} soil), Actinomycetes (20.6×10^5 cell g^{-1} soil), and fungi population (39.3×10^4 cell g^{-1} soil), CO_2 evolution (79.5 mg kg^{-1} soil), MBC (163.5 mg kg^{-1} soil) and AM spore count (111 50^{-1} g soil) in post harvest soil was recorded maximum when plot received RDF with dual inoculation (100% NPK + AM + *Azotobacter*) and minimum microbial population was observed when plot received lower dose of plant nutrients 0% and 50% NPK with microbial inoculation alone. Application of AM + *Azotobacter* inoculation with 100% NPK significantly increased the bacterial population ($44.6\text{x}10^6$ cell g^{-1} soil), fungal population ($39.3\text{x}10^4$ cell g^{-1} soil), AM spore count (111 50^{-1} g soil) in post harvest soil and grain yield (43.7 q ha^{-1}) and stover yield (64.9 q ha^{-1}). The harvest index ranged between 19.9 to 36.9% of maize. The grain and stover yield was recorded lowest when plot received 0, 50 and 75% recommended dose of fertilizer along with microbial inoculation alone. Dual microbial application supplemented dose of NPK too, contributed in improving grain and stover yield of maize crop and also check the nutrients mining fro soil. Monitoring of rhizospheric microbial population for increase bio-chemical activity is feasible by getting a good crop condition through application of recommended dose of fertilizers with dual inoculation in acid soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Organic Sources in Combination with Fertilizers on Nodulation, Growth and Yield of Soybean (*Glycine max*) in Vindhyan Plateau of Madhya Pradesh

S.R.S. Raghuwanshi*, O.P.S. Raghuwanshi, M.S. Raghuwanshi and I.M. Khan
College of Agriculture, Ganjbasoda, District Vidisha, Madhya Pradesh
**Email: shivramsinghraghuvanshi@yahoo.com*

Field experiments were conducted for consecutive three years (2013-14 and 2015-16) during kharif season on clay soil of Vindhyan Plateau of Madhya Pradesh to evaluate the effect of different organic sources (FYM), vermicompost and poultry manure in combinations with variable levels of recommended fertilizers on nodulation, growth and yield of soybean in soybean-wheat cropping system. The maximum seed yield (846 kg ha^{-1}), straw yield (1276 kg ha^{-1}), net return (Rs. 24981 ha^{-1}) and B: C ratio (2.07), was observed with treatment T_7. The next best combination was found with T_6 (50% RDF through organic source + 50% through natural sources + biofertilizer (Rhizobium + PSB) (poultry manure. N-urea, P-rock phosphate, K-feldsper, S-gypsum). As compared with RDF through natural resource (N-urea, P-rock Phosphate, K-feldspar, S-gypsum), the enhancement in seed and stover yield by best treatment was 20 per cent. Thus the combined use of different organic sources played a significant role in increasing seed and stover yields of soybean.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Phosphate Solubilizing Bacterial Isolates on Growth and Yield of Wheat Crop in Alluvium of Eastern Uttar Pradesh

B.R. Maurya, A. Babu and J.P. Vishvkarma
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, 221005, Uttar Pradesh

Phosphorus is the second important key element after nitrogen in terms of quantitative plant requirement. Its availability in restricted as it occurs mostly in insoluble forms. Phosphate solubilizing bacteria (PSB) are beneficial and capable to solubilize inorganic form of phosphorus to available form. Phosphate-solubilizing bacterial isolates from alluvial soil generally become efficient in solubilization of phosphate compared to allover of isolates from other soils. Different strains of P solubilizer isolates from part of uttar Pradesh were identified which have efficient as phosphate solubilization. Sixteen such isolates were tested in pot culture experiment with wheat in randomized block design. Their effect on growth at different days and yield attributes of wheat were studies. Plants height at 30, 45 and 60 days of inoculation increased significantly by the inoculations of P-solubilizer isolates. Plant height increased with the advancement of the period. In alluvial soil phosphorous content of chlorophyll influenced significantly by the inoculation of p-solubilizer. Content of chlorophyll did not vary much with the content of phosphorus at 45 days of inoculation but content of chlorophyll varied much with the content of phosphorus at 60 days of inoculation. PBS7 and PSB9 caused maximum growth as well as yield of wheat crop.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Isolation and Screening of Efficient K-Solubilizing Bacteria from Overburdens of Indian K-mines

B.R. Maurya[1]* and Indra Bahadur[2]

[1]*Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, B.H.U., Varanasi, 221005, Uttar Pradesh*

[2]*Soil and Land Use Survey of India, Ministry of Agriculture and Farmers Welfare, Govt. of India, Kolkata Centre, Kolkata, 700094, West Bengal*

**Email:brmauryaalas@gmail.com*

In soil, K exists mainly in four different pools: minerals, non-exchangeable, exchangeable and solution K. The concentration of soluble K in sols is meagre and its major portion (98%) exists as insoluble minerals. Microorganisms play a key role in conversion of unavailable form of K, i.e. mineral form of potassium (muscovite, biotite, feldspar, orthoclase and illite) to available form i.e. solution form of potassium. The present investigation involved an in-vitro studies in-vivo experiment at Department of Soil Science and Agricultural Chemistry. Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during the year 2014-15. To fulfil the objectives of the research programme, 70 soil samples were collected from rhizosphere and overburdens of Indian K mines of Andhra Pradesh, Rajasthan, Jharkhand and Bihar. From each sample one bacterial K-isolate was developed. Isolated bacterial K-isolates were primarily screened on basis of their K-solubilizing capacity in biotite supplemented Aleksandrow broth. Morphological, biochemical and physiological characteristics of 24 isolates were studied as well as quantitative estimation of K-released and pH dynamics of Aleksandrow broth supplemented with biotite, muscovite and feldspar were studied. Bacterial K-isolate JHK2 efficiently released K from muscovite and biotite and APN7 from feldspar. Release of K from biotite, muscovite and feldspar increased with increase in incubation period and higher amount of K release was recorded at 7 days of incubation. Five virulent KSB isolates emerged out from the various tests were used as seed inoculants with maize in *Kharif* under pot culture experiment in net house. Screened isolates were gram positive, slime producer, forming zone of solubilization, acid and siderophore producers. During the study BRG6 was found to be achidophile and RJJ4 was efficient alkaliphile. They signifies their use in acid and alkali soils, respectively. Application of bacterial K-isolates and mineral K significantly influenced the yield of maize crop and availability of K as compared to un-inoculated control. The highest grain yield (62.24 g pot^{-1}) was obtained with JHK2 followed by RJJ4 (59.85 g pot^{-1}). Inoculation of JHK2 resulted 18.30% higher grain yield as compared to un-inoculated control. Grain yield of maize influenced by various bacterial K-isolates followed the order as JHK2>RJJ4>BRG6>58.90>JHG11. These efficient bacterial K-isolates may be used as K inoculants for saving the input of K-fertilizers in agricultural crops. But prior to recommendations, their authentication through multilocation field trials are necessary. Further details study is needed for about their potentiality as well as capacity to solubilize the mica (Biotite and Muscovite).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Potassium Solubilizing Bacteria and Organic Acid on Solubilization of Potassium from Waste Mica and its Availability to Mustard (*Brassica juncea*)

Khushboo Rani*, D.R. Biswas and Mandira Barman
Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi, 110012
**Email: khushi.rani06@gmail.com*

India ranks 4th in the world as far as total consumption of potassium (K) fertilizer is concerned but the entire quantities of K-fertilizers are imported from other countries to meet the demand. The realization of enormous cost involved in the import of K-fertilizer has necessitated the search for alternative strategies for sustainable crop production, particularly in K-deficient soils. This research was undertaken to have an insight about solubilization of low-grade K-mineral (waste mica) from Koderma district Jharkhand, India, as influenced by potassium solubilizing bacteria (KSB) and organic acid and to see their effectiveness as a K source against commercial muriate of potash (MOP) using mustard (*Brassica juncea*) as the test crop. In the present study, experiments were conducted under incubation and pot culture in a K-deficient soil collected from Ranchi, Jharkhand (Alfisol). Oxalic acid @ 0 and 40 mg kg^{-1} soil was mixed with soil containing waste mica @ 0 and 50 mg K kg^{-1} soil with and without inoculation of KSB (*Bacillus* sp.). The release of different pools of K was monitored over a period of 90 days of incubation. The impact of treated waste micas as a source of K to mustard in a greenhouse pot culture experiment was also evaluated. An absolute control (without K source) and MOP @ 50 mg K kg^{-1} soil were also included for comparison. Incubation study revealed that available pools of K (water soluble and exchangeable) showed an increasing trend from 45 to 90 days after incubation irrespective of treatments. The value of available K in treatment involving application of waste mica along with oxalic acid and KSB inoculation was observed to be the highest next to treatment involving standard MOP as K source. Pot culture experiments also showed significant performance of treatments containing waste mica along with oxalic acid and KSB inoculation as compared to other treatments, in terms of seed, stover and biomass yield of mustard, total K uptake and available K status in soil at different growth stages of mustard. This study suggest that chemical and microbial treatment of waste mica is beneficial in terms of releasing K from waste mica and maintaining K supply in soil for crop production. Therefore, it may be used to reduce the dependence on costly K-fertilizer like MOP.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Combination of Inorganic, Organic Manures and Potassium Solubilising Biofertilizer on Potassium Fractions and Yield of Okra (*Abelmoschus esculentus* L.)

M.K. Priyanka, Ch. Sujani Rao, P. Ravindra Babu and M. Martin Luther
Department of Soil Science and Agricultural Chemistry, Agricultural College, Bapatla, Andhra Pradesh

A field experiment entitled potassium dynamics through organic manures and potassium solubilizing biofertilizer in Okra (*Abelmoschus esculents* L.) was conducted at Agricultural College Farm, Bapatla during 2016 to study the effect of inorganic fertilizers, organic manures and potassium solubilizing biofertilizer on different fractions of potassium and yield of okra. The test soil was non-saline, sandy loam in texture. The soil was low in available nitrogen, medium in phosphorus and high in potassium. The available Cu, Zn, Mn and Fe were above their respective critical limits.

The experiment was laid out in randomized block design with ten treatments replicated thrice. The treatments comprised of T_1: RDF; T_2: RDF + FYM @ 5 t ha^{-1} ; T_3: RDF + vermicompost @ 5 t ha^{-1}; T_4: RDF + poultry manure @ 5 tha^{-1}; T_5: RDNP + 30 kg K_2O ha^{-1} + FYM @ 5 t ha^{-1}+ K solubilizing biofertilizer, T_6: RDNP + 30 kg K_2O ha^{-1} + vermicompost @ 5 t ha^{-1} + K solubilizing biofertilizer, T_7: RDNP + 30 kg k_2O ha^{-1} + poultry manure @ 5 t ha^{-1} + K solubilizing biofertilizer; T_8: RDNP + FYM @ 5t ha^{-1} + K solubilizing biofertilizer, T_9: RDNP + vermicompost @ 5 t ha^{-1} + K solubilizing biofertilizer, T_{10}: RDNP + poultry manure @ 5 t ha^{-1} + K solubilizing biofertilizer. The results indicated that the highest water soluble K (74.2, 71.2 and 68.6 mg kg^{-1}) and exchangeable K (121.2, 130.3 and 131.9 mg kg^{-1}) was observed in combination of RDF along with poultry manure @ 5 t ha^{-1} whereas lowed non exchangeable K (405.2, 401.3 and 395.3 mg kg^{-1}) and step K (506.8, 501.3 and 494.3 mg kg^{-1}) was recorded in combination of RDNP along with poultry manure @ 5 t ha^{-1} and potassium solubilizing biofertilizer at vegetative, flowering and harvest stage respectively. The highest yield (156 q ha^{-1}) was recorded under the treatment RDF along with vermicompost @ 5 t ha^{-1} which was increased by 53.7% compared to lowest fruit yield (101 q ha^{-1}) which was observed in the treatment T_1.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Conservation Management Practices on Soil Microbail Function and Nitrogen Transformation under a Maize-Wheat System

Sarvendra Kumar*, M.C. Meena, R.S. Dwivedi and K.A. Chobe
Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi, 110012
**Email: sarv.grandee@gmail.com*

Continuous soil tillage strongly influences the soil properties therefore, it is important to apply suitable tillage practices that avoid the degradation of soil structure, ecosystem stability and maintain crops yield, Conservation agriculture (CA), practicing agriculture in such a way so as the cause minimum damage to the soil environment and is thought to take care of the soil health, plant growth and the environment. A field experiment was initiated in kharif 2013 at the research farm of ICAR-IARI, New Delhi to study the effect of crop residue and nitrogen (N) levels on soil biological activity and productivity o maize-wheat system under CA. The experiment was conducted in split-split-plot design with type of tillage operation in main plot viz. conservation and conventional, four level of sensor based N management i.e. 0.33.50 and 80% of N as basal dose and five way of fertilizers application viz. urea broadcast before & after irrigation, urea band placement, urea slow release, urea super granule. After three years of study, results revealed that adoption of CA practices improved overall biological activities of soil. Among tillage practices. CA recorded 32% higher dehydrogenase activities (DHA) than conventional practices (132 µg TPF^{1} g^{-1}soil 24 hr^{-1}). Among different way of fertilizer application, plots received urea as band placement were superior over other treatments in terms of sustaining oxidative capacity of soil. Highest DHA was recorded in urea band placement treated plots (162 TPF^{-1} g^{-1} soil 24 hr^{-1}) and minimum were in case of urea broadcast before irrigation of crop plots (149 TPF^{-1} g^{-1} soil 24 hr^{-1}) at grain filling stage of wheat crop. The soil microbial biomass (SMBC), soil microbial biomass nitrogen (SMBN), urease acitivity, NO_3-N soil were highly impacted by sensor based N application and different way of fertilizer application in soil but significant effect of tillage practices on the soil properties were not noticed. The major groups of soil microbial population were significantly increased with the adoption of conservation practices. Among sensor based N application maximum population were recorded in the plots received 50% of recommended dose of n as basal dose with either urea band placement/urea slow release fertilizer treated plots.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Analytical Hierarchical Process (AHP) for Soil Quality Ranking of a Small Sample Size

Nirmal Kumar[1,2], S.K. Singh[2], V.N. Mishra[1], G.P. Obi Reddy[2] and R.K. Bajpai[1]

[1]Department of Soil Science and Agricultural Chemistry, IGKV, Raipur, Chhattisgarh
[2]ICAR- National Bureau of Soil Survey & Land Use Planning, Nagpur, Maharashtra
Corresponding author, e-mail: urwithnirmal@gmail.com

Soil quality ranking of a small sample size has been attempted, Principal component anaylsis (PCA)-the most popular approach to define an appropriate minimum data set (MDS) and their weight for integrating these into Soil quality Index (SQI)-will easily produce errors of inference in these conditions. Our objective was to develop a soil quality assessment protocol for cotton growing soils of Hinganghat, a major cotton growing tehsil of Wardha district. A small sample size of eleven soil series reported to occur in the tehsil were selected. Soil depth, available water capacity (AWC), cation exchange, capacity (CEC), and organic matter (OC) were selected as MDS based on experts' opinion (EO). For defining weights of the indicators. Analytical Hierarchical Process (AHP) was used. AHP is widely used multi-criteria decision method which determines the weight based on pair-wise comparisons of parameters according to relative importance. The AHP approach was found to be handy in calculating SQI especially, in case of small sample size.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Evaluation of Soils of Wardha District for Cotton Suitability: An AHP Approach

Nirmal Kumar[1,2]*, S.K. Singh[2], V.N. Mishra[1], G.P. Obi Reddy[2] and R.K. Bajpai[1]
[1]Department of Soil Science & Agricultural Chemistry, IGKV, Raipur Chattisgarh
[2]ICAR- National Bureau of Soil Survey & Land Use Planning, Nagpur, Maharashtra
**Email: urwithnirmal@gmail.com*

The aim of this study was to determine soil suitability for cotton cultivation in semi-arid region of Hinganghat tehsil, Wardha district, Maharashtra, India where the probability of crop failure for average yield of cotton is reported highest and the farmers have been experiencing distress situation over the last two decades. The "Analytic Hierarchy Process (AHP)" method, an approach based on multicriteria decision analysis (MCDA), was used in this study. AHP is additive weighing model where for the weight for the suitability criteria and the score of each alternative are calculated by experts' pair wise comparisons. AHP can handle small to large samples with mixed sets of indicators, quantitative and qualitative. Six major soil series reported in the tehsil namely, Bothali, Chanakpur, Waigaon, Hewan, Karla, and Lasanpur with varying properties were selected for analysis. Soil organic matter, soil depth, soil drainage condition, and clay with associated properties were selected as suitability criteria. The weights of the parameters selected were found to be in order: depth (56%), clay properties (26%), organic carbon (12%), and drainage (6%). The result indicates that the suitability of the soil series for cotton cultivation decreases in order from Hewan, Bothali, Lasanpur, waigaon, Karla and Chanakpur.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Calcareous Soils of Chakia Block, East Champaran District, Bihar and their Management

T. Chattopadhyay*, S.K. Reza, D.C. Nayak and S.K. Singh[1]
ICAR-NBSS&LUP, Regional Centre, Block-DK, Sector-II, Salt Lake, Kolkata, 700091, West Bengal
[1]ICAR-NBSS&LUP, Nagpur, Maharashtra
**Email : taritchattopadhyay@gmail.com*

IRS-RESOURCESAT-II LISS IV IMAGE has been interpretated and two major land forms *viz.* active alluvial plain and young alluvial plain are established in the Chakia Block. Six soil series are established in the block through detailed soil survey on 1:10000 scale. Based on land use, slope and landforms, 22 Landscape Ecological units (LEU) are established in the region. Soil survey was done based on these LEU units. The soils are very deep, silt loam to silty clay loam, brown to greyish brown and calcareous in nature. The soils belong to two orders *viz.* inceptisol and entisol. The soils are slightly to moderately alkaline(pH-7.5-8.5), low in organic carbon(0.22%-0.60%) and the base saturation is high (85-91%). Soils in the area are calcareous with $CaCO_3$ content varies from 3.5 to 25.4% and are geogenic in origin. Most of the carbonates are in powdery form and are deposited. in the area being transported from the foot hill of the great Himalayan mountain by several rivers .

The potential productivity of this soil are high because of adequate water and nutrients supply. The high calcium saturation tends to keep the soils in well aggregated form and good physical condition. These soils are low in nitrogen (131 kg ha^{-1} to 225 kg ha^{-1}), phosphorous (1.50-8.9 kg ha^{-1}) and zinc (<0.6 mg kg^{-1}). However, iron content of the soils of Chakia block varied from 10 to 200 mg kg^{-1} which is sufficient.

Nitrogen fertilizer may be applied any time from just before planting up to the time the plant is well established. Application of nitrogen through side-dressing to the growing crop is an efficient way of nitrogen application. Care should be exercised so as not to apply nitrogen close to the seed as it may prevent germination. Ammoniacal sources of nitrogen and urea should not be left on the surface of calcareous soils, since considerable loss of ammonia through volatilization may occur, and they should be incorporated in the soil instead. Regarding phosphorus application, amounts to apply depend on how deficient the soil is and the crop requirements. Excess applied phosphorus may lead to deficiency of zinc or iron. To be effective on calcareous soils, applied phosphorus fertilizer should be in water soluble form. Band application of phosphate is more effective as compared to broadcast application. Application at the time of seeding has been found to be most appropriate since phosphorus is required mostly during the younger stages of plant growth. Calcareous soils in this belt suffer from lack of micronutrients,. In Chakia block zinc deficiency is most pronounced in maize, especially under high yield intensive cultivation systems. Zinc sulphate is an effective zinc source and is the most popular form in use. For soil application, zinc sulphate is broadcast and incorporated in soil. A single application lasts for several years. Foliar applications of zinc are used on fruit trees like mango and litchi in this region. There is also a need for the establishment of an effective drainage system like furrow and drip irrigation.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Land Resource Inventory (1:10000 scale) for Farm Level Planning – A Case Study of Middle Gangetic Plains, India

Jaya N. Surya*, Vikas Joon, R. P. Yadav, T. Lal, D. Singh, D.K. Katiyar, Ritu Nagdev and S.K. Singh
ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre Delhi, IARI Campus, New Delhi, 110012
**Email: jayansurya@yahoo.com*

Land resource inventory (LRI) involves systematic soil survey on 1: 10000 scale, site-specific data collection of land resources and its interpretation in GIS platform for farm planning. The present study was undertaken in Jagner Block, Agra district, Uttar Pradesh. It covers about 31,419 ha area, comprising of 52 villages and representing old alluvial plains and Arvalli hill ranges. The Cartosat-1 and IRS-P6 LISS-IV (5.8 m) data were interpreted in conjunction with on Survey of India toposheets, cadastral maps and available ground data to delineate landform, slope, land use/land cover and Landscape Ecological Unit (LEU) map. Detailed soil resource mapping on 1:10,000 scale was carried on by studying soils in different LEUs. In total, and eleven soil series were identified and mapped as 18 units (phases of soil series). The soils of occurring on nearly level old alluvial plain (39.4% of TGA) are very deep, well to moderately well drained, sandy loam to loam/clay loam classified as *fine-loamy/ coarse loamy (calcareous), Typic Haplustepts*. Soils on old alluvial plain with concave relief (15.9% of TGA) are very deep soils having problem of imperfect to poor drainage, saline/sodic in nature and are classified as *fine-loamy/ fine silty, Typic Halaquepts/Natrustalfs and Fluventic Haplustepts*. The soils of Piedmont Plain (9.4%) are moderately deep to deep, classified as *coarse-loamy, Typic Ustorthents/ Ustipsamments/Typic Ustifluvents*. Soils of Hill Slopes (16.5%) occurring on are very shallow to shallow, severely eroded and classified as *coarse loamy, Lithic Ustorthents*, whereas soils of Abandoned Channels/Fluvial Channels (6.5%) are very deep, stratified soils (*Coarse loamy, calcareous, Typic Ustifluvents)*. Nearly 16.47% area of the study area affected by severe to very severe erosion, 15.9% area suffers from imperfect to poor drainage conditions and nearly 10% is affected moderate salinity and moderate sodicity, whereas, 3% area suffer from strong salinity/sodicity. Majority of soils are moderately to strongly alkaline, low to medium in nutrient status. Detailed farm level information on present land use , soils and its interpretation, nutrient status, suitability for dominant crops, problems and potentials, socio-economic constraints were integrated and evaluated and site-specific management needs and suitable land use options were suggested for each parcel of land. The information generated in the study was essentially helpful for situation specific recommendations, nutrient management and potential crop areas for farm/village level planning.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Land Use Planning for Arid and Strategic Measures in Southern Regions of India

A.L. Shinde, V.S. Arya, Mahesh Chand, Y. Suresh Kumar, N.S. Gahlod, Munish Kumar and S. Kumavat
Soil and Land Use Survey of India, Hyderabad

Land use planning (LUP) is an interactive process between collaborator aiming at the negotiation and decision for sustainable land use as well as initiating and monitoring its implementation. Despite richness in natural endowments, the southern region (SR) of India is one of the most backward areas of the country, home for a very high proportion of the poor. Agricultural is highly risky and productivity is low. Accelerated agricultural development of the southern region state (Andhra Pradesh, Telangana, Karnataka, Tamil Nadu and Kerala) can be achieved by identification and prioritisation of constraints resolving issue related to crop production and transfer of appropriate agro-technologies. As case of district level of district level land use planning showed optimum utilization of available farm level resources with scientific farm mechanization techniques and adequate extension service will certainly elevate the productivity of the southern region many folds.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Land Use Planning for Arid and Semi-Arid (450-750 mm) Regions of India

A.L. Shinde, V.S. Arya, Mahesh Chand, Y. Suresh Kumar, N.S. Gahlod, Munish Kumar and A. Parthiban
Soil and Land Use Survey of India, Hyderabad

Land Use management is the systematic evaluation of physical, social and economical factor in such a way that to endurance and help land users in selecting land use options. This is continuously and interacting process of improvement to assess the future potential of the argil and allied enterprises in order to achieve accelerated growth and productivity through judicious management of land and water resources and maintains ecological balance together with optimum fulfillment of human needs, land use and land management have to be well-adopted to the land resources and to the ecological conditions. Day by day increasing pressure on land means that planning decision only to be made only after comprehensive analysis of all relevant factors. In India low rainfall regains (450-750 mm) suffer from biophysical and socio-economical problems, which effect in productivity of crop, livestock that's why the farmer in low rainfall regions, arid and semi-arid has develop traditional land use with multiple or mixed crops and crop livestock farming system to integrate with the risks associated with drought, market prices etc.

The various blue prints employed to achieve the best land use accessory are reducing land degradation, efficient soil health management blue print such as (cover crops, crop residue management tank siltation and integrated nutrient management). Conservation agriculture strategic, rainwater harvesting and its management, higher land productivity with efficient crops, average cropping systems, alternative land use system (*Jhum* cultivation), integrated farming system, efficient farm mechanization and agricultural service centre. The aim of new integrated approach to planning the use and management of land resources to make superior and informed choice on future uses of the land, hastily for efficient land use planning, long term planning in required for sustainable land use in both village and urban areas, backed by eight to ten years periodic action plan.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Land Quality Evaluation of Major Coconut-growing Soils of Karnataka for Productivity Enhancement

R.K. Avinash, K.S. Anil Kumar, M. Lalitha, M. Jayaramaiah, K. Sujata and S. Parvathy
ICAR-National Bureau of Soil Survey and Land Use Planning, Hebbal, Bangalore, 560024, Karnataka

Karnataka state has been ranked second in terms of area (5.15 lakh ha), production (5.14 billion nuts) and productivity (9983 nuts ha^{-1}) among the Indian states and generally it was assumed that coconut is a crop of hot humid tropics only. An experiment was conducted to study the land qualities of major coconut-growing soils of Karnataka and to evaluate the suitability of those soils for coconut cultivation, apart from identifying the soil potentials and constraints towards enhancing coconut productivity as in Karnataka major coconut-growing areas fall under hot semi-arid tropics. Seven soil pedons were selected on coconut-growing areas map, delineated with the help of land resources map and report generated at 1:2,50,000 scale by ICAR-NBSS & LUP, Bangalore and were located at Brahmavara, Beltangadi, Krishnarajapete, Arasikere, Hosadurga, Turuvekere and Gubbi representing the concentration of coconut-growing areas and agro-climatic zones.

Soils of the study area are generally deep and gravelly with sandy clay to clayey texture. Beltangadi and Brahmavara soils are strongly acid and rich in soil organic carbon, whereas, other locations had near neutral to moderately alkaline soils with medium organic carbon content. Cation Exchange capacity and base saturation ranged from low to medium. The entire study area has got low or medium available N, P_2O_5 and K_2O. Exchangeable Ca remained adequate in most soils except Beltangadi and Brahmavara, where as Mg was deficient in most of the soils along with S, B and Zn.

The major taxa of the soils identified at sub-group level of Soil Taxonomy are Ustic Kanhaplohumults, Typic Kandiustalfs, Rhodic Paleustalfs, Typic Rhodustalfs and Vertic Haplustepts. Krishnarajapete and Arasikere have moderately suitable lands having moderate limitations and others marginally suitable having severe limitations for coconut cultivation. Providing life saving irrigation and liming of acid soils and soil test based nutrient application is necessary to maintain the palms under healthy condition with enhanced crop productivity.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Different Land Use Systems on Soil Organic Carbon Pools and Their Relationship with Soil Properties under Doda District of Jammu & Kashmir

Manoj Kumar and M.P. Sharma
Division of Soil Science and Agricultural Chemistry, FoA, SKUAST-Jammu, Jammu and Kashmir

Soil organic carbon plays an important role in determining chemical, physical and biological properties of soil. The present study was conducted to monitor the effect of different of land use systems such as Agriculture, Horticulture, Forest, Grassland, Eroded land and Barren land on various organic carbon pools *viz*. soil oxidisable carbon, water soluble carbon, labile carbon, microbial biomass carbon and total carbon along with soil properties such as pH, cation exchange capacity, bulk density, water holding capacity major and micronutrients. The results indicated that soil organic carbon pools *i.e.* SOC , WSC, LC, MBC and TC ranged from 5.73-7.79 g kg^{-1}, 33.20-60.60, 1.27-3.44, 67.20-111.01 and 24.55-33.56 (mg kg^{-1}) in surface soil respectively whereas their values decreases with increases depth in all land uses. The values of aforesaid parameters were higher under Horticulture land use followed by Forestland use, Agriculture land use, Grassland, Eroded land and Barren land. The pH of different land use systems in surface soils was slightly acidic in nature whereas concentration of soluble salt was found in normal range. The texture of majority of soils was varied from sandy clay loam to loam. The organic carbon status of soil was found in medium to high range and their values decreases with increases depth in all land uses. The surface soils are having moderate quantity of Nitrogen, Phosphorous, Potassium and Sulphur whereas their values decrease with increases depth in all land uses. The DTPA extractable micronutrients viz., Zn, Cu, Mn & Fe are in sufficient range in all the surface soils whereas their values decreases with increases depth in all land uses.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Land Suitability Evaluation for Important Crops of Elamdesam Block, Idukki District, Kerala, India

M. Chandrakala[1], R. Srinivasan[1], K.S. Anil Kumar[1], K. Sujatha[1], Rajendra Hegde[1], S.K. Singh[2] and Sanjeev Kumar[3]

[1]ICAR-National Bureau of Soil Survey and Land Use Planning, RC, Hebbal, Bangalore, 560024, Karnataka

[2] ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur, Maharashtra

[3] ICAR-National Dairy Research Institute, Karnal, Haryana

**Email: chandra.ssac@gmail.com*

Land suitability assessment is a specific type of land evaluation method to assess the resources of an area for specific crop rather than for a general use. Using the soil site suitability criteria, land resources of the Elamdesam block, Idukki ditrict, Kerala was assessed for their suitability for the paddy, coconut, rubber, arecanut, pepper, banana, pineapple, tapioca and teak. Results revealed that, paddy is highly suitable in nearly 14.79, moderately suitable in 5.39, marginally suitable in 32.18 and unsuitable in 12.01 per cent of total geographical area. Coconut is highly suitable in 11.6, moderately suitable in 18.99, marginally suitable in 28.35 and unsuitable in 5.44 per cent of total area. Rubber is moderately suitable in 23.4, marginally suitable in 20.75 and unsuitable in 20.23 per cent of total area. Arecanut is moderately suitable in 17.57, marginally suitable in 35.36 and unsuitable in 11.46 per cent of total area. Pepper is highly suitable in 14.4, moderately suitable in 29.74 and marginally suitable in 20.23 per cent of total geographical area. Banana is marginally suitable in 54.16 and unsuitable in 10.22 per cent of total area. Pineapple is moderately suitable in 22.09, marginally suitable in 37.52 per cent of total geographical area. Tapioca is moderately suitable in 12.27 and marginally suitable in 32.96 per cent of total geographical area. Teak is moderately suitable in 23.4 and marginally suitable in 35.54 per cent of total geographical area.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Nutrient Content, Uptake and Quality of Wheat (*Triticum aestivum* L.) as Influenced by Drip Irrigation Schedules and Nitrogen Levels

Barkha and A.S. Bhanvadia*
Regional Research Station, Anand Agricultural University, Anand, 388110, Gujarat
**Email: ajay@aau.in*

A field experiment was carried out during *rabi* season of the year 2015-2016 at the Regional Research Station farm, Anand Agricultural University, Anand, Gujarat with main objectives to find out the effect of levels of irrigations and nitrogen on yield, N, P, K content and uptake as well as protein content of wheat and to study the effect of levels of irrigations and nitrogen on nutrient status of soil after harvest of wheat crop. The soil was sandy clay with bulk density 1.43 Mg m^{-3}, 0.24 dS m^{-1} EC and soil pH 7.7, low in available N (237 kg ha^{-1}), medium in available phosphorus (50.34 kg ha^{-1}) and potassium (347 kg ha^{-1}). The experiment was laid out in split-plot design with four replications and eight treatment combinations with four irrigation schedules (drip at 0.6, 0.8 and 1.0 ADPEF and conventional method) and two levels of nitrogen (100% RDN and 75% RDN). Irrigation schedules were relegated as main plot treatments and two nitrogen levels were allotted as sub-plot treatments. Irrigations were applied through drip irrigation. Laterals with emitters of 4 lph discharge capacity were installed at a spacing of 80 cm and the distance between two emitters was 37.5 cm. The daily pan evaporation values were measured with the help of USWB class 'A' open pan evaporimeter.

The results indicated that treatment of irrigation schedules showed significant influence on grain as well as straw yield of wheat. Similar trend was observed in case of N, P and K content in grain and straw and also for protein content in grains. Varying irrigation levels exerted a significant influence on available soil N status but not on soil P_2O_5 and K_2O. The effect of varying nitrogen levels was non-significant on grain yield and straw yield. Effect was significant on N content in grains and straw but non-significant on P and K in grain and also for P and K in straw. It was found significant on protein content of the grains where, significantly higher protein content was recorded under 100% RDN over 75% RDN. Similarly, P_2O_5 and K_2O in soil after harvest of the crop were not influenced significantly by the different nitrogen levels but it significantly influenced soil available N.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Optimization of NPK Fertigation Levels of Tomato (Heema sohna) under Different Irrigation Levels with and without Mulch under Open Field Condition

M. Uma Devi, L. Suhasini, B. Manga and G. Swathi
Water Technology Centre, Prof. Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, 500030, Telangana
**Email: baby_makam@rediffmail.com*

A field experiment was conducted at experimental field of College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar on "Optimization N P K fertigation levels and irrigation levels for tomato (Heem sohna), with and without mulch under open field condition" during *rabi* 2016-17. In this experiment, randomised block design was used with 16 treatments and each treatment replicated thrice. In these treatments, four fertigation levels (*i. e.,* 60 % (90-36-48 kg N-P_2O_5-K_2O ha^{-1}), 80 % (187.5-75-100 kg N-P_2O_5-K_2O ha^{-1}), 100 % (150-60-80 kg N-P_2O_5-K_2O ha^{-1}) of recommended NPK and also Soil application of 100 % NPK dose (262.5-105-140 kg N-P_2O_5-K_2O ha^{-1}, farmers practice), two irrigation levels ($I_{0.6}$ – Irrigation at 0.6 Epan, $I_{0.8}$ – irrigation at 0.8 E pan) with and without mulching were tried. The source of fertilizers used for fertigations were urea, urea phosphate (17-44-0) and white muriate of potash. The no. of fertigations given were 40 at 3 days interval starting from 20 DAT to 140 DAT. The results at 35 DAT showed that maximum plant height (44.83 cm) is observed at 80% NPK dose (187.5-75-100 kg N-P_2O_5-K_2O ha$^{-1)}$. The maximum mean no. of flowers plant^{-1} (4.83) were recorded at 100% NPK dose (150-60-80 kg N-P_2O_5-K_2O ha^{-1}), the maximum mean no. of fruits plant^{-1} (3.5) were observed at Soil application of 100% NPK dose ((262.5-105-140 kg N-P_2O_5-K_2O ha^{-1}). At 60 DAT the maximum plant height (84.40 cm) was recorded at Soil application of 100% NPK dose (262.5-105-140 kg N-P_2O_5-K_2O ha^{-1}) at irrigation of 0.8 Epan with mulching (25 micron, black / silver dual colour), maximum mean no. of flowers plant^{-1} (7.26) were recorded at Soil application of 100% NPK dose (262.5-105-140 kg N-P_2O_5-K_2O ha^{-1}) at irrigation of 0.6 Epan with mulching, maximum mean no. of fruits plant $^{-1}$ (14.20) were observed at Soil application of 100% NPK dose (262.5-105-140 kg N-P_2O_5-K_2O ha^{-1}) at irrigation of 0.6 Epan with mulching, maximum mean fresh fruit weight plant^{-1} (74.9) was observed at 80 % NPK dose (187.5-75-100 kg N-P_2O_5-K_2O ha^{-1}) at irrigation of 0.8 Epan with mulching. At 90 DAT the maximum plant height (101.69 cm) was recorded at Soil application of 100% NPK dose (262.5-105-140 kg N-P_2O_5-K_2O ha^{-1}) at irrigation of 0.8 Epan with mulching, maximum mean no. of flowers plant^{-1} (1.88) were recorded at 80 % NPK dose (187.5-75-100 kg N-P_2O_5-K_2O ha^{-1}) at irrigation of 0.6 Epan with mulching, maximum mean no. of fruits plant $^{-1}$ (26.88) were observed at 80 % NPK dose (187.5-75-100 kg N-P_2O_5-K_2O ha^{-1}) at irrigation of 0.6 Epan with mulching, maximum mean fresh fruit weight plant^{-1} (43.76) was observed at 100 % NPK dose (150-60-80 kg N-P_2O_5-K_2O ha^{-1}) at irrigation of 0.8 Epan without mulching. At 120 DAT the maximum plant height (103.09 cm) was recorded at 80 % NPK dose (187.5-75-100 kg N-P_2O_5-K_2O ha^{-1}) at irrigation of 0.6 Epan with mulching, maximum mean no. of flowers plant^{-1} (2.11) were recorded at 100 % NPK dose (150-60-80 kg N-P_2O_5-K_2O ha^{-1}) at irrigation of 0.8 Epan with mulching, maximum mean no. of fruits plant $^{-1}$ (18.55) were observed at 100 % NPK dose (150-60-80 kg N-P_2O_5-K_2O ha^{-1}) at irrigation of 0.6 Epan with mulching. The highest total fresh fruit yield of tomato (5.54 kg m^{-2}) was recorded at Soil application of 100 % NPK dose (262.5-105-140 kg N-P_2O_5-K_2O ha^{-1}) at irrigation of 0.6 Epan with mulching.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Residue Mulch and Irrigation Effects on Onion Productivity in a Sub-tropical Environment

C.B. Singh* and Gurveer Singh
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004 , Punjab
**Email: cbsingh12@yahoo.co.in*

Onion (*Allium cepa* L.) is one of the most important vegetable crops in the world. It requires light and frequent irrigations as majority of its roots are concentrated in upper surface. Therefore, there is an urgent need to improve the water productivity through optimum irrigation schedule and water saving techniques. Onion productivity is constrained by high evaporation and temperature during second half of the growing periods. These can be altered through mulching and irrigation schedule. Mulching with surplus rice residue is likely to provide favorable hydrothermal regime, check weed infestations, economize irrigation water use and enhance onion bulb yield. This study examined the combined effects of residue mulching and irrigation regimes on onion bulb yield and water productivity in a semi-arid sub-tropical environment of north-west India. Treatments included two mulch rates viz., no mulch (M_0) and rice straw mulch @ 6 t ha^{-1} (M_6) in main plots and sub plots comprised of three irrigation regimes based on IW/Pan-E=2.0, 1.4 and 0.8 ratios. Onion seedlings were transplanted in first week of January with recommended doses of N, P_2O_5 and K_2O and harvested in second fortnight of May.

Residue mulching improved onion bulb yields by 17 per cent over no mulch plots (24.2 t ha^{-1}). Onion response to irrigation was observed significantly up to $I_{2.0}$ irrigation regime. Irrigation based on $I_{2.0}$ and $I_{1.4}$ significantly enhanced average yield of onion bulb by 5.3 and 3.7 t ha^{-1} over the restricted irrigation with $I_{0.8}$ ratio (23.3 t ha^{-1}). Mulching benefits were more in drier year 2016 (24%) than in wet year 2015 (10%). For a similar bulb yield, mulching saved 175 mm of irrigation water. Soil moisture storage was higher in mulched plots throughout the growing period. Mulch lowered the maximum soil temperature by 1.8 to 8.8 °C over no mulch and also changed the minimum soil temperature during the growing season. The maximum soil temperature was higher by 0.1 to 4.5 °C with the irrigation regime IW/Pan-E=0.8 over IW/Pan-E=2.0. Weed infestation was lower by 92 per cent in mulched plots. Increase in frequency of irrigation also increased weed biomass. Mulch enhanced water use efficiency and these effects were greater in less-frequent irrigations. Large sized bulbs (>50 mm) were produced with mulch application. Both mulching as well as irrigation frequency improved total N uptake. Mulching effects on bulb yield and irrigation economy were attributed to its effect on moderation of soil temperature, reduction in soil water evaporation and weed infestation.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Improving Nutrient Use Efficiency through Foliar Supplementation in Rained Areas

S S Balloli, Mohammad Osman, Ch Srinivasa Rao, N. Jyothi Laxmi, S.K. Yadav and Arun Shanker

ICAR- Central Research Institute for Dryland Agriculture, Santoshngar, Hyderabad, 500059

Field studies were conducted during kharif 2016 to study whether application of water soluble fertilizers through foliar sprays during the vegetative stage can enhance the yield of maize and also to study whether the application of whether application of micro (zinc) and beneficial elements (selenium) can help in influencing some of the plant physiological processes and in-turn help minimize the yield reduction due to drought/insufficient soil moisture. Maize cv. DHM 117 was raised during kharif 2016 at Gunegal Research Farm (GRF) in randomized block design with nine treatments and three replications. The treatments tried were: 1) T1: recommended dose of fertilizer ie 90:45: 45 kg NPK/ha, 2) T2: T1 without top dressing of 45 kg N/ha at 25 DAS + foliar spray of 0.5% water soluble fertilizer (19-19-19) + 0.5% ZnSO4 + 20g/ha of sodium selenite at 25 and 55 DAS after sowing, T3: T1+ foliar spray of 0.5% water soluble fertilizer + 0.5% ZnSO4 + 20g/ha of sodium selenite at 25 and 55 DAS after sowing, T4: T1+ foliar spray of 0.5% water soluble fertilizer + 0.5% ZnSO4 + 20g/ha of sodium selenite at 55 after sowing only, T5: T1+ foliar spray of 0.5% water soluble fertilizer + 0.5% ZnSO4 + 20g/ha of sodium selenite at 25 after sowing only, T6: T1 + spraying of sodium selenite at 25 and 55 DAS T7: T1+ foliar spray of 0.5% water soluble fertilizer at 25 and 55 DAS, T8: T7+ foliar spray of 0.5% ZnSO4 + 20g/ha of sodium selenite at 25 and 55 DAS, T9: Absolute control, no fertilizers. Results of the field experiment revealed that application of recommended dose of fertilizer + spraying of 0.5% $ZnSO_4$ + 20 g/ha of sodium selenite at 25 and 55 DAS resulted in highest grain yield of maize (36.34 q/ha) followed by treatments T5 (34.08 q/ha) and T4 (33.80). Results also revealed that lowest grain yield of maize was recorded in T9 (18.16 q/ha) treatment where no fertilizers were applied basally. In treatment 2, where no top dressing of 45 kg N/ha was given has resulted in lower yield (24.73 q/ha) as compared to treatment T1(30.93 q/ha) indicating that the water soluble fertilizers can be used as a supplement to the conventional fertilizers like urea, DAP, MOP. Spraying of 0.5 % water soluble fertilizers (19-19-19) along with zinc sulphate (0.50%) and selenium (20 g/ha) resulted in increased grain yield and uptake of N, P and K by maize crop and has also resulted in increase in nitrate reductase, chlorophyll content and leaf area.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Impact of Aquaculture Effluent Irrigation on Physico-chemical Properties of Soils of Dhanti-Umbharat, Navsari, India

Ampee Tasung and Sonal Tripathi*
Department of Soil Science and Agricultural Chemistry, NM College of Agriculture, Navsari Agricultural University, Navsari, 396450, Gujarat
**Email: sdixit77@gmail.com*

Salicornia brachaita flourishes in the sea shore of Arabian Sea and Bay of Bengal. In specific, *Salicornia* is used for vegetable and vegetable salt during the religious fast of the Hindus. Aquaculture is a large growing industry which releases effluents, in varying degrees to the surrounding environment. In the present paper the main objective was to see the feasibility of saline aquaculture effluent in irrigating *Salicornia* without deterioration in soil properties. The difference on impact between two source of irrigation (S) (S_1:seawater and S_2: aquaculture effluent) with two methods of sowing (M) [M_1:broadcasting and M_2:Line sowing with dry spikelets (30 cm)] and three levels of fertilizer (F) [F_1:No fertilizer, F_2: 50% RDF (125: 37.5: 25 NPK), F_3: RDF(250: 75: 50 NPK] and their treatment combinations on soil fertility status and yield of *Salicornia* were observed at Central Soil Salinity Research Station, Dhanti-Umbharat, Navsari, India. An application of aquaculture effluent water to *Salicornia* had conceived a potent yield of fresh (31.62 t ha^{-1}) and dry biomass (3.76 t ha^{-1}) over sea water irrigation. Aquaculture nutrient loaded effluent used as irrigation on *Salicorna brachiata* was found efficient in terms of the soil properties after harvest of fresh biomass. Comparatively the pH (8.44) and EC (9.12 dS m^{-1}) of the soil was high. The soil organic carbon content was higher in aquaculture effluent treated plot and the additional effect of fertilizer application also enhanced accumulation of organic carbon. The interaction effect of aquaculture effluent source of irrigation and 100 per cent recommended dose of fertilizer was significant in the soil organic carbon content (0.63%). With application of aquaculture effluent soil CEC, 45.25 me $100g^{-1}$ was significant over seawater irrigation. Simultaneously, fertilizer application at 100 per cent recommended dose of fertilizer accounted highest soil CEC, 47.29 me $100g^{-1}$. Soil ESP (47.23) and SAR (4.65) were slightly higher from the initial values. The soil water stable aggregate (>1mm) was above 60 percent. The soil available N (465 kg ha^{-1}), P_2O_5 (26.10 kg ha^{-1}) and K_2O (5023 kg ha^{-1}) was in the medium to high soil testing range when aquaculture effluent was irrigated and 100 per cent recommended dose of fertilizer was applied. The interaction of irrigation with aquaculture effluent and application of 100 per cent recommended dose of fertilizer was significant in soil available K_2O content (5642 kg ha^{-1}). The soil Fe, Mn, Zn and Cu (6.48, 4.32, 0.72, 1.12 ppm respectively) was above the critical level with aquaculture effluent irrigation and recommended dose of fertilizer was applied. Interaction of irrigation with aquaculture effluent and application 100 per cent recommended dose of fertilizer was significant in soil available Cu that recorded 1.27 mg kg^{-1}.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Surfactant on Irrigation Requirement and Recovery Efficiency of Major Nutrients for Paddy in Terai Flood Plains

S. Biswas, B. Roy, S. Sarkar, S. Saha and F. H. Rahman[1]*
Coochbehar Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, West Bengal
[1]ICAR-Agricultural Technology Application Research Institute, Salt Lake, Kolkata, West Bengal
**Email: fhrahmancal@gmail.com*

Farmers of the Coochbehar district used to cultivate the boro paddy, one of the main crops of the district, by keeping the field continuously flooded upto dough stage. Moreover, soils of nearly 74% and 12% of cultivated area of the district area sandy loam and sandy in texture, respectively, having poor or very poor water holding capacity. So the crop requires huge amount of irrigation water that is mostly lifted from underground through bore-well. The experiment was conducted in three different villages of the district to study the water requirement, water productivity and water use efficiency of the crop as well as to assess the affectivity of different chemicals: Non-ionic surfactant (NIS), poly acryl-amide (PAM) and ethoxylated alkyl-phenol (EAP) in reducing water requirement (WR), water productivity (WP), water use efficiency (WUE) and recovery efficiency of N (REN), P (REP) and K (REK). Non-ionic surfactant (NIS), polyacrylamides (PAM) and ethoxylated alkylphenol (EAP) were applied @ 3.5 L, 10.5 – 15.0 kg and 3.0 L ha^{-1} during final land preparation before transplanting. Major nutrients N, P and K separate N, P and K omission plots were also maintained. All the surfactants used in the experiment have shown significant effect on irrigation number, WR, WUE, WP as well as NUE of the crop. Lowest number of irrigation (19) and WR (77.76 ha-cm) were recorded with application of PAM followed by EAP (21 no. and 81.00 ha-cm), NIS (22 no. and 87.48 ha-cm) marking significant differences with normal irrigation practice (26 no. and 100.44 ha-cm). Significantly higher WUE and lower WP were noted with all three surfactant being highest with PAM (77.29 kg ha-cm-1 and 1307 lit kg-1) followed by EAP (72.35 kg ha-cm-1 and 1368 lit kg-1). Keeping parity with irrigation parameters highest REN (0.53 kg N uptake kg N-1 applied) and REK (0.60 kg K uptake kg K-1 applied) were observed with PAM which was significantly higher than recorded in case of normal practice (REN-0.54 kg N uptake kg N-1applied and 0.66 kg K uptake kg K-1 applied). No observable differences were noticed in case of REP. Consequence to this considerable reduction in gross cost and enhancement in net return in treatments with PAM (Rs. 30700 and Rs. 44425), with EAP (Rs. 31375 and Rs. 41875) and with NIS (Rs. 32500 and Rs. 39750) were observed when compared with normal practice (Rs. 34750 and Rs. 34250). Benefit cost ratio as calculated were found to be ranged from 1.99 to 2.45 being highest with PAM and lowest with normal irrigation practice.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Lateral Spacings of Drip and Nitrogen Levels on Nutrient Content, Uptake and Quality of Wheat (*Triticum aestivum* L.)

Sagar and A.S. Bhanvadia*
Regional Research Station, Anand Agricultural University, Anand, 388110, Gujarat
**Email: ajay@aau.in*

A field experiment was carried out during *rabi* season of the year 2015-2016 at the Regional Research Station farm, Anand Agricultural University, Anand, Gujarat with main objectives to find out the effect of lateral spacing of drip and nitrogen on yield, N and P content and uptake as well as protein content of wheat and to study the effect of lateral spacing of drip and nitrogen on nutrient status of soil after harvest of wheat crop. The soil was sandy clay with bulk density 1.43Mg m^{-3}, EC 0.24 $dSm^{-1}$and soil pH 7.7, low in available N (237 kg ha^{-1}), medium in available P_2O_5(50.34 kg ha^{-1}) and K_2O (347 kg ha^{-1}). The experiment was laid out in split-plot design with four replications and eight treatment combinations with four lateral spacings (drip at 60, 80 and 120 cm and conventional method) and two levels of nitrogen (100% RDN and 75% RDN). Irrigation schedules were relegated as main plot treatments and two nitrogen levels were allotted as sub-plot treatments. Irrigations were applied @ 1.0 ADFPE through drip irrigation. Laterals with emitters of 4 lph discharge capacity were installed the distance between two emitters was 37.5 cm. The daily pan evaporation values were measured with the help of USWB class 'A' open pan evaporimeter.

The results indicated that treatment of lateral spacing showed significant influence on grain as well as straw yield of wheat. Similar trend was observed in case of N and P content in grain and straw and also for protein content in grains. Varying lateral spacings exerted a significant influence on available soil N status but not on soil P_2O_5. The effect of varying nitrogen levels was non-significant on grain yield and straw yield. Effect was significant on N content in grains and straw but non-significant on P and K in grain and also for P and K in straw. It was found significant on protein content of the grains where, significantly higher protein content was recorded under 100% RDN over 75% RDN. Similarly, P_2O_5 and K_2O in soil after harvest of the crop were not influenced significantly by the different nitrogen levels but it significantly influenced soil available N.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Rainfall Distribution on Soil Properties and Nutrients Availability in Upland Red Soils of Mirzapur

Alok Patel and Surendra Singh*
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, 221005, Uttar Pradesh
**Email: ssinghssac@yahoo.co.in*

Rainfall plays a major role in deterioration of soil properties and availability of nutrients in upland topography. Mirzapur district in eastern part of Uttar Pradesh falls in a belt of semi- arid to sub-humid climate. The normal period for the onset of monsoon in this region is the third week of June and lasts up to end of September of some times extends to the first week of October. About 90 per cent of the annual rainfall is received during monsoon season. Ten locations were selected for the study in upland red soils of Rajeev Gandhi South Campus (RGSC), Barkacha, Mirzapur of Banaras Hindu University. Altogether, 50 surface soil samples were collected from the selected 10 locations in five times at interval of 30 days, starting from June 15, 2016 (initial) to October 15, 2016 (end). The processed soil samples were analysed for relevant soil properties and available nutrients (N, P and S) using slandered procedures. The salient findings of the present investigation are summarized below.

Results revealed that pH and organic carbon content of upland red soils of RGSC, Mirzapur decreased at all the ten locations at 30 days of interval from their initial values due to rainfall. Results further revealed that rainfall has resulted considerably in decrease of available nitrogen, phosphorus and sulphur content of upland soils at all the locations over their initial values. The decrease in available nitrogen, phosphorus and sulphur may probably due to anions such as nitrate, phosphate and sulphate along with rainfall water from surface to lower depths. Hence, there is need to restore fertility of upland soils by addition of organic and inorganic sources of plant nutrients for sustaining crop productivity in years to come.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Drip Irrigation and Residue Management Influence on Performance of Wheat-Maize System and Water Productivity under Permanen- raised Bed Planting

O.S. Sandhu[1], R.K. Gupta[1*], H.S. Thind[1], Yadvinder-Singh[2], M.L. Jat[2] and H.S. Sidhu[3]
[1]Punjab Agricultural University, Ludhiana, Punjab
[2]International Maize and Wheat Improvement Centre (CIMMYT), NASC Complex, New Delhi, 110012
[3]Borlaug Institute for South Asia (BISA), CIMMYT, Ladhowal, 141004,Punjab
**Email: rkg1103@pau.edu*

The extensive use of traditional irrigation systems has led to over exploitation of groundwater and over use of surface water. In north-western India, maize based systems are being advocated as an alternate to rice-based systems to address the issues water table and climate-change-induced variability in rainfall and temperature. Maize has a significantly lower irrigation requirement than rice and can enhance the productivity of the system, and sustain soil health and environment quality. To this effect a two year field experiment was established with annual wheat-maize rotation in the north-western IGP of India to evaluate the effect of drip irrigation and residue management on crop production and water productivity under the conservation agriculture. Maize and wheat under drip irrigation with residue retained and moongbean system showed significant grain yield increase of 15.5% and 19.0% (mean for two yrs) compared to furrow irrigation with no residue (FI-R), respectively. System productivity was significantly higher by 50% in DI_{Mb}+R as compared to the FI-R. Water productivity obtained under DI-R, DI+R and DI_{Mb}+R was 2.06, 2.31 and 2.43 kg m^{-3}, which was 47.1%, 65% and 73.6% higher as compared to the FI-R (1.40 kg m^{-3}). Fertigation in drip irrigation with five splits in wheat and seven splits in maize at 10 days interval with 90 kg N ha^{-1} was followed over broadcast method to increase NUE in wheat-maize cropping system using conservation agriculture.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Gravity Drip Irrigation and Nitrogen Management on Yield and Water Productivity of Sweet Corn in a Sandy Loam Soil

Priyanka Ghatak* and S.K. Patra
Department of Agricultural Chemistry Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, 741252, West Bengal
**Email: ghatakp99@gmail.com*

A field experiment was conducted during winter 2015-16 to study the effects of four levels of irrigation (gravity drip irrigation at 1.0, 0.8 and 0.6 ETc and surface irrigation at 50 mm depth) and four level of nitrogen management (100% inorganic N, 75% inorganic N+25% inorganic N as vermicompost, 75% inorganic N + 25% inorganic N as FYM and 75% inorganic N + 25% inorganic N as Mustard oil cake) on marketable growth, yield components and marketable yield and water productivity of sweet corn in sandy loam soil. The results showed that surface irrigation with 75% inorganic N plus 25% organic N as vermicompost recorded the maximum growth, yield attributes and cob yield of plant which was identical with drip irrigation scheduling of 1.0 ETc with 100% inorganic N. Maximum water productivity was obtained with drip irrigation at 0.6 Etc with 75% inorganic N and 25% organic N as vermicompost. A second degree polynomial equation was best fitted to the cob yield and amount of water applied. The predicted cob yield was estimated to be 7.35 t/ha with 200 mm of irrigation water application. The amount of water distribution in drip system decreased consistently along the vertical lines, the more so in higher irrigation level than in lower irrigation level. The pattern of water distribution down the soil layers was rather inconsistent in surface irrigation. However, soil moisture storage in 0.90 depth was relatively higher in surface irrigation than in drip irrigation. There was about 13.8% more moisture storage in active rooting depth under surface irrigation as compared with overall drip irrigation system.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Evaluation of Sulfur Burner Treatment of Irrigation Water to Manage Saline-Sodic Cotton Soils

Girisha K. Ganjegunte and John A. Clark
Department of Soil and Crop Sciences, Texas A&M University System, 1380 A&M Circle, El Paso, TX

Pima Cotton occupies more than half of the cropped area in the El Paso County located in western part of Texas, USA. El Paso County is a part of the Chihuahua desert and has an extremely arid climate. Agriculture is highly dependent on irrigation and the major source is the Rio Grande River that flows through the region. However, the river water has elevated salinity and soils in cropped area are fine textured with smectitic clay. Thus long term irrigation with saline water on fine textured soil has resulted in elevated salinity and sodicity in the root zone. Although cotton is considered as a salt tolerant crop, the salinity levels in the root-zone are above its threshold, which has resulted in reduction in yield levels. Leaching of salts is problematic because of sodium hazard that has reduced the permeability of soil profile. However, these cotton soils contain up to 10% of calcite ($CaCO3$) by weight in the upper 1 m depth. Thus it may be possible to utilize native Ca sources to improve soil permeability and reduce soil salinity. New methods of water treatment such as S burner to acidify irrigation water are gaining popularity among growers. These devices are expensive and therefore need to be evaluated for their effectiveness. This study evaluated the spatial distribution of salinity and sodicity in the effective root-zone of pima cotton (upper 75 cm) using electromagnetic induction (EMI) technique. EMI signals were converted into saturated paste extract electrical conductivity (ECe) and sodium adsorption ratio (SAR) values using ESAP model developed by U.S. Department of Agriculture-ARS. The pre-study ECe and SAR in upper 75 cm at the study site ranged from <1 to 13 dS m-1 and 12-21, respectively. After one year of irrigation with S burner treated water both ECe and SAR values declined but the values in remained the threshold in worst affected parts of the field. Results of this study indicated that S burner technique has the potential to reduce sodicity and salinity of cotton fields but long term irrigation with treated water is required. Furthermore, the results also indicated that EMI technique can be effectively used to evaluate the treatment performance over space and time. This will enable development of site specific precision management practices and help in reducing treatment costs.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Enhancing Productivity and Nitrogen Use Efficiency of Neem Coated Urea in Transplanted Rice

R.K. Gupta*, Varinderpal Singh, Onkar Singh and R. Sikka
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab
**Email: rkg1103@pau.edu*

Of all the nutrients required by crops, nitrogen (N) is the one most often deficient in soils, applied in greater quantities, and has been subjected for losses in rice compared with other cereals. When urea is applied to the soil, it is transformed into other N forms, of which some are susceptible to loss and therefore lead to reduced availability of N to crop plants. In the first step hydrolysis of urea by urease enzyme takes place which rapidly converts amide-N to ammonium-N and in the second step nitrification *is* brought about by nitrifying bacteria that converts ammonium-N to nitrate-N. Ammonium-N is susceptible to loss via ammonia gas, and nitrate-N can escape soil-plant system through leaching below the rooting zone and also in gaseous forms via denitrification leading to reduced fertilizer N use efficiency. Use efficiency of urea-N by different crops is as low as 20% and it rarely exceeds 50%. In highly permeable alkaline soils of Punjab, alternating aerobic and anaerobic soil conditions under rice, applied N is readily converted to NO_3, which is prone to losses via leaching and nitrification-denitrification. Improving efficiency of fertilizer N use is vital to sustain high crop yields and achieve high NUE. Appropriate modification in fertilizer source or management practices can help reducing N losses and increase N use efficiency. The neem coated urea (NCU) contains nitrification inhibition properties and thereby delays the bacterial oxidation of ammonium –N by depressing the activity of the *Nitrosomonas* bacteria in the soil over a period of 4 to 10 weeks. This helps in controlling the loss of nitrate by leaching and or denitrification from the top soil by keeping N in the ammonium form longer and thereby increasing the N use efficiency and yield of crops. Keeping this in view, studies were conducted on NCU vs ordinary urea at Ludhiana and Kapurthala. At Ludhiana site, the grain yield of rice obtained with 100 kg N ha^{-1} through NCU was statistically similar to that obtained with the application of 120 kg N through ordinary urea. Application of 100 and 120 kg N through NCU resulted in 13.4 and 20.2 per cent increase in yield over similar application made through ordinary urea. Application of 100 and 120 kg N through NCU resulted in 8.4 and 11.2 per cent increase in grain yield of rice over the similar application made through ordinary urea at Kapurthala. The results suggest that 20 kg N can be saved with the application of N through neem coated urea.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Response of Soybean to Varied Levels of Poultry Manure in Sandy Loam Soil of Chikkaballapura District, Karnataka

T. Chikkaramappa, G.M. Prashantha, D.K. Srinivasa, Sahebgouda and K.U. Mallesh
Department of Soil Science and Agricultural Chemistry, College of Agriculture, GKVK, UAS, Bengaluru, 560065, Karnataka

Studies on the response of soybean to different levels of poultry manure with recommended dose of fertilizers was conducted during 2016 at Thondebavi village of Chikkaballapura district, Karnataka. Application of poultry manure at different levels *viz.*, 3 and 6 t ha^{-1} with 100% and 50% of recommended fertilizers with comparison to recommended dose of 100% fertilizers with FYM and absolute control. The results revealed that application of 100% recommended N, P_2O_5 and K_2O along with poultry manure at 6 t ha^{-1} registered significantly higher plant height (82.4 cm), number of leaves (12.3), number of branches (10.6) compared to all other treatments.

Seed and stover yield (1.85 and 2.97 kg ha^{-1}, respectively) were significantly higher with application of 100% recommended N, P_2O_5, K_2O + poultry manure at 6 t ha^{-1}. The lowest seed and stover yields (0.97 and 2.02 kg ha^{-1}, respectively) were recorded in absolute control, whereas 100% recommended N, P_2O_5, and K_2O was applied without any organic manure which shows the importance of organic manure. Yield parameters like higher number of pods (39.3 $plant^{-1}$) seed yield (7.6 g $plant^{-1}$) and also higher number of seeds (3.5 pod^{-1}) were obtained with application of 100% recommended N, P_2O_5, K_2O + poultry manure at 6 t ha^{-1}. Total dry matter production per plant and its accumulation differed significantly at harvest. The treatment received 100 percent recommended N, P_2O_5, and K_2O without organic manure application recorded significantly lower dry matter (30.5 g $plant^{-1}$). While the application of 100% recommended N, P_2O_5, K_2O + poultry manure at 6 t ha^{-1} resulted in maximum dry matter production of 42.2 g $plant^{-1}$.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of P Levels on Growth, Yield and Nutrient Uptake by Soybean Grown in Different Cropping Systems

R. Sikka* and R. Gupta
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab
**Email: sikkar@pau.edu*

Soybean-wheat is the most dominant soybean based cropping system and plays an important role in food security of soybean producing states. Soybean also fits well in other cropping systems such as soybean- spring maize and soybean-gobhi sarson. Soybean being a leguminous crop helps in maintenance of soil fertility and improvement in growth and yield of the succeeding crops. Soybean being a highly nutrient-exhaustive legume as well as an oilseed requires higher amounts of nutrients, particularly phosphorus (P) for its optimum production. The general recommendation for P is to apply in the *rabi* season and skip it during *kharif* for *kharif* crops. But for soybean the recommendation is to apply 80 kg P ha^{-1} for sole crop and 60 kg P ha^{-1} when grown in rotation with wheat having received 60 kg P ha^{-1}. For spring maize and *gobhi* sarson the P recommendation is to apply 60 and 30 kg P ha^{-1}. Preliminary studies have shown that the response to P application is meager beyond 40 kg ha^{-1}. Thus, the present investigation was undertaken to study the effect of P application to soybean in different cropping systems on growth, yield and nutrient uptake by soybean and other crops . The experiment was conducted in split plot design with three cropping systems *viz.*, soybean-wheat, soybean–*gobhi* sarson and soybean-spring maize in main plots and five P levels *viz.*, 0, 20, 40, 60 and 80 kg P ha^{-1} applied to soybean which were kept in the sub plot. All other package of practices were followed for soybean and the following *rabi* crops. The mean yield of soybean remained statistically similar under different cropping systems. Highest mean seed yield of soybean was observed under application of 80 kg P ha^{-1} but significant response to applied P was observed only up to 40 kg P ha^{-1} only and the increase at the 60 and 80 kg P ha^{-1} levels was not significant. The mean seed P uptake of soybean also remained statistically similar under different cropping systems. As observed for yield highest mean seed P uptake of soybean was observed under application of 80 kg P ha^{-1} and it was found to be significantly higher than all other P levels but the P uptake was statistically similar at 40 and 60 kg P ha^{-1} levels. The interaction effects of cropping system and applied P levels were however nonsignificant. No significant residual effect of different levels of P applied to soybean was observed on following *rabi* crops. A significant build-up of available P in surface soil layer was observed.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Boron on Yield and its Allocation in Different Plant Parts of Wheat in Acid Alfisol of Jharkhand

S. Firdous, B.K. Agarwal, Arvind Kumar, A. Wadood and D.K. Shahi
Department of Soil Science and Agricultural Chemistry, Birsa Agricultural University, Ranchi, 834006, Jharkhand

Boron (B) deficiencies occur over a wider range of soils and crops in the India. Boron plays a vital role in pollen tube germination and grain setting. An experiment was conducted in the experimental field of Birsa Agriculture University, Ranchi (Jharkhand) for consecutive two years *i.e.* 2012-13 to 2013-14. The initial soil properties of experimental plot were found pH 4.68, organic carbon 4.1 g kg^{-1}, boron 0.31 mg kg^{-1} and soil texture was sandy loam. The experimental site has a sub-tropical climate with a characteristic feature of dry summer and cold winter. The average annual rainfall of the area is 1398 mm and approximately 80% of it is received during rainy season. The objective of the experiment was to find out the effect of B application for maximizing yield and its allocation in different plant part of wheat. The recommended dose of N, P and K was applied at N: 120 P_2O_5: 60 K_2O: 40 kg ha^{-1} in combination with B at 0 (T1), 1(T2), 1.5 (T3) and 1 kg B ha^{-1} alongwith 2 foliar sprays of B (200 ppm) at tillering and before flowering (T4). The wheat variety K- 9107 was selected for the experiment. The experiment was laid out in RBD with three replications. The concentration of B was monitored at tillaring, pre-flowering and panicle initiation and maturity stages. At tillaring stage concentration was determined considering whole plant. Thereafter, at the pre-flowering stage, plant parts were divided into lower leaf, upper leaf and stem in which the allocation of B was recorded. At panicle initiation stage plant part was divided into lower leaf, middle leaf, upper leaf, spike and stem for translocation study whereas straw, wheat grain and husk were considered for translocation study at maturity stage.

The result showed that the highest yield (4.59 t ha^{-1} grain and 10.2 t ha^{-1} straw yield) was observed under the treatment 1 kg B ha^{-1} + 2 foliar spray of 0.2% borax at tillering and pre-flowering stages, while minimum yield was found in control (3.66 t ha^{-1} grain and 8.66 t ha^{-1} straw yield). The allocation of B in different plant parts was found in an order of lower leaf > stem > upper leaf at pre-flowering stage while at panicle initiation stage the order was lower leaf > stem > upper leaf > middle leaf > spike. At maturity, maximum accumulation of B was found in grain followed by straw and husk. Boron application increased the grain yield and from the observed trend of allocation of B it is inferred that the maximum B remains towards the lower most part and in a decreasing manner towards the sink (spike grain^{-1}).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Sulphur and Zinc Containing Specialty Fertilizers on Seed Cotton Yield, Nutrient Uptake and Soil Fertilityin Vertisols

R.N. Katkar, B. Bairwa, S.R. Lakhe, V.K. Kharche, P.R. Kadu and N.M. Konde
All India Coordinated Research Project on Micro and Secondary Nutrients and Pollutant Elements in Soils and Plants, Department of Soil Science and Agricultural Chemistry, Dr. PDKV, Akola, Maharashtra

The study was conducted at Research Farm, Department of Soil Science and Agricultural Chemistry, Dr. PDKV, Akoladuring *kharif* 2016-17 for assessing the seed cotton yield, nutrient uptake and physicochemical properties, soil fertility with the application of sulphur (S) and zinc (Zn) containing specialty fertilizers in Vertisols. The experiment was laid out in randomized block design with eleven treatments replicated thrice. The soil samples were collected and analyzed for different soil properties and availability of major and micronutrients.

The results revealed that significantly highest seed cotton yield (2.13 q ha^{-1}), number of bolls, boll weight and nutrient uptake were recorded with the application NPK + FYM @ 5 t ha^{-1} which was found at par with recommended dose through specialty fertilizer grade (12:45:00:05:01, NPKS Zn).

Among the specialty fertilizer, the grade (12:45:00:05:01) containing S and Zn recorded highest seed cotton yield, boll weight and nutrient uptake. The highest agronomic efficiency of N, P, K and S were recorded in grade of NPKS Zn (12:45:00:05:01) as compared to grade NPKS (19:38:00:07) and grade NPKS (12:46:00:07) treatments, while agronomic efficiency of Zn was recorded highest in the treatment of recommended dose through NPSZn plus compensation N and K through conventional sources followed by equivalent quantity of nutrients through treatment of conventional sources.

The findings pertaining to soil properties indicated that the significant improvement in organic carbon content, available N, P and K with the application of recommended dose of NPK (60:30:30, N, P_2O_5 and K_2O + FYM @ 5 t ha^{-1} was found at par with nutrient supplied through specialty fertilizer grade of NPKS Zn (12:45:00:05:01). In specialty fertilizer grades, the nutrients supplied through grade ofNPKS Zn (12:45:00:05:01) recorded higher Zn and S availability in soil after harvest of cotton.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Status of Available Plant Nutrients in Bathinda District, Punjab, India

B.K. Yadav, A.S. Sidhu and Deepak Kumar
Punjab Agricultural University, Regional Station, Bathinda, 151001, Punjab

The aim of this study was to evaluate availability of macro and micronutrient and nutrient index value in soils of Bathinda district. A total of 1581 soil samples were collected and analyzed for pH, electrical conductivity (EC), organic carbon (OC), available P, available K and DTPA-extractable micronutrients. Soil pH ranged from 6.5 to 10.2 and EC from 0.50 to 0.71 dS m^{-1}. It was revealed that about 80-90% soil samples were non-saline and 10-20% samples were saline in nature. The mean value of OC varied between 0.21 to 0.55% and showed that 61 to 70% samples were deficient in organic carbon. The value of available P content varied from 2.5 to 95.0 kg ha^{-1} with an average mean value of 15.6 kg ha^{-1} in the district, In general, available P ranged from low to medium, but high values of available P are also found in some part. Potassium content of these soils are generally medium to high and only about 10% soil samples showed K deficiency.

The available Fe varies between 0.25 to 45.0 mg kg^{-1}, available Cu varies between 0.02 to 5.60 mg kg^{-1}, available Zn varies between 0.40 to 10.90 mg kg^{-1} and available Mn varies between 0.50 to 30.0 mg kg^{-1} with mean value of 7.23, 0.93, 2.21 and 6.59 mg kg^{-1}, respectively depicted that on an average the soils were adequate in Fe, Cu, Zn and Mn contents. However, 21 and 22% soil samples were reported in Fe and Mn deficient during the study. Whereas, only 5 and 6% soil samples were reported in Cu and Zn deficient. The nutrient index representing fertility status of soil observed that the soils of the district are generally low in available N, low to medium in available P, medium to high in available K and sufficient in supply of Fe, Cu, Zn and Mn content.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Application of Vermicompost on Growth and Yield of Soybean in Eastern Dry Zone of Karnataka

T. Chikkaramappa, G.M. Prashantha, D.K. Srinivasa, Sahebgouda and K.U. Mallesh
Department of Soil Science and Agricultural Chemistry, College of Agriculture, GKVK, UAS, Bengaluru, 560065, Karnataka

An experiment was conducted in sandy loam soil of eastern dry zone of Karnataka in 2015-16 to know the effect of vermicompost on growth and yield of soybean. The experiment was laid out in RCBD with the different levels of vermicompost at the rate of 3 and 6 t ha^{-1} with 100 and 50% of recommended dose of fertilizers. Soybean variety MAUS-2 was used as a test crop, the soil of the experimental site is sandy loam, neutral in reaction, medium organic carbon content, low in plant available nitrogen and medium range of available phosphorus and potassium. From the experimental results, noticed that application of organic sources of nutrients (vermicompost) with recommended dose of inorganic fertilizers (NPK) and FYM, the soybean responds very well compared to application of only recommended dose of NPK and FYM.

The experimental results showed that, application of 100% recommended N, P_2O_5 and K_2O along with vermicompost at 6 t ha^{-1} registered significantly higher plant height (71.5 cm), number of leaves (11.2), number of branches (10.2 $plant^{-1}$) compared to application of 50% recommended NPK + 3t ha^{-1} of vermicompost, recommended dose of fertilizers and absolute control. Seed yield (1.44 t ha^{-1}) and stover yield (2.47 t ha^{-1}) were significantly higher with application of 100% recommended N, P_2O_5, K_2O + vermicompost at 6 t ha^{-1}. The lowest seed (0.97 t ha^{-1}) and stover yield (2.02 t ha^{-1}) were recorded in absolute control. The application of 100% NPK + 6 t ha^{-1} of vermicompost was superior over the application of 100 percent recommended NPK + 3 t ha^{-1} of vermicompost, 50% of recommended fertilizers along with 6 and 3 t ha^{-1} of vermicompost and application of recommended dose of fertilizers and absolute control. It can be concluded that the organic manures namely vermicompost and FYM in combination with each other can be used for soybean crop in place of chemical fertilizers, as these manures gave higher yield with the RDF.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Site Specific Nutrient Recommendation on Crop Yield and Nitrogen Use Efficiency (NUE) in Rice-Maize Cropping Sequence

D. Ray, A.K. Sinha, P. Mukhopadhyay and S. Dutta[1]
Department of Soil Science and Agricultural Chemistry, UBKV, Pundibari, Coochbehar, 736165, West Bengal
[1]International Plant Nnutrition Institute, South Asia program

Farmers' participatory site specific nutrient management trials were conducted in rice-maize cropping sequence in Coochbehar district, West Bengal to assess the effect of nutrient recommendation by decision support tool – Nutrient Expert®. Four treatments (NPK, PK, NK and NP) were imposed to observe the response of indigenous nutrient elements on rice and maize. The indigenous nitrogen supply (INS) was estimated from omission plots trials that varied from 69.0 to 88.2 kg ha^{-1} and 93.4 to 141.5 kg ha^{-1} in rice and maize, respectively. The trend obtained in this study indicate that the INS plays an important role in adjusting the fertilizer doses as there was better response to fertilizers application where INS was observed to be lower. Nitrogen was found to be most limiting nutrient and application of nitrogen along with phosphorus and potassium resulted in attaining the targeted yield (4.0 t ha^{-1} and 7.5 t ha^{-1}) for both the crops. In this study, nitrogen use efficiency (NUE) have been estimated to addresses some but not all aspects of the performance of the crop production system. Partial factor productivity (PPF_N) is a simple production efficiency expression that varied in rice from 39.0 to 74.6 kg grain kg^{-1} nutrients in the present study. The average PPF_N of maize is estimated to be lower than the rice and it varied from 42.5 to 53.3 kg grain kg^{-1} nutrients. Agronomic efficiency (AE_N) varied from 9.8 to 26.7 kg kg^{-1}, with an average of 19.7 kg kg^{-1} in maize, and varied from 1.83 to 35.7 kg kg^{-1} with an average of 13.4 kg kg^{-1} in rice. The low value of AE_N was detected, mainly because there was slight increase in grain yield due to the application of N compared to zero-N plots. The lower apparent recovery efficiency of nitrogen (RE_N) (20%) was recorded in maize due to the interactive effects of indigenous nutrient supply, fertilizer application, and crop nutrient uptake for a targeted yield. Internal efficiency (IE_N) is used to evaluate the ability of plants to transform nutrients acquired from all sources (soil and fertilizer) into economic yield (grain). In the present study, the IE_N was found to be optimum for both the rice and maize. The use efficiency parameters indicate that in Coochbehar NUE declined with increasing N rates. The indigenous nutrient supplying capacity should also be taken into consideration for developing any fertilizer schedule.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Response of Vermicompost and Elemental Sulphur Levels on the Productivity of Mustard

V.K. Singh, I.S. Tomar and U.P.S. Bhadoria[1]
Krishi Vigyan Kendra (R.V.S.K.V.V.), Jhabua, 457661, Madhay Pradesh
[1]RVSKVV, Gwalior, Madhya Pradesh

A field experiment was conducted during two consecutive years of 2014-15 and 2015-16 at Krishi Vigyan Kendra farm to study the response of vermicompost and sulphur levels on mustard. The treatment consisted of four level of vermicompost (0, 2, 4 and 6 t ha^{-1}) and four level of sulphur (0, 20, 40 and 60 kg ha^{-1}) applied through elemental sulphur were tested in RBD replicated thrice. Application of 6 t ha^{-1} vermicompost and 40 kg S ha^{-1} significantly increased seed and stover yield and yield attributes as compared to control. Oil content and total uptake of nitrogen (N), phosphorus (P), potassium (K) and sulphur (S) increased significantly up to 6 t vermicompost ha^{-1} and 60 kg ha^{-1}. Highest net return was recorded with the application of vermicompost ha^{-1} and 40 kg S ha^{-1} but benefit: cost ratio was recorded highest with the application of 4 t vermicompost ha and 40 kg ha^{-1}.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Nitrogen and Sulphur on Yield and Quality of Sesame

Aritra Kumar Mukherjee*, Kaushik Batabyal, Animesh Ghosh Bag, Gayatri Sahu and Nitin Chatterjee
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur. Nadia, 741252, West Bengal
**Email: aritrakm@gmail.com*

A field experiment was conducted using three levels of nitrogen (N) *viz.*, 60, 90 and 120 kg ha^{-1} and three levels of sulphur (S) *viz.*, 20, 40 and 60 kg ha^{-1} using sesame as the test crop. During flowering stage, leaf chlorophyll content was determined. After harvesting the crop, stover and grain yield was recorded. Oil content in seeds, contents of N, P, K, and S in stover and grain were analyzed. Stover and grain yield was increased with increasing application of N and S. The highest grain yield (706 kg ha^{-1}) was recorded with application of highest doses of both of the nutrients. Oil content of sesame varied from 41.8% to 46.2%. Nitrogen application increased oil content. Sulphur application resulted in increased oil content up to S_{40}. Oil yield varied from 195 kg ha^{-1} to 310 kg ha^{-1}. Increased doses of both the nutrients resulted in maximum oil yield in $N_{120}S_{60}$ treatment. Chlorophyll content of leaves at flowering stage varied from 1.97 to 2.39%. Nitrogen and S increased N content in both grain and stover. Sulphur application resulted in decreased P content in grains. Nitrogen and S application increased S content in grains. Sulphur application increased grain K content. Increased N and S application increased N content in stover. Phosphorus content in stover varied from 0.154 in plots receiving minimum doses of both the nutrients to 0.213% in $N_{90}S_{20}$ treatment. Sulphur content in stover ranged between 0.124 and 0.189%. Increased N application at N_{90} resulted in increased K content in stover and thereafter decreased the values. Application of S @ 40 kg ha^{-1} resulted in increased K content in stover. Nitrogen and S application increased total uptake of N and K. Both the nutrients interacted positively and significantly in increasing P uptake. No treatment effect was found to be statistically significant in increasing S uptake. Protein content ranged between 16.0 to 18.2%. Increasing N application up to 90 kg ha^{-1} increased protein content significantly. Further increase in N application resulted in no significant effect. Sulphur application up to S_{40} resulted in increase in protein content in sesame seeds.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Impact of Integrated Fertilization Based on Soil Test Targeted Yield and Economics of Rice-Wheat Cropping Sequence

A.K. Upadhyay*, S.S. Baghel, B. Sachidanand and Pradip Dey[1]
Department of Soil Science and Agricultural Chemistry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh
[1]Indian Institute of Soil Science, Bhopal, Madhya Pradesh
**Email: upadhyayamit8@gmail.com*

Field experiments for consecutive two years, 2014-15 and 2015-16 were conducted at the Research Field of Soil Science and Agricultural Chemistry, JNKVV, Jabalpur to evaluate the impact of fertilizers integrated with organic manure applied on soil test based targeted yield and economics for rice and wheat crops under rice-wheat cropping sequence. The experiment was laid out in permanent plot with six treatments (T_1: Control; T_2: GRD; T_3: T.Y. 50 q ha^{-1} for rice and 45 q ha^{-1} for wheat; T_4: T.Y. 60 q ha^{-1}; T_5: T.Y. 50 q ha^{-1} + FYM 5 t ha^{-1} for rice and 45 q ha^{-1} + FYM 5 t ha^{-1} for wheat and T_6: T.Y. 60 q + FYM 5 t ha^{-1}) based on targeted yield of rice and wheat replicated four times in randomized block design. The experimental soil was medium black belonging to fine, montmorillonitic, hypothermic family of Typic Haplustert, with having neutral to slightly alkaline reaction, normal electrical conductivity, low in available nitrogen and medium in phosphorus and potassium.

The integrated effect of the applied fertilizers significantly increased average grain yield of rice and wheat of two years having 5841 and 5395 kg ha^{-1} were achieved with fixed targeted yield of 60 q + FYM 5 t ha^{-1}, which deviated by ± 2.65 and 10.10%, respectively. However, the minimum grain yield of 2875 kg ha^{-1} in rice and 2625 kg ha^{-1} in wheat were registered under control. The response of the treatments were maximum in rice and wheat having 2965 and 2765 kg ha^{-1} with cost of response of Rs. 45940 and 45635 ha^{-1} were found in the fixed target of 60 q + FYM 5 t ha^{-1} in both rice and wheat crops, However, the B:C ratio of 3.49 and 3.15 and yard stick value of 7.87 and 6.73 were calculated in fixed targeted yield of 50 q ha^{-1} in rice and 45 q ha^{-1} in wheat crops, respectively.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Integrated Nutrient Management Practice on Growth of Young Rubber in Tripura- A Case Study

Debasis Mandal* and Mercykutty Joseph[1]
Regional Research Station, Rubber Research Institute of India, Agartala, 799006, Tripura
[1]Rubber Research Institute of India, Kottayam, Kerala
**Email: dmandal@rubberboard.org.in*

Integrating biofertilizer with an optimum dose of chemical fertilizers could improve the growth of plants beside sustain the soil fertility at a desired level. With this objective, a field experiment was conducted during 2009-2015 at Taranagar, West District of Tripura to study the effect of integrated nutrient management practices on growth of young rubber plants and soil chemical properties. The experiment was laid out in a randomized block design with RRIM 600 as the study material, having seven treatments and three replications. The treatments were: no fertilizer as control (T_1), standard fertilizer recommendations (SR : T_2), 25% of N and P of SR + bioinoculants (T_3), 50% of N and P of SR + bioinoculants (T_4), 75% of N and P of SR + BI (T_5), 100% of N and P of SR + BI (T_6), and BI alone (T_7). Normal dose of K was applied in all the treatments except control and bio fertilizer alone treatments. Girth and height of the plants were recorded periodically. Soil and leaf samples were analyzed to assess the nutrient availability. A significant increase in girth and height was recorded during the initial two years of plantation due to imposition of treatments and it was more pronounced under the treatment T_4 when BI was applied along with half of the prescribed dose of N and P. This treatment was continued to attain higher girth during the subsequent years and its girth was on par with standard fertilizer recommendation (T_2). Application of BI (T_7) alone effected a significant improvement in girth over control plants during the early immature phase of plantation but its effect was found non-significant from 3rd year onwards suggesting that addition of BI alone was not sufficient to meet the nutrient demand of plants. It was also observed that girth increment of plants were higher when chemical fertilizers were applied along with BI. A combination of 50% of standard recommendation of N and P and bioinoculants together with recommended dose of K was found sufficient for achieving sustained growth of young rubber plants besides maintaining the soil fertility in a desired level.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of Performance of Soil Test Based Fertilizer on Yield of Potato in Farmers' Field of Hooghly District of West Bengal

K. Barui, N. Gayen, N. Mudi, A.K. Chowdhury and S.H. Ansary and F.H. Rahman*
Hooghly Krishi Vigyan Kendra, Bidhan Chandra Krishi Viswavidyalaya,
Chinsurah, 712102, West Bengal
**Email: fhrahmancal@gmail.com*

Potato is the most important commercial crop in Hooghly district influencing the socio-economy of farmers of this district to a greater extent. Extensive use of chemical fertilizer without soil testing not only minimizes the profit margin by increasing the cost of cultivation but also affecting the soil health by different means. Hooghly Krishi Vigyan Kendra conducted a field experiment through FAI-APP Soil Health Enhancement Programme for three years during 2011-12 to 2013-14 in association with Fertilizer Association of India at farmers' field of Hooghly district of West Bengal during *rabi* season to assess the influence of soil test based fertilizer for increasing production of potato and enhancing the profit of farmers. The experiment was laid out in randomized block design with 7 number of replication and 3 treatments. The treatments comprise of Technology Option-I *i.e.* Farmers practice (FP), Technology Option II *i.e.* Farmers practice + BMP and Technology Option- III is Demonstration (Soil test based fertilizer) + BMP. From the results, it has been observed that TO III gave the highest average yield (35.03 t ha^{-1}) which is 12.3 per cent higher than the FP. As like yield, average highest net return (Rs. 93,352.50 ha^{-1}) and B:C ratio (2.13) were also recorded in TO-III *i.e.* The FAI-APP experimented plot where fertilizer was applied as per soil test based result along with best management practices.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Application of Potassic Fertilizers on the Activity of Some Beneficial Soil Microorganisms in New Alluvial Soils of West Bengal

Chandra Sekhar Paul[1], Monidipta Saha[2] and Narayan Chandra Sahu[2]
[1]*Integrated Rural Development and Management Faculty Center, Ramakrishna Mission Vivekananda University, Narendrapur, Kolkata, 700103, West Bengal*
[2,3]*Sasya Shyamala Krishi Vigyan Kendra, Ramakrishna Mission Vivekananda University, Arapanch, Sonarpur, Kolkata, 700150, West Bengal*

To evaluate the effect of different potassic fertilizers application on soil microbial activities, an experimental study was conducted under pot culture condition with two alluvial soils (Mandouri, Nadia and Sudhangsupur, South 24 Parganas district) under application of different doses (@40, 110 and 180 kg ha^{-1}) of two potassium fertilizers (KCl and K_2SO_4). The changes of different soil physicochemical properties (pH, EC_e, OC, available P and K) and soil microbial activities (microbial respiration and population of agriculturally beneficial some microorganisms) were determined by standard procedures. The results obtained from the study registered a little reduction of soil pH under fertilizers treatment as compared to control in both soils which might be due to the release of hydrogen ions from exchange complex. The EC_e was found to increase with increasing doses which might be due to increase in concentration of salt in soil solution for fertilizers application. No significant change of OC content of the soil was found. Available P content of the soils was also increased with increase in dose of fertilizer as well as incubation period which might be due to increase in microbial population including phosphate solubilizing bacteria. It was observed that there was an increase of microbial population with increase in dose of fertilizers and also with progress of incubation periods. It was revealed that the application of KCl and K_2SO_4 at lower doses stimulated the free living nitrogen fixing bacteria and *Rhizobium* sp. population in both soils in comparison to higher doses and the effect was more prominent in KCl. The reduction might be attributed to the increase of ECe values with higher doses of KCl which imparted a stress and resulting in the decrease of the populations. The same trend was also observed for the phosphate and potassium solubilizing bacterial population. But population of the potassium solubilizing bacteria was found to increase during the later periods. It was observed that both fertilizers significantly increased the *Pseudomonas* population as compared to the control. The increased *Pseudomonas* population at higher doses of fertilizers might be attributed to the excretion of the exo-polysaccharides by the *Pseudomonas* sp. which may binds the excess salt ions (Na^+, K^+, *etc.*) in the soil solution resulting a decrease of the salinity stress. It was noticed that the application of the KCl and K_2SO_4 both significantly increased the basal soil respiration as compared to the untreated soil. This might be due to the increasing microbial population with increasing doses which might be attributed to the fact that fertilizers addition generally stimulates the microbial ecosystem. Thus, it may be concluded that may higher doses of potassium fertilizers initially affects the microbial population, but with progress of time the equilibrium was restored which indicated that no such strong adverse effect on microbial activity was sustained in the soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Soil and Foliar Application of Zinc on Grain Yield and Zinc Concentration of Rice and Wheat Grown in a Cropping System

S.P. Saini*, B.S. Brar, G.S. Dheri, Vijay Singh and Pritpal-Singh
Department of Soil Science Punjab Agricultural University, Ludhiana, 141 004, Punjab
**Email: satpalsaini@pau.edu, gahuniasp1962@gmail.com*

Experiments were conducted under rice–wheat cropping system at farmer's fields in Mansa, Hoshiarpur, Ropar, Amritsar and Fatehgarh Sahib districts to evaluate the effect of soil and foliar application of zinc (Zn) on crop (rice and wheat) grain yield and Zn content. Soils at experimental sites were slightly alkaline (pH=8.1-8.3), low to medium in soil organic carbon (SOC), and sufficient in available Zn (DTPA-Zn=2.38 to 3.04 mg kg^{-1}). The treatments of the experiment were T_1 (NK), T_2 (NPK+DAP), T_3 (NPK+ SSP), T_4 (NPK+ZnDAP), T_5 (NPK+ZnSSP), T_6 (NK+0.5% $ZnSO_4$ Spray), T_7 (NPK+DAP+0.5% $ZnSO_4$ Spray), T_8 (NPK+SSP+0.5% $ZnSO_4$ Spray), T_9 (NPK+ZnDAP+0.5% $ZnSO_4$ Spray), and T_{10} (NPK+ZnSSP+0.5% $ZnSO_4$ Spray). Average across different experimental sites, wheat yield with Zn application to soil as ZnDAP or ZnSSP did not differed significantly, compared to the application of DAP and SSP. Foliar application of Zn along-with ZnDAP or ZnSSP significantly increased grain yield of wheat as compared to NK+Zn spray. Wheat grain yield was higher under soil application of ZnSSP alone, followed by a single spray of Zn as compared to other treatments. Rice grain yield with soil application of Zn as ZnDAP or ZnSSP also did not differed significantly as compared to the application of DAP and SSP. Foliar spray of Zn along with ZnDAP significantly increased grain yield of rice as compared to DAP. The concentration of Zn in wheat and rice grain significantly increased with ZnDAP (T_4), compared with the application of DAP. Foliar application of Zn along with soil application of ZnDAP or ZnSSP significantly increased the Zn concentration in grain of wheat as compared to the application of DAP and SSP application.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Soil Applied Boron to Sugarbeet (*Beta vulgaris* L.) Sandy Soil of Punjab

Jasveer Singh, Kuldip-Singh, Dhanwinder Singh and Simerjeet-Kaur
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab

Sugarbeet (*Beta vulgaris* L.) is not only the source of sugar but also provides several by-products like ethanol, cattle feed. Molasses can be used in pharmaceutical industry for vitamin B-12. The low availability of micronutrients especially boron (B) represents the main problem affecting agricultural development in arid and semiarid regions. Boron deficiency is the second most widespread micronutrient problem and dicotyledon species tend to be more sensitive to B deficiency than graminaceous crops as well as B deficiency is a particular problem on alkaline and heavily limed soils and on highly leached sandy soils. Boron is probably more important than any other micronutrients to produce high yield quality of sugarbeet. Therefore, a field experiment was initiated to study the influence of soil applied B through borax ($Na_2B_4O_7.10H_2O$ with 11%) on yield and yield attributes of sugarbeet (cv. PAC 60008) in sandy soil of Punjab at the Research Farm of Punjab Agricultural University, Ludhiana. Six levels of B (0, 0.5 0.75, 1.0 and 1.5 and 2.0 kg ha^{-1}) were tested in a randomized complete block design with three replications. With increasing rate of B application, a significant and progressive increase in available B was noticed which consequently increased B content in root and foliage of the sugarbeet. Application of B applied at the rate of 1.0 kg B ha^{-1} produced significant higher root yield (78.1 t ha^{-1}), foliage yield (12.1 t ha^{-1}), root perimeter, root length and sugar content (14.7%) of sugarbeet crop. Further, an increase in boron level non-significantly increases in root yield, foliage yield, root diameter, root length and sugar content was observed. Therfore, application of B at the rate 1.0 kg B ha^{-1} is optimum for obtaining economic yield. This signified that sugarbeet responded significantly to 1.0 kg B ha^{-1} application and resulted in 5 per cent increase in root yield over control.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Zinc Fortified Phosphatic Fertilizers on Zinc Content of Grain and Crop Yield of Rice and Wheat Grown in a Cropping System

S.P. Saini*, B.S. Brar, G.S. Dheri, H.S. Uppal and Pritpal-Singh
Department of Soil Science Punjab Agricultural University, Ludhiana, 141 004, Punjab
**Email: satpalsaini@pau.edu, gahuniasp1962@gmail.com*

Field experiment was conducted (2014-16) to assess the effect of zinc (Zn) fortified phosphatic fertilizers on Zn content in grain and crop yield of rice (*Oryza sativa* L.) and wheat (*Triticum aestivum* L.), grown under rice-wheat cropping system. Fertilizer application treatments consisting of NPK (P through DAP), NPK+Zn_{soil} ($ZnSO_4 \cdot 7\ H_2O$ @ 60 kg ha^{-1}, and P through DAP), NPK (P through ZnDAP), NPK+Zn_{foliar} (0.5% $ZnSO_4 \cdot 7\ H_2O$ at anthesis, and P through DAP), NPK+Zn_{foliar} (2 sprays, each of 0.5% $ZnSO_4 \cdot 7\ H_2O$ at anthesis and early grain development stage, and P through DAP), NPK (P through SSP), NPK+Zn_{soil} ($ZnSO_4 \cdot 7\ H_2O$ @ 60 kg ha^{-1}, and P through SSP), NPK (P through ZnSSP), NPK+Zn_{foliar} (0.5% $ZnSO_4$. 7 H_2O at anthesis, P through ZnSSP), NPK+Zn_{foliar} (2 sprays, each of 0.5% $ZnSO_4 \cdot 7\ H_2O$ at anthesis and early grain development stage, and P through ZnSSP). Wheat grain yield did not differed significantly (*$p<0.05$*) among treatments involving P application through DAP and SSP or ZnDAP and ZnSSP. Foliar application of Zn at anthesis and at early development stage resulted in significantly higher wheat grain yield, compared with control (without foliar application). Application of ZnDAP or ZnSSP was equally efficient in bio-fortification of Zn in wheat grains as compared to the application of $ZnSO_4$ with DAP or SSP, respectively. Single spray of Zn and application of ZnDAP or ZnSSP was as effective as of double spray of Zn with DAP or SSP, respectively. Soil application of $ZnSO_4$ or ZnDAP or ZnSSP did not significantly change the rice grain yield. Single foliar spray of $ZnSO_4$ along with ZnDAP or ZnSSP resulted in significantly higher rice yield, compared to no-Zn application. Two foliar sprays of $ZnSO_4$ with DAP and SSP were superior to soil application of Zn.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of Soil Fertility Status under Rice-Wheat Cropping System of South-Eastern and South-Western Districts of Punjab

Ashok Kumar
Punjab Agricultural University-Krishi Vigyan Kendra, Sangrur, 148001, Punjab
Email: ashoksangrur@gmail.com

Soil fertility refers to the assessment that permits the soil to provide the required nutrients in proper amount and in proper balance for the growth of particular plant. Continued maintenance of a high level of soil fertility is indispensable for profitable land use and sustained agricultural production. Out of the different methods for soil fertility evaluation, soil testing, is used to assess the fertility status of south-western district i.e. Ferozepur (30°58′ N latitude and 74°37′ E longitude) and south-eastern district *i.e.* Patiala (30°40′ N and 76°39′ E) districts of Punjab. Rice-wheat system is the major cropping system in these districts at present, occupying about 2,34,000 ha under rice and the same under wheat crop in Patiala, and 3,97,000 ha under wheat and 2,62,000 ha under paddy in Ferozepur. The soil samples (0-15 cm soil layer) collected during 2007 to 2012 from Ferozepur were air-dried in shade, crushed gently with pestle and mortar, and then sieved through 2.0 mm sieve to obtain a uniform soil sample. The processed samples were analyzed for physicochemical properties. Soil pH and electrical conductivity (EC) was determined using soil: water extract (1:2 ratio). Soil organic carbon (OC) was determined by dry combustion method, available phosphorus (P) was extracted by 0.5 *M* $NaHCO_3$ solution and available potassium (K) was extracted using neutral normal ammonium acetate. After analysis, most of the samples from Ferozepur were found to be loamy sand to sandy loam in texture. The soil pH was neutral (6.5-8.7 pH) and alkaline (8.7 to 9.3) in 91 and 8.5% samples, respectively. The EC was more than 0.8 dS m^{-1} in 15% samples only. Twenty eight per cent samples were found low in OC (<0.4%), 43% were medium (0.4-0.75%) and 29% were high (>0.75%). The available P content was low (<12.5 kg P ha^{-1}), medium (12.5-22.5 kg P ha^{-1}) and high (>22.5 kg P ha^{-1}) in 14, 24 and 62% samples, respectively. The available K was found sufficient (>138 kg K ha^{-1}) in 88% samples. Similarly, results of soil samples collected from Patiala (during 2008 to 2012), were found neutral and alkaline pH in 58 and 42% samples, respectively. Soil salinity was not a problem in Patiala except 5% samples. The OC and P was observed low, medium, high in 22, 65, 13 and 6, 79, 15% samples, respectively. The available K was sufficient in 91% samples. Results of the analysis showed that problem of alkalinity is more in case of Patiala and problem of salinity was reported in Ferozepur.

Application of higher dose of N and P fertilizers than recommended dose may be avoided in Ferozepur as nearly 30 and 60% samples are high in OC and P, respectively. Results of the analysis suggest that soil testing is vital tool for knowing the balance fertilizer requirements of that particular soil so that the farmers can save costly inputs and check deterioration of environment from global warming, nitrate leaching and eutrophication *etc*.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Zinc and Sulphur on Yield and Quality of Safflower (*Carthamus tinctorius* L.) in Alfisol

Nandini Roy* and G.K.Ghosh
Department of Soil Science and Agricultural Chemistry, Palli-Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan, West Bengal
**Email: nandini.agri.2012@gmail.com*

The role of sulphur (S) and zinc (Zn) in balanced fertilizer and consequently in crop production is being increasingly realized. The S and Zn deficiencies are widespread in red and lateritic soils resulting sub-optimum yield and poor quality of the produce. A field experiment was conducted at Agriculture Research Farm at Palli-Siksha Bhavana, Visva-Bharati, Sriniketan in lateritic soil during *rabi* season 2015-2016 to assess the effect of graded levels of Zn and S on yield and quality of safflower. The experiment was laid out in randomized block design with 8 treatments *viz*., control, RDF $N_{60}P_{40}K_{40,}$ RDF+ Zn@2.5 kg ha^{-1}, RDF+Zn@5 kg ha^{-1}, RDF+Zn@2.5 kg ha^{-1}+S@40 kg ha^{-1}, RDF+Zn@2.5 kg ha^{-1}+S@60 kg ha^{-1}, RDF+Zn@5 kg ha^{-1}+S@40 kg ha^{-1}, RDF+Zn@5 kg ha^{-1}+S@60 kg ha^{-1}. A significant increase in seed yield, oil yield, total biological yield, protein content and uptake of nutrients were observed with graded levels of Zn and S. The results indicated that application of 2.5 kg Zn and 40 kg of S along with recommended doses of $N_{60}P_{40}K_{40}$ fertilizer ha^{-1} resulted maximum oil content and oil yield of safflower. The combination of higher doses of Zn @5.0 kg ha^{-1} and 60 kg S ha^{-1} resulted higher uptake of nutrients and mostly at par with yield and yield attributing characters. It is interesting to note that application of Zn and S resulted about two-fold oil yield increase over control.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Long-Term Use of Organic Manures and Inorganic Fertilizers on Soil Fertility and Sustainable Productivity of Pearl Millet–Mustard Cropping Sequence

P.S. Tomar, Naresh Gupta, S.K. Verma and D.S. Dhadouria
Department of Soil Science and Agril. Chemistry, R.V.S.K.V.V., College of Agriculture, Gwalior, Madhya Pradesh

Stagnation or decline in yield has been observed in many cropping systems in many parts of country due to nutrient depletion, imbalance use of plant nutrients and sub-optimal addition of organic and inorganic fertilizers to soil. Many workers are of opinion that use of imbalanced nutrients (N or NP alone) through inorganic fertilizers without organic manure in continuous cropping cannot sustain the desired level of crop production. Integration of inorganic with organic manures will not only sustain the crop production but also be effective in improving soil health and enhancing the nutrient use efficiency. Pearl millet (*Pennisetum glaucum*) - mustard (*Brassica Juncea*) cropping sequence is extensively grown in northern part of Madhya Pradesh. Long-term fertilizers experiments may provide precise information on the change in soil fertility and productivity and could be of great helps in solving the soil fertility problems.

Present study (2003-2013) is a part of ongoing experiment with pearl millet-mustard cropping sequence in progress since 2003 *kharif* at the Research farm of the Department of Soil Science and Agricultural Chemistry, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh. The soil of experimental field is alluvial belonging to Inceptisol hyperthermic family of Typic Ustochrept. There were sixteen treatments *viz.*, T_1-control, T_2-50% NPK, T_3-75% NPK, T_4-100% NPK, T_5-150% NPK, T_6-100% NP, T_7-100% N, T_8-100% NPK-S, T_9-50% NPK + *Azotobacter*, T_{10}-75% NPK+ *Azotobacter*, T_{11}-100% NPK+ *Azotobecter*, T_{12}- 100% NPK + *Azotobacter* +PSB, T_{13}- 50% NPK+ FYM, T_{14}- 75% NPK+ FYM, T_{15}-100% NPK + FYM, T_{16}-100% NPK+ FYM+ *Azotobacter* + PSB, each treatment was replicated three times in a randomizes block design.

Results are clearly indicated that the balance application of nutrients increased the productivity of the system and incorporation of FYM enhanced it further. With application of 100% N alone for 10 years, average yields of pearlmillet and mustard recorded were 2.63 and 1.32 t ha^{-1}. Integration of P with N and K with NP raised the yield of pearlmillet to 3486 and 3679 kg ha^{-1} and that of mustard to 1.78 and 1.98 t ha^{-1}, respectively. Incorporation of FYM with NPK further pushed productivity of pearlmillet and mustard to 3.85 and 2.31 t ha^{-1}, respectively. Sustainability yield index (SYI) was highest (0.88 and 0.86) with T_{16} which receive integrated nutrient of organic + bio + inorganic and this was followed by T_{15} (organic + inorganic) nutrient application. Among the inorganic fertilizers, continuous application of N, NP adversely affected the available K content of the soil, which may be attributed to non application of potassic fertilizer, which also resulted in nutrient imbalance in the soil. Continuous omission of K in pearl millet-mustard caused mining of its native pools also resulted reduction in yield.

These findings showed that the integration of FYM @ 10 t ha^{-1} yr^{-1} and biofertilizer with NPK sustained higher productivity and uptake of nutrients by the crops and not only restored the original fertility status of soil but also increased their status at harvest which may be beneficial for the sustainable agriculture.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Integrated Nutrient Management on Quality of Mustard and Soil Fertility Status in an Alluvial Soil

P.S. Tomar, S.K. Verma and D.S. Dhadouria
Department of Soil Science and Agricultural Chemistry, R.V.S.K.V.V., College of Agriculture, Gwalior, Madhya Pradesh

Mustard (*Brassica juncea* L.) is a second important oil seed crop in India after groundnut in area and production. Nitrogen (N), phosphorus (P) and potassium (K) as major nutrients and sulphur (S) among the secondary nutrients play an important role in the yield and quality of mustard. If the nutrients in the soils are not present in adequate quantities and proportion as required for the plants to produce maximum yields on a sustainable basis, there is a need to add plant nutrients to the soil through mineral fertilizer, organic manures and biofertilizers. Keeping in view, present experiment was carried out with 12 different treatment combinations of FYM and NPKS at 2011-15 at the Research farm of the Department of Soil Science and Agricultural Chemistry, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh.

Results indicated that the application of balanced fertilizer at optimum level (100% NPK) recorded significantly higher yield of mustard by 47.1, 15.5 and 11.7 per cent over 100% N, 100% NP and 100% NPK-S treatments, respectively. Uptake of nutrients more or less followed the content and yield pattern and total uptake of nutrients (NPKS) increased with their application to the crop. A linear significant increase was observed in oil content in mustard seed up to 150% NPKS level. Balanced nutrition of NPK at optimum level (100% NPK) also showed significantly higher oil content as compared to 100% N, 100% NP and 100 NPK-S. Treatments containing FYM and PSB were superior in increasing the organic carbon content compared to NPK applied alone. Application of NPK with FYM and PSB recorded significantly higher available P than NPK applied alone. Declining trend in available K status over initial was observed in the treatments which did not receive K. The decline in available S status was in all the treatments except 150% NPK level or with additional application of FYM with 75 and 100% NPK.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Evaluations of Soil Fertility Status in Mustard Growing Field of Gwalior District

Naresh Gupta, S.K. Singh, R.S. Kushwah and U.P.S. Bhadauria[1]
Krishi Vigyan Kendra, RVSKVV, Gwalior, Madhya Pradesh
[1]RVSKVV, Gwalior, 474002, Madhya Pradesh

Gwalior district is situated in the Gird Agro Climatic Zones of Madhya Pradesh. The soils of the district are under the broad group of alluvial soils and medium black soils in patches. Soil fertility is one of the important factors controlling yields of the crops. Macronutrients (N, P and K) and micronutrients (Zn, Cu, Fe and Mn) are important soil elements that control its fertility. Soil characterization in relation to evaluation of fertility status of the soil of an area or region is an important aspect in context of sustainable agriculture production. Because of imbalanced and inadequate fertilizers use and coupled with low efficiency of other inputs, the response (production) efficiency of chemical fertilizers nutrients declined tremendously under intensive cultivation in recent years. Variation in nutrients supply is a natural phenomenon and some of them may be sufficient where others deficient. Keeping this view, one hundred one (101) GPS based soil samples were collected from different mustard growing cultivator's fields in Gwalior district under oilseed cluster programme during the year 2016.

The soil of mustard growing field was normal in soluble salts having pH values of 7.2-7.8 and show low status of organic carbon content. Available N, P, K and S varied from 161.5–256.8, 8.25–33.54, 162.4–442.4 and 11.28–48.30 kg ha^{-1} with the mean value of 213.1, 18.5, 242.0 and 21.16 kg ha^{-1}, respectively. Available (DTPA-extractable) Zn, Cu, Fe and Mn were observed in the range of 0.24–2.51, 0.22–4.55, 2.46–29.36 and 1.65–10.25 mg kg^{-1} with the mean value of 0.68, 1.58, 9.14 and 6.80 mg kg^{-1}, respectively.

Regarding soil nutrient index, the mustard growing soils of Gwalior district were found in category of low fertility status for N and medium with respect to P, K and S. The value of nutrient index for NPKS were 1.28, 1.72, 1.94 and 1.52 respectively, against the values <1.50 for low, 1.50-2.50 for medium and >2.50 for high fertility status. Under different micronutrient cations, available Zn and Fe were deficient to 54 and 18 per cent, whereas available Cu and Mn were sufficient.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Management of Secondary and Micronutrients in Rice under Rice-Wheat Cropping System in Acid Soil

P.B. Saha* and W. Aind
ZARS, Dumka, Birsa Agricultural University, Ranchi, Jharkhand
**Email: saha_purnendu@yahoo.com*

A field experiment was conducted in the experimental farm of Zonal Agricultural Research Station, Dumka, Birsa Agricultural University, Ranchi, Jharkhand during *kharif* 2016 to study the effects of secondary and micronutrients on rice under rice-wheat cropping system in acid soil. The experimental findings have been interpreted in terms of grain yield, crop response (%), P, K, S and B uptake by the crop. There were eight treatment combinations *viz.*, NPK (RD) [@(80:40:20) kg ha^{-1}], NPK+FYM [@ 3 t ha^{-1}], NPK+lime [@ 4 q ha^{-1}], NPK+S [@ 30 kg ha^{-1}], NPK+S+B [@ 200 ppm foliar spray as borax], NPK+S+B+Si [@ 20 kg K-Silicate ha^{-1}] and (NPK+FYM+S+B+Si). The experiment was laid out in RBD with three replications. It was found that the highest grain yield (3.96 t ha^{-1}) was obtained with the combined application of (NPK+FYM+S+B+Si), which also corresponded to the maximum crop response (24.4%). It was also found that application of micronutrients alone did not have significant effects on P, K, S and B uptakes unless they were applied in combination with FYM. The highest S uptake (7.10 kg ha^{-1}) and B uptake (117.2 g ha^{-1}) were recorded with (NPK+FYM+S+B+Si). The highest P uptake (13.1 kg ha^{-1}) was obtained with (NPK+lime), whereas the highest K uptake (15.9 kg ha^{-1}) was recorded with [NPK+S].

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Status of Macro and Micronutrients in Inceptisol and Vertisol of Gwalior District of Northern Madhya Pradesh

S.K. Trivedi, Renu Pathak and Shweta Jamra
Department of Soil Science, College of Agriculture, RVSKVV, Gwalior, Madhya Pradesh

Proper management of soil fertility demands careful identification of constraints of current nutrient deficiencies and monitoring changes in soil fertility to predict its deficiency. These deficiencies need to be alleviated through sound and proven practices of nutrients, water supply to crops and soil management, so as to sustain food production at a reasonable level to ensure continued high productivity in the future. Macronutrients (N, P and K) and micronutrients (Zn, Cu, Fe and Mn) are important soil elements that control its fertility. Keeping in view, 120 surface soil samples (0-15 cm) were collected from four blocks Morar & Ghatigoan (Inceptisol) and Dabra, Bhitarwar (Vertisols) of Gwalior district. Soils were studied for their physicochemical characteristics and status of different available nutrient (N, P, K, S, Zn, Cu, Mn and Fe) and their relationship with different soil properties.

The soil of Gwalior district of Madhya Pradesh is slightly alkaline in reaction and normal to soluble salts. Surface soil samples were non calcareous and low organic carbon content. Inceptisol recorded higher sand values as compared to Vertisols and Vertisols showed higher clay content as compared to inceptisol. Available N, P and K varied from 135.5 to 312.4, 6.2 to 17.6 and 168.4 to 428.6 kg ha^{-1} with the mean value of 221.4, 11.7 and 279.3 kg ha^{-1}, respectively. Whereas, status of available S ranged from 7.3 to 19.0 mg kg^{-1} with an average value of 12.2 mg kg^{-1} in different villages of Gwalior district. Available Zn, Cu, Fe and Mn observed in the range of 0.28–1.42, 0.25-2.56, 2.10–12.02 and 2.02–8.65 mg kg^{-1} with the mean value of 0.66, 0.72, 6.20 and 4.71 mg kg^{-1}, respectively.

Regarding soil nutrient index, the soils of Gwalior district were found in category of low fertility status for N and medium with respect to P, K and S. The value of nutrient index for N, P, K and S were 1.11, 1.68, 2.00 and 1.75, respectively, against the values <1.50 for low, 1.50 - 2.50 for medium and >2.50 for high fertility status. Under different micronutrient cations, available Zn and Fe were deficient to 37.5 and 17.5 per cent, whereas available Cu and Mn were sufficient. The correlation study revealed that organic carbon had greater impact on availability of nutrients. It suggested that organic matter was main contributing factor affecting the nutrient availability in soil. Deficiency of available nutrients increased with an increase in pH and calcium carbonate content whereas it decreased with an increase in organic carbon content in soils.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of Some Extractants to Determine Critical Limits of Zinc in Soils for Basmati Rice Grown in Sub-mountaineous Region of Punjab

Khushdeep Singh, Gayatri Verma[1] and J.S. Manchanda
Department of Soil Science, PAU, Ludhiana, Punjab
[1]Regional Research Station, Gurdaspur, Punjab

A study was conducted in sixteen sites in sub-mountaneous region of Punjab to estimate the critical limit of zinc (Zn) using some chemical extractants to predict the response of Basmati rice to Zn application. The amount of Zn extracted from soils using different extractants ranged markedly. The least amount of available Zn was extracted by DTPA (pH 7.3) and 0.1 *N* HCl whereas highest amount was extracted using AB-EDTA. The amount of Zn extracted using different chemical extractants was in following order: AB-EDTA> Mehlich-3> AB-DTPA> DTPA-HCl> 0.1N HCl> DTPA. The amount of Zn extracted by 0.005*M* DTPA+1*M* NH_4HCO_3 (pH 7.6), 0.01*M* EDTA+1*M* NH_4HCO_{3-} (pH 8.6), 0.005*M* DTPA+0.1*N* HCl, 0.005*M* DTPA (pH 7.3), 0.1*N* HCl and Mehlich-3 was well correlated with each other. Highest value of correlation was obtained for Mehlich-3 and it was correlated with 0.005*M* DTPA (r= 0.948**)> 0.1*N* HCl (r= 0.897**)> 0.005*M* DTPA+1*M* NH_4HCO_3 (r= 0.863**)> 0.01*M* EDTA+1*M* NH_4HCO_{3-} (r= 0.839**)> 0.005*M* DTPA+0.1*N* HCl (r= 0.867**) in this order. Most commonly used 0.005*M* DTPA solution for extracting available Zn in soils was highly and significantly correlated with all the other extractants. Positive coefficient of correlation was observed between 1*M* NH_4HCO_3+ 0.005*M* DTPA and 0.01*M* EDTA+1*M* NH_4HCO_3 (r= 0.938**). Critical limit for AB-EDTA was 0.87 mg kg^{-1} using Cate and Nelson analysis, which was highest in comparison to other extractants. Critical limit for AB-DTPA, DTPA , DTPA- HCl, Mehlich-3 and for HCl was 0.69,0.59, 0.55, 0.65 and 0.64 mg kg^{-1}, respectively. The significant correlation between different extractants suggested that all the extractants extracted largely available Zn from the soils under study and the extraction of Zn was dependent on the extractants used, the pH of the extracting solution, time of the extraction and the soil properties.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Different Organic and Inorganic Fertilizers on Yield and Quality of Cucumber (*Cucumis sativus* L.) and Soil Properties

R.G. Ghayal, K.P. Vaidya and A.A. Dademal
Department of Soil Science and Agricultural Chemistry, College of Agriculture, DBSKKV, Dapoli, Dist. Ratnagiri, Maharashtra

A field experiment entitled "Effect of different organic and inorganic fertilizers on yield and quality of cucumber (*Cucumis sativus* L.) and some soil properties" laid out in randomized block design comprising thirteen treatment combinations replicated thriceat Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.) during *kharif* season of 2015.Observations of three stages of growth period *viz.* at 30 DAS, 60 DAS and after harvest were taken. The effect of different inorganic fertilizers and organic manures like FYM, vermicompost and poultry manure either alone or in combinations on growth attributing characters, yield attributing characters, yield, nutrient content and quality of cucumber as well as on physicochemical properties and nutrient status of soil were studied.

The integration of 50% RDF through inorganic and 50% RDN through poultry manure (T_9) shown its significance on the yield, quality of fruits and nutrient content in plant. Treatment (T_9) was also found to have significant improvement in soil fertility of lateritic soil of Konkan (M.S.) by enhancing nutrient status *viz.*, N, P, K, Ca, Mg, DTPA extractable micronutrient (Fe, Mn, Zn and Cu), soil pH, electrical conductivity and organic carbon.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Properties, Nutrient Status and Yield of Ridge Gourd as Influenced by Integrated Nutrient Management in Coastal Region of Maharashtra

Pranali Rathod, V.G. Salvi*, R.V. Dhopavkar and K.D. Patil
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dapoli, 415712, District, Ratnagiri, Maharashtra
**Email: vgs1112@rediffmail.com*

A filed experiment was conducted during *kharif* 2016 with ridge gourd cv. Konkan Harita at Central Experiment Station, Wakawali to study the effect of integrated nutrient management in lateritic soil of coastal region of Maharashtra. There were eight treatment combinations replicated thrice in randomized block design. The treatments comprised of recommended dose of NPK Fertilizers (100:50:50 kg ha^{-1}), 75 and 50% RDN, 25 and 50% N through organic manures (FYM, vermicompost and poultry manure), P and K as per recommended dose and *Azotobacter* @ 250 g 10 kg^{-1} seed.

The result of the experiment showed that the treatment consisting 50% RDN + 50%–N through poultry manure + P and K + *Azotobacter* @ 250 g kg^{-1} seed significantly improved the physico-chemical properties such as soil pH, electrical conductivity and organic carbon content of the soil. The available major and secondary nutrients, *i.e.* nitrogen, phosphorus, potassium and sulphur as well as exchangeable calcium and magnesium, respectively were also improved. As far as micronutrients namely available iron, manganese, copper and zinc and bacterial count in soil was concerned, significantly higher values were observed due to application of integrated use of manure, fertilizers and biofertilizer.

On the basis of the result, obtained during present investigation, it was concluded that the integrated use of manure, fertilizers and biofertilizer is essential to improve soil health as well as yield of ridge gourd in lateritic soil of coastal region of Konkan in Maharashtra.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Studies on Status of pH, EC and Organic Carbon in Soil after Harvesting Forage Sorghum Crop Grown with Two Varieties under Different Fertility Levels

Vinay Arya*, Hemlata Dhakad, Swarnima Shrivastava and Shashi S. Yadav
Department of Soil Science and Agricultural Chemistry, Rajamata Vijayaraje Scindia Krishi Vishwavidhalaya, Gwalior, 474002, Madhya Pradesh
**E-mail:aryavinay2@gmail.com*

An investigation on "Studies on status of pH, EC and organic carbon in soil after harvesting forage sorghum crop grown with two varieties under different fertility levels" under adoptic and climatic conditions of Northern part of Madhya Pradesh was carried out during *kharif* season 2014 at the Research Farm, College of Agriculture, R.V.S.K.V.V., Gwalior (M.P.). Experiment was conducted in factorial randomzied block design, replicated three times with 12 treatment combinations, namely V_1F_1 (10 t of FYM + ICSSH-28), V_1F_2 (50% of RDF + ICSSH-28), V_1F_3 (50% of RDF + 5 t FYM + *Azotobacter* + PSB + ICSSH-28), V_1F_4 (75% RDF + ICSSH-28), V_1F_5 (75% of RDF + 2.5 t FYM + *Azotobacter* + PSB + ICSSH-28), V_1F_6 (100% RDF + ICSSH- 28), V_2F_1 (10 t of FYM + IS-17349), V_2F_2 (50% of RDF + IS-17349), V_2F_3 (50% of RDF + 5 t FYM + *Azotobacter* + PSB + IS-17349), V_2F_4 (75% RDF + IS-17349), V_2F_5 (75% of RDF + 2.5 t FYM + *Azotobacter* + PSB + IS-17349) and V_2F_6 (100% RDF + IS-17349). Forage sorghum varieties were grown by considering recommended package of practices. Variety ICSSH-28 (V1) sowing plots showed higher pH (7.71), EC (0.44 dS m^{-1}) and organic carbon (4.48 g kg^{-1}) content in soil over to variety IS-17349 (V2) sowing plots pH (7.63), EC (0.43 dS m^{-1}) and organic carbon (4.39 g kg^{-1}) but not reach the level of significance. It is clear from results that maximum pH (7.88) was recorded with the treatment 100% RDF (F6) while lowest pH (7.36) was recorded with the treatment 10 t of FYM (F1). The data recorded revealed that the maximum EC (0.497 dS m^{-1}) were recorded with the treatment 10 t of FYM (F1) while lowest EC (0.403 dS m^{-1}) was recorded with the treatment 50% of RDF (F2). Under different fertility levels, organic carbon was in the range of 4.0-5.0 g kg^{-1}. It is evident from results that application of 10 t of FYM (F1) recorded higher value of organic carbon (5.02 g kg^{-1}) which was significantly higher over rest of the treatments.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Impact of Long-Term Fertilizer Application on Profile Distribution of Micronutrients in a Vertisol

Risikesh Thakur*, D.L. Kauraw, Muneshwar Singh and V.B. Upadhyay
College of Agriculture, Balaghat, J.N. Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh
**Email: drrkthakur28@gmail.com*

The present study was conducted under the ongoing All India Coordinated Research Project on Long-Term Fertilizer Experiment with soybean-wheat cropping sequence in a Vertisol, which was commenced from 1972 at J.N.K.V.V., Jabalpur (MP). The study was aimed to find out the effect of continuous application of different agricultural inputs on the dynamics of macro (N, P, K and S), and micronutrients (Zn, Fe, Mn and Cu) of a Typic Haplustert (Vertisol). The results related to Zn, Fe, Mn and Cu contents revealed that these nutrients were relatively higher in 0-20 cm soil depth and their values continue to decrease with increasing soil depth amongst all the treatments. The nutrients, Zn, Fe, Mn and Cu contents are not limiting factors even after 35 years of intensive cropping, on account of continuous applications of various agricultural inputs to the soil. The highest values of Fe and Cu contents were recorded in 100% NPK + FYM treatments, whereas Mn content was high in 100% NP treatment and Zn in 100% NPK + Zn treatments. No crop control plots have registered the lowest values of Zn, Fe, Mn and Cu, respectively, at all the soil depths. Incorporation of FYM along with 100% NPK enhanced the Zn and Cu availability in soil as compare to 100% NPK alone. It was attributed to the direct contribution of FYM to nutrient pool and its beneficial effects, either through complexation or mobilization of native Zn and Cu. The availability of Fe and Mn was found related to the availability of K, under continuous cropping. Soil pH, EC and $CaCO_3$ contents were negatively correlated, while soil OC content registered a positive correlation with most of the micronutrients contents of the soil profile.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Macro- and Micro-Nutrient Fertility Status of Soils under Rice-Wheat and Cotton-Wheat Cropping Systems in South-Western Punjab

Gurjinder Pal Singh Sodhi*, Pritpal-Singh and Gurdeep-Singh
Krishi Vigyan Kendra, Khokhar Khurd, Mansa, 151505, Punjab
Directorate of Extension Education, Punjab Agricultural University, Ludhiana, Punjab
**Email: gpssodhi-ptl@gmail.com*

Rice-wheat and cotton-wheat are the predominant cropping systems in south-western district of Mansa (Punjab). The contrasting soil moisture regimes under which these cropping system are grown impact nutrient transformations and thus macro-and micro-nutrient availability in soil. We collected surface (0-15 cm) soil samples from different locations under two cropping systems to investigate the macro- and micronutrient status of soils. Soils were saline, near neutral to alkaline in reaction and sandy loam to loamy sand in texture. Soil pH varied between 6.10-9.63 and 6.72-9.10 under rice-wheat and cotton-wheat cropping systems, respectively. Mean concentration of soluble salts was higher in soils under cotton-wheat (EC=0.51 dS m^{-1}), compared with rice-wheat (EC=0.39 dS m^{-1}) cropping system. Comparison of soils under two cropping systems showed that the concentration of available-P and K was higher under cotton-wheat cropping system, relative to rice-wheat. Soil organic carbon (SOC) concentration was higher by 2.2 g kg^{-1} under rice-wheat, compared with cotton-wheat cropping system. The concentration of DTPA-extractable micronutrients (Fe, Zn and Cu) was higher in soils under rice-wheat cropping, in contrast to higher concentration of DTAP-Mn under cotton-wheat cropping system.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Fertilizer Management for Crop Productivity and Soil Fertility in Soybean

Sankalpa, K.K. Math and B.I. Bidari
University of Agricultural Sciences, Dharwad, Karnataka

Soybean is an important oil seed crop and finds its place in policy agenda of industrial, medical and food sector of India due to wide spectrum of its chemical composition which contain high quality protein and oil for human consumption. As soybean is an exhaustive crop, optimization of mineral nutrition is a key to maximize its production. Different methods of fertilizer recommendation which are in practice were evaluated to boost crop productivity with improvement in soil fertility. Therefore, studies were conducted to find out the effect of different fertilizer recommendation practices on the crop productivity and quality and residual nutrients status. The field experiments were conducted during *kharif* 2015 and 2016 at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad with 12 treatments replicated thrice in randomised block design on Typic Haplustert. The fertilizer doses for different treatments in different fertilizer recommendation approaches were worked out based on soil test values. Pooled analysis data of two years indicated that significantly higher plant height, number of branches and dry matter production were recorded in SSNM practice yield target at 30 q ha^{-1}. Chlorophyll content in soybean leaves at 60 DAS was also higher in the said treatment. Seed yield of soybean significantly differed due to different fertilizer recommendation practices to soybean and the highest value was recorded in the yield target at 35 q ha^{-1} and was at par with 30 q ha^{-1} and these two treatments were significantly superior to all other treatments but on par with each other. The higher seed yield in the said treatments was attributed to improvement in yield contributing characters like number of seeds and their yield per plant and test weight. The yield targets at 35 and 30 q ha^{-1} in soybean under SSNM also recorded higher oil and protein contents in soybean seed. There was significant improvement in residual available nitrogen and potassium status of soil in the said treatments. Higher net returns was recorded in 35 q ha^{-1} yield target while B:C ratio was higher under 30 q ha^{-1} target yield. Hence, the two year study clearly indicated that in Vertisols, fertilizer recommendation to soybean at 30 q ha^{-1} yield target was economical.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Phosphorus Management in Pigeonpea and Mungbean Intercropping System

Ganajaxi Math*, M.S.Venkatesh and Yamanura
AICRP on MULLaRP, University of Agricultural Sciences, Dharwad, Karnataka
**Email: gkmathshreya@gmail.com*

Under reduced per capita availability of land, to increase the pulse production for feeding the ever increasing population, multiple cropping is the only solution. Wider spaced long durated pigeonpea provides an opportunity for introducing short duration mungbean as an intercrop for efficient utilization of natural resources to harness maximum productivity per unit area. Further to avoid adverse effect of intercropping of two pulses suitable adjustment in planting pattern and phosphorus (P) requirement have to be worked out. Hence this study was conducted to find out optimum level of P and planting pattern for the pigeonpea + mungbean intercropping system.

A field experiment was conducted at Main Agricultural Research Station, Dharwad during 2015 and 2016 under rainfed condition to study the planting pattern and P management in mungbean and pigeonpea intercropping system. The experiment was laid out in split plot design with three replications and eight treatments. Among them, four planting patterns [Sole Pigeonpea, Mungbean + Pigeonpea 1:3 (120 × 20), Mungbean + Pigeonpea 1:2 (90 × 20) and Mungbean + Pigeonpea 2:2 (90 × 20)] were main plot treatments and two phosphorus levels (P_2O_5 @ 50 kg ha^{-1} and P_2O_5 @ 75 kg ha^{-1}) were sub-plot treatments. Recommended dose of P is 50 kg ha^{-1}. The soil was clay loam with available N, P_2O_5 and K_2O of 232, 23 and 419 kg ha^{-1}, respectively. Pooled data of two years indicated that, among different P levels, 75 kg P_2O_5 ha^{-1} applied plot recorded significantly higher pigeonpea seed yield (1.51 t ha^{-1}) as compared to 50 kg P_2O_5 ha^{-1} (1.39 t ha^{-1}) . Whereas, planting pattern did not differ the pigeonpea seed yield significantly. Interaction between different P_2O_5 levels and planting pattern indicated that, pigeonpea + mungbean (1:3 row ratio) with application of 75 kg P_2O_5 recorded significantly higher pigeonpea seed yield (1.55 t ha^{-1}) as compared to all other interactions and was found on par with all other planting pattern with 75 kg P_2O_5 application treatments, sole pigeonpea and pigeonpea + mungbean (1:3 row ratio) with application of 50 kg P_2O_5. These treatments were superior over remaining interactions.

Significantly higher mungbean seed yield (0.42 t ha^{-1}) was recorded with application of 75 kg P_2O_5 treatment as compared to 50 kg applied plot. Whereas, in planting pattern, sole mungbean recorded significantly higher seed yield (0.76 t ha^{-1}) as compared to all other intercropping treatments. Yield advantage indices and net returns were significantly higher in pigeonpea + mungbean (1:3) with 75 kg P_2O_5 ha^{-1} compared to others. This study indicated the need of 50% higher dose of P_2O_5 for the pigeonpea and mungbean intercropping system (1:3) in northern transition zone of Karnataka

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Integrated Nutrient Management on the Availability of Nutrients in Soil in Relation to Yield and Nutrition of Rape (*Brassica campestris* L.)

Prasenjit Adhikary*, Soumya Sundar Tewary, Joyashree Bhowmik, Arindam Patra, Priyanka Naskar and D.K. Das

Department of Agricultural Chemistry and Soil Science, Institute of Agricultural Science, University of Calcutta, Kolkata, 700 019, West Bengal

**Email: prasenjitad1993@gmail.com*

The field experiment was conducted during *rabi* season of 2016-17 at the Baruipur Research Farm of the Calcutta University using treatments as T_1-NPK 100%, T_2- Compost 100%, T_{3-} Compost 50%+NPK 50%, T_4-Vermicompost 100%, T_5-Vermicompost 50%+NPK 50%, T_6-FYM 100%, T_7-FYM 50%+NPK 50%, in a randomised block design (RBD) replicated thrice. The objectives of the present study was to evaluate the efficiency of applied organic manures in relation to release of different nutrients in soil as well as yield and nutrition of rape affected by different combinations of organic manures and chemical fertilizers. The results show that the amount of available N content in soil has been found to be increased with the progress of crop growth up to 45 days of crop growth and thereafter, the amount of the same decreased with the crop growth irrespective of treatments. The amount of P content in soil has been found to be increased with different treatments, being maintained highest amount (18.3 kg ha^{-1}) in the treatment vermicompost 50%+ NPK 50% followed by the treatment where NPK 100% and vermicompost 100% were applied. The results show that the amount of K content in soil was increased initially and thereafter, the amount of the same decreased with the progress of crop growth. The magnitude of such increase, however, varied with treatments, being maintained highest amount (310.2 kg ha^{-1}) in the treatment vermicompost 50%+NPK 50% followed by the treatment (276 kg ha^{-1}) where FYM 50%+NPK 50% was applied. The highest amount of S content (32.14 g kg^{-1}) in the treatment T_5 where FYM 50%+NPK 50% was applied where 100% vermicompost was applied followed by the treatment T_4 (18.9 g kg^{-1}) where 100% vermicompost was applied at 75 days of crop growth. The overall results suggested that the amount of available N, P, K and S content in soil and contents in plant as well as yield of rape was recorded an increase in most treatments where combined application of organic manures and chemical fertilizers were applied, being maintained higher amount with the application of vermicompost along with chemical fertilizers excepting S content in seed.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Yield and Quality Assessment of Wheat (*T. aestivum*) on Application of Boron and Liming Material under *Terai* Situation of West Bengal

P. Thakur* and D. Mukhopadhyay
Department of Soil Science and Agricultural Chemistry, UBKV, Pundibari, Cooch Behar, 736165, West Bengal
**Email: princy52thakur@gmail.com*

Boron being one of the micronutrients are essential for increasing the production potential of wheat (*Triticum aestivum* L.) under an acidic reactions of soil in West Bengal. Based on this perspectives, a field experiment with lime and boron (B) was set under two modes of B application through seed absorption and soil application on wheat (C.v.K1009) during 2014-15 and 2015-16 in *rabi* season with the aim to assess the individual and combined effect of lime and B on wheat. The potential yield of wheat and important biochemical (*viz*. protein, gluten, starch and moisture) parameters of wheat were assessed. The interaction effect of lime and B (through soil application and seed treatment) was observed. The average grain yield and straw yield under seed treated plots (3.88 t ha^{-1} and 5.82 t ha^{-1}) were relatively more than soil treated plots (3.53 and 5.6 t ha^{-1}) with B. The harvest index varied from 35.8 to 43.0% in the plots grown with the treated seed while that from 34.1-42% in the plots treated with soil application. The uptake of B (kg ha^{-1}) by wheat grain varied from 0.11-0.39 under the seed- treated plots while the same varied from 0.10-0.35 in the plots under soil application of B. The average available soil status of B (kg ha^{-1}) at harvest of the crop under seed treatment was 1.08, quite higher than soil treated plots 0.90. There was a good response of applied B and liming material on gluten and moisture content of wheat grain irrespective of the methods of applications.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Phosphorus Build-up on Zinc Availability in Soil and its Nutrition in Rice

G.C. Hazra, Sudeshna Mondal, Biplab Pal and Pabitra Kumar Mani
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, 741252, West Bengal

The present investigation was done to study the influence of phosphrous (P) build-up on distribution of available zinc (Zn) in soil as well as Zn content in plant by collecting two hundred soil samples as well as *in-situ* rice straw and grain samples from some intensively cultivated regions of West Bengal viz. Nadia, Bankura, Hooghly and Burdwan. Pot experiment was conducted with boro rice during 2014 at Central Research Farm, Gayeshpur, B.C.K.V. to study the P-Zn interaction at various levels of P as well as Zn, taking soils with high P build-up from each of the above stated districts. In the next season, a field experiment was conducted with different levels of P and Zn for validation of the pot experiment. The result of the field experiment follows the same trend as that of the pot experiment. It was found that high P levels (up to 80 kg ha^{-1}) did not affect the yield of rice grain as well as straw. Moreover, the combined application of P and Zn increased the yield of both grain and straw of rice and the increase was highest (12.1 and 14.1%, respectively over the control) when P and Zn were combined with each other at their respective highest levels. But P fertilization reduces the Zn availability (both native and applied) in soil and the effect was more pronounced in case of applied Zn. A declining trend of Zn content in plant as well as uptake by plant was recorded both in grain and straw, with the application of P at higher dose and it was least when combined application of P and Zn was done @ 80 kg ha^{-1} and 5 kg ha^{-1}, respectively. The soil available P had a significant negative interaction with plant Zn content and significant positive interaction with plant P content, plant P uptake and grain yield of rice.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Phosphorus and Potassium on Yield, Nutrient Uptake and Proximate Composition of Sweet Potato under Saline Island Ecosystem of Andaman

K. Laxminarayana
Regional Centre, ICAR-Central Tuber Crops Research Institute, Bhubaneswar, 751 019, Odisha
Email: klnarayana69@rediffmail.com; klnarayana69@yahoo.co.in

A field experiment was conducted for two consecutive *rabi* (winter) seasons during 2015-16 and 2016-17 in a natural saline sandy loam soil (Typic Sulfaquents) to optimize the doses of phosphorus (P) and potassium (K) for sustainable production and proximate composition of sweet potato under island ecosystem. The trial was laid out in a natural saline soil at farmer's field in Chouldari Gram Panchayat, South Andaman district, Andaman & Nicobar Islands. The experimental soil is slightly acidic (pH 6.03), saline (ECe 4.45 dS m^{-1} at initial), and having 5.6 g kg^{-1} organic C, 0.133% total N, and 280, 12.5 and 160 kg ha^{-1} of available N, P and K, respectively. The trial was laid out with 4 levels of P *i.e.* 0, 20, 40, 60 kg P_2O_5 ha^{-1} and 4 levels of K i.e. 0, 25, 50, 75 kg K_2O ha^{-1} replicated thrice in a two factorial split plot design. The results revealed that the mean tuber and vine yields were increased significantly due to increased doses of P and K up to 40 and 75 kg ha^{-1}, respectively. Highest tuber yield (14.5 t ha^{-1}), vine yield (17.2 t ha^{-1}), starch (16.6%), dry matter (26.9%), total uptake of N (151 kg ha^{-1}), N use efficiency (125 kg tubers kg^{-1}) and N recovery (107%) was observed due to combined application of 50-40-75 kg ha^{-1} of N, P_2O_5 and K_2O, respectively. Significant response in terms of yield and biochemical constituents in sweet potato was observed due to application of 40 and 75 kg ha^{-1} of P_2O_5 and K_2O, respectively. Highest efficiency to the applied nutrients and nutrient recovery in terms of P and K was observed due to application of 40 and 25 kg ha^{-1} of P_2O_5 and K_2O, respectively. The study emphasized that a balanced dose of 50, 40 and 75 kg ha^{-1} of N, P_2O_5 and K_2O was optimum for sustainable production of sweet potato with good quality tubers and higher nutrient use efficiency and it offers good scope for livelihood and nutritional security in the coastal saline soils under island ecosystem of Andaman & Nicobar.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Response of Crops and Soil Fertility Changes under Long-term Organic Farming in Maize-Onion Sequence

S. Sridevi, M.V. Ramana, M. Goverdhan and K. Suresh
AICRP on Integrated Farming Systems, PJTSAU, Rajendranagar, Hyderabad, 500030, Telangana

A study was conducted on permanent plots from 2003-04 to 2014-15 at the College of Agriculture, Rajendranagar to evaluate the impact of organic farming practices in comparison to chemical farming on productivity of crops and soil fertility using maize-onion as test crop sequence. During the conversion period (initial 3 years, 2004-05 to 2006-07) maize registered a productivity level of around 2.0 t ha^{-1} with the organic treatments and 3.3 t ha^{-1} of grain yield with recommended dose of fertilizers (RDF) and 3.22 t ha^{-1} with INM treatment supplying 50% N through FYM + 50 RDF. During initial 6 years a straight variety of maize was used as test variety and later a popular hybrid DHM – 117 was used as a test cultivar in the study. There was no improvement in yield levels of maize with different treatments even during first 3 years of organic farming with variety (4^{th} – 6^{th} crop cycle) over that of conversion period. Chemical and INM treatments maintained greater productivity level over complete organic farming treatments. As the yield potential of hybrids is high, the yield of maize in the present investigations from 7^{th} to 12^{th} crop cycle in maize-onion system was ranging between 4.5-5.7 t ha^{-1}. Nevertheless, the crop responded well to organic farming and a yield level of 4.5 to 5.3 t ha^{-1} was recorded during this period and it was close to that of INM (5.6 t ha^{-1}) and complete chemical fertilizer (5.7 t ha^{-1}) treatments. The results clearly showed the response of maize (either variety or hybrid) to organic farming (OF) was neither equal nor superior to chemical and INM treatments.

The productivity level of onion during conversion period (initial 3 years) was greater with INM treatment (12.95 t ha^{-1}) followed by sole chemical fertilizer application (11.83 t ha^{-1}) over organic treatments (6.58 to 8.68 t ha^{-1}). Onion started responding to organic farming in the 7^{th} crop cycle (2009-10) and yield levels in organic treatments (10.58 to 11.92 t ha^{-1}) are comparable to that of INM (13.50 t ha^{-1}) and RDF (13.57 t ha^{-1}) treatments. The treatments were found at par, the differences were less during OF period (mean over 4^{th} to 12^{th} year: 2007-08 to 2014-15). Further, introducing carrot as an intercrop in onion during rabi season with sole organic manure application resulted in significant reduction in onion yield both during conventional and organic farming period. This loss in yield was compensated by almost similar or at times greater carrot yield which has ultimately out yielded the sole onion crop yield under organic nutrient supply system.

The mean organic carbon (OC) content over 12 years was high with organic (7.0 g kg^{-1}), integrated (6.0 g kg^{-1}) and chemical (5.1 g kg^{-1}) treatments when compared to initial status (3.6 g kg^{-1}). Improvement in OC with organic nutrient management was 66.2 to 93.5 per cent when compared to initial status. When compared to inorganic nutrient management, INM had 17.9% higher OC and organic nutrient management had 16.7 to 35.9 per cent higher organic carbon. Available nitrogen was not influenced by nutrient management practices; the improvement over conventional farming with organic farming was 4.1 to 13.8 per cent. Build-up of available phosphorus over initial status was observed during the twelve year period by 45.7 per cent in chemical farming and 49.0 to 84.6 per cent under different organic nutrient management practices. Different organic farming treatments registered 2.3 to 26.7 per cent higher phosphorus than inorganic nutrient management. Available potassium also registered an increase of 8.7 per cent with application of fertilizers alone and 15.9 to 44.0 per cent with various organic nutrient management practices over it its initial status and 6.6 to 32.4 per cent over conventional farming.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Appraisal of Fertilizer Phosphorus Recovery for Maize in an Inceptisol using ^{32}P A-value Technique

Manoj Shrivastava*, Akansha Srivastava, Kapil A. Chobhe[1], B.S. Dwivedi[1] and S.D. Singh

Centre for Environment Science and Climate resilient Agriculture;
[1]Division of Soil Science and Agricultural Chemistry
Indian Agricultural Research Institute, New Delhi, 110012
**Email: manojshrivastava31@gmail.com*

A glasshouse pot experiment was conducted to evaluate the efficacy of different phosphorus (P) sources for maize (*Zea mays*) using A-value technique. Two sources of P *viz.* single superphosphate (SSP) and diammonium phosphate (DAP) were tagged with ^{32}P and applied at three rates (25, 50 and 100 kg P_2O_5 ha^{-1}). Maize variety PEHM 5 was grown in pots containing 2 kg of a medium available P soil (Inceptisol) for 42 days. Plant samples (shoots) were oven dried to constant weight at 70 °C and the dry matter yield of shoot was recorded. Inorganic ^{31}P in the digest was determined using the vanadomolybdate yellow colour method after wet digestion with 5:1 mixture of HNO_3 and $HClO_4$ and the uptake of P was estimated. One mL of digested material was transferred into a glass scintillation vial for ^{32}P determination by measuring Cerenkov radiation using a liquid scintillation analyzer. *Emax* for ^{32}P was 1.710 MeV and Cerenkov counting efficiency of the counter was found to be 48.4%. Isotopic parameters, namely, per cent P derived from fertilizer (%Pdff), *A*-value (available P from the soil), per cent fertilizer P utilization and equivalent ratio were computed. The results indicated that the dry matter yield (DMY) of maize shoot, P uptake, percent P derived from fertilizer (%Pdff) and A-value of the soil increased with increasing fertilizer rate, whereas the percent fertilizer P utilization (%FPU) was found to be higher at lower fertilizer rates. Among the fertilizer sources DAP was found to be superior in enhancing DMY of maize, P uptake and %FPU as compared to SSP. The %Pdff was found to be significantly higher in DAP treatments in comparison to SSP and reverse was true in case of A-value of the soil. The A-values of maize was higher in SSP (142-233 mg P pot^{-1}) than in DAP (64-113 mg P pot^{-1}) treatment suggesting that maize was more efficient in taking up fertilizer P in DAP treatment as compared to SSP. Results on equivalent ratio showed that DAP was more efficient than SSP, whereas, 1 kg P as SSP was equivalent to 0.49 kg P as DAP. In general, efficacy of phosphatic fertilizers for maize crop in Inceptisol was found to be in order of DAP>SSP.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Studies on Agronomic Biofortification of Rice Grains with Zinc

Kuldeep Singh*, Vivek Yadav, Brijesh Kumar and Naleeni Ramawat
Amity Center for Soil Sciences, Amity University, Noida, 201313, Uttar Pradesh
**Email:ksingh6@amity.edu*

Zinc (Zn) deficiency is the most widespread micronutrient deficiency in Indian soils, crop plants and human beings. Basic aim of this study was to enrich rice grains with Zn through Zn fertilization. Agronomic biofortification of rice with Zn through foliar as well as basal Zn application have been proposed as an agronomic strategy to increase grain Zn concentration, which can serve as a nutritional intervention in regions with low dietary Zn intake. The higher concentration of Zn in grains with Zn application as compared to control (without Zn) was taken as a principal hypothesis. Thirty field trials were conducted in variable soil Zn fertility status, during *kharif* seasons of 2015 and 2016 at farmer's field in district Faridabad, Haryana. Rice crop was grown under three different Zn applications rates as follows: i) control (no Zn application), ii) soil Zn application, and iii) foliar Zn application. The soil Zn treatment consisted of 50 kg $ZnSO_4.7H_2O$ ha^{-1} applied to the soil before sowing of rice. The foliar Zn treatment, a 0.5% (w/v) aqueous solution of $ZnSO_4.7H_2O$ was realized 2 times *i.e.,* first at anthesis stage and the second one at early milk stage. The concentration of Zn in harvested whole grains without rice husk was determined by AAS. The results showed that foliar application of Zn increased grain Zn concentration from 16 and 17 mg kg^{-1} in no zinc to 26 and 27 mg kg^{-1} across all 30 sites resulting in grain Zn increases by 16 to 41% during 2015 and 2016 respectively. The soil Zn application increased grain yield over control only at a few locations which varied from 3 to 18% and 3 to 15% during 2015 and 2016, respectively whereas foliar Zn application had no or little effect on grain yield. These results indicate that foliar application of Zn is an important agronomic practice which can be locally adopted to enrich rice grains with Zn to reduce Zn malnutrition problem in humans.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Integrated Nutrient Management in Maize (*Zea mays* L)-Wheat (*Triticum aestivum* L) Cropping System for Sustainable Production under Rainfed Conditions in Sub-tropical North India

Vivek Sharma, M.J. Singh and Anil Khokhar
Regional Research Station (Punjab Agricultural University), Ballowal Saunkhri, SBS Nagar, 144 521, Punjab

Improving and maintaining soil quality for enhancing and sustaining agricultural production is of utmost importance for India's food and nutritional security. Increase in productivity of maize-wheat cropping system with integrated use of farmyard manure (FYM) and chemical fertilizer has been widely reported. Both the crops are highly exhaustive and depleting the soil fertility because farmers of the region are not adding adequate and balanced dose of fertilizers. It is essential to maintain the balanced supply of nutrients through efficient management of nutrients in cropping system to sustain the productivity. In sub-tropical northern India, generally FYM is applied to the soil in *kharif* season under rainfed conditions due to the availability of adequate moisture. The soil moisture is the main limiting factor for crop production during *rabi* season due to almost negligible rainfall in October to December. In order to assess the effect of integrated nutrient management system in maize-wheat cropping system under rainfed conditions, an experiment was conducted with nine treatments of N, P, K, FYM, and zinc sulphate nutrients. After three years of maize-wheat cropping system, the maize and wheat yield increased significantly with integrated nutrient management treatments as compared to control. On average of three years, highest maize yield (3.40 t ha^{-1}) and wheat yield (3.19 t ha^{-1}) was recorded with treatment 100% NPK + FYM 10 t ha^{-1} which was statistically at par with treatments 100% NPK, 125% NPK and 100% NPKZn and significantly higher over the treatments control, 100% N and 100% NP, only. The net return and water use efficiency was also higher in the same treatment but B:C ratio was higher in the treatment 125% NPK treatments. Plant growth and yield parameters in maize and wheat crop also increased significantly in the treatment 100% NPK + FYM 10 t ha^{-1} over the other treatments. The nutrient uptake gave the similar results as per the yield of maize and wheat crop. The significant change in soil organic carbon, available phosphorus and available potassium has been observed with the integrated use of nutrient over the control treatment. The values of the soil organic carbon, available phosphorus, potassium and biochemical properties were found to be higher after the maize crop than the wheat crop only due to the higher moisture content. Among different treatments, treatment 100% NPK + FYM 10 t ha^{-1} performed better in increasing the crop yield and also in improving the soil health.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

PAU-Leaf Colour Chart and GreenSeeker Optical Sensor for Site-Specific Fertilizer Nitrogen Management in Timely and Late Sown Wheat (*Triticum aestivum* L.)

Varinderpal-Singh*, Bijay-Singh, R.K. Gupta, H.S. Thind, O.P. Choudhary, S. Kaur, K.S. Sekhon, B.K. Yadav, Sukhwinder-Singh, H. Ram, Jayesh-Singh and Jagmohan-Singh

Punjab Agricultural University, Ludhiana, 141 004, Punjab
**Email: singhvp72@gmail.com*

Excessive and untimely application of fertilizer nitrogen (N) is the major constrain in improving fertilizer N recovery efficiency in irrigated wheat (*Triticum aestivum* L.). Large field to field and seasonal variability further lower fertilizer N recovery efficiency when broad based blanket recommendations are followed. Fourteen field experiments were conducted in soils of varying inherent fertility in diverse agro-climatic zones to provide site specific nitrogen management (SSNM) strategy for wide range of wheat genotypes during 2014-15 to 2016-17. The leaf colour greenness of the first fully exposed top leaf measured using newly developed PAU-LCC (PAU-Leaf Colour Chart) and SPAD (chlorophyll) meter did not differ among varieties at Feekes 6 stage, thus the leaf greenness measured at this stage can be used to make SSNM decisions across the varieties. After applying prescriptive N dose of 25 kg ha^{-1} at planting, and 45/30 kg ha^{-1} at Feekes 2 stage in timely sown and late sown wheat, respectively, the leaf greenness of the first fully exposed top leaf measured with PAU-LCC or NDVI measured with GreenSeeker optical sensor at Feekes 6 stage was used to decide site-specific fertilizer N dose. The PAU-LCC guided fertilizer N dose of 15/30/45/60 kg N ha^{-1} (if the leaf colour is LCC 5 / LCC 4.5 to < LCC 5 / LCC 4 to < LCC 4.5/ < LCC 4) or GreenSeeker optical sensor algorithm guided N dose led to better grain yield and judicious fertilizer N use in comparison with the soil test based N application. The SSNM strategies either improved grain yield or agronomic efficiency of applied fertilizer N in different wheat genotypes grown under diverse range of agro-climatic conditions and in soils with variable indigenous N supply. Both PAU-LCC and GreenSeeker optical sensor were found at par in improving N-use efficiency. However, PAU-LCC being economical can be easily popularized as efficient N management tool to ensure judicious fertilizer N use.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Cogen Ash Application on Nutrient Content of Rice

N. Hamsa*, C.A. Srinivasamurthy[1], V.R. Ramakrishna Parama, L.R. Varalakshmi[2] and S. Bhaskar[3]
Department of Soil Science and Agricultural Chemistry, UAS, GKVK, Bengaluru, Karnataka
[1]Director of Research, Central Agricultural University, Imphal, Manipur
[2]Indian Institute of Horticultural Research, Hesaraghatta, Bengaluru, Karnataka
[3]Agroforestry and Climate Change, Indian Council of Agricultural Research
**Email: hamsanraj@gmail.com*

Cogen ash, a by-product of sugar mills obtained during co-generation process to produce heat and electrical energy by burning bagasse and/or coal was used to study its effect on nutrient content of rice. Utilisation of cogen ash often provide a reasonably economic means of recycling this waste in an eco-friendly manner as it contains plant nutrients in appreciable amounts. It can be used as a multi nutrient carrier material in agriculture in combination with any of organic manure like farmyard manure (FYM) to supplement organic carbon, nitrogen and phosphorus that may be present in cogen ash in trace amounts and to extract and chelate micronutrients present in it, also to improve the nutrient content of the crops. Cogen ash can be effectively used in agriculture for crops such as rice and others. The concentration of all the nutrients in rice grain and straw at harvest varied significantly due to application of cogen ash at varied levels. The nutrient concentration in rice grain and straw increased with rates of cogen ash application and further increased with the addition of FYM along with recommended dose of fertilizers. Among the treatments, the treatment which received recommended dose of NPK + recommended dose of FYM + 15 t ha^{-1} cogen ash showed significantly higher concentration of primary nutrients (N, P, K), secondary nutrients (Ca, Mg and S) and micronutrients (Fe, Mn, Cu, Zn and B) in the rice crop (grain and straw) grown in the experimental plots at Maddur compared to all the other treatments containing varied levels of cogen ash. Such improvements were possibly due to the enhanced absorption of nutrients. However, significantly lower concentration of the nutrients in rice grain and straw was observed in the treatment which received recommended dose of NPK + 2.5 t ha^{-1} cogen ash.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effects of Rates of Boron (B) Application on Sunflower (*Helianthus annuus* L.) Productivity

P.K. Basavaraja*, H. Mohamed Saqeebulla and P. Dey
AICRP on STCR, Department of Soil Science and Agricultural Chemistry,
University of Agricultural Sciences, GKVK, Bengaluru, 560 065, Karnataka
**Email: pujarikbraj@gmail.com*

Sunflower (*Helianthus annuus*) is a plant with high demand for boron (B) and, depending on specific soil conditions, for other trace elements. To some extent, the uptake of nutrients by plant roots depends on soil properties (particularly soil pH) and supply of micronutrients in the soil. The critical content of B at the time of sunflower emergence is 20 mg kg^{-1} of soil. The demand of sunflower for B is varied, depending on the stage of plant growth. The critical content of B in sunflower at the age of 4 weeks is 46.0-63.0 mg B kg^{-1} of dry matter, while 8-week old plants need just 36.0 mg B kg^{-1}. With this background a field experiments was carried out to determine the optimum rate of B of application required for high productivity of sunflower and maximal oil yield. The experiment was laid out in randomized completely block design (RCBD) with seven treatments replicated thrice comprising with five levels of B (0, 2, 4, 8 and 16 kg B ha^{-1}). The initial B concentration was 0.91 ppm.

Application of different levels of B application significantly increased the grain and straw yield and it decreased with increase in the levels of B application. Application of 2 kg B ha^{-1} significantly increased the grain yield (32.89 kg ha^{-1}) and it decreased with further increase in the B application from 4 kg B ha^{-1} (26.20 kg ha^{-1}) to 16 kg B ha^{-1} (12.58 kg ha^{-1}). Similarly, the stalk yield was significantly increased at 2 kg ha^{-1} and it decreased with further increasing the rate of B application. However, the oil content was higher (42.06% @ 2 kg B ha^{-1}) at lower rate of B application than at higher rate. The B content in soil at harvest was decreased in treatment where 2 kg B ha^{-1} was applied and it increased with increase in levels of B application.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Crop Growth-stage and Region Specific Customized Fertigation Products can Significantly Improve Farm Income for High Value Horticultural Crops

Subhendu Bhadraray* and Sunila Kumari
Centre for Agri-solutions & Technology, Tata Chemicals Ltd. Fertilizer Works Babrala, Indiradham, Dist. Sambhal, Uttar Pradesh
**Email: sbhadraray@tatachemicals.com*

India is poised to become water-scarce by 2050, and would be forced to reduce its share of water to agriculture by 20%. With only 4% access to world's freshwater resources, adoption of drip is natural choice. Water soluble fertilizer is witnessing CAGR of 20% during last two decades. Concomitant savings in both fertilizer and water, along with associated benefits led adoption of fertigation in high value horticultural crops like grape, pomegranate, tomato, banana, etc.

However, currently adopted fertigation practices are dependent on generic water soluble fertilizers; and are highly variable among growers of same crop under similar condition in terms of nutrients applied, their distribution, and cost incurred thereon. The practice is ad-hoc and more often than not in contrary to physiological demand. An efficient fertigation schedule needs crop and site specific nutrient management to synchronize dynamics of demand-supply cycles. This provides huge scope for development of crop growth-stage and geography specific customized fertigation products as component of a holistic, integrated and balanced fertigation schedule.

Following the 4R nutrient stewardship, Tata Chemical Ltd. (TCL) have developed and standardized research protocol for formulating such products. At first, benchmarking of current practice and segmentation of grower is carried out through a structured survey. This is followed by: a) Setting yield target, b) Establishing NR, c) Assuming nutrient contribution through organics and soil reservoir, d) Standardizing growth stages, e) Establishing nutrient partitioning and its uptake dynamics, f) Determining efficiency parameters, g) Developing product formulations and finally h) Evaluating alternative products/ schedules to standardize response in terms of increase in yield, improvement in quality and enhancement in farm income over current benchmarks.

Till date TCL have developed and commercialized products on grape for Maharashtra under brand name 'Tata Paras Farmoola – Fertigation'. Similar formulations for pomegranate and tomato are in final stage of research. Common underlying strategies for developing comprehensive fertigation schedule for each crop have been: i) Partial nutrient application through basal, ii) Integrated use of organics and soil reserve, iii) Micronutrients through basal or foliar, iv) Calcium and magnesium management through stand-alone sources, v) Application rate of 10 kg/acre per week (for customized products), vi)Partial N supplementation through urea, and vii) Supplemental foliar application to augment growth at critical stages.

In grape, TCL protocol led to yield increase of 30 to 50 per cent with marginal benefit of 1.1 to 2.4 lakh rupees per acre at marginal B:C ratio ranging from 9.7 to 11.4. In case of pomegranate, yield benefit ranged from 22 to 39 per cent with average benefit of rupees 78 thousand per acre at marginal B:C ratio of 20. In tomato, yield increase ranged from 20 to 60 per cent, with marginal benefit of 73 thousand rupees at marginal B:C ratio of 19.4. In all cases significant improvement in crop vigour and fruit quality were observed. Customized fertigation products have great potential to contribute towards national mission of doubling farm income by 2022.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Boron and Potassium Levels on Seed yield and Oil Quality of Sunflower (*Helianthus annuus* L.) Hybrid

P. Jyothi, T. Anjaiah*, I.Y.L.N. Murthy[1], M. Rajeshwar and S.A. Hussain
Department of Soil Science and Agricultural Chemistry, College of Agriculture,
PJTSAU, Rajendranagar, Hyderabad, 500 030, Telangana
[1]ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad, 500 030, Telangana
**Email: anjaiahtheerthala@gmail.com*

Sunflower (*Helianthus annuus*. L.) is one of the important edible oilseed crops cultivated in India in various soil types. The cultivation of sunflower is largely confined to southern parts of the country comprising the states of Karnataka, Maharastra, Tamilnadu, Andhra Pradesh and Telangana these states contributes 90% of total acrage and 78% of total production, However, productivity was very low (643 kg ha^{-1}). There is need to increase the average productivity levels from the present 643 kg ha^{-1} to 1450 kg ha^{-1} by the year 2025 to meet the ever increasing population demands for oil seeds. The low productivity of oil seed crops may be due to growing of exhaustive crops in rainfed areas coupled with imbalanced use of fertilizers. Keeping the above facts under consideration, a field experiment was conducted at college farm, College of Agriculture, Rajendranagar during *rabi* 2016 with sunflower hybrid GK 2002 in factorial randomized block design with 16 treatment combinations comprising of four levels of B and four levels of potassium *viz.*, (B_0K_0), (B_0K_{15}), (B_0K_{30}), (B_0K_{60}), ($B_{0.5}K_0$), ($B_{0.5}K_{15}$), ($B_{0.5}K_{30}$), ($B_{0.5}K_{60}$), (B_1K_0), (B_1K_{15}), (B_1K_{30}), (B_1K_{60}), ($B_{1.5}K_0$), ($B_{1.5}K_{15}$), ($B_{1.5}K_{30}$) and ($B_{1.5}K_{60}$) to investigate the influence of application of different levels of B and K with recommended dose of nitrogen (N) and phosphorus (P) fertilizers to find out the optimum dosage of B and K to increase the sunflower seed yield and oil quality. Maximum seed yield was obtained with $B_{1.5}K_{60}$ treatment (1430 kg ha^{-1}) fallowed by $B_{1.5}K_{30}$, B_1K_{30} and B_1K_{60}. Boron and potassium levels and B × K interaction were found to be significant. Even though highest seed yields with $B_{1.5}K_{60}$ treatment was recorded. The B_1K_{30} treatment showed economically beneficial. Similar trend was found in the test weight. Maximum oil content found with B_1K_{30} whereas high oil yield, protein content and protein yields were observed with $B_{1.5}K_{60}$. However, they are at par with B_1K_{30} and the lowest values were observed with control. The highest linoleic acid content (75.3%) was recorded in $B_{1.5}$ kg ha^{-1} + K_{30} kg ha^{-1} and lowest (71.3%) in control.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Screening of Different Rice Genotypes for Zinc Efficiency on the Basis of Yield and Uptake Efficiency

Dileep Kumar*, V.P. Ramani and G.J. Mistry
Micronutrient Research Project (ICAR), Anand Agricultural University, Anand, 388110, Gujarat
**Email: dileepdixit.bhu@gmail.com*

Zinc (Zn) deficiency is a global problem of considerable importance for agriculture and human health. Soil Zn deficiency limits the growth and crop yield. Growing Zn efficient cultivars *i.e.* the cultivars with high yield at low Zn supply would represent a long-term solution and sustainable approach to crop production and nutrition as well. To evaluate Zn efficiency of rice genotypes, field experiment was conducted at Anand Agricultural University, Anand. Twenty eight diverse rice genotypes were evaluated in the field at three Zn levels *viz*. low (no fertilizer Zn), medium (10 kg Zn ha^{-1} soil application through zinc sulphate) and high (20 kg Zn ha^{-1} soil applied through zinc sulphate + three foliar sprays of 0.5% zinc sulphate). Relative grain yield *i.e.* Zn efficiency index varied from 65.5 to 102.6% and relative grain Zn uptake *i.e.* Zn efficiency varied from 53.8 to 107% with a mean value of 87.1 and 76.5%, respectively. Cultivar GR-101 was having the highest Zn efficiency index as well as Zn efficiency. Based on grain yield and Zn efficiency, the genotypes were classified as efficient and responsive (Ashoka 20, Narmad, GR-12, GR-3, GR-1 and GR-2), efficient and non responsive (GR- 11, SLR -51214. GAUR-10 and GR-13), inefficient and responsive (GR-101, GR-104, GR-102 and Lalkad) and inefficient and non responsive (Gurjari, AAUDR-1, K-Kamod, GR-9, GR-5, P-2003 SK-20 and GR-7). The efficient and responsive genotypes are most desirable as they would yield higher under low Zn and respond better to Zn additions.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Boron and Potassium Levels on Dry Matter Accumulation and Yield of Sunflower (*Helianthus annuus* L.) Hybrid

P. Jyothi, T. Anjaiah*, I.Y.L.N. Murthy[1], M. Rajeshwar and S.A. Hussain
Department of Soil Science and Agricultural Chemistry, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad, 500 030, Telangana
[1]ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad, 500 030, Telangana
**Email: anjaiahtheerthala@gmail.com*

Sunflower (*Helianthus annuus* L.) is one of the important edible oilseed crops cultivated in India in various soil types. The cultivation of sunflower is largely confined to southern parts of the country comprising the states of Karnataka, Maharastra, Tamilnadu and Andhra Pradesh and Telangana contributes 90% of total acrage and 78% of total production, However, productivity was very low (643 kg ha^{-1}) there is need to increase the average productivity levels from the present 643 kg ha^{-1} to 1450 kg ha^{-1} by the year 2025 to meet the ever increasing population demands for oil seeds. Indian soils are progressively becoming deficient not only in major plant nutrients but also micronutrients. Deficiencies of major and micronutrients are responsible for lower dry matter production and thereby lower yields in crops. Boron (B) deficiency has emerged an important micronutrient problem in Indian soil and crops next to zinc (Zn), keeping these facts into consideration a field experiment was conducted on sandy loam soil at Agricultural College farm, Rajendranagar, Hyderabad, Telangana, during *rabi* 2016 with sunflower hybrid GK 2002 in factorial randomized block design with 16 treatment combinations comprising of four levels of boron and four levels of potassium *viz.*, (B_0K_0), (B_0K_{15}), (B_0K_{30}), (B_0K_{60}), ($B_{0.5}K_0$), ($B_{0.5}K_{15}$), ($B_{0.5}K_{30}$), ($B_{0.5}K_{60}$), (B_1K_0), (B_1K_{15}), (B_1K_{30}), (B_1K_{60}), ($B_{1.5}K_0$), ($B_{1.5}K_{15}$), ($B_{1.5}K_{30}$), ($B_{1.5}K_{60}$) to study the effect of B and potassium (K) levels on dry matter accumulation and yield of sunflower crop, experimental results revealed that the concentration and uptake of B and major nutrients by sunflower seed intern yields were influenced by the application of different levels of B and K to sunflower crop. The B and K application showed significant effect on seed yield. Maximum seed (1430 kg ha^{-1}), and shoot yield (4275 kg ha^{-1}) was recorded with the treatment received B @ 1.5 kg and K @ 60 kg ha^{-1} as compared to control. There was 50 and 93 per cent increases in seed and shoot yields, respectively. In the present investigation, sunflower shoot uptake of major nutrients like N and P were significantly influenced by the application of B and K at 60 and 90 days after sowing. Nutrient uptake by sunflower seed increased with increasing levels of B and K application. Seed nutrient uptake of N, P, K and B were 43.8, 11.8, 13.6 kg ha^{-1} and 33.2 kg ha^{-1}, respectively with 1.5 kg B ha^{-1}, and 60 kg K ha^{-1} treatment. These are significant and at par with B1 kg ha^{-1} and K30 kg ha^{-1} but superior over control. The B × K interactions was found statistically significant.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Long-term Soil Fertility Management in Low Land Rice Soils under Rice-Rice Cropping System of Godavari Delta, India : 25 Years Experience

Ch. Sreenivas*, A. Sireesha[1], T. Usha Rani[1] and P.V. Satyanarayana[1]
Agricultural College, Rajamahendraqvaram, 533 103, East Godavari District, Andhra Pradesh
[1]Andhra Pradesh Rice Research Institute and Regional Agricultural Research Station, Maruteru, 534 122, West Godavari District, Andhra Pradesh
**Email: csvasu@yahoo.com*

The effect of long-term fertilization with organic and inorganic sources of nutrition on the grain yield and organic carbon content in post-harvest soil under rice-rice system in alluvial soils was studied for 25 years during *kharif* and *rabi* seasons. Application of 100%NPKZnS + FYM @ 5 t ha^{-1} recorded highest grain yield (5.40 and 6.24 t ha^{-1}, respectively, during *kharif*, 2014 and *rabi*, 2014-15) and soil organic carbon content (5.40 and 6.24 g kg^{-1}, respectively, during *kharif*,14 and *rabi*,14-15) after 25 years. 100% NPKZnS produced on par for grain yield production and lower soil organic carbon than 100%NPKZnS + FYM @ 5 t ha^{-1}. Nitrogen substitution with FYM/GM performed lower than 100% NPKZnS treatment in grain yield production. However, nitrogen substitution with FYM/GM performed superior than 100% NPKZnS in increasing organic carbon content. Between GM and FYM, FYM performed better than GM during *kharif*. Application of FYM @ 10 t ha^{-1} alone was found on par with 100%NPKZnS in grain production during *kharif* only but registered higher organic carbon content.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Sulphur Enhanced SSP on Nodulation, Growth, S Uptake and Yield of Soybean in Black Soils of Madhya Pradesh

S.C. Gupta, R. Rajput, Pooja Singh and M.P. Nayak
Department of Soil Science and Agricultural Chemistry, RVSKVV,
RAK College of Agriculture, Sehore, 466001, Madhya Pradesh

Soybean (*Glycine max* (L) Merrill) is one of the important oil seed and legume crop of India. It is a triple beneficiary crop, which contains about 20% oil, 42% of protein and possessing high level of essential amino acids. Soybean area, production and productivity in world, India and in Madhya Pradesh as reported in 2014-15 was 118.01, 11.00 and 5.55 million hectares; 315.06, 10.50 and 6.02 million tonnes and 2670, 955 and 1086 kg ha^{-1}, respectively. Soybean yield in India as well as in Madhya Pradesh is comparatively low as compared to world average productivity. This might be attributed to imbalance fertilization, poor biological nitrogen fraction, improper management, high incidence of pest and diseases *etc.* Being legume as well as oil seed crop, soybean needs balance nutrition. In recent years, sulphur (S) deficiency has been widely seen and reported in many states of India including in Madhya Pradesh. Due to ease in application, farmers are mostly using DAP and NPK grade fertilizers in soybean crop, which is not taking care of S application in soil. Some farmers are using SSP for supplying phosphorus (P) to soybean crop wherein S also goes into the soil. Recently, sulphur enhanced SSP is prepared by some manufacturer which contains about 16% S instead of 12% S in regular SSP. Hence, in order to assess the efficacy of S enhanced SSP in soybean in black soils a field experiment was conducted at research farm of RAK College of Agriculture, Sehore, Madhya Pradesh during 2015-16 with four treatments *viz.*T_1- 60 kg P_2O_5 ha^{-1} through regular SSP (45 kg S ha^{-1}), T_2- 60 kg P_2O_5 ha^{-1} through S enhanced SSP (60 kg S ha^{-1}),T_3- 40 kg P_2O_5 ha^{-1} through regular SSP (30 kg S ha^{-1}) T_4- 40 kg P_2O_5 ha^{-1} through S enhanced SSP (40 kg S ha^{-1}), replicated 5 times in a RBD under black soils possessing a soil pH of 7.4, EC of 0.31 dS m^{-1}, organic carbon 4.2 g kg^{-1}, available NPK 215, 12.9 and 480 kg ha^{-1} and sulphur 9.8 ppm.

The data recorded on nodulation and yield attributes *viz*. plant height, no of pods/plant, exhibited significant increase due to use of S enhanced SSP over regular SSP both at 40 and 60 Kg P_2O_5 ha^{-1} application. As regards grain yield, treatment T_2- 60 kg P_2O_5 ha^{-1} through S enhanced SSP (60 kg S ha^{-1}a) could produce significantly higher yield (1430 kg ha^{-1}) over T_3- 40 kg P_2O_5 ha^{-1} through regular SSP (30 kg S ha^{-1}) and T_4- 40 kg P_2O_5 ha^{-1} through S enhanced SSP (40 kg S ha^{-1}) (1185 & 1270 kg ha^{-1}, respectively). However T_2- 60 kg P_2O_5 ha^{-1} through S enhanced SSP (60 kg S ha^{-1}) was statistically identical to T_1- 60 kg P_2O_5 ha^{-1} through regular SSP (45 kg S ha^{-1}) in enhancing grain yield (1368 kg ha^{-1}) of Soybean indicating fulfillment of S requirement of crop with both the sources (regular SSP and S enhanced SSP) when P applied @ 60 kg P_2O_5 ha^{-1} solely through either type of SSP. The yield enhancement by the use of S enhanced SSP over regular SSP (@ 40 kg P_2O_5 ha^{-1} and 60 kg P_2O_5 ha^{-1} levels) was 4.53 and 7.17 per cent, respectively. Grain yield enhancement by regular and S enhanced SSP @ 60 kg P_2O_5 ha^{-1} over farmers practice of 40 kg P_2O_5 ha^{-1} through regular SSP was 15.4 and 20.7 per cent higher, respectively. As regards to S content and uptake in soybean grain and straw and also available S balance in soil after crop harvest, these were significantly affected due to S enhanced SSP over regular SSP both at 40 and 60 kg P_2O_5 ha^{-1} levels.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Strategies for Phosphorus and Potassium Management in Major Soils Under Long-Term Fertilizer Experiments in India

R.H. Wanjari*, Muneshwar Singh, Shweta Jamra and R.C. Jatav
All India Coordinated Research Project on Long-Term Fertilizer Experiments,
ICAR-Indian Institute of Soil Science, Nabibagh, Berasia Road, Bhopal, Madhya Pradesh
**Email: wanjariravi@gmail.com*

The primary nutrients namely phosphorus (P) and potassium (K) also play key role in yield sustainability and food security of the country. In this context, long-term fertilizer experiments (LTFE) going on in India with the objective to study the impact of nutrient management on crop productivity and soil health across the predominant cropping systems covering major soils of the country. The results emanated from the long-term fertilizer and manurial trials indicated that the continuous application of Penhanced crop productivity in all the cropping systems across the country. However, such continuous P application over the years could led to accumulation in soil that is not directly getting reflected in yield rather excess traces poses threat to the environment. Thus, based on the high P status of the soil, P application is need to be stopped and reutilize the accumulated P by reduction in P dose to half or skipping of P from the fertilizer schedule in alternate year of the *kharif* crops. This strategy will not only provide a solution for unnecessary build-up of P but also minimizing environmental hazard without loosing crop productivity. Similarly, application of K is essential and even more necessary than nitrogen (N) in Alfisols otherwise survival of crop without K is not possible. Moreover, it has been well documented that optimum K supply catalyses utilization of N and P in plant. Even though black soils (Vertisols) are considered as high in K but studies from long-term experiments indicated that crops are gradually responding to applied K in some of the soils with high K status. Potassium balance sheet in long term experiments indicated that majority of soils are experiencing negative K balance which is due to no K in fertilizer schedule. However, in alluvial soils application of K did not contribute much towards crop yields. Therefore, there is a need to develop strategy for proper K management which may become important in the years to come. Thus, long-term fertilizer experiment clearly demonstrated that strategic management of P and K is essential in order to sustain and enhance the crop productivity as well as overall sustainability.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Zinc Nutrition of Rice Applied through Briquettes

A.V. Bulbule*, P.N. Gajbhiye, R.D. Nigade and N.Y Patil
Zonal Agricultural Research Station, Shenda Park, Kolhapur, Maharashtra
**Email: avbulbule@gmail.com*

Farmers can improve their net returns from agriculture with lower cost inputs and/or enhanced efficiency of input use. Briquettes prepared from fertilizer materials are a group of special fertilizer products that has been given special attention, such fertilizers are formulated in compacted form, with a relatively small surface-to-volume ratio which results in a slow release of nutrients. Field experiment was conducted during the year 2014-15 on zinc (Zn) deficient soil in the assured rainfall region located at Zonal Agricultural Research Station, Shenda Park Farm, Kolhapur, Sub-montane Zone of Maharashtra. The object of the experiment was to study the response of rice to Zn nutrition when applied though different soil and foliar application methods on a Zn deficient soil. The fertilizer briquettes containing Zn-EDTA were prepared on a small scale briquetting machine by compaction of the fertilizer materials. The rice crop was sown in paired rows having alternate spacing of 15-25 cm and fertilized through briquettes hand placed in the 15 cm at depth of 5-7 cm alternate bands of the paired rows to accommodate the different fertilizer levels. The recommended dose (RD) of fertilizers applied to the finger millet crop was 75:37.5:37.5 (N, P_2O_5 K $_2O$ kg ha^{-1}) through briquettes. The fertilizer treatments consisted of basal dose of recommended dose of fertilizers along with seed treatment with Zn-EDTA @ 0.5%, foliar $ZnSO_4$ (0.5 %) at 35 and 55 DAT, Zn-EDTA @ 0.2% foliar spray at 35 and 55 DAT, $ZnSO_4$ @ 25 kg ha^{-1} and Zn EDTA briquettes @ 10 kg ha^{-1}. Findings revealed that the highest grain yield was recorded by the treatment Zn-EDTA briquettes @ 10 kg ha^{-1} (4.86 t ha^{-1}) and it was at par with soil application of $ZnSO_4$ @ 25 kg ha^{-1} (4.82 t ha^{-1}). The foliar spray of $ZnSO_4$ @ 0.5 % (4.78 t ha^{-1}) was significantly superior over water spray (4.34 t ha^{-1}). The application of Zn either through foliar or soil significantly increased the uptake of Zn over the treatment without Zn application. The highest uptake of Zn was recorded by the treatment Zn-EDTA briquettes @ 10 kg ha^{-1} (148.8 g ha^{-1}). The nutrient content in soil after harvest revealed that soil application of Zn recorded higher value of DTPA extractable Zn. Whereas, the other nutrient content in soil remained unchanged. The highest B:C ratio revealed that application of Zn through $ZnSO_4$ was economical and recorded the highest B:C ratio (2.7).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Response of Finger millet (*Eleusine coracana* L.) Cultivated on Steep Hill Slopes to Foliar Nutrition

A.V. Bulbule*, P.N. Gajbhiye, R.D. Nigade and N.Y. Patil
Zonal Agricultural Research Station, Shenda Park, Kolhapur, 416 012, Maharashtra
**Email: avbulbule@gmail.com*

Under conditions of heavy rainfall finger millet (*Eleusine coracana* L.) is widely grown on steep hill slopes. The crop tolerates the heavy rains and is a sustenance food in the diets of farmers of the Western Ghat of Maharashtra. The crop is starved of nutrition due to the constraints faced by the farmers about fertilizing the crop particularly grown on steep slopes under conditions of heavy rainfall. Considering the problems faced by farmers field experiments were conducted in the region located at Zonal Agricultural Research Station, Shenda Park Farm, Kolhapur on Entisol, Sub-montane Zone of Maharashtra during the *kharif* seasons of 2014 to 2016 to study the response of finger millet crop to foliar nutrition of nitrogen (N), phosphorus (P) and potassium (K). The response of fertilizer application was studied through the conventional chemical fertilizers *viz*. urea and diammonium phosphate (DAP), muriate of potash (MOP), calcium nitrate and complex fertilizer 19-19-19. The finger millet was transplanted and fertilized through basal recommended dose of 60: 30 (N, P_2O_5 kg ha^{-1}). The foliar spray was applied at 50 days after transplanting. The chemical fertilizers used for spray were urea, DAP, MOP, complex 19-19-19 and calcium nitrate applied @ 2% foliar spray while combination treatments of urea, DAP and MOP @ 0.5% each was applied to the experimental plots.

The findings of the field experiments revealed that the application of foliar spray resulted into increased yields of finger millet crop. The highest yield was recorded by the treatment foliar spray 19-19-19 @ 2% (2.27 t ha^{-1}) over the recommended dose of fertilizer.

The soil analyses after harvest of the crop revealed that the N, P and K contents in the soil after harvest of the crop did not differ amongst the different treatments. The data on plant uptake revealed that the treatment of foliar spray 19-19-19 @ 2% recorded higher uptake of N, P and K as compared to no foliar spray application. The application of foliar spray 19-19-19 @ 2% recorded significantly highest B:C ratio (1.46).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Different Foliar Micronutrient Formulation Grades for *Kharif* Onion

A.G. Durgude*, I.R. Bagwan and A.L. Pharande
Department of Soil Science and Agril. Chemistry, Mahatma Phule Krishi Vidyapeeth, Rahuri 413 722 Dist. Ahmednagar
**Email: durgudeag@redifmail.com*

The field experiment on formulation of different foliar micronutrient grades for *kharif* onion was undertaken for three years 2013-14 to 2015-16 on Typic Ustorthent (Entisol) with the objectives of development of suitable foliar micronutrient fertilizer grades for *kharif* onion. Initial properties of soil *viz.* Textural class was silty clay, bulk density 1.30 Mg m^{-3}, pH 8.2 EC 0.18 dS m^{-1}, DTPA-Fe 4.1, Zn 0.48, Mn 5.2, Cu 2.30 and B 0.38 ppm. Two foliar spray of Govt. micro grade II (Fe 2.5 %, Zn 3.0%, Mn 1.0%, Cu 1.0%, B 0.5% and Mo 0.1%), Phule micro grade II A (Fe 2.5%, Zn 4%, Mn 0.2%, Cu 0.5% and B 0.2%) and Phule micro grade II B (Fe 3.0%, Zn 5%, Mn 0.5%, Cu 0.5% and B 0.5%) were done at 35 and 55 days after transplanting. The treatment comprises T_1: General recommended dose of fertilizers (100 :50:50 $N:P_2O_5:K_2O$ kg ha^{-1} + 20 t ha^{-1} FYM), T_2: T_1 + Two foliar spray of water, T_3: T_1 + Two foliar spray of Govt. micro grade II (0.2%), T_4: T_1 + Two foliar spray of Govt. micro grade II (0.3%), T_5 : T_1 + Two foliar spray of Phule micro grade –II 'A' (0.2%), T_6 : T_1 + Two foliar spray of Phule micro grade –II 'A' (0.3%), T_7 : T_1 + Two foliar spray of Phule micro grade-II 'B' (0.2%), T_8 : T_1 + Two foliar spray of Phule micro grade-II 'B' (0.3%). The results revealed that two foliar sprays of 0.3% Phule micro grade-II 'B' at 35 and 55 days after transplanting of onion along with general recommended dose of fertilizer (100:50:50 kg ha^{-1} $N:P_2O_5:K_2O$ + 20 t ha^{-1} FYM) to *kharif* onion was found beneficial for increase in plant height, number of leaves, chlorophyll content, bulb yield, total macro and micronutrients uptake by onion and agronomic efficiency as well as for higher monetary benefit. However, aforesaid treatment was at par with the two foliar application of 0.2% Phule micro grade 'B' along with GRDF.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Integrated Nutrient Management on Soil Properties, Yield and Quality of Indian Mustard (*Brassica Juncea* L.) in Calcareous Soils of Bihar

Sanjay Kumar Singh*, Shivendu Kumar Chandan and Anil Pandey
Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar
**Email: sanjaybhu@rediffmail.com*

To ascertain the effect of integrated nutrient management along with recommended dose of N, P, K, and S on soil properties, yield and oil quality and content of fatty acid in Indian mustard, a experiment was carried out on sandy loam calcareous soil during 2015-16 at research farm of Tirhut College of Agriculture, Dholi, Muzaffarpur a campus of Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar. The experiment was laid out in complete randomized block design (RBD) consisting 11 treatments with three replications. The yield and oil quality parameters were analyzed by prescribed standard methods and fatty acid profile was quantified using gas-chromatograph equipped with flame ionization detector. The results revealed that the highest grain yield (1.78 t ha^{-1}) of Indian mustard was obtained where applied 75% RDF + S @ 40 kg ha^{-1} + Vermicompost @ 5 t ha^{-1} + *Azotobacter*+PSB followed by application of 100% RDF + S @ 40 kg ha^{-1}+Vermicompost @ 5 t ha^{-1}+ *Azotobacter*+PSB. The low value of free fatty acid was recorded in treatment applied as 100% RDF+S @ 40 kg ha^{-1} +Poultry manure @ 2 t ha^{-1} and low quantity of free fatty acid generally occurs beneficial for human health purposes. The maximum value of palmitic and strearic acid (saturated fatty acid) exhibited, where applied 75% RDF+S @ 40 kg ha^{-1} + Poultry manure @ 2 t ha^{-1} and 100% RDF+S @ 40 kg ha^{-1}+Vermicompost @ 5 t ha^{-1}, whereas, in linoleic acid (18.18%) noticed with 75% RDF + S @ 40 kg ha^{-1} + Vermicompost @ 5 t ha^{-1}. The ratio of PUFA:MUFA and SFA:MUFA was found highest with 75% RDF + S @ 40 kg ha^{-1} and 100% RDF + S@ 40 kg ha^{-1} + Poultry manure @ 2 t ha^{-1}, respectively. The highest available nutrients *viz.* available nitrogen (200 kg ha^{-1}), phosphorus (14.1 kg ha^{-1}) and available potassium (117 kg ha^{-1}) content after crop harvesting was found in 75% RDF + S @ 40 kg ha^{-1} + Vermicompost @ 5 t ha^{-1}+ *Azotobacter* +PSB and 100% RDF + S @ 40 kg ha^{-1} + Vermicompost @ 5t ha^{-1} + *Azotobacter* + PSB.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Studies on Yield and Quality of Pomegranate in relation to Soil Properties in Koppal and Bagalkot Districts

S.I. Tolanur
College of Agriculture, University of Agricultural Sciences, Dharwad, Vijayapur, 586101, Karnataka

Studies on yield and quality of pomegranate orchards in relation to soil properties of Koppal and Bagalkot districts was conducted on randomly selected thirty pomegranate orchards, located in ten villages *viz.*, Madalagatti, Shakapura, Kalakbandi, Alwandi, Chukankal, Govinakoppa, Hiresamshi, Chiksamshi Kaladagi, and Guledagudda of Koppal and Bagalkot districts of Karnataka. The two major criteria *viz.*, crop age (more than five years' old orchards) and *hasta bahar* season were considered in selection of the orchards.

Pomegranate orchards were categorized into low (<12.45 t ha^{-1}), medium (12.45 to 17.33 t ha^{-1}) and high yielding (>17.33 t ha^{-1}). Depending on their yield levels, 13 orchards were grouped under low category with mean yield of 9.42 t ha^{-1} (7.94 - 12.3 t ha^{-1}) and 7 orchards under medium (13.26 - 17.02 t ha^{-1}) and 10 orchards in high yielding (17.64 - 24.28 t ha^{-1}) category.

The texture of soils ranged from sandy clay loam to sandy clay and soils were alkaline with non-saline in nature. Higher organic carbon, available N, P, K, S, Zn and Fe content observed in high yielding orchards while, Cu and Mn and B were relatively higher in low yielding orchards and higher exchangeable Ca and Mg was noticed in medium yielding orchard. All these nutrients in soil decrease with depth except exchangeable Ca, Mg and B in soil.

The nutrient composition in index leaves indicated that higher concentrations of N, P, K, Ca, Mg, Zn, Fe, Mn and B were observed in high yielding orchards and S and Cu in medium yielding orchards.

Quality of pomegranate fruit indicated that higher TSS, reducing sugar and lower total acidity were obtained in the high yielding orchards where, lower TSS, reducing sugar and higher total acidity were obtained in low yielding orchards.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Importance of Magnesium and Iron Nutrition in the Cultivation of Gerbera

Shiva Kumar Udayana, N.B. More[1], Anandkumar Naorem, Gyanendra Kumar and Biswapati Mandal
Department of Agricultural Chemistry and Soil Science, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal
[1]Division of Soil Science and Agricultural Chemistry, Mahatma Phule Krishi Vidyapeeth, Pune, Maharashtra

A pot culture experiment was carried out with goliath cultivar of gerbera at Hi-tech Floriculture and Vegetable Production Project, College of Agriculture, Pune (Maharashtra) during August 2013 to February 2014. The objective of the research was to assess the deficiency symptoms of magnesium (Mg) and iron (Fe) on gerbera.The experiment was laid out in factorial completely randomized design with 16 (15 + 1) treatment combinations and three replications. Cocopeat was used as growing media for this experiment. During the initial 100 days after planting, all the macro and micronutrients were applied to gerbera as per the recommended dose (200-60-250 mg N, P_2O_5 and K_2O/ plant on alternate days) and also disbudding was practiced to encourage the vegetative growth and thereafter the treatments started by reducing the nutrients in two treatments *i.e.* in one treatment that is devoid of Mg and other devoid of Fe. One treatment is maintained with all nutrients till the end of the experiment. The treatments were given so as to supply 350-60-300 mg N, P_2O_5 and K_2O/ plant on alternate days, which is the recommended dose for gerbera after flowering. The results of the experiment revealed that Mg deficiency resulted in interveinal chlorosis in recently matured leaves initially as chlorotic spots at 140 DAP and later on as interveinalchlorosis starting from leaf margin towards the mid rib at 175 DAP, inhibition in root growth which is prominent at 160 DAP and pale coloured flowers observed at 160 DAP. While iron deficiency resulted in interveinal chlorosis in younger leaves initially as chlorotic spots at 110 DAP and the entire leaves became chlorotic with veins remaining green later on at 175 DAP, besides pale petals in flowers observed at 160 DAP.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Organic Sources of Nutrient and Fulvic Acid Sprays on Growth, Yield and Nutrient Uptake after Harvest of Tomato

Prerana Bhosale, D.D. Gaikwad, R.M. Gethe, S.A. Anarse and V.M. Amrutsagar
AICRP on Agroforestry, Mahatma Phule Krishi Vidyapeeth, Rahuri, 413722, Maharashtra

The present investigation was conducted at Post Graduate Institute Farm, MPKV, Rahuri during 2005-06 to study the effect of organic sources of nutrient and fulvic acid sprays on growth, yield and nutrient uptake after harvest of tomato. The field experiments were carried out in RBD with thirteen treatments and in factorial randomized block design with twelve treatments and three replications. The different organic manure *viz.*, FYM, compost, pressmud compost, poultry manure, vermicompost, neem and castor cake used. Application of poultry manure showed significantly maximum plant height (54.8 cm), tomato yields (66.9 t ha^{-1}) and biomass yield (2.82 t ha^{-1}). Maximum plant height (53.7 cm), tomato yield (63.0 t ha^{-1}) and biomass yield (2.82 t ha^{-1}) was recorded in vermicompost application. The highest plant height (55.5 cm), tomato yield (71.1 t ha^{-1}) and biomass yield (2.99 t ha^{-1}) was recorded in poultry manure + vermicompost application with fulvic acid sprays. The application of poultry manure showed highest pericarp thickness (0.75 mm) and TSS (5.29 ^{O}Brix). However, among the concentrate *viz.*, vermicompost showed highest fruit weight (318.7 g), juice percentage (77.11%), TSS (4.85 ^{O}Brix) and pericarp (0.73 mm). The interaction effects showed that application of poultry manure + vermicompost reported the highest TSS (5.40 ^{0}Brix), pericarp (0.76 mm). The interaction effects showed that application of poultry manure + vermicompost showed highest juice percentage (77.8%). Among the bulky organic manure significantly highest acidity (0.45 meq $100g^{-1}$) was observed under poultry manure. However, among the concentrate *viz.*, vermicompost showed highest acidity (0.44 meq $100g^{-1}$), ascorbic acid (28.8 mg $100g^{-1}$) and lycopene (0.32 mg $100g^{-1}$). The interaction effects showed that application of FYM + vermicompost reported highest acidity (0.47 meq $100g^{-1}$) and ascorbic acid (30.1 mg $100g^{-1}$).

Among the bulky organic manure significantly highest nitrogen, phosphorus and potassium uptake (301.9, 63.7 and 204.7 kg ha^{-1}) was observed under poultry manure. However, among the concentrate *viz.*, vermicompost showed highest nitrogen, phosphorus and potassium uptake (287.4, 57.7 and 196.4 kg ha^{-1}). The interaction effects showed that application of poultry manure + vermicompost reported highest nitrogen, phosphorus and potassium uptake (325.5, 71.2 and 227.6 kg ha^{-1}, respectively).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Organic Manures and Graded Levels of Zinc Sulphate on Growth, Yield and Soil Properties of Pigeonpea

Prerana Bhosale and M.R. Bedis
AICRP on Agroforestry, Mahatma Phule Krishi Vidyapeeth, Rahuri, 413722, MAharashtra

The field experiment was conducted in the Pulses Improvement Project at MPKV, Rahuri, Ahmednagar during 2013-14 to study the effect of organic manures and graded levels of zinc sulphate on growth, yield and soil properties of pigeonpea. in medium black soil. The experiment was laidout in factorial randomized block design with three replication. The grain yield recorded with the application of poultry manure 20 kg ha^{-1} was significantly superior over the grain yield recorded with the application of farmyard manure (FYM) (1.34 t ha^{-1}) and control (1.19 t ha^{-1}) and was on par with the yield obtained in treatment receiving vermicompost (1.43 t ha^{-1}). The per cent increase in grain yield of pigeonpea was to the tune of 34, 20 and 13 per cent with application of poultry manure, vermicompost and FYM, respectively over control. In the present study, the graded levels of $ZnSO_4$, had a significant influence on the grain and straw yield of pigeonpea. Significantly higher seed yield (1.53 t ha^{-1}) was obtained with $ZnSO_4$ @ 20 kg ha^{-1} when compared to no zinc sulphate (1.26 t ha^{-1}) and $ZnSO_4$ @ 10 kg ha^{-1} (1.36 t ha^{-1}), while it was comparatively slightly higher with $ZnSO_4$ @ 15 kg ha^{-1} (1.40 kg ha^{-1}). The straw yield followed the same trend.

The soil fertility status in case of pH, EC and organic carbon was maintained by application of organic sources and graded levels of zinc sulphate. The maximum organic carbon (5.4 g kg^{-1}), available nitrogen (178.6 kg ha^{-1}), phosphorus (12.2 kg ha^{-1}) and potassium (447.2 kg ha^{-1}) was recorded in poultry manure application as compared to control. The highest available zinc was reported (2.10 mg kg^{-1}) in vermicompost @ 2.5 t ha^{-1} application. The application of graded levels of $ZnSO_4$ @ 20 kg ha^{-1} showed highest organic carbon (5.4 g kg^{-1}) , available nitrogen (174.9 kg ha^{-1}), phosphorus (10.8 kg ha^{-1}) and potassium (434 kg ha^{-1}) and application of 15 kg $ZnSO_4$ ha^{-1} recorded highest available zinc (1.90 mg kg^{-1}). The nutrient uptake of nitrogen (44.2 kg ha^{-1}), phosphorus (59.4 kg ha^{-1}) and potassium (74.7 kg ha^{-1}) was significantly maximum by addition of poultry manure as compared to control. Application of graded levels of $ZnSO_4$ @ 20 kg ha^{-1} showed highest uptake of nitrogen (42.7 kg ha^{-1}), phosphorus (53.5 kg ha^{-1}) and potassium (71.1 kg ha^{-1}).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Quality and Yield of Byadgi Chilli (*Capsicum annuum* L.) as Influenced by Foliar Feeding of Calcium Nitrate in a Vertisol

Kavitha Jadhav and B.I. Bidari
Department of Soil Science and Agricultural Chemistry, College of Agriculture, University of Agricultural Sciences, Dharwad, 580005, Karnataka

A field experiment was conducted during *kharif* 2016 in the farmer's field at Agadi village (Tq: Hubli) in Dharwad district to investigate the quality and yield of Byadgi chilli as influenced by foliar feeding of calcium nitrate in a Vertisol. Experiment consisted of 12 treatments with three replications.

Three foliar sprays of 1.5% $Ca(NO_3)_2$ recorded highest fruit yield (2.18 t ha^{-1}) followed by treatment that received one spray of 1.5% $Ca(NO_3)_2$ at 45 DAT (2.14 t ha^{-1}). Three foliar applications of 1.5% $Ca(NO_3)_2$ recorded significantly highest colour value (280.2 ASTA units) and highest oleoresin content (20.4%) which was on par with one foliar spray of $Ca(NO_3)_2$ (19.1%) and 1.0% on 75 DAT (17.0%). Lowest flower drop (10.0%) was recorded due to three foliar sprays of 1.5% $Ca(NO_3)_2$ that was on par with one foliar spray given on 45 DAT as well as 60 DAT of same concentration. Uptake of calcium and magnesium were significantly influenced by foliar spray of $Ca(NO_3)_2$ and highest uptake was noticed due to three foliar applications of $Ca(NO_3)_2$ at 1.5%. Nitrogen content of red fruit bears significant positive relationship with colour value (r = 0.681*) and oleoresin content (r = 0.680*) while calcium content bears significant positive relationship with colour value (r = 0.671*) and oleoresin content (r = 0.768**). The B:C ratio was highest (5.98) due to three foliar application of $Ca(NO_3)_2$ at 1.5% while lowest ratio (2.65) was in control. Foliar spray of 1.5% $Ca(NO_3)_2$ is superior in improving the yield and quality of Byadgi chillies.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Integrated Nutrient Management on Soil Health, Crop Yield and Nutrient Uptake of Crops under Rice–Maize Cropping System

Brajesh Kumar and Sudipta Tripathi*
Department of Agricultural Chemistry and Soil Science, Institute of Agricultural Science, University of Calcutta, 51/2, Hazra Road, Kolkata, 700019, West Bengal
**Email: sudipta_t@yahoo.com*

Integrated nutrient supply of inorganic and organic sources is of great importance for maintenance of soil health, crop productivity and nutrient uptake in intensive rice-maize cropping systems. A field experiment was conducted in the Krishi Vigyan Kendra, Jamui, Bihar during 2014-15 and 2015-16 with rice (cv. Rajendra mahsoori-1) as *kharif* crop and maize (Shakatiman-4 hybrid) as a *rabi* crop to investigate the influence of integrated nutrient management on soil health, yield of crops and nutrient uptake in rice-maize cropping system. The experiment comprised of nine treatments, each replicated five times with a plot size of 20 m^2 in randomized block design. Soil samples were collected and analyzed for physical, chemical and biological properties before and after the crop harvest. Based on two years pooled data, the highest grain yield (4.92 t ha^{-1}) in rice and (5.39 t ha^{-1}) in maize and maximum nutrient uptake of nitrogen, phosphorus and potassium were recorded in the T_8 treatment for both in rice and maize. The lowest grain yield was recorded in T_9 treatment. The treatments received organic amendments recorded higher microbial biomass carbon, basal soil respiration and fluorescein diacetate hydrolyzing activity over the treatments received chemical fertilizers in both rice and maize crop. The T_8 treatment comprising of 100% NPK+ Vermicompost @ 2 t ha^{-1}+ PSB @ 8 kg ha^{-1} (soil application), both in rice and maize, recommended for higher productivity and good soil health in rice-maize cropping system in southern east Bihar.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Sulphur and Zinc Nutrition on Rice Yield in Medium Upland Situation of Burdwan District

D. Ghorai
Krishi Vigyan Kendra Burdwan, ICAR-CRIJAF, Barrackpore, West Bengal
Email: dipankarghoraikvk@gmail.com

Burdwan is one of the major rice producing district in the country and, as such, is popularly known as the 'Rice bowl of India". About 80% of the net cultivable area in the district is under *kharif* rice and about 30% is under *boro* rice. The productivity of rice in the district is in the range of 4.2-5.2 t ha^{-1} with average of 4.5 t ha^{-1}. Of late the productivity is on the decline. Some essential secondary and micronutrient is on the decline due to non application coupled with intense cultivation. To address the issue one on farm trial was conducted for two years from 2013 and 2014 in participatory mode. The treatments included, Farmers' practice (90:60:30 N, P, K through urea, DAP and MOP), T1 (Recommended doses (RD) of 100:50:50 through urea, DAP and MOP), T2 (RD + 6 kg Zn ha^{-1} through Zn Carbonate), T3 (RD + 20 kg S ha^{-1} through elemental S) and T4 (RD + 6 kg Zn ha^{-1} through Zn Carbonate+ 20 kg S ha^{-1} through elemental S). The On farm trial was set with 5 replications in RBD.

The results obtained were pooled over two years. Application of S and Zn were found to be responsive regarding productivity of paddy. While single application of the nutrient resulted in at par productivity, combined application resulted in significantly higher productivity over any of the treatments (55.1 t ha^{-1}). There was significant differences in yield attributes like EBT and 1000 grain weight. Uptake of major nutrient like N and P were higher in T4 (N: 210.4 kg ha^{-1}; P: 85.6 kg ha^{-1}). S uptake in T4 was 18.1 kg/ha and that of Zn was 1.23 kg ha^{-1}.

Although farmers had to spent more in case of T4 (about Rs. 1000/ha), due to significantly higher return, the farmers profited more (return:cost of 2.06 in T4 as against 2.02 in T2 and T3).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Use of Nutriexpert® for Site Specific Nutrient Management under Rice-Rice Cropping System in Low Land Rice Soils of Godavari Delta, India

Ch. Sreenivas*, A. Sireesha[1] and T. Usha Rani[1]
Agricultural College, Rajamahendraqvaram, 533103, East Godavari District, Andhra Pradesh
[1]Andhra Pradesh Rice Research Institute and Regional Agricultural Research Station, Maruteru, 534122, West Godavari District, Andhra Pradesh
**Email: csvasu@yahoo.com*

Site specific nutrient management in rice-rice cropping system in low land rice soils of Godavari delta was done using Nutrient Expert® (NE), is a nutrient decision support tool, developed by the International Plant Nutrition Institute (IPNI). Application of fertilizers based on the Nutrient Expert® was assessed during *kharif* and *rabi* seasons. Nutrient Expert® software estimated (118-27-51) higher nitrogen and lower phosphorus and potassium than the recommended fertilizer dose (90-60-60) whereas, Nutrient Expert® estimated (142-39-72) lower phosphorus and nitrogen than the recommended fertilizers (180-90-60. During both *kharif* 2014 and *rabi* 2014-15 seasons application of fertilizers based on the Nutrient Expert® recorded highest grain yield (6.88 and 6.64 t ha^{-1}, respectively, during *kharif* and *rabi*) which were on par with respective complete fertilizer treatments. Thus, Nutrient Expert® software is not only saving the fertilizers dose but also recorded highest grain yield.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Status of Copper in an Alfisol as Influenced by Levels of Farmyard Manure

Mahasweta Chakraborty*, H.M. Chidanandappa[1] and B.C. Dhananjaya[1]

Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal

[1]Department of Soil Science and Agricultural Chemistry, College of Agriculture, Shimoga, Karnataka

[2]Krishi Vigyan Kendra, Shimoga, Karnataka

**Email: mahasweta00@gmail.com*

The element copper (Cu) is often found to behave differently in different organic matter amended soils. An experiment was thus undertaken to study the effect of farmyard manure (FYM) application on copper (Cu) status in an Alfisol under fingermillet (*Eleusine coracana* L.) crop. Three levels of FYM *viz*., 7.5, 15.0 and 22.5 t ha^{-1} with and without recommended dose of fertilizer (RDF) were used for the purpose. The available (DTPA-extractable) Cu in soil along with its different fractions were monitored. Application of FYM at all levels, with or without fertilizers, resulted in significant ($p<0.05$) increase in DTPA-Cu, the effect being more pronounced at higher levels. Increase in level of FYM application increased the water soluble, sorbed, easily reducible manganese bound, carbonate bound and organic bound fractions of Cu significantly compared to that of RDF and absolute control treatments, whereas, Fe and Al oxide bound and residual fractions remained almost unaltered. All fractions except residual fraction of Cu had positive and significant correlation with soil pH, organic carbon and their DTPA-Cu status. Whereas, residual fractions of these elements recorded a negative relationship with the above properties. Even among themselves, all fractions except residual fraction had a positive and significant correlation with each other indicating that fractions of copper are in a dynamic equilibrium with each other in soil. The treatment receiving RDF+FYM @ 22.5 t ha^{-1} excelled over others with respect to grain and straw yield of fingermillet. Thus, FYM @22.5 t ha^{-1} supplemented with RDF was found to be the superior one keeping in view the availability of Cu in soil and also yield of fingermillet.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Different Organic Sources on Content and Uptake of Nutrients in *rabi* Maize (*Zea mays* L.)

V.P. Parmar*, R.D. Shinde, J.M. Kokani and B.N. Kolambe
Department of Soil Science and Agricultural Chemistry, N.M. College of Agriculture, Navsari Agricultural University, Navsari, 396450, Gujarat
**Email: vikramparmar410@gmail.com*

An experiment was conducted on the certified organic farm, ASPEE College of Horticulture, Navsari Agricultural University, Navsari to study the effect of organic nutrient sources on content and uptake of nutrients in *rabi* maize (*Zea mayz* L.). The experiment was laid out in randomized block design with ten treatments and replicated thrice. Crop was tested by different organic manures treatments *i.e.* T_1: 100% NADEP compost (basal application), T_2: 75% NADEP compost (basal application), T_3: 50% NADEP compost (basal application), T_4: 50% NADEP compost + 50% Castor cake (basal application), T_5: Jivamrut 500 lit/ha (15 day interval), T_6: Jivamrut 500 lit/ha (30 day interval), T_7: Panchgavya 50 lit/ha (15 day interval), T_8: Panchgavya 50 lit/ha (30 day interval), T_9: Jivamrut 500 lit/ha + Panchgavya 50 lit/ha (15 day interval) and T_{10}: Jivamrut 500 lit/ha+ Panchgavya 50 lit/ha (30 day interval). All the organics were applied on equivalent N basis of RDN.

Results indicated that All the macro and micro-nutrient contents as well as uptake by maize grains and straw except N content in grains were significantly differed due to the treatments receiving application of different organic sources. The treatment receiving application of 50% NADEP compost + 50% castor cake (T_4) noted significantly higher P, K, Ca, Mg and S as well as Fe, Mn, Zn and Cu content in grains than rest of the treatments but was remained at par with treatment T_9, T_{10}, T_1 and T_2 in case of P, K, Ca, Mg and S content whereas treatment T_9 in case of Fe, Mn, Zn and Cu content in grains. However, in case of nutrient content in maize straw, significantly higher N, P and K content in straw were found due to application of 50% NADEP compost + 50% castor cake (T_4) than other treatments but was closely followed by treatments T_9, T_{10} and T_1. Former treatment (T_4) also recorded significantly higher Ca, Mg, S, Fe, Mn, Zn and Cu content in straw over rest of the treatments except treatment T_9. Inspite of treatment T_9 in case of P, K, Mg and Mn uptake by straw, all the macro and micro-nutrient uptake by grain and straw were found significantly highest under treatment receiving application of 50% NADEP compost + 50% castor cake (T_4) than rest of the treatments.

From the result, it can be concluded that the application of 50% NADEP compost along with 50% castor cake found to be beneficial in increasing the nutrient content and uptake in *rabi* maize.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Organic Farming on Nutritional Status of Wheat

R.D. Shinde*, V.P. Parmar, D.G. Jondhale and B.N. Kolambe
Department of Soil Science and Agricultural Chemistry, N.M. College of Agriculture, N.A.U., Navsari, 396450, Gujarat
**Email: rajssac@gmail.com*

An experiment was carried out on the certified organic farm of ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat to study the response of organic farming nutrient content and uptake of wheat. The experiment was laid out in factorial randomized block design with twelve treatments (organic) + one outside control (100% RDF through chemical fertilizer) and replicated thrice. The experiment comprised of two factors *viz.,* organic manures- O_1: 50% N through Bio-compost (BC):Vermicompost (VC):Castor cake (CC) (1:1:1), O_2: 75% N through BC:VC:CC (1:1:1) and O_3: 100% N through BC:VC:CC (1:1:1), and Liquid formulations- S_1: Enriched banana pseudostem sap @ 1%, S_2: Vermiwash @ 1%, S_3: Panchgavya @ 1% and S_4: Cow urine @ 1%. All the organic manures were applied on the equivalent N basis.

The different organic N levels and organic liquid formulations were significantly influenced the protein, nutrients content and uptake by wheat. The treatment receiving application of 75% (O_2) and 100% (O_3) N through BC:VC:CC as well as enriched banana pseudostem sap @1% (S_1) and cow urine @1% (S_4) increased the protein content in wheat grains significantly. Former treatments also obtained significantly maximum macro (N, P, K and S) and micronutrient (Fe and Zn) content and uptake by wheat grain and straw than other treatments. In control *vs* rest analysis, nutrient content and uptake by wheat were increased significantly due to organics than control.

From the result, it can be concluded that treatment receiving of 75 and 100% recommended dose of nitrogen through BC:VC:CC as well as spraying of enriched banana pseudostem sap @1% and cow urine @1% found effective in improving the nutritional status of wheat.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Nitrogen and Sulphur on Yield and Quality of Sesame

Aritra Kumar Mukherjee*, Kaushik Batabyal, Animesh Ghosh Bag, Gayatri Sahu and Nitin Chatterjee
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur. Nadia, 741252, West Bengal
**Email: aritrakm@gmail.com*

A field experiment was conducted using three levels of nitrogen (N) *viz.*, 60, 90 and 120 kg ha^{-1} and three levels of sulphur (S) *viz.*, 20, 40 and 60 kg ha^{-1} using sesame as the test crop. During flowering stage leaf chlorophyll content was determined. After harvesting the crop, stover and grain yield was recorded. Oil content in seeds, contents of N, P, K, and S in stover and grain were analyzed. Stover and grain yield was increased with increasing application of N and S. The highest grain yield (706 kg ha^{-1}) was recorded with application of highest doses of both of the nutrients. Oil content of sesame varied from 41.8 to 46.2%. Nitrogen application increased oil content. Sulphur application resulted in increased oil content up to S_{40}. Oil yield varied from 195 to 310 kg ha^{-1}. Increased doses of both the nutrients resulted in maximum oil yield in $N_{120}S_{60}$ treatment. Chlorophyll content of leaves at flowering stage varied from 1.97 to 2.39%. Nitrogen and S application increased N content in both grain and stover. Sulphur application resulted in decreased P content in grains. Nitrogen and S application increased S content in grains. Sulphur application increased grain K content. Increased N and S application increased N content in stover. Phosphorus content in stover varied from 0.154 in plots receiving minimum doses of both the nutrients to 0.213% in $N_{90}S_{20}$ treatment. Sulphur content in stover ranged between 0.124 and 0.189%. Increased N application at N_{90} resulted in increased K content in stover and thereafter decreased the values. Application of S @ 40 kg ha^{-1} resulted in increased K content in stover. Nitrogen and S application increased total uptake of N and K. Both the nutrients interacted positively and significantly in increasing P uptake. No treatment effect was found to be statistically significant in increasing S uptake. Protein content ranged between 16.0 to 18.2%. Increasing N application up to 90 kg ha^{-1} increased protein content significantly. Further increase in N application resulted in no significant effect. Sulphur application up to S_{40} resulted in increase in protein content in sesame seeds.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Potassium Response in Chickpea in Coarse Textured Soils of Southern Haryana

P.K. Yadav, M.K. Jat*, Abha Tikkoo and S.S. Yadav
CCS HAU, Regional Research Station, Bawal, 123501, Haryana
**Email: mukesh.rca@gmail.com*

A field study was carried out on a coarse textured medium potassium (K) status soil of CCS HAU, Regional Research Station, Bawal (Haryana) at three different locations from 2012-13 to 2015-16 to study the effect of K fertilization in chickpea in terms of yield, total K uptake, K build/depletion in soil and economics returns. The experimental soil was loamy sand in texture, alkaline in reaction (pH 8.30 to 8.42), EC (0.18 to 0.20 dS m^{-1}), low in organic carbon (1.9 to 2.0 g kg^{-1}), medium in available P (11.15 to 11.60 kg ha^{-1}) and medium in available K (170.0-171.2 kg ha^{-1}). The experiment was laid out in randomized block design with three replications. There were six graded levels of K application *viz.,* 0, 10, 20, 30, 40 and 50 kg K_2O ha^{-1} applied through muriate of potash (MOP) as basal dose at the time of sowing. Recommended dose of fertilizers for chickpea was applied @ 15 kg N ha^{-1} and 40 kg P_2O_5 ha^{-1}. Irrigation and plant protection measures were taken as per recommended practices. Crop was harvested at physiological maturity, threshed and plot wise yield was recorded. Seed, straw and soil samples were taken and analyzed for K concentration in seed and straw and available K in soil, respectively. The data was statistically analyzed and economics of K application was worked out. The result revealed that chickpea cv. HC-1 seed yield increased significantly with the application of K up to 20 kg K_2O ha^{-1}. The increase in mean seed yield was 6.12, 13.87, 16.90, 18.59 and 19.88 per cent and in mean straw yield was 3.64, 9.30, 10.81, 12.61 and 13.55 per cent due to application of 10, 20, 30, 40 and 50 kg K_2O ha^{-1}, respectively over control . The mean K uptake also increased with K application. The mean K use efficiency varied from 43.6 to 58.0% being maximum (58.0%) with application of 20 kg K_2O ha^{-1}. The mean post harvest available K status was 167.75, 169.18, 170.45, 171.72, 172.18 and 172.4 kg ha^{-1} at 0, 10, 20, 30, 40 and 50 kg K_2O ha^{-1}, respectively. The mean economic data analysis revealed that benefit cost ratio also increased with K application and the additional returns per rupee invested on K at 10, 20, 30,40 and 50 kg K_2O ha^{-1} levels of K were Rs. 16.96, 20.06, 15.02, 12.19 and 11.46, respectively. The finding of this study indicated that in coarse textured medium K status soil of Southern Haryana, application of 20 kg K_2O ha^{-1} was found to be optimum for chickpea in terms of crop yield, soil K fertility status and economics.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Enhancing P Availability in Soybean-Wheat Cropping Sequence by using Coated Single Superphosphate on Inceptisol

S.R. Shelke ,V.M. Amrutsagar, P.P. Kadu, A.G. Durgude and A.D. Kadlag
Department of Soil Science and Agricultural Chemistry, M.P.K.V., Rahuri, Maharashtra

A field experiment on use of coated single superphosphate (SSP) for enhancing available phosphorus (P) in soybean-wheat sequence on Inceptisol was conducted on the Reasearch farm of Department of Soil Science and Agricultural Chemistry, Post Graduate Instructional Farm, M.P.K.V., Rahuri, Maharashtra during the year 2012-13. The treatments comprised of 50, 75 and 100 kg ha^{-1} of P_2O_5 supplied through granulated SSP along with recommended dose of nitrogen (N) and potassium (K) to soybean. The granulated SSP was coated with three different coatings *viz*., gum coating, cow dung coating and karanj oil coating, to study their effect on increasing the fertilizer use efficiency and yield of soybean and their residual effect on the succeeding wheat crop. The coated products of SSP were compared with the general recommended treatment, without coating of SSP. A similar sets of treatments were used for laboratory incubation study. The field experimental design was factorial randomized block design (with additional treatement) and three replications.

In the field experiment studies, the cow dung coated SSP was significantly superior for release of soil available P at 3rd trifoliate, 50% flowering, pod formation and at harvest of soybean (22.8, 24.2, 23.6 and 21.6 kg ha^{-1}, respectively). The P application @ 100 kg ha^{-1} through single superphosphate recorded significantly higher content of soil available phosphorus at 50% flowering, pod formation and at harvest of soybean (24.5, 23.7 and 22.0 kg ha^{-1}, respectively). Coated SSP with cow dung applied to the soybean crop in soybean-wheat sequence showed significant residual effect on soil available P at crown initiation, tillering, 50% flowering, grain filling and at harvest stage of wheat. The high values of soil available P was observed in residual effect of all the type of coated SSP (19.0, 22.0 and 21.0 kg ha^{-1}, respectively). It was significantly higher in cow dung coated SSP (22.0 kg ha^{-1}) at 50% flowering stage.

The residual effect P levels @ 50, 75 and 100 kg ha^{-1} showed significant effect on soil available P at all the growth stages of wheat. It was significantly higher in residual effect of 100 kg ha^{-1} P application at crow initiation and tillering stage of wheat (21.9 and 22.0 kg ha^{-1}) over 75 kg ha^{-1} (20.9 and 21.0 kg ha^{-1}, respectively).

From the above result it can be concluded that in the sequence cropping of soybean-wheat application of recommended dose of N and P along with 625 kg of cow dung coated SSP was found to be beneficial for obtaining available and the residual soil P by saving of 60 kg P_2O_5 for wheat.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Development of Fertilizer Adjustment Equations for Targeted Yield of Garlic under IPNS in a Medium Black Soil of Madhya Pradesh

B. Sachidanand*, A.K. Upadhyay, S.S. Baghel and Pradip Dey[1]
Department of Soil Science and Agricultural Chemistry,
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh
[1]Indian Institute of Soil Science, Bhopal, Madhya Pradesh
**Email: drsachidanand@rediffmail.com*

Field experiments were conducted to develop fertilizer adjustment equations for garlic crop under IPNS mode at the experimental site of Soil Science and Agricultural Chemistry at JNKVV, Jabalpur, Madhya Pradesh during 2006-07 to 2009-10 on medium black soil having neutral pH, normal EC, medium in available N, P and K. Three fertility gradients were created for exhaustive crop Jowar by taking three levels of FYM (0, 10 and 20 t ha^{-1}), four levels of each N as 0, 40, 80 and 120, P_2O_5 as 0, 30, 60 and 90 and K_2O having 0, 40, 80 and 120 kg ha^{-1} with control. For developing FAEs, basic data on yield of bulb, available nutrients in soil and NPK uptake by garlic were estimated for nutrients required to produce one quintal yield, nutrients contribution from soil, fertilizers and FYM.

The results revealed that average yield of garlic increased with the increasing fertility level with the gradients, yield of 33.47, 37.83 and 39.95 q ha^{-1} and 9.61, 10.93 and 12.38 q ha^{-1} were recorded under control in $L_{1/2}$, L_1 and L_2 gradient for garlic bulb and haulm, respectively. The available N, P and K were also increased with the fertility gradients. The average response ratios of 26.27, 14.51 and 19.71 kg per kg of nutrients applied with varying FYM levels were recorded due to N, P and K application, respectively. The nutrients required for producing one quintal of garlic were 2.21, 1.30 and 1.67 kg N, P_2O_5 and for K_2O were estimated and the per cent contributions of nutrients from soil, fertilizers and FYM were 16.12, 31.67 and 21.33% for N, 51.67, 47.55 and 60.63% for P_2O_5 and 16.13, 45.67 and 35.33% for K_2O were recorded, respectively. These basic data were used to develop fertilizer adjustment equations for targeted yield of garlic with varying soil test values for NPK alone and NPK with FYM.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Long-term Application of Fertilizer and Manure on Relationship between Soil Organic Carbon Fractions with Yield of Maize and Wheat Crops under Maize-Wheat Sequence in Heplustepts

S.C. Meena*, D.P. Singh and S.R. Meena
Department of Agricultural Chemistry and Soil Science, R
ajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan
**Email: subhmeena@yahoo.com*

A field study on effect of long-term application of fertilizer and manure on establish relationship between soil organic carbon fractions with yield of maize and wheat crops under maize-wheat sequence in Heplustepts was conducted during *kharif* 2013-14 and 2014-15 in the Long Term Fertilizer Experiments initiated in *kharif*, 1997 at the Instructional Farm of the Rajasthan College of Agriculture, Udaipur. The soil of the experimental site was sandy clay loam in texture, slightly alkaline in reaction, medium in available nitrogen (N) and phosphorus (P), while high in potassium (K) and zinc (Zn). The treatment consisted of control, 100% N, 100% NP, 100% NPK, 100% NPK + Zn, 100% NPK + S, 100% NPK + Zn + S, 150% NPK, 100% NPK + *Azotobacter*, FYM 10 t ha^{-1} + 100% NPK (-NPK of FYM), 100% NPK + FYM 10 t ha^{-1} and FYM 20 t ha^{-1}. The application of FYM also increased the passive and active soil organic carbon like humin, humic acid, fulvic acid, soil microbial carbon, water soluble carbon, water soluble carbohydrate and carbon mineralization. The significant positive correlation was found of organic carbon fraction with yield of maize and wheat crops. The regression of maize grain and stover yield, wheat grain and straw yield with its forms explains the variation in forms up to 92, 99, 99 and 98%, respectively.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Calcium Silicate and Slags on Growth, Silicon Uptake and Yield of Wet Land Rice

T.S. Sandhya, V. Saravanakumar and N.B. Prakash
Department of Soil Science and Agricultural Chemistry, UAS, GKVK, Bangalore, 560065, Karnataka

Slags are the main by-products generated during iron and crude steel production.The main constituents of slags are SiO_2, CaO, Al/Fe oxides and MgO which will account to 95% of the composition. Apart from silicon (Si), high amount of sparingly soluble calcium (Ca) in slags can improve the production of rice in acid soils because of its potential ability to release Si and neutralize the acidity of soil. However, it is hypothesized that their suitability for crop production depends on its chemical properties and their ability to release Si and other nutrients to soil. Therefore, a study was conducted to characterize and evaluate the agronomic efficiency of electric arc furnace (EAF) slag and ladle furnace (LF) slag which differ in their chemical composition. The study included greenhouse and field experiments. Greenhouse study was conducted to know the release of Si from EAF and LF slag with reference to calcium silicate (CS), applied at the rate of 250 and 500 kg Si ha^{-1}. The field trial was conducted in acidic sandy loam soils of Brahmavar, Karnataka to evaluate the agronomic efficiency of EAF and LF slag applied at the rate of 2 and 3 t ha $^{-1}$. Experiment was laid out in randomized completely block design. Characterization of CS, EAF and LF slag showed that alkalinity was highest for LF slag (9.08) than CS (1.67)and EAF slag (1.48). Silicon content in CS, EAF and LF was 12.2, 8.6 and 2.2%, respectively. In the greenhouse study, it was found that LF slag could release more acetic acid extractable Si and EAF released more $CaCl_2$ extractable Si after 30 days of incubation, which was higher than extractable Si released by CS. The field study revealed that there was significant increase in the growth and yield parameters of rice with the application of these materials over the recommended dose of fertilizers (RDF). Highest plant height, number of tillers and panicle length were obtained with the application ofRDF+ EAF Slag @3 t ha $^{-1}$ which was on par with RDF + LF 2 t ha^{-1} and RDF + CS 3 t ha^{-1}. Highest straw and grain yield was obtained with the application of RDF+ EAF slag @ 3 t ha^{-1}, but on par with RDF + LF 2 t ha^{-1} and RDF + CS 3 t ha^{-1}. Highest Si uptake was obtained with RDF+ EAF slag @ 3 t ha^{-1}, however, on par with other Si treatments. Application of these Si sources significantly altered the chemical properties of the residual soil. Significant increase in pH, EC and plant available Ca was obtained with the application of RDF + LF 3 t ha^{-1}, whereas highest extractable Si was obtained with the application of RDF+ EAF slag @ 3 t ha $^{-1}$. Hence, it was concluded that the agronomic efficiency depends on the ability of slag material to release Si and its neutralizing power.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Spatial Distribution of Physicochemical Properties and Macronutrients in Rice Growing Soils of Haryana

Daljit Singh Dahiya, Chetan Gyawali, Devraj, Mohammad Amin Bhat and Rishi Ram Bhandari[1]

Department of Soil Science, CCS Haryana Agricultural University, Hisar, 125004, Haryana
[1]Institute of Agriculture and Animal Science, Tribhuvan University Paklihawa Campus 329 000, Nepal

Rice growing soils in Kaithal, Kurukshetra and Karnal were neutral to slightly alkaline in reaction and loamy sand to clay loam. In surface soil, organic carbon ranged from 3.5 to 6.8, 2.7 to 6.7 and 3.6 to 6.9 g kg^{-1} in sub-surface soil in Kaithal, Kurukshetra and Karnal, respectively. Available nitrogen (N), phosphorus (P), potassium (K) and sulphur (S) varied from 112 to 194, 86 to 180 and 115 to 193; 9 to 37, 6 to 37 and 9 to 46; 100 to 454, 54 to 306 and 126 to 456; 8 to 71, 4 to 60 and 6 to 108 kg ha^{-1} in surface soil; while in sub-surface soils varied from 88 to 145, 67 to 141 and 86 to 140; 5 to 26, 4 to 27 and 7 to 38; 92 to 426, 38 to 278 and 118 to 359; 4 to 49, 3 to 42 and 3 to 72 kg ha^{-1} correspondingly in district Kaithal, Kurukshetra and Karnal. Mostly samples were medium in organic carbon, low in N, medium to high in P, K and S. Nitrogen, P and K were positively correlated with organic carbon. Soil pH was negatively correlated with P and K.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Impact of Organic Inputs on Soil Health, Nutritional Quality and Yield of Rice Grown on Organic Farmers Field

R.M. Ghodpage, N.N. Ghube and W.P. Badole
Soil Science and Agricultural Chemistry Section, College of Agriculture, Nagpur, Maharashtra

The field investigation in relation to evaluation of soil properties, nutritional quality and yield of rice grown on organic farmer's fields in Nagpur district was carried out during *kharif* season of 2016-2017. Soil samples of 0-20 cm depth were collected randomly after the harvest of rice from four locations *viz.* Umri, Gumthala, Chacher and Gangner. Organic rice growers applied FYM @ 7 to 10 t ha^{-1}, Biola and Bioguru (625 g ha^{-1} each), Bhusampada 625 g ha^{-1}, Ghanjivamrut 500 kg ha^{-1}, Jivamrut 500 L ha^{-1} and rice straw 5 t ha^{-1}. Ghanjivamrut is a mixture of 500 kg fresh FYM + 50 L Jivamrut prepared by properly mixing 3-4 time at one week interval and ready for use within 40-45 days. Jivamrut was prepared by taking 10 kg cow dung + 10 L cow urine + 2 kg jaggary + 2 kg gram flour + 500 g organic rich soil (soil from bunds) in a 200 L capacity plastic drum and mixing a materials with wooden stick 2-3 times daily for 4-5 days. These organic inputs were applying continuously from last 5 to 15 years.

The result revealed that soil pH was reduced due to the continuous incorporation of various organic sources to rice. However, EC (0.20 to 0.78 dS m^{-1}) of soil remained almost unchanged. Organic carbon was recorded between 6.2 to 11.1 g kg^{-1} in the rice crop treated with various doses of organic inputs and chemical fertilizers alone. Organic carbon increased by 5.4 to 44.1 per cent at different locations over inorganic fertilizer under rice cultivation. Soil available N was highest at Umri location (323.9 kg ha^{-1}), which increased by 11.5 per cent with the application of FYM 10 t ha^{-1} to rice over inorganic fertilizer. An application of inorganic fertilizer results the low available P in soil than use of organic inputs continuously from 5-15 years. Soil available potassium varied from 224 to 324.8 kg ha^{-1} indicates medium to high in range. The variation in available sulphur (9.52 to 21.04 kg ha^{-1}) was observed and it found sufficient amount in all locations.

The use of different organic sources to rice found useful in maintaining the available micronutrients status. Quality parameters namely, protein, starch, lysine, carotene and tryptophan of rice grain varied from 7.00-8.35%, 51-54%, 3.38-5.02 g kg^{-1} N, 0.11-0.28 μg g^{-1} and 0.51-0.62 g kg^{-1} N with the application of various type of organic and inorganic fertilizers. The highest grain yield of rice was obtained 6.5 t ha^{-1} at Umri location with the application of balanced amount of inorganic fertilizers. However, grain yield of rice 3.2 to 5.5 t ha^{-1} was recorded under various doses of different organic resources at different locations. It is clear that the reduced of grain yield of rice with the use of organic inputs by 19.7, 16.7, 13.4, and 26.9 per cent with Umri, Gumthala, Chacher and Gangner, respectively over the application of inorganic fertilizer. The soil properties of EC, organic carbon and available nitrogen were positively correlated with yield of rice crop. On the basis of results, the addition of sufficient quantity of FYM, Ghanjivamrut, Biola and Bioguru or combination of FYM + Jivamrut or FYM+Ghanjivamrut for medium or long-term or balanced inorganic fertilizers enhanced the soil fertility, sustained the yield and maintained quality of rice.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Comparative Study of Organic Matter *vis-a-vis* Humic Acid on Fertility Status of a Fluvaquent Soil under Rice-based Cropping Sequence

Niladri Paul* and Dipankar Saha[1]
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Tripura
[1]Department of Agricultural Chemistry and Soil Science, BCKV, West Bengal
**Email: nilupaul82@rediffmail.com*

The influence of organic matter *vis-a-vis* humic acid on soil fertility status and nutrients availability during the cultivation of rice (Variety MTU 1010) followed by mustard (Variety B-9) was studied in a Typic Fluvaquent soil situated at Murshidabad district of West Bengal, India. The initial physical and chemical properties of the soil are soil texture sandy clay loam, bulk density 1.34 Mg m^{-3}, oxidizable organic carbon 10.6 g kg^{-1}, pH 6.14, EC 0.21 dS m^{-1}, total nitrogen 1.6 g kg^{-1}, available nitrogen 181.9 kg ha^{-1}, available P_2O_5 35.0 kg ha^{-1}, available K_2O 204.2 kg ha^{-1} and available sulphate 49.5 kg ha^{-1}. The C:N ratio of the added FYM and FYM extracted humic acid (EHA) were 32.1 and 13.5, respectively. The EHA had very high viscosity of 133.1 along with E_4/E_6 and ash free carboxylic group was 3.193 and 628.3, respectively. Recommended dose of fertilizers ($N:P_2O_5:K_2O$ :: 60:30:30 and 80:40:40) were applied as nutrient source and FYM was applied as treatment material at 10 and 5 t ha^{-1} for rice; 5 and 2.5 t ha^{-1} for mustard at basal. The FYM extracted humic acid was also used as treatment material at 1.0 and 0.5 kg ha^{-1} for rice; 0.5 and 0.25 kg ha^{-1} for mustard through broadcasting and spraying, respectively. All the treatments were replicated thrice with plot size of (3 m×4 m = 12 m^2) following randomized block design (RBD). Rhizosphere (0-15 cm) soil samples were collected and analyzed for oxidizable organic carbon, total nitrogen (N), available N, available phosphorus (P), available potasium (K), available sulphur (S) at different stages of both the crop growth. Plant uptake of different nutrients at different growth stages of crops, were estimated and the yield data were recorded. Irrespective of mode of application of organic sources, the amount of organic carbon and available K were gradually decreased with increase in the age of crop growth. Highest accumulation of total N, available P and available S in soil were recorded at panicle initiation and flowering stages of rice and mustard crops, respectively. However, higher accumulation of available N in soil was recorded at flowering stage of both the rice and mustard crops. In general, uptake of all the nutrients and dry matter yield showed increasing trend up to harvesting stage of both rice and mustard crops. The uptake of NPK was significantly higher in both the crops with higher dose of EHA. However uptake of S was significantly higher with higher dose of FYM. Furthermore, irrespective of modes of application, humic acid application induced significant increase in growth attributes and yield of rice as well as mustard crop. This effect was more prominent in mustard than that of rice. Although, considering the yield of crops the overall impact of humic acid on soil health was not at par with FYM but FYM can be supplemented by humic acid to some extent.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Screening of Rice Germplasm and Varieties for High Zinc and Iron Accumulation under Rice-Rice Cropping System in Low Land Rice Soils of Godavari Delta, India

Ch. Sreenivas*, T. Usha Rani[1] and A. Sireesha[1]
Agricultural College, Rajamahendraqvaram, 533103, East Godavari District, Andhra Pradesh
[1]Andhra Pradesh Rice Research Institute and Regional Agricultural Research Station, Maruteru, 534122, West Godavari District, Andhra Pradesh
**Email: csvasu@yahoo.com*

A trial was conducted to identify promising rice cultures for high iron (Fe) and zinc (Zn) contents in the grain/endosperm and to assess the influence of environment on the accumulation of nutrient in grain. A total of 41 cultures were screened at Andhra Pradesh Rice Research Institute, Maruteru during *kharif* 2013. The grain yields showed significant variation in the productivity. Among the genotypes, MTU-1064 recorded highest grain yield (8.46 kg ha^{-1}) followed by MTU-1078 (7.21 kg ha^{-1}).

Iron content was highest with WGL-14377 (123 mg kg^{-1}) and lowest with MTU-1120 (44 mg kg^{-1}). Highest Zn content was recorded with MTU-1010 (443 mg kg^{-1}) and Zn content was recorded in MTU-1001 (96 mg kg^{-1}).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Potassium Nutrition in Groundnut (*Arachis hypogaea* L.)

Ummesalma Sanadi, K.K. Math, B.I. Bidari and Basavaraj S. Yenagi
Deparatment of Soil Science, College of Agriculture, UAS, Dharwad, 580005, Karnataka

A field experiment was conducted to investigate the potassium (K) nutrition in groundnut (*Arachis hypogaea* L.) at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during *kharif* 2016. The experiment was laid out with twelve treatments replicated thrice in completely randomized block design. The soil reaction was near neutral and electrical conductivity was under safer limit with clay texture.

Pod yield in groundnut ranged from 3.01 to 3.62 t ha^{-1} due to various K nutrition treatments but the difference among them was statistically nonsignificant. However, split application of 150% recommended dose of potassium (RDK), half as basal and half at 30 days after sowing (DAS) through muriate of potash with 2% foliar spray of potassium sulphate at 60 DAS recorded highest pod yield (3.62 t ha^{-1}) closely followed by basal application of 150% RDK along with 2% foliar spray of potassium sulphate (3.57 t ha^{-1}). Control, recorded the lowest pod yield (3.01 t ha^{-1}) in groundnut. Split application of 150% RDK through MOP + 2% foliar spray of SOP at 60 DAS significantly enhanced the oil (47.84%) and protein (38.0%) contents in kernel with 6.07 and 6.89 per cent increase, respectively over control. The treatment with 150 per cent RDK through muriate of potash in split (half as basal + half at 30 DAS) + 2% foliar spray through potassium sulphate at 60 DAS recorded highest gross (Rs. 1, 51, 592 ha^{-1}) and net (Rs. 94,449 ha^{-1}) returns with higher B: C ratio (2.65) whereas, control recorded the lowest gross (Rs. 1,26,293 ha^{-1}) and net (Rs. 70,917 ha^{-1}) returns with lower B:C ratio (2.28). Thus, split application of 150% RDK through MOP plus foliar spray of 1% SOP at 60 DAS is beneficial over basal application of 100% MOP.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Zinc and Boron on Yield, Nutrition and Quality of Brinjal

Bholanath Saha*, Ashish Ranjan[1], Jajati Mandal[2], Shashank Shekhar Solankey, Sushanta Saha[3] and Pancham Kumar Singh[1]

Dr. Kalam Agricultural College, Bihar Agricultural University, Arrabari, Kishanganj, 855107, Bihar
[1]College of Horticulture, Bihar Agricultural University, Noorsarai, Nalanda, 803 113, Bihar
[2]Department of Soil Science, Bihar Agricultural College,
Bihar Agricultural University, Sabour, Bhagalpur, 813210, Bihar
[3]Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani,
Nadia, 741 235, West Bengal
**Email: bnsaha1@gmail.com*

Agricultural intensification resulted in a serious depletion in micronutrients reserve in soils and degradation of environment, along with many other pitfalls. Following such intensification, widespread deficiencies of micronutrients particularly zinc (Zn), boron (B) and iron (Fe) in soils are reported across the globe. It causes a serious depletion in their loading in edible parts of crops affecting not only crop yield but also its quality. Brinjal is one of the widely grown vegetable with high nutritive value responsive to applied Zn and B in deficient soils. With this background, a pot experiment was conducted at College of Horticulture Farm to study the effect of FYM, Zn and B on yield and quality of brinjal where two levels of FYM (0 and 5 t ha^{-1}), four levels of Zn (Zn_0: No Zn, Zn_1: 5.0 kg Zn ha^{-1} as basal, Zn_2: 10.0 kg Zn ha^{-1} as basal and Zn_3: 5.0 kg Zn ha^{-1} as basal + Foliar spray of Zn twice @ 0.5% $ZnSO_4.7H_2O$ solution) and three levels of B (B_0: No B, B_1: 1 kg B ha^{-1} and B_2: 2 kg B ha^{-1}) were applied in factorial CRD. The application of Zn and B significantly influenced the fruit yield and other agro-morphological parameters *viz*., shoot yield, number of fruits per plant, plant height, fruit diameter *etc*. The highest increase was found with the application of soil + foliar application of Zn and highest dose of B *i.e.* 2.0 kg B ha^{-1}. On average, fruit yield of brinjal varied between 0.92 to 1.31 kg pot^{-1} with a mean value of 1.12 kg pot^{-1}. Zinc application @ 10.0 kg ha^{-1} through basal (Zn_2) as well as soil + foliar application of Zn (Zn_3) significantly enhanced the fruit yield of brinjal over the application of 5.0 kg Zn ha^{-1} as well as over the control. Application of Zn fertilizers along with FYM enhanced the brinjal fruit yield to the extent of 10-24% over the control under different treatment combinations. Application of Zn @ 10 kg ha^{-1} as basal as well as soil + foliar application increased the Zn uptake to the tune of 2 to 2.5 fold over the control. Similarly, B application @ 1 kg B ha^{-1} and 2 kg B ha^{-1} increased the B uptake by fruit to the extent of 49 and 72 per cent, respectively over the control. The interaction between FYM and Zn and well as between FYM and B did not show any significant positive effect towards Zn and B uptake by brinjal fruits. On an average, ascorbic acid content in brinjal fruits varied between 18.6 to 28.2 mg 100 g^{-1} with a mean value of 23.6 mg 100g^{-1} upon application of different doses of FYM, Zn and B. Individual application of Zn and B enhanced such values to the extent of 6 and 35 per cent, respectively over the control indicating addition of fruit values in terms of nutritional quality as ascorbic acid acts as an antioxidant for human body.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Continuous Application of Different Inorganic Macro and Micro Nutrients and FYM on Crop Yield and Changes in Soil Fertility Status of an Acidic Udic Ustochrepts under Sub-Tropical Rice-Rice Eco-System

Pradipta Majhi, K.K. Rout[1] and F.H. Rahman[2]*

Krishi Vigyan Kendra Puri, OUAT, 752014, Odisha

[1]Department of Soil Science and Agricultural Chemistry, OUAT, Bhubaneswar, 751003, Odisha

[2]ICAR-Agricultural Technology Application Research Institute, Salt lake, Kolkata, 700097, West Bengal

**Email: fhrahmancal@gmail.com*

A nine year old long-term fertilizer experiment under rice-rice sequence was conducted on an acidic (pH 5.8) medium land of the Central farm of OUAT, Bhubaneswar. The experiment was carried out to study the effect of continuous application of NPK fertilizers with or without FYM and some secondary (S) and micronutrients (Zn and B) on crop yield and soil fertility. After nine years, highest grain yield with highest sustainability was achieved in both *kharif* and *rabi* seasons in the treatment that received FYM @ 5 t ha^{-1} along with recommended dose (RD) of NPK (80-40-60) through fertilizer followed by the treatment with 150% RD of NPK (120-60-90). The yields in these two treatments were significantly higher than that in other treatments those received either only NPK or NPK + Zn or NPK + Zn + S or B. Among other nutrients, application of Zn produced 10.0 per cent more yield in *kharif* and 8.2 per cent in rabi. But B and S application had no significant effect on grain yield within nine years. Continuous cropping without organic manure made the soil more acidic with a pH drop of 0.38 to 0.57 units within nine years. Addition of FYM however, resisted this drop and maintained a more favorable soil pH (5.97) with higher content of organic carbon (34.4% more) and available nutrients.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of Potentiality of Food Fodder Inter Cropping for Increasing Crop Productivity and Soil Fertility under Lateritic Soil of West Bengal

Subrata Mandal*, Sourav Mondal and Palash Ankure
Rathindra Krishi Vigyan Kendra, Institute of Agriculture,
Visva-Bharati, Sriniketan, Birbhum, West Bengal
**Email: smkvkvb@gmail.com*

An on farm trial was conducted in the lateritic soil of Birbhum district of West Bengal in the farmers field of different KVK adopted village in the winter season during the year 2015-16 to assess the potentiality of food fodder intercropping for increasing crop productivity, profitability and maintaining Soil fertility. The soils ware acidic in nature (pH 6.2) with low organic carbon (3.4 g kg^{-1}), available P (12 kg ha^{-1}) and available K (122.6 kg ha^{-1}) content. In Birbhum district, farmers are not willing to afford land for green fodder cultivation due to low crop productivity and profitability under sole fodder cultivation. Considering the facts the trials were conducted in five (5) farmers field *i.e.* 5 replications with four (4) technological options *i.e.* 4 treatments. The technological options ware T_1: Farmers practice *i.e.* sole oat fodder, T_2 = Technology options I *i.e.* oat + chickpea (1:1), T_3 = Technology options II *i.e.* oat + lentil (1:1), T_4 = Technology options III *i.e.* oat + yellow sarsoon (1:1). Recommended seed rate and fertilizer doses were maintained in this replacement series of intercropping system.

From the results, it was clearly observed that T_3 *i.e.* technological options -II *i.e.* oat + lentil (1:1) produced significantly higher fodder and intercrop yield than those of other options whereas in farmers practice sole crop produced higher fodder yield but no intercropping advantages. T_3 *i.e.* technology options II gave higher BC ratio (2.28) closely followed by T_2 *i.e.* technology options III *i.e.* oat + chickpea (1:1). Soil fertility was also improved due to cultivation of oat + lentil (OC. 5.2 g kg^{-1}, avail. P 26.8 kg ha^{-1} and available K 133.1 kg ha^{-1}) and oat + chickpea (OC 5.4 g kg^{-1}, available P 22.6 kg ha^{-1} and available K 133.8 kg ha^{-1}). So, T_3 *i.e.* technology options II *i.e.* oat + lentil (1:1) produced higher crop productivity, maintained higher soil fertility and fetched higher profitability.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Fertilization and Vine Plantation on Yield and Economics of Pointed Gourd in Terai Zone

Biplab Das and F.H. Rahman[1]*
Jalpaiguri Krishi Vigyan Kendra, West Bengal University of Animal and Fisheries Sciences, Jalpaiguri, 735219, West Bengal
[1]ICAR-Agricultural Technology Application Research Institute, Salt Lake, Kolkata, 700097, West Bengal
**Email: fhraahmancal@gmail.com*

Pointed gourd (*Trichosanthes dioica* Roxb.) is a tropical vegetable crop and it is a perennial and dioecious cucurbits and grows as a vine. West Bengal and Assam are the primary centre of origin of pointed gourd and known by the name of parwal, palwal or parmal in different parts of India. The yield of the crop in the terai areas is low as compared to the average attainable yield of the state although it is one of the most profitable cucurbitaceous crops in the eastern part of India. The reasons for this gap in productivity noticed are improper nutrient management and lack of knowledge of improved horticultural practices. Hence, a study was undertaken to demonstrate on balanced fertilization and different techniques of pollination which helped fruit setting, improve the yield and productivity in Jalpaiguri district of Terai region, West Bengal. Ten demonstrations were conducted during 2015-2016 with three treatments *viz*. Farmers' practice *i.e.* improper ratio of male : female vine + no such recommended fertilizer scheduled; TO1: proper maintenance of male: female vine ratio (1 : 9) + RDF (NPK 120-60-60 kg ha^{-1}); TO2: Proper maintenance of male: female vine ratio (1:9) + enriched vermicompost (15 q/ha) along with NPK (19 : 19 : 19) spray. The average yield obtained under TO2 i.e. proper maintenance of male and female ratio of vines 1:9+ enriched vermicompost along with NPK (19:19:19) spray was 18.1 t ha^{-1} which was 35 per cent and 5 per cent higher than yield achieved under farmers' practice (11.6 t ha^{-1}) and TO1 (17.1 t ha^{-1}), respectively. The net profit under demonstration of TO2 was Rs. 168750 and the B: C ratio was 2.66 while under farmers practice net profit was Rs. 95250 and the B:C ratio was 2.20. It can be concluded that the improved management practice 2: proper maintenance of male: female vine ratio (1:9) + Enriched vermicompost (1.5 t ha^{-1}) along with NPK (19:19:19) spray can improve yield and economics of production of pointed gourd and also increase the vine longevity.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Validation of Fertilizer Prescription Equations Based on Targeted Yield Concept for Banana Grown on Inceptisols

S.D. Kale*, A.D. Kadlag and S.M. Todmal
Department of Soil Science and Agricultural Chemistry, M.P.K.V., Rahuri, Maharashtra
**Email: sangkale@gmail.com*

A field experiment was conducted during 2012-13 at STCR farm, MPKV, Rahuri for validation of targeted yield fertilizer prescription equations developed for banana (*cv.* Grand nine). The experiment was laid out in randomized block design with three replications and eight treatments. The treatment consist of control, GRDF, as per soil test, STCRC target, 100 and 120 t ha^{-1} without FYM and with FYM @ 10 t ha^{-1}. The fertilizer prescription equations are as follows

Without FYM	With FYM
FN = 16.97 T – 2.27 SN	FN = 10.02 T – 1.34 SN – 1.76 FYM
FP_2O_5 = 2.91 T – 4.14 SP	FP_2O_5 = 2.09 T – 2.97 SP – 1.47 FYM
FK_2O = 13.97 T – 0.915 SK	FK_2O = 7.52 T – 0.49 SK – 1.28 FYM

Where, FN, FP_2O_5, FK_2O are fertilizer, N, P_2O_5 and K_2O in kg ha^{-1}. T is yield target in t ha^{-1}, SN, SP and SK are soil available N, P and K in kg ha^{-1}, respectively.

The treatment 120 t ha^{-1} yield target of banana with 10 t ha^{-1} FYM recorded the highest banana yield (112.3 t ha^{-1}) and closely followed by the GRDF treatment (111.9 t ha^{-1}). The treatment receiving fertilizers as per 110 and 120 t ha^{-1} yield target with 10 t ha^{-1} FYM were recorded 102 and 112.3 t ha^{-1} banana yield with variation of 6.4 to 6.8 per cent whereas fertilizer application as per yield target 110 and 120 t ha^{-1} without FYM recorded 98.1 and 102.2 t ha^{-1} banana yield revealed that the fertilizer prescription equations developed for banana with FYM is valid.

The nutrient uptake of banana was significantly influenced by fertilizer application as per fertilizer prescription equations with and without FYM. It was significantly higher in fertilizer application as per 120 t ha^{-1} banana yield target with FYM (541.6, 95.8 and 1219.0 kg ha^{-1} N, P, K, respectively). It was closely followed by STCRC target 110 t ha^{-1} without FYM (532.8, 112.9 and 1123.8 kg ha^{-1} N, P, K, respectively).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Efficient Nutrient Managemen of Wheat through Nutrient Expert Based Fertilizer Recommendation in Alluvial Soil of Murshidabad District of West Bengal

A. Taleb, F.H. Rahman[1*] and U. Roy, P. Pathak and A. Roy
Krishi Vigyan Kendra Murshidabad, WBUA&FS, Bhagwangola, Murshidabad, 742135, West Bengal
[1]ICAR-Agricultural Technology Application Research Institute Kolkata,
Salt Lake, Kolkata, 700097, West Bengal
**Email: fhrahmancal@gmail.com*

Nutrient Expert$^{(R)}$ (NE$^{(R)}$) for wheat was developed to provide site specific nutrient management (SSNM) to farmers in a simple and faster way. In this regards a field experiment was carried out in different places of Murshidabad district namely Dakshin Basudebpur, Beliapukur and Hossain Nagar during *rabi* of 2014 and 2015. A field experiment was conducted on NE$^{(R)}$ wheat based fertilizer recommendation at 10 farmers field of three different places in alluvial soil of Murshidabad district under irrigated condition. In the experiment the Nutrient expert based fertilizer management in wheat was compared with existing farmers fertilizer practice (FFP) and state recommendation on the basis of yield and yield attributes and economic returns. The analyzed data showed that the NE fertilizer recommendation increased grain yield by 18 and 34 per cent and the benefit-cost ratio of 22 and 32 per cent over Farmers fertilizer practice and state recommendation, respectively, across the location. The pooled data showed that the value in respect of average number of ear heads m^{-2}, number of grains ear head^{-1}, 1000 grain weight and harvest index were 9.32, 7.04, 2.53 and 5.53 per cent higher in NE$^{(R)}$ than farmers fertilizer practice (FFP) with 12, 32 and 29 per cent reduced N, P_2O_5 and K_2O application, respectively. The whole study in farmers field showed the significant improvement in yield, B:C ratio and decrease in fertilizer cost.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Boron Application on Seed Yield of Yellow Mustard in Red and Lateritic Areas of West Midnapore District of West Bengal

Asim Kumar Maiti, Naba Kumar Bej, R. Bhattacharya[1] and F.H. Rahman[1]
Sevabharati Krishi Vigyan Kendra, Jhargram, West Midnapore, West Bengal
[1]ICAR-Agricultural Technology Application Research Institute Kolkata, Salt Lake, Kolkata, 700097, West Bengal

The trial was conducted to assess the effect of boron (B) application as foliar spray at different concentration on the yield and quality of yellow mustard (*Brassica rapa)* in the farmer's field of different villages under Sevabharati Krishi Vigyan Kendra, West Midnapore district of West Bengal during 2011 and 2012. The treatments consisted of one farmers practice and two incremental doses of B application (*i.e.*, 0, 1.5 and 2 g L^{-1} as foliar spray at the time of 30 and 60 days after sowing) along with FYM (3 t ha^{-1}) and NPK (80:40:40 t ha^{-1}) application. Treatments were arranged in randomized block design (RBD) with 10 replications. The highest seed yield, 1.41 t $ha^{-1,}$ was obtained from the treatment of maximum doses of B application followed by 1.18 t ha^{-1} from the treatment of lower doses of boron application. The seed yield with 33 per cent more was obtained in the treatment of maximum doses of B application as compare to Farmers' practice. Moreover, the application of B as a micronutrient in aluminium oxide [Al $(OH)_3$] riched lateritic, red and gravely undulating region in the West Bengal improved the quality and the colour of seed.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of INM on Dry Matter Production, Yield, Nutrient Content and Uptake by Maize-Spinach Cropping System

I. Usha Rani and G. Padmaja
Department of Soil Science and Agricultural Chemistry, Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad, Andhra Pradesh

In recent years, chemical fertilizers played significant role in providing nutrients for intensive crop production. But increased use of chemical fertilizers in an unbalanced manner has created problem of multiple nutrient deficiencies, diminishing soil fertility and unsustainable crop yields. This necessitated a review of various approaches for ensuring effective use of available renewable sources of plant nutrients for supplementing commercial fertilizers. Researchers have been therefore, directed towards integrated nutrient management (INM) involving organics and biofertilizers to find out the feasibility of their use for improving soil health. The fertility of soil gets depleted by growing same crop year after year. This problem can be avoided by changing the crop in a scientific manner selecting appropriate crop rotation. Keeping the significance of organic manures in maintaining the soil health and improvement in productivity of crops, an experiment has been made critically to examine the use of different sources of nutrients to obtain better yields and to maintain good soil health in maize-spinach cropping system under integrated nutrient management.

A field experiment was conducted on a red sandy loam soil (Alfisol) during *rabi* (maize) and summer (spinach) seasons at College of Agriculture, Rajendranagar, Hyderabad with a view to study the effect of organic manures, inorganic fertilizers and their integration on dry matter production, yield soil nutrient content and uptake maize-spinach cropping system. Among the different combinations application of 75% RDF + 25% through vermicompost recorded significantly the highest dry matter production (vegetative stage and tasseling stage), grain and stover yield (3.98, 6.13, 5.24 and 6.08 t ha^{-1}) but, on par with75% RDF + 25% through poultry manure and 75% RDF + 25% through FYM. The spinach crop was grown during summer responded favourably to the residual and cumulative treatments and the highest fresh leaf yield (14.7 and 12.4 t ha^{-1}) was recorded in cumulative and residual treatments. Application of 75% RDF + 25% through VC, PM and FYM to the maize crop showed the highest content and uptake of N, P and K at vegetative, tasseling and at harvesting stages. The highest dry matter production, fresh leaf yield and nutrient uptake of N, P and K by spinach at harvest was recorded in residual and cumulative treatments receiving 100% organic manures.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effects of Phosphorus and Sulphur Interaction on Nutrient Uptake and Yield of Black Gram (*Vigna mungo* L. Hepper)

Mamta Phogat, A.P. Rai, A.K. Mondal and Pardeep Wali
Division of Soil Science and Agricultural Chemistry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir

A study was conducted at Research Farm of the university during summer season of 2015 with four levels of phosphorus (P) *i.e.* 0, 20, 40 and 60 kg P ha^{-1} and three levels of sulphur (S) *i.e.* 0, 15 and 30 kg S ha^{-1} with three replications to investigate the interaction effect of P and S application on nutrient uptake and yield of black gram (cv. Uttara) using factorial randomized block design (RBD). The experimental soil was sandy clay loam, pH: 8.25, organic carbon 3.80 g kg^{-1}, available P and S values were 21.22 and 9.29 kg ha^{-1}, respectively. The seed and stover yield were 0.96 and 2.40 t ha^{-1} with combined application of 60 and 30 kg ha^{-1}, P and S, respectively, indicating synergistic effect of P and S on each other as both the nutrients mutually help absorption and utilization by black gram probably due to balanced nutrition. The various growth parameters and yield attributes like plant height, number of pods $plant^{-1}$, 100-seed weight, number of nodules $plant^{-1}$ also increased significantly with increasing levels of P and S up to highest level and the optimum values were recorded with combined application of 60 kg P ha^{-1} and 30 kg S ha^{-1}. However, nonsignificant response of P and S application has been observed in case of plant population (m^{-2}), while it slightly increased with each successive application of P and S up to 60 kg P ha^{-1} and 30 kg S ha^{-1}. The optimum P concentration (%) and uptake (kg ha^{-1}) in seed (0.376 and 3.59) and stover (0.266 and 6.38) of black gram was also recorded with combined application of 60 kg P ha^{-1} and 30 kg S ha^{-1} indicating synergistic effect of P and S on each other. Similarly, the optimum S concentration (%) and uptake (kg ha^{-1}) in seed (0.397 and 3.79) and stover (0.134 and 3.21) was recorded with combined application of 60 kg P ha^{-1} and 30 kg S ha^{-1}. The available and organic P (kg ha^{-1}) in soil significantly increased with each successive application of P up to the highest level over control at 20 days after sowing (DAS), while it showed decreasing trend with time intervals of 40 DAS and at maturity. The application of successive doses of S also had non significant effect on available and organic P at each time interval. Similarly, significant increase has been recorded in available and organic S (kg ha^{-1}) in soil with each successive application of S up to 30 kg S ha^{-1} over control at 20 DAS of black gram, however it showed decreasing trend with time intervals of 40 DAS and at maturity of black gram. The application of successive doses of P had nonsignificant effect on available and organic S content at each time interval.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Sampoorna KAU Multimix for Foliar Application in Rice, Banana and Vegetables- An Innovative Approach in Nutrient Management

V. Thulasi*, P.P. Moossa, P. Sureshkumar and M.C. Narayanankutty
Division of Soil Science and Agricultural Chemistry, Regional Agricultural Research Station, Pattambi, Kerala Agricultural University, MelePattambi, 679506, Kerala
**Email: thulasi.v@kau.in*

Management of agricultural systems should revolve around the soil to feed the plant. Diversity of climate, vegetation, landform and hydrology has given rise to distinct soil types in the state. Adoption of high production technology and cultivation of high yielding varieties have put tremendous pressure on soil nutrient reserve in the country leading to a great imbalance in nutrient status in the soil. A large chunk of soil in the country has been rendered deficient in micronutrients, which is one of the major reasons that crops have stopped responding to fertilizers. Crop yields in acid laterite soils of Kerala are very low due to inherent soil characteristics. Low availability of soil nutrients especially micronutrients is one of the reason for the low productivity.

Soil test based nutrient management plan was developed for different agro ecological zones of Kerala as a part of a network project implemented jointly by various organizations and institutions in Kerala. Wide spread deficiency of boron (B) and magnesium (Mg) were reported in the composite samples collected from the fields of farmers all over the state. The over dominance of iron in Kerala soils result in the physiological deficiency of other cations. Moreover, the acid, leaching environment is not conducive for the retention of majority of the nutrients. Besides, multi-nutrient deficiencies are occurring very commonly in almost all the crops in recent years. Therefore soil and crop specific multi-nutrient mixtures suitable for foliar application are the need of the hour for improving productivity. The objective of the study was to develop multi-nutrient mixtures for foliar application in different crops and to evaluate their suitability for correcting the nutrient deficiencies and for improving yield.

Multi-nutrient mixtures were developed at RARS Pattambi using nutrient carriers, for foliar application in rice, banana and vegetable crops. Initially, compatible chemicals were identified by considering the mixing compatibility, solubility and storage properties. With the nine compound formula identified through various tests and trials, crop specific mixtures were prepared considering the nutrient uptake by the specific crop, status of available nutrients in Kerala soils and the optimum, sufficiency and toxicity ranges of the nutrients in the particular crop. The dosage for application is fixed based on the requirement and uptake of the nutrients by the crops and pot culture and field experiments were also conducted to evaluate the performance

The multi-nutrient mixtures contain potassium (K), magnesium (Mg), sulphur (S), zinc (Zn), copper (Cu), boron (B) and molybdenum (Mo) and traces of iron and manganese. The experimental results indicate that foliar application of the mixtures could improve crop productivity by more than 20% in all the crops tested. Toxicity testing trials were also conducted to ascertain the safety of usage of these mixtures. Based on this, the mixtures for foliar application were released into market under the name Sampoorna KAU Multimix in rice and banana and vegetables separately.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Intensive Cropping and Long-term Application of Fertilizers and Organic Manure on Sulphur Availability in Soil and its Uptake by Jute

D.K. Kundu*, S.P. Mazumdar, S. Sasmal, A.R. Saha, B. Majumdar, A.K. Ghorai and M.S. Behera
ICAR-Central Research Institute for Jute and Allied Fibres, Barrackpore, Kolkata, 700120, West Bengal
**Email: kundu_crijaf@yahoo.com*

Present investigation was carried out to study the effect of intensive cropping and long-term use of fertilizers and organic manure on sulphur (S) transformation in sandy loam soil (Eutrochrept) and nutrients uptake by jute (*Corchorus olitorius*) at Barrackpore, West Bengal. Since 1971, the field was intensively cropped to jute-rice-wheat system using ten different fertilizer/manurialteatments, *viz.* no-fertilizer/no-manure control, 50% NPK, 100% NPK, 150% NPK, 100% NPK with hand weeding, 100% NPK plus Zn, 100% NP, 100% N, 100% NPK plus FYM, and 100% NPK minus S. After 45 years of cropping and fertilization/manuring, soil samples from 0-15 and 15-30 cm depths were collected to determine availability of different forms of S besides determining physicochemical properties of the surface (0-15 cm) soil. Fibre yield and nutrients uptake of jute in the year 2016 were also determined. Chemical analyses of soil and plant samples were done following standard methods. Available S and its fractions were found maximum in 100% NPK+FYM treated plot and minimum in control. Among different forms of S, total S ranged from 318 to 352 mg kg^{-1}, organic S from 173 to 262 mg kg^{-1}, monocalcium phosphate extractable S from 15 to 30 mg kg^{-1} and calcium chloride extractable S ranged from 12 to 21 mg kg^{-1} in the surface soil. Compared with the surface (0-15 cm) soil, the sub-surface (15-30 cm) soil contained lesser amount of all forms of S. Organic S was the most dominant form of S. Fibre yield of jute ranged from 873 to 2078 kg ha^{-1} under different treatments. Application of fertilizers, alone or in combination with FYM, significantly increased the fibre yield and nutrients uptake of jute over control. Sulphur uptake of jute ranged from 7 to 16 kg ha^{-1}, the highest uptake recorded under 100% NPK+FYM as well as 150% NPK treatments, and the lowest uptake under no-fertilizer/no-manure control. Use of S-free NPK fertilizers significantly reduced (from 11.8 to 7.4 kg ha^{-1}) uptake of S with significant reduction in fibre yield (from 1.87 to 1.39 t ha^{-1}) of the jute crop. The highest fibre yield of jute was recorded with 100% NPK+ FYM treatment. The 150% NPK treatment was found to be at par with the application of 100% NPK+ FYM. There was a net build-up of organic carbon in the soil under all the treatments over the control. The SOC build-up over the control was the highest in 100% NPK+FYM treated plot followed by 150% NPK treated plot. Availability of N, P as well as K in the soil was maximum in 100% NPK+FYM treated plots followed by 150% NPK treated plot. Present study established significant role of S in nutrition and fibre production of jute.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Nitrogen Balance Components in Rice as Influenced by Irrigation, Nitrogen and Climate Change Scenario

Gurpreet Singh and Bharat Bhushan Vashisht
Department of Soil Science, Punjab Agricultural University, Ludhiana, Punjab

With prime importance to quantify the nitrogen (N) balance components in rice, field studies were conducted at research farm of Department of Soil Science, Punjab Agricultural University, Ludhiana, Punjab, on sandy loam soils during *kharif* 2016. In the field study, effect of irrigation regimes (irrigation based on two days drainage period, and based on soil water suction (16 kPa)) and N levels (0, 60, 120 and 180 kg N ha^{-1}) on growth, yield of rice and N uptake were evaluated. To assess the N balance components, DNDC (denitrification-decomposition) model was evaluated and simulations for yield and N balance components were made for past and future climate scenarios on different soil series of Ludhiana district of Punjab. Averaged over irrigation regimes, rice yield increased significantly with increasing nitrogen levels. Highest rice grain yield was recorded with application of 180 kg N ha^{-1} (5.29-5.96 t ha^{-1}), which was significantly higher than control, 60 and 120 kg N ha^{-1}. The N uptake was also found higher (46.3-56.4 kg ha^{-1}) in the treatments with 180 kg N ha^{-1}. However, treatments with 60 kg N ha^{-1} gave higher N use efficiency in terms of agronomic (20-25 kg kg^{-1}) and recovery (54.8-59%) efficiency. Simulated rice yield, N uptake and volatilization would decrease with lower N levels, coarseness in soil texture and future time slices but leaching losses would increase with higher N levels, coarseness in soil texture and future time slices. However, per cent reduction in yield would be more in end part of mid century (2041-2050). Per cent yield reduction would be low at higher N levels (150-180 kg N ha^{-1}) and in fine textured soils (silt loam). The study suggests that higher N levels could be good option to compensate yield reduction in future however higher N levels would lead to higher N leaching and volatilization.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Nutrients Omission Study for Better Nutrient Uptake and Enhanced Nutrient Efficiencies in Maize (*Zea mays* L.) under Maize-Wheat Cropping System

Ekta Joshi*, Varsha Gupta and D.S. Sasode
RVSKVV, College of Agriculture, Gwalior, 474002, Madhya Pradesh
**Email: joshi.ekta86@gmail.com*

The blanket application of fertilizers does not take into account the native soil fertility and optimized fertilizer prescription based on available resources. To achieve yield potential for a given variety and climate indicate significant opportunities to further increase their productivity through site-specific, integrated nutrient and crop management based on crop requirements, soil test values and yield targets. Thus a 2-year field experiment was conducted at research farm, Department of Agronomy, IARI during the rainy seasons (July–October) of 2012 and 2013 on a non calcareous alkaline sandy clay loam soil, to assess the effect of omitted nutrients on productivity, nutrient use efficiency and nutrient uptake by maize (*Zea mays* L.) crop in maize (*Zea mays* L.) wheat (*Triticum aestivum* L.) cropping system. The experiment was designed in a randomized complete block with fifteen treatments and three replicates in fixed plots. Treatments included a zero fertilizer check, application of N (-PKZn), NP (-KZn), NPK (-Zn) and NPZn (-K) to both maize and wheat crop, to maize and to wheat crop only, recommended rate of nutrients (RDF: 120-60-40-5.5 kg ha^{-1} N-P-K-Zn) and STCR based application of nutrients (200-100-55-4 kg ha^{-1} N-P-K-Zn). The STCR approach found more sustainable in terms of improved uptake and better nutrient use efficiencies of macro nutrients N, P, K and micronutrients as Zn, Cu, Fe, Mn by maize. It increased the total uptake of N, P, K by 14.9, 12.5 and 9.3 per cent, respectively. The sustained omission of P and K reduced the yield by 8.9-10.4 and 8.1-11.2 per cent of maize. The effect of Zn omission on productivity of maize was observed very marginal to the extent of 2-3 per cent only. The continuous omission of P resulted in 13.7, 11.5 and 4.7 per cent reduction in total uptake of N, P, K and 4.8, 0.8 and 4.5 per cent in total uptake of Cu, Fe, Mn by maize crop. Similar to P, omitting K to both crops continuously during both years also resulted in reduction of total uptake of N, P, K, Zn, Cu, Fe, Mn by 22.1, 13.6, 23.4 per cent, 1.9, 11.0, 1.4 and 9.7 per cent, respectively. Omitting Zn to both maize and wheat crop during 2012 and 2013 had no significant effect on total nutrient uptake by maize. Omitting P and K also exhibited reduced agronomic efficiency and apparent recovery of maize crop in maize-wheat cropping system.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Different Levels of Nutrients on Growth Parameters of Clonal Eucalyptus

Baljit Singh, RIS Gill and Navneet Kaur
Department of Forestry and N.R., Punjab Agricultural University, Ludhiana, 141004, Punjab

Clonal eucalyptus has been adopted by farmers of Punjab on a large scale owing to its fast growth. An experiment was conducted to standardize the nutrient requirement of clonal eucalyptus (clone 413) during its 6 years of growth for getting its better productivity. The treatments comprised of 12 selected combinations out of 24 factorial combinations of four N, three P (as P_2O_5) and two K (as K_2O) levels varying during different years. Growth parameters of plants [diameter at breast height (DBH) and height] were measured and timber weight was estimated from these parameters. Economics of eucalyptus plantation was calculated and influence of nutrient application on their content in soil was also determined. The DBH, height and timber weight of eucalyptus after 6 years of growth were the lowest without the application of nutrients (T_1) (15.9 cm, 16.3 m and 171 t ha^{-1}, respectively) and significantly higher (17.3 cm, 18.5 m and 230 t ha^{-1}, respectively) with the application of N, P and K @ $N_{30}P_{20}K_0$, $N_{60}P_{40}K_0$, $N_{90}P_{60}K_0$, $N_{120}P_{80}K_0$, $N_{150}P_{100}K_0$ and $N_{180}P_{120}K_0$ g/plant during 1st, 2nd, 3rd, 4th, 5th and 6th year, respectively (T_3). The application of K alonwith N and P (T_4) i.e. $N_{30}P_{20}K_{20}$, $N_{60}P_{40}K_{40}$, $N_{90}P_{60}K_{60}$, $N_{120}P_{80}K_{80}$, $N_{150}P_{100}K_{100}$ and $N_{180}P_{120}K_{120}$ g/plant during 1st, 2nd, 3rd, 4th, 5th and 6th year, respectively further increased these parameters, however not significantly (17.8 cm, 18.8 m and 248 t ha^{-1}, respectively). The net returns were the lowest in T_1 (Rs 8,93,625 ha^{-1}) which increased to Rs 11,84,228 ha^{-1} in T_3 and to Rs 12,70,603 ha^{-1} in T_4. The available N, P and K contents after 6 years of age were the lowest without application of nutrients i.e. T_1 (96, 9.8 and 112 kg ha^{-1}, respectively) and significantly highest (121, 16.1 and 126 kg ha^{-1}, respectively) where the maximum dose of nutrients was added ($N_{90}P_{40}K_{20}$, $N_{120}P_{60}K_{40}$, $N_{150}P_{80}K_{60}$, $N_{180}P_{100}K_{80}$, $N_{210}P_{120}K_{100}$ and $N_{240}P_{140}K_{120}$ g/plant during 1st, 2nd, 3rd, 4th, 5th and 6th year, respectively).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Differences in Distribution of Physicochemical Properties and Available Nutrients Status in Some Red, Red Laterite and Black Soils in Semi arid Region of Tamil Nadu

Rajeshwar Malavath and S. Mani[1]
Department of Soil Science and Agricultural Chemistry, College of Agriculture, PJTSAU, Hyderabad, 500030, Telangana State
[1]Department of Soil Science and Agricultural Chemistry, Agricultural College and Research Institute, TNAU, Coimbatore, 641003, Tamil Nadu

The study was carried out in the three new research stations of Tamil Nadu Agricultural University with varied soil types *viz.*, Maize Research Station, Vagarai of Dindigul district, Cotton Research Station, Veppanthatai of Perambalur district and Dryland Agricultural Research Station, Chettinad of Sivagangai district of Tamil Nadu were selected for developing the strong soil resource database for proper appraisal of their productivity potential and their rational use. This study was an embodiment with an objective of distribution of physicochemical properties, available macro and micronutrients in some red, red laterite and black soils of semi arid region of Tamil Nadu. Based on the morphological characteristics and land elevation, thirteen representative geo-referenced pedons were selected and horizon wise soil samples were collected. The red laterite soils had lower pH values ranged from moderately acidic to slightly acidic followed by red (neutral to strongly alkaline) and higher pH values in black soils (moderately alkaline to strongly alkaline) with non saline in nature. The organic carbon showed wide variation and the values were found to be vary from low to medium (2.8 to 6.5 g kg^{-1}) in surface horizons whereas in subsurface horizons it was low and ranged from 0.70 to 5.0 g kg^{-1}. The $CaCO_3$, CEC, base saturation and CEC/clay ratios were higher in black soil pedons compared to red and red laterite soils. Higher values of CEC/clay ratios indicating that the black soils are less weathered than the red soils and red laterite soils. The exchangeable bases in the red and black soil pedons are in order of $Ca^{+2} > Mg^{+2} > Na^{+} > K^{+}$ on the exchange complex. The exchangeable bases of red laterite soils were in order $Ca^{+2} > Mg^{+2} > K^{+} > Na^{+}$. The soils are low in available N, low to high in available P in red and black soils and low to medium in red laterite soils, medium to high in available K and high in available S in surface horizons when compared to subsurface horizons. The soils are deficient to sufficient in available Zn, Cu, Fe and B and sufficient in available Mn. The red soils are shallow, marginally suitable to highly suitable for cultivation of maize, greengram, sorghum, redgram and blackgram. The black soils are very deep, moderately suitable to highly suitable for cultivation of cotton, sorghum, soybean, greengram, blackgram, redgram, sunflower, sesamum, maize and pearlmillet. The red laterite soils are very shallow to deep, marginally suitable to moderately suitable for cultivation of groundnut, greengram, blackgram, redgram, horsegram and pearlmillet.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Field Testing and Verification of Soil Test Crop Response (STCR)-based Fertilizer Application for Cotton Grown in Vertisols of Guntur District of Andhra Pradesh

G. Kishore Babu and P. Madhuvani
Regional Agricultural Research staton, Lam, Guntur, Andhra Pradesh

An investigation was carried out during 2014-2016 in the major cotton growing areas of Guntur district of Andhra Pradesh to know the fitment of STCR based fertilizer application to the cotton crop. Representative soil samples were collected before sowing of the crop from Koyavaripalem, Yadlapadu and Palaparru during kharif 2014-2015 and 75 Thalluru, Merigapudi and 113 Thalluru during 2015-2016 and were analyzed for physico- chemical and chemical properties. Fertilizers were calculated and applied based on the soil test values at different stages based on the recommendations of the University. The results of the study revealed that during kharif 2014-2015 (low rainfall year) all three locations tried indicated that targeted yield of 3.0 t ha^{-1} was not achieved through STCR based fertilizer application, Even the highest yields were recorded followed by recommended dose of fertilizers (RDF) and farmers practice (FP).

During *kharif* 2015-2016 (high rainfall year) the results revealed that in two locations tried in all the treatments (STCR, RDF and FP) were recorded higher yields than the targeted yield of 3.0 t ha^{-1} in all the three locations higher yields were found in RDF followed by STCR and FP. The results of the two years in six locations revealed that in most of the locations RDF applied was found beneficial than the STCR and FP approach of fertilizer application in Guntur district of Andhra Pradesh.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Crop Productivity and Soil Fertility after 50 Years of Experimentation under Pearl Millet - Wheat Cropping System in Semi Arid Environment

Sunita Sheoran, Dev Raj*, Deepika, D.S. Dahiya and K.S. Grewal
Department of Soil Science, CCS Haryana Agricultural University, Hisar, 125004, Haryana
**Email: devraj_chauhan@rediffmail.com*

A long-term field experiment was started in 1967 on 'compensation of fertilizer nitrogen (N) through use of FYM under pearl millet-wheat cropping system' at the Research Farm of Department of Soil Science, CCS Haryana Agricultural University, Hisar. The experiment is laid out in a split plot design with different levels of fertilizer N (0 and 120 kg ha^{-1}) and different FYM modes (*rabi, kharif and both rabi & kharif*) and levels (5, 10 and 15 t ha^{-1}) having three replications. After 50 years of experimentation, highest and lowest grain yield of wheat and pearl millet was observed under $FYM_{15}N_{120}$ and control treatment, respectively. Grain yield of both the crops was found to be increased with increasing application rate of FYM and fertilizer N. However, higher grain yield was obtained with integrated use of fertilizer N and FYM as compared to applied alone. Effect of different modes of FYM application on increment in grain yield followed the order: *both seasons> rabi > kharif*. Under different treatments, organic carbon (OC), available P and available K content in soil varied from 5.6 to 18.7 g kg^{-1}, 28.5 to 127.5 kg ha^{-1} and 431.8 to 1580.0 kg ha^{-1}, respectively. Similar to the grain yield, irrespective to the mode of application, increasing application rate of FYM showed significant increment in OC, available P and K content in soil. With increased application rate of fertilizer N, OC and available P content in soil was found to increased and highest was observed under $FYM_{15}N_{120}$ treatments. However, available K content showed the reverse trend and highest was observed $FYM_{15}N_0$ treatments. Both seasons application of FYM resulted in higher build up/ retention of OC, available P and K in soil followed by *rabi and kharif* application.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of K Application on Nutrient Concentration and Uptake by Bt Cotton

Rajesh Kumar, D.S. Jakhar and Dev Raj[1]
Krishi Vigyan Kendra, Sirsa
[1]*Department of Soil Science, CCS HAU, Hisar, Haryana*

The study was carried out at the farm of Krishi Vigyan Kendra, Sirsa. The experimental soil was sandy loam in texture, low in organic carbon (OC) and nitrogen (N), medium in phosphorus (P) with medium to high available K levels. The experiment was laid out in two soils having medium and high available K. There were seven treatments *viz.* T_1 - $N_{175}P_{60}$, T_2 - $N_{175}P_{60}$ + Water Spray, T_3 - $N_{175}P_{60}$+ foliar spray of 1% KNO_3, T_4 - $N_{175}P_{60}$+ K_{30}, T_5 - $N_{175}P_{60}$+ K_{30}+ foliar spray of 1% KNO_3, T_6 - $N_{175}P_{60}$+K_{60} and T_7 - $N_{175}P_{60}$+K_{60}+ foliar spray of 1% KNO_3. Each treatment was replicated thrice in RBD. Two foliar sprays were done at the time of flowering and peak boll development stages. Application of K increased the N content in the plant parts. P content in different plant parts decreased in all the treatments over treatment where only recommended dose of N and P applied. K content in leaves, stems, bur and seed in the higher K fertility soil was higher over medium K fertility soil in the respective treatments. The relative K concentration in plant parts followed the order : leaves > bur > seed > stems. The mean N uptake in various plant parts in medium K fertility soil (4.68, 7.08, 15.31 and 48.91 in bur, leaves, stems and seed, respectively) was lower as compared to the same in high K fertility soils. The mean P uptake was slightly higher in high K fertility soils as compared to the medium K fertility soils. Soil and foliar applied K significantly increased the K uptake. The mean K uptake was highest in T_7 ($N_{175}P_{60}$ + K_{60} + Foliar spray of 1% KNO_3) treatment which measured 10.72, 15.03, 21.16 and 30.07 kg ha^{-1} in leaves, bur, stems and seed, respectively.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Role of Micronutrient in Fruit Crops – A Review

Braj Kishor Rajput and Debesh Singh
Krishi Vigyan Kendra, RVSKVV, College of Agriculture, Gwalior, 474002, Madhya Pradesh

Micronutrients are essentially as important as macronutrients to have better growth, yield and quality in plants. The requirement of micronutrients (boron, iron, copper, zinc, manganese, magnesium and molybdenum) is only in traces, which is partly met from the soil or chemical fertilizer or through other sources. Proper plant nutrition is essential successful production of fruit crops. Integrated supply of micronutrients with macronutrients in adequate amount and suitable proportions is one of the most important factors that control the growth in fruit crops. Micronutrients are involved in all metabolic and cellular functions. Plants differ in their need for micronutrients. In this review, we focus on the major functions of mineral micronutrients in fruit production. Horticultural crops suffer widely by zinc deficiency followed by boron, manganese, copper, iron (mostly induced) and Mo deficiencies. Mo, Cl, Cu, Fe and Mn are involved in various processes related to photosynthesis and Zn, Cu, Fe and Mn are associated with various enzyme system; Mo is specific for nitrate reductase only. B is the only micronutrient not specifically associated with either photosynthesis or enzyme function, but it is associated with the carbohydrate chemistry and reproductive system of the plant. The significance of micronutrients in growth as well as physiological functions of horticultural fruit crops are briefed here nutrient wise. The sufficient amount of micronutrients necessary for better plant growth which resulted in higher yield due to increased growth, better flowering and higher fruit set.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Fertility Levels and Varieties on Growth, and Forage Yield of Cluster Bean *(Cyamopsis tetragonolobus* L.)

Shashi S. Yadav, Sulekha Kesari, Akhilesh Singh and P.A. Khambalkar
Department of Soil Science and Agricultural Chemistry, College of Agriculture, RVS Krishi Vishwa Vidyalaya, Gwalior, 474001, Madhya Pradesh

Improper nutrient management under limited moisture condition is considered as major limiting factor for achieving higher productivity of fodder crops. Use of improved varieties in addition to adequate nutrient management has been reported effective in improving the productivity of cluster beanhence anexperimenton cluster bean was carried out at the Research Farm, College of Agriculture, R.V.S.K.V.V., Gwalior (M.P.). The experiment was laid out in factorial randomized block design with 6 fertility levels and two varieties BG-1 and BG-2. Green fodder yield and total green fodder yield were maximum in Variety BG-2. Similarly, BG-2 showed higher plant N, P, K and moisture content in green fodder and available N, P, and K in soil over BG-1. 100% N: 125% P: 100% K recorded significantly higher plant height, produced higher number of branches,significantly maximum green fodder yield and organic carbon (g kg^{-1}) than rest of other fertility levels. Higher value of available N and P (kg ha^{-1}) in surface soil were noted in 100% N: 125% P: 100% K level in surface soil and in fodder. The level 125% N: 125% P: 100% K recorded maximum N, P and moisture content in green fodder in both cuttings. Maximum potassium content (%) was recorded in 100% N: 125% P: 125% K, which is statistically significant over other levels.Higher available N and P in soil were recorded with 125% N: 125% P: 100% K, while higher available K in soil was recorded with 125% P: 125% K).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Evaluation of Nitrogen Use Efficiency in Different Wheat Genotypes under Rainfed Conditions

Narendra Singh Gurjar, S.K. Verma, S.P.S. Tomar, P.A. Khambalkar and D.S. Bhadouria

Department of Soil Science , R.V.S.K.V.V., Gwalior, Madhya Pradesh

Nitrogen (N) is the key element among the major nutrients in crop production and most of Indian soils are deficient in this nutrient. Production of wheat in arid and semiarid area is greatly dependent on N management. In this area, N is the most limited plant nutrient because of low soil organic matter. Therefore, N mineralization is not sufficient for cereal N requirement and optimal N application is vital for increasing wheat yields in this area. There are many reports that N-fertilizer enhances water productivity, but the efficacy of N-fertilizer depends on the availability of soil moisture. Keeping these in view, an experiment was planned with three N levels (N_1 40, N_2 60 and N_3 80 kg ha^{-1}), as main treatment and six wheat genotypes (*viz.* HI-1572, HI-1500, Lok-1, MP-3288, A-9-30-1 and HI-8627) as sub treatment; in all possible combinations was conducted at Research Farm, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, during 2010-11 and 2011-12. Each treatment was replicated thrice in split plot design. The soil was alluvial and sandy clay loam in nature having pH 7.86, available N, P and K were 187.5, 15.3 and 226.0 kg ha^{-1}, respectively.

Results indicates that the chlorophyll content and grain yield of wheat is increased with the increase of nitrogen levels up to 80 kg ha^{-1} but the difference between 60 and 80 kg N ha^{-1} did not show significant difference from each other. Content and uptake of N increased with the levels of N. Genotype MP 3288 gave highest yield as compared to other genotypes whereas lowest yield were recorded in A-9-30-1. Nitrogen use efficiency (NUE) like partial factor productivity, agronomic N use efficiency and crop recovery efficiency decreased with increasing dose of N.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of Soil Growth Media and Copper Requirement of Gerbera Cultivation Grown on Alfisol under Polyhouse Conditions

N.J. Ranshur*, V.M. Amrutsagar[1] and A.S. Patil
Department of Soil Science and Agricultural Chemistry, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra
[1]Dryland Research Station, ZARS, Solapur, Maharashtra

A pot culture experiment was conducted on topic entitled "Assessment of Soil Growth Media and Copper Cation Requirement of Gerbera Cultivation in Alfisol under Polyhouse Conditions" at Department of Soil Science and Agricultural Chemistry, Mahatma Phule Krishi Vidyapeeth, Rahuri. The experiment was laid out in factorial randomized block design. Five growth media *viz*. Soil+FYM, Soil+FYM+wheat straw, Soil+FYM+rice husk, Soil+FYM + Cocopeat and Soil+FYM+sugarcane trash were studied. The proportion of FYM and other substrate usedwas 10 per cent each on weight basis. Four levels of copper (0, 0.025, 0.05 and 0.1 mg/plant/alternate day) along with absolute control. The Sangria variety was used for experiment. The highest number of flowers per plant 10.0 were recorded in 0.1 mg/plant/alternate day. While the highest number of flowers per plant 9.73 were recorded by Soil+ FYM+ Sugarcane trash (M4) copper levels, respectively. The 0.1 mg/plant/alternate day treatment recorded highest dry matter yield 43.07 g. In case of growth media the highest dry matter yield 39.41 g was recordedby Soil+ FYM+ Sugarcane trash (M4) media with application of the copper levels. The highest copper uptake 1.42 mg plant^{-1} was recorded in 0.1 mg/plant/alternate daytreatment. The highest copper uptake (0.60 mg plant^{-1}) was recorded by Soil+FYM+ Sugarcane trash (M4) growth media. The treatment combination Soil+ FYM+ Sugarcane trash (M4) and 0.1 mg copper/plant/alternate day recorded highest copper uptake 1.50 mg plant^{-1}. The flower head diameter was recorded maximum in higher levels of copper applied *i.e.* 8.33 cm. The growth media Soil+ FYM+Sugarcane trash media (M4) recorded maximum flower head diameter 7.39 cm) copper treatment. The treatment combination Soil+ FYM+ Sugarcane trash (M4) and 0.1 mg copper/plant/alternate day recorded highest flower head diameter (8.48 cm). The treatment 0.1 mg copper/plant/alternate day recorded maximum stalk length 42.36 cm. The maximum stalk length was recorded in Soil+ FYM+ Sugarcane trash (M4) with higher levels of copper treatment combination. The highest stalk diameter 7.53 mm were recorded with higher levels of copper applied (0.1 mg copper/plant/alternate day). The highest stalkdiameter was noted in Soil + FYM+ Sugarcane trash (M4) growth media. The highest stalk diameter was recorded Soil+ FYM+Sugarcane trash (M4) with higher levels of copper *i.e.* 0.1 treatment combination. The maximum vase life 6.8 days was recorded in Cu3 treatment. In case of growth the Soil+ FYM+Sugarcane trash (M4) recorded maximum vase life in all levels of copper Soil+ FYM+ wheat straw (M3).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Fertility Status of Mandal Block in Bhilwara District of Rajasthan, India

Om Prakash Gurjar and Ramawatar Meena
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Science, B.H.U., Varanasi, Uttar Pradesh

A study was conducted to ascertain the fertility status of cultivated land near and far away from industrial area of Mandal block in Bhilwara district of Rajasthan. Soil samples were taken from cultivated fields of 52 villages (0-15 cm depth) and analyzed for EC (dS m^{-1}), pH, bulk density (Mg m^{-3}), particle density (Mg m^{-3}), water holding capacity (%), organic carbon (%), available major nutrients (kg ha^{-1}) to prepare the map on the basis of nutrient status of the soil. The pH of soil samples was found from slightly acidic to strongly alkaline ranges (6.5 to 9.2). The EC was found in the safe range (0.25 to 2.2 dS m^{-1}) for cultivated land. Soil organic matter content was found in the range of low to medium (0.15 to 1.28%). Bulk density and particle density of soil ranges from 1.12 to 1.61 Mg m^{-3} and 1.95 to 2.77 Mg m^{-3} and water holding capacity of soil observed from 19.9 to 54.6%. Available nitrogen was seen low to medium ranges from 110.8 to 412.5 kg ha^{-1}, phosphorus was also found low to medium 6.6 to 31.8 kg ha^{-1} while available potassium was found high in the soils of Mandal block ranged from 343 to 776 kg ha^{-1}, sulphur was variable and found low to high in the range 3.71 to 46.2 kg ha^{-1} in soils of Mandal block. This information generated on availability of nutrients will be helpful in optimum nutrient management in the soils of the study area for augmenting crop productivity. Soil fertility data of Mandal block, Bhilwara (Rajasthan) may be used for the recommendation of fertilizer doses to the preceding crops to get maximum output.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Integrated Nutrient Management on Soil Fertility, Yield and Quality of Greengram

K.K. Yadav, M.K. Meena[1], Gajanand Jat[1], P.K. Singh and Manjeet Singh
Department of Soil & Water Engineering, [1]Department of Agricultural Chemistry and Soil Science, MPUAT, Udaipur, 313001, Rajasthan

A field experiment was conducted at Instructional Farm, Rajasthan College of Agriculture, Udaipur, (Rajasthan) during *kharif,* 2014 on clay loam soil to study the effect of integrated nutrient management on soil fertility, yield and quality of greengram. The experiment was laid out according to factorial randomized block design with three replications. The experiment comprised of four levels of fertility (75% RDF, 75% RDF+VC @ 2 t ha^{-1}, 100% RDF and 100% RDF+VC @ 2 t ha^{-1}) and four levels of biofertiliizers (control, *Rhizobium*, PSB and *Rhizobium* + PSB) were applied to the greengram var. SML-668. The RDF for green gram was 20 kg N and 40 kg P_2O_5 ha^{-1}. The soil of the experimental site was clay loam in texture, slightly alkaline in reaction, medium in available nitrogen (N) and phosphorus (P), while high in potassium (K) and DTPA extractable micronutrients were sufficiently above the critical limits.

The application of fertility levels significantly increased the dry matter accumulation, number of pods per plant, number of seeds per pod, chlorophyll content, seed and haulm yields, N, P, K, Cu, Zn, Fe and Mn content and uptake in seed and haulm, protein content in seed, number of total and effective root nodules, fresh and dry weight of root nodules, leghaemoglobin content in root nodules, and net returns up to 75% RDF+VC @ 2 t ha^{-1} however, their further increase with application of 100% RDF+VC @ 2 t ha^{-1} was not significant. The increase in test weight was found non-significant. The organic carbon, available N, P, K, Cu, Zn, Fe and Mn in soil increased significantly with the application of fertility levels at harvest of the crop, but EC and pH remain non-significant. Seed inoculation with *Rhizobium* + PSB significantly increased the dry matter accumulation, number of pods per plant, number of seeds per pod, chlorophyll content, seed andhaulm yields, N, P, K, Cu, Zn, Fe and Mn content and uptake in seed and haulm, protein content in seed, number of total and effective root nodules, fresh and dry weight of root nodules, leghaemoglobin content in root nodules, and net returns and the test weight and harvest index were found non-significant.The organic carbon, available N, P, K, Cu, Zn, Fe and Mn in soil significantly increased with inoculation of *Rhizobium* + PSB at harvest stage of the crop, but EC and pH remain non-significant. The interactive effect of fertility levels and biofertilizers significantly influenced the seed and haulm yield, N, P and K uptake by seed and net returns and maximum being with the application of100% RDF+VC @ 2 t ha^{-1} and *Rhizobium*+PSB combination, which was at par with 75% RDF+VC @ 2 t ha^{-1} and *Rhizobium*+PSB combination.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Potassium Fertilizer Management for Enhancing *kharif* Groundnut (*Arachis hypogaea* L.) Yield and Quality in Entisol

B. Borah, D.S. Patil and R.B. Pawar
Department of Soil Science and Agricultural Chemistry, College of Agriculture (Mahatma Phule Krishi Vidyapith), Kolhapur, 416004, Maharashtra

A field experiment was conducted at Post Graduate Research Farm, College of Agriculture, Kolhapur during *kharif* season of 2016 to evaluate yield and quality of *kharif* groundnut (*Arachis hypogaea* L.) in Entisol with different sources and levels of potassium (K). The soil of the experimental site was sandy clay loam in texture and had pH 7.6 containing organic carbon 4.5 g kg^{-1} and available nitrogen (N), phosphorus (P) and potassium (K) 150.2, 21.4 and 252.8 kg ha^{-1} and S 10.4 mg kg^{-1}, respectively. The treatments comprised of five levels of K *viz.,* 0, 10, 20, 30 and 40 kg ha^{-1} K_2O and four sources of K *viz.*, muriate of potash (MOP), sulphate of potash (SOP), bagasse ash and schoenite, each with 25 and 50 kg ha^{-1} N and P_2O_5, respectively, as basal dose. The experiment was laid out in a factorial randomized block design with three replications. Significantly highest dry pod, kernel and haulm yields (3.17, 2.21 and 3.89 kg ha^{-1}, respectively) were recorded by application of 40 kg ha^{-1} K_2O. Among the sources, the corresponding highest yields (2.77, 1.93 and 3.66 t ha^{-1}, respectively) were recorded with SOP. Significantly highest oil yield was recorded by application of 40 kg ha^{-1} K_2O (1.05 t ha^{-1}) and SOP (0.91 t ha^{-1}) among the levels and sources of K, respectively. The interaction effect between levels and sources of K was non-significant in relation to oil yield. The shelling percentage was not affected by the levels and sources of K. The nutrient uptake of groundnut increased significantly with increase in levels of K and the highest total uptake of N, P, K, Ca, S and B (130.1, 19.8, 82.5, 56.9 and 18.4 kg ha^{-1} and 44.5 g ha^{-1}, respectively) were recorded for 40 kg ha^{-1} K_2O. Among the sources, the highest uptake of total N (114.3 kg ha^{-1}), Ca (53.2 kg ha^{-1}) and S (15.6 kg ha^{-1}) was recorded for SOP, while that for total P (17.9 kg ha^{-1}) K (75.5 kg ha^{-1}) and B (42.8 g ha^{-1}) was observed for MOP being at par with SOP. The effect of different levels and sources of K and their interactions were did not affect the pH, electrical conductivity, organic carbon, per cent calcium carbonate equivalent and available N, P, K, S and exchangeable Ca and Mg of soil after harvest of groundnut.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Levels and Sources of Phosphorus on Yield and Uptake of Nutrients in Black Gram (*Phaseolus mungo* L.)

Shweta Jamra*, S.K. Trivedi, Hemlata Dhakad, Vidya Simaiya, Priyanka Jadon and R.C. Jatav

Department of Soil Science and Agricultural Chemistry, College of Agriculture, R.V.S.K.V.V., Gwalior, 474002, Madhya Pradesh

**Email: shwetajamra20@gmail.com*

The field experiment was conducted to study the effect of levels and sources of phosphorus (P) on yield and uptake of nutrients in black gram (*Phaseolus mungo* L) during *kharif* season of 2015-16 at research farm of R.V.S.K.V.V., Gwalior. The experiment was laid out in randomized block design (RBD) comprising of eight treatments with four replications. Results revealed that most of growth and yield parameters were significantly influenced by different levels and sources of P. The highest yield of grain (677.6 kg ha^{-1}) and straw (1443.4 kg ha^{-1}) were recorded with the application of 60 kg P_2O_5 ha^{-1} through SSP (single superphosphate) along with $N_{30}K_{30}$ closely followed by 60 kg P_2O_5 ha^{-1} (656.6 kg ha^{-1}) through DAP (di ammonium phosphate) and was significantly superior over application of 20 and 40 kg P_2O_5 ha^{-1}. The increasing levels of P_2O_5 from 20 to 60 kg ha^{-1} applied either DAP or SSP recorded significantly higher content and nutrient uptake of NPK and S as compared to without P applied treatment or control. Application of 60 kg P_2O_5 ha^{-1} recorded highest content and uptake of NPK and S. The uptake of nutrients by black gram increased significantly with increasing levels of P in the form of both sources. Status of soil pH decreased with levels but the available N, P, K and S improved significantly with increasing levels of P in post-harvest soil. Both the sources of P were statistically at par with respect to pH, available N, P, K and S build-up in soil. The status of available P increased in post-harvest soil with SSP than that of DAP.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Test Crop Response Correlation Studies for Targeting Yield of Wheat on Vertisol

A.B. Gosavi, J.S. Chaure, B.S. Raskar and S.S. Dodake
Agricultural Research Station, Niphad, 422303, Dist. Nashik, Maharashtra

Soil test crop response correlation studies were conducted to formulate the yield target equation for wheat var. NIAW 1994 (Phule Samadhan) under integrated plant nutrition system on Vertisol. Fertilizer adjustment equations under integrated plant nutrient supply system were formulated for wheat by following Ramamoorthy's inductive-cum-targeted yield model. The main experiment was conducted at Agricultural Research Station, Niphad during *rabi* 2015-16 and during next *rabi* season, follow up trials were conducted at five locations under Mahatma Phule Agricultural University, Rahuri. The nutrient requirement for producing one tone of wheat was 4.11, 0.74 and 3.39 kg of N, P_2O_5 and K_2O, respectively. The per cent contribution from soil and fertilizer nutrients were found to be 48.7 and 50.7 for nitrogen (N), 61.2 and 32.9 for phosphorus (P) and 33.1 and 61.2 for potassium (K), respectively. Similarly, the per cent contribution of fertilizers in presence of FYM was 55.4 for N, 41.6 for P and 71.0 for K. The per cent nutrient contribution of FYM was 27.1 for N, 4.5 for P and 7.7 for K. In followup trials, the yield target of 45 and 50 q ha^{-1} was achieved in all treatments of fertilizer application as per yield target in all follow up trials. The average yield of wheat in five follow up trials were 44.2 and 47.1 q ha^{-1} in fertilizer application as per 45 and 50 q ha^{-1} and with 10 t ha^{-1} FYM (47.3 and 50.4 q ha^{-1}). These results indicated that yield target equations developed for fertilizer application with and without FYM to harvest 45 and 50 q ha^{-1} wheat yield are valid.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Integrated Nutrient Management on Dry Matter Yield, Grain Yield and Nutrient Content of Rice (*Oryza sativa*) in a Vertisol

G.D. Sharma*, Risikesh Thakur, G.S. Tagore and D.L. Kauraw
Department of Soil Science and Agricultural Chemistry, J.N. Krishi Vishwa Vidyalaya, Jabalpur, 482004, Madhya Pradesh
**Email: gdsharma_74@rediffmail.com*

A field experiment was conducted during 2011 to assess the effect of combined application of inorganic fertilizer, organic manures and biofertilizers on dry matter yield, grain yield and nutrient content of rice in a Vertisol. For the present study the treatment structure consisted of: T_1 = 100% NPK through chemical fertilizers as per STV, T_2 = 75% NPK through chemical fertilizers as per STV, T_3 = 50% NPK through chemical fertilizers as per STV, T_4 = 75% NPK + 5 t FYM ha^{-1}, T_5 = 75% NPK + BGA + PSB, T_6 = 75% NPK + 5 t FYM + BGA + PSB, T_7 = 75% NPK + Zn, T_8 = 75% NPK + 5 t FYM ha^{-1} + Zn, T_9 = 75% NPK + 5 t FYM + BGA + PSB + Zn, T_{10} = 50% NPK + 5 t FYM ha^{-1}, T_{11} = 50% NPK + 5 t FYM ha^{-1} + PSB + BGA, T_{12} = 50% NPK + 5 t FYM ha^{-1} + PSB + BGA + Zn with four replications were arranged in a randomized block design. Rice crop (JR-201) was sown during first week of July and harvested at 90-100 days and the recommended doses of NPK (100% as per soil test value) applied to rice were : N @ 27.8 kg ha^{-1}, P_2O_5 @ 61.8 kg ha^{-1} and K_2O @ 35.4 kg ha^{-1}. The results revealed that the substitution of 25% NPK through FYM in recommended dose of NPK along with 5 kg Zn ha^{-1} and PSB + BGA recorded significantly higher dry matter yield at 40, 60 and 80 DAS (day after sowing) and grain yield (3.96 t ha^{-1}) over the 100% NPK treatment (3.49 t ha^{-1}). The conjunctive use of organic and inorganic fertilizers along with biofertilizers and micronutrients gave highest N, P, K, S and Zn content in dry matters and grain of rice crops as compared to other treatment combinations. Thus, integrated resource management improved the dry matter yield, grain yields and nutrient content of rice, which is more beneficial for farmer's when the rate of nutrients application is below the normal rate.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Organic Farming versus Inorganic Farming: A Comparative Study Regarding Soil Physicochemical and Biological Properties

Parul Bhatt Kotiyal and Vanshika Thapliyal
Forest Soil and Land Reclamation Division, Forest Research Institute, Dehradun, Uttarakhand

Sustainable agriculture is that form of farming which produces sufficient food to meet the needs of the present generation without eroding the ecological assets and productivity of life supporting systems of future generations. The concept of sustainable agriculture has come up because yields from modern farming techniques had reached a plateau and the environmental problems due to excessive use of chemicals and fertilizers and pesticides residue in food chain.

The present study was undertaken in the Dehradun district of Uttarakhand, India. The aim of the present study was to assess the physical, chemical and biological properties of soils in relation to the use of organic manures and fertilizers and their effect on the soil fertility and health. The physical properties estimated were bulk density, particle density and porosity and was observed that the bulk density was low and the porosity was more in the organic soils while particle density didn't showed much variation. Chemical properties of the soil *i.e.*, total nitrogen (N), available phosphorus (P), available potassium (K), organic carbon (OC), soil organic matter, pH were analyzed for the depth of 0-15cm. The OC and soil organic matter was high in organic soil which provides food and nutrients to beneficial microorganisms. The N and P content were higher in the fertilized field because of addition of fertilizers. The content of micronutrients was also high in the fertilizer fields. With the experiments conducted it was concluded that the bacterial count was more in organic soil. This may lead to a conclusion that there was more microbial activity in the organic soil than the fertilizer soil. The repeated applications of inorganic fertilizer to the soil can suppress production of certain soil enzymes that are involved in cycling of a given nutrient thus effecting the microbial population. The result stated that the physical and biological properties were better in organic soil and showed much less difference in the nutrient status in both types of the fields.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Yield and Quality Improvement in Finger Millet through Nutrient Management in Red Sandy Loam Soils

Y. Sandhya Rani*, U. Triveni, T.S.S.K. Patro and N. Anuradha
Acharya N.G. Ranga Agricultural University, Agricultural Research Station, Vizianagaram, 535001, Andhra Pradesh
**Email: sandhya_rani337@yahoo.com*

Malnutrition and under nourishment are the major problems of Indian population due to which millets are becoming alternative sources of human food bowl. Finger millet (*Eleusine coracana* (L.) Gaertn) is a staple food crop grown by subsistence farmers in red sandy loam soils of North Coastal Zone and Scarce Rainfall zone of Andhra Pradesh. It is commonly known as "Nutricereals" and is nutritionally superior to many cereals providing proteins, minerals, calcium and vitamins in abundance. It remains highly valued by traditional farmers as it is nutritious, drought tolerant, short duration and requires low inputs. High yielding varieties of finger millet require comparatively large quantities of both macro and micronutrients and are expected to respond favourably to their application. In view of this finger millet widely grown and commonly consumed in India was explored as a vehicle for fortification with zinc and iron. A field experiment was conducted during *kharif* 2015-16 and 2016-17 at Agricultural Research Station, Vizianagaramto study the yield responses of finger millet to graded doses of inorganic fertilizers (macronutrients and micronutrients) which has been shown to be important for early establishment of finger millet. The experimental results indicated that significantly higher grain and straw yields of finger millet were recorded in the treatment with 150% RDF+$ZnSO_4$ 0.5% foliar spray + $FeSO_4$ 0.2% foliar spray (7.81 and 3.37 t ha^{-1}, respectively). The highest available soil macronutrients and uptake of plant macronutrients was also found in the same treatment. Whereas the highest available Zn in the soil was found in the treatment 150% RDF+$ZnSO_4$ soil application + $FeSO_4$ 0.2% foliar spray (3.32 ppm), and the highest available Fe in the treatment 150% RDF+ $FeSO_4$ 0.2% foliar spray (17.63 ppm).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Periodic Changes in Fertility Status of Soils of Districts Hisar and Bhiwani

B.S. Duhan
Department of Soil Science, CCSHAU, Hisar, 125004, Haryana
Email: dr.bsduhan@gmail.com

With the release of high yielding varieties and improved agro-technology we are harvesting bumper crop. Consequently, we are mining a heavy amount of nutrients from the soil. Almost all of the cultivated land in Haryana state has become deficient in nitrogen. Therefore, we should be careful regarding the soil fertility and productivity. Soil testing plays a key role in maintaining soil fertility as well as productivity.

Regional soil testing laboratory Department of Soil Science, CCSHAU, Hisar is involved in the service of farmers and other agencies. Soil and water samples received from the farmers and other agencies from different parts of Haryana and adjoining states are analyzed in laboratory for different parameters throughout the year. On the basis of results, these samples categorized in to low, medium and high in fertility status. Results of soil samples analyzed during 1999-2000, 2004-05, 2009-10, 2014-15 and 2016-17 are presented in the paper.

Soil test reports of soil samples received during 1999 -2000 to 2016-17 from Hisar district indicated that over all organic carbon (OC) contents improved over the year. During 1999-2000, OC was 64.2% under low category which decreased to 33.4% in 20016-17. Organic carbon increased under medium category from 32.2 to 62.7 and 3.6 to 3.9% under high category. Percentage of P (available P) decreased under low category and decrease was from 45.2 to 23.7. Percentage of P increased in medium category from 25.7 to 50.5, decreased from 29.1 to 25.8 under high category over the period. Percentage of K (available K) increased from 14.0 to 20.8 under low category and decreased from 57.6 to 62.2 and 28.4 to 17.0 under medium and high categories, respectively.

Incase of district Bhiwani, over all OC contents improved over the years. Organic carbon slightly decreased from 70.6 to 69.3 under low category. Organic increased from 23.9 to 28.1% under medium category. However, per cent organic carbon in soil increased from 0.5 to 2.7 under high category. Percentage of P in soil decreased from 42.1 to 37.6 under low category. Percentage of P increased in medium category and increase was from 32.1 to 43.3. Percentage of P under high category decreased from 25.8 to 19.1. Available K increased from 25.8 to 46.7% under low category but increased from 59.8 to 44.2% and 14.4 to 11.1% under medium and high categories, respectively.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Impact of SOP and MOP on Yield and Quality of Maize and Wheat Cropping System in Entisol of Jharkhand

Rakesh Kumar*, S. Karmakar[1], B.K. Agrawal, Avay Kumar[1] and S.K. Bansal[2]
Department of Soil Science and Agricultural Chemistry, [1]Department of Agronomy,
Birsa Agricultural University, Ranchi, Jharkhand
[2]Director, IPI
**Email: rkssac@rediffmail.com*

The importance of maize and wheat production is very much relevant for food, fodder and nutritional security in Jharkhand. Maize and wheat is the 2nd and 3rd important crop of the state. Maize provides nutritional security in backward, hilly and tribal areas through high production. The present maize and wheat yield rate is 1.2 and 1.7 t ha^{-1} against all India average yield of 1.96 and 2.7 t ha^{-1}, respectively. The soils of Jharkhand having sandy loam, low base saturation, acidic reaction, high P fixing capacity, poor organic matter content, poor water retention capacity and low soil available nutrients. Farmers of the Jharkhand regions are not applying K in their fertilizer schedule. The inclusion of K is essential in the fertilization schedule for higher productivity and good quality.

Keeping in view a field experiments were carried at BAU (2015-16) to study the impact of foliar application of SOP and basal MOP on yield and quality of maize and wheat comprasing. The experiment was conducted on maize (pioneer 30V 92) and wheat (K-307) in the month of June and Nov. in the Goriakarma seed multiplication farm of Birsa Agricultural University. The climate is tropical and sub-tropical. The crop was harvested in the month of October and April and the yield data including agronomical parameters were recorded.

The foliar application of SOP and basal application of MOP on yield and quality of maize and wheat system in Entisol, the highest grain yield of maize (6.15 t ha^{-1}) and wheat (5.36 t ha^{-1}) was obtained with the application of T_5 (100% NP and 75% K +2 spray of SOP) in both cases followed by T_4 (5.35 and 5.09 t ha^{-1} accordingly for maize and wheat). The T_5 treatment recorded 48 per cent higher yield in absence of K application.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Changes in Soil Nutrient Status and Yield of Hybrid Maize under Long-Term Fertilization in an Irrigated Inceptisol

Pragyan Paramita Rout*, N. Chandrasekaran and K. Arulmozhiselvan
Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu
**Email: parimita.pragyan00@gmail.com*

In the present agricultural scenario food grain production has doubled world over and trebled in India since mid-sixties due to introduction of green revolution with the massive application of science and technology. However, recently a noticeable decline in productivity of many intensively cultivated areas has been observed. Hence, in the present context of soil fertility management, long-term fertilizer experiments (LTFEs) are the valuable assets for determining yield trends, changes in soil nutrient status and balances thereby predicting soil carrying capacity, assessing soil quality and sustainability. With this background, a research study was undertaken to evaluate the effect of long-term application of inorganic fertilizers and organic manure on soil available nutrients, organic carbon and yield of hybrid maize during 2013-14 under finger millet-maize cropping sequence at TNAU, Coimbatore. There were ten treatments each replicated four times in randomized block design *viz.,* T_1- 50% NPK, T_2 - 100% NPK, T_3 - 150% NPK, T_4 - 100% NPK + hand weeding, T_5 - 100% NPK + $ZnSO_4$, T_6 - 100% NP, T_7 - 100% N alone, T_8 - 100% NPK + FYM, T_9 - 100% NPK (-S) and T_{10} - Absolute control.

The experimental results showed that application of 100% NPK with FYM recorded highest soil fertility parameters *viz.,* available nutrients (N, P, K and MNs) and organic carbon content thus emphasizing the importance of organic manure in transformations of different nutrient in soil and maintaining soil organic carbon pool in soil compared to control. The results on change in soil available K over a period from 1972-2014 under continuous cropping depicts a negative balance of K in soil irrespective of fertilizer treatments imposed, however the lowest change (- 205 kg ha^{-1}) was recorded in 100% NPK + FYM plots (T_8) indicating the need to raise the level of K fertilizer application to meet demand of crops. The organic carbon content of soil with an initial value of 3.0 g kg^{-1} (1972) had increased significantly and attained a maximum value of 6.1 g kg^{-1} in treatment that had received 100% NPK along with FYM. The fertility of the soil appeared to be adversely affected due to imbalanced use of fertilizers in treatments receiving NP or N alone. Grain and straw yield of hybrid maize were significantly highest under 100% NPK + FYM treatment which is well evidenced by a yield increase of 12.6 per cent over 100% NPK alone.

Hence, from the present study it can be concluded that under continuous cropping with finger millet and hybrid maize in sequence over a period from 1972-2014, conjoint application of organic manure along with 100% NPK not only sustained the higher yield of hybrid maize, but also improved the soil fertility. Thus, the balanced use of fertilizers continuously either alone or in combination with organic manure is necessary for sustaining soil fertility and productivity of crops.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Quality as Affected by Integrated Nutrient Management of Rice in Lateritic Soil of West Bengal

Monisankar Bera*, Suchhanda Mondal, Pabitra Kumar Biswas, Manik Chandra Kundu and Goutam Kumar Ghosh
Department of Soil Science and Agricultural Chemistry, Palli Siksha Bhavana, Institute of Agriculture, Visva-Bharati, Sriniketan, 731236, West Bengal
**Email: monisankar2010@gmail.com*

Red and lateritic soils represent 70 million ha (Mha) of the land area in India. These soils are usually less productive due to various soil related constraints, including coarse texture, low water holding capacity, acidity, poor availability of N, P, and K, low organic C status, and both excessive and inadequate levels of several secondary and trace elements. A field experiment was carried out in Agricultural Research Farm of the Institute at Sriniketan to assess the yield potential of boro rice through soil test- based, integrated nutrient management practices including vermicompost over recommended doses of fertilizer (RDF i.e. $N_{80}P_{40}$ K_{40}) and along with Zn, B, Mo to *Boro* rice (*Oryza sativa L.*) in a typical lateritic soil during summer season of 2015. The experiment was laid out in randomized block design with three replications with fifteen treatments. After harvesting, soil samples were analyzed for available-N, P, K, S and organic carbon contents. Results indicate that the RDF (T_2) was significantly superior over control (T_1) with regards to yield of grain (6.13 t ha^{-1}), straw (5.35 t ha^{-1}) and total biological yield (11.5 t ha^{-1}). It is interesting to note that the increment of 2.2 kg ha^{-1} B and 4.2 kg ha^{-1} Zn with RDF *i.e.* T_8 ($N_{80}P_{40}K_{40}B_{2.2}Zn_{4.2}$) increased the highest grain yield of rice (7.37 t ha^{-1}) significantly over control (5.49 t ha^{-1}). Integration of nutrients along with vermicompost can be reckoned as the best treatment combination for boro rice in red and lateritic belt of West Bengal.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Impact of Different Sowing Methods and Nitrogen Sources on Growth and Grain Yield of Maize (*Zea mays* l.) in Lateritic Belt of West Bengal

Joy Kumar Mandal, M.C. Kundu*, P.K. Biswas, S. Mondal and G.K. Ghosh
Department of Soil Science and Agricultural Chemistry, Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan, 731236, West Bengal
**Email: mckundu@gmail.com*

A field experiment was conducted in the *pre-kharif* season of 2015-16 in lateritic soil of the Agricultural Research Farm of Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, West Bengal with a view to study the effect of different sowing methods and sources of nitrogen (N) on grain yield of maize (*Zea mays* L.). Fifteen treatment combinations with three sowing methods [S1= ridge planting, S2=furrow planting and S3=flat sowing] and five different combination of organic and inorganic sources of N [N0=no nitrogen, N1=100% N from inorganic source (urea), N2=75% N from organic source (vermicompost) +25% N from inorganic source, N3=50% N from organic source (vermicompost) +50% N from inorganic source and N4=25% N from organic source (vermicompost) +75% N from inorganic source] were applied in a factorial randomized complete block design replicated thrice. While studying the sole effect of sowing method and N sources, it was observed that S1 or ridge sowing and N1 or 100% N from inorganic source (urea) showed highest responses to all the growth and yield attributing characteristics of maize like highest plant height, number of leaves per plant, number of plants per m^2, number of cobs per plant, cobs per m^2, cob length, cob diameter, number of grains per cob and test weight. While studying the interaction effect, it was observed that S1N1 (*i.e.*, ridge sowing + 100% N from inorganic source) treatment showed highest response to almost all the growth and yield attributing characteristics of maize. Maximum average grain yield of 4.47 and 5.91 t ha^{-1} were recorded in S1 *i.e.*, ridge sown plot and N1=100% N from inorganic source (urea) respectively. Interaction of sowing method and sources of nitrogen also showed statistically significant effect on grain yield. It had been observed that S1N1 *i.e.*, ridge sowing with application of 100% N from inorganic sources (urea) had highest grain yield of 6.19 t ha^{-1} and lowest grain yield (1.64 t ha^{-1}) was recorded in plot treated with flat sowing and without N.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Potassium Management in Furrow Irrigation Systems on Growth and Grain Yield of Maize (*Zea mays* L.) In Lateritic Belt of West Bengal

Arka Sengupta, M.C. Kundu*, P.K. Biswas, S. Mondal and G.K. Ghosh
Department of Soil Science and Agricultural Chemistry, Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan, 731236, West Bengal
**Email: mckundu@gmail.com*

A field experiment was conducted in the *pre-kharif* season of 2015-16 in lateritic soil of the Agricultural Research Farm of Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, West Bengal with a view to study the effect of different furrow irrigation systems and levels of potassium on growth and grain yield of maize (*Zea mays* L.). Fifteen treatment combinations with three irrigation systems [I1=variable alternate-furrow irrigation (VAFI), I2=fixed alternate-furrow irrigation (FAFI) and I3=conventional every-furrow irrigation (CEFI)] and five levels of potassium (K0, K1, K2, K3 and K4 @ 0, 30, 60, 90, 120 kg K_2O ha^{-1}) were applied in a factorial randomized complete block design replicated thrice. The results revealed that different furrow irrigation systems and potassium levels had significant influence on growth and yield of maize. While studying the sole effect of potassium and irrigation systems, it was observed that K4 or 120 kg K ha^{-1} and I3 or CEFI system showed highest responses to all the growth and yield attributing characteristics of maize like highest - plant height, number of leaves per plant, number of plants per m^2, number of cobs per plant, cobs per m^2, grains per cob, cob length, cob diameter. Only highest test weights of 277.3g and 246.7 g were recorded in K4 and I1, respectively. While studying the interaction effect, it was observed that I3K4 or applying CEFI and 120 kg K ha^{-1} showed highest response to almost all the growth and yield attributing characteristics of maize except test weight. Maximum average grain yield of 5.42 t ha^{-1} was recorded in CEFI system followed by 5.15 t ha^{-1} in VAFI and 4.90 t ha^{-1} in FAFI respectively. Application of 120 kg K_2O ha^{-1} recorded highest grain yield of 7.02 t ha^{-1}. Interaction between irrigation methods and levels of potassium showed highest grain yield (7.30 t ha^{-1}) in plot treated with CEFI with 120 kg K_2O ha^{-1} and lowest grain yield of 2.54 t ha^{-1} in plot treated with FAFI system without potassium. Effective utilization of applied water in CEFI along with higher doses of K_2O might have provided favourable conditions to the maize crop resulting in higher growth and grain yield.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Micronutrients Status of Soils and *Rabi* Fodders in Ropar and Sangrur Districts of Punjab

D.S. Bhatti, J.S. Manchanda and S.S. Aulakh
Punjab Agricultural University, Ludhiana, 141004, Punjab

A survey study was conducted to assess the micronutrient status of soils and *rabi* fodders (berseem and oats) in Ropar and Sangrur districts of Punjab. A total of 120 soils and fodder samples were collected for this purpose. The DTPA- extractable Cu, Zn, Fe and Mn content in soils varied form 0.14-3.88, 0.28 to 4.36, 1.2 to 27.6 and 2.5 to 16.35 mg kg^{-1} soil, respectively. Two and 3 per cent soil samples were found to be deficient in Ropar and Sangrur district, respectively. In addition to Cu, 10 per cent soil samples in Ropar and 9 per cent of soils in Sangrur district were found to be deficient in available Zn. Similarly, 6 per cent soil samples of Ropar and 11 per cent in Sangrur district were also found deficient in available Fe content. Available Mn was observed to be deficient in 7 and 5 per cent soils in Ropar and Sangrur, respectively.

Irrespective of the districts, the concentration of Cu, Zn, Fe and Mn in dry matter of *berseem* varied from 3.5-15.5, 6.5-58.5, 27.5-380, 6.5-71.5 mg kg^{-1} dry matter, respectively. The corresponding values of theses micronutrients in *oats* dry matter varied from 3.5-11.5, 9-51, 13.8-336, and 12-70 mg kg^{-1} dry matter, respectively.Considering 8.0 μg Cu g^{-1} dry matteras critical limit for fodders, 30 per cent samples of *berseem* and 36 per cent samples of oats in Ropar district contained inadequate amount of Cu to meet the Cu requirement of ruminants.The corresponding values for Sangrur district were 40 and 46 per cent for *berseem* and *oats*, respectively. On an average in both the districts, 38 per cent of the total fodder samples contained insufficient Cu content for cattle consumption. Copper content of *berseem* ($r = 0.521^{**}$) and *oats* ($r = 0.692^{**}$) were significantly and positively correlated with DTPA-Cu content of the soils. Sixteen per cent *berseem* and 13 per cent *oats* samples in Ropar district were found to be below the critical limit of 25 μg Zn g^{-1} dry matter required for animals. Fifty per cent *berseem* and 43 per cent *oats* samples in Sangrur district were tested low in Zn as per the Zn requirement of ruminants.In Sangrur district all the samples of *oats* contained adequate amount of Fe content but 3 per cent *berseem* samples were low in Fe content. Thirty three per cent samples of *berseem* and 43 per cent samples of *oats* in Ropar were found to be low in Mn (< 40 μg Mn g^{-1} dry matter) to meet the requirements of ruminants. Similarly, in Sangrur district 50 and 37 per cent of *berseem* and *oats* samples were found to be deficient in Mn for cattle consumption.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Fertilizer Dose Recommendation through Soil Test Crop Response Study with Integrated Plat Nutrient Management System for Field Pea in Inceptisol of Varanasi, Uttar Pradesh

Y.V. Singh*, Kr. Rishi Ranjan, S.K. Singh, P. Dey and P.K. Sharma
AICRP on STCR, Department of Soil Science and Agricultural Chemistry,
Institute of Agricultural Sciences , Banaras Hindu University, Varanasi, 221005, Uttar Pradesh
**Email: yvsingh59@rediffmail.co.in*

A field experiment was conducted on inceptisol of Agriucltural Research Farm, Banaras Hindu University. Varanasi during *rabi* 2016 by using integrated plant nutrient management system on the basis of STCR approach and through which we are able to get fertilizers recommendation equation for field pea. Soil test data. Pea grain yield and NPK uptake by pea crop were used for achieving four important basic parameters, *viz*. nutrients required to produce one quintal of pea grain (NR), contribution of nutrients from soil (%CS) and contribution of nutrients from organic matter-FYM (%C-OM). It was found that 5.56, 0.79 and 3.08 kg of N, P_2O_5 and K_2O, respectively were required for producing one quintal pea grain. The percent contribution of nutrients from soil, fertilizer and FYM were 36..27, 133.79 and 12.64 for N; 51.76, 24.87 and 3.04 for P_2P_5; and 23.08, 71.42 and 10.05 for K_2O, respectively. By using these basic parameters, ready eckoner of fertilizer doses wasequipped for varying soil test values and desired yield targets of pea for NPK alone and NPK with FYM.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Weed Management in Potato Crop under Organic Farming

Varsha Gupta*, Ekta Joshi and D.S. Sasode
Department of Agronomy, RVSKVV, Gwalior, Madhya Pradesh
**Email: drvarshagupta11@gmail.com*

The trial was planted in randomized block design (RBD) during *rabi* 2016-17 at Research farm College of Agriculture, Gwalior (M.P.) to find out best weed management practice in potato under organic farming. The soil was sandy clay in texture, low in available nitrogen (234 kg ha^{-1}), medium in phosphorus (14 kg ha^{-1}) and potassium (240 kg ha^{-1}). The 10 treatments replicated thrice comprised of white plastic mulch, black plastic mulch, straw mulching at 5 DAS as 5 t ha^{-1}, one hand hoeing at 20 DAS, one hand hoeing at 20 DAS + straw mulching at 25 DAS, two hand weeding at 20 and 40 DAS, one hand hoeing at 20 DAS, one hand hoeing at 20 DAS + one hand weeding at 40 DAS, recommended herbicide (metribuzin 0.5 kg ha^{-1}), recommended herbicide + one hand weeding at 40 DAS and weedy check. Field was prepared to a fine tilth by one deep ploughing by disc plough followed by two cross disc harrowing and cultivating once by cultivator. After each operation planking was done. The field was well pulverized with the disc harrow and it was leveled with the help of "Pata (Planker)". Stones and gravel were removed.

Seed of variety Kufri Chandramukhi was used for sowing in plots (5×3.6 m^2) keeping row to row spacing 60 cm and plant to plant 20 cm with uniform seed rate 3.0 t ha^{-1}. Seed treatment was done with phosphate solubilising bacteria (PSB) 1.50 g kg^{-1} seed by dipping tubers for 30 min for controlling soil and tuber born disease before sowing. The sowing was done on 15th November, 2016. A uniform manure dose of FYM 10 t ha^{-1} and Vermicompost 10 t ha^{-1} were applied at the time of field preparation. Neem cake 250 kg ha^{-1} was applied in the soil to control the termite. Different mulching materials were placed five days after sowing. After 45 days of sowing, the mulches were removed and reapplied immediately after the completion of earthing. Recommended herbicide metribuzin was sprayed at pe-emergence of crop. The crop was harvested on 20th February, 2017.

Observations for different weed spp., weed population and dry weight were recorded at 30 and 60 DAS. Crop growth parameters *i.e.* plant height, no of stems/plant and no. of leave/plant was recorded at 30 and 60 DAS. Fresh weight of plant, fresh weight of haulm were recorded at harvest stage while yield attributes *viz*. no. of tubers/plant, fresh weight and dry weight of tuber/plant and yield of tuber t ha^{-1} were recorded at harvest stage. Weed control efficiency was also worked out at 60 DAS for different weed control treatments. Overall, it was concluded that two hand weeding at 20 and 40 DAS gave highest yield (14.6 t ha^{-1}) followed by recommended herbicide metribuzin 0.5 kg ha^{-1} + one hand weeding. Among organic weed management practices one hand weeding at 20 DAS with straw mulch 5 t ha^{-1} controlled the weeds with 74.6% WCE as well as gave higher yield of potato (13.9) t ha^{-1}) followed by one hand hoeing at 20 DAS + one hand weeding at 40 DAS (13.7 t ha^{-1}) with 71.8% WCE.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Monitoring the Soil, Fertility of Low Land Rice Soils of East Godavari District of Andhra Pradesh

D. Srinivas[1]* and T.V. Sridhar
Andhra Pradesh Rice Research Institute and RRS, Maruteru, Andhra Pradesh
[1]Department of Soil Science and Agricultural Chemistry, Agricultural College, Rajahmundry, 533103, East Godavari District, Andhra Pradesh
**Email: drd_srinivas@yahoo.com*

Intensive rice monoculture is in vogue in Godavari Delta of Andhra Pradesh. This brings about changes in physical and chemical properties of soil which in turn exerts a profound influence on soil fertility and crop productivity. High dose of nitrogen, top-dressing of P, excessive use of irrigation water, ill-drained conditions are some of the factors responsible for the deficiency/toxicity of some of the nutrients. Monitoring these changes in Godavari delta at periodical intervals will help to suggest suitable ameliorative measures for improving the soil fertility. Fifty surface soil samples representing the low land rice growing areas (Bench mark sites) of East Godavari district, Andhra Pradesh were collected during the months of April-May. These soil samples were analyzed for pH, EC, available N, P, K, Ca^{2+}, Mg^{2+}, SO_4^{2-} by following the standard procedures. The cationic micronutrients *viz.*, Fe, Mn, Cu and Zn were estimated by using DTPA method. The experimental sites are being monitored for every four years on a regular basis. The results indicated that the low land rice soils were clay to clay loam in texture and medium to high inorganic carbon status. About 48% of the soils were with netural pH, 10% were slightly acidic, 18% were moderately acidic and 24% were slightly alkaline in reaction. Most of the soils (84%) are non-saline (EC: 2.8 dS m^{-1}), 8% were saline in nature and rest 8% were are injurious to crop growth. Available nitrogen status showed that 96% of the soils were in medium status and 4% of the soils were in low status. Available phosphorus status showed that 53% of the soils were medium and 47% were representing high P. Soil available potassium showed that 64% were high and 36% were in medium category. The secondary nutrients *viz.*, Ca^{2+}, Mg^{2+}, SO_4^{2-} were above the critical level in the soil. The DTPA extractable micronutrients like Fe, Mn and Cu showed the level of sufficiency in soils. However, 89% of the soil samples showed sufficiency of Zn and remaining 12% were found to be deficient in Zinc.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Nitrogen Use Efficiency in Wheat Based Cropping System

B.S. Brar, G.S. Dheri and H.S. Uppal
Department of Soil Science, Punjab Agricultural University, Ludhiana, Punjab

Nitrogen (N) is one of the basic building blocks for life and essential for quality crop growth and production. Normally, found in amino acids that make up proteins, in nucleic acids that comprise the hereditary material and life blueprint for all cells and many other organic and inorganic compounds. Nitrogen is frequently regarded as the single most important mineral nutrient limiting crop production in many agricultural crops worldwide. Nitrogen use efficiency (NUE) is a term used to indicate the ratio between the amount of fertilizer N removed from the field by the crop and the amount of fertilizer N applied. The NUE of crops is examined by taking into account both plant N uptake efficiency, focusing on the recovery of fertilizer-N, and the utilization efficiency of the absorbed N. The main sources of variation for the NUE of crops are considered, and several of them are discussed based on results from field experiments carried out of the Punjab Agricultural University Ludhiana's research farm between 1971 and 2016 on wheat-maize cropping sequence with four fertilizer treatments recommended NPK fertilizer (NPK); compost with NPK fertilizer (NPK+FYM) and unbalanced chemical fertilizers (N and NP). Six wheat cultivars were used under long-term fertilization experiment during 45 years. A discernible increase of 41.5, 17.2 and 22.2 per cent in NUE was estimated with application of P, K and FYM compared to the N, NP and NPK fertilization, respectively. The NUE was also estimated at different crop growth stages during 2015-16 *rabi* season and observed significant increase in NUE from CRI, maximum tiller, anthesis and maturity stages. In all the crop growth stages, a distinguishable improvement in NUE was estimated with addition of each major nutrient and FYM. The NUE was higher in wheat cultivar PBW 343 followed by PBW 621, PBW 550, WL 711, HD 2329 and Kalyansona.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Application of Multi-micronutrient Spray Formulations on Growth and Yield of Okra (*Abelmoschas esculentus* L. Moench) in Transitional Zone of Karnataka

G.C. Satisha*, Mazhar Jamil and A.N. Ganeshamurthy
ICAR-Indian Institute of Horticultural Research, Hessaraghatta Lake Post, Bengaluru, 560089, Karnataka
**Email: satishage@gmail.com*

Okra (*Abelmoschus esculentus* L. Moench) popularly known as 'bhendi' find a prominent place among vegetable in India. The wide spread deficiency of micronutrients has been reported in vegetable growing regions of transitional zone of Karnataka. Zinc (Zn) and boron (B) deficiency is widely encountered micronutrient deficiency in these areas. A field experiment was carried out during *kharif* 2014 and 2015 at experimental farm, ICAR-Indian Institute of Horticultural Research, Hessaraghatta, Bangalore with the objective to find out the effect of micronutrients individually or in combination as multi-micronutrients spray formulations on growth and yield of okra (cv.Arka Anamika). The treatments consisted of B, Zn, molybdenum (Mo), different spray combinations of varying concentration of Zn, B, copper (Cu), iron (Fe) and manganese (Mn) and control and the experiment was laid out in RBD with three replications. All the micronutrient spray formulations were applied in three sprays at an interval of 10 days starting from 30 days after sowing. In general, all the treatments showed significant increase in growth and productivity of okra. The application of Zn, B, individually or combination recorded significantly higher yields as compared to control. Application of spray combination (G2 mixture) of Zn (4.0%), B (3.2%) and Mo (0.0025%) with adjuvant at 5 g l^{-1} gave maximum plant height (123.2 cm), fruit length (17.6 cm), fruit weight (26.6g) and fruit yield (17.2 t ha^{-1}) followed by Arka IIHR vegetable special(15.9 t ha^{-1}), while the lowest yield was recorded in the control.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of the Influence of Organic and Inorganic Nutrient Sources on Yield and Quality of Pigeon Pea

C.B. Pandya, V.V. Sonani, V.P. Ramani and K.P. Patel
Micronutrient Research Project, Anand Agricultural University, Anand, 388110, Gujarat

To assess the influence of different organic and inorganic sources on yield and quality of pigeon pea as well as effect on soil health, an experiment was conducted at Pulses Research Station, Anand Agricultural University, Vadodara, Gujarat. The experiment comprising of 4 treatments consisted of 100% RDF (25N+50 P_2O_5 kg ha^{-1}), 100% RDN from FYM (5 t ha^{-1}), 100% RDN from (50% FYM, 25% vermicompost, 25% poultry manure) and 100% RDN from (75% from fertilizer and 25% vermicompost). Significantly the highest green pod yield (6.10 t ha^{-1}), plant height (152 cm) and pods per plant (145.8) of pigeon pea were recorded with FYM @ 5 t ha^{-1}. The increase in yield was 14.5 per cent over control with 100% RDF application. The highest value of protein (12.8%), N (3.3%) and P (0.25%), Fe (52.8 mg kg^{-1}) and Zn (30.0 mg kg^{-1}) contents were recorded with FYM (5 t ha^{-1}) application whereas, the application of 100% RDN through (50% FYM, 25% vermicompost and 25% poultry manure) recorded the highest value of TSS (3.4 g 100g^{-1}), K (3.1%) and Cu (7.3 mg kg^{-1}) contents in pigeon pea grain. Organic carbon, available phosphorus and available potassium in soil after harvest of pigeon pea were build-up under organic manure application over 100% RDF treatment. Application of FYM @ 5 t ha^{-1} also recorded significantly higher content of micronutrients *i.e.* Fe, Zn and Cu in soil after harvest of pigeon pea over control. From the view point of the results, application of 25 kg N ha^{-1} through 5 t FYM ha^{-1} at sowing found beneficial for getting higher pigeon pea yield and better quality of green pods besides maintaining soil health.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Response of Crop Yield and Soil Properties to Different Long-Term Fertilization Strategies in Rice-Wheat Sequence

H.S. Uppal, G.S. Dheri and B.S. Brar
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab

In agro-ecosystems, fertilization practices influence soil quality and crop productivity. Depending on the nature of the applied fertilizer (organic or inorganic), modifications of soil properties have been observed over the long-term fertilization. The impact of fertilization on crop yield and soil properties was investigated in a long-term (>18 year) experimental field in central) Punjab. A completely randomized block design (RBD) with seven fertilizer treatments and three replication was used. The eight fertilizer treatments were (1) recommended NPK fertilizer (NPK); (2) additional NPK fertilizer (150%, NPK); (3) compost with NPK fertilizer (NPK+FYM) @ 15 t ha^{-1}); (4) straw incorporation with NPK fertilizer (NPK+SI @6 t ha^{-1}); (5) green manure with NPK fertilizer (NPK+GM @ 20 t ha^{-1}); (6-7) unbalanced chemical fertilizers without the major elements (N and NP) and (8) an un-amended control. The long-term addition of FYM, SI and GM with recommended NPK significantly increased crop yields by 14, 11 and 4.2 per cent compared to 100% NPK in rice, respectively while the increase in wheat was 3.9, 9.2 and 3.4 per cent. The increased amount of NPK by 50% did not indicate improvement in grains yield of rice and wheat crops. The response of N (14.7%), P (25.3%) and K (2.3%) in rice and 72.4, 38.5 and 5.0 per cent in wheat was recorded compared to control, 100% N, 100% NP, respectively. The results of this long-term experiment indicate that the use of organic amendments not only reduces the need for higher amount of mineral N fertilizer but also improves the soil properties with direct effect on crop yield. The constant addition of organic matter *viz*. FYM, SI, GM and balanced fertilizers decreased the soil pH from 7.39 to around 6.9 resulted to maintain micro nutrient availability to crop after eighteen years of cultivation. Integrated use of organic manures (FYM, GM and SI) along with 100% NPK significantly improved SOC compared to fertilizer application. The SOC showed significant improvement by addition of organic amendments and balanced fertilizer (0.33-0.56%). The soil samples tested low in available N (93.2 to 128.2 kg ha^{-1}), medium to high in available P (18.7 to 51.6 kg ha^{-1}) and low in available K (61.0 kg ha^{-1}) content. The effect of 150% NPK application on SOC was non-significant as compared to 100% NPK.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Integrated Nutrient Management of Snake gourd (*Trichosanthes anguina* L.) in Lateritic Soils of Konkan

A.G. Mahale, S.B. Dodake*, M.C. Kasture and P.B. Sanap
Department of Soil Science and Agricultural Chemistry, Dr. B.S. Konkan Krishi Vidyapeeth Dapoli, 415712, Dist. Ratnagiri, Maharashtra
**Email: suresh_dodake64@rediffmail.com*

A field experiment was conducted at Vegetable Improvement Scheme, Central, Experiment Research Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth. Dapoli during *kharif* of 2016 to find out the effect of integrated nutrient management on growth yield and nutrient content in snake gourd grown in lateritic soils of Konkan region of Maharashtra. The experiment was laid out in randomized block design with 11 treatments replicated thrice. The treatments were T_1: control, T_2: recommended dose of inorganic fertilizers (100:50:50 NPK Kg ha^{-1}), T_3: 25% N through vermicompost + 75% N through inorganic fertilizer, T_4: 25% N through poultry manure+75% N through inorganic fertilizer, T_5: 50% N through vermicompost + 50% N through inorganic fertilizers, T_6: 50% N poultry manure + 50% N through inorganic fertilizer, T_7: 75% N through vermicompost +25% N through inorganic fertilizer, T_8: 75% N through poultry manure +25% N through inorganic fertilizer, T_9: 100% N through vermicompost, T_{10}: 100% N through poultry manure and T_{11}: 50% N through vermicompost + 50% N through poultry manure. The effect of integrated nutrient management including vermicompost and poultry manure either alone or in combinations with inorganic fertilizer on growth and yield attributing characters, fruit yield, nutrient content and quality of snake gourd as well as the physicochemical properties and available nutrient status of soil at harvest were studied.

The result revealed that the application of 50% N through poultry manure +50% N through inorganic fertilizers *i.e.* treatment T_6 significantly influenced the growth parameters, fruit yield of snake gourd, soil pH, EC, organic carbon, available major and secondary nutrient status (N, P_2O_5 and K_2O, Ca, Mg and S) as well as DTPA extractable micronutrients (Fe, Mn, Zn and Cu) at harvest considering the fruit yield response, nutrient content in plant and fruit, build of soil fertility, the application of 50% N through poultry manure+50% N through inorganic fertilizers was found to be suitable for snake gourd in lateritic soil of Konkan.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Efficacy of Different Strategies of Zinc Application for Correction of zinc Deficiency and its Biofortification in Hybrid rice (*Oryza sativa*)

S.K. Singh* and S.S. Jatav
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, 221005, Uttar Pradesh
**Email: sksingh_1965@rediffmail.com*

Zinc (Zn) is one of the most essential micronutrients, required for growth and development of the plant and human beings. More than one billion people, particularly infant and pregnant women suffer from Zn deficiency related health and dietary Zn shortage. Micronutrient deficiencies affect about 38% of pregnant women and 43% of pre-school children worldwide and are most prevalent in developing countries. A pot experiment was conducted in net house of the Department of Soil Science and Agriculture Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 2015-16 to assess the effectiveness of different methods of Zn application to mitigate its deficiency and biofortification in rice grain. Required quantities of fertilizers for 10 kg soil were calculated and applied in liquid form using urea, KH_2PO_4 and muriate of potash (MOP) as source of N, P and K, respectively. The recommended N, P_2O_5 and K_2O were 150, 60 and 60 kg ha^{-1}, respectively. The treatment consists of T_1: absolute control (without fertilizer); T_2: control:RDF; T_3: RDF+5.0 kg Zn ha^{-1} soil application; T_4: RDF + 2% ZnO root dipping ; T_5: RDF + (0.5% $ZnSO_4$ + 0.25% lime) foliar spray at tillering and milking stage ;T_6: RDF + 5.0 kg Zn ha^{-1} soil application + 2% ZnO root dipping; T_7: RDF + 5.0 kg Zn ha^{-1} soil application + (0.5% $ZnSO_4$+ 0.25% lime) foliar spray at tillering and milking stage; T_8: RDF +2% ZnO root dipping + (0.5% +(0.5% $ZnSO_4$ +0.25% lime) foliar spray at tillering and milking stage; T_9: RDF + 5.0 kg Zn ha^{-1} soil application + 2% ZnO root dipping + (0.5% $ZnSO_4$ + 0.25% lime) foliar spray at tillering and milking stage. The initial soil (0.15 cm depth) had pH 8.21, EC 0.19 dS m^{-1}, organic carbon 4.2 g kg^{-1} and available N 82.2 kg ha^{-1}, available P 35.5 kg ha^{-1} and available K 175.9 kg ha^{-1}. The DTPA extractable Zn, Cu Mn and Fe content of initial soil were 0.58, 2.33, 6.53 and 30 mg kg^{-1} , respectively. Among the different methods of Zn application, 5 kg Zn ha^{-1} (soil application) + foliar application of 0.5% $ZnSO_4.7H_2O$ +lime at tillering and milking stage had maximum Zn content (45.8 mg kg^{-1}) in grain. Thus, soil application of Zn at transplanting along with two foliar sprays at maximum tillering and milking stage was most effective for enriching the grains with Zn. However, to obtain maximum grain yield (37.9 g pot^{-1}), root dipping along with soil and foliar spray of Zn (T_9: RDF + SA+RD+FS) hold promise.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Application of Different Sources of Silicon on Yield of Alphonso Mango (*Mangifera indica* L.) in Lateritic Soil of Konkan Region

S.S. More, N.B. Gokhale, S.E. Shinde, M.C. Kasture, K.D. Patil, V.G. Salvi, R.V. Dhopavkar, M.R. Wahane, N.H. Khobragade and P.S. Sawant

Department of Soil Science and Agricultural Chemistry, Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist-Ratnagiri, 415712, Maharashtra

An investigation entitled "Effect of application of different sources of silicon (Si) on yield of mango (*Mangifera indica* L.) in lateritic soil Konkan Region" was carried out in lateritic soil at Dapoli. Four sources of silicon were used for study with three different concentrations. There were total 13 treatments *viz.*, T_1 (RDF i.e., FYM 10 kg + 3 kg urea + 3 kg SSP + 2 kg SOP kg tree^{-1}) T_2 (T_1+ 2t calcium silicate ha^{-1}), T_3 (T_1 + calcium silicate ha^{-1}), T_4 (T_1 + 4 t calcium silicon ha^{-1}), T_5 (T_1 + rice husk ash @ 1.0 kg tree^{-1}), T_6 (T_1+ Rice husk ash @1.5 kg tree^{-1}), T_7 (T_1+ rice husk ash and 2.0 kg tree^{-1}), T_8 (T_1+ Silixol spray @ 0.5 mL L^{-1}), T_9 (T_1 + Silixol spray @ 1.0 mL L^{-1}). T_{10} (T_1 + silixol spray @ 1.5 mL L^{-1}), T_{11} (T_1+ potassium silicate spray @ 0.5%), T_{12} (T_1+ potassium silicate spray @1.0%) and T_{13} (T_1+ potassium silicate spray @ 1.5%) replicated thrice in RBD design. Two trees for each treatment were selected. The recommended dose of fertilizer applied during month of June both years of experimentation through urea, single superphosphate (SSP), sulphate of potash (SOP) and FYM, respectively. It was revealed from the study that use of foliar spray of 1.5 mL L^{-1} stabilized silicic acid *i.e.*, silixol showed beneficial effect on percentage of fruit retention, fruit yield, average weight of fruit.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Verification Trails of Soil Test Crop Response-based Fertilizer Prescription Equations for Targeted Yield of Raya (Laxmi) under Irrigated and Dryland Farming Areas of Hisar District, Haryana

V. Goyal and Mohinder Singh
Department of Soil Science, CCS Haryana Agricultural University, Hisar, Haryana

The soil test crop response based fertilizer prescription equations under integrated nutrient supply for achieving the targeted yield of raya (Laxmi) were verified for irrigated and dryland farming areas at different farmers field during rabi 2014-15 and 2015-16. Seven fertilizer treatments were employed which included control; farmers practice (FP); generalized package recommendations (PR), STCR recommendation for 20 and 25 q ha^{-1} (TY-20 and TY-25) and 15 and 18 q ha^{-1} (TY-15 and TY-18) seed yield target with fertilizers alone; and with fertilizer and FYM (TY-20 FYM and TY-25 FYM and TY-15 FYM and TY-18 FYM) under irrigated and dryland conditions, respectively. The results showed that mean seed yield was highest for TY-25FYM in irrigated and TY-18FYM in dryland for both the years followed by TY-25 and TY-18, TY-20 FYM and TY-15 FYM, TY-20 and TY-15, PR, FP and control. The response to fertilizer application also followed the same trend. Under irrigated conditions, the yields targets of 20 and 25 q ha^{-1} were achieved within deviations of -3.0 to +6.0 and -6.4 to +3.6 per cent, respectively. It was -6.7 to +12.0 and + 5.7 to -11.7 per cent for yield targets of 15 and 18 q ha^{-1} under dryland conditions. These deviations (±10%) in the yields indicated the validity of fertilizer prescription equations for targeted yields of raya under both irrigated and dryland farming areas of Hisar district.

The economics of the fertilizer application also indicated that marginal B:C ratio of the two years varied from 8. 10 to 12.79 and 9.19 to 13.89 for different locations and years of Hisar district of Haryana under irrigated and dryland conditions, respectively. The marginal B:C ratio under different treatments are viable and remumerative. Therefore, farmers should go for 25 and 18 q ha^{-1} under irrigated and dryland areas, respectively. Also 20 and 15 q ha^{-1} can be adopted under resource constraint situations.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Sulphur and Zinc Containing Customized Fertilizer on Growth, Yield and Quality of Mustard

V.P. Ramani, D.H. Patel and A.M. Trivedi
Micronutrient Research Project (ICAR), Anand Agricultural University, Anand, 388110, Gujarat

An experiment launched to evaluate the effect of sulphur (S) and zinc (Zn) containing customized fertilizer on growth, yield and quality of mustard at Anand Agricultural University, Anand, Gujarat during *rabi* 2015-16 to 2016-17. The experiment comprising of 11 treatments consisted of RDF with the conventional and the different grade of customized fertilizers. The increase in yield of grain, straw and total was to the tune of 18.6 to 29.1, 11.7 to 19.2 and 13.3 to 21.2 per cent over control, respectively. The highest content of P, S and Zn were recorded with 100% of P, S and Zn application either through complex fertilizer or traditional sources. The significant increase in uptake of P, S and Zn due to their application indicated requirement of P, S and Zn for good quality, higher crop production. The growth and yield parameters like plant height, pod per plant, grain per pod, length of pod and number pod per plant also significantly higher in the application of 100% of P, S and Zn application either through complex fertilizer or traditional sources. In general, P S and Zn applied through customized complex fertilizer or traditional source. In general, P, S and Zn applied through customized complex fertilizer and through DAP (P), gypsum (S) and $ZnSO_4$ (Zn) as traditional sources found equality effective. The use of S and Zn containing fertilizers will add S and Zn automatically in hunger soils of Gujarat besides it release the labour and transport of separate addition of S and Zn application individually. Therefore, the customized fertilizers containing s and Zn will be beneficial to use in S and Zn deficient soils in the state.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Impact of Long-term Fertilizer Application on Productivity of Soybean-Wheat Cropping Sequence in Black Soil

A.K. Dwivedi*, B.S. Dwivedi and Abhishek Sharma
Department of Soil Science and Agricultural Chemistry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 482004, Madhya Pradesh
**Email: anildwivedi_2007@rediffmail.com*

The present study was conducted under the ongoing all India Coordinated Research project on Long-Term Fertilizer Experiment with soybean-wheat sequence. This experiment was commenced from 1972 to assess the impact of continuous fertilizer application on productivity sustenance of soybean-wheat cropping sequence in black soil having pH 7.6, EC 0.18 dS m^{-1}, OC 5.7 g kg^{-1} and available N 193, P_2O_5 7.6, K_2O 370 kg ha^{-1}. The optimal dose of fertilizer for soybean and wheat was 20:80:20 and 120:80:40 respectively. The experiment laid out in combination of optimal N, NP, NP, NPK, NPK without S and NPK with FYM *etc*. The results of forty three cycles of long-term fertilizer experiment indicated that continuous application of N alone caused a declining trend with time due to imbalanced use of nutrients. The data on grain yield of crops revealed that increasing trend was recorded with the successive application of fertilizers over control and continuous cropping without supplementing with fertilizers invariably reduced the crop yield. However, the highest yield of crops was obtained when optimal fertilizer addition along with organic manure. Further, the supplementation of P with N (100% NP) remarkably enhanced the yield while, application of K along with NP *i.e.* 100%, NPK further increased the yield. On the other hand, the deficiency of S with DAP addition manifested through reduction in comparison to SSP application. These findings indicate that integrated use of optimal dose of fertilizer and organic manure was superior thus, the balanced use of fertilizer in combination with organic manure in necessary for sustaining soil fertility and productivity of crops.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Long-term Application of Fertilizer and FYM on Nutrients Uptake in Soybean and Wheat

Abhishek Sharma*, A.K. Dwivedi and B.S. Dwivedi
Department Soil science and Agricultural Chemistry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 482004, Madhya Pradesh
** Email: soil.sharma.abhishek@gmail.com*

The present investigation was carried out under All India Coordinated research project on long-term fertilizer experiment with soybean-wheat, cropping system on a Vertisol during 2015-16 at experimental site of Department of Soil Science and Agricultural Chemistry, JNKVV Jabalpur. Experimental result indicated a increasing trend with higher uptake of N, P, K, S and Zn by soybean with successive application of fertilizer over control and the maximum uptake of nutrients was recorded when 100% NPK with FYM applied. Hence, increasing rates of fertilizer addition resulted insuccessive increment in the uptake of nutrients.

A similar, trend has also been observed with Rabi Wheat crop and the data indicated that highest uptake of N, P, K, S and Zn by wheat was observed in 100%, NPK+FYM treatment followed by 150% NPK. Increasing rate of fertilizer application successively increased the uptake of nutrients by the crop. In general, higher uptake of nutrient N, P, K, S and Zn was recorded in grain rather that the straw at the harvest of the crop. It was also noticed that higher amount of nutrients was harvested by wheat crop in comparison to the nutrient content obtained in soybean.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of Silica Effect on Yield, Quality, Nutrient Content and its Uptake of *Oryza sativa* L. in Lateritic Soil of Konkan Region

A.L. Shinde, S.B. Dodake, U.V. Mahadkar, N.B. Gokhale, S.S. Prabhudesai, J.S. Dhekale, N.H. Khobragade, K.D. Patil, M.C. Kasture, P.S. Sawant, V.G. Salvi, S.S. More and M.R. Wahane

Department of Soil Science and Agricultural Chemistry,
Dr Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli, 415712, Dist. Ratnagiri, Maharashtra

The field experiments were conducted to study the effect of different sources of silica through soil and foliar application on yield and uptake or rice (*Oryza sativa* L.) in lateritic soil of Konkan region of Maharashtra during *kharif* seasons of 2013 and 2014 in a factorial randomized block design (with extract treatment) comparising of thirteen treatments with three replications. Out of 13 treatments combinations, 12 (T_1- T_{12}) treatments were combinations of four sources of silica (silica granules, calcium silicate as a soil application, stabilized silica acid, potassium silicate-as a foliar application) and three levels of silica sources (X, 1.5X, 2X L ha^{-1}) and treatment T_{13} was absolute control where no silicon source were applied to judge the fate of native nutrients.

The results indicated that the application of silica sources at graded levels significantly increased the grain and straw yield of rice (Var. Ratnagiri-24), as compared to absolute control. Among the different sources of silicon, application of calcium silicate and between levels of silica @ 200 kg ha^{-1} to cereals (*i.e.* rice) significantly increased the yield attributing characteristics, straw and grain content of rice, improved quality parameters, total uptake of primary, secondary and beneficial nutrients, soil physicochemical properties, total uptake primary, secondary and beneficial nutrients, soil physicochemical properties, available N, P_2O_5, K_2O, S, SiO_2 and exchangeable (Ca and Mg) status.

It is, therefore, concluded that in lateritic soil of Konkan for rice, application of calcium silicate @ 200 kg ha^{-1} to rice as a basal dose through soil application be adopted for the purpose of increasing crop productivity as well as improving soil fertility.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Integrated Nutrient Management of Snake Gourd (*Trichosanthes anguina* L.) in Lateritic Soils of Konkan

A.G. Mahale, S.B. Dodake*, M.C. Kasture and P.B. Sanap
Deparetment of Soil Science and Agricultural Chemistry,
Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli, 415712 Dist. Ratnagiri, Maharashtra
**Email: suresh_dodake64@rediffmail.com*

A field experiment was conducted at Vegetable Improvement Scheme, Central Experiment Research Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during *kharif* of 2016 to find out the effect of integrated nutrient management on growth yield and nutrient content in snake gourd grown in lateritic soils of Konkan region of Maharashtra. The experiment was laid out in randomized block design with 11 treatments replicated thrice. The treatments were T_1: control, T_2: recommended dose of inorganic fertilizers (100:50:50 NPK Kg ha^{-1}), T_3: 25% N through vermicompost + 75% N through inorganic fertilizer, T_4: 25% N through poultry manure +75% N though inorganic fertilizer, T_5: 50% N through vermicompost + 50% N through inorganic fertilizer, T_6: 50%, N through poultry manure + 50% N through inorganic fertilizer. T_7: 75% N through vermicompost + 25% N through inorganic fertilizer, T_8: 75% N through poultry manure + 25% N through inorganic fertilizer, T_9: 100% N through vermicompost, T_{10}: 100% N through poultry manure and T_{11}: 50% N through vermicompost + 50% N through poultry manure. The effect of integrated nutrient management including vermicompost and poultry manure either alone or in combinations with inorganic fertilizer on growth and yield attributing characters, fruit yield, nutrient content and quality of snake gourd as well as the physicochemical properties and available nutrient status of soil at harvest were studies.

The result revealed that the application of 50% N through poultry manure + 50% N through inorganic fertilizers *i.e.* treatment T_6 significantly influenced the growth parameters, fruit yield of snake gourd, soil pH, EC, organic carbon, available major and secondary nutrient status (N, P_2O_5 and K_2O, Ca, Mg and S) as well as DTPA extractable micronutrients (Fe, Mn, Zn and Cu) at harvest. Considering the fruit yield response, nutrient content in plant and fruit, build of soil fertility, the application of 50% N through poultry manure+ 50% N through inorganic fertilizers was found to be suitable for snake gourd in lateritic soil of Konkan.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Integrated Nutrient Management on Productivity and Quality of Soybean [*Glycine max* (L.) Merrill] under Typic Haplustepts

S.N. Verma, Mahendra Sharma and Urmila
Department of Agricultural Chemistry and Soil Science, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture & Technology, Udaipur, 313001, Rajasthan

A field experiment was conducted at the Instructional Farm, Rajasthan College of Agriculture, Udaipur (Rajasthan) during *kharif* 2014 and 2015 to assess the effect of integrated nutrient management on productivity and quality of soybean [*Glycine max* (L.)] Merrill]. The site is situated at south-eastern part of Rajasthan at an altitude of 579.5 m above mean sea level, at 24°35′ N latitude and 74°42′ E longitude. The mean annual rainfall of the region is 637 mm, most of which is contributed by south-west monsoon from July to September, maximum and minimum temperatures ranged between 25.9 to 33.7^{0}C and 7.7 to 22.4 °C, respectively during *kharif*. The soil of the experimental site are well drained, clayey with moderate erosion and classified as clayey mixed, Hyperthermic (Calcareous) Typic Haplustepts. The soybean crop fertilized with 75% NPK through chemical fertilizers + 25% other rest of N through vermicompost and seeds were dual inoculated with *Rhizobium* + PSB resulted in maximum value of the seed yield (2.35 t ha^{-1}), haulm yield (2.76 t ha^{-1}) and biological yield (5.12 t ha^{-1}), oil content (20.2%), oil yield (476.2 kg ha^{-1}), protein content (41.5%), protein yield (976.9 kg ha^{-1}), net returns (71882 Rs. ha^{-1}) and B:C ratio (2.90) than other rest of the treatments. It is concluded that application of chemical fertilizers alone could not sustain the soil fertility status and productivity. Thus, integrated nutrient management improved soil health and sustain productivity of soybean for long-term basis.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Fertility Status of Some Villages in Bolagarh Block in Khurda District of North-Eastern Ghat Agroclimatic Zone of Odisha

Sabyasachi Das, Antaryami Mishra*, Subhashis Saren, Prava Kiran Dash, Badrieddi Revathi and Baman Prasad Acharya

Orissa University of Agriculture and Technology, Bhubaneswar, 751003, Odisha
**Email: antar199@yahoo.co.in*

A soil fertility status inventory work was carried out in few selected villages o of Bolagarh block in Khurda district, Odisha. Results show that soil texture of the village under investigation varied from sandy to sandy loam and soil colour from pale brown (10YR 6/3), brown (10YR 5/3), light yellowish brown (10YR 6/4) to black yellowish brown (10YR 4/6). Clay content in all the soils varied from 5 to 24.4%. Soil pH value varied between 4.65 to 7.13 and electrical conductance of all the soils are below 1.0 dS m^{-1} which is safe for all types of plant to grow. Soil organic carbon (SOC) content ranged between 3.5 to 12 g kg^{-1}. Available nitrogen content in these soils was found to be low as it ranged between 62.7 and 217.2 kg ha^{-1} . Available phosphorus (P_2O_5) content varied widely from 2.25 to 60.29 kg ha^{-1}. Available potassium (K_2O) content varied from 45.7 to 280.9 kg ha^{-1}. The $CaCl_2$ extractable soil sulphur varied from 2.25 to 12.68 mg kg^{-1} which renders the soil deficient in S. Hot water soluble boron content ranged from 0.66 to 2.20 mg kg^{-1}. All the figures in lower range were found in upland soils while the higher values for all the parameters were found in low land. There was an increasing trend with respect to soil reaction, SOC, N, P, K, S and B from upland to lowland which is due to the washing down of basic cations, organic matter and plant nutrients from upland and subsequent deposition in low land giving rise to their higher value in low lying areas. Clay content was found to be positively correlated with all the parameters except phosphorus. Significant positive correlation of OC, N, K and B was found with soil reaction. Similarly, SOC was found to be positively correlated with clay, macro and micronutrients.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Monitoring the Soil Fertility of Rice Growing Areas of West Godavari District of Andhra Pradesh

T.V. Sridhar* and D. Srinivas[1]*
Andhra Pradesh Rice Research Institute & RARS, Maruteru, A.P. India
Office of Dean of Agriculture, ANGRAU, Lam Guntur, Andhra Pradesh
[1]Department of Soil Science Agricultural Chemistry, Agricultural College, Rajahmundry, 533103, East Godavari District, Andhra Pradesh
**Email: sridhar119@yahoo.com*

Soil fertility and productivity in Godavari Delta are likely to be affected due to intensive rice monoculture with imbalance fertilization under excessive use of irrigation water. Monitoring the changes in physicochemical properties of low land rice growing areas of West Godavari District, Andhra Pradesh at periodical intervals will help to suggest suitable ameliorative measures for improving the soil fertility. Forty-two surface soil samples representing the low land rice soil of West Godavari District were collected during the months of April/May. These soil samples were analyzed for pH, EC, available N, P, K, Ca, Mg, S by following the standard procedures. The cationic micronutrients *viz.*, Fe, Mn, Cu and Zn were estimated by using DTPA method. The experimental sites are being monitored for every four years on a regular basis. The low land rice soils were clay to clay loam in texture and organic carbon content medium to high. Forty per cent of soils were with a pH of 6.5 to 7.5 (neutral), 32% were slightly alkaline and 27% were moderately acidic in reaction. Majority of the soils (59%) were non-saline, 23% were saline and rest of the 18% were injurious to crops. The available N status of the soils was medium (91%) to high category (9%). The available P in the soils ranges from medium (59%) to high status (41%). All the secondary nutrient status *viz.*, calcium, magnesium and sulphate sulphur were in the levels of sufficiency in the soils. DTPA extractable copper ranges from (1.62 to 18.62 mg kg^{-1}). manganese (6.52 to 46.82 mg kg^{-1}), iron (11.52 to 58.65 mg kg^{-1}), and zinc (0.65 to 8.45 mg kg^{-1}). DTPA extractable copper, manganese and iron were above critical limits, whereas 12% of the soil samples were found to be zinc deficient.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Temporal Variation of Microbial Biomass, Physico Chemical Properties and Heavy Metal Content of Brick Kiln Ash Amended Soil

Ananya Mondal, Satya Sundar Bhattacharyya[1] and Pradip Bhattachary*

Agricultural and Ecological Research Unit, Indian Statistical Institute, Giridih, 815301, Jharkhand

[1]Soil and Agro Bio-Engineering Laboratory, Department of Environmental Science, Tezpur, Central University, Napaam, Tezpur, 784028, Assam

**Email: pradip.bhattacharyya@gmail.com*

Brick kiln ashes (BKAs) are generated coal fired brick kiln factories in India and pose substantial environmental hazards. High metal concentrations (Cd, Cr, Pb, Mn, Zn and Cu), widely varying pH, high unburnt C and nutrients (NPK) are some major features of the BKAs. In the present investigation, we assessed the impacts of BKAs on soil environment. The BKAs were collected from different brick kilns of Assam and West Bengal. Eventually, a typical alluvial soil (Typic Endoaquepts) was incubated with various concentrations (10, 5, 2.5, 1.0, and 0.5%) of BKAs for 90 days in laboratory conditions. The dynamics of various properties (pH, NPK, microbial biomass carbon, and enzyme activity) were analyzed at periodic interval. The study revealed that pH significantly decreased in both BKA treated soil; while, soil organic carbon (SOC), Ca and S gradually increased in the treated soils. However, slight retardation in N and P availability was recorded but the microbial biomass carbon and enzyme activity interestingly increased in BKA treated soil. Overall the study reveals the brick kiln ashes have good potential to be used as soil conditioners, while the richness in metal contents is the major constraint.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Direct Effect of Fly Ash, Farmyard manure with Biofertilizers on Soil Properties and Growth and Yield of Rice

P. Muthusamy, P. Balasubramaniam, S. Avudainayagam[1] and P. Pandiyarajan
Department of Soil Science and Agricultural Chemistry,
Anbil Dharmalingam Agricultural College and Research Institute, Trichy, 620009, Tamil Nadu
[1]Department of Environmental Sciences, Tamil Nadu Agricultural University,
Coimbatore, 641003, Tamil Nadu

Micro- plot experiment was conducted during 2014-15 with rice variety ADT 49 at Anbil Dharmalingam Agricultural College and Research Institute, Trichy to study the direct effect of fly ash on soil physicochemical properties under rice ecosystem. The results revealed that the addition of fly ash @ 25 t ha^{-1} + 12.5 t ha^{-1} FYM + biofertilizers + soil test based NPK favourably altered the soil physicochemical properties and growth, yield and its attributes and content and uptake of nutrients at harvest stage of rice. The growth and yield parameter *viz*., plant height, no. of productive tillers, no. of filled grains per panicle, thousand grain weight, yield of grain and straw were significantly increased with substantial reduction of chaffy rains by the application of fly ash @ 25 t ha^{-1} + 12.5 t ha^{-1} FYM + Biofertilizers + soil test based NPK over control. The yield increase was 27 and 21 per cent in grain and straw, respectively over control. The soil porosity and water holding capacity were increased in addition to improvement in hydraulic conductivity and intrinsic permeability in the post-harvest soil. Addition of fly ash alone did not make any substantial increase of soil pH, EC, soil organic carbon and available N and P. However, its application along with FYM and biofertilisers improved the above properties. The soil available K and Si increased correspondingly to level of fly ash application from 25 to 100 t ha^{-1}. The observed values of Si and K were found to be 287.2 kg ha^{-1} and 99.7 mg kg^{-1}, respectively. An increase in soil available micronutrients Fe (38.8 mg kg^{-1}), Mn (27.9 mg kg^{-1}), Cu (4.69 mg kg^{-1}) and Zn (4.63 mg kg^{-1}) was also observed over control in addition to the content and uptake of nutrients in plant by the addition of fly ash @ 25 t ha^{-1} + 12.5 t ha^{-1} FYM + biofertilizers + soil test based NPK.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Validation of Targeted Yield Equation of Potato in Alluvial Soils of West Bengal

A.R. Saha*, S.P. Mazumdar, B. Majumdar, R. Bhattacharyya, Mukesh Kumar, R. Saha and D.K. Kundu

ICAR- Central Research Institute for Jute and Allied Fibres, Barrackpore, Kolkata, 700120, West Bengal
**Email: amitsaha60@yahoo.co.in*

A study was conducted in the alluvial soils of Eastern India to find out the correlation between soil test and crop response for potato. Initial soil test values were estimated for the experimental plot. Recommended doses of fertilizers for potato were applied. Tuber yield and nutrient uptake were estimated. On the basis of these, basic data *e.g.* nutrient requirement for potato, soil efficiency, fertilizer efficiency and FYM efficiency were determined. Using these basic data fertilizer prescription equation for potato with and without integrated plant nutrient supply was developed. The fertilizer prescription equation were verified in the farmers' field of Haringhata block of Nadia district of West Bengal. It was observed that on the basis of fertilizer prescription equation the targeted yield of potato (both 200 and 220 q ha^{-1}) was achieved in all the trials under farmers' field condition. It may be inferred from the results that the application of inorganic fertilizer along with FYM on the basis of soil test values and targeted yield concept can improve the yield of potato and benefit the farmer' economically as compared to the recommended doses of fertilizers.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Balanced Nutrient Management on Rice (*Oryza sativa*) in Red and Lateritic Soils of West Bengal

Nitin Chatterjee*, Gayatri Sahu, Animesh Ghosh Bag, Biplab Pal, Riju Dey and GC Hazra
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, 741252, West Bengal
**Email: nitinashma@gmail.com*

A field experiment was conducted at Agriculture farm, institute of agriculture, Sriniketan, Visva-Bharati during *kharif* season of 2015 to study the effect of balanced nutrient management on rice in red and lateritic soils of West Bengal. The soil of experimental field was sandy in texture. Initially the pH of the soil was 4.35 with low in organic carbon (3.5 g kg^{-1}), available N (160 kg ha^{-1}), available P (16 kg ha^{-1}), available K (72 kg ha^{-1}) available S (14 kg ha^{-1}). Seventeen treatments consisting with different nutrient management were tested in randomized block design with three replications. After harvesting the crops, stover and seed yield was recorded. Protein content in seeds, concentration of N, P, K and S in stover and grain and uptake of those nutrients by seed, stover and total plant were analyzed. The last experiment was conducted using four levels of potassium *viz.*, 0, 20, 40 and 60 kg ha^{-1}, four levels of sulphur *viz.*, 0, 10, 20 and 30 kg ha^{-1}, nitrogen in a single dose @ 80 kg ha^{-1} and the residual effect of micronutrients from the previous crop using rice as the test crop. Straw and grain yield was increased with application of micronutrients along with sulphur. The highest grain, straw and biological yield (8.43 and 19.71 t ha^{-1}, respectively) was recorded with application of sulphur, zinc and boron @ 20, 4 and 1 kg ha^{-1}. Zinc and boron increased nitrogen content in both grain and straw. Potassium application resulted in increased P content in grains. Nitrogen and sulphur application increased sulphur content ingrains. Potassium application increased grain potassium content. Zinc and boron application increased total uptake of nitrogen, potassium and sulphur. Both the nutrients interacted positively and significantly in increasing phosphorus uptake. Protein content ranges between 14.3 to 17.9%. Application of micronutrients significantly effects the yield, uptake as well as protein content in rice.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Permanent Manurial Experiment on Maize Cropping in Red Sandy Loam Soil of Vagarai under Irrigated Condition

M. Elayarajan and C. Bharathi
Water Technology Centre, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu

The experiment on permanent manorial experiment was started in 2011 using maize green gram cropping system. So far six maize (TNAU hybrid maize Co-6) and six green gram (Co-6) crops were raised to study the changes in soil parameters and yield. Maize crop was raised during *rabi* and green gram crop at summer. Treatments consisted of control, organic, in organic and integrated nutrient management (INM). In the inorganic treatment blanket recommendation of 250:75:75 kg NPK ha^{-1} was applied. Organic plot received the application of farmyard manure (FYM) on N equivalent basis, while INM plot received 12.5 t FYM ha^{-1} and blanket recommendation of fertilizer along with biofertilizer.

The field experiments were conducted with the above said four treatments in a non-replicated trial with CO-6 hybrid maize as a test crop at Maize Research Station, Vagarai, Tamil Nadu. The experimental soil is a sandy loam. The result indicated that the grain and stover yield ranged from 4.24 to 7.79 t ha^{-1} and 7.68 to 1.06 t ha^{-1} respectively. The highest grain yield was observed in INM practice (7.79 t ha^{-1}) which was significantly differed from other treatments. The control recorded that lowest grain yield. The highest stover yield was recorded in INM (10.7 t ha^{-1}) followed by inorganic, organic treatments. The change in available N showed increasing trend in all the treatments except control. In the case of available P and K there was a decline in all the treatments; however, the rate of decrease was lowest in the case of organic.

Microbial population estimated in various inorganic and INM treatments varied widely. The counts of bacteria, fungi and actinomycetes were very high under INM treatment. Population counts decreased under inorganic fertilization. Bacterial count was very low under control. High amount of biomass carbon and biomass nitrogen were noticed under INM treatment. Relatively high amount of biomass C and N was observed under inorganic treatment. Among soil enzymes, the activity of alkaline phosphatase was very high, followed by dehydrogenase, acid phosphatase and urease.

The INM practice resulted in higher growth and yield parameters consequently the higher grain, haulm yield and nutrient uptakes of green gram when compared to others indicating the superiority of INM practice. The same trend was observed in the maize crop also. Increase in organic carbon and available N status were observed in INM practice while available P and K contents were slightly reduced. Soil biological properties were enhanced in the INM plot followed by the organic plot.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Seed Treatment with Zinc Oxide Nano Particles on Growth and Yield of Maize (*Zea mays* L.)

K.P. Patel* and Pankaj K. Tiwari[1]
B.A. College of Agriculture, Anand Agricultural University, Anand, 388110, Gujarat
[1]ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar, 751002, Odisha
**Email: kishorbhai_patel@rediffmail.com*

In order to study the effect of seed treatment of ZnO nano-particles (NPs) on growth and yield of maize, a microplot study was conducted during *rabi* and repeated during summer season of the year 2015- 2016. The treatments included 8 seed Zn treatments: on Zn; 500, 1000, 2000 ppm concentrations each of ZnO NPs and bulk ZnO, and ZnO slurry replicated three times in CRD.

Results of the experiment indicated that among the Zn treatments, ZnO-NPs application at 1000 ppm registered maximum seed germination in maize which was significantly higher than all other Zn treatments including bulk ZnO in both seasons as well pooled analysis. Application of lower dose of ZnO-NPs i.e. 500 ppm also resulted in significant increase in seed germination over control however; it was at par with all 3 doses of bulk ZnO and standard dose of ZnO slurry during both seasons. Furthermore, seed germination was significantly hampered by increasing the level of ZnO-NPs to 2000 ppm across the seasons and pooled results.

The application of Zn in the form of either nano or bulk ZnO through seed treatment caused significant increase ingrain. Stover and total dry matter yield of maize over no Zn control during both the crop seasons. However, among different ZnO treatments, ZnO, NPs at 1000 PPM registered significantly the highest grain, stover and total dry matter yield during both the seasons. Interestingly, the lowest dose of ZnO-NPs *i.e.* 500 ppm was much better in enhancing the yield over its corresponding bulk level. It is worth mentioning here that higher dose of ZnO-NPs *i.e.* 2000 ppm caused significant reduction ingrain yield of maize. Overall, grain, stover and total dry matter yield of maize was significantly greater during *rabi* than summer season. The results further indicated that on average, seed treatment with ZnO, NPs resulted in 37, 40 and 39 per cent increase in grain Zn concentration during *rabi*, summer and pooled analysis, respectively over no Zn control. The same pattern was observed in case of Zn uptake as the highest Zn uptake in all three plant parts *i.e.* grain, stover and root was registered under the treatment receiving 1000 ppm ZnO-NPs through seed treatment.

Further, total Zn uptake by maize plant increased by two-fold following seed treatment with ZnO-NPs at 1000 ppm over no Zn control. In general, stover retained relatively greater quantity of total Zn uptake than the root as well as grain of maize following Zn applied through seed treatment. Application of ZnO NPs at 1000 ppm also resulted in the highest (37.3%) increase in accumulation of Zn by maize plant. The important soil properties *viz*. pH, EC, OC (%), and DTPA-extractable micronutrients contents of the experimental microplots, determined at the end of the experiment *i.e.* after harvest of maize crop in both the seasons did not show any significant change due to various Zn seed treatments. In general, use of ZnO-NPs has shown promising effect in increasing yield and Zn utilization by maize which indicated that the Zn use efficiency could be increased when Zn in used in the form of Zn nano particles.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Integrated Supply of Nutrients on Available Nutrient Status, Yield and Uptake in Rice (*Oryza sativa*)

Gayatri Sahu*, Nitin Chatterjee, Animesh Ghosh Bag, Aritra Kumar Mukherjee
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, 741252, West Bengal
**Email: gayatrisahu27@gmail.com*

A field experiment was conducted on rice during *kharif* season of 2015 in red and lateritic soils of West Bengal at the Agricultural Farm of Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan to study the effect of combined application of organics and in organics on available nutrient status, yield and uptake in rice. The experiment was laid out in randomized block design with fifteen treatments. The soil of experimental field was sandy in texture. Initially the pH of the soil was 4.35 with low in organic carbon (3.2 g kg^{-1}), available N (160 kg ha^{-1}), available P (15.9 kg ha^{-1}), available K (72 kg ha^{-1}) available S (11.2 kg ha^{-1}). The seed was inoculated properly with the culture of *Azotobactor* and *Azospirillium* in case of rice. The soil samples and available nutrient status were analyzed following the standard procedures. Processed samples were analyzed for pH and EC in 1:2.5 soil-water suspensions by using glass electrode pH meter and electrical conductivity meter, respectively. Organic carbon was estimated by wet digestion method of Walkley and Black. Highest grain yield (5.79 t ha^{-1}, straw yield (9.35 t ha^{-1}), biological yield (15.1 t ha^{-1}) in rice was recorded due to combined application of macro and micronutrients along with sulphur. Highest N and K uptake was associated with the treatment $N_{80}P_{40}K_0S_{10}Zn_{10.5}Mo_{1.0}B_{0.5}$ and the highest P uptake was due to the treatment $N_{80}P_{40}K_0S_{10}Zn_{10.5}Mo_{1.0}B_{1.0}$ whereas highest S uptake was obtained in treatment $N_{80}P_{40}K_0S_{20}Zn_{21}$Mo2.0. The value of available nitrogen content varied between 167 kg ha^{-1} to 351 kg ha^{-1}. Highest value was observed in $N_{80}P_{20}K_{20}$ + *Azotobacter* + *Azospirillum* followed by $N_{80}P_{20}K_{20}$ + *Azotobacter*. It was observed that biofertilizer along with other inorganic fertilizer gave significantly higher value compared to all other treatments. The available phosphorus content ranges from 22.8 kg ha^{-1} to 52.8 kg ha^{-1} after harvesting of rice with minimum in control and maximum in $N_{80}P_{40}K_0S_{20}Zn_{21}Mo_{2.0}$ followed by $N_{80}P_{40}K_0S_{10}Zn_{10.5}Mo_{1.0}$. The highest value of available potassium was observed in $N_{80}P_{40}K_{60}Zn_{21}$ which was treated with higher dose of potassium *i.e.* @ 60 kg K_2O ha^{-1} followed by $N_{80}P_{20}K_{60}Zn_{10.5}$(i.e. 64.7 kg ha^{-1}) and lowest value was observed in control plot. Highest value was observed in $N_{80}P_{20}K_{20}$ + *Azotobacter* + *Azospirillum* due to application of biofertilizer along with inorganic fertilizer followed by $N_{80}P_{40}K_0S_{20}Zn_{21}$ $Mo_{2.0}$ (17.8 kg ha^{-1}). It was observed that biofertilizer has a great role to increase the available sulphur status in soil. Next to this micronutrients along with sulphur and macronutrients also play a role to increase available sulphur status in soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessing Climate Variability and to Develop Adaptation Strategies for Coastal Salinity Management in Indian Sundarbans through Land Shaping and Crop Diversification

Uttam Kumar Mandal*, D. Burman, Subhasis Mandal, Sourav Mullick, Dibyendu Bikas Nayak, B. Maji, K.K. Mahanta, S. Raut, and A.K. Bhardwaj
ICAR-Central Soil Salinity Research Institute, Regional Research Station, Canning Town, 743329, West Bengal
ICAR-Central Soil Salinity Research Institute, Karnal, Haryana
**Email: uttam_icar@yahoo.com*

Sundarbans in West Bengal, India by virtue of its strategic location in the Eastern coast of the Bay of Bengal falls in the most vulnerable zones of abrupt climate change. Analysis of the long period rainfall data (1966-2014) indicates that the region receives very high annual rainfall (1818.5 mm), which is concentrated only over a few monsoon months; most of the rain water goes waste as runoff and creates widespread water logging of the low-lying agricultural fields. On an average 84 rainy days in a year was recorded in the region, whereas during last ten years (2005-2014), the number of rainy days was reduced to 78.8 days/year. There was 2.7 times surplus rainfall than crop evapo-transpiration during monsoon months indicating very high scope of water harvesting to tackle water logging during the monsoon season and unavailability of fresh water for irrigation during lean season. The present study assessed the effects of different land shaping models i.e., farm pond (FP), deep furrow and high ridge (RF) and paddy cum fish (PCF) system for rain water harvesting in restoring the productivity of degraded coastal soils in Sundarbans during 2012, 2013 and 2014 with an annual rainfall of 1583 (normal), 2164 (excess) and 1368 mm (deficit), respectively. A water balance was done to estimate the soil moisture, crop evapotranspiration, runoff and water depth in the reservoir. On an average the amount of runoff harvested was 3273, 1387 and 952 m^3 per hectare per year in FP, RF and PCF system. The amount of runoff going out of the system was 12.2, 23.6 and 25.5% of the annual rainfall in FP, RF and PCF system whereas in monocrop rice-fallow system, the runoff was 34.6% of the annual rainfall during these three years period (2012-2014). On an average annually 1717, 1042 and 791 m^3 of harvested water was used for irrigation during lean period in FP, RF and PCF system. We estimated all the three components of water footprints (WF) i.e., blue WF (WFblue), green WF (WFgreen) and gray WF (WFgray) for washing excess salt accumulation as an aggregative indicator to evaluate environmental impact of each land shaping system along with dominant rice-fallow and rice-rice system. In FP system, out of total WF of 808.5 m^3t^{-1}, WFgreen was 608.1, WFblue 103.1 and WFgray was 97.3 m^3t^{-1}, respectively, whereas in case of RF system total WF was 976.2 m^3t^{-1}out of which WFgreen, WFblue and WFgray was 783.7, 75.3 and 117.2 m^3t^{-1}, respectively and in PCF system total WF, WFgreen, WFblue and WFgray was 1029.2, 836.2, 63.3, and 129.7 m^3t^{-1}, respectively. In rice fallow and rice-rice system the total WF, WFgreen, WFblue and WFgray was 3644.8, 3113.6, nil and 531.2; and 1883.5, 974.2, 702.4 and 206.9, respectively indicating copious use of ground water in rice-rice system. Large scale adaptation of different land shaping models for rain water harvesting in farmers' field increased the cropping intensity and net farm income in the region and there was reduction in salinity during summer and water logging during rainy season and overall improvement in soil quality.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Characterization of Ground Water Quality of Firozpur-Jhirka Block of Mewat District and their Effect on Soil Properties

Sanjeev Kumar Pal, Rajpaul*, Satyavir Singh Yadav and Ramprakash
Department of Soil Science, CCS Haryana Agricultural University, Hisar, 125004, Haryana
**Email: rajpaul_yadav@yahoo.com*

In Firozpur Jhirka block 20.24, 41.67, 3.57, 32.14 and 2.38 per cent water was found under good, marginally saline, saline. high SAR saline and marginally alkaline categories, respectively. The pH, EC, SAR and RSC in ground water of Firozpur Jhirka block ranged from 7.39 to 9.17, 0.70 to 13.70 dSm-1, 2.54 to 50.26 (mmol l^{-1})1/2 and 0 to 3.20 me l^{-1}, The sodium was dominant cation followed by magnesium, calcium and potassium in ground waters. Likewise, in case of anions, chloride was the dominant anion followed by sulphate, bicarbonate, carbonate and nitrate. The analysis of soil profile samples revealed that the lowest and highest cation exchange capacity of the soils in Firozpur Jhirka block was observed in Pol (4.12 cmol(p^+) kg^{-1}) and Nangal (8.07 cmol(p^+)kg^{-1}), respectively. The lowest and highest exchangeable sodium percentage in Firozpur Jhirka block was observed in Righar (6.00) and Mallahka (18.86) villages. The lowest and highest soil organic content in Firozpur Jhirka block was observed in Mallahka (0.09%) and Mahoon (0.36%) villages. The saturation percentage of soils was lowest and highest in Pol (20.93) and Naharika (29.62) villages of Firozpur Jhirka block, respectively. The lowest ECe in Firozpur Jhirka block was recorded in Righar (0.76 dS m^{-1}) and highest in Gangwani (10.05 dS m^{-1}). Highest electrical conductivity was observed in surface layers of the soil profile which gradually decreased with depth. The lowest and highest of pH of soil saturation extract in Firozpur Jhirka block was found in Nangal (7.25) and Mahoon (8.95) villages The mean cationic composition of soil extract in soil profile in Firozpur Jhirka block was of the order $Na^+ > Ca^{2+} > Mg^{2+} > K^+$ likewise, in most of the samples the mean anionic composition of soil extract was of order $Cl^- > SO_4^{2-} > HCO^{3-} > CO_3^{-2}$. The ground water quality map of the block showed that maximum area was falling under poor quality water with high area under salinity hazard as compared to sodicity hazard of Mewat district.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

A Study of Nitrogen Use Efficiency in SRI over Direct Seeded and Transplanted Rice

Chowdhury Monirul Haque, Aritra Saha and Pabitra Kumar Mani*
Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalay, Mohanpur, Nadia, 741235, West Bengal
**Email: pabitramani@gmail.com*

A field study on assessment of crop establishment methods on yield, different N fractions and nitrogen use efficiency (NUE) of rice cultivars under lowland production ecologies was conducted during Rabi season of 2015-16 and *kharif* season of 2016 in Instructional Farm (Mohanpur, Latitude 22.9466 °N, Longitude-88.5386°E,Elevation- 9.75 m.s.l), Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India. The experiment was laid-out in a strip-plot design and replicated five times. The main-plot treatments included three crop establishment methods, viz. wet direct-seeded rice (DSR), system of rice intensification (SRI) and conventionally transplanted rice (CTR). In sub-plots, different nitrogen sources for same dose were taken for their comparative evaluations with respect to yield, mineralizable N and inorganic fractions of N (NH_4^+ and NO_3^-). The result revealed that rice grown with SRI method produced 36% and 26.4% higher grain yield in Rabi 2015-16 and 5.7 and 9.4% higher in Kharif 2016, over DSR and CTR, respectively. Among the crop establishment methods highest amount of mineralizable N was recorded from SRI (219.1kg ha^{-1}) at maturity stage and among the treatments of different N sources, neem coated urea with organics (T_5) outperformed other treatments with the highest amount of mineralizable N (218.8 kg ha^{-1}) in maturity stage of Kharif 2016. NH_4^+-N was higher in case of SRI throughout the growing season except in panicle initiation stage and NO_3^--N was least in maturity stage while it was higher in other stages in case of SRI. Here also T_5 was higher in almost all stages than other treatments with respect to different N fractions. The agronomic efficiency (AE_N) was highest in T_5 in both the seasons i.e. 28.4 and 20.6 in Rabi 2015-16 and Kharif 2016, respectively and recovery efficiency (RE_N) was also highest in case of T_5 (ranged between 0.21 to 0.73) as the N uptake in grain (ranged between 38.81-46.63 kg ha^{-1}) and straw (ranged between 33.31-49.19 kg ha^{-1}) was highest in T_5. So among the crop establishment methods, SRI was best on the ground of yield, nitrogen use efficiency and different fractions of N. On the other hand neem coated urea with organics (T_5) gave us the best output in terms of yield, nitrogen use efficiency and different N fractions in different stages of rice growth in both the season.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Evaluation of Green Manuring and Crop Residue Enhancing Crop Productivity and Improvement of Salt Affected Soils of Purna Valley in Vidarbha Region of Maharashtra

P.R. Kadu, D.P. Lanje, B.A. Sonune, S.M. Jadhao and D.V. Mali
Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, 444104, Maharashtra

The present field experiment on green gram-chickpea sequence was conducted on farmers' field in Purna valley of Vidarbha region to evaluate the effect of in situ green manuring and crop residue for improving soil properties and yield of green gram-chickpea during 2016-17. The experiment was initiated during 2011-12 on cotton followed by green gram–chickpea rotation which is the predominate crop rotation in the region. The green manures, crop residues and gypsum applied to previous cotton crop and their residual effect on green gram–chickpea has been selected for the present study. The treatments comprised of five different green manures, two crop residues, gypsum and control. There were nine treatments replicated thrice in randomized block design, where one farmer was treated as one replication.

The use of green manuring and crop residues was found beneficial as that of gypsum in improving physical properties of the soils in addition to gradual chemical amelioration. Although considerable improvement in chemical properties has been observed with gypsum application indicating significant reduction in pH and ESP over initial value, the application dhaincha and sunhemp in green manuring was also found significant in reduction of pH and ESP. The organic amendments were also found useful and superior to gypsum in improving the organic carbon, SOC stock, available NPK and biological properties of soil. The organic amendments showed their potential not only for slow reclamation but also for improvement in characteristics of sodic soils. The organic amendments like dhaincha and sunhemp were found equally beneficial for obtaining crop yields as that of gypsum besides gradual soil reclamation.

Hence it can be concluded that the use of dhaincha in situ green manuring was found equally beneficial for obtaining green gram – chickpea yields as that of gypsum besides significant improvement in soil physical, chemical and biological properties of salt affected soil of Purna valley of Vidarbha region, Maharashtra.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Influence of Crop Residues and Green Manuring on Carbon Sequestration and Yield of Cotton in Soils of Purna Valley

N.M. Konde*, P.R. Kadu, D.V. Mali, Nilam Kanase, S.M. Jadhao, S.R. Lakhe and S.K. Pawar

Department of Soil Science and Agricultural Chemistry,
Dr. PanjabraoDeshmukh Krishi Vidyapeeth, Akola, Maharashtra

An experiment was carried out to study the influence of crop residues and green manuring on carbon sequestration and yield of cotton in soils of Purna valley. The study was executed on selected farmers fields in Purna valley during 2015-16. The treatments comprised of five different green manures, two crop residues, gypsum and control. The nine treatments were replicated on three farmers' fields using randomized block design. Soil microbial biomass carbon (SMBC) significantly increased under various treatments of organic amendments. The SMBC was comparatively lower with gypsum and control, while it was highest (168.72 µg g^{-1} soil) with the use of dhaincha in situ green manuring. The highest SMBN (79.39 µg TPF g^{-1} 24 h^{-1}) was noticed with incorporation of dhaincha which was at par with Sunhemp in situ green manuring (68.66 µg TPF g^{-1} 24 h^{-1}). In case of soil respiration, among all treatments dhaincha in situ green manuring resulted in 53.10 mg 100 g^{-1} soil respiration which was at par with sunhemp in situ green manuring (50.99 mg 100 g-1 soil).While in respect of carbon stock, the highest (15.21 Mg ha^{-1}) carbon stock was noted with the use of in situ green manuring of Sunhemp followed by cow pea in situ green manuring. Dhaincha and sunhemp have shown remarkable effect in sequestration of carbon under cotton. Similarly, it has also contributed positively in sequestration of CO_2 in upper as well as subsoil. The application of gypsum showed higher yield of cotton (12.29 q ha^{-1}) followed by dhaincha 11.70 q ha^{-1} in situ green manuring. Therefore considering erratic rainfall pattern, inferior infiltration and cracking nature of soil, the adoption of green manuring and crop residues are much advisable for improvement of degraded lands and yield of cotton in purna valley of Vidarbha region in Maharashtra.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Impact of Antitranspirants Application on Rice Grown under Water Stress Condition in Inceptisol of Varanasi, Uttar Pradesh

Ruby Patel* and Priyankar Raha
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, 221005, Uttar Pradesh
**Email: rubypppppp@gmail.com*

Antitranspirants are applied to plant foliage to curtail water loss. To increase the duration of moisture availability with the existing available soil moisture, the losses of it from plant (transpiration) and soil (evaporation) have to be reduced. Antitranspirants, in general, reduce the transpiration loss of water occurring mainly through closing stomatal pores present on leaf surface. Keeping these points in view, a pot experiment was conducted to find out the effect of application of leaf reflectance type antitranspirants, viz. kaolinite (kaolin) and long chain fatty acids (Green Miracle) application on growth, yield and quality of rice under both submerged and water stress condition grown in inceptisol in Varanasi, Uttar Pradesh. The present investigation was carried out in green house and rice (HUR-105) was grown under both submerged and water stress condition. The kaolin (0%, 4%, 6% and 8%) and Green Miracle (0%, 0.15%, 0.3% and 0.6%) water suspension / solution respectively, were sprayed twice viz. during vegetative stage (50 days after transplanting) and panicle initiation stage (70 days after transplanting). The growth attributes of rice crop were taken at three physiological stages, *viz.* tillering, panicle initiation stage and grain filling stages. The biochemical parameters of the standing crop *i.e.* chlorophyll content and Brix value were also taken in three stages. The N,P and K content in straw and grain were analyzed for nutrient uptake pattern by rice crop. The rice grain yield and quality (starch and protein content) were assessed after harvesting the crop. Results indicated that antitranspirant treatments affected the dry matter production significantly. Plants treated with Green Miracle and kaolin produced more dry matter than untreated check (control). The nutrient uptake and quality of grain were also significantly improved by application of both Green Miracle and kaolin. Kaolin application as antitranspirants under water stress performed better than long chain fatty acids antitranspirants (Green Miracle) in rice grown in inceptisol of Varanasi, Uttar Pradesh.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Cyclic Irrigation of Sodic and Canal Waters on Canola in Cotton-Canola Rotation

O.P. Choudhary*, Manpreet S. Mavi and Amanjeet Singh
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab
**Email: opc_2k@yahoo.com*

In arid and semi-arid regions, farmers have to use brackish ground water due to inadequate and unassured availability of good quality surface water. Long-term use of sodic water (SW) results in deterioration of soil properties that adversely impacts crop production. One approach in managing the use of SW for irrigation is its cyclic use with canal water (CW). Information on cyclic use of SW and CW on canola in cotton-canola rotation is not known, although some information is available on cotton in cotton-wheat system. The present study was carried out to investigate the effects of irrigation with SW and CW in different cyclic modes on yield of canola in a cotton-canola rotation. Canola was grown during rabi season from 2012-17 in plots measuring 2.5×2.5 m^2 at the experimental farm, Punjab Agricultural University, Ludhiana. The soil was loamy sand (Typic Ustochrept) having pH (1:2 soil and water) 8.02, organic carbon 2.8g C kg^{-1}; cation exchange capacity 9.7 cmol(p^+)kg^{-1} soil and exchangeable sodium percentage 3.8-4.4 in 0-30 cm soil layer. The treatments were: irrigation with CW; irrigation with SW; two CW irrigations and one SW (2CW: SW) applied in a cyclic mode; one CW and one/two SW (CW:SW, CW:2SW); one SW with one/two CW (SW:2CW, SW:CW) and two SW irrigation alternating with one CW (2SW:CW). Each treatment was replicated thrice in a completely randomized design. Compared with CW irrigation, reduction in relative yields of canola under SW alone treatment was 21% (averaged over 5 years of cropping) possibly due to deterioration of soil properties under long-term SW irrigation. This was also confirmed by significantly higher pH and EC values in treatment with SW irrigation alone compared to CW irrigation. However, alternating irrigation between CW and SW helped achieve significantly higher canola yield compared with SW alone treatment; increase was 9-30% under different CW and SW cyclic treatments. In general, canola yield in 2CW:SW and SW:2CW treatments were found to be at par with CW irrigation. In addition, alternating CW and SW reduced the adverse effect of SW on pH and EC by 3-11% and 22-65%, respectively. The results indicate that sustainable yield of canola can be obtained by cyclic irrigation with CW and SW when good quality water is not available. However, SW can be applied occasionally as pre-sowing irrigation provided deterioration in the soil properties is prevented by applying CW irrigation later.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Spatial Evaluation of Water Quality for Irrigation in Dumka District of Jharkhand, India

Arvind Kumar, Manas Denre, Ruplal Prasad and Jai Prakash Kumar
Department of Soil Science and Agricultural Chemistry, Birsa Agricultural University, Kanke, Ranchi, 834006, Jharkhand

Irrigated agriculture is dependent on adequate water supply of usable quality. Because water quality has become a global concern due to ever-increasing population and developmental activities that had over exploited and polluted the water resources available to us, the situation warrants immediate redressal through radically improved water resource and water quality management strategies. In this context, the present study has been undertaken on "*Spatial Evaluation of Water Quality for Irrigation in Dumka District of Jharkhand, India*".

Dumka district (Jharkhand) is one bounded by Godda and Banka district in the north, Pakur in the east, West Bengal in the south and Jamtara and Deoghar in the west. Total geographical area of the district is 4410 sq. km. The district has a total cultivated area of 1,97,124 ha. Net sown area is 1,28,126 ha. and only 11,532 ha. is irrigated (*i.e.*, 15% of the net cropped area). The average rainfall varies from 1300 to 1400 mm. The district experiences a prolonged dry period during January to May which keeps the soil dry for more than 90 days. Paddy based primary cropping system is in practice in the district, while vegetables, mustard and pulses are also in practice as secondary cropping system near water resources.

Twenty two geo-referenced (ranged from N24°03.553' to N24°30.448' Lat., E87°00.981' to E87°24.982' Long. and 77 to 200 msl) water samples were collected from different sources *viz.*, well, canal, river, bore well, pond and dam (which are used for irrigation purpose) around Dumka district during Rabi season of 2015. The present investigation indicated that water samples were acidic to slightly alkaline in nature with pH range varied from 6.15 to 7.79 with the mean value of 7.03. Electrical conductivity ranged between 0.34-1.09 dS m^{-1} with the mean value of 0.57 dS m^{-1}. The concentration of Zn, Cu, Fe, Mn and B in water varied from 0.015 to 0.105, 0.012 to 0.025, 0.013 to 0.913, 0.050 to 0.340, 0.006 to 0.550 mg L^{-1} with their mean value of 0.041, 0.018, 0.445, 0.083 and 0.161 mg L^{-1}, respectively while content of Pb, Ni and Co varied from 0.248 to 0.875, 0.160 to 0.513 and 0.043 to 0.125 mg L^{-1} with their respective mean value of 0.370, 0.337 and 0.098 mg L^{-1}, cadmium (Cd) concentration were not detected by AAS-4139 in water samples. The results indicated that the trace elements except nickel (Ni) and cobalt (Co) are safe for irrigation while, Ni and Co were found slightly higher concentration as per the guidelines of irrigation water. Therefore, a monitoring programme is needed to provide reliable information about the current irrigation water quality and control the contaminants in order to utilize this effectively for irrigation purpose particularly in post-rainy season crops.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Water Quality Monitoring and Assessment of Kolleru Lake Wetland Environment, India - Lake Water, Aquaculture Ponds and Agriculture Water: A Comparative Study

Ch. Sreenivas and D. Srinivas
Agricultural College, Acharya N.G. Rang Agricultural University, Rajamahendravaram, 533103, East Godavari district, Andhra Pradesh

Kolleru Lake is the largest freshwater wetland ecosystem in South India. Presently, Lake environment is at stake due to conflicting interests of Agriculture and Aquaculture. Hence an attempt was made to asses water quality of Kolleru Lake, aquaculture ponds and Agriculture drain and their role in Lake water Quality. The methods of study broadly confined to field and laboratory investigation.

Monthly water samples were collected from selected 30 bench mark sites during January to December, 2010 covering Kolleru lake area and Upputeru River Estuary. The total cations (TZ^+) and total anions (TZ^-) balance show the charge balance error. The error percentage is between ± 1% to ±10% with few exceptions for certain ions. Sodium is the major cation (61.5%) followed by magnesium (19.9%) calcium (16.7%) and potassium (1.9%). Whereas, among the anions Chloride is the major anion (47.4%) slightly followed by bicarbonate (40.4%), sulphates (11.8%) and carbonates (0.5%). Monthly water quality maps were prepared using surfer software to know the spatial variability. Cations and their ratios were used for assessing temporal variability. Salinity in the system is gradually increasing from January to May and reaching its highest salinity and started decreasing gradually by December. In addition to salinity Mg/Ca ratio can be taken as the criterion for evaluating the system. During August to November months the lake and river are in fresh environment and recorded the lowest salinity in the system in particular during September month.

Water samples were collected from selected 25 bench mark sites each from Kolleru lake, Aquaculture ponds and Agriculture fields in and around Kolleru Lake. Average salinity of water is more in Aquaculture ponds (1480 µmho/cm) followed by Lake water (939 µmho/cm) and lowest with Agriculture (675 µmho/cm) but all are not suitable for drinking purpose. Eutrophication potential (PO^{-2}_4) is found to be six times higher in Aquaculture ponds (0.06 me/l) followed by Kolleru lake (0.03me/l) than Agriculture (0.01 me/l). Mean total bacterial count ($x10^4$) is higher in lake (10.87) than aquaculture ponds (2.33) and agriculture fields (1.33). Whereas, fungal count($x10^3$) is highest in aquaculture ponds (8.67) followed by agriculture fields (7.3) and lake (6.38).

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Performance of Dill (*Anethum graveolens*) with Sodic Irrigation Water in Typic Haplustepts

O.P. Aishwath, P.N. Dubey, R.K. Yadav, R.L. Meena, B.K. Jha and G. Lal
ICAR- National Research Centre on Seed Spices, Tabiji, 305 206, Ajmer, Rajasthan

For the successful crop production during winter, irrigation is utmost essential particularly in arid and semi-arid regions. However, good quality of underground irrigation water is rarely available in sufficient quantities to fulfil the need of all the crops grown in these area. Therefore, use of available saline/alkali/sodic water in crops become inevitable in these areas, which is a limiting factors for most of crops. There are two options to overcome this problem, one is to ameliorate the water and other is to replace the crop with tolerant one. The first option is cost intensive and unsustainable, while second one is cost effective and far sustainable. Keeping these in view, an experiment was carried out under control conditions on dill (Ajmer dill-1) with irrigation water having residual sodium carbonate (RSC) 4.0, 8.0, 10.0, 12.0, 14.0 and 16.0 me l^{-1} and these were compared with control having RSC < 1.0 me l^{-1}. Results revealed that number of branches (primary and secondary), number of umbel per plant, number of umbellate per umbel and number of seeds per umbellate were more even with higher RSC water up to 12.0 me $l^{-1}$and reduced thereafter. In case of plant height, it was more even at higher level of RSC (14 me l^{-1}) and beyond it. Yield enhancement in seed and stover with RSC 12.0 accounted as 34.1 and 35.8 per cent over the control, respectively. However, seed and stover yield reduction with RSC 22.5 was 9.5 and 17.5 per cent, respectively. N and P content in seed was not influenced by RSC levels, content was decreased in stover with rise in RSC. K content in both seed and stover decreased and Na content increased with increase in RSC. Among the micronutrients, Fe content in both seed and stover increased with RSC levels, whereas Mn and Zn increased up to a certain extent and then decreased. Moreover, Cu content did not show a definite trend with RSC. Uptake of N, P, K, Cu and Fe were highest at RSC-10. However, Na, Mn and Zn was highest at RSC-12. Soil pH increased and SOC decreased with RSC of irrigation water. However, EC increased with tube well water having RSC 3-4 and decreased at RSC 8.0, whereas it increased slightly with higher RSC. Soil available N, and micronutrients except Zn decreased increase in RSC levels. However, phosphorus and potassium availability was not influenced due to sodicity of water up to RSC-14 and reduced thereafter. Based on the findings of the investigation, it could be concluded that dill has capability to draw the nutrients, water and withstand well up to RSC 12.0 me $l^{-1}$of irrigation water in loamy sand soil to sandy loam type. Higher growth and yield realized at that level of RSC ($\approx$ 12.0 mel^{-1}) and could be recommended for its cultivation under those conditions, even though such water leaves deleterious effect on other field crops.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Elevated CO_2 and Temperature Effect on Nutrient Uptake in Soybean

Narendra K. Lenka*, Sangeeta Lenka and Jyoti K. Thakur
Indian Institute of Soil Science, Nabibagh, Bhopal, Madhya Pradesh
*Email: nklenka@rediffmail.com

Elevated carbon dioxide induces better crop growth, commonly known as CO_2 fertilization effect. However, the bio-geochemical feedback of elevated CO_2 in terms of nutrient uptake from soil by crops is not fully understood. The effect gets complicated in the presence of elevated temperature. Hence, a field experiment was taken up in the *kharif* season of 2016 in Open Top Chambers (OTC) to study the effect of climate change on nutrient uptake by the soybean crop. The soybean (var. JS 20-29) crop was grown under two levels of CO_2 (ambient, 550 ppmv) in combination with two levels of air temperature (ambient, + 2.0 °C). Thus, there were five different climate treatments : open field (OF), ambient chamber (AC), elevated temperature (eT), elevated CO_2 (eC) and elevation of both temperature and CO_2 (eCeT). At the time of sowing, vermicompost @ 2.0 ton ha^{-1} was applied along with 30 kg N ha^{-1} (in form of urea), 60 kg P_2O_5 ha^{-1} (through SSP) and 40 kg K_2O ha^{-1} (through MOP) to the soybean crop. The grain yield and biomass were measured at harvest. The uptake of N, P and K were computed from the biomass and grain yield and the concentration of N, P and K in the grain and plant tissue. As compared to ambient chamber, the N and K concentration in soybean grain were not affected by elevation in CO_2 and/or temperature. However, grain P content reduced with elevation in CO_2 and increased with temperature elevation. Elevated CO_2 resulted a reduction in N content in plant tissue, though the effect was not significant when combined with temperature elevation. A significant increase in uptake of N, P and K was observed under climate change treatments as compared to ambient chamber and open field conditions. The N uptake varied from 110 kg ha^{-1} under open field treatment to 125, 190 and 221 kg ha^{-1} under AC, eC and eCeT treatments, respectively. The P uptake varied from 11.8 to 20.7 kg P ha^{-1} and K uptake varied from 30.4 to 55.0 kg ha^{-1}, with minimum under OF and maximum under eCeT treatments. The study indicated elevated CO_2 and/or temperature may result in higher nutrient uptake by crop plants, which may necessitate additional external inputs to avoid nutrient mining from soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Deficit Irrigation on Salinity Dynamics and Productivity of Maize in Coastal Saline Soil

T.D. Lama*, D. Burman, S.K. Sarangi, K.K. Mahanta, B. Maji, and U.K. Mandal
ICAR-Central Soil Salinity Research Institute, Regional Research Station,
Canning Town, 743329, West Bengal
**Email: tashi.lama@icar.gov.in*

Shortage of good quality irrigation water is one of the major constraints that limit agricultural production during post rainy season in the *Sundarbans*. Soil salinity is another inherent bottleneck to sustainable crop production in the region. Much of the land is therefore mono-cropped and a vast expanse is left fallow during the dry season. There is an urgent need to shift towards practices that allow use of fresh, as well as, poor quality water in an efficient way not only to mitigate the problems of water shortages but also to sustain crop productivity and increase cropping intensity in the region. In view of the above, a study was carried out at ICAR-Central Soil Salinity Research Institute, RRS, Canning Town, West Bengal to study the salinity dynamics and yield response of maize to saline water irrigation. The treatments consisted of three irrigation water qualities *viz.*, good quality water (EC < 2 dSm^{-1}) and saline water having electrical conductivity (EC) of 4 and 8 dSm^{-1} in combination with application of irrigation water levels at 125, 100, 75 and 50% of cumulative pan evaporation (CPE). Results indicated that soil salinity was higher at the end of the crop growth period and increased at higher levels of irrigation water salinity. Highest mean EC_e of 7.1 dSm^{-1} of saturation paste was observed in the surface soil layer with the application of irrigation water having salinity level 8.0 dSm^{-1}. With the application of decreasing level of good quality water, soil EC_e showed an increasing trend. However the trend was reverse when saline water was applied in decreasing amounts due to higher salt loading resulting from application of saline water in increasing quantities. Maize growth and yield parameters (grain yield, cob yield, dry biomass, plant height) declined with deficit irrigation and saline irrigation. The reduction in grain yield and dry biomass was by 17.3 and 21.5% respectively in deficit irrigation treatment (50% CPE) as compared to irrigation level of 100% CPE. Statistically at par maize yields were obtained at 100 and 75% CPE. The above ground biomass and seed yield of plants irrigated with 8.0 dSm^{-1} irrigation water were reduced by 44.3 and 31.1% respectively over that obtained with good quality water. However, the differences in yield of maize irrigated with good water to that with saline water of 4.0 dSm^{-1} was insignificant. Highest value of water productivity (5.52 t ha^{-1} mm^{-1}) was obtained with irrigation level at 125% CPE and the lowest for 50% CPE (3.84 t ha^{-1} mm^{-1}). The water productivity values at 100% and 75% CPE was at par. Irrigation with fresh water provides higher advantage in terms of yield and water productivity of maize. In case of limited water supply irrigation with 4 dSm^{-1} saline water or deficit irrigation at 75% CPE could be an alternative for irrigation in maize production under coastal saline environment.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Managing Abiotic Stress to Grow Glycophyte and Halophyte across Water Salinity Gradient for Food Security in Arid Areas

Vanaja Kankarla[1], Akram Ben Ali[1], Manoj K. Shukla[1] and Bhabani S. Das[2]

[1]Plant and Environmental Sciences, New Mexico State University, Las Cruces, NM, USA

[2]Agriculture and Food Engineering Department, Indian Institute of Technology, Kharagpur, West Bengal

South-western US has scarcity of fresh water for irrigation and brackish groundwater is increasingly used to supplement the shortfall. The groundwater aquifers in New Mexico are large; although not contiguous, they are mostly brackish. For maintaining soil salinity to sustain production, brackish groundwater needs treatment, for example using reverse osmosis (RO), prior to irrigation. Inland RO process generates highly saline concentrate and reuse or disposal is a challenge. This study aims to design improved irrigation strategies for arid regions to grow a suitable of food and forage crops using natural brackish groundwater and RO concentrate, while quantifying the underlying mechanisms related to exclusion or osmotic adjustments. Salt tolerance of three glycophytes (chile-peppers, pecan, and alfalfa) and several halophytes (*Atriplexcanescens*, *Hordeum vulgare*, *Lepidiumalyssoides, Distichlisstricta*, *Panicumvirgatum*, ×*Triticosecale, Chenopodium quinoa, and Salicornia californicum*) was studied at various growth stages including germination, emergence, and vegetative growth in a greenhouse using brackish groundwater (4-5 dS m^{-1}) and RO concentrate (8-10 dS m^{-1}). For glycophyte species, percent germination did not change but percent emergence decreased with increasing irrigation water salinity. Mean germination and emergence times increased with irrigation water salinity. Evapotranspiration (ET) and yield of chile-peppers decreased with increasing soil or irrigation water salinity for a constant leaching fraction (LF). Chile peppers did see early flowering and more flowers were seen in pots irrigated with brackish groundwater and RO concentrate than control. Overall, the exponent in van Genuchten yield response curve was 1.63, much less than that suggested for most crops. The 50% yield reductions also occurred at much higher soil salinity. Therefore, chile-peppers, irrigated with calcium dominated brackish groundwater, in this study, were more salt tolerant and yield reduction was less than those reported for NaCl dominant saline irrigations. However, irrigation with brackish groundwater and RO concentrate, except occasionally as nutrient supplement, will increase soil salinity and decrease chile-peppers yield severely. For halophyte species, germination percentages were similar within a species across salinity gradient and with the exception of *A. canescens*, all species showed germination delays in response to increasing salinity. No significant differences were observed for photosynthetic, stomatal conductance, and transpiration rates by soil texture or irrigation water salinity. The ET and biomass did not change for most halophyte species with increasing irrigation water salinity. Although plant ion uptake were higher for halophytes indicating osmotic adjustment, overall plant ion uptake was low causing accumulation in the soil. Periodic increase in LFs during the season, and irrigation with freshwater at the start of the growing season are needed to sustain soil quality. Continuous use of brackish groundwater without appropriate LFs will enhance abiotic stress for both species, and exacerbate soil salinity. Periodic soil salinity monitoring and sustainable RO concentrate reuse for growing salt-tolerant plants could aid the implementation of inland groundwater desalination in the arid southwestern U.S. RO irrigations to grow halophytic plants on desert margins has the potential to improve air quality and control desertification.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Performance of Different Wheat (*Triticum aestivum* L.) Varieties under Poor Quality Irrigation Water Conditions in South-west Punjab

A.S. Sidhu, Anureet Kaur, K.S. Sekhon and Sudhir Thaman
PAU, Regional Research Station, Bathinda, Punjab

A field experiment was carried out to find out suitable wheat (*Triticum aestivum* L.) varieties under saline water irrigation environments and the effect of saline sodic water irrigation on soil properties and water expense efficiency in loamy sand soil at Punjab Agricultural University, Regional Research Station, Bathinda during 2010-14. The experimental field was non saline and alkaline in reaction having EC 0.230 dS m^{-1} and pH 8.4, organic carbon (0.26%), available phosphorus 13.1 kg ha^{-1} and available potassium 311 kg ha^{-1}. The experiment was planned with five varieties of wheat *viz.* PBW-343, DBW-17, KRL-19, PBW-590 and PBW-550 under three replication in randomised complete block design. The crop was sown during *Rabi* season in the month of November every year under canal water and poor quality tubewell water. The recommended package and practices of Punjab Agricultural University were followed for raising the crop. The crop was harvested during the month of April and observations on yield and yield attributing characteristics were recorded. Soil samples were collected after harvesting the crop and analysed for pH, EC and other soil characteristics as per standard methods. The results of the experiment revealed that the yield of different wheat varieties differed under poor quality irrigation as compared to canal water conditions. The varieties PBW-550 and DBW-17 performed better under saline water than canal water. Whereas, significant difference in yield of different varieties were also observed among themselves under both conditions. The water expense efficiency was higher in canal water as compared to tubewell water. The pH, EC and SAR increased under irrigation with poor quality water.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Different Levels of Gypsum on Sodic Soil Properties under Suru Sugarcane Crop

M.R. Chauhan and Mohite P.B.
Department of Soil Science and Agricultural Chemistry, MPKV, Rahuri, Maharashtra

The field experiment was conducted during the year 2013-14 at Post Graduate Institute M.P.K.V. Rahuri dist –Ahmednagar (M.S.) to study the effects of gypsum on sodic soil under suru sugarcane. Randomized block design with three replication and eight treatments were laid out for conduct of the experiments. The treatment comprised of control, GRDF levels of gypsum, Phospho gypsum and elemental sulphur 50% and 100% as per the gypsum requirement. The results of the experiment revealed that there was decrease in bulk density and increase in hydraulic conductivity ECe, and available Potassium due to application of GRDF + phosphor gypsum 100% as per gypsum requirement. Phs, ESP, Na + of soils were significantly decreased due to application of GRDF + phospho gypsum 100% as per gypsum requirement. The organic carbon content significantly increased in the treatment with the application of GRDF + elemental sulphur 50% as per the gypsum requirement. However the available phosphorus and sulphur content was increased in the treatment with application of GRDF + elemental sulphur 100% as per the gypsum requirement. The Ca^{2+} and Mg^{2+} content in soil extract significantly increased with application of GRDF + phosphor gypsum 50% as per gypsum requirement. In general cations in saturation paste extract of soil followed the decreasing concentration of $Ca^{2+} > Mg^{2+} > Na^{2+} > K^{+}$ and anions in saturation paste extract of soil followed decreasing trend of $Cl^{-} > SO_4 > HCO_3^{-}$ in all the treatment. It is concluded that application of GRDF + phospho gypsum @ 8.20 tha^{-1} in sodic soil was found beneficial for improvement of physical properties of soil and reclamation of sodic soil by reducing PHs, ESP, and Na+.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Studies on Management of Nursery Beds for Machine Transplanting in Rice

T. Usha Rani*, Ch. Sreenivas, A. Sirisha, P.V. Satyanarayana and J. Radha Krishna

Andhra Pradesh Rice Research Institute and Regional Agricultural Research Station, Maruteru, Andhra Pradesh

**Email: usharani.angrau@gmail.com*

A field experiment was conducted on the performance of rice seedlings in nursery beds with different substrates at APRRI & RARS, Maruteru during the year 2013-2016. The experiment was laid out in factorial randomized block design consisting of application of different substrates in trays for the growth of paddy seedlings for machine transplanting. The treatments consists of alluvial soil (100%), sandy soil (100%), coir pith (100%), compost (100%), alluvial soil and sandy soil (1:1) ratio, alluvial soil and coir pith (1:1) ratio, alluvial soil and compost (1:1) ratio, sandy soil and compost (1:1), sandy soil and coir pith (1:1) sandy soil and vermicompost (3:1) as check. The tested variety was MTU 7029 for *kharif* and MTU 1010 for Rabi season. The data on bulk density, ease of pulling of seedlings from the tray, height of seedlings at the time of machine planting was recorded. The results revealed that the application of alluvial soil along with coir pith (1:1) recorded the optimum bulk density (1.04 g cm^{-3}) for the growth of the seedling and ease of pulling of seedlings followed by the application of alluvial soil along with FYM (1.15 g cm^{-3}). The grain yield and straw yield also found maximum with the application of alluvial soil and coir pith (1:1) as the establishment of seedlings were found maximum with this combination of alluvial soil and coir pith.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effects of Long-term Sodic Water Irrigation along with Gypsum and FYM on Available Nutrient Status of Soil

Deepika*, Dev Raj, Sunita Sheoran, R.S. Antil and D.S. Dahiya
Department of soil science, CCS Haryana Agricultural University Hisar, 125004, Haryana
**Email: dhangerdeepika@gmail.com*

An ongoing long-term field experiment established in 1994 under different vegetable cropping systems at Research Farm of Department of Vegetable Science, CCS HAU, Hisar, India was selected to study the effects of long term sodic water irrigation along with gypsum and FYM on available nutrient status of soil. The field was irrigated with high RSC (11.5 me L^{-1}) sodic water having three levels of gypsum (G_0 = Control, G_1=50% neutralization of RSC, G_2 = 100% neutralization of RSC) and three levels of FYM (F_0 = control, F_1= 10 t ha^{-1}, F_2 =20 t ha^{-1}). The soil of experimental field was sandy loam (*Typic Ustochrept*) having 19.6 per cent clay and 9.3 cmol(p^+)kg^{-1} CEC in 0-30 cm layer. All the available nutrients (N, P, S, Mn, Cu, Fe, Zn) increased with increasing levels of FYM from 0 to 20 t ha^{-1} and gypsum from 0 to 100% neutralization of RSC, respectively. Highest value of available K was observed in 20 t ha^{-1} and lowest in control (no FYM), but it decreased with increasing level of gypsum application from control to 100% neutralization of RSC. The pH of soil was very high under F_0G_0, and decreased with the use of FYM and gypsum as amendments. These results indicates that the combined use of FYM and gypsum improved soil health and maintained the sustainability of the different vegetable cropping system.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Mulching and Deficit Saline Water Irrigation Improve Soil Properties and Yield for Sorghum-Wheat Cropping System in a Salt-affected Soil of Northwest India

Nirmalendu Basak[1]*, Gobinath R.[1,2], Arvind K. Rai[1], Parul Sundha[1], Bhaskar Narjary[1], Gajender[1], Satyendra Kumar[1] and Rajender K. Yadav[1]

[1]*ICAR-Central Soil Salinity Research Institute, Karnal, 132 001, Haryana*
[2]*ICAR-Indian Institute of Rice Research, Hyderabad, 500 030, Telengana*
**Email: Nirmalendu.Basak@icar.gov.in*

Soil salinity and sodicity are the two major environmental stresses leading to soil degradation in irrigated agriculture of arid and semi-arid regions. Soils of these regions have high pH, excessive soluble salts, presence of carbonate/bicarbonate ions, exchangeable sodium percentage (ESP), sodium adsorption ratio (SAR) and low organic matter. Appropriate soil, irrigation and cultural practices neutralize the deleterious impact of soil salinity/sodicity, enhance water/ nutrients availability and sustain yield. Therefore to address these issues a field experiment is continuing since 2014 with *kharif* fodder sorghum (*cv*. HSSG-5000)-*Rabi* wheat (*cv*. KRL-210) with initial soil salinity (EC_e, electrical conductivity of saturation extract) ranging from 4.0-36.0 dS m^{-1} and saline water irrigation of 8.0 dS m^{-1} at Nain Experimental Farm, ICAR-CSSRI, Panipat, Haryana with deficit saline irrigation water and mulch treatments *viz.*, 100% water requirement through best available water (100BW); 100% water requirement through saline water + 5 t ha^{-1} rice straw mulching (100SWM); 100% water requirement through saline water without mulching (100SW); 60% water requirement through saline water + 5 t ha^{-1} rice straw mulching (60SWM) and 60% water requirement through saline water without mulching (60SW) in three replication. Soil pH_s (7.7 to 8.3), EC_e (6.2 to 10.2 dS m^{-1}) and sodicity (9.1 to 25.1) increased along depth contrarily organic C (4.1 to 1.1 g kg^{-1}) and available Zn (0.55 to 0.37 mg kg^{-1}) decreased along soil depth (from 0-120 cm soil layer). Soils irrigated with 100BW showed greater and lower values of soil pH_s (8.60) and EC_e (4.15 dS m^{-1}), respectively. Mulching improved Zn status of soil (P <0.001) and reduced deleterious impact of alkaline anion [CO_3^{2-} + HCO_3^- to Cl^- + SO_4^{2-} ratio (CBCS) (P < 0.01)]. Mulching with 60% WR showed significant effect on wheat and dry forage sorghum yield (5.9 and 153 Mg ha^{-1}) compared to 100% water application without mulching (5.4 and 125 Mg ha^{-1}). Keeping soil fallow is not an acceptable practice oppositely cultivation of saline soils improved soil quality by declining soil EC. Irrigation with best available water leached soluble salts. As good quality irrigation is a crisis for this area. So mulching @ 5.0 t ha^{-1} with deficit saline irrigation (60% water requirement) can decline EC, sodicity and improve Zn availability in soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Boron Fortified Briquettes on Yield and Quality of Arecanut in Coastal Soils of Konkan

M.C. Kasture, A.A. Dademal, S.S. More and S.S. Prabhudesai
Department of Soil Science and Agricultural Chemistry, College of Agriculture, DBSKKV, Dapoli, Maharashtra

An experiment was conducted on arecanut during the year 2013-14 to 2015-16 in coastal soils of the Konkan region for maximization of yield and to avoid the cracking of the nuts. Total seven treatments comprising the levels of nitrogen and boron were applied through the straight fertilizers a well as through the boron fortified Konkan Annapurna Briquettes (KAB). The treatment included *viz*; T_1- Recommended Dose of Fertilizers, T_2- RDF + 4 kg B ha^{-1} through soil application, T_3- RDN + 4 kg B ha^{-1} containing KAB, T_4- RDN + 2 kg B ha^{-1} containing KAB, T_5- 150% RDF + 4 kg B ha^{-1} through soil application, T_6- 150% RDN + 4 kg B ha^{-1} through KAB and T_7- 150% RDN + 2 kg B ha^{-1} through KAB. The experiment was laid out in randomized block design replicated thrice.

The application of the Boronated KAB as well as application of straight fertilizers showed the significant results in reducing the splitting of nuts as well as increasing the yield of arecanut. The pooled data indicated that the treatment T6 in which 150% RDN along with 4 kg B ha^{-1} through KAB was applied showed significant increase in the all the nutrients in the nut and husk which helped to reduce the cracking of the nuts as well as increasing the yield of arecanut. The available nitrogen, phosphorus and potash showed significant effect with the application of higher doses of nutrients through KAB along with the Boron application. The hot water extractable boron found maximum (0.58 ppm) in the T6 treatment in which 150% RDF along with 4 kg B ha^{-1} was applied through KAB and found at par with T_3 and T_5 treatments in which boron was applied @ 4 kg ha^{-1}.

It is concluded that the application of 150% RDN along with 4 kg B ha^{-1} through KAB (T_6) recorded highest B: C ratio with higher yield and lowest percentage of splitting of the nuts in the arecanut of Konkan region.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Long-term Impact of Conservation Tillage on Soil Organic Carbon and Available Nutrient Contents under Soybean-Wheat System in Vertisols of Central India

K.M. Hati, V. Kushwa, R.K. Singh, J. Somasundaram, N.K. Sinha, R.S. Chaudhary, A.K. Biswas and M. Mohanty

ICAR-Indian Institute of Soil Science, Nabibagh, Berasia Road, Bhopal, 462038, Madhya Pradesh

Efficient nutrient management in conservation tillage is one of the major concerns in vertisols as residue retention on soil surface and reduction in tillage operation can have a major impact on nutrient dynamics and stratification. The present study examined profile distribution of soil organic carbon (SOC) and available nutrients under long-term (twelve years) imposition of four different tillage systems namely, conventional tillage (CT), mould board tillage (MB), reduced tillage (RT), no tillage (NT) and three nitrogen levels viz., $N_{50\%}$, $N_{100\%}$ and $N_{150\%}$. The SOC concentration in the conservation tillage treatments namely, NT and RT was significantly higher than that in CT in 0-5 and 5-15 cm soil layers but the difference was not significant in 15-30 cm layer. Highest SOC concentration in 15-30 cm layer was recorded in MB due to deep ploughing and mixing of residues. Stratification ratio of the SOC in NT (2.20) and RT (1.93) was higher than that of CT (1.51). Similar to the SOC concentration, the available nitrogen concentration was the highest in NT followed by RT and MB and it was the lowest in CT in the top 15cm soil depths. However in 15-30 cm soil layer, available nitrogen concentration was the highest in MB and it was significantly more than the other three tillage treatments. Following NT and RT practices in the long-term increased the available nitrogen concentration by 60 and 48%, respectively and 13 and 20%, respectively over the conventional tillage (CT) in 0-5 cm and 5-15 cm soil layers, respectively. Among the tillage treatments, available phosphorus concentration was significantly higher in NT and RT than that in MB and CT at 0-5 cm depth. It was in general lower at deeper soil layers. Decrease in available phosphorus concentration with increase in soil depth was sharper in NT and RT while it was more gradual in MB. The stratification ratio was 2.3 and 2.2, respectively for the NT and RT while it was 1.5 and 1.8, respectively for the MB and CT. Effect of tillage on available potassium concentration followed a trend similar to that of available phosphorus but the stratification of available K was less compared to available P owing to higher mobility of K in soil. The tillage treatments and their interactions with N levels did not significantly influence the yield of soybean and wheat pooled over the years. It is concluded that the organic carbon content and available soil nutrient concentration under no tillage and reduced tillage system increased compared to conventional tillage due to retention of crop residues and minimum disturbances in the former systems. Greater stratification of P and K in the profile under conservation tillage systems were due to less vertical mixing of soils in these treatments compared to conventional and mould board treatments. The study also suggested that conservation tillage to soybean and wheat with balanced dose of fertilizer can be a viable alternative to conventional tillage for sustainable production with concomitant improvement in nutrient availability and carbon sequestration in Vertisols of central India.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effects of Sodic Water Irrigation along with Gypsum and FYM on Soil Organic Carbon Pools and Nitrogen Fractions under Semi-arid Environment

Deepika, Dev Raj*, Sunita Sheoran, R.S. Antil and D.S. Dahiya
Department of Soil Science, CCS Haryana Agricultural University, Hisar, 125004, Haryana
**Email: devraj_chauhan@rediffmail.com*

In arid and semi-arid regions of the world the inadequate and un-assured supplies of good quality water have forced the farmers to use sodic ground waters for irrigating crops. Continuous use of this poor quality water for irrigation can deteriorate the soil quality. Keeping in view of above fact a long-term field experiment was initiated in 1994 under different vegetable cropping systems at Research Farm Department of Vegetable Science CCS HAU, Hisar. The experimental soil was sandy loam (*Typic Ustochrept*) having 19.6 per cent clay and 9.3 cmol$(p^+)kg^{-1}$ CEC in 0-30 cm layer. The field was irrigated with high RSC (11.5 me L^{-1}) sodic water having three levels of gypsum i.e. G_0 = Control, G_1=50% neutralization of RSC, G_2 = 100% neutralization of RSC, as well as four levels of FYM *i.e.* F_0 = Control, F_1= 10 t ha^{-1}, F_2 =20 t ha^{-1}. The changes in soil organic C fractions (DOC, MBC, LFC and HFC) and N fraction (acid insoluble-N, hydrolysable NH_3-N, amino acid-N, amino sugar-N, hydrolysable unknown-N and total hydrolysable-N) were more dynamic in various treatments consisting FYM and gypsum levels. Highest value of carbon fractions (MBC, DOC, LFC, HFC) was noticed when FYM applied at 20 t ha^{-1} followed by 10 t ha^{-1} over no FYM application. With the application of gypsum, MBC, LFC, HFC content in soil increased but DOC content decreased. Lowest value of DOC was observed in 100% neutralization of RSC, and highest value was observed in no gypsum application treatments. All nitrogen fractions increased with increasing levels of FYM from 0 to 20 t ha^{-1} and gypsum from 0 to 100% neutralization of RSC, respectively. Adverse effect of residual alkalinity of irrigation water was quite prominent on chemical and microbiological properties of soil. These results indicate that the combined use of FYM and gypsum improved soil health and maintained the sustainability of the different vegetable cropping system.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Conservation Agriculture Practices on Macro- and Micro-Nutrient Status in a Rainfed Vertisol

J. Somasundaram[1]*, A.K. Shukla[1], N.K. Sinha[1], R.S. Chaudhary[1], K.M. Hati[1], M. Mohanty[1], S. Neenu[1], A.K. Biswas[1], A.K. Patra[1] and R.C. Dalal[2]

[1] ICAR- Indian Institute of Soil Science, Nabibagh, Berasia Road, Bhopal, 462038, Madhya Pradesh
[2]School of Agriculture and Food Sciences, The University of Queensland, St Lucia, QLD 4072, Australia
**Email: somajayaraman@gmail.com*

This study investigated the short-term effect (< 5 year) of conservation agriculture (CA) practices on the nutrient status especially N, P and K and micro-nutrients (Fe, Mn, Zn, and Cu) in a Vertisol of Central India. The field experiment was laid out in a split plot design consist of two tillage treatments: conventional tillage (CT) and reduced tillage (RT) as main plots with six cropping systems as sub plots. About 144 soils samples collected from the field experiment to assess soil properties and nutrient (major and micro-nutrient) status. It was observed that soil pH was not affected ($p > 0.05$) either by tillage or cropping system or their interactions. RT coupled with crop residue retention relatively increased soil organic carbon (SOC) compared to CT in surface layer. In surface soil layer (0-5 cm), the major- and micro-nutrients concentrations were higher compared to sub-surface layers, regardless of tillage and cropping systems. The SOC showed a significant positive ($p< 0.001$) relationship while soil pH and a significant negative relationship with N, P, K, and DTPA extractable Fe, Mn, Zn and Cu. The DTPA extractable -Cu, Fe, Mn and Zn displayed decreasing trends with increasing depth. Except Cu, other micronutrients concentration was significantly affected by tillage after four crop cycles, whereas cropping system had significant effect on DTPA-Cu and -Fe only. Therefore, conservation tillage practices coupled with retention of crop residue demonstrated a positive effect on macro-and micronutrient distribution and availability in soils after four crop cycles. This study further highlights the importance of nutrient dynamics under different tillage and cropping systems and thus improves the nutrient recommendation under reduced tillage in rainfed Vertisols of Central India. The results emanated from the study will be useful in a similar agro-ecological region for managing Vertisols for better soil health and crop productivity.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Resource Conservation Practices for Soil Carbon Sequestration under Cotton-Soybean Rotation in Vertisols

V.K. Kharche, B.A. Sonune, D.V. Mali and N.M. Konde
Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, 444104, Maharashtra
**Email: vilaskharche@redifmail.com*

The present experiment was conducted to evaluate the various resource conservation practices for soil carbon sequestration under cotton-soybean rotation at Dr. PDKV, Akola during 2011-12 to 2016-17. The experiment was carried out in RBD with nine treatments replicated thrice. The treatments comprised of 100% RDF through only chemical fertilizers, 25% N (through sesbania lopping, composted cotton stalk, wheat straw and sorghum stubbles), 50% N through FYM and leucaena loppings and 100% N through FYM with RDF compensation applied to cotton. While, 100% RDF through chemical fertilizers and FYM were applied to soybean.

The pooled results revealed that the application of 100 or 50% N through FYM or 25% N through dhaincha loppings recorded significantly higher soil organic carbon, residual soil fertility status and soil biological properties along with improvement in soil quality index over rest of the treatments. The highest soil carbon sequestration was recorded under 100 or 50% N through FYM or 25% N through dhaincha loppings. The application of neem cake and green manuring for substitution of 25 per cent nitrogen along with remaining nutrients of RDF through chemical fertilizer to cotton and RDF of soybean through chemical fertilizers or 100% recommended N of cotton and soybean through FYM along with phosphorus compensation through phosphocompost to cotton was found beneficial in respect of seed cotton yield and grain yield of soybean. The highest soil carbon sequestration and soil organic carbon stock was recorded under 100% recommended N of cotton and soybean through FYM along with phosphorus compensation through phosphocompost.

Hence, it can be concluded that application of dhaincha loppings for substitution of 25% nitrogen along with remaining nutrients of RDF through chemical fertilizers and 100% through FYM was found beneficial in respect of improvement in soil carbon sequestration, soil fertility and productivity of cotton-soybean cropping system in Vertisols of Maharashtra.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessing Climate Variability and to Develop Adaptation Strategies for Coastal Salinity Management in Indian Sundarbans through Land Shaping and Crop Diversification

Uttam Kumar Mandal*, D. Burman, Subhasis Mandal, Sourav Mullick, Dibyendu Bikas Nayak, B. Maji, K.K. Mahanta, S. Raut, and A.K. Bhardwaj
ICAR-Central Soil Salinity Research Institute, Regional Research Station, Canning Town, 743329, West Bengal
ICAR-Central Soil Salinity Research Institute, Karnal, Haryana
**Email: uttam_icar@yahoo.com*

Sundarbans in West Bengal by virtue of its strategic location in the Eastern coast of the Bay of Bengal falls in the most vulnerable zones of abrupt climate change. Analysis of the long period rainfall data (1966-2014) indicates that the region receives very high annual rainfall (1818.5 mm) which is concentrated only over a few monsoon months; most of the rain water goes waste as runoff and creates widespread water logging of the low-lying agricultural fields. On an average 84 rainy days in a year was recorded in the region, whereas during last ten years (2005-2014), the number of rainy days was reduced to 78.8 days yr^{-1}. There was 2.7 times surplus rainfall than crop evapo-transpiration during monsoon months indicating very high scope of water harvesting to tackle water logging during the monsoon season and unavailability of fresh water for irrigation during lean season. The present study assessed the effects of different land shaping models i.e., farm pond (FP), deep furrow and high ridge (RF) and paddy cum fish (PCF) system for rain water harvesting in restoring the productivity of degraded coastal soils in Sundarbans during 2012, 2013 and 2014 with an annual rainfall of 1583 (normal), 2164 (excess) and 1368 mm (deficit), respectively. A water balance was run to estimate the soil moisture, crop evapotranspiration, runoff and water depth in the reservoir. On an average the amount of runoff harvested was 3273, 1387 and 952 m^3 per hectare per year in FP, RF and PCF system. The amount of runoff going out of the system was 12.2, 23.6 and 25.5% of the annual rainfall in FP, RF and PCF system whereas in monocrop rice-fallow system the runoff was 34.6% of the annual rainfall during these three years period (2012-2014). On an average annually 1717, 1042 and 791 m^3 of harvested water was used for irrigation during lean period in FP, RF and PCF system. We estimated all the three components of water footprints (WF) i.e., blue WF (WFblue), green WF (WFgreen) and gray WF (WFgray) for washing excess salt accumulation as an aggregative indicator to evaluate environmental impact of each land shaping system along with dominant rice-fallow and rice-rice system. In FP system out of total WF of 808.5 m^3t^{-1}, WFgreen was 608.1, WFblue 103.1 and WFgray was 97.3 m^3t^{-1}, respectively, whereas in case of RF system total WF was 976.2 m^3t^{-1}out of which WFgreen, WFblue and WFgray was 783.7, 75.3 and 117.2 m^3t^{-1}, respectively and in PCF system total WF, WFgreen, WFblue and WFgray was 1029.2, 836.2, 63.3, and 129.7 m^3t^{-1} respectively. In rice fallow and rice-rice system the total WF, WFgreen, WFblue and WFgray was 3644.8, 3113.6, nil and 531.2; and 1883.5, 974.2, 702.4 and 206.9, respectively indicating copious use of ground water in rice-rice system. Large scale adaptation of different land shaping models for rain water harvesting in farmers' field increased the cropping intensity and net farm income in the region and there was reduction in salinity during summer and water logging during rainy season and overall improvement in soil quality.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Health Management of a Degraded Ravine Land through Soil Amendments and Integrated Nutrient Management

S.K. Verma

Department of Soil Science and Agricultural Chemistry, Rajmata Vijayaraja Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh

The ravine soils belong to most fragile ecosystem having degraded land deprived of all kinds of favourable physical, Chemical and biological properties. This is a big challenge to make them productive for crops as well as vegetables. Two different experiments one under laboratory conditions and second in field conditions were carried to find out suitable amendment as well as nutrient suppliers to make these soils more productive. In a laboratory experiment different soil amendments like, gypsum, crop residue and spent wash (distillery byproduct) and their combinations (12 treatments) were applied to the soil collected from Chambal ravine. The results showed that combined application of gypsum (@ 1.0 t ha^{-1}), crop residue (@10 t ha^{-1}) and spent wash (@5.0 l ha^{-1}) was found very much effective in upgrading soil physical and chemical properties. The other experiment was carried out in a partially reclaimed ravine field by applying seven treatments viz. Farmers practice, recommended dose of fertilizers (RDF), dose calculated on basis of STCR developed by IARI. RDF+deficient micronutrients, RDF+FYM@ 10 t ha^{-1}), RDF+FYM+ deficient micronutrients and RDF + FYM+Bio fertilizers to wheat crop in a randomized block design in a plot size of 6×3m. The results indicated that us of integrated nutrient management approach was most suitable for nutrient supply and crop production.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

An Overview of Ground Water Quality of Block Rania of Sirsa in Haryana

D.S. Jakhar
Krishi Vigyan Kendra, Sirsa, Haryana

Ground water is a major source of irrigation in district Sirsa. Ground water is used by the farmers for irrigation in different crops without considering its impact on soil physico-chemical properties as well as on crop production. A large no of tube wells exist in Rania block. As per studies conducted previously, about 65 per cent water in the district is either not of good quality or should be used with prescriptions. Hence the farmers are advised to get their water tested so that it can be used safely for crop production. A large no of water samples are being received in soil testing laboratory of Krishi Vigyan Kendra Sirsa. Out of these samples 100 samples were selected from the villages representing the whole block. The samples selected so were analysed for chemical properties *viz*. EC, CO_3^{-2}, $HCO_3^-Cl^-$ and $Ca^+ + Mg^+$. Residual sodium carbonate was calculated and used as a measure of sodicity. The EC ranged from 0.6 to 8.8 dS m^{-1} with a mean of 3.5 dS m^{-1}. CO_3^{-2}, HCO_3^- and Cl^- ranged from 0.1 to 1.0 me L^{-1}, 7.0 to 9.0 me L^{-1}, and 1.0 to 21.6 me L^{-1} respectively. The respective mean values were 0.26, 6.8 and 10.87 me L^{-1}. Ca+Mg ranges from 3.0 to 24.0 me L^{-1} with a mean value of 10.36 me L^{-1}. Seventy per cent samples were found in safe zone having RSC less than 2 me L^{-1}. Fifteen percent samples were having RSC falling in the range 2.1 to 4.0 me L^{-1} and remaining 10 per cent samples were categorised in the range>4.0 me L^{-1}.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Groundwater Quality Assessment of Palwal Block of Palwal District

Gagandeep[1], Ram Prakash[1]*, Sanjay Kumar[2], Rajpaul[1], Satyavan[1] and S.K. Sharma[1]
[1]Department of Soil Science, [2]Department of Soil and Water Engineering,
CCS Haryana Agricultural University, Hisar, 125004, Haryana
**Email: ramsansanwal@gmail.com*

The present study examined the quality of groundwater in a 49,785 ha region comprising Palwal block of Palwal district of Haryana state, lies adjoining to Faridabad district and at a distance of 45 km from the northern border of New Delhi. 132 groundwater samples from running tubewells in the block have been analyzed for ionic concentrations of CO_3^{2-}, HCO_3^-, Cl^-, SO_4^{2}, Ca^{2+}, Mg^{2+}, Na^+ and K^+. Parameters such as electrical conductivity (EC), sodium absorption ratio (SAR) and residual sodium carbonate (RSC) have been evaluated. According to AICRP classification, it was found that 34.8% water samples were of good quality, 49.2% saline and 16.0% alkali in nature. Out of the saline water, 24.2, 1.5 and 23.5% were marginally saline, saline and high SAR saline, respectively. In alkali group, 2.3, 2.3 and 11.4% were marginally alkali, alkali and high alkali, respectively. The study revealed that out of 133 samples, 101 of the samples showed EC upto 4 dS m^{-1} and the maximum value of EC ((11.0 dS m^{-1}) was found in village Rakhuta. Residual sodium carbonate (RSC) and sodium adsorption ratio (SAR) varied from nil to 5.50 me L^{-1} and 2.50 to 23.40 (m mol $L^{-1})^{1/2}$, respectively. Spatial variable maps of EC, SAR, RSC and water quality of groundwater used for irrigation in the block were prepared through GIS to study the spatial variability.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Study of Soil Salinity and Organic Matter under Different Landforms in Coastal West Bengal using Remote Sensing and GIS

Shishir Raut, B. Maji, S.K. Sarangi and T.D. Lama
ICAR-Central Soil Salinity Research Institute, Regional research Station, Canning town, S24PGS, 743329, West Bengal

The production of rice in coastal West Bengal suffers from soil salinity. Therefore, assessment of soil salinity is a need to improve crop yield for the area. The soil salinity and cropping behavior under different landforms have an important influence on soil organic matter. IRSP6 L4 satellite data for 13th Feb., 2015 was collected from NRSA. Land use map for 2015 *rabi* season was prepared for the study area in ARC-GIS v.10 using satellite data and related information. From the satellite data a normalized different vegetation index (NDVI) map was also prepared. Areas coming under different landforms of a coastal Block (Gosaba) were also studied using maximum likelihood classifier. Soil samples in replicates were collected from cultivated and fallow lands for determining EC and pH. Results showed that out of 1327 sq km study area, cultivated area was around 453 sq km and fallow land was around 179 sq km. The study area mainly comprised of three different types of landforms namely, mangrove/mudflat, deltaic and depressed low land. The normalized different vegetation index values for mangrove/mudflat, detaic and depressed lands were found to be 0.06-0.37, 0.15-0.27, and 0.12-0.22, respectively. The areas under mangrove, deltaic and depressed land for Gosaba Block were 9820 ha, 12436 ha, and 8580 ha, respectively. With increase in salinity of soil, in general, there was a decrease in organic carbon content of soil resulting in decrease in NDVI value for all types of landforms.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Different Sources of Calcium on the Incidence of Blossom-end Rot, Marketable Yield and Fruit Quality of Tomato (*Lycopersicon esculenum* Mill.)

G.C. Satisha, A.N. Ganeshamurthy and Mazhar Jamil
ICAR-Indian Institute of Horticultural Research, Hessaraghatta Lake Post,
Bengaluru, 560089, Karnataka
**Email: satishagc@gmail.com*

The fruit cracking and blossom-end rot have been identified as significant factors of crop loss at pre-harvest stage in tomato, chillies and well pepper. Blossom-end rot is a nutritional and or physiological disorder, not a disease and that can dramatically reduce both marketable yield and quality of fruits. Blossom-end rot is local deficiency of calcium (Ca) in tomato fruit. The most likely causes of the disorder are poor Ca uptake by the roots and/or inadequate distribution of Ca to the fruit at a period of high Ca demand. The present investigation aimed to examine the effect of different sources of calcium-foliar application on yields, fruit quality and incidence and severity of blossom-end rot in tomato. Pot experiments were conducted at ICAR-IIHR during the year 2013-14 to study the efficiency of foliar spray of different calcium sources on tomato varieties (cv, Arka Vikas and Arka Abha) and results showed that foliar spraying of curd in combination with slaked lime significantly increased fruit yield, yield attributes and fruit quality. The foliar application of curd (200 ml L^{-1} + slaked lime (5g L^{-1}) decreased the percentage of incidence and severity of blossom-end rot compared with other treatments in both the cultivars. The disease severity was 36.30% and 22.50% in Arka Vikas and Arka Abha with curd+slaked lime compared with 67.50% and 61.30% in the unsprayed treatment, respectively. The study also revealed that the Ca uptake and the Ca content of the fruit were significantly decreased at distal end of the fruit. The distal end (blossom-end) of the fruit contained less Ca than the middle and the calyx end or proximal end in both the verities. Considerably higher calcium content of the fruit was also recorded with spraying of curd and slaked lime compared to other treatments suggesting Ca moves with the transpirational water flow via xylem transport, which have reduced the onset of blossom-end rot. The best results were obtained from the spraying of curd (200 ml L^{-1}) with slaked lime (5g L^{-1}) in controlling the severity of blossom-end rot and also is found to be best for improving the marketable yield and fruit quality of tomato.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessing the Water Quality in Kundadam Block of Tiruppur District, Tamil Nadu

M. Elayarajan, B.J. Pandian and V. Karthika
Water Technology Centre, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu

The prevalence of fluorosis is mainly due to the consumption of more fluoride through drinking water. It is necessary to find out the fluoride endemic areas to adopt remedial measures to the people on the risk of fluorosis. In the present wok, our aim was to study about the ground water quality assessment. Ground water quality and ionic composition were assessed through the collection and analysis of the samples in the Amaravathi river basin area during July-August 2017. GPS based water samples were collected from different location i.e., 50 villages of Kundadam block of Tiruppur district Tamil Nadu, which are almost uniformly distributed over the river basin area. The analysis was carried out for physicochemical parameters and various water quality parameters were worked out. The overall mean value of ground water quality parameter on hydrogen ion concentration collected from the different locations in the study area did not vary much and the mean pH value in general ranged from 8.28 to 9.31. The overall mean value of electrical conductivity in the groundwater samples vary widely from 0.37 to 3.76 dS m^{-1}. The range of TDS of ground water samples of the study area falls in between 236.8 and 2406.4 mg L^{-1} with a mean value of 988.0 mg L^{-1}. Most of the water samples in the study area fall within the maximum permissible limit of 2100 mg L^{-1} except in few locations. The high value of TDS may be due to the various pollutants into groundwater.

Results on fluoride content in the ground water samples of the study area suggested that there were variations in the concentration of fluoride ion within the river basin, but the concentration in most cases were within tolerable limits (<1.5 mg L^{-1}) except in few locations of Kundadam village. The range of fluoride content for ground water samples of the study area falls in between 0.18 to 2.12 mg L^{-1} with a mean value of 0.78 mg L^{-1}. A low fluoride content was usually associated with a high calcium content as CaF_2 (Fluorite) is of limited solubility.

The overall mean values on calcium ion concentration in the ground water samples ranged from 2.8 to 45 me L^{-1} with a mean value of 14.9 me L^{-1}. The results on magnesium content of the wells located at Kundadam block varied from 0.4 to 26.2 me L^{-1} with a mean value of 8.84 me L^{-1}. The carbonate ion of Kundadam block was found to vary between 2.0 to 10.0 me L^{-1} with an overall mean value of 4.8 me L^{-1}. The bicarbonate ion in the study area was found to very between 1.0 to 27.0 me L^{-1} with an overall mean value of 3.1 me L^{-1}.

From the study, it was observed that Kundadam block of Tiruppur district in Tamil Nadu is moderately fluoride endemic. About 26 per cent of the villages in this block have fluoride level more than the prescribed permissible limit in drinking water. Assessment of ground water samples from various parameters indicates that the ground water in most part of the study area is chemically unsuitable for drinking purpose.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Iron Slime on DTPA-extractable Cationic Micronutrients and Heavy Metals of Soils under Different Land Use Systems: An Incubation Study

Souvik Roy Chowdhury, Pravat Utpal Acharjee, Debashis Ghosh, Swarbinay Mahanta, Sajal Saha, Sandip Hembram and Prasanta Kumar Patra

Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, P.O. Krishi Viswavidyalaya, Mohanpur, 741252, Nadia, West Bengal

Disposal of by-products generated during steel making require substantial monetary involvement in one hand and loss of valuable resource on the other. Application of iron slime with soil has been found to increase the organic carbon, available and total nitrogen, available P and K content of soil. To examine whether it has some detrimental effect, a laboratory based pot culture experiment was carried out for a period of 180 days on addition of graded dose of iron slime on the availability of some micronutrients and heavy-metals in soils collected from 14 agro ecosystem across different locations in West Bengal. Irrespective of ecosystem and level of iron slime application, while a progressive increase with time of incubation, was observed in extractable Fe, Cu, Zn, Cd and Ni content, extractable Mn and Pb content recorded a decreasing trend. Higher levels of iron slime application resulted in higher levels of extractable Cu (2.04 mg kg^{-1}), Zn (2.37 mg kg^{-1}), Cd (0.11 mg kg^{-1}) but lower levels of extractable Mn, Ni and Cr. At the end of 180 days of incubation, irrespective of iron slime application, maximum change (%) with respect to their initial level was observed in Fe, Mn and Zn in Eucalyptus plantation, that of Cu in rubber, of Pb in Guava and of Cr in the fallow soil and that of Cd and Ni in rice ecosystem. Maximum per cent decrease in the available Cu, Mn, Zn and Cr were observed in soils collected from fallow, okra, jute and litchi ecosystems, respectively. Little response with respect to available Fe, Cu, Mn, and Zn content was observed in soils collected from Rice, Eucalyptus, Litchi and Okra ecosystem, respectively, due to application of Iron slime. Correlation study revealed strong negative correlation of Mn content with Fe (-0.615**) and positive correlation with Pb (0.654**). Extractable Cd and Ni were found to be in strong correlation with Cu. At the end of 180 days of incubation, Fe concentration of soils ranged from 15.67 mg kg^{-1} in Brinjal to 65.82 mg kg^{-1} in Eucalyptus with a mean of 41.5 mg kg^{-1}; that of Cu ranged from 0.86 mg kg^{-1} in Tea soils of North Bengal to 5.10 mg kg^{-1} in rice soils with a mean of 5.10 mg kg^{-1}; for Mn, these values ranged from 6.15 mg kg^{-1} in Sal to 26.31 mg kg^{-1} in Eucalyptus with a mean of 11.67 mg kg^{-1} and for Zn, it ranged from 1.28 mg kg^{-1} in Jute to 5.83 mg kg^{-1} in Sal with a mean of 2.35 mg kg^{-1}.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Phosphorus Application on Arsenic Availability in Soils and its Uptake by Rice

Sumandeep Kaur, Dhanwinder-Singh and Kuldip-Singh
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab

Rice-wheat crop rotation is mainly followed in most parts of Punjab. Exposure of rice fields to arsenic through groundwater irrigation may lead to As accumulation in soil to unacceptable levels and eventually increasing the possibility of its uptake in rice plants. Phosphorus (P), being an essential macro nutrient, is added to the soils to get higher yield. Due to continuous use of P fertilizers for many years, the status of available P in soils of Punjab has reached medium to high. Phosphorus (P) is a chemical analogue of As and competes with As in plant uptake. To understand the interactive behaviour of P (applied as P fertilizer) and As (present in irrigation water) in soil and its effect on As bio-availability, rice (*Oryza sativa* L.) crop was raised in pots in a greenhouse study. The crop were irrigated with arsenic laced water (0, 2.5, 5.0, 10.0 μM As L^{-1}) throughout the growing period, without and with phosphate fertilization (0, 60 and 120 mg kg^{-1}). Arsenic uptake and dry matter yield in different parts of rice crop were assayed after application of As alone and simultaneous supplementations (As + P). A synergistic interaction between P and As was observed. Addition of As through irrigation water significantly reduced yield of rice grain, straw and root. Subsequent addition of P further decreased the yield of rice grain, straw and root but increased the As uptake and its toxicity in rice. The effect of P on dry matter yield was more pronounced at its higher dose (120 mg kg^{-1}) as compared to its lower dose (60 mg kg^{-1}). The presence of P either alone or added along with As significantly enhanced the As concentration and its uptake by different parts of rice and higher As concentration was observed with addition of highest level of applied P (120 mg kg^{-1}). Fractionation of As among different soil fractions, indicated that P supplementation increased the As uptake due to transformations of As associated with less labile soil fractions, to more labile soil fractions. The significance of this study is that omission of P fertilizer to rice crop, grown in medium to high available P status soils, can help in reduction of As uptake in rice.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Bioavailability of Heavy Metals on Textile Sludge Application to Soil

K. Anand Kumar, P. Prabhu Prasadini, G. Ramachandra Rao and G. Kishore Babu
Department of Environmental Sciences, Advanced Post Graduate Centre,
Acharya N.G Ranga Agricultural University, Lam, Guntur, 522 034, Andhra Pradesh

Textile industry being second largest sector in India after sugar industry is facing problems with its sludge disposal. The commonly adopted, safe disposal of sludge from textile industry as plant nutrient source, requires research on bioavailability and concentration of toxic heavy metals. In this connection, an incubation experiment was conducted with textile sludge obtained from NSL Textiles, Guntur district of Andhra Pradesh in the Department of Environmental Science, ANGRAU. The sludge contained 37.6, 22.6, 4.5 and 106.6 mg kg^{-1} of Ni, Pb, Cd and Cr, respectively. Cr content was found to be higher than that prescribed in MSW Rules, Cd content exceeded SEPA of China permissible limits and all others were within the permissible limits. The treatments of the experiment included fine textured soil with conjoint application of the textile sludge with and without microbial consortium in plastic boxes maintained gravimetrically at maximum water holding capacity for 45 days of incubation period. The 10 combinations studied were : T_1- Soil alone (control), T_2 - Soil + sludge @ 3 t ha^{-1}, T_3 - Soil + sludge @ 5 t ha^{-1}, T_4 - Soil + sludge @ 10 t ha^{-1}, T_5 - Soil + sludge @ 3 t ha^{-1}+ microbial consortium, T_6 -Soil +sludge @ 5 t ha^{-1}+ microbial consortium, T_7 - Soil + sludge @ 10 t ha^{-1}+ microbial consortium, T_8 - Soil + sludge decomposed with microbial consortium @ 3 t ha^{-1}, T_9 - Soil + sludge decomposed with microbial consortium @ 5 t $ha^{-1}$and T_{10} - Soil + sludge decomposed with microbial consortium @ 10 t ha^{-1}. Study was carried out with 3 sets of such, for sampling at 15, 30 and 45 days of incubation for heavy metal analysis of soil. The analysis of the incubation study data revealed that the variation among the treatments and among the incubation intervals was statistically significant. The interaction effect was found to be non-significant except in case of nickel. Over sludge treatments, the mean available Pb, Ni, Cd and Cr values were found to decrease from 15 to 45 days of incubation. This might be due to formation of complexes over time of decomposition of sludge. The available Pb, Ni, Cr and Cd content in soils were significantly higher in all sludge treatments compared to control. The lead values were significantly higher by 0.28, 0.25 and 0.31 mg kg^{-1} with the application of untreated sludge @ 3, 5 and 10 t ha^{-1} respectively over that of recorded (2.74 mg kg^{-1}) in control. The nickel content was significantly increased by 0.029, 0.053 and 0.069 mg kg^{-1} with the increased doses of untreated sludge @ 3, 5 and 10 t ha^{-1} over control (0.345 mg kg^{-1}). The increase in Cd and Cr in soil with increased doses of sludge @ 3, 5 and 10 t $ha^{-1}$was also significant. Broadly, comparing the sludge types over incubation intervals, it was noticed that the untreated sludge applied treatments recorded the highest values of toxic heavy metals in soil followed by that recorded by decomposed/treated sludge treatments.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Protocol for Fixing Permissible Limit of Extractable Metals in Polluted Soils in relation to Human Health

Debasis Golui, S.P. Datta*, B.S. Dwivedi and M.C. Meena
Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi, 110 012
**Email: spdatta.manish@gmail.com*

The specific objectives of the present investigation were to predict the uptake of Zn, Cu, Ni, Cd and Pb by spinach and wheat grown on metal polluted soil using integrated solubility and free ion activity model (FIAM) and to fix the permissible limit of these metals in polluted soils in relation to human health hazard. For this purpose, twenty eight bulk surface soil samples with diverse soil properties such as pH, organic carbon and metal content were collected from smelter effluent, industrial sewage, polluted river water, domestic sewage, solid waste and cycle factory effluent deposited sites across the country. Metal contents in spinach and wheat grain were predicted by the integrated solubility-FIAM without actually measuring the free ion activity in soil solution. Results indicated that 78, 57, 64, 67 and 93% variation in Zn, Cu, Ni, Pb and Cd content of spinach could be explained by soil pH, organic carbon and EDTA-extractable metals, respectively. The model yielded prediction coefficient of 0.51 for Zn, 0.55 for Cu, 0.63 for Ni, 0.66 for Pb and 0.87 for Cd, when DTPA-extractable metals were used as an estimate of labile pool. Risk assessment of metal polluted soil in terms of hazard quotient (HQ) indicated that wheat grown on solid waste, industrial effluent and sewage irrigated soils were not safe (>0.5) to be consumed by human being as far as Zn, Cd and Ni content in spinach and wheat grain are concerned. A ready reckoner was developed for computing permissible limit of DTPA extractable metal in soil based on the predicted HQ (0.25 and 0.50 for spinach and wheat, respectively) by integrated solubility-FIAM for intake of metals by human through consumption of spinach and wheat. The permissible limit of DTPA-extractable Cd would be 0.54 mg kg^{-1} for spinach, if soil pH and organic carbon are 6.0 and 0.25%, respectively, while at organic carbon 0.5%, the DTPA-extractable Cd could be 1.10 mg kg^{-1} if pH is 6.0. Novel approach as used in assessing the risk of metal polluted soils in relation to human health proved to be useful and promising.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Quality Assessment by Different Methods in Selected Cotton Growing Areas of Vidarbha Region, Maharashtra

Dhanashree S. Pable[1], S. Chatterji[1], M.V. Venugopalan[2], T.K. Sen[1] and S. Chatteraj[1]
[1]ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur, 440 033, Maharashtra
[1]ICAR-Central Institute of Cotton Research, Nagpur, 441 108, Maharashtra

The concern for agricultural sustainability and food security that started growing in the twentieth century has assumed more serious proportions in the 21st century. It has been due to, among other factors, deteriorating soil quality. The process of assessing SQ is undertaken through a number of approaches. The paper presents an assessment of soil quality by different methods in cotton growing environs (AESR 6.3 and AESR 10.2) of Vidarbha Maharashtra. Six soils each in AESR 6.3 (Akola district) and AESR 10.2 (Nagpur district) were selected, studied for their morphological, physical, chemical and biological properties and assessed for their quality. Minimum datasets (MDSs) required for assessing soil quality were developed using i) expert knowledge, and ii) Principal Component Analysis (PCA). The major soil constraints identified in AESR 6.3 were shallow depth, high BD, low hydraulic conductivity and high ESP and those in AESR 10.2 were high clay content, high BD and low hydraulic conductivity. The MDS developed by expert knowledge as used in developing Relative Soil Quality Index (RSQI) and Composite Soil Index (CSI) by conventional and fuzzy modeling-based method respectively. PCA was also used in developing MDS, followed by use of a (contemporary) PCA-based method for soil quality assessment through Soil Quality Index (SQI). The results indicate that all the methods identified pedon 3 and pedon 12 as the best soil (rank 1) in AESR 6.3 and AESR 10.2 respectively. The PCA-based method was identified as the best method of soil quality assessment in AESR 6.3 whereas conventional method was superior to other methods in AESR 10.2.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of FYM and Vermicompost on Phytostabilization of Chromium Contaminated Soil by using Rice (*Oryza sativa L.*)

P.K. Sharma, K. Ramya Krishna, Vipin Kumar, Y.V. Singh and S.K. Singh
Department of Soil Science and Agricultural Chemistry and, Banaras Hindu University, Varanasi, 221005, Uttar Pradesh

Contamination of soil with chromium is an environmental concern. The reduction of the mobility of heavy metals in soil involves phytostabilization. A pot experiment was carried out to study the effect of FYM and vermicompost on phytostabilization of Cr contaminated soil by using rice. Results indicated that the rice grain yield decreased with increasing Cr concentration. The Cr content in grain and straw of rice significantly increased with increase in Cr levels.The highest Cr content was recorded in straw followed by grain in rice crop. The application of farm yard manure (FYM) and vermicompost significantly decreased Cr content of rice grain and enhanced uptake of chromium by roots and straw. The Cr application increased DTPA extractable -Cr of the soil. The application of amendments significantly decreased DTPA extractable –Cr content. Enrichment factor and translocation factor were greater than 1 which indicates that rice can hyper accumulate Cr from roots to shoots. Upon application of organic amendments there was accumulation of Cr was observed more in the roots Hence, toxic effect of Cr on crop could be mitigated more effectively with vermicompost and FYM application and reduce the risk of health hazards for human beings and animals.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Prospect of Cr (VI) Remediation in Chromite Mining Areas

Madhumita Das, P.S.B. Anand, S. Roy Chowdhury and K. Laxminarayana[1]
ICAR – Indian Institute of Water Management, Chandrasekharpur, Bhubaneswar, 751 023, Odisha
[1]ICAR – CTCRI Regional Station, Bhubaneswar, Odisha

Mining and processing of chromite ore release the hexavalent Cr in the neighboring environment. To study the extent of Cr (VI) present in soil and water an investigation was carried out in largest chromite reserves in the world, i.e. Sukinda area in Odisha. Soils collected in and around the chromite mining areas are found acidic (pH 5.3 to 7.2) in reaction, contained 0.32 to 1.36% organic carbon and 2.54 to 190.11 mg kg^{-1} exchangeable Cr (VI) and, while water samples collected from different drainage streams during monsoon contained Cr (VI) in a range of 0.062 to 0.339 mg L^{-1}, and 82% are found not usable by containing toxic level of Cr (VI).

However, to remediate hexavalent Cr a pot experiment was carried out at varied concentrations of Cr (VI) as $Cr_2O_7^{-2}$ ranged from 0.3 to 1.0 mg L^{-1} by growing *Pistia stratiotes,* Water lily, *Hydrilla verticillata, Salvinia minima* and *Ipomoea aquatica* for a period of 38 days of imposing Cr treatments (0, 0.1, 0.5 and 1.0 mg L^{-1}) in water under net house condition. Observations of plant weight against Cr concentration at different dates revealed that *Pistia stratiotes* reduces the Cr concentration in a tune of 45 to 97% in expense of losing 18 to 30% of its biomass. Water lily however slightly reduced the Cr level losing 47 to 51% of biomass under similar situation and thus indicates its inability to withstand under Cr enriched situation. While *Hydrilla verticillata* showed a 5 to 49% decrease of Cr surrendering 71 to 75% of its biomass within 13 days of imposing Cr treatment in the water and eventually found unsustainable for removing Cr from the water; *Salvinia minima* apparently indicated a positive growth rate with the application of Cr over 'no Cr' with 13 to 87% reduction of Cr in water and *Ipomoea aquatic*a revealed a 10 to 89% reduction of Cr with 6 to 20% loss of biomass under similar situation. The growth rate and chromium removal capacity of the species could be combined for exploiting Cr (VI) remediation in chromite mine areas.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of Treated Distillery Effluent and NPK Fertilisers on Ammoniacal (NH^+_4-N) and Nitrate Nitrogen (NO^-_3-N)

K. Sivasabari* and L. Chithra
Department of Soil Science and Agricultural Chemistry, ADAC&RI, TNAU, Trichy, Tamil Nadu
**Email: sabarisiva3@gmail.com*

Distillery spentwash, after the recovery of biogas is known as biomethanated distillery spentwash (BDS) or post methanated distillery effluent or treated distillery effluent (TDE). The distillery effluent contains large quantity of soluble organic matter and plant nutrients like nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), sulphur (S), iron (Fe), Zinc (Zn), copper (Cu), manganese (Mn), boron (B) and molybdenum (Mo). The use of inorganic fertilizer is becoming costlier day by day. To increase the yield of rice and to decrease the burden caused to the farmers by the expenditure towards the fertilizer cost, it is better to go for agro-based waste material as a source of nutrient to the crop. In order to improve the supply of all essential nutrients and also to maintain good soil health, it is necessary to use organic wastes like TDE in conjuction with fertilizers for maximising the productivity.

In view of the above, the long term effect of pre plant application of TDE, the experiment was conducted as 10th crop during November, 2012 in the ongoing long term experiment since 2008 at Anbil Dharmalingam Agricultural College and Research Institute, Trichy, Tamil Nadu with rice (TRY-1) as test crop with an objective to study the effect of treated distillery effluent and different doses of NPK fertilizers on soil biological properties. There were four main plots *viz.*, M_1 (Continuous application of TDE), M_2 (TDE application at once in two years), M_3 (TDE application at once in three years) and M_4 (Control) and six fertilizer levels in subplots *viz.*, S_1 (Control), S_2 (100% recommended doses of NPK), S_3 (50% N alone), S_4 (50% N+50% K), S_5 (100% N alone) and S_6 (100% N + 50% K). The treatments were replicated twice in a split plot design.

The results of field experiment have showed that, in all the three stages viz., active tillering, panicle initiation and post harvest stage the highest NH_4^+-N (245, 195, 146 kg ha^{-1}) and NO_3^--N (108,112,132 kg ha^{-1}) were recorded in the treatment which received continuous application of TDE along with 100% RD of NPK (M_1S_2). In active tillering stage, NH_4^+-N and NO_3^--N content increased with increase in dose of TDE, which indicated that the application of TDE added large amount of N and increased the ammonification and nitrification. Application of different levels of inorganic N fertilizer also significantly increased the NH_4^+-N and NO_3^--N in soil. It indicated that the TDE not only adds N to soil, but also enhances the mineralization of N from organic N pool (native) in soil. There was a reduction of NH_4^+-N in panicle initiation stage and this might be due to crop removal and also absorption on clay particles or lost through NH_3 volatilization.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Evaluation of Rice Varieties for Mitigation of Arsenic Accumulation in Contaminated Areas of West Bengal

Prasanta Kumar Patra, Sandip Hembram, Pushparani Senjam, Pravat Utpal Acharjee, Debasis Ghosh, Swarbinoy Mahanta, Susanta Kumar Pal and Supradip Sarkar
Arsenic Research Group, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal

Contamination of food chain through rice grains in arsenic contaminated area being a serious health concern, an experiment was conducted during *kharif* season 2016 in Gontra village, Chakdaha block of Nadia district in West Bengal to evaluate 75 rice varieties for accumulation of arsenic (As)in their grains. The experimental soil had total As content of 38.23 mg kg^{-1} soil and extractable As (Olsen's extractants) of 21.88 mg kg^{-1} soil. These 75 varieties could be classified into 10 clusters using K Means cluster analysis. The numbers of varieties in each of these clusters with cluster center values (mg kg^{-1} polished rice grains) were: 0.113 (16); 0.187 (18); 0.288 (13); 0.397 (15); 0.513 98); 0.651 (1); 0.792 (1); 0.869 (1); 1.093 91) and 1.571 (1). Thus 34 number of varieties *viz.*, Aas Fal, Bansh Manik, Chini Kamini, Kedar Gauri, Kalo Nunia, Hemilton, Jhulur, Kandhrakhi, Dhudh Ghas, Bal Singha, Mala, Jasuya, Rapsal, Gaya Sur, Khejur Shari (Sada), Pati Jira, Gobind Bhog, Modi, Bir Pala, Jamai Naru, Langal Kuthi, Badsha Bhog, MTU-7029, Lal Dahlisar, Ghas Khani 9, Mariz Shal, Kalo Namak, Bansh Tara, Bahurupi, Khasa, Dano Guri, CB-1, Para andBR-34 were identified with their ability to exclude As in the soil environment and accumulate <0.2 mg As kg^{-1} polished rice grain, the critical value considered safe for human consumption. These varieties merit evaluation under diverse soil and climatic conditions under different levels of As contamination for their adoption for cultivation or their use as genetic resource for development of new varieties.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessing Soil Degradation in relation to Heavy Metal Pollution-A Case Study

Debasis Golui, S.P. Datta*, B.S. Dwivedi, M.C. Meena, E. Varghese[1] and S.K. Sanyal[2]
Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi, 110 012
[1]ICAR-Indian Agricultural Statistics Research Institute, New Delhi, 110 012
[2]Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, 741 252, West Bengal
**Email: spdatta.manish@gmail.com*

The present investigation aimed at assessing the degree of soil degradation in relation to metal accumulation through long-term use of waste water and municipal solid waste. Soil samples having a long history of receiving waste water (industrial effluents, sewage, polluted river water) and municipal solid waste were collected and designated as Zn smelter effluent-S1, sewage effluent-S2, polluted river water-S3, domestic sewage effluent-S4, solid waste-S5, cycle factory effluent-S6. Extraordinarily high contents (mg kg^{-1}) of total Zn (6887±10651), Pb (731±1277) and Cd (109±136) were recorded in S1 as compared to other polluted soils. Relatively higher level (mg kg^{-1}) of total Pb (666± 339) was also recorded in the S5. Elevated levels (mg kg^{-1}) of Zn (2353±1145), Cu (1192±801), Ni (864±455) and Cd (9.81±4.65) were recorded in S6. Heavy metal build-up in S2, S4 and S3 were much lower, compared to that in S1, S5 and S6. The value of different indices (I_{geo}, PI, IPI and PLI) suggests the different degrees of pollution at different sites, for example, S1 with Zn, Pb and Cd, while S5 and S6 were polluted with Pb, Cd and Zn, Cu, Ni, respectively. Protocol developed for assessing soil quality in relation to metal pollution proved to be useful. Soil quality index as developed by PCA, were 0.49 for S1, 0.61 for S2, 0.94 for S3, 0.80 for S4, 0.66 for S5, and 0.42 for S6. Such soil quality indices (SQI-PCA and EO) indicate the degree of soil degradation of soil due to waste water-irrigation from various sources.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Assessment of Soil Quality Indicators under Rice Ecosystem in Acidic Soils of Assam

Anjuma Gayan*, D.J. Nath, Ipsita Ojah and Smrita Buragohain
Department of Soil Science, Assam Agricultural University, Jorhat, 785013, Assam
**Email:anjumagayan@gmail.com*

Soil quality indices (SQI) under rice ecosystem of AESR 15.4 located in Assam, were assessed integrating 21 soil physical, chemical and biological attributes which were considered as minimum dataset. 146 numbers of soil samples were analyzed under flood free and flood prone areas comprising of cultivated soils and nearby uncultivated soils.SQI was computed using principal component analysis (PCA) and expert opinion (EO). Rice yield data were recorded from selected farmers. Relative soil quality index (RSQI) using 20 soil attributes was developed for comparative analysis of soils. In about 65% of rice cultivation sites, very low amount of nitrogenous fertilizers (<20 kg N ha^{-1}) and organic inputs (< 3.0 t ha^{-1}) were used in which the average rice yield of 4.26 t ha^{-1} was obtained. In rice cultivated soils, PCA-SQI value ranged between 0.76 and 0.43 with a mean of 0.580 (±0.069). Of the seven key indicators selected, fluorescein di-acetate (FDA) activity contributed the highest contribution (25.86%) towards mean value of SQI (0.58). Under EO-SQI, soil functions like nutrient cycling and water availability accounted for 73.02% towards the mean (0.63±0.06) value, and showed a high degree of relationship (r=0.700**) with PCA-SQI. The RSQI computed using 20 soil attributes rated 1.37% samples as poor (<50% RSQI), 58.90% samples as medium (50-70% RSQI) and 39.73% as good (>70% RSQI) category. High degree of relationship (r=0.672**) was observed between PCA-SQI and RSQI. The uncultivated soils showed relatively good soil quality (mean PCA-SQI value 0.59) compared to cultivated soils (mean PCA-SQI value 0.58). However, under rice cultivation the soil functions illustrated a better soil quality (mean EO-SQI,0.63) as compared to uncultivated soil (mean EO-SQI,0.62) indicating the continuance of soil properties at a sustenance level. SQI and rice yield obtained, illustrated that EO-SQI explained a high degree of relationship followed by RSQI and PCA-SQI. Study indicated that 80% or more of existing rice yield (5.20t ha^{-1}) could be sustained with optimum values of 0.55 and 0.61 computed for PCA-SQI and EO-SQI respectively, and 64.76% for RSQI in AESR 15.4.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Characterization of Cogen Ash for their Physical and Chemical Properties

N. Hamsa[1]*, C.A. Srinivasamurthy[2], V.R. Ramakrishna Parama[1], L.R. Varalakshmi[3] and S. Bhaskar[4]

[1]Department of Soil Science and Agricultural Chemistry, UAS, GKVK, Bengaluru, Karnataka
[2]Central Agricultural University, Imphal, Manipur
[3]Indian Institute of Horticultural Research, Hesaraghatta, Bengaluru, Karnataka
[4]Agroforestry and Climate Change, Indian Council of Agricultural Research
**Email: hamsanraj@gmail.com*

Cogen ash, a by-product of sugar mills obtained during co-generation process to produce heat and electrical energy by burning bagasse and/or coal was used to study its effect on soil properties, growth and yield of paddy. Waste recycling is an age old technology as it is eco friendly and economically feasible. Cogen ash is one such waste generated from sugar industries whose characteristics depend mainly on the source used, combustion and storage condition. As this contains plant nutrients as well as heavy metals in trace amounts it is important to characterize cogen ash which consist of bagasse ash and/or coal ash to understand its impact on soil and crop eco-system. Cogen ash to be used in the experiment was collected from Sri Chamundeshwari Sugars Ltd., Bharathi nagar, Maddur taluk, Mandya district. Though the cogen ash samples were collected at regular intervals and analysed throughout the experiment, there was no much variation in the analysed parameters at different intervals, hence the average values of the analysis are quoted in the abstract. The ash was found to be of silt loam texture containing 40.5% of sand, 50.49% silt and 9.0% clay sized particles, with Bulk Density of 1.06 Mg m^{-3} and 61.1% of maximum water holding capacity. The analysis of the samples revealed that the cogen ash was alkaline in nature with pH value of 8.43. Electrical conductivity was low (0.124 dS m^{-1}), the total carbon content was 1.58%.The cogen ash had trace amounts of nitrogen (0.08%), the total P, K, Na, Ca, Mg and sulphur contents were 0.82%, 1.19%, 0.09%, 0.79%, 0.31% and 142.15 mg kg^{-1}, respectively. The total Fe, Mn, Cu, Zn and B contents were 10321.3, 353.0, 69.09, 135.44 and 174.93 mg kg^{-1}. It also contained some quantity of total heavy metals like Cr and Ni to an extent of 286.52 and 74.77 mg kg^{-1}, respectively, but Pb and Cd were not detected in the cogen ash samples. The available nutrient content of cogen ash was found to be 74.01, 45.14 and 1406.16 mg kg^{-1} of N, P_2O_5 and K_2O, respectively. It also had 0.47, 16.6, 7.2 cmol(p^+)kg^{-1} and 27.0 mg kg^{-1} of Na, Ca, Mg and S, respectively. DTPA-extractable micronutrients were present in 10.08, 9.26, 1.44, 2.62, 0.24 mg kg^{-1} Fe, Mn, Cu, Zn and B, respectively. DTPA- extractable Pb, Cr, Cd and Ni were not detected in the cogen ash samples.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Suitable Extractants for Predicting Bioavailable Cadmium Concentration in Soil and Its Phytotoxicity Limit for Major Soil Orders of India

M. Vassanda Coumar, J.K. Saha, S. Rajendiran, M.L. Dotaniya, Tapan Adhikari, Ajay and A.K. Patra

ICAR-Indian Institute of Soil Science, Nabibagh, Berasia Road, Bhopal, 462038, Madhya Pradesh

Critical limits for metals contaminating the terrestrial environment are often required and the risk associated has to be assessed by comparing current concentrations against concentrations above which adverse effects are considered likely to occur. Pot culture experiments were conducted to derive phytotoxicity limits of cadmium for major soil orders (alfisol, vertisol and inceptisol) of India. Also incubation study was conducted to evaluate the suitable extractants for predicting bioavailable cadmium concentration in soil. Bulk soil samples were collected from Kanpur (alluvial soil), Indore (black soil) and Ranchi (lateritic soil) for conducting pot culture and incubation studies. Soils collected from 3 soil type were spiked with 7 levels of Cd (2 to 40 mg kg^{-1} soil) and test crop spinach was grown.

The results showed that cadmium application had significant yield reduction over control. The dry weight of above biomass of spinach at highest level (40 mg kg^{-1}) of cadmium application was 49.7%, 39.7% and 38.5% as compared to control in alluvial, lateritic and black soil, respectively. Phytotoxicity limit of cadmium for spinach biomass was more in alluvial soil of Kanpur as compared to black soil of Indore. Plant accumulation of cadmium increased with increasing levels of cadmium in all the 3 soil types. At their corresponding levels, cadmium accumulation in spinach biomass leaf was more in lateritic soil followed by alluvial and black soil. At the highest level (40 mg kg^{-1}) of cadmium application, the leaf Cd concentration was 151.23, 78.15 and 64.85 mg kg^{-1} of biomass in lateritic, alluvial and black soil, respectively. Indicating that the transfer coefficient value for cadmium was significantly high in lateritic soil (4.87) followed by alluvial (3.22) and black soil (2.32). Also different extractants (0.01M $CaCl_2$, 1M$CaCl_2$, DTPA and 0.43MHNO_3) were evaluated to predict the bioavailable concentration of Cd in soil. Among the different extractants, the magnitudes of bioavailable fraction were highest in 0.43MHNO_3 followed by 1M$CaCl_2$, DTPA and 0.01M $CaCl_2$ extractant. Among the soil types, the bioavailable concentration was significantly higher in lateritic soil followed by alluvial and black soil in all the extractants used. Significant linear relationship were observed in all the soil types between the extractable fraction by 1M $CaCl_2$ extractant and total Cd content in soil with R^2 value of 0.985, 0.982 and 0.962 in lateritic, alluvial and black soil. Similarly, significant linear relationship were observed in all the soil types between the extractable fraction by 1M $CaCl_2$ extractant and plant content in soil with R^2 value of 0.968, 0.866 and 0.994 in lateritic, alluvial and black soil.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Soil Quality and Wheat Yield after Utilization of Sewage Sludge on Agricultural Land in an Inceptisol

N.P.S. Yaduvanshi and S.P. Datta

Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, New Delhi, 110012

Rapid industrialization and population explosion in India has led to the migration of people from villages to cities, which generate thousands of tons of sewage sludge (SS) daily. The sewage sludge amount is expected to increase significantly in the near future as the country strives to attain an industrialized nation status by the year 2020. To develop an appropriate sewage sludge based prescription for sustainable productivity of maize (*Zea mays*) - wheat (*Triticum aestivum* L.) system and without affect the soil health was initiated in the year 2014-15 at IARI, New Delhi with the following treatment combinations: T1, Control; T2, 100% RDF NPK (150:60:50); T3, 25% N by SS + NPK; T4, 50% N by SS + NPK; T5, 100% N by SS + PK; T6, 200% N by SS ; T7, 300% N by SS and T8, T2 + 2.5 t sludge ha^{-1}. The experimental soil had pH 8.2, available N 171, available P 28.1 kg ha^{-1}, available K 265 kg ha^{-1}, DTPA Zn 1.91 mg kg^{-1}, DTPA Mn 3.39 mg kg^{-1}, DTPA Fe 4.22 mg kg^{-1} and DTPA Cu 1.33 mg kg^{-1}. The Sewage sludge was applied 15 days before sowing of wheat as per treatments. Standard agronomic practices were followed for raising wheat (November to April).

Combined application of 100% NPK with 2.5 t ha^{-1} SS increase significantly in comparison to 100% NPK alone treatment. Highest yield of wheat was obtained with 100% NPK combined with 2.5 t ha^{-1} SS which was more or less equal yield of wheat with the application of 25% N substituted by SS without NPK. However, there was no significant difference in the yield of wheat amongst 100% NPK alone and 25% or 50% N substituted by SS with NPK treatments. A net saving of 37.5 to 75 kg N can be obtained through 2.5 to 5.0 t ha^{-1} of sewage sludge. The residual effect of 2.5 t ha^{-1} sewage sludge with 100 NPK was obtained maximum yield of maize but there is no significantly difference to 100% recommended NPK. The results further showed that wheat yields could be maintained even at 50% N substituted by SS when used in conjunction with NPK fertilizers. Incorporation of SS with and without inorganic fertilizers increased the build-up of available N,P, K and DTPA Zn, Fe, Mn and Cu in soil. The increase heavy metals contents of Pb, Cr, Ni and Cd ranged from 50.3-100.6%, 22.6-59.7%, 71.9-112.6% and 32.4-91.2% in soil and 13.9-129%, 52-178%, 39-126% and 62-128% in wheat grain, respectively in comparison to 100% NPK recommended treatments.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Alleviating Iron Toxicity in Rice under Acid Soils of Tamirabarani River Basin

S. Jothimani, P. Stalin and K. Sivasabari
Rice Research Station, TNAU, Ambasamudram, 627401, Tamil Nadu

Rice is the most important food crop in Asian Countries including India. Tamil Nadu is a leading state, positioned in the top ten list of rice production. Rice is cultivated nearly one lakh ha every year by following rice-rice cropping system under Tamiraparani river basin in southern Tamil Nadu. The soil in the foot hill of the Western Ghats is acidic, continuously submerged from June to March every year and generates iron toxicity which limits the rice grain yield. Iron toxicity syndrome may be due to higher concentration of reduced iron (Fe^{2+}) in the soil solution. The Fe^{2+} in submerged rice soil may be associated with the presence of iron bearing parent materials, oxidation - reduction status, soil pH, ionic concentration and fertility level. The typical visual symptom associated with these processes is the "bronzing" of rice leaves leading to substantial yield losses. The yield losses usually between 15% and 30% and it can also reach the level of complete crop failure under unmanageable condition.

In order to manage iron toxicity in rice, an experiment was conducted during *Pishanam* seasons of 2014-15 and 2015-16 with ASD16 as test crop at Rice Research station, TNAU, Ambasamudram by using different amendments. The field trial was conducted on randomized block design with the treatments viz., T_1 : STCR based NPK alone, T_2 : T_1 + Application of Lime (50% requirement) + 25 kg $ZnSO_4$ ha^{-1}, T_3 : T_1 + 25% extra P and K + 25 kg $ZnSO_4$, T_4 : T_1+ Calcium Silicate @1 t ha^{-1}, T_5 : T_1 + Rice bran @ 3 t ha^{-1}, T_6 : T_1 + Phosphobacteria @ 2 kg ha^{-1}+ K release bacteria @ 2 kg ha^{-1}, T_7 : T_1 + Soil application of 25 kg $ZnSO_4$ ha^{-1} + Foliar spray of 2% DAP + 1% KCl at PI and flowering stages and were replicated four.

Application of various amendments to acid soils in foot hill of Western Ghats significantly influenced yield and yield attributes of rice. The percentage of iron toxicity symptoms varies from 4.1 to 7.8 in both the years. The rice grown under the application of STCR based NPK + 50% lime requirement (4.5 t $CaCO_3$ ha^{-1}) + $ZnSO_4$ @ 25 kg ha^{-1} registered significantly less iron toxic symptoms (4%), more number of productive tillers (288 and 293 m^{-2}) and higher grain (5.4 and 5.6 t ha^{-1}) and straw (7.1 and 6.5 t ha^{-1}) yields followed by the application of STCR based NPK + 25% extra P and K + $ZnSO_4$ 25 kg ha^{-1} which recorded the grain yield of 5.2 and 5.4 t ha^{-1}. The increase in grain yield of rice may be due to the reduction of ferrous concentration by replacement of active ferrous iron in soil solution by the calcium from the applied lime and maintaining balanced nutrient ratio through the application of STCR based NPK and Zinc sulphate.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Heavy Metals Pollution in Groundwater in and around Industrial Area of Gujarat

Anil R. Chinchmalatpure, David Camus D., Ram Vaibhav, Shrvan Kumar, Indivar Prasad, Sagar Vibhute and Monika Shukla
ICAR- Central Soil Salinity Research Institute, Regional Research Station, Bharuch, 392012, Gujarat

Groundwater samples were collected from 50 sites in and around Ankleshwar Industrial Estate and Amla Khadi, a tributary of Narmada in which effluents from the industrial estate are discharged. The data collected from these sites were used to study the seasonal fluctuations in the concentration of heavy metals and the intensity of heavy metal pollution. The concentration of heavy metals like cadmium (Cd), chromium (Cr), copper (Cu), manganese (Mn) and nickel (Ni) was determined by using a tomic absorption spectrometer. The mean value of Cd, Cr, Cu, Mn and Ni in the pre-monsoon season were 0.015, 0.079, 0.106, 0.105 and 0.182 mg L^{-1} respectively and 0.013, 0.000, 0.016, 0.007 and 0.006 mg L^{-1} in the post-monsoon season. The concentrations of Cd, Cr, Cu and Ni in the pre-monsoon season exceeded the acceptable limit for drinking water prescribed by BIS, 2012, whereas in the post-monsoon season only Cd had concentrations above the acceptable limit. The paired t test showed that the heavy metal concentration of pre-monsoon season was statistically higher than that of the post-monsoon season and showed significant variation in their concentrations. Five heavy metals chosen for interpretation accounted for 95.7 percent of total variance. The first factor is an association of Cd, Cr, Cu and Ni which contributed to 84.9 percent of the total variance. The second factor which contributed to 10.8 percent of the total variance was made up of Mn. Heavy metals concentrations of the analyzed metals were used to evaluate the Heavy metals Pollution Index (HPI). The mean value of HPI was 537.20 in the pre-monsoon season and 359.51 in the post-monsoon season. 82 percent of the sites had HPI values higher than the critical value of 100 in the pre-monsoon season and 68 percent of the sites had HPI values higher that the critical value in the post-monsoon season. The intensity of heavy metal concentration in post-monsoon season reduced to a certain extent in all the sites compared to the pre-monsoon concentration. The higher values of HPI may be attributed to the discharge of industrial effluents into the nalas/khadi/river and subsequent mixing with ground water. Lower HPI values in the post-monsoon season may be due to dilution effect resulting in reduction of heavy metal concentration in the post-monsoon season.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

An Overview on Remediation of Water and Soil Pollution using Nanocomposite Clays

Abhirup Saha[1] and Swapna Mukherjee
[1]Department of Earth Science, IIT Roorkee, Uttarakhand
[2]Presidency University, Kolkata, West Bengal

In the past decade, innovations in the field of nanotechnology have enabled us to unravel the mysteries of the nano-world by tailoring materials and designing devices on the nanometer scale (less than 100nm). The nanometer scale is simply arranged between micro and molecular dimensions. Materials science and chemistry research groups are often engaged in research on the nanometer scale, for example, the dimension of crystal structure.

Some petroleum-based compounds, pesticides, herbicides, ols, paints and several other industrial and household chemicals, which are classified as anthropogenic contaminants pose threat to the environment. The presence of radioactive wastes also have a severe impact on environment. Oil spills and presence of unwanted organic materials in groundwater possess undoubtedly environment damaging effects. Even a very small quantity of soil can contaminate the groundwater. Heavy metals such as arsenic are leached out of the excavated rocks and carried downstream when acidic water washes over them. These wastewaters with toxic heavy metals can be introduced into the soil and water bodies by processes such as irrigation. Wastewater treatment plants, agricultural activities, food processing, intensive animal-rearing facilities etc. contributes to the ammonia pollution in aquatic systems. In addition, fertilizers and pesticides added to the soil for agricultural purposes and land filling by municipal waste are growing causes of soil pollution.

The applications of the nano particles includes removal of pollutants from soil or wastewater. Granular-activated carbon effectively removes a large range of organic molecules from water but is very poor in removing large molecules such as humic acid and wastewaters containing emulsified oil and grease. Organoclays proved to be the technology of choice for treating such large molecules to removals of contaminants from wastewaters. Partitioning is the mechanism responsible for the sorption of organics by organoclays. Due to the high cation exchange capacity (CEC) of smectite clays it can accommodate 33% cation substitution in their structure, making them of great interest in the removal of heavy metals. To obtain the best results, microorganisms using a particular organic contaminant as the sole carbon and energy source and which are also capable of mineralizing organic contaminant completely into CO_2 and water are combined with organoclays.

Modified clays are used as adsorbent in the removal of organic compounds in waste water and for the prevention of leaching of contaminants to groundwater and sensitive surface water bodies. They are incorporated into the contaminant outflow or the aquifer to be remediated and by the process of sorption, the modified organoclays prevent a further spread of the contaminants. Reactive barriers are of great significance in soil and aquifer remediation. Thus, naturally occurring layer silicate clay minerals can be value added by modifying their surface properties to enhance their efficiency in the remediation of environmental contaminants. Hence, organoclays show much promise for environmental remediation applications.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Remediation of Heavy Metals of Exfoliated Biochar

Shuvrodeb Roy[1] and Pradip Bhattacharyya[2*]
[1]*Agricultural and Ecological Research Unit, Indian Statistical Institute, Kolkata, West Bengal*
[2]*Agricultural and Ecological Research Unit, Indian Statistical Institute, Giridih, Jharkhand*
**Email: pradip.bhattacharyya@gmail.com*

Now days, Biochar has drawn the burning attention of agricultural scientists and soil chemists due to its multidirectional applications in versatile fields. Biochar has the tremendous capabilities to improve soil health and quality in environmental friendly manner. Addition of even Nano molar concentration of Biochar concentration of Biochar initiates a cascade which ultimately results in the crop production in positive manner. Enhancement of porosity, accessibility of micronutrients, attraction of microbial population, enhancement of water retention capability and such as several mechanisms start immediately after the addition of very minute concentration of Biochar. Apart from agricultural benefits, it has the appliciability in supercapacitor development, catalysis, carbon sequestration and heavy metal remediation like important public, domain. But, having such kinds of potential, very is known about its synthesis roots and further surface engineering techniques. In some studies, several starting components like lignocellulosic feedstock, pine wood, corn cob, rosin, lauan, dairy,manure and broiler litter manure have been studies with its temperature variations. But, molecular level structural analysis and manufacturing mechanism is still required to clearly understand its activity limit.

In our work, we have focused onto its manufacturing up gradation which is not only enhancing its surface to volume ratio, but also segregating individual biochar sheets from its stagnant positioning. We further doped different metal onto its surface to get a complete mechanism of its structural and functional relationship. These exfoliated carbon sheets have tremendous tendency to sequester heavy metals onto its surface. Heavy metal bioaccumulation, biomagnifications and its resultant toxicity to human health is a very challenging matter of concern in recent days. Toxic heavy metalloid like Arsenic is a very challenging threat for human civilization as soils and water source are contaminated with it in a larger area in India. Probably, environmentally benign and cost effective decontaminant adsorbents like Biochar carbon sheets will be effective for in-situ arrest of toxic heavy metals in near future. But, much more attentions will have to be paid into its manufacturing and surface area enhancement to finally achieve the target.

In our work, we have manufactured different exfoliated Biochar carbon sheets by using inexpensive agricultural brown waste materials and further compared there heavy metal sequestering capabilities. Having 74.81m^{-2} g^{-1} BET surface area, exfoliated Biochar sheets from bamboo shell can effectively sequester A_{max} 1.675 mg g^{-1} of Cu^{2+}, 1.89 mg g^{-1} of Pb^{2+} and 0.784 mg g^{-1} of As^{2+} from a single solute aqueous system at 27^0C. The adsorption maxima are not too high in comparison to some Nano-adsorbents, but inexpensive manufacturing technique and environmentally benign nature make this architecture unique in comparison with other adsorbents had been used before.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Direct and Residual Effect of Applied Chromium and Amendments on Dry Matter Yield, Chromium content and Uptake in Maize-Indian Mustard Rotation

Neeraj Rani, Dhanwinder Singh and R. Sikka
Department of Soil Science, Punjab Agricultural University, Ludhiana, 141004, Punjab

A screenhouse experiment was carried out at Department of Soil Science, PAU Ludhiana to study the bioavailability of chromium to crops as influenced by organic manure and lime application. Bulk soil samples for this purpose were collected, one each from tubewell water irrigated (TWI)) and sewage water irrigated (SWI) fields, Maize and Indian Mustard crops were grown in these soils after amending with Cr levels (0, 40, 80, 160 and 320 mg kg^{-1}) in the presence and absence of amendments (FYM and lime @ 1% each). The experiment was laid out under factorial completely randomized block design with three replication Maize and Indian mustard crops were harvested after 45 and 50 days of growth, respectively. The results indicated that maize yield decreased significantly due to direct effect of applied Cr by 35% at 80 mg kg^{-1} of applied Cr in TWI and 53% in SWI at 160 mg kg^{-1} of applied Cr by 35% at 80 mg kg^{-1} of applied Cr in TWI and 53% in SWI at 160 mg kg^{-1} of applied Cr while residual effect was found beneficial up to Cr320 which improved the mustard yield by 30% and 7% in tubewell irrigated and sewage irrigated soil over control. The Cr content in maize significantly increased by 4.27% in TWI and 4.53% in SWI with increase in Cr application due to both direct and residual effect of Cr on Indian Mustard by 8.74% in TWI and 7.81% in SWI. The application of FYM and lime significantly decreased the Cr content of maize by 28% in TWI and 13% in SWI followed by mustard 16% in TWI and 18% in SWI. The Cr application also significantly increased the Cr uptake in both the crops but the uptake was more pronounced in mustard crops indicating that mustard can tolerate Cr toxicity. The application of amendments decreased Cr uptake both the soils. Among the amendments, it was concluded that the toxic effect of Cr on crops could be mitigated more effectively with FYM over lime application and reduce risk of health hazards for human beings and animals.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Heavy Metal Status in Soils of Chamrajanagar District, Karnataka

C.T. Subbarayappa*, Anand, V.N. Mahesh and P.N. Siva Prasad
Department of Soil Science and Agricultural Chemistry, UAS (B), GKVK, Bangalore, 560065, Karnataka
**Email: ctsubbarayappa@gmail.com*

Potentially harmful metals generally find their way in soils from the bed rock, anthropogenic sources, agricultural inputs and fall out of industrial and urban emissions. These heavy metals will bring health hazards, as they enter into food chain and environment. Accumulation of heavy metals in agricultural soils also brings depletion of soil quality. Keeping this in view a field survey was conducted in Chamarajanagar district covering different locations of varied cropping systems. Geo referenced surface soils (350) were collected and processed and analysed for heavy metals such as chromium, cadmium, nickel and lead by using standard procedures, Chromium in the studied soils was in the ranges of 0.66-0.714 with a mean 0.352 mg kg^{-1}. Where as cadmium, nickel and lead ranges from 0.018-0.31 with a mean of 0.064 mg kg^{-1}, 0.042-3.036 with a mean of 1.082 and 0.09-1.954 with a mean of 0.877 mg kg^{-1} respectively. It is clearly evident that all the collected soils of Chamarajanagar district are very low in heavy metals. The order of abundance of heavy metals for the surveyed soil samples was in the order of Nickel >Lead> Chromium >Cadmium.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Impact of Use of Irrigation with Mixed Industrial Effluent as Well as Tube well Water on Micronutrients and Heavy Metals Content of Plant in Industrial Areas of Vadodara and Ahmedabad Districts

G.J. Mistry[1]* and K.P. Patel[2]
[1]*Micronutrient Research Project, ICAR Unit-9, Anand Agricultural University, Anand, 388110, Gujarat*
[2]*B.A. College of Agriculture, Anand Agricultural University, Anand, 388110, Gujarat*
**Email: gimistry910@yahoo.in*

Gujarat being a leading industrial state, several industries have been established from Vapi to Mahesana which is known as the 'Golden Corridor' among which especially in Vadodara and Ahmedabad districts has caused several problems of soil-water pollution due to use of mixed industrial effluent water for irrigation purpose. Which effect on yield and quality of crops grown on effluent irrigated contaminated soils. The loading of soil with micronutrients & the heavy metals mainly through irrigating soils with industrial effluents. The accumulation of heavy metals in soils; inhibits microbial enzyme activity and reduces the population of micro organisms and soil fauna. Not only in peri urban areas, but nearby industrial effluent channel and canal, growing of crops with effluent water is a general practice. They grow all kinds of crops including cereals, oilseeds, fodder, legume and vegetables. Very little basic information is available on its absorption by different plant species. Therefore survey work was carried out in effluent irrigated soils of peri urban area along the effluent channel in Vadodara and Khari canal in Ahmedabad districts to study the impact of use of effluent as well as tube well water on plant content of micronutrients & heavy metals of agricultural crops as well as naturally growing plant species in the areas and also to assess the level of contamination of heavy metals in plant system as well as naturally growing plant species/trees. The plant samples were collected from the contaminated areas irrigated with mix industrial effluent water as well as Non-contaminated sites of the adjoining field irrigated with tube well water. The samples were analyzed for different micronutrients Viz; Fe, Mn, Zn & Cu & heavy metals *viz;* Cd, Ni, Cr, Co and Pb by standard methods.

The result revealed that the content of micronutrients as well as heavy metals in all groups (cereals, oilseeds, vegetables, fruits, trees and others) of crops was higher in contaminated soil compared to non contaminated areas at both the sites. In general, vegetable, oilseed ad tree recorded comparatively higher content of different micronutrients and heavy metals than other groups of crops. The overall contamination level of the crops with different heavy metals was higher in Khari canal area (Ahmedabad) than ECPL, channel (Vadodara) Soils. The results clearly indicated about the contamination of different crops with heavy metals in area irrigated with contaminated water/effluent in peri urban areas of both Ahmedabad and Vadodara along the effluent channel/river canal. The naturally growing neem, drumstick and mango trees were found almost equally efficient for their phytoextraction capacity of heavy metals as the contents of heavy metals in their leaves were more or less similar.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Status of Macro-Micronutrients and Heavy Metals of Industrial Effluent-Tube Well Water and Soils in Industrial Area of Vadodara District

G.J. Mistry[1]* and K.P. Patel[2]
[1]Micronutrient Research Project, ICAR Unit-9, Anand Agricultural University, Anand, 388110, Gujarat
[2]B.A. College of Agriculture, Anand Agricultural University, Anand, 388110, Gujarat
**Email: gimistry910@yahoo.in*

The rapid industrial development in Gujarat especially in Vadodara has caused several problems of soil water pollution due to release of large quantity of effluents either on land or in open canals. Therefore, not only soil but the ground water which is the main source or irrigation is also found to be contaminated with heavy metals. The unwise use of such contaminated water for irrigation purpose has elevated levels of available heavy metals in the cultivated layer of the soil. Such effluent water acts as a carrier as well as a prominent source of heavy metals besides higher nutrients *viz.*, P_2O_5, K_2O, S and micronutrients in agricultural land and ultimate in ground water. Therefore, survey work was carried out in nearby areas of ECPL Channel as well as adjoining areas irrigated with tube well water at Vadodara district to find out the heavy metals as well as micronutrient accumulation in mixed industrial effluent as well as tube well water irrigated soils. The study was carried out to assess the level of contamination of heavy metals as well as nutrients in water and soils. The effluent water and soil samples were collected from contaminated area irrigated with mixed industrial effluent water as well as Non-contaminated sites of the adjoining field irrigated with tube well water. The samples were analysed for different heavy metals *viz.*, Cd, Ni, Cr, Co and Pb as well as micronutrient *viz.*, Fe, Mn, Zn and Cu besides higher nutrients *viz.*, P_2O_5, K_2O, S by standard method.

The result revealed that the effluent as well as tube well water and soil system were found contaminated with heavy metals (Cd, Ni, Cr, Co and Pb) and also found accumulated with micronutrients (Fe, Mn, Zn and Cu) besides higher nutrients *viz.*, P_2O_5, K_2O, S. The general quality of the effluent as well as tube well water was poor with respect to its sutability for irrigation due to excess presence of trace & heavy metals besides soluble cations & anions. The BOD and COD values of the effluents water were above permissible limits for field application. The effluent irrigated fields showed higher content of heavy metals and micronutrients besides higher nutrients *viz.*, P_2O_5, K_2O, S compare to tube well irrigated fields. The content of different soil parameters were higher in 0-15 cm followed by 15-30 cm than at 30-45 cm soil depth compared to tube well irrigated non-contaminated soil. The content of heavy metals as well as micronutrients soils was higher due to increase in available nutrients. However, the increase in DTPA-heavy metals indicated the deterioration in soil health under contaminated area than non-contaminated sites.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Effect of High Temperature Stress on Rice during Vegetative and Reproductive Stages and its Mitigation through Boron Application

Mohammad Shahid*, Amaresh Kumar Nayak, Rahul Tripathi, Jawahar Lal Katara, Banwari Lal and Priyanka Gautam
ICAR-National Rice Research Institute, Cuttack, 753006, Odisha
**Email: shahid.vns@gmail.com*

Rice is the staple food for more than 100 million households in developing countries in Asia, Africa and Latin America and its cultivation is the main source of income for them. The accumulation of greenhouse gases in the atmosphere has warmed the planet and caused changes in the global climate. It is reported that high temperatures would cause a marked decrease in world rice production. In tropical regions, high temperature are a constraint to rice production and the most damaging effect is on grain sterility. Boron (B) plays a very important role in the cell wall formation, sugar translocation and reproduction of the rice crop. A pot culture experiment was conducted to study the effect of B on high temperature tolerance of genotypes under B deficient soil and its tolerance mechanism. The treatments comprised of four boron application treatments and foliar viz. control (B1), soil application of 1 kg B ha^{-1} (B2), soil application of 2 kg B ha^{-1} (B3) and foliar spray of 0.2% B (B4); three rice cultivars *viz*. Annapurna, Naveen and Shatabdi; and three temperature regimes *viz*. ambient (T1), high temperature at vegetative state (T2) and high temperature at reproductive stage (T3). The results revealed the cell membrane stability (CMS) was greater in plants grown under ambient condition compared with the plants grown under high temperature either at vegetative or reproductive stage. On average, plants grown under high temperature showed 9% (at reproductive stage) and 21% (at vegetative stage) increase in electrolytic leakage compared with plants grown under ambient temperature. Application of boron at 1 kg ha^{-1} , 2 kg ha^{-1} and 0.2% foliar spray decreased electrolytic leakage by 23.6, 26.8 and 13.8%, respectively, compared with untreated plants. Under high temperature both at vegetative and reproductive stage, rice plants showed increased level of reducing and non-reducing sugars content varying from 21 to 38%, as compared to ambient temperature. Application of B at 2 kg ha^{-1} led to about 18 and 31% decrease in reducing and non-reducing sugar contents, respectively as compared to the no application of B (control). Application of B at 1 kg ha^{-1} and 0.2% foliar spray also decreased the reducing and non-reducing sugars over the control. High temperature at vegetative stage has caused a 9.4% reduction in yield over the ambient temperature, while high temperature at reproductive stage has resulted in 30.3% reduction in yield over ambient temperature. Application of B results into higher grain yield under both ambient and high temperature condition over control. Higher yield were observed with soil application of B as compared to foliar spray. The results suggest that the exogenous application of boron has a substantial effect on cell membrane stability, sugar mobilization, pollen viability and spikelet fertility, hence the yield. The cultivars due to their variation in the tolerance level for high temperature stress behaved differently, and at high temperature stress, more response of the application of boron was seen in susceptible cultivars.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Development of Integrated Farming System Model in Coastal Saline Soils of Maharashtra

K.D. Patil*, P.B. Vanave, V.R. Vartak, D.K. Borse and S.B. Dodake
Kharland Research Station, Panvel, Dr. B.S.K.K.V, Dapoli, 410206, Maharashtra
**Email: kashinath_111@yahoo.com*

The total area of coastal saline soils in five districts of Konkan is estimated to be 65,465 ha. In view of adaption of Integrated Farming System, the efforts has been made for "Development of IFS model for coastal saline soils" for 1 ha. area. The IFS model developed comprised different enterprises *viz.,* crops and cropping systems on an area of 0.52 ha, horticulture component (fruit crops + spices) 0.19 ha, livestock components namely, poultry on area of 0.0035 ha, Fish pond on 0.2035 ha, vermi-compost unit on 0.0040 ha, kitchen garden 0.0028 ha and rest of the land (0.0762 ha) used for operational and other purposes. Under crops and cropping systems, Rice - Field bean and Okra crop systems were grown on 0.52 ha area. This component produced gross and net returns of Rs. 56,046.25 and Rs. 8,294.77, respectively. The horticulture component included fruit crops namely, sapota, coconut and spices grown on area of 0.19 ha. The contribution of horticulture component in terms of Rs. 71,690 and Rs. 29,165.36 gross and net monetary returns, respectively. In poultry component, 50 chicks for each year 2015-16 and 2016-17 were reared. The average production for pooled data of Rs. 10,495 and Rs. 1,864.5 gross and net returns, respectively. Crop residues, livestock manures/droppings and shed wastes were used for preparation of vermicompost. The vermicompost unit produced giving Rs. 35,785 and Rs. 16,289.25 average gross and net returns, respectively. The fishery component contribute Rs. 1,32,000 gross return and Rs. 71,942.50 net return. Total cost of production of the IFS model in pooled data was Rs. 1,78,460.87 ha^{-1}, which included outside purchase for Rs. 1,17,854.62 ha^{-1} value of recycled material within the system of Rs. 25,596.25 ha^{-1} and for farm labours costing Rs. 35,010 ha^{-1}.Farmers can increase their net returns by saving the expenditure on farm labours through employment of family labours. In terms of economic returns pooled data showed, the gross and net returns were Rs. 3,06,016.25 and Rs. 1,27,555.38, respectively with B: C ratio 1.71.

Studies showed that rain water storing desalinizes the surrounding area of pond. It was observed that EC was 3.10 dS m^{-1} at close to pond and 4.86 dSm^{-1} at 50 meter distance from pond. Salinity increases gradually as distance increase from fish pond. From two year pooled data results, it was concluded that stored rain water in fish pond had shown influence on EC of saline soil. It seems to be gradually increased as distance from fish pond increases. It was lowest at 0 meter and maximum at 50 meters. It may be attributed due to dilution and leaching of salts due to leaching of harvested rain water from fish pond.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Alternate Land Use Options of Meghalaya State of India for Profitable Farming

T.K. Sen, R.K. Jena, S.K. Ray, S. Chatterji and S.K. Singh
ICAR-National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur 440033, Maharashtra

Soils, landscape and socio-economic conditions of Meghalaya State of India have been studied through field visits for alternate land use options. Meghalaya is spread over an area of 22, 429 square kilometres, and lies between 25.00° N and 26.10° N latitude and 89.45 °E and 92.47 °E longitude. Per humid climate with average rainfall ranging between 2000 to 4000 mm, the region supports wide range of natural vegetation encompassing shrub, pine, moist deciduous and ever green forest. The geology of the state ranged from the Archean gneissic complex to the Cretaceous tertiary sediments. The soils are shallow to deep, well drained, medium to heavy textured, acidic, with fairly high organic carbon cornet and low base saturation. Agriculture is the prime source of livelihood of more than 80 percent of population. Despite favourable agro climate the prospect of agriculture is still at low ebb. Amongst others soil acidity, rugged topography, lack of transportation and non availability of quality seed & other agricultural inputs are the bottlenecks for agricultural development. Agriculture in Meghalaya remained non remunerative. Besides other interventions ,traditional farming like broom grass (Growing wild in the forests), pineapple, ginger, jackfruits, citrus and other trees can be replaced with cash-crops ginger, banana, betel nut, beetle vain, fruits, and a varieties of spices having market demand. Plantation crops like, strawberry, tea, rubber and cashew nut are better options which can be introduced matching with landscape and soil characteristics. Based on the perceived knowledge from the interviews with stake holders and traversing the study area promising land use options have been proposed.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Pedological Significance of *Jhuming*

Prasenjit Ray, S. Bandyopadhyay[1], R.K. Jena, S. Ramachandran, P.D. Roy[2], G.K. Sharma, S.K. Singh[3] and S.K. Ray

ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Jorhat, 78004, Assam
[1]ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Kolkata, 700091, West Bengal
[2]ICAR-Indian Institute of Water Management, Bhubaneswar, 751023, Odisha
[3]ICAR-National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur, 440033, Maharashta

Jhuming (shifting cultivation) is a landuse system found particularly in the hill slopes of the North Eastern (NE) region, where the area under forest is slashed and burnt for agricultural purposes. The area under such landuse is left fallow for the next few years (the fallow period is known as *jhum* cycle) by the farmers after cultivation. *Jhuming* is the most traditional and dominant landuse system in the NE region. It is known that the destruction of natural forest and its conversion to cropland during the course of *jhuming* leads to environmental degradation through increased soil loss due to erosion, which in turn is likely to impress upon the natural pedological formation of soils. Pedological manifestations as affected due to *jhuming* have not been studied properly. Therefore, a study was undertaken in Mokokchung district of Nagaland to understand the pedological significance of *jhum* cultivation in the NE Himalayan region of the country. The *jhum* lands in the district were delineated in GIS environment using high resolution IRS-P6 LISS-IV images. Digital elevation model (DEM) was used for the delineation of landform units in the study area. Pedons were studied in the *jhum* lands and adjoining forest lands distributed in different landforms. Results indicated that *jhum* lands occupy 6.31% of the total geographic area of the district, which were mostly concentrated in high and medium hills. Soil resource study indicated that soils of *jhum* lands on high hills with steep (25-33%) to very steep (>33%) slopes and medium hills with very steep slopes (>33%) were *Hapludults* with clay CEC more than 16 cmol$(p^+)kg^{-1}$. The soil resources on medium hills with 25-33% slopes were highly weathered *Kandiudults* with low activity clays (<16 cmol$(p^+)kg^{-1}$ clay CEC). Soils of *jhum* lands on low hills with moderately steep (15-25%) slopes were relatively less weathered (base saturation > 35%) *Kandiudalfs* with clay CEC less than16 cmol$(p^+)kg^{-1}$. On the contrary, soil resources in the forests adjoining to the *jhum* lands on high and medium hills were organic matter rich (organic carbon >12 kg/m^2 up to a depth of 100 cm) *Haplohumults* and *Kandihumults*, respectively. Forest soils on low hills with 15-25% slopes (*Hapludalfs*) were relatively less weathered than the adjoining *jhum* lands. Results of the investigation indicate that soils under *jhum* cultivation are depleted with respect to organic matter. However, *jhuming* had no pedological significance on the soil resources developed on low hills with moderate (5-10%) to strong (10-15%) slope positions. Relatively low steepness in respect of slope positions may be attributed to such results. Results of the present investigation showed that soils of the forests followed a progressive pedogenesis (though might be obliterated due to the *jhum* cycle), whereas soils of the *jhum* lands followed a regressive pedogenesis. In the later the pedological equilibrium is disturbed in a random manner due to its dependence upon the *jhum* cycle and management. The study finds importance in opening new vistas of *jhum* cycle-soil related research and also promises to have far reaching implications upon soil and land degradation, carbon sequestration and sustainable development. The present study on pedological significance of *jhum* cultivation may provide the basis for formulation of policy in relation to improved and sustainable *jhuming* in the NE region of the country.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

On Farm Testing of Balanced Nutrient Management on the Productivity of Rabi Maize (*Zea mays* L.) under Sub-humid Conditions

Ranjeet Singh*, H.L. Bugalia, B.S. Bhati, R.L. Soni and Jeewan Ram Jat
Krishi Vigyan Kendra, Banswara
Maharana Pratap University of Agriculture & Technology, Udaipur (Rajasthan)
**Email: ranjeetsingh1970@gmail.com*

To convince the farmers for adoption of balanced nutrient management practices to enhance the productivity of maize, on farm trials were conducted for two consecutive years (2015-16 and 2016-17) in rabi season in Ghatol block of Banswara district of Rajasthan. Three treatments *viz.*, T_1 (farmer practice 110:60:0 kg N, P_2O_5 and K_2O ha^{-1}), T_2 (recommended doses of fertilizer 150:60:0 kg N, P_2O_5 and K_2O ha^{-1}) and T_3 (balanced nutrient management based on soil test value 150:60:30 kg N, P_2O_5 and K_2O + 25 kg zinc sulphate ha^{-1}) were tested in a randomized block design with five replication and each farmers field was considered as a replication accommodating all the three treatments. The grain yield of maize was influenced by the treatments in both the years. The average grain yield increased from 4.58 to 5.42 t ha^{-1} with application of recommended doses of chemical fertilizers over farmer's practice of nutrient management. Use of balanced nutrient management on soil test basis increased grain yield further to 6.4 t ha which were higher than application of RDF alone. The increase in grain yield was of the order of 39.28 per cent over farmer's practice. The B:C ratio was also higher (2.05) with balanced nutrient management as compared to 1.59 with farmer's practice. Higher cost benefit ratios proved the economic viability of the balanced nutrient management practices made under on farm trial and convinced the farmers on the usefulness of intervention.

82nd Annual Convention: December 11-14, 2017
National Seminar on Developments in Soil Science: 2017

Livelihood Improvement and Sustainable Soil Management through Integrated Farming Systems under Irrigated Dry Conditions of Telangana

M.V. Ramana[1], S. Sridevi[2], M. Goverdhan[2], K. Suresh and Ch. Pragathi Kumari
[1]*Associate Director of Research, RARS, Palem*
[2]*AICRP on Integrated Farming Systems, PJTSAU, Rajendranagar, Hyderabad, 500030, Telangana*

Studies were conducted on Integrated Farming Systems (IFS) for marginal/small farmers under irrigated dry situation for five years under AICRP-IFS since 2011-12 to 2015-16 by integrating crops, horticulture and animal components in 1 ha area. The crop component in 0.7 ha, includes arable cropping systems viz., rice-maize, rice-sunflower, maize-castor, maize + pigeonpea-cowpea and pigeonpea+greengram-groundnut, fodder block and boundary plantation. The horticulture component (0.2 ha) included a fruit crop guava and vegetable intercrops like tomato, green chillies during rainy season and carrot, cluster bean in *rabi* season. The Livestock component (0.1 ha) was initiated with 2 dairy buffaloes (Murrah Breed), 6 goats (Osmanabadi) and a supplementary unit of 20 backyard poultry birds (Vanaraja). Complementary units Vermicomposting and composting were included for residue recycling in the system.

During a period of five years (2011-12 to 2015-16) holistic integration of animals with crops in 1 ha area resulted in mean net income of Rs.1,05,000/- compared to that of an average farmers' net income of Rs 52,000/- in Southern Telangana Zone of Telangana state. Out of this total net income, 61.00% returns from crops including fodder, 2.95% returns from horticulture and 36.05% from livestock unit, were recorded. Component wise share of inputs and labour in total cost of cultivation (COC) indicated that 24.3% of total COC was on inputs purchased from outside and 27.5% of COC could be met through input recycling, 30.0% of expenses on labour could be met through family labour and only 18.1% of total COC was on hiring of labour. At the end of 5th year livelihood analysis indicated that the current Crop + Livestock + Horticulture integrated farming system resulted in a total family saving of Rs 2,17,707/-. The system resulted in production of Rs.3,65,805/- worth of marketable surplus after meeting the requirement of family (worth of Rs.55,525/- with an assumed family size of 2+3) and material worth of Rs.1,03,324/- was recycled in the system. The system also provides an opportunity to save around Rs 1,09,500/- worth of labour wages through employment generation of 878 man days. Nutritional, food and fodder security of the farm family could be met round the year from 1 ha of Crop + Livestock (Dairy & Goat) + Horticulture farming systems through production of cereals, pulses, oilseeds, fruits, vegetables, milk, meat and fodder for cattle.

Availability of diverse farm products in the system facilitated in effective recycling and in turn their utilization as inputs for the other integrated components in the unit. From the system through residue recycling and manure production, on an average, 8625 kg of FYM and 1269 kg of vermicompost could be produced which was equivalent to 135-77-103 kg of N, P and K and saving a fertilizer worth of Rs 8000/- year^{-1}. Continuous use of crop residues and manures through residue recycling over these years helped improving the soil fertility of the unit with perceptible improvement in organic carbon from an initial status of 0.36% in ID block to 0.49%. Improvement in status of available phosphorus and potassium was also evident in IFS unit. Similar advantage in increased available phosphorus from an initial status of 14.8 to 39.8 in fodder block and 30.0 kg under other cropping systems and potassium from an initial of 170 kg ha^{-1} to 224 kg ha^{-1} (178- 250 kg ha^{-1}) was noticed in IFS block.

Author Index