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SALINITY News

भाकृअनुप - केन्द्रीय मृदा लवणता अनुसंधान संस्थान
CSSRI
ISO 9001:2008

Vol. 21, No. 1 January-June 2015

From the Director's Desk

Soils are a finite natural resource and are nonrenewable on a human time scale. Although the area under fertile soils is limited yet it is increasingly subject to degradation, pollution and is being usurped by domestic and industrial sectors. Since soils are the foundations for food, animal feed, fuel, natural fiber production besides a range of ecosystem functions, generating awareness on the life-supporting functions of soil is called for to reverse the degradation trends. It is only way to achieve the levels of food production necessary to meet the demands of food and nutrition for the population levels predicted for 2050. The 68th UN General Assembly declared 2015 as the International Year of Soils (IYS). The Food and Agriculture Organization of the United Nations has been nominated to implement the IYS 2015, within the framework of the Global Soil Partnership and in collaboration with Governments and the Secretariat of the United Nations Convention to Combat Desertification. The IYS 2015 aims to increase awareness and understanding of the importance of soils for food and nutritional security and essential ecosystem functions. In line with these objectives, ICAR-Central Soil Salinity Research Institute has planned several activities such as painting and declamation competition for students, question-answer session for farmers and brain storming session for scientist to create awareness on soil health at various levels as well as to plan the research programmes required to prevent degradation and reclaim the already degraded lands.

The current issue of the Salinity Newsletter provides brief highlights of research, development and capacity building activities undertaken at the institute during January-June 2015. Some of the significant achievements are: exploiting plant-microbe interactions for remediation of coastal saline areas of Gujarat, integrated nutrient management for dry season rice in coastal areas, impact of salt tolerant varieties of wheat in sodic soil, Narendra Beal-5: a promising salt tolerant cultivar and impact of subsurface drainage technology: a success story in Karnataka.

Human resource development and capacity building activities undertaken during this period include 'International Training on Use of Poor Quality Water in Agriculture' for AARDO member countries during February 11-24, 2015 and International training workshop 'Approaches for Integrated Analysis of Agricultural Systems in South Asia: Field, to Farm, to Landscape Scale'. Institute's Foundation day was celebrated on March 1st 2015. Dr. A.K. Sikka, DDG (NRM), ICAR, New Delhi delivered the foundation day lecture. To disseminate institute technologies to the farming community, Rabi Kisan Mela was organized at the main campus of the Institute on 10th March, 2015. Dr. A.K.Singh DDG (Agril. Extn.), ICAR, New Delhi inaugurated the Mela and addressed several queries raised by the farmers. To sensitize the farmers on water conservation, its sustainable use and ways and means to avoid its degradation, world water day was celebrated on 21st March, 2015. Mera Gaon Mera Gaurav meeting was organized on 27th May at Mundri village in Kaithal district in Haryana. Biennial workshop of AICRP on 'Management of Salt-affected Soils and Use of Poor Quality Water in Agriculture' was organized at ICAR-CIGR, Makhadoom (Mathura) during June 5-7, 2015. The meeting was inaugurated by Dr. A.K.Sikka, DDG (NRM), ICAR, New Delhi.

We had an opportunity to receive a number of dignitaries and experts at the institute that enabled constructive discussions with these learned visitors on our research experiments and plans. The notable visitors were: Dr. Thomas A Lumpkin, DG, CIMMYT, Dr. Etienne Duveiller, Director Research, South Asia, CIMMYT, Dr. Gurbachan Singh, Chairman ASRB, New Delhi, Dr.H.S. Gupta, DG, BISA, Ludhiana, Dr. A.K. Sikka, DDG (NRM), Dr. A.K.Singh DDG (Agril. Extn.), Dr. V.S. Tomar, Vice Chancellor, JNKVV, Jabalpur and Dr. S.K. Chaudhari, ADG (SWM), ICAR New Delhi.

Eight scientists joined the institute during this period. We welcome them to ICAR-CSSRI family and wish them all the best for their future professional advancement. A number of colleagues retired from service after rendering valuable services to the institute during this period. We wish them a very healthy and happy retired life. We always look forward for comments/suggestions from the readers for improvements in the Newsletter as it is our endeavor to improve its contents on a regular basis.

(D.K. Sharma)
Director

In this issue...

ICAR – CENTRAL SOIL SALINITY RESEARCH INSTITUTE, KARNAL - 132 001 INDIA

Phones : 0184-2290501; Fax : 0184-2290480, 2292489 | Email: director.cssri@icar.gov.in

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Integrated Nutrient Management for Dry Season Rice in Coastal Areas

Integrated nutrient management (INM) is not only essential for the higher productivity of rice, especially in the dry season, but also to maintain or even improve the soil fertility and reduce the higher costs of fertilizer application. This can be achieved by integrating the chemical fertilizers with locally available organic sources of plant nutrients. In an experiment, recommended dose of fertilizers (RDF, 120-20-0 kg N-P_2O_5-K_2O ha^{-1}) integrated either with *Azolla* as dual cropping with rice and *in situ* incorporation, or integrated use of organic and inorganic fertilizers comprising of 5 t ha^{-1} of Farm Yard Manure (FYM 0.5% N, 0.25% P & 0.4 % K) + RDF was applied. Before the field application of *Azolla*, its basic stock was maintained in a nursery with a water depth of 3-6 cm. *Azolla* stocks were put into beds at 1 kg m^{-2}, and were allowed to grow for a month. Fresh *Azolla* at 2 t ha^{-1} was inoculated in the main field one week after rice transplanting. The *Azolla* mat was incorporated into the soil 4 weeks after inoculation. Since most of the farmers in coastal areas of West Bengal rear cattle as an integral component of their farming systems, FYM is easily available for INM. Grain and straw yields of dry season rice under RDF + FYM were, 24 and 21% higher, respectively than RDF, but were only 11 and 12% higher, respectively as compared with RDF + *Azolla* treatment. Integrated management practices combining a salt-tolerant variety and chemical and organic fertilizers could therefore, enhance the productivity of rice in coastal saline soils.

Azolla mat in the rice field during dry season

S. K. Sarangi, B. Maji, D. K. Sharma, D. Burman and S. Mandal

Impact of Salt Tolerant Varieties of Wheat

ICAR-CSSRI Regional Research Station, Lucknow in collaboration with International Rice Research Institute (IRRI), Phillipines and Krishi Vigyan Kendra, Raebareli, conducted front line demonstrations of salt tolerant wheat varieties-KRL 19 and KRL 213- along with other cultivars on 63 farmers' fields covering an area of 25 ha during *Rabi* 2013-14. About 25 q seeds of salt tolerant varieties along with technical folder having complete package of practices for cultivation of wheat in salt affected soils were distributed to the resource poor farmers of 36 villages under 10 blocks. Selection of the farmers was done on the basis of degree and extent of salt affectedness in their fields. The soil pH of the selected fields ranged from 8.6 to 9.4. The data revealed that the average yield of KRL 213 was higher than KRL 19 and other cultivars at all the pH levels. The average yield difference among the varieties was the maximum at pH 8.8-9.0 and the minimum at pH 8.6-8.8. The maximum increase in yield (34.78%) was recorded at pH 9.2-9.4 with variety KRL 213 and the minimum (4.65%) with variety KRL 19 at pH 8.6-8.8. Based on the feedback received from the farmers, it was observed that 70% farmers preferred variety KRL 213 because of more tillering and higher yield. It is concluded that adoption of KRL 213 with recommended agronomic practices could give the best results under moderate to high sodicity stresses.

Wheat PBW 343 on farmers' field *Salt tolerant variety KRL 213*

Y.P. Singh, V.K.Mishra, Awanindra Tiwari and Sudhanshu Singh

Narendra Bael-5 (*Aegle marmelos* Correa): A Promising Salt Tolerant Cultivar

Given the growing interest in commercial cultivation of bael (*Aegle marmelos* Correa; Rutaceae), an underutilized fruit of Indian origin valued for its medicinal properties, four improved bael cultivars (NB-5, NB-9, CB-1 and CB-2) were evaluated under different soil (EC_e 1.3, 6.5 and 10.7 dS m^{-1}) and water (EC_{iw} 0.5, 3 and 6 dS m^{-1}) salinity treatments to identify the salt tolerant cultivar. Under salinity stress, NB-5 outperformed other cultivars. In moderately saline soils (6.5 dS m^{-1}), it exhibited significantly higher (66%) survival and growth of salt stressed plants was comparable to control. Even under high salinity (10.7 dS m^{-1}), where other cultivars failed to establish, it showed good growth. Although salinity stress significantly increased Na^+ accumulation in tested cultivars, NB-5 plants showed relatively similar distribution of Na^+ ions in leaves, stems and roots, particularly at high salinity, and also maintained higher K^+ concentrations

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resulting in a favourable K^+/ Na^+ ratio for plant growth. NB-5 plants retained toxic Na^+ ions in basal stems and roots and thus prevented its accumulation in leaves and shoots. NB-5 cultivar also showed better photosynthetic relations (relative chlorophyll, net photosynthetic rate, stomatal conductance and transpiration), higher membrane stability and relative water content in leaves as compared to other genotypes in saline soils. At 6.5 dS m^{-1} salinity, average number of fruits in NB-5 was 2 (Fig.1.).

Regular application of saline waters (EC_{iw} 3 and 6 dS m^{-1}) did not adversely affect plant growth in NB-5 while other cultivars exhibited severe injury symptoms- yellowing, cholorosis and defoliation of leaves (Fig. 2). Application of 6 dS m^{-1} saline water caused heavy membrane injury and drastically reduced relative water content in leaves of all cultivars except NB-5. Saline water (6 dS m^{-1}) treated NB-5 plants exhibited significantly lower (0.22) Na^+ /K^+ ratio in leaves while it ranged from 0.34 to 0.59 in other cultivars. Data on chlorophyll pigments and proline concentration in leaves also pointed to higher salt tolerance of NB-5 as compared to other cultivars.

Based on these results, NB-5 was identified as a salt tolerant bael cultivar and is recommended for commercial cultivation in moderately saline (EC_e 6-7 dS m^{-1}) soils with the use of good quality water. Similarly, NB-5 plants growing in normal soils performed well when irrigated with either 3 or 6 dS m^{-1} saline water and may be taken up for cultivation in areas having problem of water salinity provided water logging free sites are selected and normal water is applied for enabling better establishment in the first year of growth.

Fig. 1. Fruiting in NB-5 cultivar in saline soil (6.5 dS m^{-1}).

Fig. 2. Effects of saline irrigation (6 dS m^{-1}) on plant growth in bael cultivars.

Anshuman Singh, P. C. Sharma, M. D. Meena and D. K. Sharma

Impact of Subsurface Drainage Technology in Karnataka – A Success Story

The village Ugar Budruk in Athani taluk of Belgaum district of Karnataka had severe problems of waterlogging and salinity over the past 20 years. About 82 per cent of the farmers in village belong to small and marginal category, posses 57 per cent of the total landholdings and are heavily dependent on agriculture for livelihoods. Owing to their poor economic status, these farmers were not in a position to invest in sub-surface draianage projects involing higher installation and maintenance costs. Thanks to the efforts of some of the progressive farmers and the technical expertise from ICAR-CSSRI, subsurface drainage (SSD) systems were installed in the salinity affected pockets of the village during 2009-10 to 2012-13. In total, 925 ha waterlogged saline lands have been reclaimed with total expenditure of Rs. 499.51 lakhs. About 644 cultivators, with majority of them being small and marginal farmers, have benefitted from this project. The installation cost was Rs. 52000 per hectare with expected project life of about 50 years. The project cost was borne by the Department of Land Resources, Govt. of India (60%), the State government (20%) and the farmer beneficiaries (20%).

Location of project area in Karnataka

Sugarcane, which occupies more than 90 per cent of the cultivated area, is the major crop in the project area followed by oilseeds (5.7%), fruits and vegetables (1.2%) and cereals and pulses (0.5%). Before installation of SSD systems, shallow water table (<1 m) and soil salinity (> 7 dS m^{-1}) adversely affected the crop growth. After installation of SSD, however, significant reductions in water table depth (>2 m) and soil salinity (<2 dS m^{-1}) resulted in substantial increase in crop yields. For example, sugarcane yield increased from 20-25 t ha^{-1} to 70-75 t ha^{-1} and wheat yield from 0.25 t ha^{-1} to 0.75 t ha^{-1} in post reclaimation phase indicating 200-300% increase in the crop productivity after the implementation of SSD project. The average annual farm income increased to Rs. 140000 to 150000 per hectare in the post-reclamation period as compared to Rs.40000 to Rs. 50000 per ha in pre-reclamation period.

The studied farmers revealed that land value has increased almost five times after reclaimation. They were of view that SSD system is the best technological intervention for reclamation of waterlogged saline lands for sustainable and economic benefits. It was observed that strong willingness by the farmers to actively participate in the implementation of the project and maintenance of the SSD systems played a crucial role in its success.

R. Raju, Thimmappa, K. and Satyendra Kumar

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Exploiting Plant-Microbe Interactions for Remediation of Salt Affected Soils

Consistent with the fact that bio-remediation of salt affected soils using halophilic bacteria holds enormous practical utility, an experiment was carried out to study the efficiency of bacterial isolates in sodium removal from and plant growth promotion in salt affected soils. Soil samples were collected from the rhizosphere of halophytes growing in coastal saline areas of Gujarat and the bacteria were isolated having salt tolerance up to 10% NaCl in the nutrient agar media. Two promising halophilic bacterial strains positive for plant growth promotion were selected and tested for their salt removal efficiency. Halophilic strain CSSRO2 (*Planococcus maritimus*) was more efficient in reducing sodium concentration from 1,12,230 ppm in supernatant to 1,00,190 ppm at 24 hour while strain CSSRY1 (*Nesterenkonia alba*) reduced Na concentration to 92,730 ppm at 48 hours in halophilic broth with 15% NaCl (Fig.1). This showed that inoculation of strains in liquid media resulted in removal of 12040 and 19500 ppm of Na by halophilic bacterial strains CSSRO2 and CSSRY1, respectively. These halophilic strains also showed high potential for removal of sodium ions from soil. CSSRY1 efficiently removed sodium at higher (6%, 8%, 10% NaCl) salt concentration in comparison of CSSRO2 and association of both organisms (CSSRY1 and CSSRO2). This was also confirmed by reduction of electrical conductivity or total dissolved salts (TDS). It is hypothesized that once the sodium ion concentration is reduced in rhizosphere, plants become able to resume nutrient and water uptake.

To test their sodium removal efficacy, these halophilic strains were inoculated in sterile soils containing 0% to 10% NaCl. Strain CSSRY1 decreased soluble sodium content up to 31% at 4% NaCl concentration while removal efficiency was only 19% at 10% NaCl concentration. In greenhouse pot experiments, saline water irrigated wheat and maize plants exhibited better growth and yield when seeds were inoculated with halophilic strains. It was observed that there was 10-12 per cent increase in yield attributes and yield of wheat at 6% NaCl as compared to 2% NaCl. Plants inoculated with a consortium of halophilic bacteria also showed growth at 10% NaCl, whereas inoculation with a single isolate did not promote plant growth at this salt concentration. The maximum fresh weight, dry weight, shoot length and root length of plants were noted in "Consortium 5% NaCl" treated pot, with 194.5% increase in fresh weight, 98.97% increase in dry weight, 15.37 cm increase in shoot length and 7.4 cm increase in root length as compared to the uninoculated control plants. The plant growth promoting effects of these bacterial isolates in salt affected soils primarily appear to be due to higher biosynthesis of auxin and thus enhanced root growth. Another very likely mechanism is the alleviation of salinity stress via plant growth promoting rhizobacteria that express ACC deaminase activity. This enzyme removes ethylene from the rhizosphere. Also, the halophilic/halotolerant bacteria remove excess sodium from the surrounding soils and thus create favourable conditions for plant growth.

Many other halophilic bacterial strains *viz. Bacillus subtilis*, *B. aerius*, *B. aquimaris*, *B. megaterium*, *Brevibacterium halotolerans*, *Virgibacillus salarius*, *Paecilomyces variotii*, *Pseudomonas indica*, *Pseudomonas stutzeri*, *Sinorhizobium fredii*, isolated from coastal saline soils and deposited to NCBI database, were found to have plant growth promoting traits as well as nutrient mobilization to mitigate salt stress. Halophilic endophytic bacteria *Acinetobacter baumannii*, *Bacillus cereus*, *Bacillus firmus*, *Bacillus aerius*, *Pseudomonas fluorescens* and *Bacillus subtilis* isolated from leaves of halophytes were positive for ammonia production while phosphate solubilization was positive for *A. baumannii* and *P. fluorescens*.

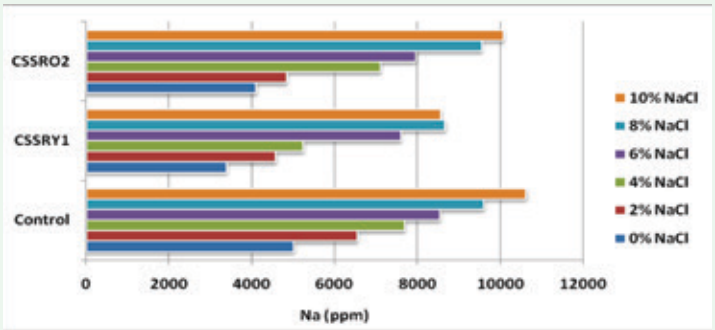

Fig.1. Sodium removal by halophilic bacterial inoculates in saline soil

Sanjay Arora, G.G. Rao and D.K. Sharma

International Training Programme on Use of Poor Quality Water in Agriculture

A two weeks international training programme on "Use of Poor Quality Water in Agriculture" for Afro-Asian Rural Development Organisation (AARDO) member countries was organized during February 11-24, 2015. Dr. R.K. Yadav, Course Director highlighted the rationale, structure and objectives of the training programme. Ten delegates from Iraq, Nigeria, R.O. China (Taiwan), Ghana, Egypt, Sri Lanka and Sudan participated. Different aspects such as global extent and distribution of poor quality waters, their adverse impacts on soil and environmental health, strategies for their sustainable and profitable use in crop production and the best management practices for mitigating the deleterious effects were discussed.

Dr. S.K. Chaudhari, ADG (SWM), ICAR, New Delhi inaugurated the training programme. He briefly discussed the increasing scarcity of fresh water and underlined the need for safe use of poor quality and wastewaters in irrigation. He said that poor quality water could be a good substitute for fresh water for agricultural crops if required quantity of acceptable quality water is applied through proper scheduling and appropriate irrigation method. Dr. D.K. Sharma, Director discussed the achievements of the Institute in developing technologies for

Dr. S.K. Chaudhari, addressing the inaugural function of the International Seminar

the sustainable use of saline, sodic and wastewaters in crop production. He was optimistic that proper use of wastelands and poor quality waters can make a remarkable contribution in increasing food grain production to sustain the livelihoods of the farmers.

Foundation Day

ICAR-CSSRI, Karnal celebrated its 46th Foundation Day on 1st March 2015 by organizing a lecture delivered by Dr. Alok Kumar Sikka, DDG (NRM) ICAR, New Delhi. On the occasion, Dr. D.K. Sharma, Director welcomed the Chief Guest and other delegates and gave a glimpse of institute's achievements. He said that growing national and international reputation of the institute can be gauged from various awards conferred on the institute and its scientists from time to time. Dr. Sikka addressed the gathering on subject 'Harnessing synergies from degraded lands for enhancing food production in the country'. He said that India has 2.3 % land, 4.2 % freshwater, 16 % population and 17 % of world's cattle. Net sown area has increased from 119 to 141 M ha. About 121 M ha land is suffering from different forms of land degradation, pervasive land use as well as faulty crop management practices which are responsible for land degradation. In India, about 39% area is having soil erosion rate of more than 10 t $ha^{-1}yr^{-1}$, while about 11% area has erosion rates of more than 40 t $ha^{-1}yr^{-1}$. Some of the states in the north-west and north-east Himalayas are severely affected with over 1/3rd of their

Dr. A.K. Sikka delivering the 46th Foundation Day lecture

geographical area suffering from very severe (40-80 t $ha^{-1}yr^{-1}$) erosion. Various researchable and policy issues were emphasized to be addressed on high priority for checking land degradation and ensure food security by minimizing the production losses. About 200 scientists and other officers from Karnal based ICAR institutes participated in this function.

Rabi Kisan Mela

Rabi Kisan Mela was organized on 9th March, 2015 at Karnal. Dr. A.K. Singh, DDG (Agril. Ext.), ICAR, New Delhi was the Chief Guest while Dr. D.K. Sharma, Director, ICAR-CSSRI presided over the function. About 800 farmers from Haryana, Punjab, Uttar Pradesh and students participated in the *Mela*. A number of experts from Karnal-based ICAR Institutes and officials of the state agriculture department also participated in the *Mela* to suggest solutions to the challenges being faced by the farmers.

An impressive exhibition of technologies of ICAR Institutes, state department of agriculture, CCSHAU, RRS Karnal and other private agencies/NGOs was the main attraction of mela. Free testing of soil and water samples, field visits to experimental sites, sale of improved seeds of salt tolerant rice varieties developed by ICAR-CSSRI and an interactive *Kisan Goshthi* were other major highlights of the *Mela*. There was a very high demand for ICAR-CSSRI rice seeds and 100 quintal improved seeds of CSR 30, CSR 36, CSR 43 and Pusa 44 varieties were sold to the farmers. The students were apprised about the Central Laboratory facility, meteorological unit, groundwater recharge system and the herbal garden of the Institute.

The farmers were informed about the technologies for reclamation of salt-affected soils, resource conservation, groundwater recharge, use of poor quality water, crop diversification and salt tolerant varieties. Dr. D.K. Sharma,

Dr. A.K. Singh, DDG (Agril. Ext.) addressing the farmers

Director, ICAR-CSSRI highlighted the major achievements of the Institute, including a multi-enterprise agriculture model involving integration of crop, fishery, fodder and cattle components which is a resource use effeicient production system and provides regular income to the farmers.

Dr. A.K. Singh appreciated the efforts of ICAR-CSSRI for developing and disseminating different technologies for the sustainable management of salt-affected soils and poor quality waters as reflected by large scale adoption of its varieties and technologies by the farmers. He emphasized that adoption of resource conservation technologies such as zero-tillage and direct seeded rice and diversification with low water requiring crops such as pulses and oilseeds was the need of the day. Referring to the '*Pradhan Mantri Krishi Sinchai Yojna*' and '*Soil Health Card*' programmes of the Central government, he stressed the need for vigorous research and extension efforts to popularize drip and sprinkler irrigation and soil-test based fertilizer use to realize higher production while ensuring high water and fertilizer use efficiencies. Thirteen progressive farmers were felicitated on this occasion.

International Training Workshop on Approaches for Integrated Analysis of Agricultural Systems in South Asia: field, to farm, to landscape scale

A six days international training programme on 'Approaches for Integrated Analysis of Agricultural Systems in South Asia: field, to farm, to landscape scale' was organized during May 18-23, 2015. The programme was inaugurated by Dr. D.K. Sharma, Director of the Institute. Twenty four scientists from Bangladesh, Nepal and India participated in this workshop. Dr. Santiago Lopez Ridaura, CIMMYT, Mexico briefed about the importance of farming systems models. Dr. Tomothy Krupnik, CIMMYT, Bangladesh discussed different farming systems of Bangladesh. Dr. David Berre, CIMMYT, Zimbabwe briefed about the economic importance of farming system approach. Dr. Alison Laing, CSIRO, Australia shared his experiences in farming system research from Australia and the eastern Gangetic plains. Dr. D.K. Shrama, Director, ICAR-CSSRI shared his experience of farming system research at Karnal and said that there is proper utilization of family labour, regular income generation and nutritional security for the farmers' family by adopting multienterprize agriculture model. He emphasized the need to adopt climate smart production practices and water saving technologies

such as direct seeded rice, zero tillage, laser leveling and crop residue management. He informed that during *rabi* season of 2014-15, heavy rainfall in the month of March and subsequent waterlogging reduced the wheat yield by about 20-30% but in case of turbo seeded wheat, the loss was only 5-10 %. Dr. M.L. Jat, CIMMYT India explained the farming system approach and said that different farming systems modules should be developed for the different natural resource base scenarios. Dr. P.C. Sharma, Head, Crop Improvement Division and Dr. H.S. Jat shared their experiences about different cropping systems.

World Water Day

The institute celebrated 'World Water Day' on 21st March, 2015 with a view to sensitize the farmers about the importance of water as a precious resource and its sustainable use. About 200 farmers, scientists and extension workers participated in this important event. Sh. S.K. Jain, Regional Director, Central Ground Water Board, Chandigarh and Chief Guest of the

Dr. D.K. Sharma addressing the farmers and scientists on World Water Day

function informed the farmers about the aquifer mapping which will provide information on availability of water and its quality up to 1000 m depth in a particular area. Dr. D.K. Sharma Director, ICAR-CSSRI, Karnal said that under limited availability of resources and increasing cost of cultivation, the Institute has developed a multi-enterprise agriculture model which could help in multiple uses of water. He also briefly discussed the importance of different resource conservation technologies such as direct seeded rice in efficient use of irrigation water. Dr. S.K. Kamra, Head, Division of Irrigation and Drainage Engineering informed that 40 per cent water is of good quality and 60 percent is brackish in Haryana. Therefore, efficient use of good quality water by adopting management practices is the need of the day. He also elaborated the ground water recharge technology which can enhance the availability of ground water in future. On this occasion, Nukkad Natak '*Jal Hi Jivan Hai*' was also played.

Biennial Workshop of AICRP on Management of Salt Affected Soils and Use of Saline Water in Agriculture

The Biennial workshop of AICRP on Management of Salt Affected Soils and Use of Saline Water in Agriculture was organized at ICAR-CIRG, Makhadoom during June 5-7, 2015. About 80 Scientists and progressive farmers participated in the workshop. The workshop was inaugurated by Dr. A.K. Sikka, DDG (NRM), ICAR, New Delhi. Dr. Sikka said that secondary salinization and resodification, soil degradation, water scarcity and climate change have posed threats to sustainable crop production. He felt the need to develop low cost technologies for draining out saline water and emphasised the importances of cost effective reclamation technologies such as biodrainage, biosaline agriculture, phytoremediation and protected cultivation for management of salt affected soils and waters. He informed that distillery spent wash could be an efficient and viable alternate source of gypsum for the reclamation of sodic soils. He further suggested that the poor quality waters should only be used in alternate land use systems. Dr. S.S. Khanna, Ex. Advisor, Planning Commission, Govt. of India felt the need to explore the prospects of sea weed cultivation in coastal saline soils. Dr. S.K. Chaudhari, ADG (SWM), ICAR, New Delhi expressed the need to develop salt tolerant varieties in other crops besides rice, wheat and mustard.

Dr. D.K. Sharma, Director, ICAR-CSSRI and Project Coordinator presented the achievements of the AICRP. He informed that increased adoption of stress tolerant varieties and resource conservation technologies seem to be strategic options for ensuring higher yields in salt affected environments which are now reeling under the adverse impacts of climate change. Dr. S.K. Ambast, Director, ICAR-IIWM, Bhubaneshwer said that climate change induced increase in sea water intrusion in coastal agricultural lands is a cause for concern and briefly discussed the potential of controlled sub-surface drainage and protected cultivation in productive utilization of salt affected soils and waters. Dr. S.K. Agarwal, Director, ICAR-CIRG, Makhdoom informed that milk and food production have increased from 17 to 134 million tonnes and from 51 to 260 million tonens, respectively during 1951-2014. In 'Scientist-Farmers Interaction Meeting', the farmers presented their problems like lodging of

Dr. A.K. Sikka addressing the gathering during inaugural function of the Workshop

wheat crop even in low rainfall years, serious attack of termite, problems encountered in the installation and maintenance of sub-surface drainage systems in waterlogged saline lands, lack of technical know-how for soil and water sampling and non availability of the seeds of salt tolerant wheat varieties. The scientists suggested appropriate remedial measures for overcoming these problems. The participating centres (Hisar, Trichy, Bapatla, Kanpur, Indore, Bikaner, Gangawati, Vyttila, Port Blair, Bathinda and Panvel) presented their research achievements in the workshop

Visit of Philippines Rice Achiever Awardees to ICAR-CSSRI RRS, Lucknow

A delegation consisting of 13 Rice Achiever Awardees of Philippines sponsored by International Rice Research Institute (IRRI), Philippines visited ICAR-CSSRI Regional Research Station, Lucknow on 29th June, 2015 to learn the current rice research and development strategies in India. Dr. V.K. Mishra, Head, RRS presented the overview of the research activities of the station. He emphasized the need to develop alternatives to gypsum for sodic soil reclaimation and discussed the importance of resource conservation technologies and crop diversification for sustaining the productivity of sodic soils. Dr. Y. P. Singh, Principal Scientist discussed the rice production scenario in salt affected environments and highlighted the ongoing collaborative efforts between ICAR-CSSRI and IRRI to increase the rice productivity for enhancing the livelihoods of the resource poor farmers. Dr. Sanjay Arora, Senior Scientist elaborated the importance of soil health cards for the balanced use of fertilizer in crops, nutrient management and assessment of sodic soils through GYPCAL software. Dr. T. Damodaran,

Senior Scientist explained the crop yield enhancing potential of 'CSR-Bio' with special reference to rice. Dr. C. L. Verma and Dr. A.K. Singh discussed different land modification models for harnessing the productivity potential of waterlogged sodic soils. Mr. Nestor P. Battalla, Provincial Rice Programme Coordinator, Pangasinan province, Philippines and leader of the delegation explained the involvement of extension agencies in seed production and dissemination in Philippines.

Noteable Publications

Basak, N., Chaudhari, S.K. & Sharma, D.K. 2015. Impact of varying Ca/Mg waters on ionic balance, dispersion, and clay flocculation of salt-affected soils. *Comm. in Soil Science and Plant Analysis*, 46: 827-844.

Datta, A., Basak, N., Chaudhari, S.K. & Sharma, D.K. 2015. Soil properties and organic carbon distribution under different land use in reclaimed sodic soils of North-West India. *Geoderma Regional,* 4: 134-146.

Minhas, P.S., Yadav, R.K., Lal K. & Chaturvedi, R.K. 2015. Effect of long-term irrigation with waste water on growth, biomass production and water use by eucalyptus (*Eucalyptus tereticornis*) planted at variable stocking density. *Agricultural Water Management,* 152: 151–160.

Sarangi, S.K., Maji, B., Singh, S., Burman, D., Mandal, S., Sharma, D.K., Singh, U.S., Ismail, A.M. & Haefele, S.M. 2015. Improved nursery management further enhances the productivity of stress-tolerant rice varieties in coastal rainfed lowlands. *Field Crops Research*, 174: 61-70.

Singh, R.K., Srivastava, R.C., Pandey, C.B., & Singh, Anshuman. 2015. Tribal institutions and conservation of the bioculturally valuable 'tasat' (*Arenga obtusifolia*) tree in the eastern Himalaya. *Journal of Environmental Planning and Management*, 58: 69-90.

Visits Abroad

Dr. S.K. Sarangi, Sr. Scientist visited Philippines for participating in short course "ORYZA Training Programme for Beginners', from April 13-17, 2015.

Dr. S.K. Kamra, Head, Division of Irrigation and Drainage Engineering visited Taiwan for participation as a Humboldtians of 2015 International Conference on Ecology, Environment & Energy, from April 20-22.

Dr. A.K. Bhardwaj, Sr. Scientist visited Argentina for availling TWAS-UNESCO Associateship, from May 1-June 30, 2015.

Dr. R.K. Singh, Sr. Scientist visited Australia for availling Endeavour Research Fellowship, from May 1-Sept. 30, 2015.

Distingushed Visitors

A delegation from CIMMYT headed by Dr. Thomas A. Lumpkin, Director General and Dr. Etienne Duveiller, Director of Research for Soth Asia visited the institute.

Published by
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ICAR-Central Soil Salinity Research Institute, Karnal

Edited by
Dr. D.K. Sharma
Dr. Anshuman Singh
Dr. Randhir Singh

Compiled by
Sh. Madan Singh