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SALINITY NEWS

From Directors' Desk

Since its establishment in 1969, the ICAR-Central Soil Salinity Research Institute (ICAR-CSSRI) has made remarkable progress in developing technologies to reclaim salt-affected soils in India. These efforts have significantly enhanced land productivity and farm incomes in degraded salt-affected regions. India currently has an estimated 6.67 million hectares (Mha) of salt-affected land, but projections indicate this could rise to 16 Mha by 2030 due to climate change and anthropogenic mismanagement. Such an increase could result in economic losses amounting to thousands of crores. Technologies such as gypsum-based amendments, salt-tolerant crop varieties, and sub-surface drainage (SSD) systems, developed by ICAR-CSSRI, have had a transformative impact nationwide. Emerging advancements are now paving the way for alternative reclamation methods based on innovative biological and chemical mechanisms previously unexplored. While these advancements offer promising solutions for improving salt-affected lands, new challenges at both regional and national levels demand sustained and accelerated efforts. Continued research into fundamental processes and the development of improved technologies are crucial to making substantial progress toward ensuring food security.

This volume of Salinity News (January-June, 2024) includes following listed major research achievements: CSM 21: a high biomass yielding germplasm of Melia dubia for the marginal sodic soils, Legume manuring technology for sustaining yield and soil health in sodic soils, Greenhouse gas flux shifts with soil-foliar hybrid nitrogen fertilizer use in intensive agroecosystems, Residue management and plant growth promotion by microbial consortia, Nano-Urea: A viable option for replacing 33% urea for enhancing use efficiency in rice-wheat cropping system, Exploring Phytoplankton Dynamics and Environmental Drivers in a Tropical Mangrove Estuary: Insights from the Matla Estuary Study and Residue management and plant growth promotion by microbial consortia. This issue also includes information regarding 56th ICAR-CSSRI Foundation Day Celebration and other programmes: World Environment Day, Implementation of the supplements distribution program and the mineral mixture making machine for livestock under the FFP, Farmers-scientist interface meeting-cum-rice seed distribution programme and Five-day training to SC Farmers in Bharuch.

(R.K. Yadav)
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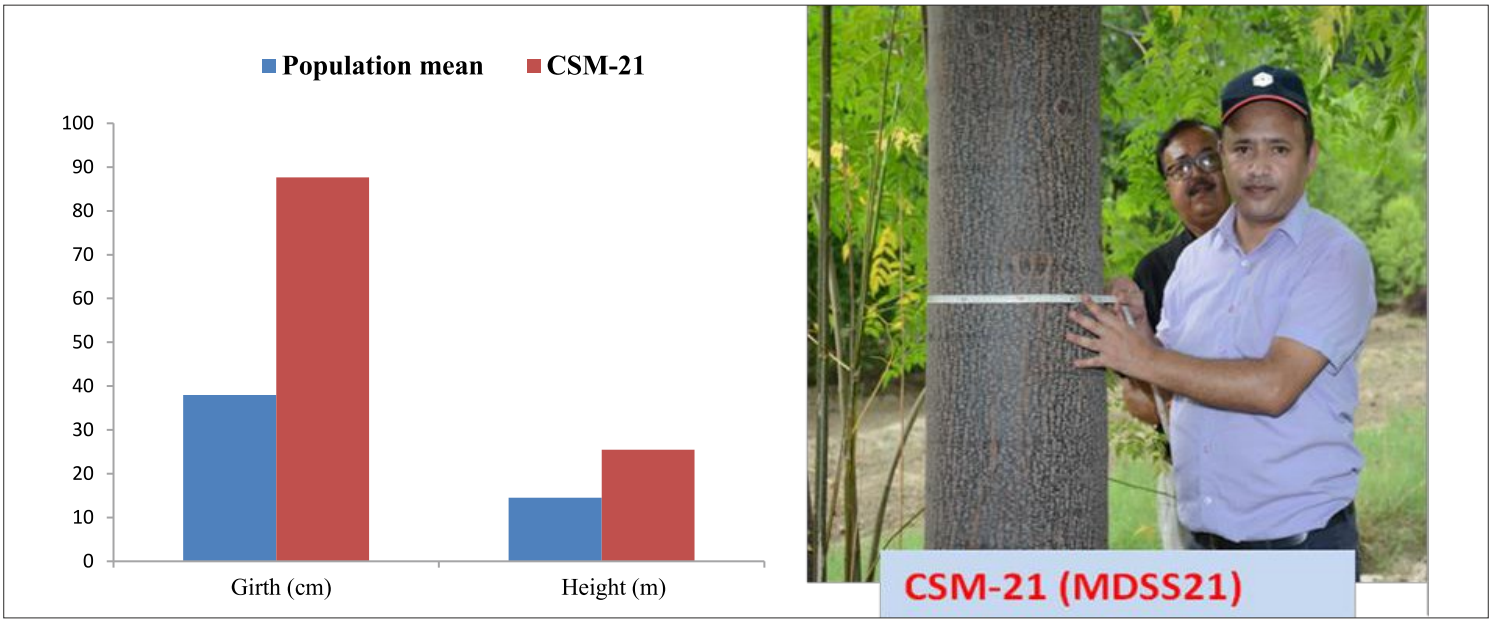
CSM 21: a high biomass yielding germplasm of *Melia dubia* for the marginal sodic soils

Melia dubia, often known as Malabar neem, is a rapidly growing tree species valued for its high-quality timber. In recent years, species has become increasingly popular for plantations in various regions of the country, because of its economic and ecological significance. Therefore, the twenty-five germplasm of Melia dubia were collected to assess the genetic diversity and to identify germplasm for alkalinity tolerance in the species. Results showed that the MDSS06, MDSS13, and MDSS21 (CSM 21) genotypes produced greater height and diameter growth, biomass, as well as depicted high salt tolerance, and hence were recommended for commercial plantations in the marginal alkali soils. Overall, among the genotypes, MDSS21 (CSM 21) showed exceptional productivity in alkali soils of pHs 9.0. This germplasm attained girth of 90cm within a span of four years under field conditions and at three locations. Overall, the productivity and growth rate of CSM 21 are 1.5 to 2.0 times higher than the rest of the germplasm.



Performance of Melia dubia (CSM-21) after four years

Raj Kumar Thakur

Legume manuring technology for sustaining yield and soil health in sodic soils

Fertilization is crucial for enhancing agricultural yields, but excessive and unbalanced fertilizer use without adequate nutrient recycling can degrade soil properties, particularly in salt-affected soils, ultimately reducing productivity. Integrating inorganic and organic fertilizers is a more sustainable approach to improving soil health. Legumes, as nitrogen-fixing plants, play a key role in this process. Incorporating legumes into cropping systems and recycling their nitrogen-rich biomass adds significant organic carbon and nutrients to the soil, reducing reliance on chemical fertilizers and providing an eco-friendlier solution. Three legume manuring techniques were tested at the ICAR-Central Soil Salinity Research Institute to sustain rice-wheat cropping systems and improve soil health in sodic soils of the Indo-Gangetic Plain: Green Manuring (GM), Brown Manuring (BM), and Grain Legume Manuring (GLM). Green Manuring (GM) involves planting a green manure crop like Dhaincha (Sesbania aculeata) between wheat and rice seasons. The crop is sown in mid-May and incorporated into the soil 35-40 days later, just before rice transplanting in early July. This practice reduces chemical fertilizer use by 50-75%. After rice, wheat can be grown with recommended or reduced fertilizer inputs. Brown Manuring (BM) is used for direct-seeded rice. Dhaincha is sown alongside the rice and knocked down after 30 days with a herbicide. Wheat is then grown with recommended or reduced fertilizer inputs. Grain Legume Manuring (GLM) uses mung bean (Vigna radiata) as an "opportunity crop" between wheat and rice. The seeds are sown in early April, and after 60 days, the pods are harvested, with the remaining biomass incorporated into the soil before rice transplanting. These techniques not only reduce fertilizer inputs but also enhance soil carbon, biological health, and nitrogen mineralization. They improve electrochemical properties, such as lowering redox potential and pH during the rice season, helping crops absorb nitrogen more

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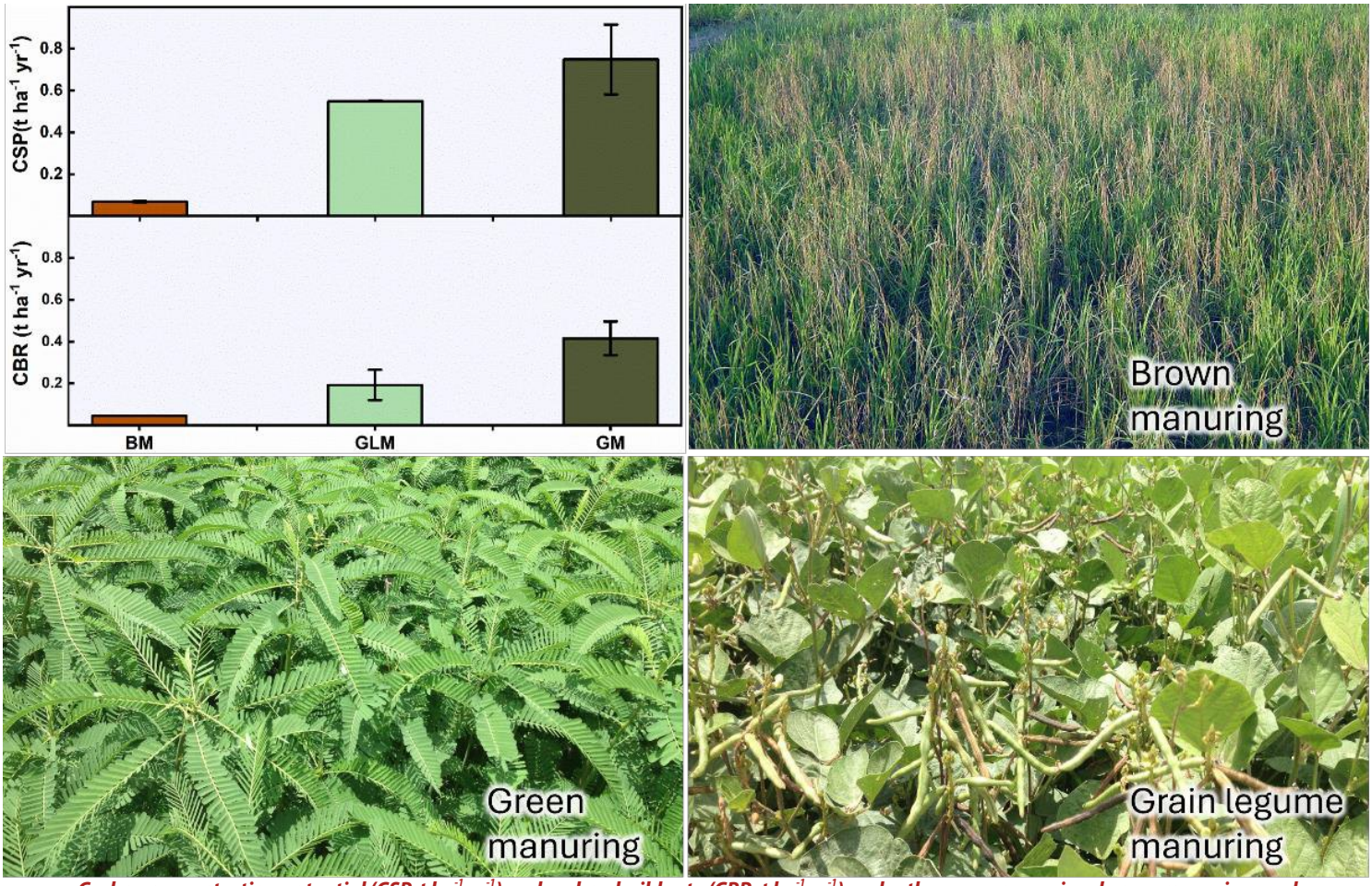

Carbon sequestration potential (CSP, t ha^{-1} yr^{-1}) and carbon build rate (CBR, t ha^{-1} yr^{-1}) under the green manuring, brown manuring, and grain legume manuring in the Indo-Gangetic Plain

efficiently in sodic environments. Overall, legume manuring offers farmers a sustainable way to reduce chemical fertilizer use, improve yields, and increase resilience to climate change.

Ajay Kumar Bhardwaj and Kapil Malik

Greenhouse gas flux shifts with soil-foliar hybrid nitrogen fertilizer use in intensive agroecosystems

Agriculture contributes approximately 10-12% of total anthropogenic greenhouse gas (GHG) emissions, while accounting for 60% of all anthropogenic methane (CH_4) emissions and 59% of all anthropogenic nitrous oxide (N_2O) emissions. The use of nitrogen fertilizers increases soil nitrogen levels, which promotes the release of nitrous oxide (N_2O) into the atmosphere via nitrification and denitrification processes. N_2O depletes the ozone layer and has a global warming potential (GWP) 296 times that of carbon dioxide (CO_2) and 12 times that of methane (CH_4) over a 100-year period. Given its high GWP, N_2O is a major concern for climate change. Therefore, effective nitrogen management to minimize environmental leakage is crucial in fertilizer-intensive agroecosystems. Additionally, soil-based fertilizer application leads to greater nitrogen (N) losses, favoring N transformation into highly reactive forms that are lost more rapidly than absorbed by plants. Foliar application offers an advantage in reducing losses but may not fully meet the substantial plant requirements, especially for essential macronutrients like N. Thus, studies were undertaken to evaluate the incremental substitution of soil-applied prilled urea with foliar-applied nano-nitrogen. The studies comprised four nitrogen management strategies involving the replacement of prilled urea with nano-N at varying levels: 33% replacement (R33), 50% replacement (R50), 66% replacement (R66), and 100% replacement (R100). Additionally, two precision-scheduling treatments were included: one based on leaf color chart (LCC) values after the first basal dose with prilled urea (M-LCC), and the other based on GreenSeeker (GS) values after the first basal dose

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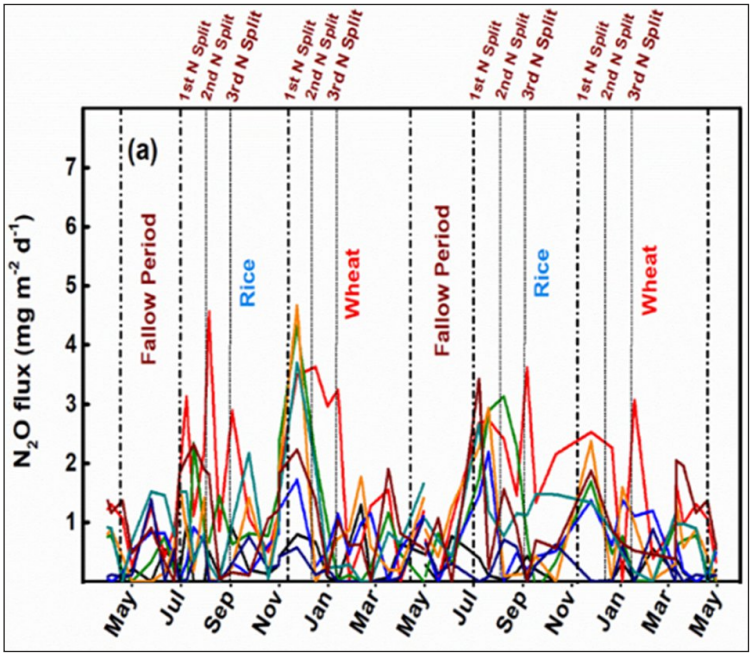
of prilled urea (M-GS). Throughout the two-year experiment (2021-22, 2022-23), it was observed that the daily N_2O flux (mg m^{-2} d^{-1}) peaked when using the 100% recommended dose of nitrogen (N) via prilled urea (R0) in the rice-wheat system. (Figure). Nevertheless, substituting nitrogen via prilled urea with Nano-N at varying rates of substitution (R33, R50, R66, R100) led to a decrease in daily N_2O flux compared to R0 (100% N application with prilled urea). Method-based strategies (M-GS, M-LCC) also notably reduced daily N_2O flux compared to R0. The lowest daily N_2O flux was observed in the No-N treatment with no nitrogen application, yet a 1-split dose replacement of prilled urea with foliar application of nano-nitrogen also let to a significant reduction (>30%) in N_2O emissions with no effects on yield. Moreover, a peak in N_2O flux occurred after fertilizer application during each split application in rice and wheat crops. In summary, the study underscores the promising potential of a 2:1 hybrid technique combining one-part foliar application of nano-nitrogen with two-part soil application of prilled urea. This approach enhances vital ecosystem services by reducing nitrous oxide (greenhouse gas) emissions.

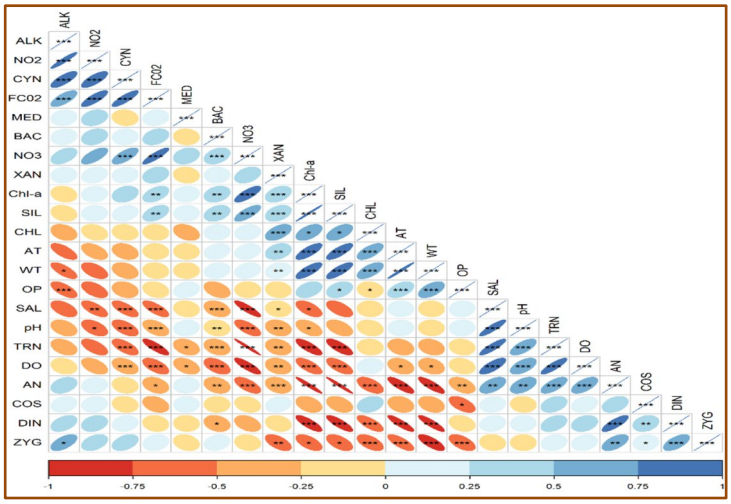


N_2O fluxes in rice-wheat system under different soil-foliar hybrid fertilization techniques

AK Bhardwaj, M Rani, K Malik, S Devi, A Kumar, P Sheoran, A Mann and RK Yadav

Exploring Phytoplankton Dynamics and Environmental Drivers in a Tropical Mangrove Estuary: Insights from the Matla Estuary Study

Mangrove estuaries are crucial and highly productive coastal ecosystems essential for supporting fisheries in tropical regions. These ecosystems maintain high productivity and biological balance through the interaction of living and non-living components, which are vital for aquatic food webs, including both grazing and detrital food chains. While mangrove litter has traditionally been considered the primary driver of biotic dynamics, recent studies emphasize the significant but previously underestimated role of phytoplankton in addition to detritus-based food webs. With this background a study was conducted in the Matla estuary to examine the dynamics of phytoplankton in relation to environmental parameters across the upper, middle, and lower reaches over three different seasons. The study identified phytoplankton belonging to 38 genera and 8 classes. Four classes accounted for 96% of the abundance: Coscinodiscophyceae (35%), Mediophyceae (27%), Bacillariophyceae (25%), and Dinophyceae (9%). Diversity indices revealed spatio-temporal variation, peaking during the monsoon season in the upper reaches of the estuary. Bacillariophyceae exhibited the highest species richness, while Coscinodiscophyceae were the most abundant in terms of density. A one-way ANOVA (post hoc Tukey test) indicated statistically significant differences ($p < 0.05$) for parameters such as water temperature, air



*Pearson's correlations correlation matrix between physicochemical parameters and phytoplankton abundance. Blue color = positive correlation and red color = negative correlation; the darker the shades of color signifies stronger degree of relationship. Correlation coefficient: *** (significant at $p < 0.001$), ** (significant at $p < 0.01$), and * (significant at $p < 0.05$).*

temperature, alkalinity, dissolved oxygen, free carbon dioxide, salinity, transparency, silicate, nitrate, nitrite, ammonia, and chlorophyll-a, except for pH and orthophosphate. Various

phytoplankton groups showed a positive correlation with physicochemical parameters including temperature, alkalinity, free CO2, NO3, NO2, silicate, orthophosphate, and chlorophyll-a (Fig.). BIO-ENV analysis highlighted air temperature and free CO2 (ρ= 0.4929) as key factors influencing phytoplankton distribution and community structure. Canonical Correspondence Analysis (CCA) further demonstrated the significant impact of parameters such as temperature, silicate, nitrite, and orthophosphate on the phytoplankton community. The findings of this study enhance our understanding of estuarine ecosystem dynamics, which is crucial for the long-term conservation and management of both biotic and abiotic components within estuaries.

Rinchen Nopu Bhutia and Uttam Kumar Mandal

Residue management and plant growth promotion by microbial consortia

Rice-wheat (RW) cropping system generates large quantities of crop residue out of which more than 50 % is burnt in-situ in IGP of India, leading to a loss of carbon, nitrogen, sulphur and also destruct the beneficial microflora of the soil. The in-situ decomposition of these residue can prove a viable option for not only residue management but also enhancing soil health without creating any type of pollution. The in situ incorporation of rice straw in the soil with tillage and complete/partial retention on the surface as mulch using zero tillage systems with the application of the microbial consortia is an effective alternative for the management of rice straw. Lignocellulose decomposing fungi along with plant growth promoting bacteria can serve the purpose of residue management with promotion of plant growth. For this of spray of fungal (Penicillium spp. and Alternaria spp) and bacteria (Bacillus spp.) was done on residue (incorporation and retention) under normal, saline and sodic soils. After harvest of wheat (around 5 months of placing residue), maximum weight loss of rice residue observed under fungi+bacteria treatment in both types of residue placements. Under incorporation of the residue the loss of weight is 65% and 63% respectively under normal and saline soils in fungi+bacteria treatment whereas under retention in the same treatment it was

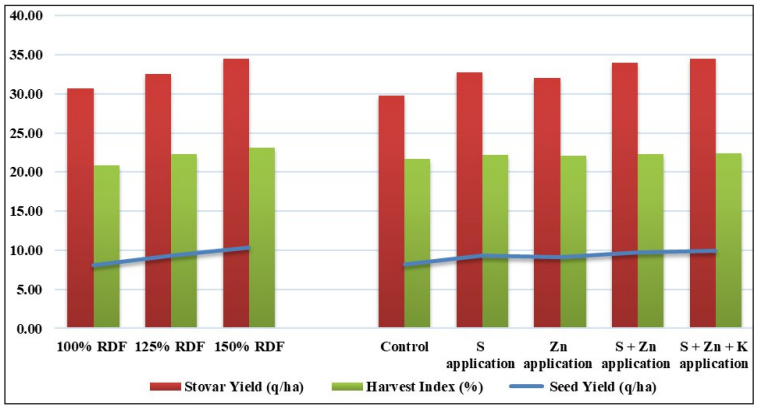
Effect of microbial formation (F- fungi) on rice residue decomposition

48% and 44 % respectively. It was also maximum under sodic soils in fungi+bacteria treatment under retention of residue (59%) but under incorporation it was found maximum under Halo+fungi+bacteria treatment (61%). Under the retention of residue, the weight loss of residue was found 42%, 38% and 20% respectively in normal, saline and sodic soils.

Madhu Choudhary, HS Jat, Rakesh Kumar, Sanjay Arora, Hardev Ram and RK Yadav

Enhancing mustard yield with nutrient management under saline *Vertisols*

The Baratract of Gujarat having saline Vertisols, possesses limited choice of crops to be grown in rabi season due to unavailability of good quality of water. Studies conducted at ICAR-CSSRI, RRS, Bharuch to introduce mustard as a new crop under these areas, stated that salt tolerant mustard varieties can be taken up with saline water irrigation in Vertisols. However, the production in this region is low from the potential yield of these varieties. So, for enhancing yield through various agronomic means, experiment was conducted to find out suitable fertilizer dose with application of Sulphur and Zn for mustard crop for this region. Salt tolerant mustard variety CS 58 was sown on mid of November and different levels of recommended dose of fertilizers (N and P) i. e. 100, 125 and 150% and application of additional nutrients i. e. no additional



Mustard seed, stover yield and harvest index with different treatments

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nutrients, S application, Zn application, S+Zn application and K+S+Zn application was given to the crop. Irrigation has been given whenever needed to the crop with available saline groundwater (EC_{iw}- 6-8 dSm^{-1}). Different growth parameters i. e. plant height, dry weight per plant and root length at 30 and 60 DAS, no. of primary branches, secondary branches, no. of pods per plant were found significantly highest with application of 150% RDF (N&P). However, the values for these parameters were statistically at par with application of 125% RDF (N & P). Application of 150% recommended dose of nutrients (N&P) provided significantly highest seed yield, stover yield, total biomass, and harvest index as compare to 125% and 100% dose of fertilizers. In case of additional nutrients, various growth and yield parameters and seed yield was significantly higher with application of K @ 40 kg/ha + S @ 40 kg/ha +Zn @ 5 kg/ha, however these results were found at par with application of S @40 kg/ha +Zn @ 5 kg/ha. Stover yield and test weight also significantly improved with application of additional nutrients as compared to no application. So, it can be concluded that application of higher doses of recommended dose of N & P (125 and 150%) with additional nutrients S, Zn and K are able to improve mustard yield in this area.

Monika Shukla, Anil R Chinchmalatpure, Sagar D Vibhute and Vineeth TV

World Environment Day at CSSRI: A call to action for a sustainable future

Institute celebrated World Environment Day-2024 during 26 May to 5 June 2024, with a series of planned activities to promote the objectives of Mission LiFE-Lifestyle for Environment. The theme of this year's programme was "Land Restoration, Desertification, and Drought Resilience". On this occasion, Dr R. K. Yadav, Director ICAR-CSSRI, Karnal emphasized the need to use renewable energy sources, conservation of natural resources, and reduce the consumption of electricity. He also encouraged the use of ecofriendly bags instead of plastic bags to prevent the pollution and associated environmental implications. The celebrations began with the LiFE pledge for promoting the sustainable production and consumption for better environmental outcomes. During this period, institute organized various activities including a tree plantation drive, a bi-cycle and walk rally. Additionally, a drawing competition for children was organized, and winner were given prizes.

Dr. RK Yadav promoting LiFE for environment

Dr. RK Yadav during plantation event

Nano-Urea: A viable option for replacing 33% urea for enhancing use efficiency in rice-wheat cropping system

Numerous issues affecting cropping systems' capacity to be sustained in the current agricultural scenario includes dwindling crop output, inefficient fertiliser usage, nutrient depletion, climate change, and limited water availability. Among these, NPK usage efficiency of conventional fertilizers and their availability is the biggest issue in India. To overcome these issues, experiments were conducted strategically to substitute conventional nitrogen (urea) through nano-nitrogen (IFFCO, India) by the concentration of 33%, 50%, 60% and 100% replacement of N through nano-N. Morphological and physiological traits at physiological maturity stage showed superiority of 33% N replacement through nano-N in both rice and wheat crop for nitrogen balance index, RWC, leaf area, chlorophyll content and gas exchange attributes over 100% N through conventional fertilizers. Results also depicted that yield attributes (number of effective tillers, number of spike, spikelets per spike and ear filling ratio) were statistically at par under farmer`s practice and 33% N replacement, while grain yield was marginally higher under 33% N replacement (3789 and 4206

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kg/ha) than farmers practice (3737 and 4183 kg/ha) in rice and wheat, respectively. The key enzymes of N metabolism showed constant decrease in the activity of NR, NiR, GS, GOGAT and GDH enzymes with increased substitution of urea with nano-N. But, it was also interesting to note that activities of N-metabolism enzymes depleted by 12-16 days but the activites of enzyme constantly increased under 33% N replacement in both rice wheat crops. Maximum availability of available N was noted under farmer`s practice. So, it was concluded from the study that nitrogen (urea) could be substituted by 33% without hampering growth and physiology of rice-wheat.

Ashwani Kumar, Parvender Sheoran, Anita Mann and AK Bhardwaj

56th Foundation Day Celebration

ICAR-Central Soil Salinity Research Institute celebrated its 56th Foundation Day on 1st March 2024. Chief Guest, Dr. Narender Kumar Tyagi, Ex-Member, ASRB, inaugurated the function with lightning the lamp. Dr. Raj Kumar shared a brief presentation about the present postion of research and technologies of the Institute. Dr. Rajender Kumar Yadav, Director briefed about the various technologies developed by the institute and also about the achievements of the institute. The chief guest congratulated the Director and staff of ICAR-CSSRI for their work in development of various reclamation technologies, new varieties for different climatic eco-regions and other initiatives towards the progress in recent soil map. He also mentioned about how closely he is able to monitor the work of CSSRI and how it pleases him to see the Institute performing so good in so many areas. Chief guest also distributed the Annual Awards for the year 2021. Sh. Dilbagh Singh and Sh. Kartar Singh were awarded with best employee award in technical category for the year 2023. Sh. Gurcharan Singh was awarded with best employee award in administrative staff category for the year 2023. Sh. Abhishek Rana, Chief Administrative Officer of the Institute, addressed the audience with vote of thanks. On this occasion: Dr. Gurbachan Singh, Ex-Chairman, ASRB and Dr. PC Sharma, Ex-Director of CSSRI were also present. Dr. Gyanender Singh, Director, ICAR-IIWBR also graced the function with his presence.

Dr. NK Tyagi, Chief Guest, delivering the foundation day lecture

Implementation of the supplements distribution program and the mineral mixture making machine for livestock under the FFP

On May 16, 2024, at Kathura village in Sonepat district of Haryana, the ICAR-Central Soil Salinity Research Institute (CSSRI) conducted a mineral mixture, anionic mixture, and bergafat distribution programme under the Farmer FIRST Project. As part of this effort, nutritional inadequacies in animals were addressed through the distribution of supplements to improve livestock productivity and health. A total of 36 dairy farmers from Kathura village participated in the programme. Further, a mineral mixing machine was provided under the the Farmer FIRST project to prepare the animal-feed using the locally available grains. Dr. Sohanvir Singh, Principal Scientist, ICAR-NDRI and Co-PI of the Farmer FIRST Project imparted training on "preparing the mineral mixtures" and their appropriate combinations. He explained about the functioning of the mineral mixture machine and guided them to make best use of the same. Dairy animals with a diet rich in minerals have better immune systems and are more resilient to illnesses and infections. Bergafat improves milk production in cows and buffaloes without influencing feed intake. Additionally, Dr. Sohanvir Singh demonstrated of a unique, user-friendly and cost-effective technique for detecting livestock heat using a microscope and animal saliva.

FFP Team with Kathura Village Farmers

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Five-day training to SC Farmers

ICAR-Central Soil Salinity Research Institute, Regional Research Station, Bharuch organized Five-day training on "Entrepreneurship development among resource-poor farmers of saline lands through diversified agriculture" from 22 to 26 April 2024 at Village-Ankhi; Taluka-Jambusar; Dist.- Bharuch under SC Subplan Scheme of central government. 50 SC farmers participated from 14 villages (Ankhi, Umra, Magnad, Jhamdi, Kavli, Vavli, Jambusar, Samoj, Kalak, Karmad, Uchhad, Chhidra, Runad and Achhod) of Jambusar and Amod Taluka of Bharuch district. Among 50 participant eight participants were women farmers. Station Head Dr. Anil Chinchmalatpure, all scientific staff, Dr. Monika Shukla, Dr. Sagar Vibhute and Dr. David Camus and Farm Manager Sh. Champak Taviyad attended and managed the training programme for five days.

Some photos from the training programme

Farmers-scientist interface meeting-cum-rice seed distribution programme

Under the Farmer FIRST Project, led by CSSRI, a Kisan Goshthi was organized on May 22, 2024. The purpose of the meeting was to distribute the seeds of high-yielding crop (CSR 30, CSR 56, CSR 60, CSR 76, PB 1718, PB 1692, PB 1121, & PB 1509) to increase crop productivity. A total of 72 farmers from different villages (Kathura, Dhanana, Chhiri, Banwasa, and Khalpa) participated in the programme. In addition to seed distribution, farmers were also sensitized about the insect and pest management, irrigation management and soil health management. Further, farmers were also advised to use the balanced use of fertilisers including micronutrients and bio-fertilizers based on the recommendation of SHCs (soil health card) to avoid the over-expenditure as well as associated environmental implications.

FFP Team distributing seeds to Kathura Farmers

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