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# SALINITY NEWS

## From Directors' Desk

ICAR-CSSRI has made significant progress since its inception in 1969. It has pioneered techniques for rehabilitating salt-damaged soils across the country. The implementation of gypsum technology, cultivation of salt-tolerant crop varieties, and adoption of sub-surface drainage technology have contributed to soil reclamation and increased crop yields. Despite these achievements, several challenges persist in restoring salt-affected lands. These include outdated databases of salt-affected soils and waters, limited availability of amendments, coexistence of multiple abiotic stresses, resodication of waterlogged alkali soils, and a lack of options for managing dry land salinity. Current research efforts focus on identifying ameliorative measures and refining cultural practices. The overarching goals are to enhance productivity, ensure profitability, and promote sustainability. By formulating appropriate policies and action programs at the national level, we aim to achieve sustainable development objectives.

This volume of Salinity News (January-June, 2023) includes following listed major research achievements: Management options to halt groundwater depletion under climate change scenario in north-west India, CS 64 - salt tolerant Indian Mustard variety, Development of the Linseed reference set for salt tolerance, Use of the silicious chalk for sodicity reclamation and nutrient source, LULC Analysis of Sharda Sahayak Canal Command in Lucknow and Raebareli districts of Uttar Pradesh, Evaluation of efficiency of different sources of gypsum for sodic soil reclamation and CSR 95 (CSR 189-11-122): A SaltolQTL introgressed line governing tolerance to salt stress.This issue also includes information regarding 55th ICAR-CSSRI Foundation Day Celebration, Kharif Kisan Mela 2023 and International Yoga Day 2023.

(R.K. Yadav)
Director

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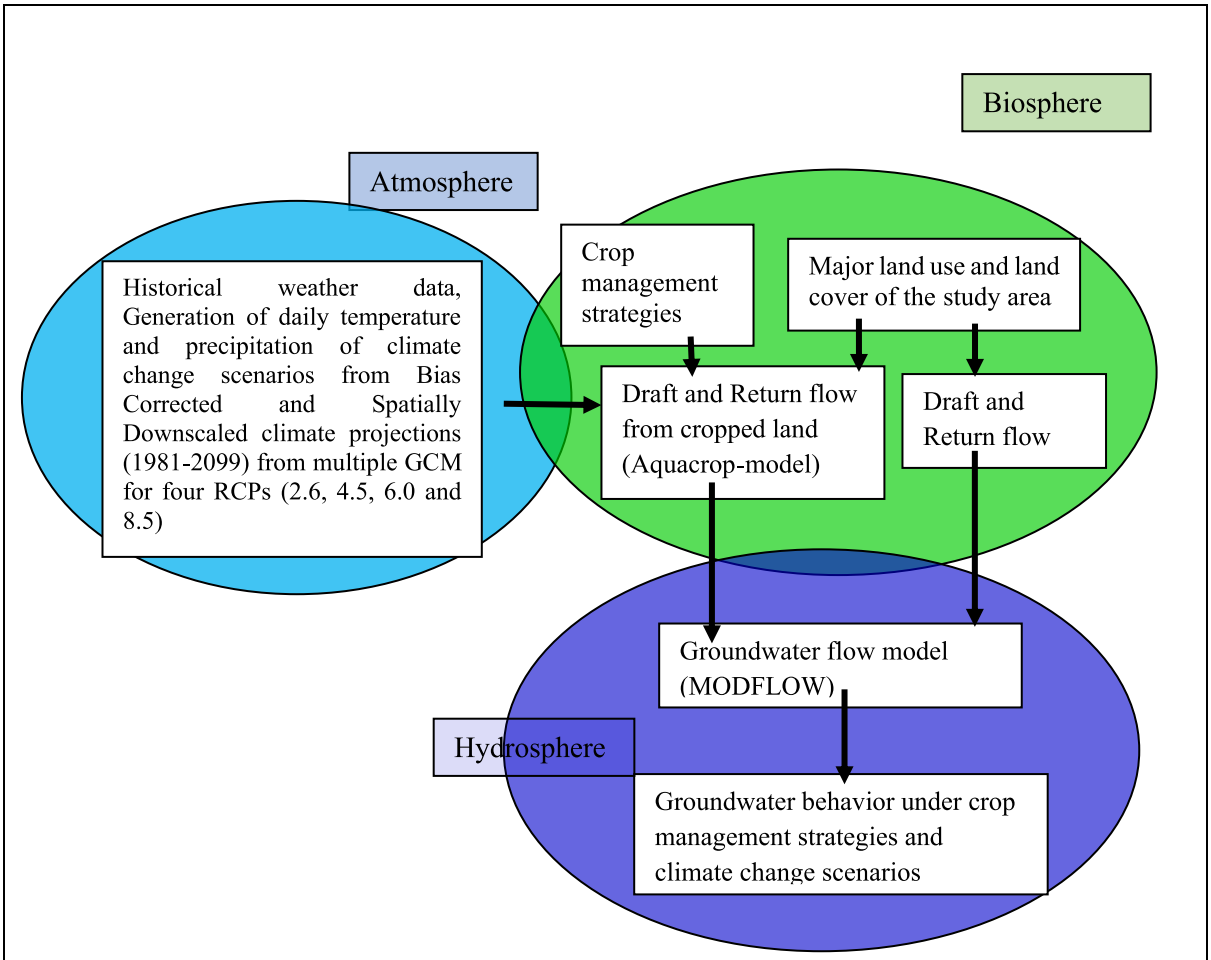
# Management options to halt groundwater depletion under climate change scenario in north-west India

Simulation study was done to evaluate the management options to halt groundwater depletion under climate change scenario. Effect of crop production on groundwater resources was simulated for existing rice-wheat cropping system and with alternate crop management strategies such as shift in sowing dates of rice and wheat, and fractional shift of rice area to maize as crop diversification. For assessing climate change impact on groundwater behaviour (draft, recharge, depth to water table), the Inter-Governmental Panel on Climate Change (IPCC) Fifth Assessment Report's climate change projections based on Representative Concentration Pathways (RCPs 2.6, 4.5, 6.0, and 8.5) were used in this study. Aquacrop model (version 5) was used to estimate groundwater draft (irrigation) and return flow (deep drainage) from the cropped area using soil, crop, and climate data, and estimated net draft was used as input in MODFLOW model for simulating groundwater behavior in future periods under climate change scenario. The impact of crop management plans such as shift in sowing dates of rice and wheat, and fractional replacement of rice area to maize as crop diversification was simulated to assess the effectiveness of different options in minimizing groundwater depletion under climate change scenarios.

**Key points**

- Delaying sowing dates of rice- wheat from the prevailing 15 June-15 November, increases groundwater draft, while advancing only wheat sowing date by 10 days from existing 15th November with 15th June of rice cultivation would reduce groundwater decline by 3.1, 6.4 and 10.6 m by early, mid and end century periods vis-à-vis prevailing sowing dates.
- Crop diversification i.e. fractional replacement of rice area by maize during Kharif and wheat during Rabi season has clear advantage in terms of controlling groundwater decline over




*Conceptual Framework*

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prevailing rice-wheat cropping system. Replacing 20%, 30% and 40% rice area by maize in rice- wheat system can reduce mean (average of RCPs) groundwater decline by 6.8, 9.6 and 13.8 m, respectively in comparison to projected end century (2100) decline of 28.50 m under prevailing sowing dates of rice-wheat. Adoption of these crop management plan can be used as an option to mitigate future groundwater level declining rate driven by anticipated climate change.

***Satyendra Kumar, Bhaskar Narjary, Vivekanand, RK Yadav and SK Kamra***

## ICAR-CSSRI developed salt tolerant Indian Mustard variety CS 64

The salt tolerant Indian Mustard CS 64 developed by ICAR-CSSRI, Karnal and was released by Central Sub-Committee on Crop Standards, Notification & Release of Varieties (CVRC) for salt affected area of the Haryana, Punjab, Rajasthan, Delhi and Uttar Pradesh, Plains of Jammu and Kashmir and Himachal Pradesh during the 90th meeting on 2 May, 2023. The productivity of this variety under normal soils is 25-28 q/ha, while under salt affected soil and irrigation water (ECe/iw 13 dS/m) and sodicity (pH 9.4), is 20-23 q/ha with 40% oil content. It matures in 130-138 days. The height of CS 64 is 160-168 cm and 1000 seed weight is 5.0-5.3g. This variety showed resistance to alternaria blight, white rust, powdery mildew, downy mildew, stag head, sclerotinia stem rot and mustard aphid under field conditions also.


***Jogendra Singh, Vijayta Singh and Ravi Kiran KT***

## Development of the Linseed reference set for salt tolerance

Reference set of linseed for salt tolerance was developed on the basis of two year evaluation of 2612 lines at two location under saline (ECe 8.5-10.2 dS/m) and sodic (pH2 9.4-9.6) environments. For salinity stress, a reference set of 396 lines including tolerant, moderately tolerant, moderately susceptible and susceptible lines was developed by using CSSRI Karnal and CCS HAU, Hisar data. For sodicity tolerance, a reference set of 299 lines including tolerant, moderately tolerant, moderately susceptible and susceptible lines was developed by using two years data generated at ICAR-CSSRI, Karnal and CSAU&AT, Kanpur.

| Categories | Saline | Sodic |
|---|---|---|
| Tolerant (STI* > 0.65) | 170 | 229 |
| Moderately tolerant (STI = 0.51 to 0.65) | 85 | 20 |
| Moderately sensitive (STI = 0.35 to 0.50) | 86 | 20 |
| Sensitive (STI < 0.35) | 55 | 30 |
| **Total Accessions** | **396** | **299** |
| STI*- Salt tolerance index | | |

***Criteria used for classification of genotypes***

***Performance of different genotypes under control and sodic conditions***

***S.K. Sanwal and Ashwani Kumar***

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## Use of the silicious chalk for sodicity reclamation and nutrient source

Silicious–chalk are the amorphous materials recovered from the gypsum mines. It is mainly composed of silica, Ca, Mg and Al. The calcium oxide content of this mineral varies from 17.1–26.2 in different mines. It also contains an appreciable quantity of Si and other micronutrients. It can serve as the source of Ca for sodic soil reclamation as well as nutrient source for different crops. A joint collaboration of CSSRI with FCI Aravali Gypsum and Minerals India Ltd, Jodhpur, Rajasthan, aimed to assess the sodic soil reclamation potential of the silicious chalk in different soil conditions, its nutrient supplying capacity and possibility of biological interventions to augment the solubilization of the mineral constituents for developing value added product for different agricultural usage. The possibility of the gypsum replacement by silicious chalk for assessing the reclamation potential was evaluated in the sodic soil of Haibatpur, Karnal with initial soil $pH_{1:2}$ 10.1 and $EC_{1:2}$ 0.7 dS $m^{-1}$. The exchangeable sodium per cent (ESP), cation exchange capacity (CEC), and clay content was 41.5%, 10.9 cmol (P+) $kg^{-1}$, and 17.9%, respectively. The gypsum requirement was 16.7 Mg $ha^{-1}$. The gypsum applied on 50GR Gypsum replacement by silicious chalk showed impact on sodic soil pH. The highest decreased of soil pH appeared in 50GR gypsum. The decline in pH reduces gradually with replacement of the gypsum by siliccious chalk. About 10-20% replacement of gypsum had non-significant effect on lowering soil pH compared to 100% gypsum. Grain and straw yield was also declined in proportion to increased replacement; however, 10-20% replacement had similar grain yield. Silicious chalk was effective as Ca source as compared to silica in nutrition of rice crop. Residual effect of the silicious chalk was evident on the wheat crop. The water soluble constituents in silicious chalk increase the EC of the soil saturation extract. The available P and K contents of the soil improved with increasing proportion of the chalk application in soil. About 100–200 kg $ha^{-1}$ application of silicious chalk recorded relatively greater grain yield of wheat compared to recommended dose of the fertilizers under slightly sodic soil conditions.

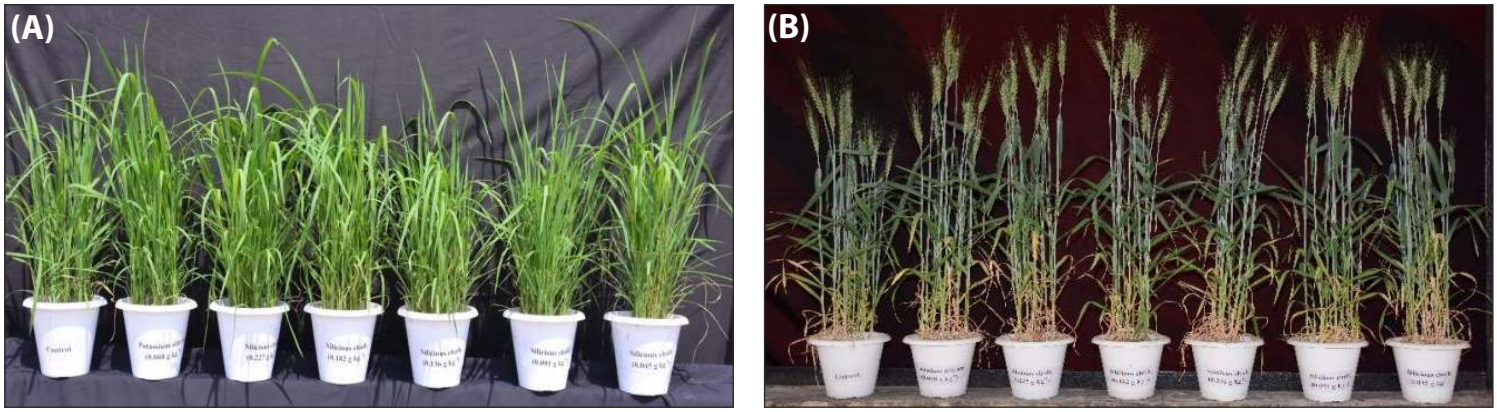


*Plate 1. Effect of silicious chalk as source of silica in rice (A) and residual effect in wheat (B)*

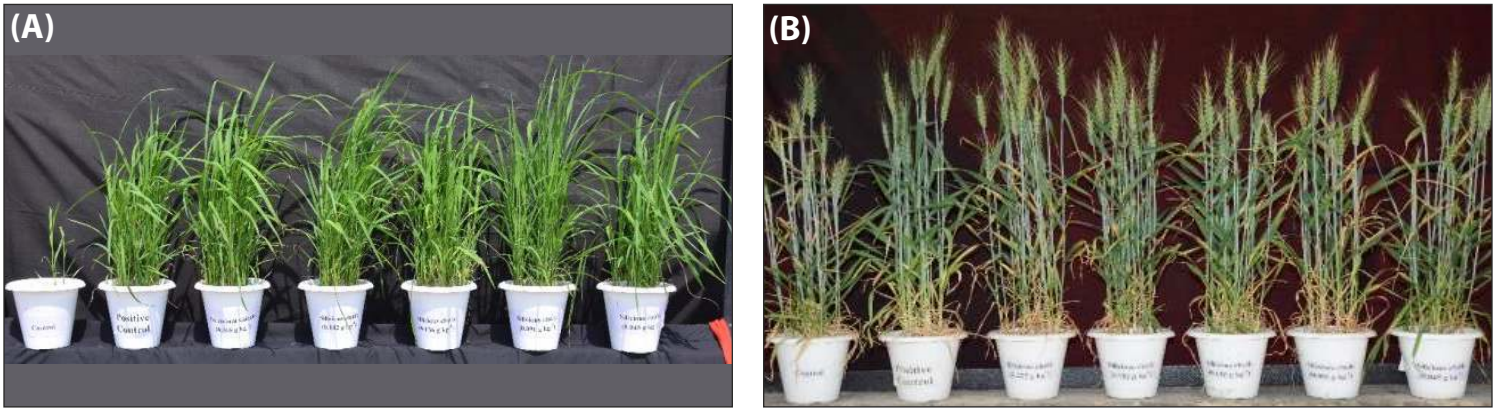


*Plate 2. Effect of silicious chalk as source of calcium ($Ca^{2+}$) in rice (A) and residual effect in wheat (B)*

*AK Rai, Nirmalendu Basak, Parul Sundha, Priyanka Chandra,Devvrat Dhiman, Kajal, Sanjay Kumar and RK Yadav*

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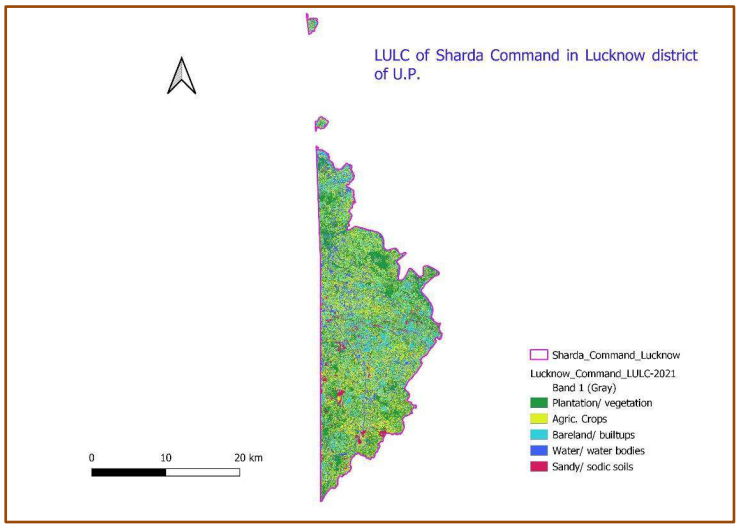
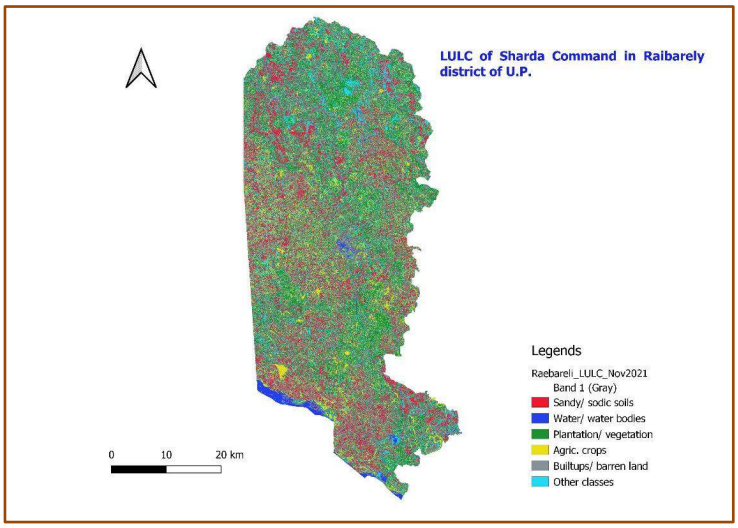
## LULC Analysis of Sharda Sahayak Canal Command in Lucknow and Raebareli districts of Uttar Pradesh

Sentinel-2B MSI data of November 2021 for Sharda Sahayak command in Lucknow and Raibarely districts was downloaded, and pre-processed using Quantum GIS, an open source software. The downloaded images were mosaiked and then clipped using districts boundary shape files and Sharda Canal command shape files. These images were classified for land uses land covers (LULC) by applying unsupervised method (Isodata). This classified image was then reclassified into known number of classes with the help of false colour composite and ground check points (total – 27).

According to this LULC, area under agriculture crops come out to be 37.3 percent. Estimated area under sandy/ sodic soils was 2231.73 ha, which is about 5.07 percent of total command area in Lucknow. Vegetation/ plantation covered an estimated area of 11806.78 ha of total 44014.70 ha area. In case of Raebareli, sandy/ sodic soils accounted for 22.3 percent of total command area in the district. Highest area was found under vegetation/ plantation class (25.97%). Area under crop was only 11.3 percent because considerable area was under sandy/ sodic soils.




*LULC of Sharda command in Lucknow district of U.P.*




*LULC of Sharda command in Raebareli district of U.P.*

*RH Rizvi, Sanjay Arora, CL Verma and RK Yadav*

## Evaluation of efficiency of different sources of gypsum for sodic soil reclamation

Gypsum is frequently used for sodic soil management because it is relatively soluble and affordable. Mineral gypsum (GYP) has been utilized extensively for the sustainable management of deteriorated sodic soils in different parts of the country, but its application in agriculture has been hindered by scarcity of supplies, industrialization, and urbanization. Without affecting crop production, mineral gypsum could be utilized as an effective alternative ameliorant for restoring deteriorated sodic soils. Hence, the field experiment was conducted at ADA C&RI (TNAU), Tiruchirappalli (Tamil Nadu) to assess the reclamation efficacy of mined mineral gypsum, industrial byproduct Phospho-gypsum and salt pan industry by-product marine gypsum. Based on initial soil sample analysis, 100% gypsum requirement (GR) for the reclamation of experimental field was calculated as 7.15 t $ha^{-1}$. Only 50 % GR was used for reclamation of sodic soils as a standard procedure. Adoption of different sources of gypsum application


*Paddy crop with application of mineral gypsum on farmer's field in Tamil Nadu*

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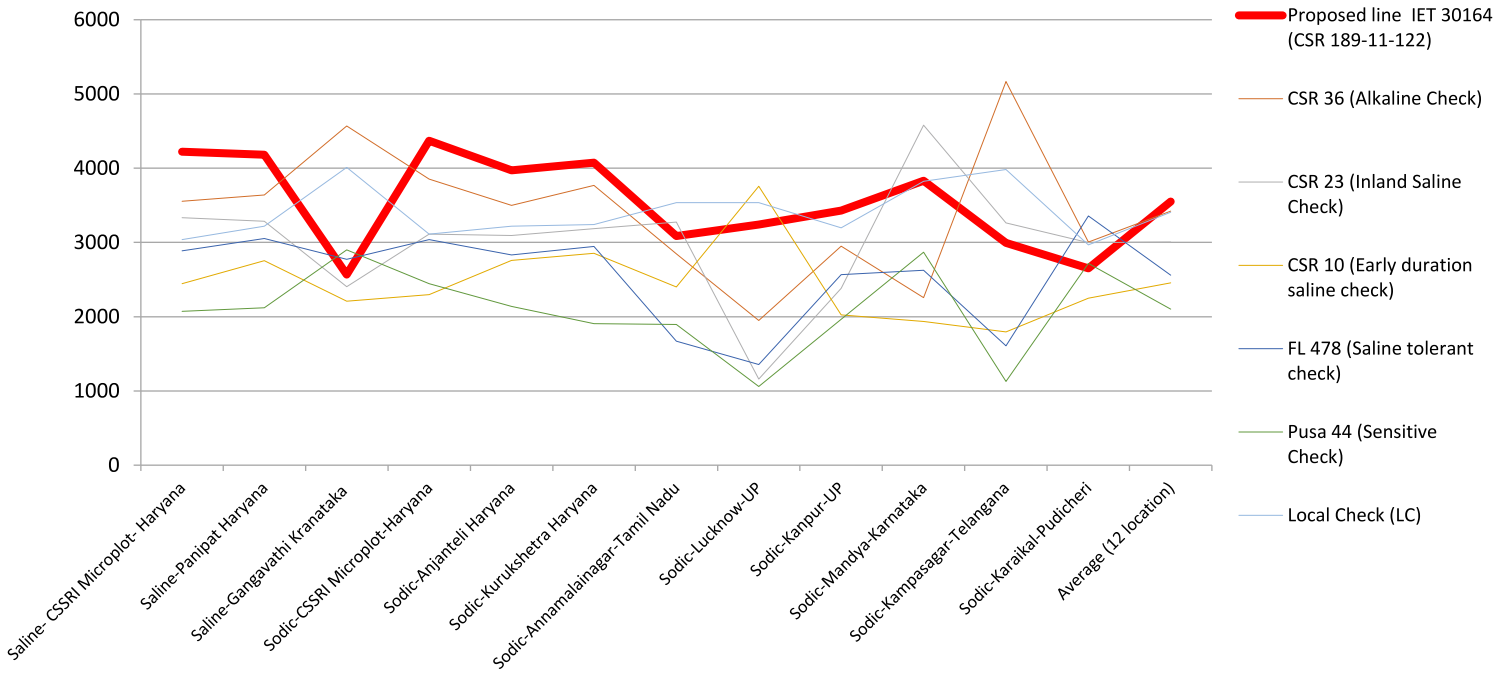
results in significant difference in grain yield of transplanted rice (TRY-5) under sodic soil condition. Among the different treatments, grain yield was higher in marine gypsum (50 % GR) (5.24 t $ha^{-1}$) followed by mineral gypsum (50 % GR) (4.79 t $ha^{-1}$). However, the mineral gypsum (50 % GR) was at par with phosphor-gypsum (50 % GR) (4.62 t $ha^{-1}$). The lowest grain yield was recorded in control (3.04 t $ha^{-1}$). Among the various sources of gypsum application, soil pH was lower in marine gypsum (50 % GR) (8.41) followed by mineral gypsum (50 % GR) (8.45) and phosphor-gypsum (50 % GR) (8.51). The highest pH value was recorded in control (9.62). In case of EC, marine gypsum (0.68 $dSm^{-1}$), mineral gypsum (0.65 dSm-1) and phosphor-gypsum (0.63 $dSm^{-1}$) all scored higher than control, where control recorded lower EC (0.51 $dSm^{-1}$). However, the lowest Exchangeable Sodium Percentage (ESP) was recorded in marine gypsum (50 % GR) (14.1) followed by mineral gypsum (50 % GR) (14.2) and phosphor-gypsum (50 % GR) (15.1). Higher ESP was recorded in control (40.1). Therefore, a substitute for mined gypsum can be readily used as an external source of Ca for this region. Marine gypsum may be a viable alternate for mined mineral gypsum where its availability for farmers is limited.

***S Rathika, M Baskar, RL Meena and BL Meena***

## CSR 95 (CSR 189-11-122): A SaltolQTL introgressedline governing tolerance to salt stress

Rice is an important staple crop in India. Drought and salt are the most significant biotic and abiotic stresses affecting rice production. More than 800 million hectares of the world's land area (6%) is salt-affected, including 6.73 million hectares in India. Rice is vulnerable to salt stress at both the seedling and reproductive stages. Tolerance at the seedling stage is essential for crop survival and establishment under salt-stress conditions. FL478 (RIL of IR29 × Pokkali) is a seedling stage salt tolerant variety having a major QTL called saltol. CSR 95 (CSR 189-11-122) was developed by a marker-assisted backcrossing approach with sensitive variety Sarjoo52 as a recurrent parent and FL478 as a donor for saltol QTL (Sarjoo52 / FL478 // Sarjoo52 *3). The NIL CSR 95 (CSR 189-11-122) and seven sister lines positive for saltol QTL linked markers RM3412 and AP3206 were examined under glass house and micro plot saline (ECe = 10 $dSm^{-1}$) environments from 2019 to 2021. CSR 95 (CSR 189-11-122) performed admirably throughout the season, with the lowest salt injury score (3.00), identical to FL478. In addition to seedling stage tolerance, it possesses desired agronomic qualities such as medium duration (130-135 days), dwarf culture, with green leaves, medium thin grains, and full panicle exertion. As a result, line CSR 95 (CSR 189-11-122) was nominated to the AICRP AL&ISTVT trials on rice and assessed in saline (ECe = 10 $dSm^{-1}$) and




*Performance of CSR 95 (CSR 189-11-122; IET 30164) for grain yield across the salt affected locations*

alkaline (pH-9.5) environments. This line CSR 95 (CSR 189-11-122) was found yield superiority over CSR 36 (Alkaline Check), CSR 23 (Inland Saline Check), CSR 10 (Early duration saline check), FL 478 (Saline tolerant check), Pusa 44 (Sensitive Check) and Local Check by 3.80%, 18.15%, 44.61%, 38.76%, 68.99%, and 4.26%, respectively under various high salinity and alkaline condition during 2021 (Figure). This line CSR 95 (CSR 189-11-122) has saltol QTL and seedling stage salinity tolerance with excellent yield potential; hence, it may be exploited for the creation of salt-tolerant cultivars and can be registered as genetic stocks

***SL Krishnamurthy, BM Lokeshkumar, Suman Rathor, AS Warraich and PC Sharma***

## 55th Foundation Day Celebration

ICAR-Central Soil Salinity Research Institute celebrated its 55th Foundation Day on 1st March 2023. Chief Guest, Dr. Trilochan Mohpatra, Ex-DG, ICAR & Secretary, DARE inaugurated the function. Dr S. K. Chaudhary, DDG (NRM, ICAR) graced the occasion as the Guest of Honour. The chief guest congratulated the Director and staff of 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. Dr S.K. Chaudhary praised the institute's progress in the recent years in addressing the changing climate issues and sustainable goals through various approaches and encouraged the staff to step forward to meet the need of hour. Dr. P.C. Sharma, Director briefed about the various technologies developed by the institute and also about the achievements of the institute. On this CSSRI. Dr. Satyendra Kumar was awarded woccasion, the chief guest released two research bulletins and three technical folders. Chief guest also distributed the Annual Awards ofith the ICAR-CSSRI Excellence Award in Soil Salinity for the year 2021. Smt. Chanchal Rani was awarded with best employee award in technical category for the year 2022. Sh. Niranjan Singh was awarded with best employee award in skilled supporting staff category for the year 2022.


*Dr. Satyendra Kumar being awarded with ICAR-CSSRI Excellence Award*


*Dr. Trilochan Mohpatra releasing research bulletin*

## Kharif Kisan Mela 2023

The institute organized Kharif Kisan Mela 2023 on 1st March 2023 at main campus, Karnal. Sh. Dinesh Kulkarni, All India Sangathan Mantri of Bhartiye Kisan Sangh graced the occasion as chief guest while Dr. Trilochan Mohpatra, Former DG ICAR and Secretary Department of Agriculture Research and Education, Govt. of India, New Delhi, Dr. Suresh Kumar Chaudhary, DDG, Natural Resource Management, Dr. Gurbachan Singh, President, GS Foundation for Research and Development, Karnal were the Guest of honors of the Kisan Mela. The chief guest highlighted the importance of traditional crops in climate resilience under changing scenarios. He urged the farmers to adopt the crop diversification and conservation agriculture to combat with agricultural production risks to weather vagaries, market fluctuations and to improve soil fertility and maintain long term sustainability. Dr. Mohpatra stressed on the use of market oriented farming and adoption of integrated nutrient management and micro irrigation techniques. Dr. Chaudhary urged the farmers to adopt recent residue management technologies and conservation agriculture to improve soil health and productivity. Dr. Gurbachan Singh said that small and marginal land holders should adopt the multi-enterprise farming involving dairy, fisheries, poultry, horticultural crops etc. to increase income and balanced nutrition. About 70 exhibition

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stalls by various govt., private and farmers groups were also displayed to so case the recent technological schemes to visiting farmers. Free soil and water analysis facility was also provided to the farmers by the Central Laboratory of the Institute. The Kisan Mela was attended by 1800 farmers, students and other stakeholders.


*Sh. Dinesh Kulkarni addressing the farmers*


*Dr. Trilochan Mohpatra addressing the farmers*

## Yoga for Health & Wellness

Employee's health is important for increasing the productivity of organization. Keeping this in mind, from 1 May 2023, "Yoga Break" (Y-Break) was started at Regional Research Station, Bharuch as per circulars issued by ICAR and by the Ministry of AYUSH. International Yoga Day 2023 was celebrated on 21st June 2023 at Institute headquarters and regional stations. On this occasion, Dr. S.K. Sanwal, Director Acting highlighted the importance of daily yoga on physical, mental and spiritual health. He urged all the employees to practice daily yoga for at least 30-45. Sh. Munna Kumar Shastri, Yoga Instructor, Karnal was invited for practicing yoga to all the employees present on the occasion. He emphasized that especially for those who do less physical activity, yoga should be a part of daily routine to keep themselves healthy. On this occasion, basic yoga asanas like Griva Sanbandhan, Udgeet, Anulom Vilom, Bhramari, Sheetkari, Uttan Pad Hasan etc. were performed as per the protocol of International Day of Yoga. The program was coordinated by Dr. Kailash Prajapat, Mr. Dalip Singh and Er. Yudhvir Singh Ahlawat.

*Bharuch Employees performing Yoga Aasans during Y-Break*

*International Yoga Day 2023 celebration in Karnal*

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