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In Vitro and *In Vivo* Screening of Rice Genotypes for Yield Attributes and Proximate Analysis in Relation to Salinity Tolerance

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ABSTRACT

An experiment on *in vivo* and *in vitro* screening of rice germplasm for salinity tolerance was carried out to screen rice genotypes. The results revealed that all the genotypes were affected by the increasing salinity levels but there were genotypic differences also. Among morphological characters almost all the characters showed reduction with increasing salinity levels except proline content, sodium content and chloride content. Sodium and Potassium content increased tremendously with increasing salinity levels where as there was significant reduction in K/Na ratio. On the basis of this the genotype CSR 23, CSR 36, HKR 47 and F_1s viz. CSR 36 x HKR 126, CSR 36 x IR 64, CSR 36 x HKR 127 and HKR 126 x IR 64 expressed to be salt tolerant whereas CSR 23 x CSR 36, IR 64 x HKR 127 and HKR 47 x HKR 127 as sensitive to salinity. The salinity tolerant genotypes may be used in rice breeding to develop elite genotypes.

Keywords: Rice, salinity, tolerance, *in vitro*, *in vivo,* screening

Introduction

Rice is a most important cereal crop in India and it contributes about 45% to the cereal production, 41% of the total food grain production. It is cultivated round the year in one or the other parts of the country, in diverse ecologies spread. Now a days, salinity is a serious environmental constraint to crop production in many parts of the world (Krishanamurthy et al., 2022). It is especially prevalent in irrigated agriculture and in marginal lands, associated with poor drainage or high water tables. Around 30% of the world's rice cultivation land is affected by soil salinity (Hopmans et al., 2021). The development of crops/varieties with improved salt tolerance is proposed as part of the solution to some of these problems (Sajid et al., 2017).

High salt stress disrupts homeostasis in water potential and ion distribution. This disruption of homeostasis occurs at both the cellular and whole plant levels. Drastic changes in ion and water homeostasis lead to molecular damage, growth arrest and even death. Increased salt tolerance is need for rice crop grown in salt affected areas and those at risk of salinization. This requires new genetic sources of salt tolerance and more efficient techniques for identifying salt tolerant germplasm, so that new genes for tolerance can be introduced into crop cultivars (Singh et al., 2021). Conventional techniques of screening rice germplasm for tolerance to soil salinity include growing of plants for long period of times to measure biomass or yield. However, this is subjected to genotype-environment interactions and environment effects to unknown extent. This sometimes jeopardizes whole selection effort. The other approach is based on physiological traits, accumulation of osmolytes for osmotic adjustment by way of amino acids, sugars *etc.* and sodium exclusion trait. While many physiological traits have been tried but sodium exclusion trait has been accepted as one reliable trait for screening crop germplasm for salt tolerance (Ahmadizadeh et al., 2016; Singh et al., 2021).

Most of the cultivated rice varieties are susceptible to salinity but rice germplasm do have source for salt tolerance character traditional land races/ varieties such as Pokkali, Dasal, Getu *etc*. have sufficient salt tolerance level and thus can be involved in breeding programme (De Leon et al., 2015). At CSSRI, Karnal, a series of salt tolerant rice varieties (*e.g*. CSR 10, CSR 11, CSR 13, CSR 19, CSR 26, CSR 30) have been developed through traditional breeding methods. However the selection under field conditions (*in vivo*) requires longer time and efforts but selection done under real conditions can stand the test of time. Keeping above facts in view the present study was carried out.

Materials and Methods

The present investigation was carried out for *in vivo* and *in vitro* screening of rice genotypes. The experiment was conducted in the screening house complex, Regional Research Station, CCS HAU, Uchani, Karnal. The soil was air dried, ground and passed through the rough 2 mm sieve before filling the pots. Polyethylene lined earthen pots were filled in with five kg air dried soil. The soil was added in lots to maintain uniform bulk density though out the pot. In this study, 10 genotypes *viz*., IR 64, HKR 46, HKR 47, HKR 120, HKR 126, HKR 127, CSR 13, CSR 23, CSR27, CSR36 were screened under four levels of salinity (0(control), 2dS/m, 4 dS/m and 6 dS/m) in three replications. To test the effect of different levels of salinity, ten genotypes of rice were sown. A population of five plants per pot was maintained after germination and allowed to grow up to maturity. All recommended package of practices were followed.

Creation of salinity levels

Amount of salts required for creating different salinities on soil saturation basis as follows:-

Desired Ece (dS/m)	TDS (me/l)	Amount of salts (me/l)				
		Na	Ca	Mg	Cl : SO_4	
2	25	12.5	3.12	9.38	17.5	7.5
4	50	25.0	6.25	18.75	35.0	15.0
6	72	36.0	9.00	27.00	50.4	21.6

Development of salinity levels in the soil: Varying levels of salinity *viz*., control, 2, 4 and 6 dSm^{-1} were created by saturating the respective number of pots with distilled water (control) and artificially prepared saline waters of 2, 4 and 6 dSm^{-1} electrical conductivity, respectively. The pots were kept covered with polyethylene sheet for one week to attain equilibrium. Thereafter, the pots were uncovered and allowed to approach the moisture level suitable for rice sowing. The surface soil was remixed thoroughly before sowing. The pots were irrigated with deionised/ distilled water on as and when required basis in order to maintain the constant level of salinity in the pots. The pots were also protected from rain water so as not to allow any interference due to rain water.

Observations: The crop was harvested at maturity. The observations on four morphological characters were recorded namely plant height (cm), number of panicle/plant, 1000- grain weight (g) and Seed yield/plant. The crop matured at different times due to the treatment effects and nature of genotypes. After harvesting, the plant samples were washed in tap water and then with distilled water, dried at 65±2°C in a forced air oven to a constant weight, the grains were then separated out. The straw and grain yields were recorded before grinding the sample. The samples were stored in sealed polyethylene bags for further analysis.

Chlorophyll (mg/g fresh weight): Chlorophyll (a & b) were extracted as per standard procedure of Hiscox and Israestam (1979). Method: 80 mg of washed and fine chopped leaf tissue was placed in a test tube containing 7 ml of DMSO (Di Methyl Sulphoxide). The chlorophyll was extracted without grinding by incubating at 65°C for one hour. The extracted liquid was transferred to a graduated cylinder and volume made up to 10 ml with DMSO and O.D. was recorded using spectrophotometer at 645 and 663 nm. When stored at 0-4°C for 24 hours there was no effect on the absorbance. Chlorophyll content was calculated following the standard equation as follows:

Chl a (mg/g): 11.63 X A663 – 2.39 X A645

Chl b (mg/g): 20.11 X A645 – 5.18 X A663

Plant Analysis: After the harvest, the plant samples were washed first with tap water and then by distilled water, dried at 65±2°C to a constant weight, ground and analysed for different constituents. One gram of the ground plant material (straw) was digested in 4:1 HNO_3: $HClO_4$ mixture. The material was heated for 90 minutes at 160°C and finally for 30 minutes at 220°C. After cooling the digest was made 50 ml with distilled water. Then this end product was filtered into plastic bottle of 100 ml and such digest were further used for analysis of K, Na, Ca, Mg and SO_4 content.

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Chemical Parameters: Proline content (Mg/g dry weight) was estimated by the standard procedure of Bates et al., (1973). Potassium and Sodium content (ppm) was determined by flame photometer. Calcium content (ppm) was measured by Versenate titration method using Calcon indicator (Hesse, 1971). Magnesium content (ppm) was estimated by subtracting the Ca content from the Ca^{+} Mg content, obtained by Versenate titration method as outlined in USDA hand book-60 (Richards, 1954). Chloride content (%) was determined by chloride specific ion selective electrode (Orion) using 0.5 M HNO_3 and 0.5 KNO_3 as supporting electrolyte according to procedure of Chhabra et al., (1976). Sulphate content (ppm) was determined colorimetrically by turbidity method at 440 nm wave length. K^{+}/Na^{+} ratio was calculated by dividing potassium content with sodium content. Ca^{++}/Mg^{++} ratio was calculated by dividing Calcium content with Magnesium content. The statistical parameters were calculated as per Completely Randomized Design experimental analysis (Sheoran et al., 1998).

Results

The present investigation was resolved into experiments dealing with *in vivo* and *in vitro* screening of rice genotypes. The salient features of results are described here under:

Plant height (cm): Plant height decreased with increasing salinity levels in all the genotypes (table 1). The overall genotypic mean decreased from 70.73 to 57.13 cm with an increase from control to 6 dSm^{-1}. It means that increasing salinity stress led to dwarfing. The least affected genotypes were HKR 47 X HKR 127, followed by CSR 23 and CSR 23 X HKR 47 at 6 dSm^{-1} of salinity stress.

Number of panicle/plant: Increasing salinity levels exhibited adverse effects on the number of panicle/plant as evident from table 1. The maximum number of panicle/plant at 6 dSm^{-1} salinity level was exhibited by IR 64, followed by CSR 36 X HKR 126, CSR 23, and CSR 36 X IR 64. The maximum decrease in number of panicle/plant was observed in CSR 36 X IR 64 followed by CSR 13, HKR 46 and HKR 126 X HKR 127 at 6 dSm^{-1} salinity level.

1000-grain weight (g): The 1000-grain weight at 6 dSm^{-1} was reduced for every genotype (table 2). Genotypes HKR 127 and CSR 36 X HKR 127 had lowest per cent reduction whereas maximum reduction was found in genotype HKR 120 X IR 64 in 1000 grain weight at 6 dSm^{-1} compared to the control.

Seed yield/plant (g): The salinity level of 2 dSm^{-1} acted as a stimulus for seed yield/plant for the genotype CSR 36 X HKR 127. While at salinity level 6 dSm^{-1}, the seed yield/plant decreased drastically in all genotypes (table 2). Lowest per cent decrease was noticed in CSR 23 (32.23%), followed by HKR 47 (39.07%) and CSR 36 (39.62%) whereas, maximum per cent decrease was noticed in the genotype CSR 23 X CSR 36 (90.14%) followed by CSR 36 X HKR 47 (89.09%), IR 64 X HKR 127 (88.60%) and HKR 47 X HKR 127 (86.75) at 6 dSm^{-1}.

Chlorophyll 'a' (mg/g, fresh weight): All stresses *i.e.* 2 dSm^{-1}, 4 dSm^{-1} and 6 dSm^{-1} proved as stimulus for increased chlorophyll 'a' content in genotype HKR 127 whereas, salinity level 2 dSm^{-1} and 4 dSm^{-1} proved as stimulus for genotype CSR 23 X HKR 127 and CSR 36 X HKR 126 as shown in table 3. The maximum decrease in chlorophyll 'a' content was found in genotype CSR 27 at 6 dSm^{-1} salinity level.

Chlorophyll 'b' (mg/g, fresh weight): Chlorophyll 'b' of all the genotypes reduced significantly with increasing salinity levels. It was evident from the data in table 3 that minimum reduction percentage in chlorophyll 'b' content was found in the genotype HKR 47 followed by HKR 46 and IR 64 whereas maximum reduction percentage was observed in the genotypes HKR 120, followed by CSR 36 X HKR 126 and CSR 23 X HKR 127.

Proline content (mg/g): Proline, a stress indicator, increased with increasing salinity levels in every genotype but with a varying magnitude due to genotypic differences (Table 4). Comparative evaluation of proline content at 6 dSm^{-1} with that at control, revealed the highest proline content in HKR 47 (6.99 mg/g), followed by CSR 13 (6.868 mg/g), CSR 36 (6.857 mg/g) and CSR 27 (6.591 mg/g). On the other hand, the minimum proline content was observed in genotype IR 64 X HKR 47 (5.898 mg/g), followed by CSR 36 X HKR 126 (5.971 mg/g) and CSR 23 X HKR 126 (6.041) at 6 dSm^{-1} salinity level.

Potassium content (ppm): Potassium content of rice genotypes decreased drastically with increasing salinity levels, that with genotypic differences too. But all the F_1's except genotype CSR 36 X HKR 47 showed reverse trend with increase in salinity levels (table 4). The maximum increase in potassium content was found in the genotype CSR 23 X CSR 36, followed by CSR 36 X HKR 127 and CSR 23 X HKR 126 whereas, maximum decrease was observed in the genotype in genotype CSR 36 X HKR 47 followed HKR 46, HKR 120 and HKR 126.

Sodium content (ppm): A significantly increase in sodium content was observed with increasing salinity levels (Table 5). At a salinity level of 6 dSm^{-1}, the lowest sodium content was observed in the genotype HKR 47 X HKR 127 (4133.35 ppm), followed by HKR 47 (4400.88 ppm), HKR 126 X HKR 127 (7566.76 ppm) and CSR 23 X CSR 36 (4600.85 ppm) whereas the highest sodium content was observed in the genotype HKR 126 (7766.67 ppm), followed by IR 64 (7634.21 ppm), HKR 127 (7400.86 ppm) and CSR 27 (7234.20 ppm).

Calcium content (%): With the increasing salinity levels there was a linear decrease in the calcium content in rice straw. The highest decrease was noticed in HKR 46 i.e. from 2.159% (at control) to 1.044% (at 6 dSm^{-1}), followed by CSR 36 from 2.087% (at control) to 1.058% (at 6 dSm^{-1}) and HKR 126 from 2.394% (at control) to 1.249% (at 6 dSm^{-1}). The minimum decrease in calcium content was noticed in CSR 23 from 1.769% at control to 1.466% at 6 dSm^{-1} (table 5). Maximum calcium content in rice at 6 dSm^{-1} was observed in the genotypes HKR 126 X HKR 127 (1.837%), followed by HKR 126 X IR 64 (1.732%) and CSR 36 X HKR 126 (1.710%).

Magnesium content (%): A linear decrease in the magnesium content was observed with increasing salinity levels in each genotype (table 6). Highest decrease in magnesium content was observed in CSR 23 *i.e.* from 1.806% at control to 0.466% at 6 dSm^{-1}, followed by CSR 23 X CSR 36 from 1.415% at control to 0.386% at 6 dSm^{-1}, CSR 23 X IR 64 from 1.737% at control to 0.482% at 6 dSm^{-1} and CSR 36 X HKR 126 from 1.142% at control to 0.324% at 6 dSm^{-1} whereas, the minimum decrease was found in the genotypes CSR 13, followed by CSR 27 and HKR 126.

Chloride content (%): The chloride content in rice increased in a linear fashion with increasing salinity levels (table 6). The highest increase was observed in HKR 126 from 2.034% at control to 6.185% at 6 dSm^{-1}, about three times increase, followed by CSR 13 from 2.679% at control to 7.323% at 6 dSm^{-1}, CSR 23 X CSR 36 from 2.757% at control to 7.375% at 6 dSm^{-1}, CSR 46 from 2.439% at control to 6.510% at 6 dSm^{-1} and CSR 27 from 2.493% at control to 6.609% at 6 dSm^{-1}. The highest chloride content in rice at 6 dSm^{-1} was recorded in CSR 23 X CSR 36 (7.375%), followed by CSR 23 X HKR 126 (7.324%), CSR 13 (7.323%) and CSR 36 (7.020%).

Sulphate content (ppm): The sulphate content decreased substantially at all salinity levels i.e. 2 dSm^{-1}, 4 dSm^{-1} and 6 dSm^{-1} compared to control in all genotypes (table 7). But in case HKR 127 at 2 dSm^{-1} sulphate content increased. Maximum decrease in sulphate content from control to 6 dSm^{-1} was observed in the genotypes HKR 126 (26433.33 ppm to 17801.61 ppm), followed by HKR 46 (26566.67 ppm to 15266.75 ppm), CSR 36 X HKR 47 (25233.48 ppm to 14637.51 ppm) and CSR 36 X HKR 126 (24833.37 ppm to 14533.83 ppm). On the other hand the minimum decrease in sulphate content from control to 6 dSm^{-1} was observed in the genotype HKR 127 (21233.82 ppm to 19133.67 ppm).

K^+/Na^+ ratio: Every genotype exhibited a significant decrease in K^+/Na^+ ratio with increasing salinity levels (table 8). At salinity level 4 dSm^{-1} the maximum K^+/Na^+ ratio was observed in CSR 23 (4.12), followed by CSR 23 X CSR 36 (3.99), CSR 23 X HKR 126 (3.93), HKR 47 X HKR 127 (3.92) and HKR 47 (3.91). When compared at salinity level of 6 dSm^{-1}, the maximum K^+/Na^+ ratio was observed in the genotypes CSR 23 X HKR 126 (3.54), followed by HKR 126 X HKR 127 (3.51), CSR 23 X CSR 36 (3.48), IR 64 X HKR 127 (3.43) and CSR 23 X IR 64 (3.30).

Ca^{++}/Mg^{++} ratio: It is evident from data in table 8 that the Ca^{++}/Mg^{++} ration increased at all the salinity levels i.e. 2 dSm^{-1}, 4 dSm^{-1} and 6 dSm^{-1} as compared to control in all genotypes but the magnitude of increase varied from genotype to genotype. At 6 dSm^{-1} salinity level maximum increase was noticed in CSR 23 (0.980 to 3.163), followed by CSR 23 X IR 64 and CSR 23 X CSR 36.

Discussion

Salinity limits rice yield or prevent rice planting over large land areas around the world. Investigation on the effects of salinity on plant growth and productivity have been conducted to enhance the salt tolerance in rice. Genetic improvement of crop plants depends upon availability of requisite genetic variability in germplasm. In genus *Oryza*, traditional landraces/varieties such as Pokkali, Dasal, Getu *etc*. are well adapted to saline conditions and can be used as donor of salt tolerance trait in rice breeding programs. Some progress in developing improved varieties has been made through conventional breeding method by introgression of salt tolerance genes/traits from salt tolerant germplasm to cultivated rice varieties. In spite of considerable efforts, only a few salt-tolerant cultivars have been released. CSR 10 is one of the salt tolerant variety developed from crosses between CSR 1 (Damodar, salt tolerant landrace) and Jaya (high yielding indica) by Central Soil Salinity Research Institute, Karnal, India.

In the present investigation, a screen house experiment was conducted for the screening of 10 rice genotypes and their 15 F_1 hybrids for their salt tolerance at

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varying levels of salinity (Control, 2, 4 and 6 dSm^{-1}). The genotypes were grown up to maturity. The grain and straw yields were recorded and also analyzed for different chemical/biochemical parameters. The yield and yield attributes of all the genotypes were affected differentially by salinity levels. Minimum reduction in leaf area over control was observed in HKR 47. The decrease in leaf area might be due to poor development of meristematic tissue due to stresses caused by increasing levels of salinity. Similar results were also reported by Bhatt et al., (2020).

The increasing levels of soil salinity also resulted in decreased plant height, number of panicle/plant, number of seeds/panicle, 1000-grain weight, seed yield and dry aerial biomass. This was observed in all the genotypes and the magnitude of reduction varied between cultivars. The number of seeds/panicle decreased in IR 64, from 85.17 to 22.27 seeds/panicle with an increase in salinity level from control to 6 dSm^{-1}, respectively. Similarly seed yield/plant of CSR 13 decreased from 18.10 to 2.47 gram per plant with increasing salinity, from control to 6 dSm^{-1}, respectively. Seed yield per plant reduction in F_1's was high as compared to their parents. Except genotypes CSR 36 x HKR 126 and CSR 36 x HKR 127 all F_1's had more than 50% reduction in seed yield per plant. Whereas in parents only HKR 127 and IR 64 had more than 50% reductions in seed yield. Similar findings were also reported by Krishanamurthy et al., (2022).

The adverse effect of increasing salinity levels on the yield and yield traits of almost all the genotypes of rice may be attributed to the adverse effect of soluble salts on nutrient and water absorption by roots, probably due to high osmotic pressure/potential of soil solution than that of root cell sap. This is the most important single factor which influences the growth of crops grown in saline environments. Further the poor growth of genotypes of rice in saline environments may also be ascribed due to its inhibitory effect on cell division and its enlargement in plants growing points. Reduced growth of shoot caused by excess soluble salts may be due to their adverse effect on tissues (Singh et al., 2021). Consequently, stunted growth of plants was observed.

All stresses *i.e.* 2 dSm^{-1}, 4 dSm^{-1} and 6 dSm^{-1} proved as stimulus for increased chlorophyll 'a' content in genotype HKR 127 whereas, salinity level 2 dSm^{-1} and 4 dSm^{-1} proved as stimulus for genotype CSR 23 X HKR 127 and CSR 36 X HKR 126. The maximum decrease in chlorophyll 'a' content was found in genotype CSR 27 at 6 dSm^{-1} salinity level. Chlorophyll 'b' of all the genotypes reduced significantly with increasing salinity levels. The minimum reduction percentage in chlorophyll 'b' content was found in the genotype HKR 47 followed by HKR 46 and IR 64 whereas, maximum reduction percentage was observed in the genotypes HKR 120, followed by CSR 36 X HKR 126 and CSR 23 X HKR 127. The decrease in the chlorophyll content due to increasing salt stress might have affected the photosynthetic activity in plants resulting in drastic reduction in grain and dry aerial biomass yield. Plants have evolved diverse strategies of acclimation and avoidance to cope with adverse environmental conditions; various solutes accumulate under stress conditions to protect the plant from damage. Out of these, proline is only one which has been shown to protect plants against singlet oxygen and free radical induced damages. It is thought to play a role as a singlet oxygen quencher and scavenger of OH radicals. Increase in proline accumulation under salt-stress as witnessed in present study was also observed by various investigators (Bhatt et al., 2020). Comparative evaluation of proline content at 6 dSm^{-1} with that at control, revealed the highest proline content in HKR 47 (6.99 mg/g). On the other hand, the minimum proline content was observed in genotype IR 64 X HKR 47 (5.898 mg/g) at 6 dSm^{-1} salinity level. Elevated proline content with enriched salt stress tolerance has been described by Bhatt et al., (2020).

Na exclusion or uptake reduction and increased absorption of K to maintain a good Na: K balance in the straw has been associated with salinity tolerance in rice. The potassium content decreased drastically with increasing salinity levels of almost all rice genotypes. But all the F_1's except genotype CSR 36 X HKR 47 showed reverse trend with increase with salinity levels. Potassium is well known for its role in stress tolerance in plants. The maximum increase in potassium content was found in the genotype CSR 23 X CSR 36, followed by CSR 36 X HKR 127 and CSR 23 X HKR 126 whereas, maximum decrease was observed in the genotype CSR 36 X HKR 47 followed HKR 46, HKR 120 and HKR 126. The accumulation of K in salt tolerant genotypes also influences the K/Na ratio of straw. The ranking according to Na, K absorption alone is not a reliable parameter for salinity tolerance reactions. However, the classification of susceptible and tolerant based on field laboratory and greenhouse tests is clearly related to the Na:K concentration. Thus Na: K ratio, which is the balance between Na and K in straw, could be a valid criterion in measuring salinity tolerance in rice.

Calcium content decreased with the increasing salinity levels in rice straw. The highest decrease was noticed in HKR 46 *i.e.* from 2.159% (at control) to 1.044% (at 6 dSm^{-1}). The minimum decrease in calcium content was noticed in CSR 23 from 1.769% at control to 1.466% at 6 dSm^{-1}. Maximum calcium content in rice at 6 dSm^{-1} was observed in the genotypes HKR 126 X HKR 127 (1.837%). A linear decrease in the magnesium content was observed with increasing salinity levels in each genotype. Highest decrease in magnesium content was observed in CSR 23 i.e. from 1.806% at control to 0.466% at 6 dSm^{-1} whereas, the minimum decrease was found in the genotypes CSR 13, followed by CSR 27 and HKR 126. In F_1's highest decrease in magnesium content was observed in CSR 23 X CSR 36 from 1.415% at control to 0.386% at 6 dSm^{-1} followed by CSR 23 X IR 64 from 1.737% at control to 0.482% at 6 dSm^{-1} and CSR 36 X HKR 126 from 1.142% at control to 0.324% at 6 dSm^{-1}.

The sulphate content decreased substantially with the increasing salinity levels in all genotypes. But in case HKR 127 sulphate content increased at 2 dSm^{-1}. Maximum decrease in sulphate content from control to 6 dSm^{-1} was observed in the genotypes HKR 126 (26433.33 ppm to 17801.61 ppm). The higher accumulation of sulphate content in HKR 127, CSR 23, CSR 36, IR 64 and HKR 126 might have alleviated the toxic effect of Cl on plants. The chloride content in rice increased in a linear fashion with increasing salinity levels. The highest increase was observed in HKR 126 from 2.034% at control to 6.185% at 6 dSm^{-1}, about three times increase. The highest chloride content in rice at 6 dSm^{-1} was recorded in CSR 23 X CSR 36 (7.375%). Bhatt et al., (2020) studied the salinity tolerance mechanism in rice and also reported tolerant land races.

Conclusions

It may be concluded that the parents CSR 23, CSR 36, HKR 47 and crosses CSR 36 x HKR 126, CSR 36 x IR 64, CSR 36 x HKR 127 and HKR 126 x IR 64 figured to offer promise as they depicted less reduction in the yield and involved divergent parents. Proximate studies postulate them as salt shock protein mediated salinity stress tolerant genotypes which may be used as potent parents in crosses for further rice improvement through recombination breeding.

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Table 1. Performance of rice genotypes at different salinity levels for Plant height (cm).

Genotypes	Plant Height (cm)				Mean	Number of Panicle/Plant				Mean
	Control	2 dSm-1	4 dSm-1	6 dSm-1		Control	2 dSm-1	4 dSm-1	6 dSm-1	
IR 64	70.50	60.33	60.27	58.00	**62.28**	9.33	8.50	8.50	8.50	**3.37**
HKR 46	56.67	54.67	54.50	49.77	**53.90**	7.00	6.33	5.50	4.00	**3.37**
HKR 47	72.00	65.77	65.00	63.67	**66.61**	10.50	8.50	8.00	7.00	**3.43**
HKR 120	82.50	73.00	69.33	54.50	**69.83**	7.17	6.00	5.00	4.50	**3.44**
HKR 126	71.50	66.00	59.50	51.00	**62.00**	7.50	6.67	5.83	5.33	**3.51**
HKR 127	73.50	70.83	66.17	64.00	**68.63**	7.50	7.17	6.50	6.00	**3.56**
CSR 13	63.00	55.33	49.50	45.33	**53.29**	11.50	9.83	6.50	6.50	**3.55**
CSR 23	77.00	76.77	73.50	70.50	**74.44**	9.00	7.50	7.50	7.50	**3.56**
CSR 27	71.50	67.33	66.67	62.00	**66.88**	7.00	7.17	6.83	5.50	**3.58**
CSR 36	59.00	58.00	56.83	52.83	**56.67**	9.50	6.50	6.50	6.17	**3.62**
CSR 23 X CSR 36	75.33	65.83	65.00	60.50	**66.67**	9.33	8.83	8.00	6.67	**3.65**
CSR 23 X HKR 126	74.57	64.00	60.50	60.00	**64.77**	7.67	7.17	4.83	4.27	**3.57**
CSR 23 X IR 64	74.70	62.57	59.17	58.00	**63.61**	7.67	7.10	7.00	6.70	**3.60**
CSR 23 X HKR 47	74.57	67.50	65.27	63.30	**67.66**	8.00	7.50	7.00	6.50	**3.58**
CSR 23 X HKR 127	74.90	71.67	69.23	67.93	**70.93**	8.00	7.67	7.50	7.17	**3.56**
CSR 36 X HKR 126	72.00	70.33	69.17	50.50	**65.50**	9.50	7.50	6.00	8.33	**3.54**
CSR 36 X IR 64	83.00	60.50	55.00	49.67	**62.04**	14.83	12.00	8.33	7.50	**3.52**
CSR 36 X HKR 47	73.17	65.00	61.50	59.50	**64.79**	8.00	7.50	6.50	6.00	**3.47**
CSR 36 X HKR 127	65.27	61.00	60.00	58.50	**61.19**	8.00	8.00	7.67	6.50	**3.53**
HKR 126 X IR 64	66.47	62.67	58.73	57.30	**61.29**	7.60	7.50	7.33	7.17	**3.54**
HKR 126 X HKR 47	66.40	64.23	59.13	58.00	**61.94**	7.00	6.83	6.67	6.50	**3.53**
HKR 126 X HKR 127	67.00	67.00	64.67	56.50	**63.79**	7.50	7.00	6.50	4.50	**3.53**
IR 64 X HKR 47	69.43	66.90	50.83	47.63	**58.70**	8.17	7.83	7.50	7.17	**3.53**
IR 64 X HKR 127	70.60	67.33	50.87	49.47	**59.57**	7.67	7.50	7.33	7.20	**3.53**
HKR 47 X HKR 127	63.67	63.17	62.00	59.87	**62.18**	7.50	6.50	6.33	5.87	**3.53**
Mean	**70.73**	**65.11**	**61.29**	**57.13**		**3.52**	**3.54**	**3.53**	**3.53**	
			CD	**SE (d)**	**SE (M)**			**CD**	**SE (d)**	**SE (M)**
Salinity Levels			0.56	0.28	0.20			0.17	0.08	0.06
Genotypes			1.40	0.71	0.50			0.42	0.21	0.15
Salinity Levels x Genotypes			2.79	1.41	1.00			0.83	0.42	0.30

Table 2. Performance of rice genotypes at different salinity levels for number of panicle/plant.

Genotypes	1000-Grain Weight (gr)					Seed Yield/Plant (gr)				
	Control	2 dSm^{-1}	4 dSm^{-1}	6 dSm^{-1}	Mean	Control	2 dSm^{-1}	4 dSm^{-1}	6 dSm^{-1}	Mean
IR 64	47.00	45.00	42.33	35.00	**42.33**	17.67	13.67	9.70	7.90	**12.24**
HKR 46	47.00	46.00	43.67	41.00	**44.42**	20.33	15.60	15.00	7.53	**14.62**
HKR 47	39.00	36.00	33.67	31.67	**35.09**	21.50	21.27	16.47	13.10	**18.09**
HKR 120	43.00	41.67	31.67	30.67	**36.75**	19.63	18.50	10.83	10.47	**14.86**
HKR 126	45.00	40.33	37.00	35.33	**39.42**	20.43	20.23	13.00	11.47	**16.28**
HKR 127	39.33	38.33	36.00	35.67	**37.33**	22.67	19.77	14.97	9.13	**16.64**
CSR 13	36.00	36.00	31.00	28.67	**32.92**	18.10	9.80	3.63	2.47	**8.50**
CSR 23	44.67	42.33	39.33	36.67	**40.75**	16.63	15.43	12.43	11.27	**13.94**
CSR 27	45.33	43.33	38.00	36.00	**40.67**	21.53	15.33	13.73	7.17	**14.44**
CSR 36	43.00	43.00	38.33	35.33	**39.92**	13.53	11.53	10.83	8.17	**11.02**
CSR 23 X CSR 36	42.67	42.33	37.67	35.00	**39.42**	24.33	14.37	10.07	2.40	**12.79**
CSR 23 X HKR 126	45.00	43.00	38.00	36.00	**40.50**	14.33	13.90	13.27	4.23	**11.43**
CSR 23 X IR 64	44.00	41.67	37.00	35.00	**39.42**	16.47	16.47	12.43	3.30	**12.17**
CSR 23 X HKR 47	40.67	39.00	36.00	33.67	**37.34**	19.33	19.03	17.20	5.40	**15.24**
CSR 23 X HKR 127	40.00	38.67	36.67	32.67	**37.00**	14.87	14.50	11.77	2.13	**10.82**
CSR 36 X HKR 126	44.00	41.33	37.67	34.67	**39.42**	19.00	14.97	11.70	11.33	**14.25**
CSR 36 X IR 64	43.00	40.00	37.00	35.33	**38.83**	18.87	12.77	9.70	8.77	**12.53**
CSR 36 X HKR 47	47.33	44.33	37.67	35.33	**41.17**	16.50	13.50	6.60	1.80	**9.60**
CSR 36 X HKR 127	38.00	36.33	36.67	34.33	**36.33**	10.90	11.17	6.67	6.47	**8.80**
HKR 126 X IR 64	47.00	45.67	40.00	36.67	**42.34**	15.27	15.10	12.87	6.57	**12.45**
HKR 126 X HKR 47	41.00	38.67	35.67	32.67	**37.00**	19.00	18.87	16.97	6.10	**15.24**
HKR 126 X HKR 127	47.00	45.00	42.00	37.00	**42.75**	15.50	10.03	2.77	2.23	**7.63**
IR 64 X HKR 47	44.67	41.00	37.00	34.00	**39.17**	18.67	18.43	16.03	7.40	**15.13**
IR 64 X HKR 127	42.00	40.33	38.00	34.67	**38.75**	15.53	3.67	3.30	1.77	**6.07**
HKR 47 X HKR 127	41.33	39.00	37.00	33.33	**37.67**	12.60	2.73	2.30	1.67	**4.83**
Mean	**43.08**	**41.13**	**37.40**	**34.65**		**17.73**	**14.43**	**10.97**	**6.41**	
			CD	**SE (d)**	**SE (M)**			**CD**	**SE (d)**	**SE (M)**
Salinity Levels			0.47	0.24	0.17			0.40	0.20	0.14
Genotypes			1.18	0.60	0.42			0.99	0.50	0.35
Salinity Levels x Genotypes			2.35	1.19	0.84			1.98	1.00	0.71

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Table 3. Performance of rice genotypes at different salinity levels for Chlorophyll ‘a’ & ‘b’ (mg/g fresh wt.).

Genotypes	Chlorophyll ‘a’ (mg/g fresh wt.)					Chlorophyll ‘b’ (mg/g fresh wt.)				
	Control	2 dSm^{-1}	4 dSm^{-1}	6 dSm^{-1}	Mean	Control	2 dSm^{-1}	4 dSm^{-1}	6 dSm^{-1}	Mean
IR 64	3.487	3.347	3.146	2.651	**3.158**	0.763	0.716	0.706	0.688	**0.718**
HKR 46	2.999	2.816	2.807	2.235	**2.714**	0.867	0.820	0.801	0.781	**0.817**
HKR 47	3.924	3.872	3.612	3.234	**3.661**	0.855	0.827	0.819	0.796	**0.824**
HKR 120	2.345	2.277	2.146	1.768	**2.134**	0.751	0.716	0.694	0.523	**0.671**
HKR 126	2.939	2.822	2.748	2.478	**2.747**	0.812	0.789	0.700	0.684	**0.746**
HKR 127	2.740	2.974	2.879	2.754	**2.837**	0.674	0.650	0.585	0.572	**0.620**
CSR 13	3.034	2.867	2.654	2.426	**2.745**	0.829	0.799	0.773	0.734	**0.784**
CSR 23	2.869	2.796	2.651	2.051	**2.592**	0.870	0.800	0.785	0.765	**0.805**
CSR 27	2.468	2.058	1.824	1.383	**1.933**	0.768	0.728	0.684	0.620	**0.700**
CSR 36	2.675	2.414	2.301	1.808	**2.300**	0.828	0.793	0.766	0.696	**0.771**
CSR 23 X CSR 36	2.598	2.314	2.259	1.780	**2.238**	0.850	0.793	0.780	0.712	**0.784**
CSR 23 X HKR 126	2.058	1.996	1.944	1.529	**1.882**	0.669	0.603	0.568	0.562	**0.601**
CSR 23 X IR 64	2.099	1.829	1.892	1.691	**1.878**	0.700	0.627	0.610	0.551	**0.622**
CSR 23 X HKR 47	1.719	1.363	1.266	1.184	**1.383**	0.568	0.498	0.482	0.451	**0.500**
CSR 23 X HKR 127	1.206	1.264	1.382	0.998	**1.213**	0.392	0.384	0.355	0.299	**0.358**
CSR 36 X HKR 126	1.650	1.768	1.811	1.202	**1.608**	0.524	0.483	0.443	0.367	**0.454**
CSR 36 X IR 64	2.366	2.263	2.037	1.934	**2.150**	0.726	0.683	0.630	0.597	**0.659**
CSR 36 X HKR 47	2.622	2.303	2.375	2.307	**2.402**	0.803	0.773	0.747	0.695	**0.755**
CSR 36 X HKR 127	2.026	2.028	1.837	1.622	**1.878**	0.635	0.606	0.579	0.520	**0.585**
HKR 126 X IR 64	2.496	2.339	2.154	2.062	**2.263**	0.701	0.691	0.665	0.617	**0.669**
HKR 126 X HKR 47	2.834	2.313	2.445	2.108	**2.425**	0.749	0.697	0.678	0.629	**0.688**
HKR 126 X HKR 127	2.035	2.004	1.767	1.565	**1.843**	0.562	0.526	0.488	0.427	**0.501**
IR 64 X HKR 47	2.553	2.124	2.055	1.960	**2.173**	0.688	0.634	0.611	0.559	**0.623**
IR 64 X HKR 127	2.016	1.949	1.826	1.686	**1.869**	0.622	0.600	0.579	0.524	**0.581**
HKR 47 X HKR 127	2.826	2.617	2.503	2.112	**2.515**	0.789	0.724	0.681	0.645	**0.710**
Mean	**2.503**	**2.349**	**2.253**	**1.941**		**0.720**	**0.678**	**0.648**	**0.601**	
			CD	**SE (d)**	**SE (M)**			**CD**	**SE (d)**	**SE (M)**
Salinity Levels			0.043	0.022	0.015			0.004	0.002	0.001
Genotypes			0.108	0.055	0.039			0.010	0.005	0.004
Salinity Levels x Genotypes			0.215	0.109	0.077			0.020	0.010	0.007

Table 4. Performance of rice genotypes at different salinity levels for Proline content (mg/g dry wt.) and Potassium Content (ppm).

Genotypes	Proline Content (mg/g dry wt.)				Mean	Potassium Content (ppm)				Mean
	Control	2 dSm^{-1}	4 dSm^{-1}	6 dSm^{-1}		Control	2 dSm^{-1}	4dSm^{-1}	6 dSm^{-1}	
IR 64	4.960	5.745	5.930	6.317	**5.738**	14934.15	15535.08	13367.19	12202.63	**14009.76**
HKR 46	5.323	5.967	6.058	6.270	**5.905**	15836.94	15367.86	12668.09	12402.08	**14068.74**
HKR 47	6.414	6.253	6.631	6.919	**6.554**	14803.21	13900.86	13100.85	12702.22	**13626.79**
HKR 120	5.264	5.893	6.049	6.230	**5.859**	15269.50	14368.75	13434.01	12102.18	**13793.61**
HKR 126	4.900	5.583	5.774	6.112	**5.592**	15469.21	14266.67	13833.33	12366.67	**13983.97**
HKR 127	5.209	5.780	5.890	6.169	**5.762**	14767.96	13441.74	13534.56	12901.48	**13661.44**
CSR 13	5.568	5.185	6.645	6.868	**6.067**	15538.30	13967.45	13540.71	12967.55	**14003.50**
CSR 23	5.427	6.340	6.360	6.574	**6.175**	15668.94	15033.33	14268.33	12800.11	**14442.68**
CSR 27	5.330	5.951	6.537	6.591	**6.102**	15203.12	14473.72	13633.41	12833.33	**14035.90**
CSR 36	5.701	6.275	6.822	6.857	**6.414**	14635.74	14234.42	13567.09	12908.08	**13836.33**
CSR 23 X CSR 36	5.584	6.148	6.463	6.524	**6.180**	15000.42	15200.00	15569.86	16000.02	**15442.58**
CSR 23 X HKR 126	5.226	5.734	5.894	6.041	**5.724**	15801.71	16134.04	16400.86	16633.33	**16242.49**
CSR 23 X IR 64	5.139	5.703	5.985	6.115	**5.736**	14801.11	15066.67	15300.53	15466.67	**15158.75**
CSR 23 X HKR 47	5.628	6.049	6.329	6.460	**6.117**	15467.86	15653.08	15933.45	16002.86	**15764.31**
CSR 23 X HKR 127	5.401	5.769	5.945	6.149	**5.816**	14966.67	15133.75	15302.12	15433.33	**15208.97**
CSR 36 X HKR 126	5.400	5.712	5.960	5.971	**5.761**	15034.20	15200.90	15434.07	15702.22	**15342.85**
CSR 36 X IR 64	5.309	5.822	6.044	6.307	**5.871**	14202.22	14500.01	14666.90	14833.58	**14550.68**
CSR 36 X HKR 47	5.730	6.080	6.247	6.360	**6.104**	14803.28	15055.12	15133.56	10710.04	**13925.50**
CSR 36 X HKR 127	5.446	5.858	5.992	6.046	**5.836**	14400.85	14866.67	15100.42	15337.51	**14926.36**
HKR 126 X IR 64	5.262	5.623	6.075	6.194	**5.789**	15100.85	15400.22	15533.89	15721.12	**15439.02**
HKR 126 X HKR 47	5.294	5.800	6.136	6.212	**5.861**	15602.39	15834.19	16033.85	16200.29	**15917.68**
HKR 126 X HKR127	5.075	5.684	5.901	6.062	**5.681**	15302.85	15633.33	15802.11	16001.39	**15684.92**
IR 64 X HKR 47	5.389	5.774	5.835	5.898	**5.724**	14901.09	15101.09	15333.34	15368.84	**15176.09**
IR 64 X HKR 127	5.024	5.771	5.934	6.042	**5.693**	14536.10	14801.40	14935.71	15100.02	**14843.31**
HKR 47 X HKR 127	5.331	5.906	5.815	6.136	**5.797**	15068.08	15201.20	15435.53	15701.62	**15351.61**
Mean	**5.373**	**5.856**	**6.130**	**6.297**		**15084.67**	**14934.86**	**14674.55**	**14255.97**	
			CD	**SE (d)**	**SE (M)**			**CD**	**SE (d)**	**SE (M)**
Salinity Levels			0.061	0.031	0.022			268.79	136.3	96.38
Genotypes			0.153	0.078	0.055			671.96	340.74	240.94
Salinity Levels x Genotypes			0.306	0.155	0.110			13343.93	681.48	481.88

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Table 5. Performance of rice genotypes at different salinity levels for Sodium content (ppm).

Genotypes	Sodium Content (ppm)					Calcium Content (%)				
	Control	2 dSm^{-1}	4 dSm^{-1}	6 dSm^{-1}	Mean	Control	2 dSm^{-1}	4 dSm^{-1}	6 dSm^{-1}	Mean
IR 64	2533.74	3368.42	5822.89	7634.21	**4839.82**	1.917	1.707	1.587	1.134	**1.586**
HKR 46	2368.75	3066.67	4000.00	5133.44	**3642.22**	2.159	1.985	1.764	1.044	**1.738**
HKR 47	2069.60	2908.45	3368.76	4400.88	**3186.92**	1.913	1.782	1.374	1.178	**1.562**
HKR 120	2400.00	3433.33	4000.41	5634.83	**3867.14**	2.029	1.861	1.462	1.115	**1.617**
HKR 126	3202.85	3802.55	4101.54	7766.67	**4718.40**	2.394	1.865	1.479	1.249	**1.747**
HKR 127	2066.67	3033.33	4300.00	7400.86	**4200.22**	2.180	1.905	1.496	1.389	**1.743**
CSR 13	2001.20	3012.08	3600.00	6100.00	**3678.32**	2.109	1.831	1.566	1.343	**1.712**
CSR 23	2342.18	2633.33	3468.42	6067.09	**3627.76**	1.769	1.744	1.625	1.466	**1.651**
CSR 27	2666.67	3369.60	3966.68	7234.20	**4309.29**	1.844	1.797	1.610	1.224	**1.619**
CSR 36	3068.41	3500.00	3666.67	6400.00	**4158.77**	2.087	1.897	1.752	1.058	**1.699**
CSR 23 X CSR 36	2766.67	3200.00	3902.75	4600.85	**3617.57**	1.899	1.828	1.615	1.424	**1.692**
CSR 23 X HKR 126	2902.99	3466.74	4166.95	4700.00	**3809.17**	2.137	1.767	1.755	1.510	**1.792**
CSR 23 X IR 64	2467.19	3004.26	4236.09	4700.86	**3602.10**	1.792	1.732	1.631	1.460	**1.654**
CSR 23 X HKR 47	2500.00	3200.00	4366.67	5067.20	**3783.47**	1.798	1.675	1.647	1.447	**1.642**
CSR 23 X HKR 127	2200.78	2933.33	4134.86	5000.00	**3567.24**	1.945	1.783	1.735	1.284	**1.687**
CSR 36 X HKR 126	3402.22	3834.20	4201.90	5402.98	**4210.33**	2.219	2.044	1.926	1.710	**1.975**
CSR 36 X IR 64	3066.67	3400.00	4402.08	4902.98	**3942.93**	1.937	1.730	1.622	1.278	**1.642**
CSR 36 X HKR 47	2834.83	3834.01	4600.00	5300.15	**4142.25**	1.913	1.782	1.671	1.421	**1.697**
CSR 36 X HKR 127	2737.53	3336.08	4369.10	4933.33	**3844.01**	2.059	1.872	1.778	1.583	**1.823**
HKR 126 X IR 64	3066.67	4000.00	4900.42	5401.42	**4342.13**	2.160	2.030	1.915	1.732	**1.959**
HKR 126 X HKR 47	3167.40	4007.20	5166.67	5908.78	**4562.51**	2.121	1.938	1.820	1.610	**1.872**
HKR 126 X HKR 127	2768.06	3200.00	4069.42	4566.76	**3651.06**	2.293	2.185	2.000	1.837	**2.079**
IR 64 X HKR 47	2600.00	3700.52	5267.86	5633.33	**4300.43**	1.831	1.691	1.627	1.198	**1.587**
IR 64 X HKR 127	2369.55	3000.00	4067.45	4402.75	**3459.94**	2.044	1.855	1.750	1.316	**1.741**
HKR 47 X HKR 127	2302.92	3072.21	3934.79	4133.35	**3360.82**	2.044	1.843	1.815	1.444	**1.787**
Mean	**2634.94**	**3332.65**	**4243.30**	**5537.08**		**2.024**	**1.845**	**1.681**	**1.378**	
			CD	SE (d)	SE (M)			CD	SE (d)	SE (M)
Salinity Levels			57.40	29.11	20.58			0.020	0.010	0.007
Genotypes			143.51	72.77	51.46			0.050	0.025	0.018
Salinity Levels x Genotypes			287.03	145.54	102.92			0.099	0.050	0.036

Table 6. Performance of rice genotypes at different salinity levels for Magnesium content (%).

Genotypes	Magnesium Content (%)					Chloride Content (%)				
	Control	2 dSm-1	4 dSm-1	6 dSm-1	Mean	Control	2 dSm-1	4 dSm-1	6 dSm-1	Mean
IR 64	1.627	0.743	0.609	0.539	**0.880**	2.373	3.499	4.592	5.955	**4.105**
HKR 46	1.555	0.800	0.568	0.520	**0.861**	2.439	4.090	4.900	6.510	**4.485**
HKR 47	1.336	0.766	0.631	0.513	**0.812**	2.728	4.008	5.232	6.880	**4.712**
HKR 120	1.149	0.551	0.627	0.447	**0.694**	2.419	3.835	4.692	6.185	**4.283**
HKR 126	1.049	0.630	0.502	0.481	**0.666**	2.034	2.897	4.662	6.042	**3.909**
HKR 127	1.079	0.497	0.459	0.416	**0.613**	2.599	3.474	4.725	6.410	**4.302**
CSR 13	1.260	0.774	0.750	0.625	**0.852**	2.679	4.342	5.533	7.323	**4.969**
CSR 23	1.806	0.715	0.757	0.466	**0.936**	2.762	4.515	5.431	6.463	**4.793**
CSR 27	1.275	0.612	0.676	0.585	**0.787**	2.493	3.816	4.888	6.609	**4.452**
CSR 36	1.135	0.787	0.587	0.431	**0.735**	2.785	3.871	4.910	7.020	**4.647**
CSR 23 X CSR 36	1.415	0.793	0.655	0.386	**0.812**	2.757	4.284	5.407	7.375	**4.956**
CSR 23 X HKR 126	1.430	0.803	0.672	0.433	**0.835**	2.837	4.361	5.487	7.324	**5.002**
CSR 23 X IR 64	1.737	0.847	0.653	0.482	**0.930**	2.599	3.431	4.301	5.750	**4.020**
CSR 23 X HKR 47	1.622	0.818	0.627	0.511	**0.895**	2.782	3.796	4.753	6.219	**4.388**
CSR 23 X HKR 127	1.423	0.783	0.585	0.429	**0.805**	2.679	3.817	4.769	6.662	**4.482**
CSR 36 X HKR 126	1.142	0.641	0.456	0.324	**0.641**	2.365	3.511	4.584	5.908	**4.092**
CSR 36 X IR 64	1.237	0.712	0.565	0.437	**0.738**	2.558	3.489	4.526	5.829	**4.101**
CSR 36 X HKR 47	1.142	0.616	0.507	0.352	**0.654**	2.735	4.206	4.951	6.898	**4.698**
CSR 36 X HKR 127	1.136	0.580	0.416	0.404	**0.634**	2.551	3.888	4.746	6.428	**4.403**
HKR 126 X IR 64	1.312	0.763	0.525	0.432	**0.758**	2.363	3.297	4.627	6.012	**4.075**
HKR 126 X HKR 47	1.164	0.529	0.428	0.415	**0.634**	2.352	3.517	4.535	6.122	**4.132**
HKR 126 X HKR 127	1.147	0.497	0.443	0.398	**0.621**	2.271	3.068	4.049	5.831	**3.805**
IR 64 X HKR 47	1.437	0.753	0.578	0.533	**0.825**	2.554	3.521	4.555	5.907	**4.134**
IR 64 X HKR 127	1.326	0.660	0.470	0.403	**0.715**	2.480	3.392	4.451	5.667	**3.998**
HKR 47 X HKR 127	1.232	0.530	0.469	0.376	**0.652**	2.579	3.935	4.905	5.801	**4.305**
Mean	**1.327**	**0.688**	**0.569**	**0.454**		**2.551**	**3.754**	**4.808**	**6.365**	
			CD	**SE (d)**	**SE (M)**			**CD**	**SE (d)**	**SE (M)**
Salinity Levels			0.013	0.007	0.005			0.060	0.030	0.021
Genotypes			0.033	0.017	0.012			0.149	0.076	0.054
Salinity Levels x Genotypes			0.066	0.033	0.024			0.298	0.151	0.107

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Table 7. Performance of rice genotypes at different salinity levels for Sulphate content (ppm).

Genotypes	Salinity Levels				Mean
	Control	2 dSm⁻¹	4 dSm⁻¹	6 dSm⁻¹	
IR 64	24234.23	21035.83	19633.75	17871.24	**20693.76**
HKR 46	26566.67	22100.42	17000.53	15266.75	**20233.59**
HKR 47	25433.38	20033.85	17500.07	17166.67	**20033.49**
HKR 120	26433.33	22100.00	17701.73	15036.26	**20317.83**
HKR 126	23600.09	21101.65	18733.33	17801.61	**20309.17**
HKR 127	21233.82	21500.88	20333.42	19133.67	**20550.45**
CSR 13	21435.53	19233.34	17201.53	15733.60	**18401.00**
CSR 23	27066.67	23501.39	18300.86	18600.42	**21867.34**
CSR 27	23867.52	21769.65	19600.00	16834.73	**20517.98**
CSR 36	25333.33	23200.08	22100.53	18402.38	**22259.08**
CSR 23 X CSR 36	25888.79	23100.00	17500.09	16534.44	**20755.83**
CSR 23 X HKR 126	25100.86	22602.47	16466.68	15468.25	**19909.57**
CSR 23 X IR 64	25433.33	22833.33	16633.42	15168.19	**20017.07**
CSR 23 X HKR 47	25801.53	23100.00	17600.42	16967.41	**20867.34**
CSR 23 X HKR 127	24802.89	21903.12	17202.94	14700.49	**19652.36**
CSR 36 X HKR 126	24833.37	21735.73	16968.06	14533.83	**19517.75**
CSR 36 X IR 64	25100.00	22333.33	17433.33	14969.50	**19959.04**
CSR 36 X HKR 47	25233.48	22635.21	17566.75	14637.51	**20018.24**
CSR 36 X HKR 127	23900.00	19966.67	18900.22	15067.49	**19458.60**
HKR 126 X IR 64	24400.89	21400.53	19066.67	15767.61	**20158.93**
HKR 126 X HKR 47	24500.00	21336.29	19369.24	16100.50	**20326.51**
HKR 126 X HKR 127	23000.00	19568.29	17901.11	14868.27	**18834.42**
IR 64 X HKR 47	24900.56	21400.00	17969.52	14801.39	**19767.87**
IR 64 X HKR 127	23200.03	20401.39	17534.20	14668.06	**18950.92**
HKR 47 X HKR 127	23200.09	20221.20	17400.35	15038.02	**18964.92**
Mean	**24580.02**	**21604.59**	**18144.75**	**16045.53**	

	CD	SE (d)	SE (M)
Salinity Levels	107.34	54.43	38.49
Genotypes	268.35	136.08	96.22
Salinity Levels x Genotypes	536.71	272.16	192.44

Table 8. Performance of rice genotypes at different salinity levels for K^+/Na^+ ratio and Ca^{++}/Mg^{++} ratio.

Genotypes	K^+/Na^+ Ratio					Ca^{++}/Mg^{++} Ratio				
	Control	2 dSm^{-1}	4 dSm^{-1}	6 dSm^{-1}	Mean	Control	2 dSm^{-1}	4 dSm^{-1}	6 dSm^{-1}	Mean
IR 64	5.966	4.626	2.298	1.599	**3.622**	1.179	2.301	2.607	2.117	**2.051**
HKR 46	6.775	5.019	3.167	2.417	**4.345**	1.389	2.483	3.107	2.017	**2.249**
HKR 47	7.283	4.786	3.911	2.890	**4.718**	1.433	2.337	2.177	2.310	**2.064**
HKR 120	6.489	4.190	3.368	2.149	**4.049**	1.772	3.391	2.345	2.497	**2.501**
HKR 126	4.838	3.755	3.379	1.593	**3.391**	2.287	2.966	2.954	2.597	**2.701**
HKR 127	7.169	4.439	3.159	1.744	**4.128**	2.026	3.835	3.266	3.343	**3.118**
CSR 13	7.785	4.638	3.765	2.127	**4.579**	1.676	2.373	2.095	2.150	**2.074**
CSR 23	6.716	5.726	4.120	2.111	**4.668**	0.980	2.443	2.158	3.163	**2.186**
CSR 27	5.716	4.301	3.449	1.775	**3.810**	1.447	2.963	2.384	2.093	**2.222**
CSR 36	4.779	4.070	3.714	2.019	**3.646**	1.844	2.414	2.984	2.470	**2.428**
CSR 23 X CSR 36	5.432	4.753	3.991	3.485	**4.415**	1.342	2.305	2.468	3.693	**2.452**
CSR 23 X HKR 126	5.449	4.655	3.938	3.540	**4.396**	1.494	2.200	2.613	3.491	**2.450**
CSR 23 X IR 64	6.016	5.019	3.617	3.296	**4.487**	1.032	2.047	2.496	3.028	**2.151**
CSR 23 X HKR 47	6.193	4.894	3.651	3.160	**4.475**	1.108	2.048	2.626	2.829	**2.153**
CSR 23 X HKR 127	6.811	5.161	3.704	3.087	**4.691**	1.367	2.279	2.965	2.994	**2.401**
CSR 36 X HKR 126	4.422	3.977	3.675	2.907	**3.745**	1.951	3.193	4.234	5.291	**3.667**
CSR 36 X IR 64	4.652	4.267	3.333	3.026	**3.820**	1.565	2.430	2.871	2.937	**2.451**
CSR 36 X HKR 47	5.231	3.930	3.291	2.024	**3.619**	1.678	2.894	3.492	4.046	**3.028**
CSR 36 X HKR 127	5.287	4.461	3.456	3.112	**4.079**	1.815	3.226	4.290	3.918	**3.312**
HKR 126 X IR 64	4.933	3.852	3.171	2.913	**3.717**	1.646	2.661	3.650	4.020	**2.994**
HKR 126 X HKR 47	4.933	3.957	3.104	2.742	**3.684**	1.825	3.665	4.256	3.877	**3.406**
HKR 126 X HKR 127	5.547	4.888	3.890	3.509	**4.459**	2.019	4.398	4.514	4.615	**3.887**
IR 64 X HKR 47	5.736	4.082	2.912	2.731	**3.865**	1.275	2.248	2.817	2.248	**2.147**
IR 64 X HKR 127	6.150	4.937	3.674	3.431	**4.548**	1.542	2.815	3.731	3.264	**2.838**
HKR 47 X HKR 127	6.552	4.955	3.928	3.799	**4.809**	1.662	3.479	3.873	3.849	**3.216**
Mean	**5.874**	**4.534**	**3.507**	**2.687**		**1.574**	**2.786**	**3.089**	**3.154**	
			CD	**SE (d)**	**SE (M)**			**CD**	**SE (d)**	**SE (M)**
Salinity Levels			0.107	0.054	0.038			0.059	0.030	0.021
Genotypes			0.266	0.135	0.095			0.147	0.075	0.053
Salinity Levels x Genotypes			0.532	0.270	0.191			0.295	0.150	0.106

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