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Screening of Rice Accessions for Yield and Yield Attributes Contributing to Salinity Tolerance in Coastal Saline Soils of Tamil Nadu, South India

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Abstract: A field experiment was conducted in the saline field of Annamalai University, experimental farm, Annamalai Nagar during Kharif season of 2000-2001, to study the screening of rice accessions for growth and yield attributes contributing to salinity tolerance. The experiment was laid out in Randomized Block Design with three replications. Fifteen rice accessions from the International Rice Soil Stress Tolerance Screening Nursery Trial (IRSSTN) of IRRI were used for the study. Based on the grouping, the rice accessions were grouped into High Yielding Tolerant (HYT), High Yielding Susceptible (HYS), Low Yielding Tolerant (LYT) and Low Yielding Susceptible (LYS). The results revealed that the rice accessions of the high yielding and tolerant group recorded a higher value for the yield characters viz., number of productive tillers/hill, number of filled grains/panicle and thousand grain weight in which Rice Acc. No. 12 (IR-60494-2B-18-3-2-3) recorded the highest value for yield characters. The rice accession of the high yielding and tolerant group recorded a higher value for the grain and straw yield of which Rice Acc. No. 12 (IR-60494-2B-18-3-2-3) recorded the highest value for grain and straw yield. Based on the results of the investigations, it clearly indicates the direct effects of growth and yield attributes on the higher yield of rice accessions for salinity tolerance. It appears that the number of productive tillers/hill, number of filled grains/panicle and thousand grain weight had direct influence on the grain yield of rice accessions grouped in high yielding and tolerant category for saline soils.

Key words: Rice accessions, salinity tolerance, grain yield, high yielding tolerant

INTRODUCTION

Soil salinity affects 2 of the 15 million km^2 of land under cultivation and between 30 and 50% irrigation agriculture. Rice or paddy, is usually grown on soils flooded by water obtained from rainfall, surface streams or wells. At transplanting during the monsoon water of good quality is generally available in adequate amounts. As the season progresses or during seasons of limited rainfall, the volume of stream flow may decrease and the salt content of the water increases[1]. Under these conditions, it may be necessary to use well water as a supplement to stream flow in order to maintain the desired water level in the fields. These well waters may contain even more salt than the streams. As a result, the soil salinity was increased as the season progresses. Though rice is usually considered moderately sensitive to salinity, most studies concerning the salt tolerance of rice at different stages of development have not considered the effects of progressive increases in the salt content of the water during the season[2]. Selection of highly salt tolerant genotypes within a species can be expected to provide useful material for experimental comparisons with the salt sensitive ones. Hence, the present study was undertaken, to know the response of the rice plant to salinity as a whole.

MATERIALS AND METHODS

The study was conducted during 2000-2001 in the Faculty of Agriculture, Department of Agronomy, Annamalai University, Annamalai Nagar to investigate the growth and yield attributes contributing to salinity tolerance of different rice accessions. A consensus selection from a subset of IRRI germplasm collection was chosen to include accession of various reputation with regard to salt resistance, most of the accessions were or genotypes released by IRRI used frequently in the recent crosses with a duration of 120-145 days. The experiment was laid out in Randomized Block Design with three replications. The soil of the experimental field was classified as saline soil with deep clay, low in available nitrogen, medium in available P_2O_5 and high in available K_2O.

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The experimental details of the treatments were given in Table 1.

Table 1: Experimental details of the treatments

Acc. No.	Designation	Cross	Origin
1.	NC 493	Pure line selection	India
2.	IR 40931-33-1-3-2	BKNFR 76106-16-0-1-0/IR 19661-131-1-2	IRRI
3.	IR 63731-1-1-4-3-2	IR 8/NONA BOKRA	IRRI
4.	IR 45427-2B-2-B-1-2	Cheriviruppu/IR 10205-37-1-3	IRRI
5.	IR 26916-Es	Cheriviruppu/IR 5657-33-2/IR 42	IRRI
6.	IR 52717-B-B-4-B-1-3	IR 32429-47-3-2-2/IR 9884-54-3/NONO BOKRA	IRRI
7.	IR 63731-1-1-4-2-3	IR 8/NONA BOKRA	IRRI
8.	B 6996 D-MR-13-1	CISADANE*4/FR 13A	Indonesia
9.	IR 63731-1-1-1-3-3	IR 8/NONA BOKRA	IRRI
10.	TCCP 266-1-3B-10-2-1	-	IRRI
11.	IR 55233-3B-23-3	IR 15324-117-3-2-2/IR 10167-129-3-4	IRRI
12.	IR60494-2B-18-3-2-3	IR 9884-54-3-IE-PI/IR 33451-12-1-1-2/POKKALI	IRRI
13.	IR 59932-2B-4-2	IR 32429-47-3-2-2/BW297-2	IRRI
14.	IR 5217-B-B-4-B-B-1-3	IR32429-47-3-2-2/NONA BOKRA/POKKALI	IRRI
15.	Co.43	Dasal x IR 20	India

RESULTS AND DISCUSSION

Number of productive tillers/hill: Number of productive tillers/hill was found to be significant among the rice accessions (Table 2). The high yielding and tolerant group rice accession No.12 (IR 60494-2B-18-3-2-3) significantly recorded the highest number of productive tillers of 7.04 hill^{-1}. Rice Acc. No.5 (IR 26916-Es) of high yielding and susceptible group ranked second in increasing the number of productive tillers/hill (6.28). This result was supported with the findings of Krishnamurthy *et al.*[3] who reported that the salt resistant cultivars AV 1, Co 43 and ESC 1 exhibited high salinity indices and experienced less reduction of tiller than the salt-sensitive cultivars.

Number of filled grains/panicle: The number of filled grains/panicle was found to be significantly higher (105) in Rice Acc. No. 12 (IR 60494-2B-18-3-2-3) of high yielding and tolerant group over rest of the accessions tried (Table 2). This might be due to salinity tolerance during the reproductive stage of the crop growth. The high yielding and susceptible Rice Acc. No. 5 (IR 26919-Es) performed better next to that for number of filled grains/panicle (85.66). This is in accordance with findings of Barik *et al.*[4] who opined that number of filled grains/panicle was maximum with the variety IR 36 which was significantly superior to all other varieties.

The low yielding and susceptible Rice Acc. No. 3 (IR 63731-1-14-3-2), Rice Acc. No.4 (IR 45427-2B-2-B-1-2), Rice Acc. No. 7 (IR 63731-1-1-4-2-3) and Rice Acc. No. 11 (IR 55233-3B-23-3) recorded the lower number of filled grains/panicle. This indicates that it is sensitive to salinity as compared to other accessions. This result is in consonance with findings of Makiharat *et al.*[5] who found that number of filled grains/panicle decrease in KR 1 due to soil salinity.

Thousand grain weight: The thousand grain weight was found to be significantly higher in Rice Acc. No. 8 (B 6996D-MR-13-1) (21.93) of high yielding and tolerant

Table 2: Performance of Rice Accessions on yield and yield attributes

Accession No.	Designation	Mean value: No. of productive tillers/hill	No. of filled grains/panicle	Thousand grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Acc 1	NC 493	4.70	83.33	20.26	3011.00	5675.00
Acc 2	IR 40931-33-1-3-2	5.34	85.66	18.46	3682.00	6841.00
Acc 3	IR 63731-1-1-4-3-2	4.12	72.00	21.50	2323.00	4429.00
Acc 4	IR 45427-2B-2-B-1-2	4.04	69.00	19.60	2275.00	4371.00
Acc 5	IR 26916-Es	6.28	85.66	20.33	4308.00	8177.00
Acc 6	IR 52717-B-B-4-B-1-3	4.73	81.66	19.20	3046.00	5716.00
Acc 7	IR 63731-1-1-4-2-3	3.37	66.00	21.60	1602.00	3085.00
Acc 8	B 6996 D-MR-13-1	6.35	86.33	21.93	4334.00	8216.00
Acc 9	IR 63731-1-1-1-3-3	4.49	80.66	20.30	2985.00	5222.00
Acc 10	TCCP 266-1-3B-10-2-1	6.17	102.00	18.16	4284.00	8115.00
Acc 11	IR 55233-3B-23-3	3.48	73.66	17.50	1690.00	3193.00
Acc 12	IR60494-2B-18-3-2-3	7.04	105.00	18.46	4943.00	9371.00
Acc 13	IR 59932-2B-4-2	5.48	85.33	19.23	3678.00	6903.00
Acc 14	IR 5217-B-B-4-B-B-1-3	4.63	78.66	20.30	2930.00	5193.00
Acc 15	Co.43	4.13	85.00	18.83	2362.00	4483.00
	CD (p =0.05)	0.50	11.10	1.00	438.15	764.63

group followed by Rice Acc. No. 7 (IR 63731-1-1-4-2-3) (21.69) of low yielding and susceptible group (Table 2) which inturn comparable with Rice Acc. No. 3 (IR 63731-1-14-3-2) (21.50) of low yielding susceptible group. Similar results was also in conformity with the findings of Barik *et al.*[4] who reported that thousand grain weight was found higher in the variety IR 36 over rest of the varieties. This might be due to tolerance of the variety to salinity. Among the accessions, Rice Acc. No. 10 (TCCP 266-1-3B-10-2-1) recorded lesser thousand grain weight of 18.16. This clearly indicates that the accession is susceptible to the salinity which results in poor performance in registering the thousand grain weight. This result is in consonance with the findings of Makiharat *et al.*[5] who reported that test weight decrease in KRI due to salinity.

Grain yield: The variations in grain yield among the saline tolerant rice accessions were significantly different (Table 2). Among the rice accessions, the high yielding and tolerant Rice Acc. No. 12 (IR60494-2B-18-3-2-3) markedly increased the yield (4943 kg ha^{-1}) which could be attributed to salinity tolerant under soil salinity. The results of present findings are in concordance with the findings of Barik *et al.*[4] who reported that among the high yielding variety IR 36 and CSR 4 performed best in respect to grain (51.61 ha^{-1}) which has 130.95 per cent more in grain yield than the local variety Golanti due to their higher number of panicles and number of filled grains/panicle. The lowest grain yield (1602 kg ha^{-1}) was recorded in Rice Acc. No. 7 (IR 63731-1-1-4-2-3) due to its susceptibility for salinity. This is in accordance with the findings of Powar and Mehta[6] who reported that grain yield decreased with increasing salinity.

Straw yield: The straw yield between different accessions was found to be significant (Table 2). The highest straw yield of 9371 kg ha^{-1} was registered in Rice Acc. No. 12 (IR60494-2B-18-3-2-3) of high yielding and tolerant group. The reasons attributed for higher straw yield due to highest plant height and LAI recorded in this rice accession under salinity condition over other accessions tried[7]. This indicates that they are not sensitive to salinity during the maturity stage of the crop growth. Similar results were reported by Afria and Narnolia[8]. The low yielding and susceptible Rice Acc. No. 3 (IR 63731-1-1-4-3-2), Rice Acc. No. 4 (IR 45427-2B-2-B-1-2), Rice Acc. No. 7 (IR 63731-1-1-4-2-3) and Rice Acc. No. 11 (IR 55233-3B-23-3) recorded the lower straw yield. It was severely affected by salinity as compared to other accessions. This indicates that it is sensitive to salinity during maturity stage of the crop. This is in accordance with the findings of Powar and Mehta[6].

From the results of investigations made it could be concluded that among the 15 accessions, Rice Acc. No. 12 (IR60494-2B-18-3-2-3) is ideal one promising growth and yield attributes contributing to salinity tolerance.

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