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Studies on the screening of rice accessions and its yield attribute contributing to salinity tolerance

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Abstract: A field experiment was conducted at Annamalai University experimental farm during Navarai 2000 to screening of rice accessions for yield attributes contributing to salinity tolerance and nutrient uptake. The rice accession of the high yielding and tolerant group recorded a higher value for the yield characters *viz.* number of productive tillers hill^{-1}, number of filled grains panicle^{-1}, straw yield and harvest index. Among the rice accessions of high yielding and tolerant group rice accession no. 12 (IR 60494-2B-18-3-2-3) recorded the highest value for yield characters with higher value of N, P and K uptake and lower value of Ca, Mg and Na uptake. This rice accession no.12 was not affected by salinity due to salinity tolerance.

Key words : Rice accession, Yield attributes, Nutrient uptake, Salinity tolerance.

Introduction

Soil salinity affects 2 of the 15 million km^2 of land under cultivation and between 30 per cent and 50 per cent of irrigated agriculture. The crop plants differ widely in their ability to grow in saline conditions. Rice is one of the most suitable crops for saline soils although it is usually considered moderately sensitive to salinity. Saline soils are usually under waterlogged conditions where other crops could not grow except rice. Salinity damage is not a determinate quantity, but can be expected to show extremely high genotype environment interaction. It is intrinsic to a screening procedure that the phenotype (which is evaluated) should adequately reflect the potential of the genotype; and salinity resistance has been treated as if it was a single factor (which could include a genetically linked group of factors). Keeping this in view, identification of salinity tolerance of rice accessions and effect of soil salinity on the growth, yield and nutrient uptake of rice accessions were studied.

Materials and Methods

The study was conducted during Navarai 2000 in the faculty of agriculture, Department of Agronomy, Annamalai University, Annamalai Nagar to investigate the yield attributes and yield contributing to salinity tolerance of differe rice accessions. A consensus selection from subset of IRRI germplasm collection was chose to include accession of various reputation wit regard to salt resistance, most of the accession (or) genotypes released by IRRI were use frequently in the recent crosses with duratio of 120-145 days. The experiment was laid ou in randomised block design with three replications The soil of the experimental field was classifie as saline soil with deep clay, having the physico chemical characteristics of pH-8.4, EC-3.2% OC-0.7%, available N, P_2O_5 and K_2O of 337.0 21.30, and 322 kg ha^{-1} respectively. It als contains available Ca, Mg and Na of 130.65 92.13 and 370.8 kg ha^{-1} respectively.

Results and Discussion

Yield characters

Number of productive tillers hill^{-1} and numbe of filled grains panicle^{-1}

Number of productive tillers hill^{-1}, numbe of filled grains panicle^{-1} were found to be significan among the rice accessions (Table 1). The hig yielding and tolerant group rice acc.no.12 (IF 60494-2B-18-3-2-3) significantly recorded the highest number of productive tillers of 7.0 hill^{-1} and number of filled grains panicle^{-1} (105)

he experiment details of the treatments as furnished below.

cc o.	Designation	Cross	Origin	Tolerance status
	NC 493	Pure line selection	India	Semi tolerant
	IR 40931-33-1-3-2	BKNFR 76106-16-0-1-0/ IR 19661-131-1-2	IRRI	Susceptible
	IR 63731-1-1-4-3-2	IR8/NONA BOKRA	IRRI	Highly susceptible
	IR 45427-2B-2-B-1-2	Cheriviruppu/IR 10205-37-1-3	IRRI	Highly susceptible
	IR 26916-Es	Cheriviruppu/IR 5657-33-2//IR 42	IRRI	Susceptible
	IR 52717-B-B-4-B-B-1-3	IR 32429-47-3-2-2/9884-54-3/ Nono Bokra	IRRI	Semi tolerant
	IR 63731-1-1-4-2-3	IR8/NONA BOKRA	IRRI	Highly susceptible
	B 6996 D-MR-13-1	CISADANE*4/FR 13A	Indonesia	Tolerant
	IR 63731-1-1-1-3-3	IR8/NONA BOKRA	IRRI	Semi tolerant
	TCCP 266-1-3B-10-2-1	-	IRRI	Tolerant
	IR 55233-3B-23-3	IR 15324-117-3-2-2/ IR 10167-129-3-4	IRRI	Highly susceptible
	IR 60494-2B-18-3-2-3	IR 9884-54-3-IE-P1/ IR 33451-12-1-1-2/Pokkali	IRRI	Tolerant
	IR 59932-2B-4-2	IR 32429-47-3-2-2/BW 297-2	IRRI	Susceptible
	IR 5217-B-B-4-B-B-1-3	IR 32429-47-3-2-2/NONA BOKRA/POKKALI	IRRI	Semi tolerant
	CO 43	Dasal x IR 20	India	Tolerant

ice acc.no.5 (IR 26916-Es) of high yielding nd susceptible group ranked second in increasing ie number of productive tillers hill^{-1} (6.28) umber of filled grains panicle^{-1} (85.66). This esult was supported with the findings of rishnamurthy *et al.* (1987) reported that the alt resistant cultivars AV 1, CO 43 and ESC 1 xhibited high salinity indices and experienced ss reduction of tiller than the salt sensitive ultivars. Higher filled grains panicle^{-1} might e due to salinity tolerance during the reproductive age of the crop growth.

The lower number of productive tillers ill^{-1} and filled grains panicle^{-1} in rest of the ce accessions indicate to salinity as compared other accessions. This result in their sensitivity ith findings of Makiharat *et al.* (1999) who ound that number of filled grains panicle^{-1} ecreased in KR 1 due to soil salinity.

Grain yield

The variations in grain yield among the saline tolerant rice accessions were significantly different (Table 1). Among the rice accessions, the high yielding and tolerant rice acc.no.12 (IR 60494-2B-18-3-2-3) markedly increased the yield (4943.66 kg ha^{-1}) which could be attributed to salinity tolerant under soil salinity. The results of the present findings are in concordance with the findings of Barik *et al.* (1993) who reported that among the high yielding variety IR 36 and CSR-4 performed best in respect to grain 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^{-1}. The lowest grain yield (1602.66 kg ha^{-1}) in rice acc.no.7 might be due to its susceptibility for salinity. This is in accordance with the findings of Powar and Mehta (1997) who reported that grain yield decreased with increasing salinity.

Table 1. Performance of rice accessions on yield attributes and yield

Acc.No.	Designation	No. of productive tillers hill^{-1}	No. of filled grains panicle^{-1}	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index
Acc 1	NC 493	4.70	83.33	3011.66	5675	34.6
Acc 2	IR 40931-33-1-3-2	5.34	85.66	3682.00	6841	34.9
Acc 3	IR 63731-1-1-4-3-2	4.12	72.00	2323.33	4429	34.4
Acc 4	IR 45427-2B-2-B-1-2	4.04	69.00	2275.33	4371	34.2
Acc 5	IR 26916-Es	6.28	85.66	4308.66	8177	34.5
Acc 6	IR 52717-B-B-4-B-B-1-3	4.73	81.66	3046.00	5716	34.7
Acc 7	IR 63731-1-1-1-4-2-3	3.37	66.00	1602.66	3085	34.1
Acc 8	B 6996D-MR-13-1	6.35	86.33	4334.00	8216	34.5
Acc 9	IR 63731-1-1-1-3-3	4.49	80.66	2985.00	5222	36.3
Acc 10	TCCP 266-1-3B-10-2-1	6.17	102.00	4284.66	8115	34.5
Acc 11	IR 55233-3B-23-3	3.48	73.66	1690.66	3193	34.6
Acc 12	IR 60494-2B-18-3-2-3	7.04	105.00	4943.66	9371	34.5
Acc 13	IR 59932-2B-4-3	5.48	85.33	3678.00	6903	34.7
Acc 14	IR 5217-B-B-4-B-B-1-3	4.63	78.66	2930.00	5193	36.0
Acc 15	CO 43	4.13	85.00	2362.66	4483	34.5
	SEd	0.25	5.52	217.98	380.41	0.11
	CD (P=0.05)	0.05	11.10	438.15	764.63	0.22

Table 2. Effect of rice accession on nutrient uptake under saline soil

Acc.No.	Designation	Nutrient uptake (kg ha^{-1})					
		N	P	K	Na	Ca	Mg
Acc 1	NC 493	118.71	37.81	110.41	20.86	6.48	6.18
Acc 2	IR 40931-33-1-3-2	109.17	44.75	123.73	32.12	5.77	4.70
Acc 3	IR 63731-1-1-4-3-2	90.53	30.11	96.83	30.43	7.92	7.56
Acc 4	IR 45427-2B-2-B-1-2	78.26	23.83	80.11	30.46	7.95	7.65
Acc 5	IR 26916-Es	144.67	50.85	124.39	32.86	4.82	3.77
Acc 6	IR 52717-B-B-4-B-B-1-3	127.91	43.88	122.31	26.74	6.36	6.02
Acc 7	IR 63731-1-1-1-4-2-3	77.61	23.89	79.46	33.76	8.26	8.35
Acc 8	B 6996D-MR-13-1	144.75	51.03	133.61	21.69	4.70	3.69
Acc 9	IR 63731-1-1-1-3-3	109.63	37.69	109.64	21.35	6.65	6.21
Acc 10	TCCP 266-1-3B-10-2-1	144.31	50.42	132.35	21.96	4.82	3.85
Acc 11	IR 55233-3B-23-3	78.11	24.29	79.64	30.69	8.15	8.32
Acc 12	IR 60494-2B-18-3-2-3	145.31	51.41	133.85	19.82	3.60	2.78
Acc 13	IR 59932-2B-4-3	128.22	44.41	120.17	30.69	5.70	4.89
Acc 14	IR 5217-B-B-4-B-B-1-3	129.06	37.41	109.47	27.72	6.70	6.28
Acc 15	CO 43	91.35	30.63	97.34	22.00	7.84	7.52
	SEd	6.20	1.40	3.92	2.23	0.40	0.40
	CD (P=0.05)	12.46	2.82	7.88	4.68	0.81	0.80

Straw yield

The straw yield between different accessions was found to be significant (Table 1). The highest straw yield of 9371 kg ha^{-1} registered in rice acc.no.12 (IR 60494-2B-818-3-2-3) of high yielding and tolerant group was due to highest plant height and LAI under salinit condition over other accessions tried. This indicate that they are not sensitive to salinity durin the maturity stage of the crop growth. Simil results were reported by Afria and Narnoli (1999).

The susceptible rice accessions no.3,4,7 id 11 were severely affected by salinity and corded the lower straw yield.

arvest index

The high yielding and tolerant rice accession .12 (IR 60494-2B-18-3-2-3), rice accession .8 (B 6996-D-MR-13-1) and rice accession .10 (TCCP P266-11-3B-10-2-1) recorded the ghest harvest index over rest of the accessions able 1). This indicates that they are nsitive to salinity during the crop growth. iis is in accordance with findings of Singh 984). The lower harvest index of low yielding sceptible accessions might be due to their nsitive to salinity during the crop growth.

trient uptake by crop

rogen uptake

The high yielding and tolerant group e accession no.12 (IR 60494-2B-18-3-2-3), e acc.no.8 (B 6996D-MR-13-1) and rice c.no.10 (TCCP 266-1-3B-10-2-1) recorded nificantly higher N uptake (Table 2). They re not affected by salinity as compared to ier accessions. This indicates that they are ot sensitive to salinity during the crop growth. his is in accordance with the findings of arik *et al.* (1993) who reported that the grain ield increased significantly with increasing N ptake upto 150 kg ha^{-1} in rice. The low yielding nd susceptible rice accessions recorded lower uptake. Thus they were affected by salinity s compared to other accessions. This indicates eir sensitivity to salinity during the crop growth. his is in accordance with the findings of itant (1981), who reported that increasing evels of salinity depressed the nitrogen contents f rice and also decreased yields.

hosphorus uptake

The variations in phosphorus uptake among ne saline tolerant rice accessions were significantly ifferent (Table 2). Among the rice accessions, he highest uptake of phosphorus (59.41 kg a^{-1}) was recorded by rice acc.no.12 (IR 60494-B-18-3-2-3) of high yielding and tolerant group ollowed by rice acc.no.5 (IR 26916-Es) (50.85 kg ha^{-1}) of high yielding and susceptible group. Phosphorus uptake could be contributed to highest tolerant to salinity condition. This is in accordance with findings of Singh (1984) in rice cv. Madhuri which recorded higher P uptake with higher yield under saline condition. Whereas, low uptake of P in rice acc.no.3,4,7 and 11 indicates their susceptibility to saline condition. This result is in consonance with Bandyopadhyay *et al.* (1985) who observed, that P uptake decreased in susceptible rice varieties.

Potassium uptake

The uptake of potassium by different rice accessions was found to be significant (Table 2). Rice acc.no.12 (IR 60494-2B-18-3-2-3) and rice acc.no.8 (B6996D-MR-13-1) of high yielding tolerant group, recorded significantly higher K uptake of 133.85 and 133.61 kg ha^{-1} respectively. This might be due to salinity tolerance exhibited by these accessions as compared to the rest of the accessions tried. This is inconformity with the findings of Bohra and Doerffling (1993). Rice acc.no.4,7 and 11 which were recorded significantly lower K as compared to other accessions were grouped under low yielding susceptible category. This indicates the nature of the accessions sensitive to salinity during crop growth.

Sodium uptake

Sodium uptake and salinity tolerance were inversely proportional to each other. Rice acc.no.12 (IR 60494-2B-18-3-2-3) of high yielding and tolerant group significantly recorded least uptake of sodium (19.82 kg ha^{-1}) (Table 2), however it was comparable with rice acc.no.1 (NC 493) of low yielding and susceptible and is in agreement with the findings of Asch *et al.* (1999). The higher sodium uptake by remaining rice accessions indicates the sensitivity of higher sodium to salinity during the crop growth.

Calcium uptake

The calcium uptake among the saline tolerant rice accessions were significantly different (Table 2). High yielding and tolerant group rice acc.no.12 (IR 60494-2B-18-3-2-3-) recorded

lower calcium uptake (3.60 kg ha^{-1}) substantially over other treatments. This was followed by rice acc.no.8 (B6996D-MR-13-1) of high yielding and tolerant group (4.70 kg ha^{-1}). Reducing the calcium uptake, clearly indicates their ability to salinity tolerance as compared to the rest of the accessions tried. This is in conformity with the findings of Bal and Dutt (1986). The low yielding and susceptible rice acc.no.3, 4,7 and 11 recorded higher uptake of calcium. It shows that they were sensitive to salinity during the crop growth.

Magnesium uptake

The magnesium uptake was found to be low (2.78 kg ha^{-1}) in rice acc.no.12 (IR 60494-2B-18-3-2-3) of high yielding and tolerant group over other accessions (Table 2). This could be attributed to higher uptake of N,P and K recorded in this accession. Bajwa (1982) reported that in salt sensitive rice variety, the Mg content diminished with a substantial increase in N,P and K contents.

Based upon the grouping of rice accessions for salinity tolerance, the rice accessions from the high yielding and tolerant group recorded a higher value for the N,P and K uptake and lower value for the Na, Ca and Mg uptake. Among the 15 accessios, rice accession no.12 (IR 60494-2B-18-3-2-3) is ideal one possessing growth and yield attributes contributing to salinity tolerance with higher nutrient uptake under saline soil condition.

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