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Studies on salinity tolerance of restorer lines in rice

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Abstract
Seedling salinity tolerance of 60 identified restorer lines of rice was studied in the present investigation. The results revealed germination per cent to range from 37.33 (TCNP 21 and TCNP 22) to 98.00 (IR 7693-2B-7), while seedling length ranged from 4.13cm (TCNP 22) to 16.89 cm (IR7693-2B-7). 18 restorers had recorded SES score of '7' and were categorized as "Susceptible", while 12 restorers with '9' SES score were classified as "Highly Susceptible". The results also revealed low germination per cent and seedling length in susceptible and highly susceptible restorers. SES final score of '1' was recorded for 12 restorers (IR7 693-2B-7, IRT 11176, MCM 27, MCM 41, MCM 48, MCM 100, MCM 223, MCM 225, MTU 1031, MTU 1061, STBN 12-10 and STBN 12-5) and hence, the restorers were categorized as "Highly Tolerant". Six restorers (MTU 2274-3-2-2, IR 64, MTU 1153, MTU 1156, MTU 1229 and MTU 4870) with '3' final score were categorized as "Tolerant", while 12 restorers (BPT 2270, MTU 2231-18-1-3, MTU 1001, MTU 1010, MTU 1032, MTU 1121, MTU 1140, MTU 1210, MTU 1213, MTU 1224, MTU 2716 and PLA 1100) with '5' final score were categorized as "Moderately Tolerant". These restorers are therefore identified as salinity tolerant restorers with good potential for use in the development of salinity tolerant rice hybrids.

Keywords: germination per cent, restorers, rice, salinity tolerance, seedling length, SES

Introduction
Rice is an important staple food and is referred to as "Global Grain". It is an important food source for people in Asia, Latin America, parts of Africa and the Middle East. Rice production employs about one billion people and is essential for the economic development of rural areas in India, Bangladesh and Southeast Asia. Even though significant improvement in rice production and productivity has been achieved through green revolution, yield plateaus coupled with biotic and abiotic stresses are limiting the efforts for increasing production to meet the demands of ever growing population, especially in the developing and under developed countries. Abiotic stresses alone contribute to 50 per cent of the total yield losses in rice. Salinity (both inland and coastal salinity) is the second most important abiotic stress after drought, which affects the rice production (Yasseen *et al*., 2010). Salt stress adversely affects rice crop productivity and losses due to salinity have been estimated to be around 28 per cent in case of low to medium salinity and up to 76 per cent in case of high salinity (Naifer *et al*., 2011) [4]. Despite the advanced technologies available today, salinization of millions of hectares of land continues to reduce rice crop productivity severely worldwide. Nearly 20 per cent of the world's cultivated area (800 million hectares) and nearly half of the world's irrigated lands are affected by salinity (Maser *et al*., 2002) [3]. In Andhra Pradesh, 2.74 lakh hectares of rice area is affected by salinity (NRSC, 2010) [5]. To meet the demand of burgeoning population and overcome the problem of increasing salinity of the rice cultivated areas, in addition to achieving food security in the country, hybrid rice breeding was identified as an effective strategy towards sustainable enhancement of rice production in the country. The success of hybrid rice programme for salinity tolerance, however, depends on the availability of salinity tolerant restorer lines. In this context, the present investigation was undertaken to evaluate the seedling salinity tolerance of identified restorer lines in rice.

Material and Methods
The experiment was taken up during *Kharif* 2016 at Andhra Pradesh Rice Research Institute & Regional Agricultural Research Station, Maruteru, West Godavari, AP. The screening of rice varieties at seedling stage was carried out using hydroponics as per the procedure detailed by Gregorio *et al.* (1997) [2] during *Kharif* 2016. Healthy and uniform seeds of 60 identified restorer lines of rice were surface sterilized and washed with distilled water, followed by surface drying using tissue paper.

Twenty seeds of each restorer line were placed in Petridishes With Moistened filter papers and were incubated at 30 ^{0}C for 48 hrs for germination (Plate 1). Two pre-germinated seeds were placed on the Styrofoam seedling float per hole**.** The radicle was inserted through the nylon mesh and placed on the tray filled with distilled water for the seedlings to grow normally for three to four days (Plate 1). After three days, when seedlings were well established, distilled water was replaced with standard nutrient solution suggested by Gregorio *et al.* (1997) [2]. Initial salinity stress was imposed with EC=6 dSm^{-1} by adding 3 g of NaCl to the nutrient solution. The solution was renewed eight days after initial salinization. The pH was monitored daily and was maintained at 5.0. After eight days of initial salinization, the EC was increased to12 dSm^{-1} by adding 6 g of NaCl to nutrient solution. Initial scoring of the individual plants was recorded at 10 days after initial salinization as per the Salinity Evaluation Score (SES) of IRRI (1997) [2]. The final score was recorded at 16 days after initial salinization. In addition, 100 healthy and surface sterilized seeds were sown in petridishes with moistened filter paper and treated with saline solution of 12dSm^{-1}, prepared by dissolving 7.70g of NaCl per litre of water. The petridishes were incubated in seed germinator maintained at 25 $\pm$ 1 ^{o}C with 12 hours of daylight and data on the following parameters was recorded:

Germination (%): The number of seedlings germinated was recorded on 10th day and expressed in per cent.

Seedling length (cm): It was measured from tip of the root to the tip of the longest leaf on 16th day and was expressed in centimeters.

Results and Discussion

Sixty identified restorers were screened for salinity tolerance at seedling stage and the results obtained are presented in Table 1. A perusal of the results revealed germination per cent to range from 37.33 (TCNP 21 and TCNP 22) to 98.00 (IR 7693-2B-7), while seedling length ranged from 4.13cm (TCNP 22) to 16.89 cm (IR7693-2B-7). Results on SES revealed final score of ‘1’ for 12 genotypes (IR7 693-2B-7, IRT 11176, MCM 27, MCM 41, MCM 48, MCM 100, MCM 223, MCM 225, MTU 1031, MTU 1061, STBN 12-10 and STBN 12-5) and hence, these genotypes were categorized as “Highly Tolerant”. Six genotypes with ‘3’ final score (MTU 2274-3-2-2, IR 64, MTU 1153, MTU 1156, MTU 1229 and MTU 4870) were categorized as “Tolerant”, while 12 genotypes with ‘5’ final score (BPT 2270, MTU 2231-18-1-3, MTU 1001, MTU 1010, MTU 1032, MTU 1121, MTU 1140, MTU 1210, MTU 1213, MTU 1224, MTU 2716 and PLA 1100) were categorized as “Moderately Tolerant”. Further, 18 genotypes (BPT 3291, MTU 1006, MTU 1064, MTU 1071, MTU 1075, MTU 1078, MTU 112, MTU 1184, MTU 1187, MTU 1194, MTU 1226, MTU 2067, MTU 2077, MTU 3626, MTU 5182, MTU 5293, MTU 7029 and TCNP 22) had recorded final score of ‘7’ and were categorized as “Susceptible”, while 12 genotypes (BPT 5204, MTU 5249, TCNP 13, TCNP 14, TCNP 21, TCNP 106, TCNP 114, TCNP 118, TCNP 119, TCNP 124, TCNP 170 and TCNP 177) with ‘9’ final score were classified as “Highly Susceptible”. In general, 20 per cent of the genotypes (Table 2) studied were observed to be highly tolerant, 10 per cent tolerant and 20 per cent moderately tolerant, while 30 per cent of the genotypes studied were susceptible and 20 per cent were highly susceptible. A perusal of the results also revealed low germination per cent and seedling length in susceptible and highly susceptible genotypes, compared to highly tolerant, tolerant and moderately tolerant genotypes (Table 2 and Fig. 1 and 2). These observations are supported by the findings of Gill and Singh (1989) [1] and Sudha Rani (2012) [7] who stated that the salt tolerant genotypes showed faster and higher germination than the sensitive varieties.

The results also revealed an increase in the SES score from initial to final with increase in the salinity level from 6dSm^{-1} to 12dSm^{-1} for several genotypes studied in the present investigation (Table 3). Few restorers, however had recorded uniform initial and final SES score and are presented in Table 4. The genotypes, IR 7693-2B-7, IRT 11176, MCM 27, MCM 41, MCM 48, MCM 100, MCM 223, MCM 225, MTU 1031, MTU 1061, STBN 12-10 and STBN 12-5 had recorded highly tolerant score at both initial and final levels. Similarly, MTU 4870 had recorded uniformly tolerant score at both levels. Further, MTU 1001, MTU 1010, MTU 1121 and PLA 1100 had recorded uniformly moderately tolerant score at both levels. These genotypes are therefore identified as salinity tolerant restorers for use in salinity tolerant hybrid rice breeding programmes.

Table 1: Screening of identified restorers for salinity tolerance

S. No.	Restorers studied	Germination (%)	Seedling length (cm)	SES score	
				Initial score	Final score
1	BPT 2270	69.33	6.43	3	5
2	BPT 3291	56.00	5.35	5	7
3	BPT 5204	45.33	4.59	7	9
4	MTU 2231-18-1-3	68.67	6.34	3	5
5	MTU 2274-3-2-2	83.00	7.48	1	3
6	IR64	81.67	7.44	1	3
7	IR7693-2B-7	98.00	16.89	1	1
8	IRT11176	97.33	11.18	1	1
9	MCM 27	95.67	8.75	1	1
10	MCM 41	95.67	8.75	1	1
11	MCM 48	95.33	8.63	1	1
12	MCM 100	97.00	10.24	1	1
13	MCM 223	96.33	10.31	1	1
14	MCM 225	96.00	9.94	1	1
15	MTU 1001	85.00	7.43	5	5
16	MTU 1006	55.33	5.31	5	7
17	MTU 1010	79.00	7.31	5	5

18	MTU 1031	94.33	8.35	1	1
19	MTU 1032	65.33	6.29	1	5
20	MTU 1061	95.33	8.22	1	1
21	MTU 1064	55.33	5.28	3	7
22	MTU 1071	54.67	5.27	5	7
23	MTU 1075	54.00	5.26	3	7
24	MTU 1078	53.33	5.24	5	7
25	MTU 1112	53.00	5.24	5	7
26	MTU 1121	65.00	6.21	5	5
27	MTU 1140	63.33	6.19	1	5
28	MTU 1153	78.00	7.13	1	3
29	MTU 1156	76.67	7.05	1	3
30	MTU 1184	53.00	5.16	1	7
31	MTU 1187	53.00	5.15	5	7
32	MTU 1194	52.33	5.14	5	7
33	MTU 1210	63.33	6.15	3	5
34	MTU 1213	65.67	6.31	3	5
35	MTU 1224	63.00	6.14	1	5
36	MTU 1226	52.33	5.14	5	7
37	MTU 1229	76.00	7.02	1	3
38	MTU 2067	52.33	5.13	3	7
39	MTU 2077	52.00	5.13	3	7
40	MTU 2716	71.67	6.12	3	5
41	MTU 3626	53.00	4.98	5	7
42	MTU 4870	83.00	7.13	3	3
43	MTU 5182	51.67	5.12	3	7
44	MTU 5249	43.33	4.31	5	9
45	MTU 5293	51.00	5.09	5	7
46	MTU 7029	51.00	5.07	1	7
47	PLA 1100	70.33	6.05	5	5
48	STBN-12-10	94.00	8.12	1	1
49	STBN-12-5	92.67	8.09	1	1
50	TCNP 13	39.67	4.29	7	9
51	TCNP 14	38.33	4.29	5	9
52	TCNP 21	37.33	4.29	7	9
53	TCNP 22	37.33	5.05	1	7
54	TCNP 106	43.00	4.28	7	9
55	TCNP 114	40.67	4.28	5	9
56	TCNP 118	40.33	4.21	5	9
57	TCNP 119	50.33	4.17	5	9
58	TCNP124	39.67	4.15	9	9
59	TCNP 170	38.33	4.14	1	9
60	TCNP 177	37.67	4.13	5	9
	Minimum	37.00	4.07		
	Maximum	98.00	16.89		

Table 2: Germination per cent and seedling length of different categories of salinity tolerant and susceptible restorer lines

S. No.	Category	Number of restorers	Restorer lines	Mean Germination (%)	Mean Seedling length (cm)
1	Highly tolerant	12	IR 7693-2B-7, IRT 11176, MCM 27, MCM 41, MCM 48, MCM 100, MCM 223, MCM 225, MTU 1031, MTU 1061, STBN 12-10, STBN 12-5	95.63	9.78
2	Tolerant	6	MTU 2274-3-2-2, IR 64, MTU 1153, MTU 1156, MTU 1229, MTU 4870	79.72	7.20
3	Moderately tolerant	12	MTU 1032, MTU 1140, MTU 1224, BPT 2270, MTU 2231-18-1-3, MTU 1210, MTU 1213, MTU 2716, MTU 1001, MTU 1010, MTU 1121, PLA 1100	69.13	6.41
4	Susceptible	18	MTU 1184, MTU 7029, TCNP 22, MTU 1064, MTU 1075, MTU 2067, MTU 2077, MTU 5182, BPT 3291, MTU 1006, MTU 1071, MTU 1078, MTU 1112, MTU 1187, MTU 1194, MTU 1226, MTU 3626, MTU 5293	52.25	5.17
5	Highly susceptible	12	BPT 5204, MTU 5249, TCNP 13, TCNP 14, TCNP 21, TCNP 106, TCNP 114, TCNP 118, TCNP 119, TCNP 170, TCNP 177	41.16	4.26

Table 3: Details of restorers with increase in initial to final salinity evaluation score (SES)

S. No.	Restorer lines	SES Score		Number of restorers
		Initial	Final	
1	MTU 2274-3-2-2, IR 64, MTU 1153, MTU 1156, MTU 1229	1	3	5
2	MTU 1032, MTU 1140, MTU 1224	1	5	3
3	MTU 1184, MTU 7029, TCNP 22	1	7	3
4	TCNP 170	1	9	1
5	BPT 2270, MTU 2231-18-1-3, MTU 1210, MTU 1213, MTU 2716	3	5	5
6	MTU 1064, MTU 1075, MTU 2067, MTU 2077, MTU 5182	3	7	5
7	BPT 3291, MTU 1006, MTU 1071, MTU 1078, MTU 1112, MTU 1187, MTU 1194, MTU 1226, MTU 3626, MTU 5293	5	7	10
8	MTU 5249, TCNP 14, TCNP 114, TCNP 118, TCNP 119, TCNP 177	5	9	6
9	BPT 5204, TCNP 13, TCNP 21, TCNP 106	7	9	4

Table 4: Restorers with uniform initial and final SES score

S. No.	Restorer lines	Uniform SES Initial and Final score	Number of restorers
1	IR 7693-2B-7, IRT 11176, MCM 27, MCM 41, MCM 48, MCM 100, MCM 223, MCM 225, MTU 1031, MTU 1061, STBN 12-10, STBN 12-5	1	12
2	MTU 4870	3	1
3	MTU 1001, MTU 1010, MTU 1121, PLA 1100	5	4
4	-	7	-
5	TCNP 124	9	1

Seeds sown in Petridishes

Hydroponic screening

Plate 1: Screening for seedling salinity tolerance in rice

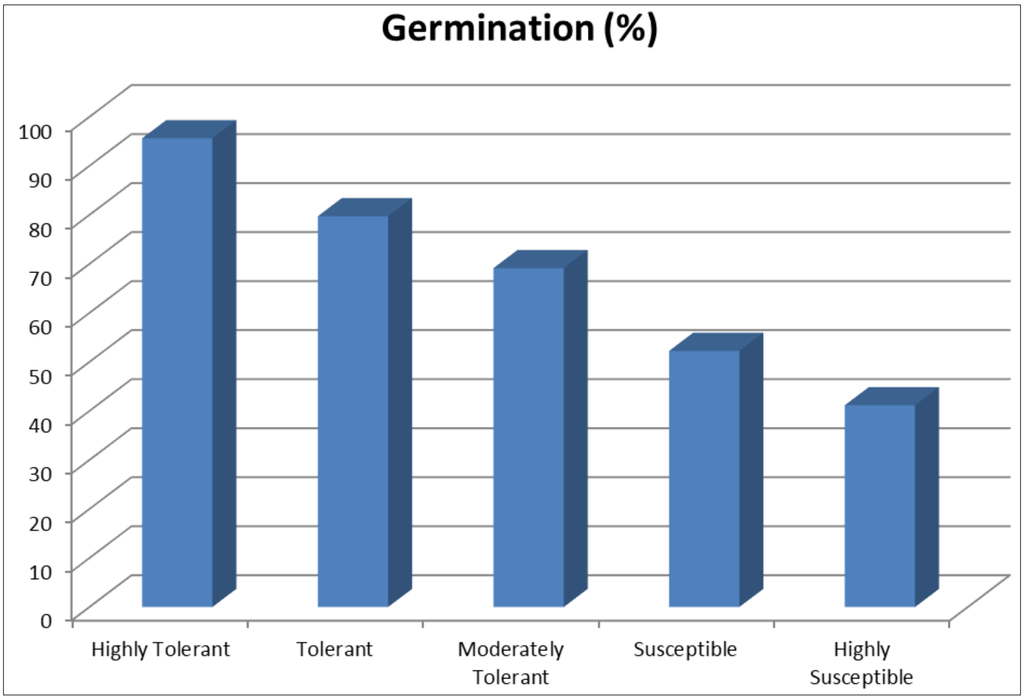

Fig 1: Average germination per cent of different categories of seedling salinity tolerance in rice restorer lines

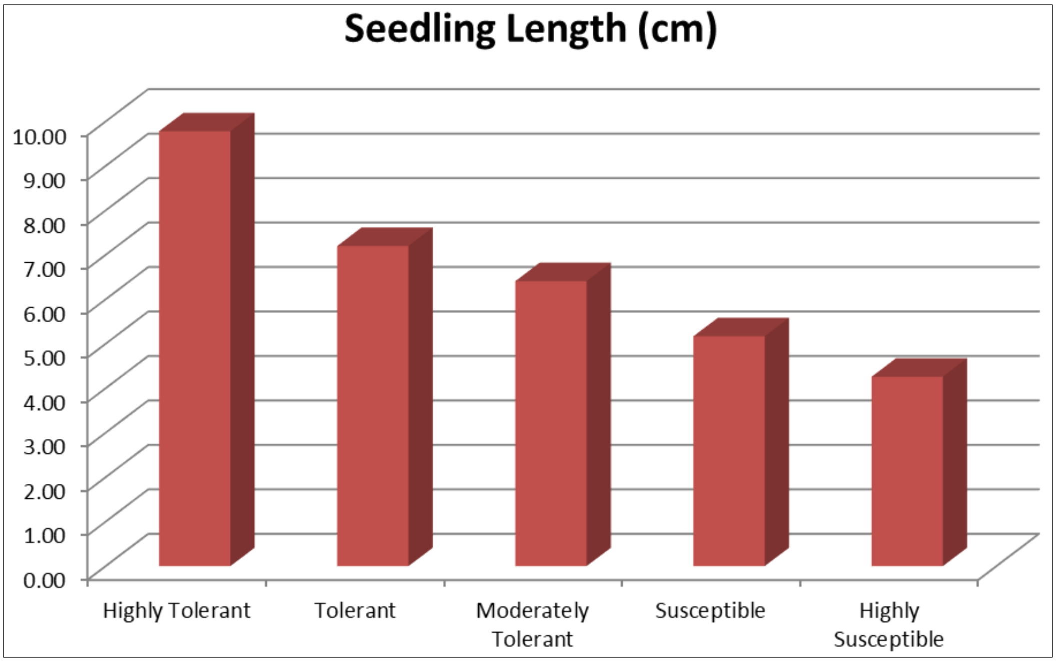

Fig 2: Average seedling length of different categories of seedling salinity tolerance in rice restorer lines

References

1. Gill KS, Singh OS. Effect of salinity on growth, chemical composition and yield in paddy. Oryza 1989;26:162-167.
2. Gregorio GB, Senadhira D, Mendoza RD. Screening rice for salinity tolerance. IRRI discussion paper series No. 22. International Rice Research Institute, Los Banos. Laguna, Philippines 1997, 1-30.
3. Maser P, Gierth M, Schroeder JI. Molecular mechanisms of potassium and sodium uptake in plants. Plant and Soil. 2002;247:43-54.
4. Naifer A, Al Rawahy SA, Zekri S. Economic impact of salinity. The case of al-batinah in Oman. International Journal of Agricultural Research 2011;6:134-142.
5. National Remote Sensing Centre (NRSC) Annual Report 2010.
6. Salinity Evaluation Score (SES) IRRI, Manila, Philippines 1997.
7. Sudha Rani M. Genetic analysis components of salinity tolerance in rice (*Oryza sativa* L.). PhD Thesis, Acharya NG Ranga Agricultural University, Hyderabad 2012.
8. Yaseen BT, Basal Abu-Al MA, Alhadi FA. An analysis of leaf growth under osmotic stress. Journal of Plant Science 2010;5:391-401.