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Grouping of Rice Genotypes for Salinity Tolerance Based upon Grain Yield and Na: K Ratio under Coastal Environment

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Abstract: A field experiment was conducted in the saline field of Annamalai University, experimental farm, Annamalai Nagar during *Navarai* season of 2000-2001, to study the Grouping of rice accessions for salinity tolerance and yield under coastal environment. 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 grain yield the rice accessions were grouped in to High Yielding Tolerant (HYT), High Yielding Susceptible (HYS), Low Yielding Tolerant (LYT) and Low Yielding Susceptible (LYS) for salinity tolerance. The rice accessions from the high yielding and tolerant group recorded a lower value for the Na:K ratio higher value of grain yield. The lowest sodium and potassium ratio and highest grain yield was recorded by Rice Acc No. 12 (IR60494-2B-18-3-2-3) as compared to the others in the high yielding and tolerant rice accessions. The Rice Acc No. 12 (IR60494-2B-18-3-2-3) is considered potentially tolerant to salinity.

Key words: Rice accessions, salinity tolerance, grain yield and Na:K ratio

INTRODUCTION

Selection of highly salt tolerant genotypes within a species can be expected to provide useful material for experimental comparisons with the salt sensitive ones. Even the most tolerant of traditional varieties, such as Nona Bokra, still suffer a yield reduction of one-third at an EC of only 4.5 mS cm^{-1}[1]. 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 were a single factor (which could include a genetically linked group of factors). If this were not true, i.e. if salt tolerance in non-halophytes were the product of several independent factors, there follow two important conclusions. Firstly, there would be cause to believe that salt resistance in rice can be increased beyond the present phenotypic range because there is no reason to expect that, in the absence of selection pressure, current varieties have evolved the optimal combination of characters for salt resistance. Secondly, such characters will commonly be cryptic, i.e. the genotype for one may not on its own influence the phenotype sufficiently for that phenotype to be selected in a screening process.

MATERIALS AND METHODS

The site chosen for study is in the saline soils of the Annamalai University Experimental Farm representing the coastal environments. 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 experimental farm is situated at 11°24' North Latitude and 79°41' East Longitude at an altitude of 5.79 m above mean sea level. 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.

The experimental details of the treatments are furnished in Table 1.

This type of grouping was suggested Gregorio *et al*[2]for rice genotypes based upon grain yield and Na-K ratio as in indicator for tolerance to as salinity. This Na-K ratio which is balanced between Na and K in the shoot is a valid criteria in measuring salinity tolerance in rice. This is a good parameter in quantifying the degree of salinity tolerance of rice genotypes based upon yield (Fig. 1).

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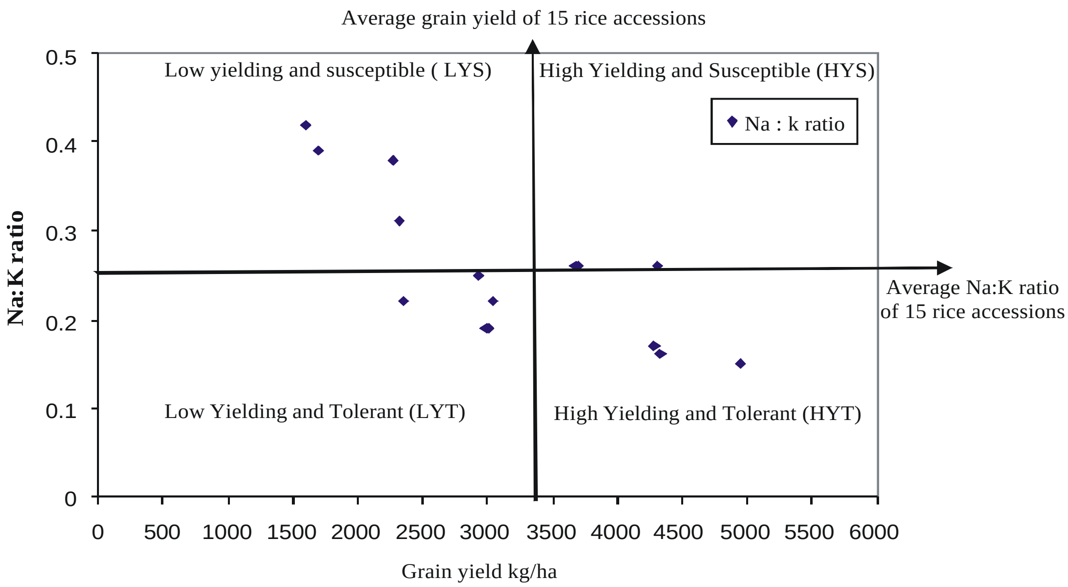
Table 1:

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

Fig. 1. Classification of rice genotypes for grain yield based upon salinity tolerance



High yielding tolerant (HYT): The first group consist of rice accession which are high yielding and tolerant to a salinity. The rice accession falling in these groups were Acc 8, Acc 10 and Acc 12.

High yielding susceptible (HYS): The second group consist of rice accession which are high yielding and susceptible. The rice accession falling in these groups were Acc 2, Acc 5 and Acc 13.

Low yielding tolerant (LYT): The third group consist of rice accession which are low yielding and tolerant. The rice accession falling in these groups were Acc 1, Acc 6, Acc 9, Acc 14 and Acc 15.

Low yielding susceptible (LYS): The fourth group consist of rice accession which are low yielding and susceptible. The rice accession falling in these groups were Acc 3, Acc 4, Acc 7 and Acc 11.

RESULTS AND DISCUSSIONS

Available Na: K ratio: The variations in soil available Na:K ratio among the saline tolerant rice accessions were significantly different (Table 2). In Group I (High yielding and tolerant) Rice Acc No. 12 (IR60494-2B-18-3-2-3) recorded the least soil available Na:K ratio of 0.15. They were not affected by salinity as compared to other accessions. This indicates that they are not sensitive to salinity during the maturity state of the crop growth. This is in accordance with the findings of Bajwa [3]. In Group II (High yielding and susceptible) Rice Acc No. 5 (IR26196-Es) Rice Acc No. 2 (IR40931-33-1-3-2) and Rice Acc No. 13 (IR59932-2B-4-3) recorded the least soil available Na:K ratio of 0.26 and the least soil available Na:K ratio of 0.19 was recorded in Group III (Low yielding and tolerant) for Rice Acc No. 1 (NC493) and Rice Acc No. 9 (IR6373-1-1-1-3-3). In Group IV (Low yielding and susceptible) Rice Acc No. 3 (IR 63731-1-1- 4-3-2) recorded the least soil available Na:K ratio of 0.31. They were affected by salinity as compared to other accessions. This indicates that is sensitive to salinity during the maturity stage of the crop growth. This is in accordance with the findings of Sundar Daniel Paulas and Sree Rangawamy [4].

Grain yield: The Rice Acc No. 12 (IR60494-2B-18-3-2-3), Rice Acc No. 8 (B6996D-MR-13-1) and Rice Acc No.10 (TCCP266-1-3B-10-2-1) were grouped as high yielding and tolerant recorded a higher grain yield (Table 2). They were not affected by salinity as compared to other accessions. This indicates that they are not sensitive to salinity during the maturity stage of the crop growth. The results of the present findings are in concordance with the

Table 2: Grouping of rice accessions based on the grain yield and Na: K ratio for salinity tolerance.

Accession No.	Designation	Mean	
		Grain yield kg ha^{-1}	Na : K ratio
	High yielding tolerant (HYT)		
Acc 8	B 6996D-MR-13-1	4334.00	0.16
Acc 10	TCCP266-1-3B-10-2-1	4284.66	0.17
Acc 12	IR 60494-2B-18-3-2-3	4943.66	0.15
	High yielding susceptible (HYS)		
Acc 2	IR 40931-33-1-3-2	3682.00	0.26
Acc 5	IR 26916-Es	4308.66	0.26
Acc 13	IR 59932-2B-4-3	3678.00	0.26
	Low yielding tolerant (LYT)		
Acc 1	NC 493	3011.66	0.19
Acc 6	IR 52717-B-B-4-B-B-1-3	3046.00	0.22
Acc 9	IR 63731-1-1-1-3-3	2985.00	0.19
Acc 14	IR 5217-B-B-4-B-B-1-3	2930.00	0.25
Acc 15	CO 43	2362.66	0.22
	Low yielding susceptible (LYS)		
Acc 3	IR 63731-1-1-4-3-2	2323.33	0.31
Acc 4	IR 45427-2B-2-B-1-2	2275.33	0.38
Acc 7	IR 63731-1-1-4-2-3	1602.66	0.42
Acc 11	IR 55233-3B-23-3	1690.66	0.39
	SE_D	217.98	0.09
	CD	438.15	0.18

findings of Barik *et al.* [5] who reported that among the high yielding variety IR 36 and CSR-4 performed best in respect to grain (51.6 q ha^{-1}) which has 130.95 per cent more in grain yield than the local variety Golganti due to their higher number of panicles, number of filled grains $panicle^{-1}$ and test weight. Similar results were reported by Gonzales and Ramirez [6] and Afria and Narnolia [7].

The low yielding and susceptible Rice Acc No. 3 (IR63731-1-1-4-3-2), Rice Acc No. 4 (IR45427-2B-2-B-1-2), Rice Acc No. 7 (IR63731-1-1-4-2-3) and Rice Acc No. 11 (IR55233-3B-23-3) recorded the lower grain yield. It was severely affected by salinity as compared to other accessions. This indicates that is sensitive to salinity during maturity stage of the crop. This is in accordance with the findings of Powar and Mehta [8] who reported that grain and straw yield decreased with increasing salinity.

Based upon the grouping of rice accessions for salinity tolerance and yield; the rice accessions from the high yielding and tolerant group recorded a lower value for the Na:K ratio higher value of grain yield. The lowest sodium and potassium ratio and highest grain yield was recorded by Rice Acc No. 12 (IR60494-2B-18-3-2-3) as compared to the others in the high yielding and tolerant rice accessions. The Rice Acc No. 12 (IR60494-2B-18-3-2-3) is considered potentially tolerant to salinity.

REFERENCES

1. Yoshida, S., 1981. ‘Fundamentals of rice crop science’. (International Rice Research Institute: Los Banos).
2. Gregorio, G.B., S. Dharmawansan and R.D. Mendoza, 1997. Screening rice for salinity tolerance. IRRI, 22: 17-20.
3. Bajwa, M.S., 1982. A study on salt and sodium tolerance of rice, J. Agric. Sci., 98(3): 475-482.
4. Sundar Daniel Paulas and Sree Rangasamy, 1995. Performance of rice genotypes under salt stress. Oryza, 32: 245-248.
5. Barik, A.S., R. Das, S.K. Pal, N.Samini and R.C. Majundor, 1993. Screening of high yielding rice cultivars in the saline sundarbans of West Bengal during rainy season. Indian Agric., 37(2):109-114.
6. Gonzales, O.M. and R. Ramirez, 1998. Genetic variability and path analysis in rice grown in saline soil. IRRN, 23: 3-19.
7. Afria, B.S and R.K. Narnolia, 1999. Effect of cycocel and saline irrigation on physiological attributes, yield and its components in different varieties of wheat. Indian J. Plant Physiol., 4(4): 311-314.
8. Powar S.L. and V.B. Mehta, 1997. Integrated nutrient management for rice in coastal saline soil of high rainfall area. Ann. Agril. Res., 18(4): 538-540.