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Assessment of Salt Tolerance at Panicle Initiation Stage of Different Rice (*Oryza sativa* L.) Genotypes

M.Sala[*] M.Gopal and S.Jebaraj
*Assistant Professor, Thanthai Rover Agricultural College and Research Institute, Perambalur.
[2]Department of Agronomy, AC&RI, Killikulam – 628252, TNAU, Tamil Nadu, India.
[3]Special officer, Thanthai Rover Agricultural College and Research Institute, Perambalur.

***Abstract* – Salinity screening was performed at Tamil Nadu Rice Research Institute, Aduthurai for ten rice genotypes at EC6dS/m. Phenotyping of the genotypes was done at panicle initiation stage and scoring was done based on IRRI system of classification. The two land races *viz.*, Nona bokra and Pokkali were highly tolerant to salinity followed by FL 478 and CSR 36 which were tolerant. The variety *viz.*, CSR 10 was moderately tolerant and the remaining high yielding popular varieties *viz.*, ADT 37 and ADT 42 were susceptible and ADT 43, ADT(R) 47 and TNAU Rice ADT 49 was recorded highly susceptible. The indentified salt tolerant genotypes *viz.*, Nona bokra and Pokkali can be potential germplasm sources for future breeding program.**

***Keywords* – Rice, Salinity, Panicle Initiation Stage, Sodium Chloride, Genotypes.**

I. INTRODUCTION

Rice (*Oryza sativa* L.) is the most important food crop in the world, which accounts for more than 21% of the calorific needs of the world's population and up to 76 % of the calorific intake of the population of South East Asia (Ma *et al.*, 2007 and Melissa *et al.* 2009). Rice production employs one billion people and is essential for the economic development of rural areas in India and Southeast Asia by providing rural employment and prosperity. Rice area in Tamil Nadu accounts 21 lakh ha and the production is 93 lakh million tones. The average yield of rice is 4429 kg/ha which is higher than the national average of 2186 kg/ha (Rice policy note, 2014-15).Though significant improvement in productivity has been achieved over the years a series of biotic and abiotic stresses limits its productivity worldwide.

Abiotic stresses alone contribute to 50 % of the total yield losses. Among abiotic stresses, salinity, drought and extreme temperatures are major barriers to limit rice crop production. The area affected by different levels of salinity covers about 400-950 million hectares around the world (Ismail *et al.* 2010). In India a potential area of 20 million hectares of land has been affected by varying degrees of salinity. In Tamil Nadu 1, 32,000 hectares are affected by salinity and 3,54,784 hectares are affected by alkalinity [(1)]. Rice production in vast stretches of coastal areas is hampered due to high soil salinity. To increase rice production in salt affected areas it needs to develop rice cultivars suited to saline environments.

Rice is a salt sensitive species, has considerable genetic variation for salt tolerance within the cultivated gene pool [(11)]. Salinity affects plants at all stages of development but the response of rice to salinity varies with growth stages. Several studies indicated that rice is tolerant during germination, becomes very sensitive during early seedling stage (2-3 leaf stage), gains tolerance during vegetative growth stage, becomes sensitive during pollination and fertilization, and then become increasingly more tolerant at maturity [(4)].

During the reproductive stage the rice plants are continuously exposed to saline media, salinity affects the panicle initiation, spikelet formation, fertilization of florets and germination of pollen grains, leading to an increased number of sterile floret [(2)]. Salinity severely reduced the panicle length, number of primary branches per panicle, number of spikelet per panicle, seed setting percentage and panicle weight and thereby indirectly reduced the grain yield [(10)]. Salinity at reproductive stage reduced the grain yield more when compared to salinity effect at vegetative growth stage[(2)]. The effect of salinity stress is more pronounced in reproductive stage than vegetative stage. Efforts have been made to screen the salt tolerance in rice at panicle initiation stage is very important.

Materials and methods:

The present investigation was carried out in the department of Plant Breeding and Genetics, research farm, Tamil Nadu Rice Research Institute, Aduthurai during 2014-2016 with the objectives of studying the salt tolerance at panicle initiation stage, of different rice genotypes; five high yielding and salinity susceptible lines *viz*., ADT 37, ADT 42, ADT 43, ADT(R) 47, TNAU Rice ADT 49 and five salinity tolerant testers *viz*., Nona bokra, Pokkali, FL 478, CSR 10 and CSR 36. For this screening, the genotypes at tillering stage were transferred to pots in completely randomized design with three replications. For establishment the nutrient solutions (YOSHIDA) were added in weekly interval [(12)]. After establishment the seedlings were treated with saline solutions at 6 Electrical Conductivity (EC dSm^{-1}) in weekly interval along with the nutrient solution. The genotypes were tested for their tolerance to saline toxicity at 6 EC dSm^{-1} at panicle initiation stage and scoring was done based on IRRI system of classification [(3)] and given in Table 1.

II. RESULTS AND DISCUSSION

Phenotypic study of salinity tolerance at panicle initiation stage

Ten tested genotypes had recorded wide variation in tolerance for saline toxicity at panicle initiation stage of 6 EC dSm^{-1} and its score ranging from 1 (highly tolerant) to 9 (highly susceptible). Scoring was done based on IRRI system of classification (Table 2). The two land races *viz.*, Nona bokra and Pokkali, were highly tolerant (score 1) to

salinity followed by FL 478 and CSR 36 which were tolerant (score 3) (Plate 1).

The variety *viz.*, CSR 10 was moderately tolerant (score 5) and the remaining high yielding popular varieties *viz.*, ADT 37 and ADT 42 were susceptible (Score 7) and ADT 43, ADT(R) 47 and TNAU Rice ADT 49 was recorded highly susceptible (Score 9) Table 2. Similar results were also found by Rubel *et al.* (2014) reported that salinity screening was done at seedling and reproductive stages for 27 rice genotypes. Phenotyping of the germplasm was done at EC 12 dSm^{-1} and 6 dSm^{-1} at seedling and reproductive stages, respectively. Based on modified standard evaluation score for visual salt injury at seedling stage, eight genotypes were salt tolerant, four were moderately tolerant and the rest fifteen were susceptible. At the reproductive stage, six genotypes were tolerant (score 3) to EC 6 dSm^{-1} where as eleven of them were susceptible (score 7).

Naresh Babu *et al. (*2014) observed that Pokkali was highly salt tolerant, CSR 10 was tolerant and FL 478 and CSR 30 were moderately tolerant to salinity at reproductive stage. Nayon Hossain (2014) found the salinity screening salinized (EC14 dSm^{-1}) with culture solution at reproductive stage.

III. Conclusion

The indentified salt tolerant genotypes *viz.*, Nona bokra and Pokkali can be used as potential germplasm sources for future breeding program to breed salinity resistant cultivars. In future, by utilizing the highly genetic divergent parents of ADT(R) 47 and Nonabokra and Pokkali may help to develop high yielding salt tolerant varieties.

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Table 1. Modified standard evaluation score (SES) for salt injury (IRRI, SES 1996).

Score	Observation	Tolerance
1	Normal growth, no leaf symptoms	Highly tolerant
3	Nearly normal growth, but leaf tips or few leaves whitish and rolled	Tolerant
5	Growth severely retarded; most leaves rolled; only few are elongating.	Moderately tolerant
7	Complete cessation of growth; some plants dying	Susceptible
9	Almost all plants dead or dying	Highly susceptible.

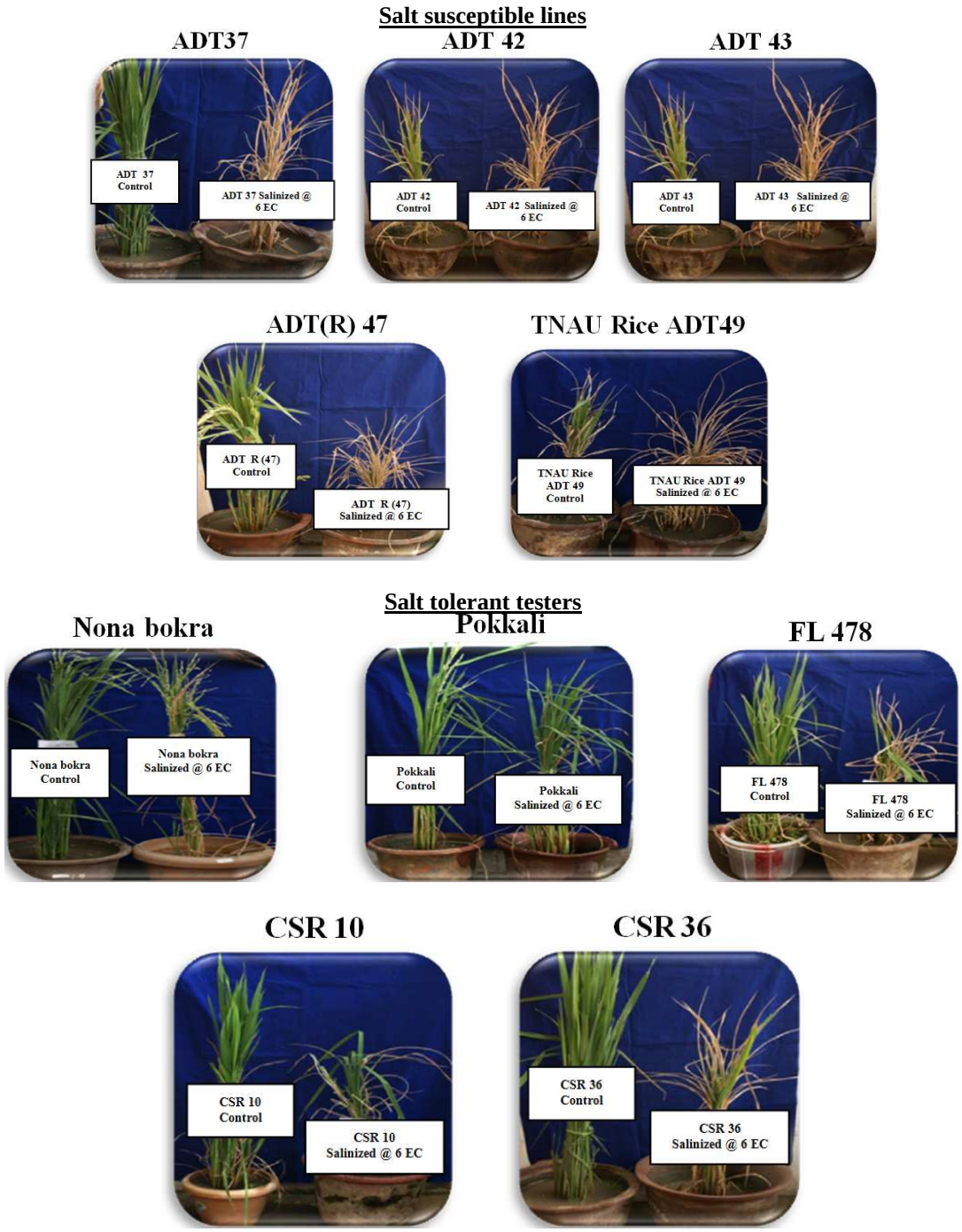
Table 2. Screening of parents (6 EC dSm^{-1}) at panicle initiation stage

S.No	Entries	Score	Reaction to salinity at panicle initiation stage (6 EC dSm^{-1})
1	ADT 37	7	S
2	ADT 42	7	S
3	ADT 43	9	HS
4	ADT(R) 47	9	HS
5	TNAU Rice ADT 49	9	HS
6	Nona bokra	1	HT

7	Pokkali	1	HT
8	FL 478	3	T
9	CSR 10	5	MT
10	CSR 36	3	T

S-Susceptible, HS-Highly Susceptible, T-Tolerant, MT-Moderate Tolerant.

Plate 1. Screening of parents for salt tolerance of 6 EC dSm^{-1} at panicle initiation stage



AUTHOR'S PROFILE

Name - M.SALA
Father Name - C. Murugan
Date of birth - 10-06-1989
Age - 27
E.Mail - swtsala1@gmail.com
Sex - Female
Community - BC
Mobile - 8012460114
Email - swtsala1@gmail.com

MSc Details:
Post graduate in **Plant Breeding and Genetics**
Thesis title: **Rice Breeding for Biofortification with high iron and zinc content in Segregating population**
Chairman: Dr. C.R.Ananda kumar. Ph.D., Professor
Co-chairman: Dr.S.Geetha, Prof. & Head, NPRC, Vamban.

Ph.D Details:
Thesis title: **Genetic analysis for yield and yield contributing traits in salinity tolerant rice (*Oryza sativa*).**
Chairman: Dr. B.Selvi, Professor, Department of millets, TNAU, Coimbatore.
Scheme PI: Dr.P.Shanthi, Assistant Professor, TRRI, Aduthurai.