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Study of Estimates of Genetic Parameters for Yield and Physiological Traits in Rice (*Oryza sativa* L.) under Saline Soil Conditions

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ABSTRACT

Study of variability parameters in F_2 progenies of rice under saline soil conditions revealed high heritability estimates as well as genetic advance for number of total tillers plant^{-1}, number of productive tillers plant^{-1}, panicle length, panicle weight, number of filled grains panicle^{-1}, spikelet fertility per cent, 1000-grain weight, grain yield plant^{-1}, Standard Evaluation Score for visual salt injury symptoms and Na^+/K^+ ratio in the shoot. The results indicated that these characters are more amenable for selection as they appeared to be predominantly controlled by additive gene effects and are found to be least influenced by environment and more emphasis may be given to these traits while executing selections under saline conditions.

Key words : Genetic parameters, Physiological traits , Yield.

The presence of adequate genetic variability is regarded as the fundamental pre-requisite to launch any crop improvement programme and the success depends on its magnitude in a given species. Knowledge of nature and magnitude of genetic variability present in a population is of immense value for planning an efficient breeding programme to improve the yield potential of genotypes. The present day breeding activities do involve hybridization, mutation and other such techniques to create variability.

The genotypic coefficient of variation measures the magnitude of genetic variability present in the crop. Since, it reflects the heritable portion of variability, it is considered to be more useful than phenotypic coefficient of variation. Moreover, the difference between phenotypic and genotypic coefficients of variation indicates the operation of environmental factors. Information on heritability along with genetic advance will be helpful in formulating selection criteria. The studies of variability parameters in rice under saline soil conditions are very limited . Hence, the present study was conducted with an objective to estimate phenotypic and genotypic coefficient of variation (PCV and GCV), heritability in broad sense, genetic advance and genetic advance as per cent of mean were computed for ten agronomic characters and five physiological characters in F_2 generation.

MATERIAL AND METHODS

The diallel set of 28 F_2 populations were sown during *kharif*, 2010 on the raised nursery beds of Agricultural Research Station, Machilipatnam. Thirty day old seedlings were transplanted in 10 paired rows of 10 m length by adopting the spacing of 20 x 15 cm between and within row. The mean electrical conductivity (E.C) of the soil during crop growth was 7.3 dS/m with a pH of 7.1. The recommended agronomic, cultural and plant protection measures were adopted in conducting the experiment. Observations were recorded on 90 random plants in each F_2 population.

The phenotypic and genotypic coefficients of variation (PCV and GCV) were calculated using the formulae suggested by Burton (1952) and the categorization of the range of variation was effected as proposed by Sivasubramanian and Madhava Menon (1973). The heritability in broad sense was estimated using the formula of Allard (1960) and categorized by Johnson *et al.* (1955). Genetic advance was estimated as per the formula proposed by Lush (1940) and categorized by Johnson *et al.* (1955).

RESULTS AND DISCUSSION

In the present investigation the phenotypic co-efficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the attributes indicating the influence of environment (Table 1). This view had also been reported by Das *et al.* (2001). The genotypic coefficient of variation ranged from 3.07 (Plant height) to 48.25 per cent (Grain yield plant^{-1}) Highiest genotypic coefficient of variation was observed for grain yield plant^{-1} (48.25) followed by panicle weight (32.14), number of filled grains panicle^{-1} (26.69) and number of productive tillers plant^{-1} (21.03) indicating the higher opportunities for further improvement of these characters under saline soil conditions. In accordance to the present findings, higher estimates of GCV and PCV were reported for grain yield plant^{-1}, panicle weight and productive tillers by Sawant and Patil (1995), Gonzales and Ramirez (1998), Balan *et al*. (1999), Zeng and Shannon (2000) and Seetharam *et al.* (2009) for grain yield plant^{-1} and number of fertile florets panicle^{-1} by Karthikeyan *et al*. (2007) under similar soil environment. In contrast to the present study, Ravindra Babu (1996) reported moderate GCV for productive tillers plant^{-1}, number of filled grains panicle^{-1}, dry matter production plant^{-1} and grain yield plant^{-1}.

Moderate genotypic coefficient was noticed for the characters *viz.,* number of tillers plant^{-1} (19.01), Standard Evaluation Score (SES) for visual salt injury symptoms (18.87), panicle length (15.99), root/shoot ratio (15.09), 1000-grain weight (13.14), spikelet fertility (11.99), which indicated the moderate chances for further improvement of these parameters. The traits *viz*., SPAD chlorophyll meter reading (8.57), days to 50 per cent flowering (4.08), harvest index (3.60) and plant height (3.07) showed low GCV, thereby offered limited scope to improve further. However, high variability was reported for grain yield plant^{-1} and number of fertile florets panicle^{-1} by Das *et al.* 2001 and moderate estimates of phenotypic and genotypic coefficient of variation were observed for plant height and panicle length by Karthikeyan *et al.* (2007).

Unlike the present findings, Ravindra Babu (1996) reported low variability for plant height, harvest index, 1000-seed weight and panicle length, while Seetharam *et al.* (2009), Sajjad (1987) and Bala (2001) also observed low GCV for 1000-grain weight.

High heritability was observed for the characters *viz.,* panicle weight (87%) followed by 1000-grain weight (86%), grain yield plant^{-1} (86%), Na^+/K^+ ratio (86%), number of filled grains panicle^{-1} (85%), root/ shoot ratio (71%), spikelet fertility (70%), panicle length (65%), number of productive tillers plant^{-1} (63%) and number of tillers plant^{-1} (61%). The earlier researchers Ramalingam and Gunasekaran (1999), Bala (2001) and Seetharam *et al.* (2009) also observed high heritability for plant height, number of tillers plant^{-1}, productive tillers plant^{-1}, panicle weight and grain yield plant^{-1} under saline conditions. Similarly, high heritability was also observed for days to 50 per cent flowering, dry matter production plant^{-1}, 1000-grain weight, number of filled grains panicle^{-1}, harvest index and panicle length by Sajjad (1987), Karthikeyan *et al.* (2007), while moderate level of heritability was noticed by Yao *et al*. (2004).

However, moderate heritability estimates were exhibited by Standard Evaluation Score for visual salt injury (56%), days to 50 per cent flowering (39%) and SPAD chlorophyll meter reading (33%). Further, low heritability estimates were registered for harvest index (8%) and plant height (13%). In contrast to the present findings, Karthikeyan *et al*. (2007) reported the low heritability values for productive tillers plant^{-1}.

In the present study, genetic advance expressed as per cent of population mean ranged from 2.05 to 83.08 per cent. High genetic advance expressed as per cent of population mean was observed for Na^+/K^+ ratio (83.08), panicle weight (61.60), number of filled grains panicle^{-1} (50.74), number of productive tillers plant^{-1} (34.28), number of tillers plant^{-1} (30.50), Standard Evaluation Score for visual salt injury (29.01), panicle length (26.62), root/shoot ratio (26.25), grain yield plant^{-1} (25.52), 1000 grain weight (25.15) and number of filled grains panicle^{-1} (20.71). However, moderate genetic advance was reported by SPAD chlorophyll meter reading (10.15), while low genetic advance as percent of mean was expressed by days to 50 per cent flowering (5.27), plant height (2.31) and harvest index (2.05).

The traits harvest index and plant height recorded low heritability and low genetic advance

Table 1. Estimates of variability and genetic parameters among 28 F_2 progenies for yield, its components and physiological traits under saline soil conditions

S.No.	Character	Mean	Range	Coefficients of variation		Heritability (%) (bs)	Genetic advance (GA)	Genetic advance as percent of Mean (%)
				Genotypic (%)	Phenotypic (%)			
1.	Plant height (cm)	105.59	91.93 – 117.70	3.07	8.42	13	2.44	2.31
2.	Days to 50% flowering	105.46	94.00 – 115.67	4.08	6.51	39	5.55	5.27
3.	No. of tillers plant^{-1}	7.83	4.33 – 11.33	19.01	24.40	61	2.39	30.50
4.	No. of productive tillers plant^{-1}	6.02	3.67 – 8.67	21.03	26.59	63	2.06	34.28
5.	Panicle length(cm)	18.31	12.90 – 23.03	15.99	19.79	65	4.87	26.62
6.	Panicle weight (g)	2.12	0.97 – 3.24	32.14	34.55	87	1.31	61.60
7.	No. of filled grains panicle^{-1}	101.05	51.02 – 155.3	26.69	28.92	85	51.27	50.74
8.	Spikelet fertility(%)	67.33	52.63 – 78.93	11.99	14.30	70	13.95	20.71
9.	1000-grain weight (g)	17.75	13.68 – 21.54	13.14	14.14	86	4.46	25.15
10.	Grain yield (g plant^{-1})	12.58	2.63 – 24.22	48.25	52.03	86	11.60	25.52
11.	SES for visual salt injury	4.38	2.94 – 6.02	18.87	25.28	56	1.27	29.01
12.	Root/shoot ratio	0.44	0.31 – 0.57	15.09	17.86	71	0.12	26.25
13.	Harvest Index (%)	39.38	31.07 – 43.90	3.60	13.05	8	0.81	2.05
14.	Na^+/K^+ ratio	1.70	0.54 – 3.11	43.55	47.02	86	1.41	83.08
15.	SPAD chlorophyll meter reading	37.28	26.60 – 42.27	8.57	14.91	33	3.78	10.15

as per cent of mean, while moderate heritability and low genetic advance observed for SPAD chlorophyll meter reading and days to 50 per cent flowering indicating that they are highly influenced by the environment and selection may not be effective to improve these characters under saline conditions.

The high heritability estimates of number of total tillers plant^{-1}, number of productive tillers plant^{-1}, panicle length, panicle weight, number of filled grains panicle^{-1}, spikelet fertility per cent, 1000-grain weight, grain yield plant^{-1} and SES for visual salt injury, Na^+/K^+ ratio coupled with high genetic advance as per cent of mean indicated that these characters are more amenable for selection as they appeared to be predominantly controlled by additive gene effects and are found to be least influenced by environment. Similarly, high heritability coupled with high genetic advance for number of filled grains panicle^{-1} and grain yield plant^{-1} was reported by Karthikeyan *et al. (*2010). High heritability and moderate genetic advance for days to 50 per cent flowering, panicle length and 1000-grain weight was observed by Thirumeni and Subramanian (1999) and Seetharam *et al.* (2009), while high heritability and low genetic advance was reported for 1000-grain weight, panicle length and grain yield plant^{-1} by Das *et al.* (2001) and Karthikeyan *et al. (*2010), while Sundaram *et al.* (1988) and Ravindra Babu (1996) also reported high heritability and high genetic advance for number of filled grains panicle^{-1}, dry matter production plant^{-1}, grain yield plant^{-1} and productive tillers plant^{-1}.

Therefore, it would be rewarding to lay due emphasis on the selection of plants with more number of total as well as productive tillers plant^{-1}, longer panicle, higher panicle weight, more number of filled grains panicle^{-1}, higher spikelet fertility per cent, 1000-grain weight, grain yield plant^{-1} and low SES for visual salt injury and Na^+/K^+ ratio for rapid improvement of grain yield under saline conditions.

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