GENETIC VARIABILITY AND HERITABILITY STUDIES IN RICE (*ORYZA SATIVA L.*) UNDER SALINE CONDITION

Vanave P.B.*, Vaidya G. B., Dapke J.S., Narawade A.V. and Jadhav B.D.

Department of Genetics and Plant Breeding, Navsari Agricultural University, Navsari
Email: pbvanave@gmail.com

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Abstract: Genetic parameters of variability and heritability of different characters were studied in 17 genotypes of rice. The coefficient of variation was highest for plant height followed by grain yield. The maximum genotypic coefficient of variability and phenotypic coefficient of variability were observed for Na^+/K^+ ratio, straw yield^{-1}, proline content, test weight. The heritability estimates were highest for Na+/K^+ ratio, plant height and chlorophyll content. GA as % over mean were higher for Na^+/K+ ratio, chlorophyll content, proline content, straw yield plant^{-1} and test weight. Results on yield and contributing characters possesses sufficiently high values of heritability and genetic adavance which can be utilized for further improvement of rice and evolving a high yielding saline tolerant variety.

Keywords: Rice, Coastal salinity, Variability, Heritability

INTRODUCTION

Rice (*Oryza sativa* L.) occupies a pivotal place in the Indian agriculture. Rice is also called as the "Grain of Life" because it is not only the staple food for more than 70 per cent of the Indians but also a source of livelihood for about 120-150 million rural households. Rice has been grown under diverse ecological conditions and gets exposed to different environmental stresses like salinity, alkalinity, drought, cold etc. Soil alkalinity and salinity are widespread problems in a number of rice growing countries, particularly in Asian continent. Among the South Asian countries, India has the largest area of about 13.3 million ha, followed by Bangladesh and Sri Lanka. In India alone, 6.7 million ha is characterized by coastal salinity, and inland alkaline and saline soils cover an area of about 6.6 million ha (2.64 million ha saline and 3.96 million ha saline alkaline) (Anon., 2003).

Variation is the basis of plant breeding. As success of any crop improvement programme largely depends on the magnitude and range of variability on the available genetic stock. A critical estimate of genetic variability is a prerequisite for initiating appropriate breeding procedures in crop improvement programmes. Hence, it becomes necessary to spilt over-all variability into its heritable and nonheritable components with the help of certain genetic parameters, which may enable the breeders to plan a proper breeding programme. Therefore, the progress of a population mainly depends upon the amount and magnitude to genotypic variability present in the population. Information of genetic variability among growth as well as yield components in rice has been reported by many workers (Sivasubramanian and Madhava Menon, 1973; Latif and Zamin 1965). In this regard identification and evaluation of salt tolerant genotypes of rice was undertaken with objective to study genetic variability under coastal salinity condition that would be economical to the farmers in increasing their production.

MATERIAL AND METHOD

The material for the present study consisted of 17 genotypes of rice. Field experiment was conducted at Coastal Soil Salinity Research Station, Danti, Gujarat. The experiment laid out in Randomized Complete Block Design (RCBD) with three replications. All cultural practices followed as per the package of practices adopted for irrigated rice. Soil samples from all the three replications collected and they analyzed for parameters such as pH, electrical conductivity using standard procedures.

Observations were recorded on five randomly selected plants in each replication for plant height, days to 50 per cent flowering, productive tillers plant^{-1}, panicle length, spikelets panicle^{-1}, spikelet fertility (%), days to maturity, L/B ratio, proline content, chlorophyll content, Na^+/K^+ ratio, thousand grain weight, harvest index, grain yield and straw yield plant^{-1}. Using data for the above traits were subjected to statistical analysis *viz.*, analysis of variance done by Singh and Chaudhary (1985), Genotypic variance determined by formula given by Burton (1952), coefficient of variation estimated as suggested by Burton (1952), heritability in broad scene was computed by formula suggested by Johnson *et al.* (1955) and expected genetic advance was estimated as suggested by Allard, 1960

RESULT AND DISCUSSION

The coefficient of variation was estimated as suggested by Burton (1952), Expected genetic advance was estimated as suggested by Allard; 1960. Analysis of variance showed highly significant differences due to treatments for all the characters. In general estimates of phenotypic coefficient of

*Corresponding Author

variability (PCV) were higher than those due to genotypic coefficient of variability for all characters (Table 1). Similar results were also reported by (Das *et al*., 2001 and Majumdar *et al*., 1971). The phenotypic coefficient of variation (PCV) in general was higher than genotypic coefficient of variation (GCV) for all the characters studied indicated the influence of environment on the manifestation of these characters. However, the difference between PCV and GCV was less for the characters *viz*; days to fifty percent flowering, plant eight, L/B ratio, days to maturity and Na^+/K^+ ratio, which indicated low environmental influence and predominance of genetic factors controlling variability in these traits.

The genotypic coefficient of variability was found maximum for Na^+/K^+ ratio followed by straw yield plant^{-1}, proline content and chlorophyll content. The lowest variability was observed for the characters *viz*; days to fifty percent flowering, days to maturity and spikelet fertility percent.

The amount of genetic variation considered alone will not be of much use to the breeder unless supplemented with the information on heritability estimate, which gives a measure of the heritable portion of the total variation. It has been suggested by Burton and Devane (1953) that the GCV along with heritability estimate could provide a better picture of the amount of advance to be expected by phenotypic selection. Since genetic advance is dependent on phenotypic variability and heritability in addition to selection intensity, the heritability estimates in conjunction with genetic advance will be more effective and reliable in predicting the response to selection (Johnson *et al*., 1955). Heritability in broad sense includes both additive and non-additive gene effects (Hanson *et al*., 1956). While, narrow sense heritability includes only additive components (Johnson *et al*., 1955). In the present study, heritability was found highest in all the characters. High heritability were observed for Na^+/K^+ ratio followed by plant height, chlorophyll content, 1000-grain weight, length / breadth ratio, days to maturity and proline content. Burton (1952) suggested that the genetic coefficient of variation along with heritability give clear picture of the amount of advance to be accepted from selection.

In the present studies, the character viz. chlorophyll content grain yield plant^{-1}, proline content, LB ratio, Na^+/K^+ ratio, panicle length and number of productive tillers plant^{-1} had high heritability values but exhibited low genetic advance. Similar result for length of panicle and 1000-grain weight was reported earlier Das *et al*. (2001) and Karthikeyan *et al.*(2010) for grain yield plant^{-1} productive tillers plant^{-1} and panicle length. High heritability coupled with genetic advance can be more useful in selection types with such characters. A relative comparison of heritable estimates and expected genetic advance expressed as percentage of mean will give an idea about the nature of gene action governing a particular character. A comparison of heritability and genetic advance as percentage of mean revealed that chlorophyll content, grain yield plant^{-1}, plant height, proline content, Number of spikelets panicle^{-1} 1000-grain weight, Na^+ to K^+ ratio and straw yield plant^{-1} had high heritability coupled with high expected genetic advance as percentage of mean. Abdul *et al.* (2011) also observed higher broad sense heritability for number of spikelekts per panicle, 1000 rain weight and total biomass. This showed the substantial contribution of additive genetic variance in the expression of these characters. These substantial contribution of additive genetic variance were in confirmation with earlier report of Johnson *et al*., (1955) while number of fertile florets/ panicle and grain yield /plant had high heritability coupled with high expected genetic advance as percentage of mean were also observed by Shivani and Sreeramareddy (2000).

Johnson *et al.*, 1955 suggested that heritability estimates coupled with genetic advance are more helpful than the heritability value alone. This is because heritability estimates subject to genotype environment interactions. Furthermore genetic advance gives extent stability and genetic progress for particular traits under suitable selection system.

On the basis of heritability estimates and expected genetic advance as percentage of mean for different characters studied in the present studies, selection criteria based on chlorophyll content, grain yield plant^{-1}, plant height, proline content, number of spikelets panicle $^{-1}$, 1000-grain weight, Na^+/K^+ ratio, and straw yield plant^{-1} will be useful for further improvement of rice and evolving a high yielding saline tolerant variety.

Table 1. Estimates of different genetic parameters in rice.

Parameter	CHL	DFF	GY	PH	PRO	SPF	SPIKE	TW	LB	Maturity	HI	NA/K	SY	PL	PT
Mean	0.46	98.33	20.41	110.59	0.65	72.74	132.51	23.54	2.77	128.06	47.47	1.77	22.74	22.68	13.07
GCV%	16.63	4.00	12.84	12.03	17.06	5.24	12.87	16.15	9.08	4.40	9.37	40.07	17.26	8.31	9.30
PCV%	17.10	4.48	15.18	12.30	18.40	7.21	14.79	17.09	9.69	4.71	10.21	40.25	18.94	9.44	10.92
Heritability	94.64	79.94	71.57	95.63	85.94	52.85	75.68	89.26	87.82	87.18	84.17	99.13	83.10	77.53	72.60
GA	0.15	7.25	4.57	26.79	0.21	5.71	30.56	7.40	0.49	10.83	8.41	1.45	7.37	3.42	2.13
GA (%mean)	33.33	7.37	22.38	24.23	32.57	7.84	23.07	31.43	17.53	8.46	17.71	82.19	32.42	15.08	16.33
(C.V.)%	4	2	8.1	10.7	6.9	4.9	7.3	5.6	3.4	1.4	4.1	3.8	7.8	4.5	8.2
(C.D.) at 5%	0.03	3.29	2.75	6.36	0.07	6	16.12	2.2	0.16	3.13	3.22	0.11	2.95	1.69	1.58

CHL (µgfw^{-1}) : Chlorophyll content; DFF : Days to fifty percent flowering; GY (g): Grain yield plant^{-1} ; PH (cm): Plant height; PRO (µgfw^{-1}) : Proline content; SPF (%) : Spikelet fertility per cent; SPIKE: Number of spikelets panicle^{-1}; TW (g) : 1000-grain weight; LB : Length to breadth ratio; Maturity : days to maturity; HI (%) : Harvest index; Na^{+}/K^{+} : Na to K ratio; SY(g) : Straw yield plant^{-1}; PL (cm): Panicle length; PT: Productive tillers plant^{-1}.

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