The Andhra Agric. J 59(1):31-34, 2012

Genetic Variability for Yield, Yield Components and Physico- Chemical Characteristics in Rice Genotypes

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ABSTRACT

Phenotypic and genotypic coefficients of variability, broad sense heritability and genetic advance as per cent of mean were studied in 35 genotypes of rice. High values for PCV, GCV, heritability and genetic advance were observed for number of filled grains panicle^{-1}, grain yield (kg plot^{-1}), harvest index (%) and absolute growth at 50-65 DAT and 65-80 DAT. High heritability coupled with high genetic advance as per cent of mean was observed in case of plant height (cm), panicle length (cm), Number of filled grains panicle^{-1}, test weight (g), grain yield (kg plot^{-1}), harvest index (%), kernel length (mm), volume expansion ratio on cooking, protein content of grain and absolute growth rate at both 50-65 DAT and 65-80 DAT indicating additive gene action.

Key words : Genetic advance, Genetic variability,Rice.

Rice (*Oryza sativa* L.) is the most important food crop in south and south east Asian countries particularly in developing countries like India. Rice offers a great wealth of material for genetic studies because of its wide ecological distribution and enormous variation for various morphological and physiological characters. A thorough knowledge on relative magnitude of heritability coupled with nature and extent of variability in the breeding material gives an idea for effective genetic improvement of yield through selection. Heritability (h^2) measures the relative amount of heritable portion of the variability, while genetic advance (GA) indicates the amount of progress that can be expected with selection for a character. High heritability is not always an indication of high genetic gain. Hence, there is a need to estimate genetic advance, which is a relative measure and reliable indication of true genetic gain. High heritability coupled with high genetic advance is more valid for selection than heritability estimates alone.

Grain yield is a complex trait and is the result of many variables. Physico-chemical characters of the rice grain are of prime importance in rice improvement because they determine the cooking, eating and processing qualities of rice and market price. Success of selection in the improvement of a character by systematic breeding methods depends on the extent and nature of variability, heritability and genetic advance in the segregating populations. It is the genetic variability (or) more precisely variability due to additive gene effects and heritability of the character which decide the response to selection in segregating populations. Therefore, the present investigation was under taken to obtain information on magnitude of genetic variability, heritability and genetic advance in rice genotypes.

MATERIAL AND METHODS

Thirty five rice genotypes were raised in a randomized complete block design with three replications during *kharif* 2009-10 at Agricultural College Farm, Bapatla. The inter and intra-row spacing adapted was 20cm x 15cm. Each plot consisted of ten rows of 5m length and observations were recorded on ten randomly selected plants from each plot in each replication for characters *viz*., plant height (cm), days to 50% flowering, absolute growth rate (AGR), number of ear bearing tillers /m^2, panicle length (cm), number of filled grains panicle^{-1}, test weight (g), grain yield (kg plot^{-1}), harvest index (%), grain length (mm), grain breadth (mm), kernel length (mm), kernel breadth (mm), volume expansion ratio on cooking, head rice recovery, milling (%), hulling (%) and protein content of the grain (%).

The mean values were used for analysis of variance as per the method given by Cochran and Cox (1950). Phenotypic and genotypic coefficients of variation (PCV and GCV) were computed according to Burton (1952), while heritability in

Table 1. Analysis of variance for yield and yield components among 35 genotypes of rice (*Oryza sativa* L.)

Source	Replications	Treatments	Error
Degrees of freedom	2	34	68
	MEAN SQUARES		
Plant height cm	7.0187	716.6116**	61.9595
Days to 50% flowering	6.4667	280.8387**	5.5941
No. of ear bearing tillers/ m²	96.2809	2522.1484**	161.0579
Panicle length (cm)	12.9100	29.1711**	4.9179
No. of filled gains/ panicle	276.0145	3506.2456**	128.5454
Test weight (g)	0.5783	38.4960**	0.6082
Grain yield (*kg/ Plot)	0.0211	4.3629*	0.2036
Harvest index (%)	6.7106	408.3675**	29.3236
Grain length (mm)	0.4502	1.5229	0.4903
Grain breadth (mm)	0.0088	0.1430	0.0372
Kernel length (mm)	0.0320	1.1478	0.0373
Kernel breadth (mm)	0.0114	0.1398	0.0216
Hulling (%)	151.6524	98.6429**	60.9488
Milling (%)	25.2655	44.5532**	8.8394
Head rice recovery	93.9942	77.9177**	31.0002
Volume expansion ratio	0.0152	1.8926*	0.1238
Protein content of grain	0.6516	3.4869*	0.3282
Absolute growth rate 50-65 DAT	0.0362	0.8639	0.0124
Absolue growth rate 65-80 DAT	0.0079	1.3072	0.0102

*=significant at 5% level (0.193), **= significant at 1% level (0.252)

broad sense was worked out according to the formula given by Allard (1960). Genetic advance was estimated as per the formula proposed by Lush (1940) and Johnson *et al.* (1955).

RESULTS AND DISCUSSION

The analysis of variance (Table 1) indicated significant differences among the genotypes for all characters except grain length (mm), grain breadth (mm), kernel length (mm), kernel breadth (mm) and absolute growth rate (AGR) indicating the presence of genetic variability in the material. The estimates of range, mean, phenotypic and genotypic coefficients of variability for each character indicated a substantial variation among the 35 genotypes (Table 2). High values for PCV, GCV were observed for number of filled grains panicle^{-1}, grain yield (kg plot^{-1}), harvest index (%) and absolute growth at 50-65 DAT and 65-80 DAT indicating the presence of wider variability for these traits in the genotypes studied . High heritability coupled with high genetic advance as per cent of mean was observed in case of plant height (cm), panicle length (cm), number of filled grains panicle^{-1}, test weight (g), grain yield (kg plot^{-1}), harvest index (%), kernel length (mm), volume expansion ratio on cooking, protein content of grain and absolute growth rate at both 50-65 DAT and 65-80 DAT. These results were in accordence with Suman *et al.* (2005), Rita Bisne *et al.* (2006), Neelima *et al.* (2007) and Sobitha Devi *et al.* (2006). Moderate heritability estimates were obtained for grain length, grain breadth, milling (%) and head rice recovery indicating their

Table 2. Mean, variability, heritability and genetic advance as per cent of mean for yield and yield components in rice (*Oryza sativa* L.).

Character	Mean	Range		Coefficient of variation (%)		Heritability (%) (broad sense)	Genetic advance as percent of mean (5%level)
		Minimum	Maximum	PCV	GCV		
Plant height (cm)	84.71	61.07	121.66	19.76	17.44	77.89	31.70
Days to 50% flowering	99.43	76.00	118.00	9.92	9.63	94.25	19.26
No. of ear bearing tillers/ m²	282.06	241.10	349.79	10.92	9.95	83.01	18.67
Panicle length (cm)	20.82	15.30	28.46	17.31	13.65	62.18	22.18
No. of filled grains/ panicle	146.37	72.60	245.46	24.20	22.92	89.75	44.74
Test weight (g)	19.64	13.33	27.64	18.52	18.09	95.41	36.39
Grain yield (*kg/Plot)	5.58	3.92	9.96	22.59	21.10	87.20	40.58
Harvest index (%)	46.39	18.63	74.56	26.89	24.23	81.16	44.97
Grain length (mm)	8.29	6.84	9.76	11.01	7.07	41.25	9.36
Grain breadth (mm)	2.32	1.94	2.86	11.57	8.08	48.70	11.61
Kernel length (mm)	5.90	4.87	7.08	10.80	10.30	90.86	20.22
Kernel breadth (mm)	1.98	1.56	2.37	12.44	10.00	64.65	16.57
Hulling (%)	75.72	61.82	86.10	11.32	4.68	17.09	3.99
Milling (%)	86.71	77.13	93.99	5.25	3.98	57.39	6.21
Head rice recovery	61.66	44.63	68.97	11.07	6.41	33.53	7.65
Volume expansion ratio	4.00	3.13	7.32	21.07	19.15	82.64	35.87
Protein content of grain	6.80	3.80	9.52	17.27	15.08	76.24	27.12
Absolute growth rate 50-65 DAT	1.23	0.30	2.73	44.23	43.29	95.80	87.28
Absolute growth rate 65-80 DAT	1.06	0.02	2.89	62.26	61.54	97.70	125.32

PCV= Phenotypic coefficient of variation GCV= Genotypic coefficient of variation

importance in breeding programme. Similar results were also reported earlier by Singh *et al.,* (2005) and Satish Chandra *et al.,* (2009) in rice. The genetic advance with heritability is more important than heritability alone in predicting the genetic gain and to decide suitable breeding methodology.

The estimates for heritability and genetic advance were in general high for the traits, plant height (cm), panicle length (cm), number of filled grains panicle^{-1}, test weight (g), grain yield (kg plot^{-1}), harvest index (%), kernel length (mm), volume expansion ratio on cooking, protein content of grain and absolute growth rate at both 50-65 DAT and 65-80 DAT in these genotypes populations suggested that these are simple inherited traits governed by a few major genes. Additive gene effects play an important role in the inheritance of these traits even if they are under polygenic control. In the segregating populations also selection for plant height (cm), panicle length (cm), number of filled grains panicle^{-1}, test weight (g), grain yield (kg plot^{-1}), harvest index (%), kernel length (mm), volume expansion ratio on cooking, protein content of grain and absolute growth rate at both 50-65 DAT and 65-80 DAT would be quite effective. The traits *viz.,* days to 50% flowering, number of ear bearing tillers m^{-2} and kernel breadth (mm) exhibited high heritability with moderate genetic advance as per cent of mean revealing the role of both additive and non-additive gene actions in controlling these traits. Hence exploitation of additive and non-additive components of variation by recurrent selections and biparental matings for the improvement of such traits are recommended.

In the present study differences in the estimates of various genetic parameters among 35 rice genotypes was observed and these differences were attributed to the differences in the genetic structure of the populations. So, the selection might not be equally effective in improving the similar traits in all the 35 genotypes studied.

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(Received on 31.03.2011 and revised on 21.04.2011)