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ASSESSMENT OF GENETIC VARIABILITY AND CORRELATION STUDIES AMONG TRADITIONAL LAND RACES AND IMPROVED CULTIVARS FOR SEGREGATING GENERATIONS OF RICE (*ORYZA SATIVA* L.)

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ABSTRACT
Rice (*Oryza sativa* L.) being most important food crop for more than 2 billion people in Asia, provides 27% of dietary energy and 20% of overall dietary protein (Bashir *et al*., 2007). The experimental material used were four traditional land races and six improved high yielding varieties of Tamil Nadu raised in non replicated plots during Kharif 2012-14. In this study six crosses of F_1 generation were advanced to F_2 and F_3 segregating generations for variability, heritability and genetic advance of rice genotypes. Among the six crosses studied, best two crosses, IR 72 x Veeradangan and ADT 39 x Kavuni exhibited superior *per* se performance in both F_2 and F_3 generations for almost all the economic characters studied including yield. The F_2 and F_3 populations of the IR 72 x Veeradangan and ADT 39 x Kavuni showed moderate PCV, GCV coupled with high heritability estimates and high genetic advance as percentage of mean for number of productive tillers per plant, number of filled grains per panicle and single plant yield. These populations could well be subjected to simple pure line selection to improve single plant yield. Single plant yield was found to be positively and significantly correlated with all the yield contributing characters at genotypic levels indicating the importance of these characters for yield improvement in segregating population.

KEY WORDS: Rice, Genetic variability, Heritability, Genetic advance, Correlation.

INTRODUCTION

Rice (*Oryza sativa* L.), a member of poaceae family, is the major food crop of more than half of the global population and will continue to occupy the pivotal place in global food and livelihood security systems (Singh and Singh, 2008). Traditional rice varieties or landraces, have a high level of genetic heterogeneity compared to modern cultivars. Landraces comprise of the unique source for gene of high adaptability but are poor yielders. Therefore, it is an indispensable demand for varietal improvement in such situation. To formulate a sustainable breeding program precise knowledge about genetic divergence for yield components is a crucial one as varietal improvement depends mainly on the selection of parents with high genetic divergence in hybridization. Crop improvement for specific trait has been achieved through effective use of F_2 and F_3 segregating population and fixing desirable combinations. Therefore, the present investigation was undertaken to estimate the genetic variability for F_2 and F_3 segregating generations for selected two crosses and correlation studies in F_3 generation for six crosses. The knowledge regarding relative contribution of individual traits to yield may be accomplished by correlation studies. However, simple correlation does provide the adequate information about the contribution of each factor towards yield. The present investigation was undertaken to gather some useful information of genetic variability and character association in selected crosses F_2 and F_3 segregating generation.

MATERIALS & METHODS

The present investigation was carried out during 2012 to 2014 using the experimental material consisting of five generations including P_1, P_2, F_1, F_2 and F_3. The experimental material consisted of four medicinal landraces *viz.*, Veeradangan, Kavuni, Kathanellu and Navara which were collected from Tamil Nadu and Navara is a medicinal landrace of Kerala these landraces are having superior nutritional grain qualities and low yielder and six improved semi-dwarf high yielding varieties *viz.*, IR 72, ADT 39, ADT 45, ASD 16 and TPS 4 of medium grain quality along with standard check ADT 43 by adopting a spacing of 30 x 10 cm at Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Madurai during Kharif 2012-14. P_1, P_2 and F_1s of six cross combinations were transplanted in Randomised Block Design with three replication. F_2 and F_3 of six crosses were raised in non replicated plots. Single seedling per hill was planted with a spacing of 15 x 10 cm. Recommended agronomic practices were followed throughout the crop growth period. Among the six crosses studied, IR 72 x Veeradangan and ADT 39 x Kavuni exhibited superior *per* se performance for biometrical traits in both F_2 and F_3 generations for almost all the economic characters studied including yield. Data were recorded 10 plants for replication in parents for 200 and 250 plants in F_2's and F_3's respectively for days to 50 per cent flowering (days), plant height (cm), number of productive tillers per plant, number of filled grains per panicle, hundred grain weight (g) and single yield per plant (g) in single plant observation. The mean data for

each character individually was subjected to statistical analysis. Standard statistical procedures were used for the analysis of mean variance, genotypic and phenotypic coefficients of variation (Burton, 1952), heritability (Lush, 1940) and genetic advance. Coefficient of correlation was determined using the technique outlined by Dewey and Lu (1959).

RESULTS & DISCUSSION

The potentiality of a cross is measured not only by mean performance but also on the extent of variability. Knowledge on nature and magnitude of genotypic and phenotypic variability present in any crop species plays an important role in formulating successful breeding programmes (Allard, 1960). Sivasubramanian and Mathavamenon (1973) also highlighted the importance of variability in early segregating generations and suggested that magnitude of genotypic coefficient of variability and phenotypic coefficient of variability should be given importance. Jennings *et al.* (1979) suggested that crosses which will realise early homozygosity are ideally suited for further breeding work. The paper deals with high variability among the six crosses studied, selected IR 72 x Veeradangan and ADT 39 x Kavuni crosses exhibited superior *per* se performance for biometrical traits in both F_2 and F_3 generations (Table 1 & 2) (Fig 1 & 2). Among the two crosses studied in F_2 generation, ADT 39 x Kavuni revealed a wide range of variability for days to 50 per cent flowering and it ranged from 90 to 113 days. In F_3 generation, ADT 39 x Kavuni registered the widest range of variability followed by IR 72 x Veeradagan. Heritability estimates were high in IR 72 x Veeradagan except ADT 39 x Kavuni. . For the trait days to 50 per cent flowering in moderate heritability in ADT 39 x Kavuni in F_2 and F_3 population, while the genetic advance as per cent of mean was low in both the crosses of F_2 and F_3 population. High heritability with low genetic advance was reported by Singh *et al.* (2006). Among the two crosses studied in F_2 generation ADT 39 x Kavuni revealed a wide range of variability for plant height and it ranged from 98.50 to 139.60 cm. In F_3 generation, IR 72 x Veeradagan registered the widest range of variability followed by ADT 39 x Kavuni. IR 72 x Veeradagan and ADT 39 x Kavuni exhibited moderate genetic advance as per cent of mean in both the population (Table 2 and Fig. 2). High heritability with moderate genetic advance was observed in IR 72 x Veeradagan, ADT 39 x Kavuni of F_2 and F_3 population which indicates non-additive gene action. ADT 39 x Kavuni in F_2 revealed a wide range of variability for number of productive tillers per plant. High heritability combined with high genetic advance as per cent of mean was observed in two crosses. In respect to number of productive tillers per plant high heritability with high genetic advance as per cent of mean was recorded for two crosses of F_2 and F_3 population. These results were in accordance with the earlier findings of Anilkumar (2008) and Sangeetha (2013). The aforesaid points revealed additive gene action and showed the possibility of selection *per se* in these crosses for the improvement of number of productive tillers per plant.

In F_2 population, variability in panicle length was found to be maximum in IR 72 x Veeradagan (19.62 cm to 28.51 cm). In F_3 population for ADT 39 x Kavuni, recording the maximum variability for panicle length (29.81 cm). Phenotypic and genotypic coefficients of variations were low in two crosses of F_2 and F_3 population. Two crosses exhibited high heritability in both the population. Two crosses exhibited low genetic advance as per cent of mean except ADT39 x Kavuni showed moderate genetic advance as per cent of mean in F_2 and F_3 population. High heritability with high genetic advance as per cent of mean was observed in ADT 39 x Kavuni of F_2 and F_3 population, it indicates non additive gene action and similar findings were reported by Koutu (2013). ADT 39 x Kavuni revealed the maximum range of variability for number of filled grains per panicle in both the population. The mean number of filled grains per panicle was high in IR 72 x Veeradagan (121.22) in F_2 population. The two crosses exhibited high heritability with high genetic advance as per cent of mean in F_2 and F_3 in both the population. That the trait was under the control of additive gene action and this was in accordance with Sala (2012) and Sangeetha (2013). Hence selection for this trait was effective for improvement through selection. The range of variability in F_2 population for hundred grain weight was maximum in IR 72 x Veeradagan (2.04 g to 3.73 g) in F_2. The heritability estimates were high in two crosses. IR 72 x Veeradangan, ADT 39 x Kavuni exhibited moderate genetic advance as per cent of mean. High heritability along with high genetic advance was seen for hundred grain weight indicating predominance of additive gene action and less environmental effect (Chauhan and Chauhan, 1994). These results were in accordance with Nandeshwar *et al.* (2010) and Sangeetha (2013). A wide range of single plant yield was observed in IR 72 x Veeradagan (21.46 g to 61.15 g) and F_3 (16.24 g to 59.24 g) followed by ADT 39 x Kavuni. The two crosses exhibited high heritability with high genetic advance as per cent of mean in F_2 and F_3 population. High heritability with high genetic advance as per cent of mean was observed in IR 72 x Veeradagan, ADT 39 x Kavuni. Moderate heritability along with moderate genetic advance was reported by Bharadwaj *et al.* (2007) in F_2 generation which indicates that the trait was highly controlled by additive gene effect which can be further improved through mass selection. Single plant yield is a complex trait influenced by the other component characters. A knowledge on the association between single plant yield and other biometrical traits and also among the component traits helps in improving the efficiency of selection. The idea about the nature of association will be useful to identify the key characters for which selection can be successfully made. In the present study, the simple correlation coefficients between single plant yield and contributing characters and inter correlation among yield components in F_3 generation of six crosses (Table 3).

Positive and significant direct correlation of single plant yield with number of productive tillers per plant (0.353), panicle length (0.413) and number of filled grains per panicle (0.586) was observed in F_3 population. Days to 50 per cent flowering had positive and significant inter correlation with plant height (0.167) and hundred grain weight (0.213) while, negative inter correlation with number of filled grains per panicle (-0.180).

TABLE 1. Genetic variability parameters for different quantitative traits for IR 72 x Veeradangan in F_2 and F_3 generation of rice

Characters	Generation	Mean	Range	PCV (%)	GCV (%)	Heritability (%)	Genetic Advance as % Mean
Days to 50 per cent flowering (days)	F_2	74.97	67-85	5.99	4.91	66.98	8.27
	F_3	79.02	72-93	5.52	4.45	64.93	7.38
Plant height (cm)	F_2	101.07	81.37-119.31	7.11	6.29	78.21	11.45
	F_3	99.46	79.71-115.36	7.08	6.22	77.32	11.28
Number of productive tillers per plant	F_2	14.08	8-19	18.41	16.80	83.30	31.59
	F_3	15.40	12-23	15.93	14.37	81.35	26.70
Panicle length (cm)	F_2	24.96	19.62-28.51	6.08	5.43	79.58	9.98
	F_3	25.22	20.37-27.59	5.85	5.18	78.37	9.45
Number of filled grains per panicle	F_2	121.22	82.49-179.38	20.66	19.95	93.27	39.69
	F_3	119.66	83.29-168.36	13.96	12.87	84.88	24.42
Hundred grain weight (g)	F_2	2.56	2.04-3.73	13.51	10.86	64.66	18.00
	F_3	2.49	2.01-3.25	13.61	10.80	62.94	17.65
Single plant yield (g)	F_2	38.09	21.46-61.15	19.95	16.87	71.56	29.41
	F_3	39.24	16.24-59.24	18.49	15.34	68.81	26.22

TABLE 2. Genetic variability parameters for different quantitative traits for ADT 39 x Kavuni in F_2 and F_3 generation of rice

Characters	Generation	Mean	Range	PCV (%)	GCV (%)	Heritability (%)	Genetic Advance as % Mean
Days to 50 per cent flowering (days)	F_2	104.18	90-113	4.95	3.53	50.86	5.19
	F_3	107.85	97-119	4.61	3.16	47.13	4.47
Plant height (cm)	F_2	126.19	98.50-139.60	6.71	6.31	88.47	12.23
	F_3	123.90	103.08-136.37	6.34	5.90	86.61	11.31
Number of productive tillers per plant	F_2	13.85	8-25	17.02	14.47	72.27	25.35
	F_3	15.19	10-21	15.33	12.97	71.58	22.61
Panicle length (cm)	F_2	24.82	19.06-27.43	8.54	7.89	85.51	15.04
	F_3	26.10	20.12-29.81	8.11	7.50	85.46	14.28
Number of filled grains per panicle	F_2	117.72	74.35-181.24	18.70	17.97	92.40	35.60
	F_3	113.85	78.25-175.23	15.52	14.58	88.22	28.21
Hundred grain weight (g)	F_2	2.28	1.85-2.94	9.49	8.78	85.51	16.72
	F_3	2.30	1.92-2.83	8.66	7.88	82.88	14.78
Single plant yield (g)	F_2	34.88	18.27-56.25	19.30	16.23	70.70	28.11
	F_3	34.78	21.12-48.28	16.68	12.98	60.56	20.82

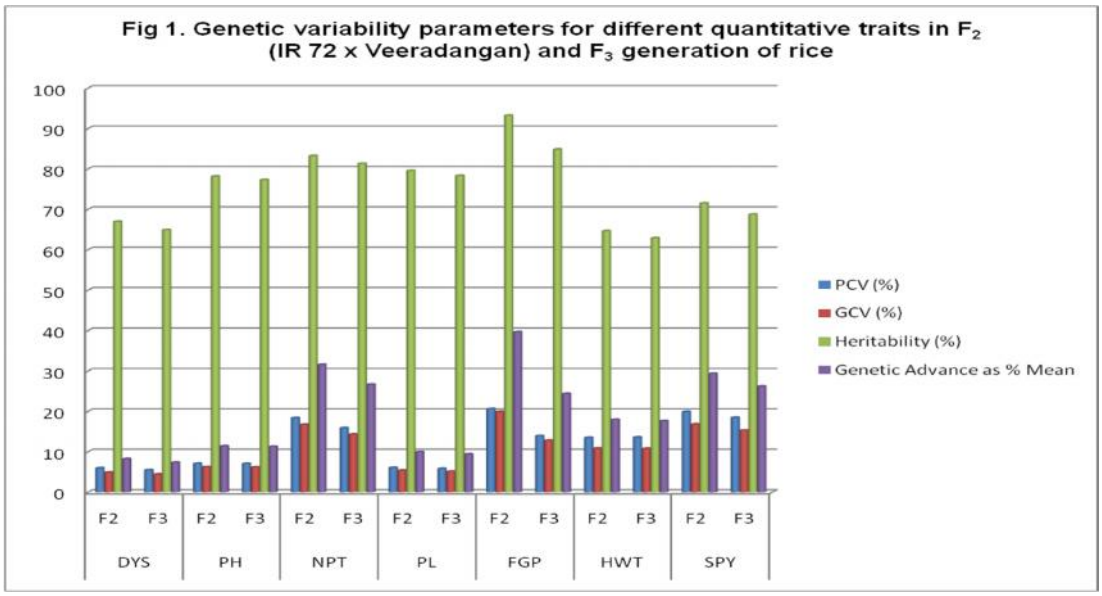
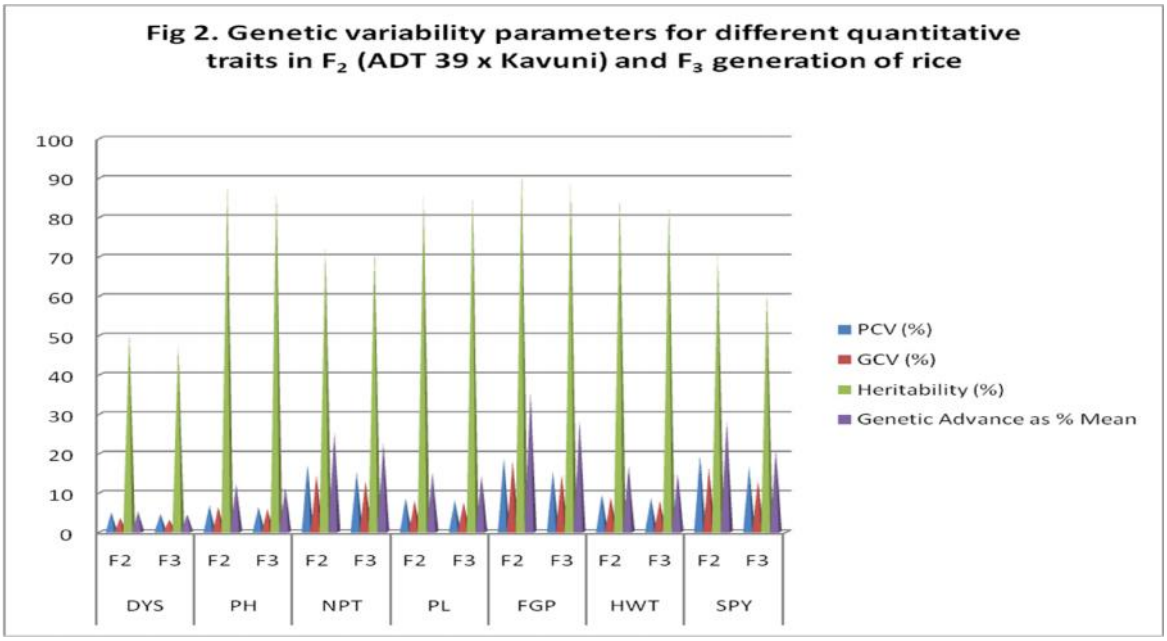


TABLE 3. Simple correlation coefficients for biometrical characters in F_3 generation

Characters	Crosses	PH (cm)	NPT	PL (cm)	NFG	HGW (g)	SPY (g)
DF (days)	Cross 1	0.167**	0.071	0.068	-0.180**	0.213**	-0.171**
	Cross 2	0.134*	- 0.088	-0.167**	0.009	0.011	-0.066
	Cross 3	0.010	0.042	-0.128*	-0.114	-0.008	-0.185**
	Cross 4	-0.154*	0.039	-0.007	-0.207**	-0.095	-0.043
	Cross 5	0.044	0.002	0.156*	0.186**	-0.062	0.034
	Cross 6	0.059	0.234**	-0.002	0.004	0.073	0.101
PH (cm)	Cross 1		-0.060	0.034	-0.120	0.050	-0.152*
	Cross 2		- 0.053	0.101	0.163**	0.016	0.029
	Cross 3		0.260**	0.069	-0.003	0.063	0.225**
	Cross 4		0.088	0.079	0.047	-0.032	0.054
	Cross 5		-0.027	0.127*	0.170**	0.020	0.069
	Cross 6		0.024	-0.077	0.149*	0.151*	0.158*
NPT	Cross 1			0.629**	0.205**	-0.375**	0.353**
	Cross 2			0.425**	0.095	0.323**	0.597**
	Cross 3			0.177**	0.282**	-0.098	0.353**
	Cross 4			0.053	0.194**	-0.010	0.553**
	Cross 5			0.203**	0.216**	0.114	0.442**
	Cross 6			-0.120	0.071	0.242**	0.183**
PL (cm)	Cross 1				0.272**	-0.197**	0.413**
	Cross 2				0.214**	0.229**	0.435**
	Cross 3				0.126*	0.076	0.226**
	Cross 4				-0.009	-0.239**	0.110
	Cross 5				0.032	0.108	0.045
	Cross 6				0.040	0.162**	0.003
FGP	Cross 1					-0.146*	0.586**
	Cross 2					0.089	0.415**
	Cross 3					0.011	0.546**
	Cross 4					0.070	0.550**
	Cross 5					0.086	0.590**
	Cross 6					0.214**	0.416**
HGW (g)	Cross 1						0.070
	Cross 2						0.359**
	Cross 3						0.201**
	Cross 4						0.033
	Cross 5						0.224**
	Cross 6						0.384**

***** Significant at 5 % level ** Significant at 1 % level.



Number of productive tillers per plant showed positive significant association with panicle length (0.629) and number of filled grains per panicle (0.205). Number of productive tillers per plant (-0.375) exhibited negative significant correlation with hundred grain weight (-0.375). Panicle length showed positive correlation was observed for number of filled grains per panicle (0.272) whereas negative and significant correlation with hundred grain weight (-0.197). Number of filled grains per panicle showed negative inters correlation with hundred grain weight (-0.146). Similar association have already been reported for days to 50 per cent flowering with plant height, number of filled grain per panicle and hundred grain weight by Sala (2012). Number of productive tillers per plant (0.597), panicle length (0.435), number of filled grains per panicle (0.415) and hundred grain weight (0.359) showed positive significant direct association with single plant yield in F_3 population. Days to 50 per cent flowering showed positive inter correlation with plant height (0.134), while it showed negative inter correlation with panicle length (-0.167). Plant height showed positive inters correlation with number of filled grains per panicle (0.163). Number of productive tillers per plant exhibited a strong positive inter correlation with panicle length (0.425) and hundred grain weight (0.323). Panicle length showed positive and significant correlation with number of filled grains per panicle (0.214) and hundred grain weight (0.229). The results of present investigation were in accordance with Selvaraj *et al.* (2011) for number of productive tillers per plant, panicle length by Rao *et al.* (2010), Nandan *et al.* (2010) for number of filled grain per panicle, Muthuvijayaragavan (2012) for hundred grain weight

Plant height (0.225), number of productive tillers per plant (0.353), panicle length (0.226), number of filled grains per panicle (0.546) and hundred grain weight (0.201) had positive significant correlation with single plant yield in F_3 population. Days to 50 per cent flowering showed negative inter correlation with panicle length (-0.128). Plant height showed positive significant association with number of productive tillers per plant (0.260). Number of productive tillers per plant had positive significant association with panicle length (0.177) and number of filled grains per panicle (0.282). Panicle length had positive inter correlation with number of filled grains per panicle (0.126). These results were in coincidence with the findings of Malarvizhi *et al.* (2010) for hundred grain weight. Number of productive tillers per plant (0.553) and number of filled grains per panicle (0.550) showed positive significant correlation with single plant grain yield in F_3 population. Days to 50 per cent flowering showed negative and significant association with plant height (-0.154) and number of filled grains per panicle (-0.207). Number of productive tillers per plant had positive inter correlation with number of filled grains per panicle (0.194). Panicle length exhibited negative inter correlation with hundred grain weight (-0.239). Number of productive tillers per plant (0.442), number of filled grains per panicle (0.590) and hundred grain weight (0.224) exhibited positive and significant correlation with single plant yield. Days to 50 per cent flowering showed positive and significant association with panicle length (0.156) and number of filled grains per panicle (0.186). Plant height showed positive significant association with panicle length (0.127) and number of filled grains per panicle (0.170). Number of productive tillers per plant exhibited a positive and significant inter correlation with panicle length (0.203) and number of filled grains per panicle (0.216). Number of filled grains per panicle (0.416) and hundred grain weight (0.384) showed positive and significant correlation with single plant yield in F_3 population. Days to 50 per cent flowering showed positive and significant association with number of productive tillers per plant (0.234). Plant height showed positive and significant association with number of filled grains per panicle (0.149) and hundred grain weight (0.151). Number of productive tillers per plant depicted positive and significant inter correlation with hundred grain weight (0.242). Panicle length expressed positive inter correlation with hundred grain weight (0.162).

Number of filled grains per panicle had positive and significant correlation with hundred grain weight (0.214). Positive and significant association between number of filled grains per panicle and single plant yield was recorded in all the crosses. The present investigations revealed that, number of filled grains per panicle showed positive and significant inter correlation with hundred grain weight in TPS 4 x Katha nellu. These results were in agreement with Prasad *et al.* (2009). From the above discussion, it was concluded that the characters *viz.,* panicle length, number of filled grains per panicle and hundred grain weight had positive and significant correlation with single plant yield in almost all the six crosses. Therefore selection pressure exerted on positive side of these traits will automatically result in increased single plant yield. From the correlation studies it was clear that the crosses IR 72 x Veeradangan, ADT 39 x Kavuni were having significant correlation for more than four characters with single plant yield. Selection pressure exerted on positive side of these traits will automatically result in increased single plant yield. So, these crosses can be forwarded for further generations. These lines have been actively utilized in further breeding program.

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