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GENETIC VARIABILITY, INTERRELATIONSHIP AND PATH ANALYSIS OF YIELD AND YIELD CHARACTERS IN EARLY MATURING INDICA AND JAPONICA RICE GENOTYPES

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ABSTRACT

Indicas were characterised by greater values of mean, range and variance components for yield and yield characters. The GCV was the highest for grains per panicle followed by tiller number, culm length and seedling height in both indicas and japonicas. The genetic advance was also high for those characters with high variability. Both additive and non-additive gene actions were important in the expression of characters in both the botanic varieties. Days to 50 per cent flowering, tiller number and panicle length were positively correlated with plant yield in indicas. In japonicas, days to 50 per cent flowering showed a positive association while tiller number showed a negative association with plant yield. Selection for panicle length would serve as the best criterion for plant yield in both indicas and japonicas. Path analysis of yield components showed that seedling height and culm length had considerable direct effect in both indicas and japonicas. In addition, tiller number in indicas and days to 50 per cent flowering in japonicas had positive direct effect.

KEY WORDS : Rice, Variability, Heritability, Correlation.

New genotypes are often collected and evaluated for economically important characters in order to identify genetic stock with desirable genes for use in crop improvement. The present investigation was undertaken with the primary object of assessing the relative genetic worth of indica and japonica rice genotypes in addition to taking up a comparative analysis of genetic variability, inter relationship and path analysis of yield and yield characters in the two botanic varieties of rice.

MATERIALS AND METHODS

Forty early maturing rice genotypes comprising of 24 indica and 16 japonica types constituted the material for the present study. Indicas were represented by genotypes from China (2), India (8), Italy (2), Japan (1), Korea (3), Nepal (2), Philippines (1), Taiwan (2) and U.S.A. (2). Similarly japonicas included genotypes from China (9), Japan (3), Pakistan (1), Romania (2) and U.S.A (1). The experiment was conducted in U.C. Block of IRRI farm puddled condition. Each genotype was grown in six row plots of 5 m. length with a spacing of 30 x 25 cm, adopting a completely randomised block design with two replications. Data were collected on ten random plants as per procedures outlined in descriptors of rice (1980). Standard statistical procedures were followed for calculating the genetic constants, simple correlations and path coefficients (Burton, 1952; Dewey and Lu, 1959 and Johnson *et al.*, 1956.)

RESULTS AND DISCUSSION

Variability, heritability and genetic advance

Indicas were in general characterised by higher values of mean, range and components of variation for characters under study (Table 1). The range of variation for different characters indicated wide differences among the genotypes in indicas as also japonicas. The maximum range of variation was observed for grains

to 50% flowering, seedling height, plant yield, tiller number and panicle length. Analysis of variance showed that the observed differences in the genotypes mostly due to their diverse geographic origin and differential adaptability were highly significant. There was a preponderance of genotypic variation in both indicas and japonicas which were not very much influenced by environmental changes. The phenotypic and genotypic co-efficient of variability was high for grains per panicle, tiller number, plant yield and culm length and moderate for seedling height, panicle length and days to 50% flowering in indicas. In japonicas, it was high for grains per panicle and tiller number, moderate for seedling height and culm length and low for panicle length, plant yield and days to 50% flowering. The extent of genetic variability for yield and yield characters was relatively greater in indicas than japonicas offering scope of improvement through selection and other appropriate breeding methods. High genotypic co-efficient of variability was observed for grains per panicle, tiller number and single plant yield (Battacharyya, 1978; Das and Borthakur, 1974)

The heritability estimates were high for all characters in indica genotypes and selection based on phenotypic values would be effective. High heritability estimates were obtained for all characters

Table 1. Estimates of parameters of variability and genetic advance in indica (I) and japonica (J) rice genotypes.

Details		Seeding height (cm)	Days to 50% flowering	Culm length (cm)	Tiller number	Panicle length (cm)	Grains per panicle	Plant yield (g)
Mean	I	40.5	76.7	94.2	18.6	22.7	108.9	22.4
	J	39.5	63.7	62.7	15.4	18.7	71.0	16.4
Range	I	25.6	34.3	64.8	15.2	12.3	152.5	15.4
	J	14.0	16.5	31.9	10.8	7.5	108.2	6.0
P.V.	I	54.2	64.7	356.5	24.7	9.3	1385.7	26.4
	J	24.1	27.1	74.6	17.6	3.3	963.1	4.0
G.V.	I	53.7	64.3	356.1	20.6	8.6	1338.5	24.4
	J	23.6	26.8	74.1	13.4	2.6	916.8	2.0
P.C.V.	I	18.2	10.4	20.1	26.7	13.5	34.2	22.9
	J	14.4	8.2	13.8	27.3	10.1	43.7	12.1
G.C.V.	I	18.1	10.5	20.0	24.4	12.9	32.6	22.0
	J	14.2	8.1	13.7	23.8	8.9	42.6	8.6
Heritability	I	99.2	99.1	99.1	83.5	92.4	97.2	92.5
	J	98.5	99.1	99.3	76.2	78.3	95.1	50.6
Genetic advance	I	15.0	16.5	38.9	8.5	5.8	74.1	9.8
	J	10.0	10.6	17.7	6.6	2.9	60.7	2.1
Genetic advance as % of mean	I	37.0	21.5	41.3	45.9	25.6	67.9	43.6
	J	29.0	16.6	28.2	42.7	16.2	85.5	12.4

P.V. : Phenotypic variance
G.V. : Genotypic variance
P.C.V. = Phenotypic coefficient of variability
G.C.V. = Genotypic coefficient of variability

except plant yield for which it was moderate in japonicas.

Genetic advance as per cent of mean was high for grains per panicle, tiller number, plant yield, culm length and seedling height and moderate for panicle length and days to 50% flowering in indicas. As against this, the genetic advance as per cent of mean was high for grains per panicle and tiller number, moderate for seedling height and culm length and low for days to 50% flowering, panicle length and plant yield in japonicas (Table 1).

Heritability in conjunction with genetic coefficient of variation would give a more reliable index of selection value (Burton, 1952). Few highly heritable characters such as grains per panicle and tiller number in both indicas and japonicas, had high genetic advance and this indicated that additive effects had a major role in the expression of these characters. The same inference was drawn earlier based on the larger magnitude of genetic coefficient of variability for grains per panicle and tiller number. High heritability of days to 50% flowering and panicle length but with low genotypic coefficient of variability implying the non additive gene action for the characters in japonicas resulted in low genetic advance and hence their response to selection would be poor. Plant yield in japonicas, showed not only low heritability but also low genotypic co-efficient of variability ultimately resulting in low genetic advance. Very little improvement would be possible for plant yield in the present japonica collections. The observed high heritability and moderate genetic advance for panicle length and days to 50% flowering in indicas and seedling height and culm length in japonicas would indicate the importance of both additive and non additive gene action in the control of these characters, also reported by other workers in rice (Singh *et al.*, 1980; Sukanya Subramanian and Rathinam, 1984, Amirthadevarathinam, 1983; Panwar *et al.*, 1983 and Ananda Kumar and Sree Rangasamy, 1984).

Inter-relationship between yield and yield characters in indica and japonica rice genotypes

Each of the three characters viz., days to 50% flowering, tiller number and panicle length was positively and significantly correlated with plant yield in indicas. Days to 50% flowering showed a positively significant association with plant yield in japonicas. The correlation between tiller number and plant yield was significant but negative in japonicas. The inter relationship between panicle length and plant yield in japonicas was fairly strong with non significant correlation value. The association between culm length and plant yield was also strong and positive in indicas and negative in japonicas. Such differences in the magnitude and direction in the correlation between character pairs in indicas and japonicas was observed in common (Table 2). Positive correlations of grain yield with days to 50% flowering (Lal *et al.*, 1983) and tiller number (Battacharyya, 1981) have been reported.

Among the yield components, days to 50% flowering with panicle length, culm length with panicle length, culm length with grains per panicle and tiller number with panicle length showed positive and significant association in indica genotypes. Days to 50% flowering was negatively correlated with grains per panicle in indicas. In japonicas, seedling height with tiller number, days to 50% flowering with panicle length, days to 50% flowering with grains per panicle and panicle length with grains per panicle showed positive and significant association. Seedling height with culm length and tiller number with panicle length had negative and significant associations in japonicas. Selection for

Table 2. Total correlation coefficients between yield and yield characters in indica (I) and japonica rice genotypes.

		Seeding height (X1)	Days to 50% flowering (X2)	Culm length (X3)	Tiller number (X4)	Panicle length (X5)	Grains per panicle (X6)	Plant yiel (X7)
X1	I	–	0.082	0.135	0.248	0.239	0.336	0.142
	J		0.481	-0.812**	0.588**	-0.255	0.132	0.297
X2	I			0.223	0.389	0.535**	-0.404*	0.639**
	J			0.255	0.342	0.557*	0.666**	0.724**
X3	I				0.081	0.443*	0.645**	0.294
	J				-0.132	0.410	0.207	-0.287
X4	I					0.473*	0.375	0.534**
	J					-0.683**	0.159	-0.583*
X5	I						0.279	0.561**
	J						0.505*	0.299
X6	I							0.066
	J							-0.374

* Significant at 5 per cent level ** Significant at 1 per cent level

panicle length would serve as the best criterion for plant yield.

Path coefficient analysis

The cause and effect relationships as indicated by direct and indirect effects of component traits on yield were studied by path coefficient analysis. Among the yield components, days to 50% flowering, tiller number and panicle length were significantly associated with plant yield in indicas. Days to 50% flowering was also significantly associated with plant yield in japonicas.

The direct contribution of days to 50% flowering was quite dissimilar in indicas and japonicas. In indicas, it was very high and negative whereas it was positive in japonicas. The indirect effects through grains per panicle, tiller number, culm length and panicle length were positive and considerable and these cumulatively counter balanced the direct negative effect resulting in the significant and positive correlation in indicas. In japonicas, grains per panicle, tiller number and panicle leng had considerable indirect negati contributions to make towards the to significant correlation of days to 50 flowering with plant yield. Nevertheless, th positive direct effect and the positiv indirect effects through seedling height an culm length not only nullified the indire negative effects but also enabled significant and positive associatio (Table 3).

As for the observed significar correlation between tiller number and plan yield in indicas, the direct effect was hig and positive as also observed by Rao *et al* (1980). The direct effect was fortified by th positive indirect effect through panicl length, culm length and seedling height t counteract the high and negative indirec effects through grains per panicle and day to 50% flowering resulting in significar correlation. In case of japonicas where negative and significant correlation wa observed, the direct contribution by tille number was by itself high and negative. Th

Table 3. Path analysis of yield components in indica (I) and japonica (J) rice genotypes.

		Seeding height (X1)	Days to 50% flowering (X2)	Culm length (X3)	Tiller number (X4)	Panicle length (X5)	Grains per panicle (X6)	Total correlation (X7)
X1	I	0.695	-0.345	0.504	0.763	0.286	-1.762	0.142
	J	1.740	1.009	-1.218	-1.511	0.431	-0.153	0.297
X2	I	0.057	-4.209	0.833	1.198	0.640	2.119	0.639**
	J	0.837	2.098	0.382	-1.878	-0.941	-0.773	0.724**
X3	I	0.093	-0.938	3.137	0.249	0.530	-3.354	0.294
	J	-1.413	0.535	1.500	0.339	-0.693	-0.242	0.287
X4	I	0.172	-1.637	3.302	3.079	0.566	-1.967	0.534**
	J	1.023	0.717	-0.198	-2.575	1.155	-0.184	-0.583**
X5	I	0.166	-2.252	1.655	1.456	1.197	-1.463	0.561**
	J	-0.443	1.161	0.615	1.756	-1.691	-0.586	0.299
X6	I	0.233	1.707	2.410	1.155	0.334	-5.246	0.066
	J	0.229	1.397	-0.313	-0.408	-0.845	-1.160	-0.374

Residual : I = 0.462
J = 1.473

Figures underlined are the direct effects.

indirect effects through culm length and grains per panicle were also negative. The positive indirect effects through panicle length, seedling height and days to 50% flowering were cancelled out by the negative direct and indirect effects and ultimately resulted in negative association.

In the significant correlation of panicle length with plant yield in indicas, the direct effect of panicle length was high and positive. The indirect effects through culm length, tiller number and seedling height were also positive and all these jointly wiped out the very high negative indirect effects through days to 50% flowering and grains per panicle and resulted in positive correlation.

Among the components, tiller number, culm length, panicle length and seedling height could be mentioned as important ones in producing considerable indirect effects in indicas. In japonicas, days to 50% flowering assumed significance in the manifestation of indirect effect. The useful indirect contribution was noted in rice (Chang and Tagumpay, 1970; Saini and Gagneja, 1975) by analysis.

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PHENOTYPIC STABILITY FOR GRAIN YIELD IN CERTAIN BREEDING LINES AND VARIETIES OF GRAIN-CUM-FODDER SORGHUM

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ABSTRACT

Genotype X environment interaction was investigated for grain yield in 18 genotypes and varieties of fodder-cum-grain sorghum in six environments during 1985-'87 rabi and summer seasons. There was a significant variation for genotype and genotype X environment interaction for grain yield. Both linear and non-linear components were significant and between the two, the linear component was higher in magnitude. Rabi season characterised by the highest mean maximum temperature of 32°C was congenial for sorghum production. Summer season with a mean maximum temperature above 32°C (with a mean of about 38°C) resulted in reduced grain yield and was found unsuitable for sorghum cultivation. KS 7631, KS 7634 and KS 7637 were found to be most stable with wide adaptability. Tenkasi local and KS 6317 were found to be useful and potential parents for transferring the stability attributes. K 4 was found to be the best performer under unfavourable conditions.

KEY WORDS : Sorghum, Genotype Environment interaction, stability.

Sorghum (*Sorghum bicolor* L. Moench) is next in importance to rice as a valuable food-cum-fodder crop in Tamil Nadu. It is grown under widely different edaphic and environmental conditions and it is known to exhibit a high degree of genotype environment interactions. There is, therefore, a need to develop varieties with stability in performance over a wide range of environmental conditions. The present study was taken up to evaluate promising breeding lines and varieties of grain-cum-fodder sorghum in multi-environmental tests in order to identify high yielding and stable genotypes.

MATERIALS AND METHODS

A total of 18 genotypes that included 11 breeding lines and seven popular and improved varieties of grain-cum-fodder

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