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VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN RICE (ORYZA SATIVA L.)

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ABSTRACT

Genetic variability, heritability and genetic advance were studied in F_2 populations of six intervarietal crosses of rice and their three parents. Wide variability was observed for number of productive tillers per plant, grain number per panicle and single plant yield. The high heritability coupled with high genetic advance recorded in respect of these three traits indicated the role of additive gene action in controlling the traits. High heritability with moderate to low genetic advance was recorded for days to flowering, plant height, panicle length and 100 grain weight.

KEY WORDS : Rice, Variability, Heritability, Genetic advance

The variability available in the breeding material is important in the selection of superior plant types. The genetic variation of quantitative characters is influenced by environmental effects. The partitioning of the overall variances as genetic and non genetic components becomes necessary for any effective breeding programme. In the present paper, the extent of variability available in the F_2 generation of six cross combinations involving three parents of rice and the scope of selection through heritability and genetic advance estimates have been indicated.

MATERIALS AND METHODS

The material comprised of the F_2 progeny of six intervarietal hybrids crossing ADT 16, Co 33 and Co 37 as parents in all possible combinations. The F_2 populations were raised in a randomised block design with two replications at Tamil Nadu Rice Research Institute, Aduthurai, Tamil Nadu. Observations were recorded on days to flowering, plant height, number of productive tillers per plant, panicle length, grain number per panicle, 100 grain weight and single plant yield.

The estimates of variability such as phenotypic and genotypic coefficients of variability (PCV and GCV) were calculated adopting the formulae suggested by Burton (1951). Heritability in broad sense was estimated according to Lush (1940) and the genetic advance was calculated following Johnson *et al.* (1955).

RESULTS AND DISCUSSION

The data on the co-efficient of variability, heritability and genetic advance are furnished in Table 1.

For days to flowering, the PCV and GCV values were medium (i.e. 10 to 20%), showing moderate variability which might be due to the involvement of short duration varieties as parents which yielded a large number of early segregants. Similar variability for the trait was observed by Gopinath *et al* (1983), in the intervarietal crosses. But heritability was high for days to flowering. This indicates the less predominant influence of environment on the trait. Similar findings were reported by Sivasubramanian and Madhava Menon (1973) and Ravindranath *et al.* (1983) in the F_2 progenies of rice.

In respect of plant height, the extent of variability for this trait was moderate as shown by the PCV and GCV values, which

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Table 1. Variability, heritability and genetic advance of various characters in rice.

Characters/ crosses. (1)		Genetic parameters			
		PCV (%) (2)	GCV (%) (3)	h^2 (%) (4)	GA as percentage of mean. (5)
Days to flowering					
Cross	1	11.0	10.8	97.1	22.0
	2	7.7	7.5	94.6	14.9
	3	6.0	5.6	87.5	10.7
	4	6.0	5.6	87.0	10.7
	5	12.7	12.5	96.4	25.3
	6	7.0	6.7	91.8	13.3
Plant height (cm)					
Cross	1	17.0	14.9	76.9	26.8
	2	13.8	12.0	75.3	21.4
	3	11.5	10.7	87.2	6.8
	4	13.7	13.0	91.1	25.6
	5	10.5	6.5	38.7	8.3
	6	9.9	6.7	46.3	9.4
Number of productive tillers per plant					
Cross	1	44.8	29.8	44.3	40.9
	2	40.5	34.2	71.3	59.5
	3	44.2	35.7	65.5	59.6
	4	45.1	36.9	66.7	45.1
	5	45.5	36.6	64.6	60.5
	6	42.1	34.6	67.1	58.2
Panicle length					
Cross	1	14.8	12.3	68.4	20.9
	2	13.0	10.7	67.8	18.1
	3	10.4	8.1	59.5	12.3
	4	14.1	12.5	78.1	22.7
	5	10.2	7.5	54.3	11.4
	6	14.4	12.2	72.6	21.5
Grain number/panicle					
Cross	1	27.8	19.2	47.7	27.3
	2	27.2	17.2	39.9	22.3
	3	26.5	19.1	51.8	28.3
	4	25.8	18.9	53.7	28.5
	5	25.7	17.4	46.0	24.3
	6	35.7	25.6	61.2	41.2
100 grain weight					
Cross	1	17.5	14.3	66.6	24.0
	2	12.9	9.5	53.8	14.3
	3	13.9	10.6	58.1	16.6
	4	13.3	9.1	47.2	12.9
	5	12.5	9.7	59.7	15.4
	6	12.0	9.5	63.2	15.6
Grain yield per plant					
Cross	1	51.7	38.4	55.0	58.9
	2	50.3	46.1	83.9	86.9
	3	55.1	48.6	78.1	88.5
	4	45.8	36.6	63.8	60.2
	5	42.1	28.8	46.8	40.5
	6	43.6	33.8	60.1	54.0

Cross	1	ADT 16/Co 33
	2	Co 33/ADT 16
	3	Co 33/Co 37
	4	Co 37/Co 33
	5	Co 37/ADT 16
	6	ADT 16/Co 37

anged from 10 to 20 per cent. Similar esults were reported by Amirthalingam (1980) in the IR 36 hybrid derivatives. High eritability upto 91.1 per cent and moderate genetic advance upto 26.8 per cent were observed for this trait in the present study. This might be due to the less pronounced influence of environment and high additive gene action. Similar results were reported by Gopal Reddy and Goud (1970) and Goud *et al.* (1974) in T(N) 1/TKM 6 crosses.

The PCV for the number of productive tillers per plant ranged from 40.5 to 45.5, while GCV showed a range of 29.8 to 36.9 per cent for this trait. High heritability combined with high genetic advance were observed in the crosses. This indicated strong additive gene effects and low environmental influence for the trait. The positive trend of these parameters indicate the scope of selection for desirable segregants. Similar results were reported by Kaul and Bhan (1974), Nagesha (1976) and Verma *et al.* (1977) in rice varieties and Shanmugasundaram (1975) and balasubramaniam (1975) in the F_2 populations of rice.

Variability for the panicle length was moderate, as shown by the variability estimates which ranged between 10 and 20 per cent. High heritability coupled with moderate to high genetic advance was observed for this trait indicating high additive gene effect. Ravindranath *et al.* (1983) and Gopinath *et al.* (1983) also reported similar results in the F_2 populations of rice.

Higher variability for grain number per panicle was observed in the F_2 populations as shown by the variability estimates which were more than 20 per cent. Gopal Reddy and Goud (1970) and Natarajamoorthy (1979) reported high variability for grain number per panicle in the F_2 population. Moderate to high heritability combined with high genetic advance observed for this trait indicated the presence of additive gene action and low environmental influence. Swamy Rao and Goud (1974), Tripathi *et al.* (1973) and Nagesha (1976) reported high heritability and genetic advance estimates for this trait.

The variability estimates with respect to 100 grain weight, PCV and GCV were medium between 10 to 20 per cent. Mishra *et al.* (1973) and Khaleque *et al.* (1977) reported low variability for the trait. Moderate to high heritability and genetic advance estimates were observed for the trait in the present study. Similar results were reported by Tripathi *et al.* (1974) and Das and Borthakur (1974) in rice varieties and Ravindranath *et al.* (1983) in the F_2 population of rice for hundred grain weight.

As far as single plant yield is concerned, there was high variability since CV value in the crosses was doube the value of the parents. The PCV and GCV percentages ranged from 42.1 to 55.1 and 28.8 to 48.6 respectively. Such high variability for grain yield was reported by Sree Rangasamy and Murugesan (1973) in diploid and tetraplid rice, Nagesha (1976) in high yielding rice varieties and Balasubramanian (1975) in the F_2 population of intervarietal crosses of rice.

The heritability ad genetic advance estimates were very high for single plant yield, ranging from 46.8 to 83.9 and 40.5 to 88.5 per cent respectively. Sivasubramanian and Madhava Menon (1973) reported similar results in the F_2 population of widely divergent varieties or rice.

From the above results, it appears that yield cannot be improved by direct selection as this trait is subjected to greater environmental effect. However, yield can be improved indirectly by selecting F_2 plants with high tillering, high grain number per panicle and high grain weight as these

characters showed high heritability coupled with high genetic advances.

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