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GENETIC COMPONENTS OF VARIATION IN RICE

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ABSTRACT

Genetic analysis of components of variation for yield and yield components revealed the importance of both additive and non-additive type of gene action in the inheritance of characters, in a 7 x 7 diallel study. However, dominance component was higher than the additive component for number of productive tillers per plant, panicle weight, panicle length, 1000-grain weight, number of fertile spikelets per panicle, yield per plant and harvest index and these traits had low narrow sense heritability. Plant height had high heritability. The breeding techniques to exploit the genetic components are discussed.

Key words: *Oryza sativa*, gene action, heritability, biparental mating.

The current rice breeding programmes are directed towards exploitation of exotic and local germplasm in improving and stabilising the yield potential. Hence proper choice of parents which can nick well to produce superior offsprings is essential for rapid success in any conventional hybridisation programme. Diallel technique of analysis provides genetic information on the inheritance and behaviour of quantitative characters associated with yield and yield components. The present study of 7 x 7 diallel was, therefore, made to understand the genetic architecture of eight quantitative characters in rice.

MATERIALS AND METHODS

All possible crosses were made (excluding reciprocals) using seven genotypes viz., HP 19, HP 11, HP 15, HP 8, Mandya Vijaya, IET 7575 and HP 32. All the 21 F_1s along with their parents were raised in randomised complete block design with three replications with a spacing of 25 cm between rows and 20 cm between plants. The recommended cultural practices were followed. Data recorded on ten random plants from each replication were used for statistical analysis. The genetic components of variance were worked out as per the

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Hayman's Model [1, 2]. The observations were recorded on eight quantitative traits (Table 1).

RESULTS AND DISCUSSION

Components of variance analysis showed that the dominance component was relatively larger than the additive component for all the characters except plant height, for which significant additive effect (D) was recorded (Table 1). The values of H_1 and H_2 for all the characters except for plant height, were higher than those of D and were significant and positive, which indicate the predominance of non-additive genetic variance to control most of the characters under study. Similar results have also been reported earlier [3, 4].

Table 1. Genetic component of variation for eight quantitative characters in rice

Genetic component or proportion	Plant height	Productive tillers per plant	Panicle weight	Panicle length	No. of fertile spikelets per panicle	1000 grain weight	Yield per plant	Harvest index
D	102.05**	1.17	0.05	2.56	170.62	0.57	9.15	1.11
F	19.23**	−1.74	−0.04	−0.79	−101.79	−0.35	−8.56	−1.85
H_1	20.94**	30.53**	0.56*	16.80**	1675.95**	9.83*	96.80**	22.97*
H_2	19.34**	29.51**	0.54**	16.52**	1626.95**	9.68*	94.56**	21.57*
h^2	5.72*	3.31	0.19	1.66	506.47	2.20	20.74	0.43
E	0.07	0.01	0.01	0.02	0.34	0.01	0.32	0.01
$(H_1/D)^{\frac{1}{2}}$	0.45	5.09	3.41	2.55	3.13	4.15	3.24	4.56
$H_2/4H_1$	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.23
KD/KR	1.52	0.74	0.78	0.88	0.82	0.86	0.74	0.68
$k=h^2/H_2$	0.29	0.11	0.35	0.10	0.31	0.22	0.21	0.02
H_1-H_2	1.60	1.02	0.02	0.28	49.00	0.15	1.74	1.40
r.(Wr+Vr)YR	−0.61	−0.14	−0.47	−0.36	−0.27	−0.40	−0.34	−0.30
% Heritability (n.s.)	98.08	3.50	7.33	12.68	8.75	5.27	7.93	4.26
t^2	0.73	16.05**	5.97	3.23	2.42	23.87**	5.47	36.06**
t for b-0	8.57**	0.84	0.74	0.95	0.36	0.60	0.44	0.87
t for b-1	0.52	−7.82**	−6.05**	−3.87*	−3.94*	−9.68**	−5.85**	−11.59**

*,**Significant at 5% and 1% levels, respectively.

F values were mostly negative and nonsignificant, indicating that recessive alleles were more frequent than dominant ones. This was also corroborated by the lower values of KD/KR for all the characters except plant height. All the characters exhibited dominance effect as indicated by h^2 values. Similar observations for some traits were recorded by earlier workers also [4–6].

The t^2 estimates of test the uniformity of the Wr, Vr values were not significant for plant height, panicle weight, panicle length, number of fertile spikelets per panicle and yield per plant indicating the fulfilment of diallel assumptions for these traits. For remaining traits, the t^2 values were highly significant indicating the failure of one or a few assumptions for diallel mating design. Significant regression coefficients deviating from unity also revealed the existence of large quantity of linkage and epistasis except for plant height.

The values of $(H_1/D)^{\frac{1}{2}}$ ratio were more than unity for all the characters except plant height, indicating the operation of over dominance as reported earlier by Singh et al [4]. However, for plant height partial dominance was observed as also reported earlier [5]. The H_2 component was smaller than the H_1, indicating the unequal proportion of positive and negative alleles in the loci governing the characters. The asymmetrical distribution of genes in the parents was evidenced by the value of $H_2/4H_1$ which was less than 0.25 in all the cases, which was similar to the findings of [6]. The number of blocks of genes influencing the character was just one for all the characters as revealed by the h^2/H_2 value. Subramanian and Rathinam [5] have also obtained similar results for some of these characters.

The negative correlation between the mean values of the parents Yr and the order of dominance Y (Wr + Vr) in all the characters suggest that the dominant genes were associated with high mean expression. Similar results were obtained by [5, 6]. Heritability in narrow sense was observed to be low for all the characters except plant height. Similar findings were also reported by earlier workers [4–8]. In the present study, since both additive and nonadditive genetic components were important in governing the yield and yield components, biparental mating in early generation among the selected lines or diallel selective mating can be adopted in breeding programmes for the improvement of the characters studied, as suggested by Jensen [9].

REFERENCES

1. B. I. Hayman. 1954. The theory and analysis of diallel crosses. Genetics, **39**: 789–809.

2. B. I. Hayman. 1954. Analysis of variance in diallel tables. Biometrics, **10**: 235–244.

3. M. A. Khaleque and O. E. Joarder. 1978. Nature of gene interaction in the inheritance of yield and yield components in some rice crosses. Oryza, **15**(2): 157–172.

4. R. P. Singh, R. R. Singh, S. P. Singh and R. V. Singh. 1980. Estimation of genetic component of variation in rice. Oryza, **17**(1): 24–27.

5. S. Subramanian and M. Rathinam. 1984. Genetic components of variation in rice. Madras Agric. J., **71**(9): 561–565.

6. S. Kalaimani and M. K. Sundaram. 1987. Genetic analysis in rice (*Oryza sativa* L.). Madras Agric. J., **74**: 369–372.

7. D. M. Maurya. 1976. Heritability and genetic advance in rice. Oryza, **13**: 97–100.

8. S. Sardana and D. N. Borthakur. 1987. Combining ability for yield in rice. Oryza, **23**(1): 14–18.

9. N. F. Jensen. 1970. A diallel selective mating system for cereal breeding. Crop Sci., **10** : 629–635.