https://doi.org/10.29321/MAJ.10.A02512

Madras Agric. J. 71, (9) 561-565 September 1984.

GENETIC COMPONENTS OF VARIATION IN RICE*

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Grain and straw yields in rice were under the influence of dominance gene action predominantly and the heritability was moderate. Plant height, number of grains per panicle, hundred grain weight, harvest index (grain-straw ratio), length, width and length-width ratio of grain were found to be governed by additive gene action mainly, having high heritability estimates. Tiller number was controlled by dominance gene action with low heritability while panicle length was influenced by both additive and dominance gene action with high heritability. Under the above situation, a reciprocal recurrent selection or modified back-cross technique may be resorted to evolve high yielding short stature strains with fine quality of rice.

Success of any plant breeding programme depends largely on the choice of suitable parents which on crossing would throw desirable segregants. Diallel technique of analysis provides genetic information on the inheritance and behaviour of major quantitative characters associated with yield or the economic trait of concern to the breeder. The results of the investigation carried out in ten rice varieties and their ninety combinations are reported.

MATERIALS AND METHODS

Ten varieties viz., Jaya, Taichung (Native) 1 (T(N)1), Dee geo-Woo-gen (Dg Wg), I-geo-tze(Igt), TNAU 13613, TKM 6, SLO 16, Basmati 370, TKM 4 and Co 20 were selected and crossed in all possible combinations. All the 90 hybrids and the parents were raised under uniform conditions in randomised blocks design with two replications during three seasons namely 1976 *kar* season (June to September), 1977 *navarai* season (January to April) and 1978 *samba* season (August to November) at the Paddy Breeding Station, Tamil Nadu Agricultural University, Coimbatore. Each variant was raised in two rows of two meters length with a spacing of 20 x 10 cm. Twenty plants chosen at random in each variant from each replication were studied for plant height, earbearing tillers per plant, panicle length, number of grains per panicle, 100 grain weight yield of grain and straw per plant, grain-straw ratio, length and width of grain and length-width ratio of grain. The genetic components of variance were worked out after Hayman (1954 a and b). The correlation between parental order of dominance (Wr + Vr) and parental measurements (Yr) was compared as proposed by Johnson and Askel (1959).

RESULTS AND DISCUSSION

For most of the characters the additive component was relatively larger

* Formed a part of Ph. D. thesis of the senior author approved by the Tamil Nadu Agricultural University, Coimbatore.

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than the dominance component except for grain yield and straw yield per plant (Table 1). Significant additive genetic effect (D) as well as dominance effect (H_1) were found for all the characters. However, the values of D were higher than the values of H_1 for all the characters except earbearing tillers, grain and straw yield per plant, which indicated the predominance of additive genetic variance in the present experimental material. For grain and straw yield per plant, non-additive component was predominant. Both non-additive and dominance effects were found important for grain yield per plant by Singh *et al.* (1980). Except earbearing tillers, grain and straw yield per plant, all the characters exhibited low dominance effect as indicated by low h^2 values (Table 2) compared to D values. The values $(H_1 / D)^{\frac{1}{2}}$ ratio (Table 3) were below 1.0 for all the characters except for ear-bearing tillers, grain and straw yield per plant indicating the presence of partial dominance in the former and over dominance in the latter three characters. Sukanya Subramanian and Madhava Menon (1973) also found over dominance for grain and straw yield and partial dominance for other characters.

The value of H_2 component of genetic variation was positive and significant for all the characters. However, the values were less than D values for all the characters indicating predominance of additive gene action except for earbearing tillers and straw yield per plant. The values of $H_2/4H_1$ were suggesting asymmetric distribution of positive and negative genes among all the parents for all the characters. The ratio of dominant and recessive genes (KD/KR) showed that the dominant genes were in excess for all the characters except for plant height and straw yield for which recessive genes were in excess, as also observed by Singh *et al.* (1980).

The number of blocks of genes influencing the character was just one for panicle length, number of grains per panicle, grain-straw ratio, lengtn and width of grain, 1 to 2 for plant height and 100 grain weight, 2 to 3 for grain and straw yield per plant and 3 to 5 for earbearing tillers per plant.

Heritability in narrow sense (Table 3) was observed to be low for earbearing tillers per plant, moderate for grain yield and high for all other characters studied. Similar high values were reported by Singh (1973) for these characters while low heritability for tillers and grain yield was reported by Maurya (1976).

The negative correlation between the mean values of the parents and the order of dominance in all the characters except number of grains per panicle, grain-straw ratio and length-width ratio of grain suggests tnat tne dominant genes are associated with high mean expression. The positive correlation for the number of grains per panicle, grain-straw ratio and length-width ratio of grain suggests high mean expression to be associated with recessiveness. The possession of recessive genes with high expression is an advantage in breeding programme as it might facilitate fixation of the trait in the early generations.

Table 1 Eastimates of genetic Parameters

Character	Season	D	F	H_1	H_2	h^2	E
Plant height	S_1	915.8**	85.8**	173 4**	150.3**	170.5**	0.5
	S_2	924.3**	-46.9	196.1**	168.2**	286.1**	0.2
	S_3	665.1**	86.9**	166.6**	156.5**	210.3**	0.1
Earbearing tillers per plant	S_1	1.7**	2.7**	5.2**	3.9**	11.9**	0.1
	S_2	1.9**	2.3**	2 9**	2.2**	10.6**	0.1**
	S_3	0.9**	0.6	2.3**	1.8**	7.9**	0.1**
Panicle length	S_1	9 6**	2.4	4.7**	3.9**	0.4	0.11
	S_2	4.8**	2.6**	4.5**	3.5**	0.2	0.03
	S_3	4.9**	0.6	1.6**	1.5**	0 8**	0.19**
Number of grains per panicle	S_1	92.3**	40 9	94.9**	83.8**	28.6**	0.8
	S_2	44.9**	14.3	32.8**	27.0**	3.8	0.2
	S_3	42 2**	3.5	11.9**	9 4**	0.03	0.9**
100 grain weight	S_1	0.13**	0.01	0.03**	0.03**	0.02**	0.00004
	S_2	0.17**	0.11	0.10	0.04	0 06	0.00005
	S_3	0.14**	0.01*	0.02**	0.02**	0.02**	0.00007
Grain yield per plant	S_1	22.2**	13 5**	32.7**	23.0**	36.9**	0.08
	S_2	24 2**	9.3**	18.5**	14.9**	31.9**	0.05
	S_3	15.8**	5 4**	20.3**	15.4**	36.8**	0.14
Straw yield per plant	S_1	105.9**	54.9	212.1**	171.54**	294.2**	0.539
	S_2	120.9**	21.7	173.7**	143.27**	269.22**	0.086
	S_3	104.8**	73.2	188.6**	146.78**	303.59**	0 244
Grain-straw ratio	S_1	0 05**	0.007	0.029**	0.025**	0.015**	0.00009
	S_2	0.05**	0.010	0.031**	0.027**	0.026**	0.00002
	S_3	0.05**	0.005	0.032**	0.028**	0.022**	0.00027
Grain length	S_1	0.5**	0.037	0.109**	0.097**	0.077**	0.00062
	S_2	0.5**	0 029	0 078**	0.072**	0.064**	0.00131
	S_3	0.5**	0.031	0.068**	0.070**	0.056**	0.00598
Grain width	S_1	0.09**	0.012**	0.012**	0.010**	0.0005	0.0006
	S_2	0.09**	0.009**	0.009**	0.008**	0.0019	0.0005
	S_3	0.08**	0.001	0.014**	0.012**	0.0034	0.0005
Length-width ratio of grain	S_1	0.58**	0.027**	0.042**	0.036**	0.0002	0.0015
	S_2	0.55**	0.024**	0.028**	0.023**	0.0010	0.0007
	S_3	0.54**	0.028**	0.035**	0.031**	0.0104**	0.0004

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

D —Component of variation due to additive effects of the genes

F — Covariance of additive and dominance effects

H_1—Component of variation due to dominance effects of the genes

H_2—Dominance indicating asymmetry of positive and negative effects of gene

h_2—The sum of dominance effects over all loci

E —Environmental component of variance

Table 2 Ratios involving different genetic parameters

Character	Season	$(H_1/D)^{\frac{1}{2}}$	$H_2/4H_1$	K_D/K_R	h^2/H_2	Heritability (Percentage)	r(Wr+Vr), Yr
Plant height	S_1	0.44	0.22	0.81	1.13	93.1	−0.72*
	S_2	0.46	0.21	0.89	1.70	92.2	−0.91**
	S_3	0.50	0.23	0.77	1.34	90.5	−0.96**
Earbearing tillers per panicle	S_1	1.73	0.19	2.67	3.05	40.9	−0.75*
	S_2	1.22	0.18	2.77	4.89	27.1	−0.95**
	S_3	1.59	0.19	1.47	4.35	41.0	−0.83**
Panicle length	S_1	0.69	0.20	1.43	0.11	79.2	−0.61
	S_2	0.97	0.19	1.77	0.07	63.9	−0.49
	S_3	0.57	0.24	0.98	0.49	81.9	−0.55
Number of grains per panicle	S_1	1.01	0.22	1.56	0.34	59.1	−0.07
	S_2	0.85	0.21	1.46	0.14	72.3	+0.51
	S_3	0.53	0.19	0.86	0.0029	88.1	+9.57
100 Grain weight	S_1	0.47	0.22	1.22	0.69	93.9	−0.79**
	S_2	0.77	0.09	2.50	1.64	91.9	−0.63**
	S_3	0.39	0.23	1.32	0.84	92.7	−0.63
Grain yield per plant	S_1	1.21	0.18	1.67	1.60	61.2	−0.71*
	S_2	0.87	0.20	1.56	2.14	70.9	−0.49
	S_3	1.13	0.19	1.35	2.39	65.8	−0.73*
Straw yield per plant	S_1	1.41	0.20	0.69	1.71	69.9	−0.67*
	S_2	1.20	0.21	0.86	1.88	70.7	−0.72*
	S_3	1.34	0.19	0.59	2.07	74.9	−0.56
Grain-straw ratio	S_1	0.76	0.22	1.21	0.59	78.3	0.88**
	S_2	0.80	0.21	1.30	0.97	75.7	0.89**
	S_3	0.80	0.22	1.13	0.77	77.1	0.89**
Grain length	S_1	0.46	0.22	1.12	0.79	90.6	−0.78**
	S_2	0.39	0.23	1.16	0.89	92.6	−0.80**
	S_3	0.38	0.26	1.19	0.81	90.4	−0.88**
Grain width	S_1	0.36	0.20	1.45	0.05	93.2	−0.75**
	S_2	0.32	0.21	1.41	0.25	94.4	−0.87**
	S_3	0.41	0.21	0.98	0.29	92.7	−0.79**
Length-width ratio of grain	S_1	0.27	0.21	1.19	0.01	96.4	0.17
	S_2	0.23	0.20	1.21	0.04	97.6	0.57
	S_3	0.26	0.22	1.23	0.34	96.9	0.73

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

(H_1/D) 1/2 — Mean degree of dominance over all loci

$H_2/4H_1$ — Estimate of average frequency of positive and negative alleles in the parents

K_D/K_R — Ratio of total number of dominant to recessive genes in the parents

h^2/H_2 — The number of groups of genes controlling the character

r(Wr+Vr), Yr — Coefficient of correlation between parental order of dominance and parental measurements.

Most of the desirable grain yield attributes are found to be controlled by both additive and non-additive gene actions as indicated by the significant values. However, plant height, panicle length, number of grains 100 grain weight and harvest index are predominantly governed by additive factors while tiller number, grain yield and straw yield are influenced mostly by non-additive factors. All the grain quality factors viz., length, width, and length-width ratio of grain are controlled by additive gene action predominantly. In such a situation, where there is predominance of non-additive components or influence of both addtive and non-additive components, simple pedigree selection method may not be adequate since it will not yield a desirable level of improvement. Probably this may be the reason for the slow progress in combining high yield and fine quality of grains.

REFERENCES

HAYMAN, B. I. (1954 a). The theory and analysis of diallel crosses. *Genetics*. 39:789-809.

HAYMAN, B. I. (1954 b). The analysis of variance of diallel tables. *Biometrics*. *10* : 235-244.

JOHNSON, L. P. V. and R. ASKEL (1959). Inheritance of yielding capacity in a fifteen parent diallel cross of barely *Can. J. Genet. Cytol.*, *1* : 209-265.

MAURYA, D. M. (1976). Heritability and genetic advance in rice. *Oryza*. *13* : 97-100

SINGH, R. P., B. R. SINGH, S. P. SINGH and R. V. SINGH (1980). Estimation of genetic component of variation in rice. *Oryza*. *17* : 24-27.

SINGH, R. S., 1973. Diallel and path coefficient analysis for certain quantitative characters in *Oryza sativa* L. Ph. D. thesis, Banaras Hindu University.

SUKANYA SUBRAMANIAN and P. MADHAVA MENON (1973). Pattern of variation in yield attributes and yield in the hybrids of rice (*Oryza sativa* L.). *Madras agric. J.* *60* : 1118-1124.

Madras Agric J. 71 (9) 565-567 September 1984

STUDIES ON COMBINING ABILITY FOR GRAIN PROTEIN AND LYSINE CONTENTS IN DURUM WHEAT

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Combining ability study was carried out for protein and lysine contents in a diallel set of five durum wheat (*Triticum durum* Desf.) strains. General as well a specific combining ability variances were highly significant for both the traits. However, the magnitude of GCA variances was higher than that of SCA varinces fo both the characters reflecting the predominance of additive gene effects in the genetic control of these quality traits. The *per se* performance of the parents was associated with their GCA effects. The varieties, Raj 911 followed by MACS 9 were the good combiners for both protein and lysine contents. The cross Raj 911 X RCBD 8 could be exploited further for obtaining nutritionally high protein hybrids in durum wheat.

Little information is available on plant breeding approaches to evaluate nutritional quality of durum wheat (*Triticum durum* Desf.) With this, in view, combining ability for grain protein and lysine, an essential amino-acid, in a diallel cross of five varieties was undertaken.

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