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TRIPLE TESTCROSS ANALYSIS FOR YIELD AND YIELD COMPONENTS IN RICE (*ORYZA SATIVA* L.)

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ABSTRACT

Triple testcross analysis involving three testers (P_1, P_2 and F_1) and seven lines was performed to detect epistasis for plant height, days to first flowering, tillers/plant, grains/panicle, grain weight/panicle, 1000-grain weight, and grain yield/plant. Epistasis was found to contribute significantly for all the seven traits. The additive and dominance components were estimated by excluding the lines showing significant estimates for epistasis. Additive effects were the main source of variation for plant height, days to flowering, 1000-grain weight, and grain yield/plant, while dominance effects were important for 1000-grain weight, grain weight/panicle, and grain yield/plant.

Key words: Epistasis, rice, additive, dominance.

Recent genetic studies using different biometrical techniques, have indicated presence of a sizeable amount of nonadditive gene effects for different traits in rice [1–5]. The present investigation has been undertaken to estimate the nonadditive gene effects, particularly the epistatic component of genetic variation, using triple testcross design [6, 7].

MATERIALS AND METHODS

The popular variety Govind of early duration was crossed with the medium maturity variety Jaya. Both the parents and the hybrid were also crossed next year to a set of seven varieties (lines): Saket 4, Manhar, Pant Dhan 4, DV 85, UPRB 31, IET 4141, and Mahsuri. In the next season, 25-day-old seedlings were transplanted in randomized block design with three replications. Five competitive plants from all the entries in each replication were tagged randomly for recording observations on seven quantitative characters (Table 1).

Analysis of variance was done to detect epistasis jointly for all the lines via testing the null hypothesis $H_0 : L_1 + L_2 = 2L_3$. Since the F value of epistasis was significant for all the characters, individual lines were tested for epistasis via testing the null hypothesis $H_0 : L_{1i} + L_{2i} = 2L_{3i}$ (i = 1 ... 7) by 2-sample t test before estimating the additive and dominance components. These components were estimated by pooling together those lines for which the null hypothesis was not rejected [7].

RESULTS AND DISCUSSION

Epistasis was highly significant for all the characters (Table 1). Further partitioning of epistasis into homozygote x homozygote (i type) and homozygote x heterozygote (j and l) types of interactions indicated that j and l types of interactions were significant for all the characters, while i type interactions were significant only for plant height, days to first flowering, tillers/plant, and grain yield/plant.

Table 1. Estimates of epistasis jointly for all lines based on ANOVA (mean square)

Source	d.f.	Plant height	Days to flowering	Tillers per plant	1000-grain weight	Grains per panicle	Grain weight per panicle	Yield per plant
Replications	2	186.3	37.5	19.7	4.1	481.4	1.4	0.5
Epistasis	7	1978.9**	1709.5**	346.0**	38.6**	10929.5**	8.5**	4390.5**
i type epistasis	1	4297.1*	6596.8**	819.7**	0.4	2781.8	1.2	5917.7**
j+l type epistasis	6	1592.6**	895.0**	267.0**	44.9**	12287.4**	9.7**	4136.0**
i type epistasis x replicates	2	186.3	37.5	19.7	4.1	481.4	1.4	0.4
j+l type epistasis x replicates	12	40.6	9.3	16.0	4.4	986.4	1.6	80.0
Epistasis x replicates	14	61.5	13.3	16.6	4.3	914.3	1.5	68.6

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

The results of the 2-sample t test (Table 2) indicated the presence of epistasis at least in three lines for all the components of yield. However, for grain yield per se only two lines (UPRB 31 and IET 4141) showed the presence of epistasis. Significant estimates of epistasis in rice have also been reported earlier for tillers/plant and grain yield/plant [3], grains per panicle [4], grain weight/panicle [8] and 1000-grain weight [9, 10].

By ignoring the presence of epistasis, one would not only loose some important genetic information but the estimates of additive and dominance components would also be biased. Thus, the variances of those lines which showed absence of epistasis were pooled together to estimate the additive (D) and dominance (H) components (Table 3) along with the degree

Table 2. Estimates of epistasis for individual lines based on 2-sample t test

Line	Calculated values of t						
	plant height	days to flower-ing	tillers per plant	1000-grain weight	grains per panicle	grain weight per panicle	yield per plant
Saket 4	0.7	4.1	0.6	8.9**	5.1*	0.2	0.8
Manhar	11.2**	2.3	3.3*	3.5*	3.6*	4.2*	2.7
Pant Dhan 4	4.8**	3.3**	4.7*	3.1*	4.0*	3.3*	4.3
DV 85	0.7	10.0*	2.5	2.4	1.4	0.4	3.7
UPRB 31	10.7**	3.0*	18.8**	0.2	1.9	0.3	10.1**
IET 4141	2.8*	1.9	5.4**	0.9	12.5**	11.2**	6.0*
Mahsuri	1.4	29.0**	2.0	1.6	7.7*	1.5	3.2

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

Table 3. Estimates of additive and dominance components and correlation coefficients

Parameter	Plant height (3)	Days to flowering (3)	Tillers per plant (3)	1000-grain weight (4)	Grain weight per panicle (4)	Yield per plant (5)
Additive (D)	4971.0**	20522.9**	24.1	97.0**	0.8	2902.0**
Dominance (H)	372.0	44.5	177.9	24.4**	7.6**	2423.9**
Degree of dominance	0.3	0.1	2.7	0.5	3.0	0.9
r (sum, diff.)	0.0	– 0.8	0.8	0.7	0.9*	0.6

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

Note. No. of lines showing absence of epistasis which were used to estimate these parameters are shown in parentheses for each character.

of dominance and the correlation coefficients between sums and differences. Both the D and H components were highly significant for 1000-grain weight and grain yield/plant. The additive component was significant for plant height and days to flowering, while the dominance component played a significant role in the expression of grain weight/panicle.

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