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HETEROSIS AND INBREEDING DEPRESSION OF INDUCED MUTANTS IN BASMATI RICE (ORYZA SATIVA L.)

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Heterosis and inbreeding depression were studied for yield components in six hybrids of four parents. Significant heterosis and inbreeding depression were estimated for traits studied. The maximum heterosis of 111.6% were observed for yield in hybrid DM16-5-1 x Kashmir Basmati. Cross combinations of Basmati 370 x DM16-5-1 and DM16-5-1 x DM107-4 showed highly significant heterosis with a non-significant inbreeding depression. The traits of other hybrids are also discussed.

INTRODUCTION

The use of mutants in plant breeding programmes has become more popular (Maluszynski *et al.*, 1986). The new genetic resources obtained by induced mutants of rice in USA have been successfully used for the development of productive semidwarf rice varieties (Rutger, 1983). Before the initiation of these endeavours, it may be imperative to conduct studies for heterosis and inbreeding depression on the mutants. These studies may reveal the type of gene action, which may have the direct effect on breeding procedures. Information on mutant heterosis in different crop plants (Gottschalk, 1976; Micke, 1976) and heterosis and inbreeding depression in rice (Singh *et al.*, 1977 and 1980) is enormous. Such an information on the mutants dlt. derived from Basmati 370 is rather scanty which prompted the present investigation.

MATERIALS AND METHODS

The four parents viz. Basmati 370, Kashmir Basmati, DM16-5-1 and DM107-4 having contrasting traits, i.e. no. of tillers per plant, primary branches per panicle, total spikelets per panicle, fertility %, panicle weight and grain yield per plant were crossed in all possible combinations producing one way hybrids. The F_1 hybrids and F_2 generations alongwith their parents were transplanted with single seedling per hill at the NIAB Farm, Faisalabad during the year 1982-83 with a plant to plant and row to row distance of 20 cm in a randomized complete block design with three replications. The transplanting was done in such a way that one row of ten plants each of non-segregating populations and 8 rows for the F_2 segregating populations in each replication were grown. At maturity, the data about yield and yield components were recorded on individual plants.

The analysis of variance was performed to find out the differences between parents, F_1 and F_2 populations. The degree of heterosis over better parent was calculated following Fanseco and Peterson (1968) (F_1– better parent/better parent x 100) and the percentage increase (+) or decrease (–) of F_2 populations over F_1 hybrids was also worked out as a measure of inbreeding depression.

RESULTS AND DISCUSSION

The mean value of different characters in respect of parents, F_1 hybrids and F_2 populations differed significantly in all the characters studied (Table1).

Performance of F_1 hybrids compared to the mean of better parent and inbreeding depression from F_1 to F_2 generation for six characters are presented in Table 2. In general, higher the heterosis, higher was the inbreeding depression. Tillers/plant and fertility percentage showed least significant heterosis in total cross combinations, while panicle weight and grain yield/plant showed maximum heterosis.

As regards tillers/plant maximum and significant heterosis and inbreeding depression was observed in cross Nos.6 and 1, respectively while the other crosses neither showed heterosis nor inbreeding depression. For primary branches per panicle, maximum and highly significant heterosis accompanied by inbreeding depression was found in cross No. 1 while cross No. 5 showed significant heterosis and non–significant inbreeding depression. The remaining cross combinations did not show any significant heterosis. In case of total spikelets per panicle the cross Nos. 1, 4 and 5 showed highly significant heterosis while highly significant inbreeding depression was observed in cross Nos. 1 and 5 only.

For fertility percentage, maximum and significant heterosis was observed in cross No. 1 only while the other crosses depicted significant inbreeding depression. As regards panicle weight, all the cross combinations showed highly significant heterosis except cross No. 2 while the maximum and highly significant inbreeding depression was observed in cross No. 1. For yield per plant, maximum heterosis was found in cross No. 4. However, the cross Nos. 1, 3, 5 and 6 also manifested significant heterosis. Hybrid no. 6 proved an ideal one, by showing significant positive heterosis for no. of tillers per plant (57.83%) and yield per plant (58.06%) and highly significant positive heterosis for panicle weight (59.65%) with non–significant inbreeding depression for these traits.

Although different cross combinations have exhibited significant positive heterosis for yield and yield components but they have also shown the same magnitude of inbreeding depression. The ideal cross combination will be one which shows substantial positive heterosis with non–significant inbreeding depression. Such an ideal situation can be observed for cross combinations of Basmati 370 x DM16–5–1 and DM16–5–1 x DM107–4 for number of tillers per plant, panicle weight and yield per plant. Therefore, possibilities of selecting variants with more tillers and heavy panicles consequently with higher

Table 1. Performance of parents, F1 hybrids and F2 population for various characters in rice

Parent/hybrid		Tillers/ plant (No.)	Primary branches/ panicle (No.)	Total spikelets/ panicle (No.)	Fertility (%)	Panicle weight (g)	Grain yield/ per plant (g)
Basmati–370		7.53	10.87	154.53	93.27	16.63	15.14
Kashmir Basmati		9.85	8.87	139.25	80.70	17.13	14.57
DM16–5–1		7.73	11.40	152.93	87.46	16.09	12.94
DM107–4		11.67	8.80	113.67	72.80	15.25	13.08
DM107–4/ Kashmir Basmati	F_1	13.25	11.65	186.05	90.34	32.08	26.82
	F_2	9.06	10.57	136.13	82.37	13.79	11.12
Basmati–370/ DM107–4	F_1	9.47	11.60	157.80	94.44	21.63	19.62
	F_2	9.10	11.05	150.95	89.68	19.50	13.03
DM16–5–1/ DM107–4	F_1	12.27	11.68	150.67	93.91	28.45	24.88
	F_2	9.37	11.47	148.00	89.31	20.40	16.89
DM16–5–1/ Kashmir Basmati	F_1	12.33	11.93	182.27	93.94	33.85	30.83
	F_2	9.50	11.82	164.23	88.90	19.83	17.00
Basmati–370/ Kashmir Basmati	F_1	11.40	11.87	197.53	92.12	29.36	25.98
	F_2	9.29	11.13	152.60	83.70	18.18	15.33
Basmati–370/ DM16–5–1	F_1	12.20	12.07	163.13	93.69	26.55	23.93
	F_2	8.72	11.77	155.94	89.34	19.37	20.13
L.S.D. for parents & F_1	5%	3.51	0.97	17.24	7.02	8.42	7.37
	1%	–	1.33	23.4	9.61	11.14	10.09
L.S.D. for parents & F_2.	5%	3.17	0.76	26.03	3.32	8.74	7.86
	1%	–	1.04	35.37	4.52	11.8	10.68

yield from subsequent generation of both the hybrids may exist.

Performance of the four varieties with respect to the six traits studied showed that Basmati 370 surpassed in three traits namely total spikelets per panicle, fertility (%) and grain yield per plant whereas, Kashmir Basmati, DM16–5–1 and DM107–4 were found superior in one character each, i.e. panicle weight, primary branches per panicle and tillers per plant, respectively. The performance of the parent varieties reveals a wide variation among the parents for these characters and possibilities of selecting desirable variants from the offspring of different cross combinations of parental types. A potential hybrid mentioned above is a typical example of such variants obtained

Table 2. Estimation of heterosis (a) and inbreeding depression (b) for yield and yield components in some hybrids of rice

Combination		Tillers/ plant (No.)	Primary Branches/ panicle (No.)	Total spikelets/ panicle (No.)	Fertility (%)	Panicle weight (g)	Yield/ plant (g)
DM107–4/ Kashmir Basmati	a	+ 1.35	+31.34**	+ 33.61**	+11.95**	+87.27**	+ 84.08**
	b	–31.62*	– 9.27**	–26.83**	– 8.82**	–57.01**	– 58.54**
Basmati–370/ DM107–4	a	–18.85	+ 6.72	+ 2.38	+ 1.25	+30.07	+ 28.93
	b	– 3.91	– 4.74	– 4.34	– 5.04**	– 9.85	– 33.25
DM16–5–1/ DM107–4	a	+ 5.14	+ 2.46	– 1.48	+ 7.37	+76.82**	+ 90.21**
	b	–23.63	– 1.80	– 1.77	– 4.90**	–28.30	– 32.11*
DM16–5–1/ Kashmir Basmati	a	+25.18	+ 4.65	+19.19**	+ 7.41	+97.61**	+111.60**
	b	–22.95	– 9.30**	– 9.90	– 5.37**	–41.42**	– 44.86**
Basmati–370/ Kashmir Basmati	a	+15.70	+ 9.20*	+27.83**	– 1.16	+71.40**	+ 71.60**
	b	–18.51	– 6.23	–22.75**	– 9.21**	–23.46*	– 40.99*
Basmati–370/ DM16–5–1.	a	+57.83*	+ 5.88	+ 5.57	+ 0.45	+59.65**	+ 58.06*
	b	–28.52	– 2.49	–4.41	–4.64*	–27.04	– 15.88

* Significant at 5% level of probability.
** Significant at 1% level of probability.

by hybridization between the two varieties.

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