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EXPRESSION OF HETEROSIS IN SOME INTER-VARIETAL HYBRIDS OF *ORYZA SATIVA* LINN.[1]

K. KARUNAKARAN[2]

Utilisation of heterosis in a self pollinated and seed propagated crop like rice, where each crossed seed is the result of emasculation and pollination of individual spikelets, has so far been considered to be of no practical significance. The present trend is to see whether the persistent vigour can be tapped at the F_2 level by fixing up suitable parents showing the Itast variation for height, flowering duration, and grain characters but expressing hybrid vigour.

Studies on heterosis f©r various plant characters in rice were reported by Jones, (1926), Juachon (1932), Ramiah (1935), Idsumi (1936), Kadam (1937), Sethi (1937), Capinpin and Punyasing (1958), Naga® and Takahashi (1941), Opsomer (1942), Capinpin and Amaba (1949), Ramiah (1953), Nagamatsu and Ikeda (1955), Richharia and Misro (1959), Subbiah Pillai (1961), Joseph (1962), Misro and Shastry (1962), Namboodiri (1963), and Jennings (1966).

Results of an investigation with twenty hybrid combinations from nine varieties of *Oryzasativa* including three Chinese types are reported in this paper.

Materials and Methods

Nine varieties as detailed below, representing *indica*, *Chinese*, *japonica* and *tjereh* groups of *O. sativa* selected from the germ plasm maintained at the Paddy Breeding Station, Coimbatore, were employed in the studies:

Variety	Group	Origin	Salient features		
Co, 13	indica	India	Short duration,	awnless,	white rice
Ptb. 10	indica	India	—do— ,	—do—,	red rice
Adt. 3	indica	India	—do— ,	—do—,	white rice
CH. 45	Chinese	China	—do— ,	—do—,	—do—
CH. 62	Chinese	China	— do —,	—do—,	-do-
CH. 63	Chinese	China	-do- ,	—do—,	—do—
Aikoku	japonica	Japan	-do- ,	awned ,	—do—
Norin. 1	japonica	Japan	-do- ,	awnless,	—do—
T. 2357	tjereh	Indonesia	Long duration ,	—do—,	—do—

1. From M. Sc. (Ag.) thesis submitted to the University of Madras in 1964.

2. Present Address : Research Scholar, Research Institute for Irrigation and Rice Cultivation. Szarvas, Hungary.

The hybrid combinations studied are given in Tables 1 and 2. Estimation of heterosis for plant height, number of tillers, flowering duration, yield of grain and straw, length of primary earhead, the length, breadth, and thickness of grain, and 1000-grain-weight was made by comparing the F_1 values with the higher parental values as well as with the parental means. In the case of parents, measurements of 20 individual plants and in the case of hybrids those of all the plants available in each cross were recorded.

Results

Results are given in Tables 1 and 2. It may be seen from Table 1 that out of the 20 crosses studied, 18 show positive heterosis for breadth of grain; 15 each for thickness of grain, 1000-grain-weight and number of tillers; 14 for length of grain; 13 for panicle length; 12 for plant height; and 11 each for flowering duration, straw yield and grain yield, when the F_1 values -are compared to the mid-parental values. From Table 2 it is observed that when compared with the higher parental values, 15 out of the 20 crosses show positive heterosis for breadth of grain; 12 for thickness of grain; 10 eaeh for number of tillers and 1000-grain weight; 8 for straw yield; 7 for panicle length; 6 for flowering duration; 5 each for grain yield and length of grain and 4 for plant height.

Among the twenty cross combinations studied, four hybrids namely, Aikoku x CH. 62, Co.13 x CH.63, CH.63 x Ptb. 10 and CH.63 x T.2357 show positive heterosis over the higher parents for the most important economic characters of grain yield and straw yield. The cross Co. 13 x T.2357 shows positive heterosis over the higher parent for grain yield alone.

Discussion

Though variations in the percentages of heterosis are evident in the cross combinations, positive heterosis over the higher parental value is observed in a few combinations for each of the characters studied. Thus breadth of grain shows positive heterosis in the maximum number of hybrid combinations, closely followed by thickness of grain, 1000-grain-weight and number of tillers. Capinpin and Punyasingh (1938) have reported heterosis for grain thickness, Namboodiri (1963) for grain breadth and thickness and Capinpin and Amaba (1949) for grain length.

Eleven hybrids have shown positive heterosis for grain yield over the parental mean and five over the higher parental values. Similar results have been reported by Kadam (1937), Capinpin and Punyasingh (1938), Nagao and Takahashi (1941), Opsomer (1942), Subbiah Pillai (1961; and Jennings (1966).

In all the cross combinations where the hybrids show positive heterosis over the higher parent for both grain and straw yields, one of the parents is a Chinese variety. Usefulness of a good number of Chinese varieties of rice as direct introductions in many of the States of India has been well recognised in recent times (Chatterji 1952; Ramiah 1953; Negi 1955; Negi and Saini 1957; Rajagopalan and Samad 1960 and Richharia and Govindaswamy 1062). Srinivasan and Sounderarajan (1963) have succeeded in isolating some promising cultures with non-lodging character from some *indica* x *Chinese* crosses.

TABLE 1

Degree of heterosis for different characters in some inter-varietal hybrids of O. sativa

(Heterotic increase over varietal mean)

Cross combination	Grain yield per plant	Straw yield per plant	No. of tillers	Panicle length	Flowering duration	Plant height	1000-grain-weight	Grain length	Grain breadth	Grain thick-Bess	Total No. of characters showing + heterosis
Ad. 3 x Nin 1	— 72	+ 123	+ 26	+21	— 1	+11	+ 6	+ 5	+ 2	+ 3	8
Nin 1 x Ad. 3	— 7[illegible]	+ 359	+142	+21	— 3	+24	+ 2	+ 3	— 1	+ 2	7
CP. 62 x Aij. oku	+ 3[illegible]	+ 64	+ 94	+10	+ 1	—17	+14	+ 3	+10	+ 6	9
Aij. oku x CP. 62	+ 7[illegible]	+ 225	+181	+13	— 1	+21	+ 6	+ 8	+ 9	+13	9
Nin 1 x CP. 62	— [illegible]	— 28	+ 99	— 7	— 4	+15	+14	+ 5	+ 8	+ 6	6
Nin 1 x CP. 63	+ 1[illegible]	+ 23	+ 81	— 1	— 9	+14	+13	2	+10	+ 7	7
Aij. oku x T. 2357	— [illegible]5	— 50	— 14	— 1	9	— 3	Nil	+ 5	+ 4	3	2
T. 2357 x Aij. oku	+ 1	— 50	— 19	1	— 6	— 8	— 1	+ 3	+ 2	4	3
Co. 13 x CP. 62	+ 8	+ 3	+ 12	+ 8	+ 5	+ 7	+11	+ 1	+ 9	+ 5	10
CP. 62 x Co. 13	+ 12	+ 1	+ 3	+ 4	+ 5	— 1	+13	+ 3	+ 8	+ 9	9
Co. 13 x CH. 63	+ 85	+ 29	+ 25	+18	+ 5	+17	+ 4	— 1	+ 6	+ 4	9
Ptb. 10 x CH. 62	— 11	+ 27	+ 13	— 2	+ 5	— 2	+ 1	+ 9	+ 3	+ 7	7
CP. 62 x Ptb. 10	— 49	— 8	+ 13	— 6	— 9	—10	+ 9	+ 3	+ 9	+ 8	5
Ptb. 10 x CH. 63	— 28	— 43	— 42	+ 2	—18	+ 1	+ 2	+12	+ 5	+ 9	6
CP. 63 x Ptb. 10	+ 21	+ 57	— 26	+21	+29	+35	+11	+ 3	+ 9	+ 6	9
Co. 45 x Co. 13	— 43	— 36	+ 48	+ 5	+ 2	—14	—23	+ 1	—11	— 8	4
Aij. 3 x CH. 63	— 24	— 2	— 7	+11	+ 5	+ 3	— 5	Nil	+ 5	+ 5	5
Co. 13 x T. 2357	+ 61	— 24	+ 31	+ 9	+ 2	+ 4	— 1	— 3	+ 3	— 6	6
T. 2357 x CH. 62	+ 42	+ 3	+ 37	+ 6	+ 2	— 4	+ 1	— 1	+ 9	— 1	5
CH. 63 x T. 2357	+ 61	+ 39	+ 44	+ 1	+ 2	+ 6	+ 4	— 6	+12	+ 2	9
Total No. of crosses showing + heterosis	11	11	15	13	11	10	15	14	18	15	

TABLE 2

Degree of heterosis for different characters in some inter-varietal hybrids of *O. satis a*

(Percentage increase over the higher parental value)

Cross combination	Grain yield / plant	Straw yield / plant	No. of tillers	Panicle length	Flowering duration	Plant height	100-grain-weight	Grain length	Grain breadth	Grain thickness	Total No. of characters showing + heterosis
Adt. 3 x Norin 1	-81	+ 79	— 8	+ 7	—5	—9	+ 2	— 4	+ 1	+ 1	5
Norin 1 x Adt. 3	—81	+268	+ 76	+ 7	— 6	+ 2	— 2	— 6	— 1	Nil	4
CH. 62 x Aikoku	—14	+ 20	+ 58	—13	—16	—35	+ 12	+ 6	+ 8	—1	5
Aikoku x CH. 62	+ 6	+138	+128	—10	—19	— 5	+ 4	+ 2	+ 7	+ 6	7
Norin 1 x CH. 62	—39	—49	+ 60	—20	— 6	— 5	+ 14	+ 3	+ 7	+ 2	5
Norin 1 x CH. 63	—25	— 22	— 27	— 5	—14	—7	+ 12	— 7	+ 9	+ 3	4
Aikoku x T. 2357	—64	— 71	— 40	—27	—37	—33	—15	—17	— 4	—6	—
T. 2357 x Aikoku	—44	— 71	—43	—27	—35	—37	-16	—19	— 6	—7	—
Co. 13 x CH. 62	—20	— 22	— 15	+ 7	+ 19	— 7	+ 7	— 6	+ 8	+ 5	5
CH. 62 x Co. 13	-17	— 23	— 22	+ 3	+ 19	-14	+ 8	— 3	+ 7	+ 8	5
Co. 13 x CH. 63	+ 34	+ 17	+ 11	+ 17	+ 21	+ 3	+ 1	— 4	+ 6	+ 3	9
Ptb. 10 x CH. 62	—20	+ 20	— 12	—2	+ 1	—2	—3	+ 1	+ 1	+ 6	5
CH. 62 x Ptb. 10	—55	— 13	— 12	— 6	—13	—10	+ 4	— 4	+ 7	+ 7	3
Ptb. 10 x CH. 63	—37	—51	— 47	—1	—19	— 1	— 1	+ 6	+ 3	+ 8	3
CH. 63 x Ptb. 10	+ 5	+ 34	— 32	+ 19	+ 27	+ 33	+ 7	— 2	+ 7	+ 5	8
CH. 45 x Co. 13	—58	— 49	+ 40	Nil	Nil	—25	—26	— 3	—11	—9	1
Adt. 3 x CH. 63	—29	— 17	— 18	+ 6	+ 13	+ 12	— 9	— 7	+ 5	+ 3	5
Co. 13 x T.2357	+ 57	— 36	+ 18	—2	—16	— 2	—14	—16	— 3	—8	2
T. 2357 x CH. 62	-12	— 35	+ 13	—15	—19	—20	—16	—18	+ 2	—3	2
CH. 63 x T. 2357	+ 86	+ 8	+ 43	—11	—18	—11	-13	—20	+ 5	—2	4
Total No. of crosses showing + heterosis	5	8	10	7	6	4	10	5	15	12	

Summary

Spread of heterosis in twenty inter-varietal hybrids in *Oryza sativa* has been ascertained. Breadth of grain shows positive heterosis in the maximum number of cross combinations. Eight hybrids show positive heterosis for grain yield and straw yield over the parental mean and four over the higher parental values. Positive heterosis to a marked extent for both grain and straw yields was recorded in certain *indica* x *Chinese* crosses.

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