

Heterosis in Wheat

by

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Introduction: The work on the development of hybrid wheat in India has been started very recently and very little information is available on the manifestation of hybrid vigour between indigenous and exotic varieties. The present investigations were carried out to find out the amount of heterosis in different crosses and which may further be used for the production of hybrid wheat.

Materials and Methods: Three strains *i.e.* NP 825, NP 824 and NP 823 developed at IARI, New Delhi, six strains *i.e.* Mex 5392, S 308, S. 395, S. 408, S 310 and S 210 received from Mexico and *Transac* obtained from United States were crossed with C 273 the local standard variety. The F₁ seed was space planted 27 cm apart in rows planted at an interval of 40 cm in a compact block with uniform fertility. Due to limited quantity of seed, only one row of each cross containing 10–12 plants was grown. Five plants in each row were selected at random for detailed observations. The data recorded for each of the five plants (which were averaged for presentation) were: 1) Number of tillers per plant 2) Plant height in cm from ground level to tip of the ear without awns, 3) Number of days taken to earing, 4) Length of ear in cm, 5) Number of spikelets per ear, 6) Number of grains per ear, 7) 1000-grain weight in g and 8) Grain yield per plant in g

The performance of the hybrids were compared against the parents (mean of the two parents) and with better parents. χ^2 values were calculated and compared against the tabulated values at 0.05 probability to test their significance.

Results: The data showing the performance of different hybrids for various characters are given in a table.

Number of tillers per plant: Seven of the ten hybrids possessed greater number of tillers than the mean of their parents, however only three of them exceeded their better parent. The maximum heterosis for this character was observed in the cross *Transac* x C 273 which had 18.4% greater number of tillers than its parents. Hybrids between crosses S 210 x C 273 and NP 825 x C 273 showed no hybrid vigour whereas in case of S 310 x C 273, the hybrids had 12% less tillers than their parents.

Plant height: All the ten crosses showed hybrid vigour for plant height as they were slightly taller than the mean of their parents; The hybrid,

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involving *Transac* and C 273 exceeded in height than C 273 which is the taller parent. In all the crosses involving dwarf and tall strains, the hybrids had lesser height than their tall parents.

TABLE I. *The performance of different hybrids for various characters*

Hybrid	Number of tiller per plant		Plant height		Days to earing		Length of ear	
	% increase or decrease of F ₁ over		% increase or decrease of F ₁ over		% increase or decrease of F ₁ over		% increase or decrease of F ₁ over	
	Parents	Superior Parents	Parents	Superior Parents	Parents	Superior Parents	Parents	Superior Parents
C 275 × S 386	7.9	0.0	9.1	-7.7	-4.9	-5.9	9.9	7.1
C 273 × S 395	11.4	11.4	4.7	-11.8	-2.7	-2.7	-3.5	-6.7
C 273 × S 408	7.9	-4.9	10.3	-7.5	-4.6	-6.8	0.0	0.0
C 273 × S 210	0.0	0.0	8.5	-2.4	-6.1	-8.5	-14.3	-22.9
<i>Transac</i> × C 273	18.4	9.7	8.0	6.6	0.8	-4.8	7.1	7.1
NP 825 × C 273	0.0	-14.3	1.4	-2.0	-1.4	-1.8	10.7	10.7
NP 824 × C 273	16.6	0.0	3.5	0.0	-1.4	-2.7	1.6	-3.3
NP 823 × C 273	10.3	-8.6	3.9	-0.9	0.0	-0.9	0.0	0.0
S 310 × C 273	-12.0	-38.6	6.1	-11.7	-2.8	-3.6	3.5	3.5
Mex × 5392 × C 273	12.3	8.0	10.9	-8.3	-4.4	-6.8	0.0	0.0

Hybrid	Number of spikelets per ear		No. of grains per ear		1000-seed wt.		Grain yield per plant	
	% increase or decrease of F ₁ over		% increase or decrease of F ₁ over		% increase or decrease of F ₁ over		% increase or decrease of F ₁ over	
	Parents	Superior Parents	Parents	Superior Parents	Parents	Superior Parents	Parents	Superior Parents
C 273 × S 396	0.0	-11.6	-19.2	-29.5	12.5	12.5	-10.0	-25.0
C 273 × S 395	-2.3	-8.7	16.6	8.6	26.5	25.0	66.0	55.0*
C 273 × S 408	-2.5	-4.8	-7.4	-12.3	18.7	12.5	-5.0	-23.1
C 273 × S 210	6.6	-4.0	-6.2	-15.3	32.4*	27.5	25.8	18.8
<i>Transac</i> × C 273	17.6	-3.3	13.9	-4.7	16.6	-12.5	69.3*	58.7*
NP 825 × C 273	2.1	-10.4	6.0	5.0	13.2	9.3	24.2	18.7
NP 824 × C 273	4.3	-7.5	14.6	6.9	23.4	21.9	51.7*	37.5*
NP 823 × C 273	-2.1	-14.9	3.4	1.6	-3.3	-15.1	21.6	12.5
S 310 × C 273	0.0	-8.4	3.7	-2.8	28.2	25.2	24.0	8.7
Mex × 5392 × C 273	7.3	4.7	16.0	4.1	27.7	15.0	59.0*	45.8*

* Significant at 5% level

Days taken to earing: In eight of the ten hybrids, the ear emerged earlier than the mean of their parents, however the difference was very meager. The cross C 273 × S 210 showed maximum heterosis for earliness in which

ear emergence took place in 108 days as compared to 112 and 118 days taken by the parents. Only in case of *Transac* × C 273 the hybrid was slightly later in earing than the mean of the parents.

Length of the ear: The length of the ears in five crosses C 273 × S 326, *Transac* × C 273, NP 825 × C 273, NP 824 × C 273 and S 310 × C 273 exceeded their parents, the superiority of the hybrids being 1.6% to 10.7%. In crosses C 273 × S 408 and NP 825 × C 273, the length of the ear was only 13.5 cm compared to that of 14 cm and 17.5 cm of its parents, thus registering a decline of 22.9% over the superior parent.

Number of spikelets per ear: In five crosses, the hybrids had greater number of spikelets per ear than their parents whereas in the remaining five crosses they were either equal or less than their parents. The maximum heterosis for this character was depicted in the cross *Transac* × C 273 which had 17.6% more spikelets than the mean of the two parents. In all the crosses except Mex 5392 × C 273, the hybrids were inferior in number of spikelets per ear than their better parent.

Number of grains per ear: In seven crosses, the number of grains were greater than the parents, the superiority being as high as 16.6%. In three crosses i.e. C. 273 × S 386, C 273 × S 408 and C 273 × S 210, the hybrids possessed fewer grains than their parents. In case of C 273 × S 386, the hybrid had 19.2% and 29.5% fewer grains than the mean of the parents and superior parent respectively.

1000-seed weight: In all the crosses save NP 823 × C 273, the hybrids had greater seed weight than their parents, the maximum increase being in case of C 273 × S 210 where the F₁ hybrids had 32.4% higher seed weight. Eight of the ten hybrids also possessed heavier seed than their superior parents.

Grain yield per plant: Grain yield per plant of the hybrids varied from 10.0% to 69.3% over the mean of the parents. Only two crosses viz: C 273 × S 386 and C 273 × S 408 were inferior in yield than their parents. The yield of the remaining eight crosses not only exceeded the mean of the parents but the superior parents as well. The maximum heterosis for yield was observed in case of *Transac* × C 273 which was closely followed by C 273 × S 395 and Mex 5392 × C 273.

Discussion: The work reported to date reveal varying degree of heterosis for different characters (Engledew and Pal 1934, Pal and Sikka 1956). In the present study all the hybrids exceeded in height than the mean of their parents; however they were not as tall as the tall parent indicating that the dominance

of genes controlling height was not complete. The heterosis effect of number of spikelets per ear varied in different crosses. Five of ten crosses showed heterosis for this character. This may be done to the genetic back ground of the parents. Sikka *et al* (1959) observed F_1 's to be superior to the parents. The data on days taken to earing show that in most cases earliness was dominant over lateness. Grain weight was the most important yield component showing considerable heterosis effect. Save *Transac* \times C 273 and NP 823 \times C 273, the grain weight of all the hybrids exceeded to that of their superior parents. Similar results were reported by Sax (1921) and Briggie and Daum (1964) for 1000 grain weight in wheat.

In eight of the ten crosses, the yield of the hybrids was greater than their respective higher yielding parents. The yield of the hybrids involving S 386 and S 408 was lower than the mean of their parents indicating that these two strains are poor combiners. Four strains *i e.* S 395, *Transac*, NP 824 and Mex 5392 showed high heterosis and their hybrids with C 273 outyielded their superior parents proving high combining ability of these strains. Gandhi *et al* (1961) and Briggie and Daum (1964) observed considerable heterosis for grain yield in wheat crosses. The superior yield performance of the hybrids is indicative of the scope of hybrid wheat. Although more work is needed for the commercial utilization of heterosis in wheat, the present study will help a great deal in this direction.

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