Vol. XIII (2), 1976.

HETEROSIS IN INTER- AND INTRA-SPECIFIC CROSSES OF BRASSICA

Rana Muhammad Afzal Naz, Muhammad Aslam Javed and Siraj-ud-Din Shah*

Eleven inter- and intra-specific crosses of Brassica were involved in these studies. Considerable heterosis was observed for total number of pods and primary branches while the average number of seeds per pod, 1000 seed weight and seed-yield per plant showed moderate heterosis. Generally, the amount of heterosis expressed in intrspecific crosses was more pronounced than in the interaspecific crosses.

INTRODUCTION

Although a few attempts seem to have been made to determine the extent of crossability in brassica, yet there appears to have been made no systematic study of hybrid performances of the Brassicas and possibility of its commercial exploitation. Kiss (1953) observed that in interspecific crosses of Brassica, fruit set and number of seeds per fruit were higher with B. napus as female parent than in the reciprocal crosses Olsson (1955) found that heterotic effects were more pronounced in intraspecific crosses between B. campestris, B. chinensis and B pekinensis than the intervarietal crosses of B. campestris. Grabeic (1967) studied interspecific crosses in genus brassica and reported marked changes in the morphology, fruit shape, and seed size and colour; he observed high degree of heterosis in the hybrids. Afzal (1970), while studying inter-and intra-specific crosses of Brassica, found that heterosis occurred to a large extent for total number of seeds per pod. The present study was initiated to explore the extent to which heterosis might be expressed for certain agronomic characters in inter- and intra-specific crosses of Brassica under local conditions.

MATERIALS AND METHODS

The research work was carried out in the Department of Plant Breeding and Genetics, University of Agriculture, Lyallpur during the years 1973 and 1974. The experimental materials consisted of the following crosses involving seven different species :—

1. B. campestris (toria) x B. campestris (sarson).
2. B. campestris (toria) x B. napus.

*Department of Plant Breeding and Genetics, University of Agriculture, Lyallpur

3. B. campestris (toria) x B. chinensis.
4. B. campestris (toria) x B. trilocularis.
5. B. trilocularis x B. campestris (sarson).
6. B. trilocularis x B. chinensis.
7. B. nigra x B. chinensis.
8. B. nigra x B. napus.
9. B. juncea x B. campestris (sarson).
10. B. juncea x B. napus.
11. B. juncea x B. chinensis.

While attempting these crosses, pollinations were made invariably in the bud stage after emasculation with a pair of fine forceps. All the precautions necessary to avoid contamination of the treated flowers were observed.

The following year the successful crosses alongwith their parents were planted under conditions of average soil fertility, in a randomized complete block design, with three replications. The plants were spaced 36 cms apart in 54 cms wide rows.

The data were recorded on five agronomic characters of the F1 plants. The analysis of variance was run on the data to determine the significance of differences among the various hybrids and the parent populations. Mean performances of the F1's were compared by the new Duncan's multiple range test.

RESULTS AND DISCUSSION

Number of branches per plant.

All the crosses except B. juncea x B. chinensis (9.13) and B. juncea x B. napus (9.03) produced a greater number of branches than their respective mid-parents. Five crosses showed appreciable increase in the number of branches than their mid- as well as the better-parents. Maximum hybrid vigour for this character (35.44%) appeared in the cross B. juncea x B. campestris (sarson). Since most of the crosses outperformed their mid- as well as better-parents, it is most likely that the observed heterosis in F1 was mostly free from species control. A highly significant 'F' value (3.16) with S.E. of 0.76 for this character revealed real differences among the various F1 hybrids and their parents.

Number of pods per plant.

Ten crosses showed an increase over their mid- as well as the better-parents. Five crosses expressed highly significant heterosis with an 'F' value of 10.78 and S.E. of 62.71; whereas one cross indicated negative values for this character. The cross B. campestris (toria) x B. trilocularis produced the maximum number (1199.06) of pods per plant. The maximum increase over the mid- and the better-parents was shown by the cross B. campestris (toria) x B. trilocularis, with the values of 131.05% and 105.14% respectively.

TABLE 1. *Average number of branches per plant in different varieties and their F_1 hybrids.*

Crosses	Female parent	Male parent	Mid-parent	F_1	Percent increase (+) or decrease (—) of F_1 over	
					Mid-parent	Better Parent
1. B. campestris (toria) x B. campestris (sarson)	9.63	8.20	8.91	10.46	+17.39	+8.61
2. B. campestris (toria) x B. napus.	9.63	9.00	9.31	12.06	+29.53	+25.23
3. B. campestris (toria) x B. chinensis	9.63	9.06	9.34	9.93	+ 6.31	+3.11
4. B. campestris (toria) x B. trilocularis.	9.63	9.20	9.41	12.60	+33.90	+30.84
5. B. trilocularis x B. campestris (sarson).	9.20	8.20	8.70	11.16	+28.27	+21.30
6. B. trilocularis x B. chinensis.	9.20	9.06	9.13	9.23	+1.09	+0.32
7. B. nigra x B. chinensis.	9.96	9.06	9.51	9.83	+3.36	—1.30
8. B. nigra x B. napus.	9.96	9.00	9.48	11.86	+25.10	+19.07
9. B. juncea x B. napus.	9.53	9.00	9.26	9.03	—2.48	— 5.24
10. B. juncea x B. campestris (sarson)	9.53	8.20	8.86	12.00	+35.44	+25.91
11. B. juncea x B. chinensis.	9.53	9.06	9.29	9.13	—1.72	— 4.19

TABLE 2. *Average number of pods per plant in different varieties and their F_1 hybrids.*

	Crosses	Female parent	Male parent	Mid-parent	F_1	Percent increase (+) or decrease (—) of F_1 over	
						Mid-parent	Better parent
1.	B. campestris (toria) x B. campestris (sarson)	584.50	416.70	500.60	925.56	+84.89	+58.35
2.	B. campestris (toria) x B. napus	584.50	471.96	528.23	665.50	+25.04	+13.85
3.	B. campestris (toria) x B. chinensis.	584.50	543.36	563.93	769.60	+36.47	+31.66
4.	B. campestris (toria) x B. tilocularis.	584.50	453.43	518.96	1199.06	+131.05	+105.14
5.	B. tilocularis x B. campestris (sarson).	453.43	416.70	435.06	630.56	+44.93	+39.06
6.	B. tilocularis x B. chinensis.	453.43	543.36	498.39	756.26	+51.74	+39.18
7.	B. nigra x B. chinensis.	674.36	543.36	608.86	1005.66	+65.17	+49.12
8.	B. nigra x B. napus.	674.36	471.96	573.16	771.93	+34.67	+14.40
9.	B. juncea x B. napus.	649.23	471.96	560.59	524.26	+ 6.48	—19.24
10.	B. juncea x B. campestris (sarson).	649.23	416.70	532.96	682.43	+28.04	+5.11
11.	B. juncea x B. chinensis.	649.23	543.36	596.79	704.70	+18.08	+8.54

TABLE 5. *Average seed yield (grams) per plant of different varieties and their F_1 hybrids.*

	Crosses	Female parent.	Male parent	Mid-parent.	F_1	Per cent increase (+) of decrease (—) of F_1 over	
						Mid-parent.	Better parent.
1.	B. campestris (toria) x B. campestris (sarson)	21.27	14.20	17.73	20.02	+12.91	... 5.87
2.	B. campestris (toria) x B. napus	21.27	8.10	14.68	9.08	—38.14	—57.31
3.	B. campestris (toria) x B. chinensis.	21.27	10.96	16.11	23.83	+47.92	+12.03
4.	B. campestris (toria) x B. trilocularis.	21.27	8.96	15.11	25.11	+66.18	+18.05
5.	B. trilocularis x B. campestris (sarson)	8·96	14.20	15.58	12.31	+ 6.30	—13.30
6.	B. trilocularis x B. chinensis.	8.96	10.96	9.96	20.33	+104.11	+85.49
7.	B. nigra x B. chinensis.	13.26	10.96	12.11	14.36	+18.57	+ 8.29
8.	B. nigra x C. napus	13.26	8.10	10.68	14.42	+35.01	+ 8.74
9.	B. Juncea x B. napus.	16.60	8.10	12.39	6.06	—51.08	—63.69
10.	B. Juncea x B. campestris (sarson).	16.69	14.20	15.44	9.33	—39.57	—44.02
11.	B. juncea x B. chinensis.	16.69	10.26	13.82	9.34	—32.41	—44.03

LITERATURE CITED

Afzal, M. 1970. Heterotic development of plant characters in some inter- and intra-specific crosses of Oleiferous brassica. M.Sc. thesis, Univ. of Agri., Lyallpur.

Grabeic, B. 1967. Investigations in the interspecific crosses of the genus Brassica. Hodowala Roslin Aklimatyz Nasianic Two. 11; 178—234. P.B. Abst. 38, 1968.

Kiss, A. 1953. Interspecific hybridization with rape and turnip rape. Noventermeles, 2: 134–143 P.B. Abst. 24, 1954.

Olsson, G. 1955. Crosses within the campestris group of genus Brassica. Hereditas Lund. 40: 398—418.

Singh, P. 1973. Heterosis and combining ability estimates in Indian Mustard (B. juncea, L). Crop Sci. 13 (5): 497–499.