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Heterosis in Varietal Crosses of Maize

by

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Five flint parents, five dent parents and the 25 crosses between them were planted in a randomised block design with four replications to study the heterotic response for grain yield and flowering date. A large number of crosses showed high degree of heterosis for yield and earliness over mid parents. A close association was recorded between the performance of parents and their hybrids. The utility of such crosses in maize breeding programme has been discussed.

INTRODUCTION

High Heterosis in intervarietal crosses of maize has been reported in the past by Lonnquist and Gardner(1961) Dhawan and Singh (1961), Moll, Salhauna and Robinson (1962) and Paterniani and Lonnquist (1963). They observed a spectacular increase in yield of F_1's when crosses were made between parents of wider genetic diversity and contrasting endoperm types. The present investigation was undertaken to study the response of heterosis in crosses of dent and flint parents of white grained maize. The parents involved were of sufficient genetic diversity.

MATERIAL AND METHODS

The experiment involved ten white grained parents of dent and flint types These were composite A_8 (flint), Sonora Gr. II (flint), CRHT composite (flint), B_1(W) (flint), (KT 41 x NL Gr. 7) (flint), Composite A_4 (dent); Mexican June (dent), Chihuaha Gr. 13 (dent), Jellicorse (dent) and (CM 400 x CM 300) (dent). Crosses were made between flint (as seed parent) and dent (as pollen parent) stocks and seeds of 25 crosses were procured by hand pollination. The ten parents and their 25 crossed were grown at Rajendra Agricultural university farm in a randomised block design with four replications. The recommended hybrid Ganga safed-2 was included as check. Observations were recorded on grain yield and days to silk. Heterosis was calculated as percentage increase in F_1 generation over the mid parent and the better parent.

RESULTS AND DISCUSSION

The significant differences existed among parents and their crosses for yield and days to silk (Table 1). The mean performance of mid parents, better parents and F_1's for yield and days to silk are listed in Table 2 and 3 respectively. These tables also show the manifestation of heterosis in crosses over mid parent and better parent. A perusal of data in table 2 shows that the average heterotic response over mid

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parent was 20 per cent with a range of-12.48 to 73.94 percent. Similarly, the manifestation of heterosis over better parent was present to the extent of 40.93 per cent. The average heterotic response over better parent was 8 per cent. The highest yielding F_1 cross was CRHT Comp. x Jellicorse (4431 kg/ha) which yielded 40.80 per cent more over its better parent and 8.58 per cent more over Ganga safed 2, a widely grown hybrid in this State. Eleven of the crosses exhibited significant heterotic response over mid parent while 8 crosses were significantly superior to both mid as well as better parents. The average yield of the crosses was significantly correlated ($r=0.404$) with the mid parent value.

The average heterotic response for days to silk was 3 per cent with a range of-4 per cent to 11 per cent (Table 3). When compared with better parent, the average heterotic response was 0.52 per cent with a range of-7 to 9 per cent. Here mention may be made that positive heterosis in this case refers to earliness and in a cross better parent means earlier parent. The earliest cross was Sonora Gr. II x Mexican June which exhibited 11.42 and 8.54 per cent heterosis over mid parent and better parent respectively. Similarly the cross Sonora Gr. II x Chiuaha Gr. 13 was quite early (58 days). It may be noted from Table 2 that these crosses also exhibited high degree of heterosis for yield.

This investigation reveals that all the crosses of Jellicorse (dent) with flint parents gave highly significant heterotic response. This is in agreement with the findings of Lonnquist and Gardner (1961), Moll, Salhauna and Robinson (1962), and Paterniani and Lonnquist (1963). Dhawan and Singh (1961) also reported high yield of crosses between dent and flint parents. A close association ($r = 0.404$) between the performance of parents and hybrids supports earlier findings of Jenkins (1929) and Hayes and Johnson (1939). Their findings have an added significance since the parents included in this study are composites and not the inbred lines as used in their studies. From the stand point of economy and practicability the development of new hybrid merits consideration only when it exceeds in yield the widely grown hybrid by at least 25 per cent margin. In the present investigation even though several crosses have shown appreciable increase over their better parants none could outyield Ganga Safed-2. However. certain crosses like Sonora Gr. II (W) x Mexican June, Sonora Gr. II (W) x Chihuaha Gr. 13; and CRHT comp. x Jellicorse exhibited an ideal combination of yield as well as flowering date. They have exhibited significant heterotic response with respect to yield as well as days to silk. These crosses may form new base materials to start breeding programmes. In recent years increasing importance of additive genetic variance is being realised in maize populations (Lindsey, Lonnquist and Gardner (1962), and stuber, Moll and Hanson, (1966). Thus the high yielding crosses recorded in this study may be used as base population to start recurrent selection programme to extract inbred lines for use in hybrid breedings programme.

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TABLE 1 Analysis of variance fo. yield and days to silk

Sources of : Variation :	D. F.	Mean squares	
		Yield	Days to silk
Replication	3	0.83	4.56
Male	4	5.54**	28.27**
Female	4	0.87	63.89**
Female x Male	16	1.18**	12.70**
Error	72	0.45	4.41

* Significant at 5% level

** Significant at 1% level

TABLE 2. Meen performance and expression of heterosis over mid parent and better parent for yield.

Crosses	Mean performa (Kg/ha)			Heterosis in percentage over	
	Mid parent	Better parent	Fi crosses	Mid parent	Better parent
Comp A3 × Comp A4	3205	3445	3742	16.75	8.62
Comp A3 × Mexican June	3164	3445	3073	−2.89	−12.10
Comp A3 × Chihuaha Gr. 13	2496	3445	2749	10.14	-25.31*
Comp A3 × Jellicorse Syn	3157	3445	4019	27.30*	16.61
Comp A3 × (CM 400 × CM 300)	3779	4113	3694	− 2.24	−11.34
Sonora Gr. II (W) × Comp A4	2679	2965	3742	39.67*	26.20*
Sonora Gr. II (W) × Mexican June	2688	2965	3573	32.92*	23.89*
Sonora Gr. II (W) × Chihuaha Gr. 13	2019	2492	3512	73.94*	40.93*
Sonora Gr. II (W) × Jellicorse Syn.	2681	2870	3708	38 30*	20.19*
Sonora Gr. II (W) × (CM 400 × CM 300)	3303	4113	2891	−12.48	−29.72
CRHT Comp × Comp A4	3056	3147	3694	20.87*	17.38
CRHT Comp × Mexican June	3016	3147	3418	13.32	8 61
CRHT Comp × Cnihuaha Gr. 13	2346	3147	3384	44.24*	7.53
CRHT Comp × Jellicorse Syn	3009	3147	4431	47.25*	40.80*
CRHT Comp × (CM 400 × CM 300)	3630	4113	3694	1.76	−11.34
Comp B1 (W) × Comp A4	3100	3235	2911	−6.09	−11.13
Comp B1 (W) × Mexican June	3060	3235	2972	−2.87	−8.84
Comp B1 (W) × Chihuaha Gr. 13	2391	3235	2870	20.02	12.71
Comp B1 (W) × Jellicorce Syn	3053	3235	3890	27.41*	20.24*
Comp B1 (W) × (CM 400 × CM 300)	3674	4113	4073	10.86	−0.98
(KT 41 × NL Gr 7) × Comp A4	2947	2965	3667	24.43*	23.67*
(KT 41 × NL Gr. 7) × Mexican June	2884	2884	3134	8.66	8 66
(KT 41 × NL Gr. 7) × Caihuaha Gr. 13	2215	2884	2756	24.42	−4.64
(KT 41 × NL Gr. 7) × Jellicorse Syn.	2877	2884	3701	28.64*	28.32*
(KT 41 × NL Gr. 7) × (CM 400 × CM 300)	3499	4113	4032	15.23	−2.00
Ganga Safed 2 (Check)			4081		
C. D. at 5%	–	–	–	543 Kg/ha	622 Kg/ha

Mid parent 'r' = 0.404* Better parent 'r' = 0.139

*Significantly different from parent.

Table 3. Average days to silk and heterosis over mid parent and better parent for silking date.

Average days to silk			Heterosis in percent over	
Mid parent	Better parent	F 1 crosses	Mid parent	Better parent
63.37	61.00	62.50	1.38	−2.45
63.25	61.00	65.50	−3.55	−7.37
62.87	61.00	62.50	0.59	−2.45
60 51	60.00	59.00	2.50	1.67
59 50	58.00	59.75	−0.42	−3.01
63.62	61.50	59.52	6.48*	3.26*
63.50	61.50	56.25	11.42*	8.54*
63.12	61.50	58.50	7.32*	4 88*
60.75	60.00	59.50	2.06	0.84
59.76	58 00	59.75	0 00	−3.01
64.00	62 25	59.75	6 65	4 02
63.87	62.25	59.75	6.46*	4 02
63.50	62.25	60.00	5.52*	3 62
61 12	60.00	58.50	4.29*	2.50
60.12	58 00	59.75	0 62	−3.01
66.62	65.75	62.25	6 56*	5.33*
66.50	65.75	64.75	2 64	1 15
66.12	64.75	66.50	−0·57	−2.70
63.75	60.00	60.75	4.71	−1 25
62.75	58.00	60.00	4.39*	−3.44
61.12	56.50	59.50	2.66	−5 30*
61.00	56.50	61.50	−0.81	−8.84*
60.62	56 50	60.00	1.03	−6 19*
58.25	5650	57.50	1.29	−1.76
57.25	56.50	57.25	0.00	−1.32
...	...	57 00	...	...
C. D. at 5%			2.52	2.91

Mid parent 'r' = 0.608** Better parent 'r' = 0.517*

a — See Table 2 for details of parents

*Significantly different from parent.