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Research article

HETEROSIS STUDIES FOR GRAIN YIELD AND ITS COMPONENT TRAITS IN SINGLE CROSS HYBRIDS OF MAIZE (*Zea Mays* L.)

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ABSTRACT: A line × tester set was obtained by crossing 15 inbred lines with 3 testers in maize. Forty five F_1`s along with 18 parents (15 lines and 3 testers) and two standard checks were evaluated in Randomized Block Design with three replications for eleven characters during kharif, 2011. Out of 45 crosses, 42 crosses over better parent and 28 crosses over standard check (DHM 117) significantly out yielded for grain yield. The crosses 5050 × BML 10, 3511 × BML 7, 1234 × BML 10, 1234 × BML 13 and 5050 × BML 7 had high mean performance and standard heterosis over check DHM 117 for grain yield per plant and other yield contributing characters like number of kernels per row, 100-kernel weight, number of kernel rows per ear, ear girth and ear length. Thus these crosses possess high heterosis which can be exploited commercially for higher yield in maize.
Key words: Maize, Standard heterosis, Grain yield per plant, Lines, Testers

INTRODUCTION

Maize ranks third amongst the cereal crops in the world next to rice and wheat for area and production. It is one of the most important cereal crop in the world agriculture economy both as food for human beings and a feed for animals and industrial uses. Because of its immense potential, maize occupies the unique place as queen of cereals. Maize is a highly cross pollinated crop and the scope for the exploitation of hybrid vigour will depend on the direction and magnitude of heterosis and also the type of gene action involved. The magnitude of heterosis provides information on extent of genetic diversity of parents in developing superior F_1s so as to exploit hybrid vigour and has direct bearing on the breeding methodology to be adapted for varietal improvement. Hence, the present investigation was carried out to know the direction and magnitude of heterosis in maize.

MATERIALS AND METHODS

Fifteen inbred lines of maize *viz.*, BML 14, PVT MH 08-09, 3511-2, 3530-3, 3521-3-1, 3521 A-2-3, CML 284, CML 409, CML 423, Z56-5, 5040, 5050, 5059, 5076, 1234 were crossed with three testers *viz.*, BML 10, BML 13 and BML 7 during *rabi*, 2010-11 at Maize Research Centre, Rajendranagar, Hyderabad to generate 45 crosses. The forty-five crosses and eighteen parents, along with standard check (DHM 117) were evaluated in randomized block design with three replications at Research farm, College of Agriculture, ANGRAU, Rajendranagar, Hyderabad during *kharif*, 2011. Each entry was raised in two rows with a row length of 4m and the spacing maintained was 75 cm between rows and 20 cm between plants. The recommended package of practices was followed to raise a good crop. Observations were recorded on five randomly tagged plants for plant height, ear height, ear length, ear girth, number of kernel rows per ear, number of kernels per row, 100-kernel weight and grain yield per plant [4]. Whereas, observations for the characters namely days to 50 % tasseling, days to 50 % silking, days to maturity were recorded on plot basis. The mean values were used for statistical analysis. Computation of heterosis for all characters was carried out as per procedure suggested by Fonesca and Patterson [5].

RESULTS AND DISCUSSION

Analysis of variance revealed significant differences for all the 11 quantitative traits studied which was presented in Table 1. This indicates considerable variability existed among genotypes for all the characters studied.

The mean squares due to parents and crosses were highly significant for all the characters which indicated that the parents chosen were diverse and with a different genetic background. Similarly, significant mean squares due to parents vs. crosses indicated presence of average heterosis for all the characters. These results were in confirmation with Avinashe [2], Premalatha [7], Sundarajan and Shenthil [11] and Saidaiah [9]. Considerable amount of heterosis was observed for all the eleven characters under study, however the magnitude varied with characters presented in Table 2. In the present study, out of 45 crosses, heterosis for grain yield per plant was significant and positive in 42 crosses over better parent and 28 crosses over standard check (DHM 117) respectively. Among these, five crosses 5050 x BML 10 (25.25%), 3511-2 x BML 7 (23.97%), 1234 x BML 10 (23.20%), 1234 x BML 13 (23.03%) and 5050 x BML 7 (21.03%) recorded highest positive significant heterosis over standard check DHM 117. Similar results of commercial exploitation of maize crosses were reported by Avinashe [2], Singh [10], Hemavathy and Balaji [6] and Saidaiah [9]. The range of heterosis for 100-kernel weight varied from -12.93 (PVT MH x BML 13) to 45.83 % (5050 x BML 10) over better parent and from -27.92 (3521-3-1 x BML 7) to 13.05 % (5059 x BML 10) over standard check. For number of kernels per row, the range of heterobeltiosis and standard heterosis varied from -12.59 (5059 x BML 10) to 105.72 % (3511-2 x BML 7) and -6.65 (PVT MH 08-09 x BML 13) to 19.57 % (3511-2 x BML 7) respectively. Similarly, for number of kernel rows per ear, heterosis ranged from -10.17 (3521A-2-3 x BML 7) to 26.92 % (3511-2 x BML 7) over better parent and from 16.24 (Z56-5 x BML 13) to 12.82 % (3511-2 x BML 7) over standard check. The range of heterosis for ear girth varied from -8.61 (CML 409 x BML 7) to 28.72 % (3511-2 x BML 10) over better parent and -23.29 (CML 409 x BML 7) to 6.83 % (3511-2 x BML 7) over standar check. For ear length, the range of heterobeltiosis and standard heterosis varied from -6.76 (5040 x BML 13) to 43.59 % (3521A-2-3 x BML 7) and -14.08 (5076 x BML 13) to 18.31 % (3521A-2-3 x BML 7) respectively. These results were in confirmation with Ram reddy [8], Bhavana [3] and Singh [10].

Table 1. Analysis of variance for grain yield and its component traits in maize

Source of variation	d.f	Days to 50% tasseling	Days to 50% silking	Days to Maturity	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear girth (cm)	Number of kernel rows per ear	Number of kernels per row	100 kernel weight (g)	Grain yield (g per plant)
Replications	2	2.13	3.11	6.68	444.45 *	226.27 **	1.46 *	0.89 *	0.02	0.13	0.06	2.13
Genotypes	62	42.27 **	43.48 **	38.40**	1650.06 **	497.19**	12.39 **	4.40 **	3.76**	79.98**	45.75 **	4590.39**
Parents	17	65.49 **	69.34**	49.73**	1748.84 **	391.99**	10.06**	2.41**	3.69**	96.54**	29.53 **	3571.86 **
Parent vs crosses	1	720.57 **	697.30**	267.47**	37354.67**	11020.24**	411.60**	128.59**	46.23**	2608.55**	1048.83 **	175151.61**
Crosses	44	17.88 **	18.63**	28.82**	800.43**	298.67**	4.21**	2.35**	2.83**	16.12**	29.22 **	1107.52 **
Lines	14	30.59 **	26.48	42.41	545.12	243.81	5.13	3.11	3.50	28.10 *	33.98	1557.75
Testers	2	26.58	19.48	35.46	3712.28 *	1708.98 **	17.64 **	3.43	3.21	5.05	19.41	1272.01
Line x Testers	28	10.90 **	14.63**	21.55**	720.10**	225.37**	2.80 **	1.90**	2.46**	10.92**	27.54**	870.66**
Error	124	1.809	1.836	2.424	134.187	36.018	0.342	0.180	0.134	0.541	0.197	3.577

Table 2. The range of heterobeltiosis and standard heterosis and number of crosses showing significant heterobeltiosis and standard heterosis for 11 characters in single cross hybrids of maize.

S.No.	Character	Range of heterobeltiosis (%)	Range of Standard heterosis (%)	No. of crosses showing significant	
				Heterobeltiosis	Standard heterosis
1	Days to 50 % tasseling	-25.54 to 5.33	-19.38 to 0.63	42	36
2	Days to 50 % silking	-24.87 to 1.91	-19.30 to -1.71	41	41
3	Days to maturity	-13.29 to 2.95	-9.82 to 2.18	33	32
4	Plant height	-9.02 to 46.61	-22.55 to 7.62	21	1
5	Ear height	-8.04 to 53.02	-33.81 to 6.04	25	0
6	Ear length	-6.76 to 43.59	-14.08 to 18.31	39	7
7	Ear girth	-8.61 to 28.72	-23.29 to 6.83	35	1
8	Number of kernel rows per ear	-10.17 to 26.92	-16.24 to 12.82	22	3
9	Number of kernels per row	-12.59 to 105.72	-6.65 to 19.57	39	28
10	100-kernel weight	-12.93 to 45.83	-27.92 to 13.05	36	11
11	Grain yield per plant	-9.73 to 239.99	-35.13 to 25.25	42	28

The range of heterosis for plant height and ear height characters varied from -9.02 (CML 409 x BML 7) to 46.61% (3521-3-1 x BML 13) and -8.04 (5059 x BML 13) to 53.02 % (CML 409 x BML 13) over better parent and -22.55 (5050 x BML 13) to 7.62 % (CML 284 x BML 7) and -33.81 (1234 x BML 13) to 6.04 % (5040 x BML 7) over standard check, respectively. These results were comparable with findings of Ram reddy *et al.(*2011), Bhavana *et al.*(2011) and Chattopadhay *et al.* (2005). Heterosis in negative direction is desirable for days to 50% tasseling, days to 50% silking and days to maturity. For days to maturity trait, 33 crosses over better parent and 32 crosses over standard check exhibited significant negative heterosis. The range varied from -13.29 (3521-3-1 x BML 13) to 2.95 % (5059 x BML13) over better parent and from -9.82 (3521-3-1 x BML 13) to 2.18 % (5050 x BML 10) over standard check. The range of heterosis for days to 50% tasseling and days to 50% silking varied from -25.54 (5050 x BML 7) to 5.33 % (3521A-2-3 x BML13) and -24.87 (5050 x BML 7) to 1.91 % (CML 423 x BML 13) over better parent and from -19.38 (Z56-5 x BML 10) to 0.63 % (3521A-2-3 x BML 7) and -19.30 (Z56-5 x BML 10) to -1.17 % (3521A-2-3 x BML 7 and 5076 x BML 7) over standard check, respectively. Negative heterosis for these three characters indicates the possibilities for breeding of maize for earliness and results were in conformity with earlier reports of Avinashe [2], Saidaiah [9] and Appunu [1].

CONCLUSION

The crosses 5050 × BML 10, 3511 × BML 7, 1234 × BML 10, 1234 × BML 13 and 5050 × BML 7 had high mean performance and standard heterosis over check DHM 117 for grain yield per plant and other yield contributing characters like number of kernels per row, 100-kernel weight, number of kernel rows per ear, ear girth and ear length. The present study on heterosis had indicated clearly that heterotic response for yield and its components result only in selected cross combinations. Further, this indicates the predominant role of non-fixable inter-allelic interactions. Thus, these crosses may be commercially exploited after critical evaluation for its superiority in performance with stability across the locations over years.

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