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Heterosis breeding in maize (*Zea mays* L.)

C.G. PATEL, D.B. PATEL, N.D. PRAJAPATI, M.D. PATEL AND K.R. PATEL

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SUMMARY

Twenty eight F_1 crosses of maize derived by diallel mating design involving 8 inbred lines (excluding reciprocals) was studied to investigate heterosis over better parent (BP) and standard heterosis over the best check Narmada Moti for grain yield per plant and ten yield components. The hybrids GWL-2 x GWL-12, GWL-2 x GWL-8, GWL-3 x GWL-12 and GWL-8 x GWL-12 showed significant positive heterobeltiosis and economic heterosis for grain yield per plant and other yield component traits.

Key words : Diallel cross, Economic heterosis, Heterobeltiosis, Inbred lines.

The phenomenon of heterosis for hybrid breeding has been commercially exploited in cross pollinated crops like maize, sunflower, pearl millet and sorghum. Maize is a highly cross pollinated crop and hand emasculation (detasseling) and wind borne pollination is used to produce hybrid seeds on a commercial scale. The cost of hybrid seeds at commercial scale is comparatively low due to higher rate of successful seed setting and large number of grains per ear. Heterosis is also useful in deciding the direction of future breeding programme and to identify the cross combinations which are promising for hybrid breeding programme. In the present study heterosis over better parent as well as standard check (Narmada Moti) were estimated as these varieties were quite different for grain yield and yield attributing traits.

MATERIALS AND METHODS

The present investigation was carried out to study heterosis in maize. The experimental material comprised of 8 inbred lines *viz.*, (CML-260, CML-264, GWL-2, GWL-3, GWL-8, GWL-12, GWL-14 and GWL-17) and hybrids generated by crossing the above inbreds in all possible combinations excluding reciprocals. The 8 parents and 28 hybrids were raised in randomized block design with three replications at agronomy farm, Anand Agricultural University, Anand during *rabi*-2006-07. All the management practices were followed as per recommendations, so as to raise a normal crop. Observations were recorded on 5 randomly selected plants of each treatment in each replication for 11 characters *viz.*, days to 50% tesseling, days to 50% silking, plant height (cm), ear height (cm), days to 75% dry husk, ear length (cm), ear girth (cm), number of grain rows per ear, number of grains per row, 100-kernal weight and grain yield per plant.

Correspondence to:
C.G. PATEL, Department of Plant Breeding and Genetics, C.P. College of Agriculture,S.D. Agricultural University, Sardar Krichingar, BANASKANTHA (GUJARAT) INDIA
Authors' affiliations:
N.D. PRAJAPATI, M.D. PATEL AND K.R. PATEL, Department of Plant Breeding and Genetics, B.A. College of Agriculture, Anand Agricultural University, ANAND (GUJARAT) INDIA

RESULTS AND DISCUSSION

For grain yield per plant, 6 hybrids exhibited significant heterosis over the better parent (Table 1). Of these, hybrids GWL-2 x GWL-12, GWL-2 x GWL-8, GWL-3 x GWL-12 and GWL-8 x GWL-12 showed significant better parent and economic heterosis over check Narmada Moti. The cross GWL-2 x GWL-12 was found significantly superior for ear length, ear girth and 100-kernel weight (better parent and Narmada Moti), ear height (Narmada Moti) and number of grains per row (better parent). The hybrid GWL-2 x GWL-8 exhibited significant heterotic effect for plant height, ear height and ear length (Narmada Moti); number of grains per row (better parent) and 100-kernel weight (better parent and Narmada Moti). The hybrid GWL-3 x GWL-12 manifested significant heterosis for days to 50 % tasselling and days to 50 % silking (better parent and Narmada Moti); plant height and ear height (Narmada Moti); ear girth and number of grains per row (better parent). While, the cross combination GWL-8 x GWL-12 was found significantly superior for days to 50 % tasselling, days to 50 % silking, plant height, ear height and days to 75 % dry husk (Narmada Moti). The hybrid CML-260 x GWL-17 exhibited significant heterosis for grain yield over standard check Narmada Moti along with the significant heterosis for component traits like days to 50% tasselling, plant height and ear height in desirable direction. All these crosses exhibiting desirable heterosis for grain yield; also showed heterosis for yield attributes. Thus, total yield could be the result of combinational heterosis. Similar findings were also obtained by Akhtar

Table 1 : Per cent heterosis over better parent and standard check (Narmada Moti) for grain yield and its component traits in maize

Hybrids / crosses	Days to 50% tesseling		Days to 50% silking		Plant height (cm)		Ear height (cm)		Days to 75% dry husk		Ear length (cm)	
	BP	Check	BP	Check	BP	Check	BP	Check	BP	Check	BP	Check
CML-260 x CML-264	-1.26	-3.68*	1.69	-1.09	59.03**	-1.39	51.23**	-16.60**	2.01	2.70*	-1.54	3.94
CML-260 x GWL-2	1.89	-0.61	2.81	0.00	47.03**	-1.27	39.53**	-6.98*	-2.65*	-0.68	-0.88	4.64
CML-260 x GWL-3	-6.29**	-8.59**	-2.81	-5.46**	57.79**	-7.20*	89.11**	-16.46**	-0.68	-2.03	4.62	10.44
CML-260 x GWL-8	6.90**	-4.91**	6.40**	0.00	74.22**	-7.39*	58.14**	-27.57**	3.46**	1.01	-3.31	8.35
CML-260 x GWL-12	-1.89	-4.29**	0.56	-2.19	29.69**	-5.85	89.96**	-5.15	-1.68	-1.35	4.84	10.67
CML-260 x GWL-14	2.01	-6.75**	1.69	-1.09	29.47**	-6.81*	6.59	-15.58**	5.23**	2.03	-15.16*	-10.44
CML-260 x GWL-17	1.30	-4.29*	3.37*	0.55	14.73**	-13.36**	40.8**	-12.80**	3.68**	4.73**	-4.62	0.70
CML-264 x GWL-2	-4.85**	-3.68*	-7.45**	-4.92**	29.98**	-19.40**	19.29**	-34.21**	1.68	2.36	-4.62	-4.18
CML-264 x GWL-3	-7.45**	-8.59**	-8.56**	-6.56**	22.38**	-28.02**	40.95**	-37.74**	1.71	0.34	3.73	3.25
CML-264 x GWL-8	2.07	-9.20**	0.00	-6.01**	53.22**	-18.55**	63.91**	-24.93**	3.46**	1.01	-3.73	7.89
CML-264 x GWL-12	-3.77*	-6.13**	-0.56	-2.73	25.20**	-22.36**	41.93**	-29.13**	-1.35	-1.01	3.96	3.48
CML-264 x GWL-14	0.67	-7.98**	-1.12	-3.28*	19.62**	-25.83**	40.17**	-22.70**	3.48**	0.34	2.56	2.09
CML-264 x GWL-17	-0.65	-6.13**	-1.12	-3.28*	33.71**	-17.09**	45.70**	-19.65**	-2.01	-1.35	8.86	8.35
GWL-2 x GWL-3	10.56**	9.20**	5.88**	8.20**	51.37**	-10.97**	66.72**	-26.36**	7.88**	6.42**	-0.92	-0.46
GWL-2 x GWL-8	23.45**	9.82**	15.12**	8.20**	70.24**	-9.51**	62.43**	-25.61**	6.92**	4.39**	6.83	19.72**
GWL-2 x GWL-12	0.00	-2.45	1.12	-1.09	42.45**	-4.35	63.23**	-18.50**	5.72**	6.08**	17.55*	18.10**
GWL-2 x GWL-14	11.41**	1.84	7.26**	4.92**	47.55**	-0.92	36.99**	-8.67**	10.45**	7.09**	11.78	12.30
GWL-2 x GWL-17	11.04**	4.91**	6.15**	3.83**	41.76**	-4.81	17.72**	-27.10**	5.69**	6.76**	8.78	9.28
GWL-3 x GWL-8	0.69	-10.43**	0.00	-6.01**	51.34**	-19.55**	76.53**	-22.02**	3.81**	1.35	-5.59	5.80
GWL-3 x GWL-12	-7.55**	-9.82**	-5.59**	-7.65**	41.56**	-16.74**	67.02**	-26.22**	0.68	-0.68	14.29	7.66
GWL-3 x GWL-14	0.67	-7.98**	-1.12	-3.28*	52.75**	-10.16**	86.20**	-17.75**	2.44	-0.68	28.50**	15.08*
GWL-3 x GWL-17	-1.95	-7.36**	-2.79	-4.92**	42.60**	-16.13**	84.82**	-18.36**	2.74*	1.35	20.44*	2.55
GWL-8 x GWL-12	0.69	-10.43**	0.58	-5.46**	60.03**	-14.93**	71.60**	-21.41**	-0.69	-3.04*	-5.59	5.80
GWL-8 x GWL-14	2.07	-9.20**	-1.16	-7.10**	72.19**	-8.47**	82.84**	-16.26**	2.09	-1.01	1.86	14.15*
GWL-8 x GWL-17	4.14*	-7.36**	1.74	-4.37**	78.42**	-5.16	81.51**	-16.87**	7.27**	4.73**	-3.31	8.35
GWL-12 x GWL-14	2.01	-6.75**	0.56	-1.64	17.70**	-15.28**	29.04**	-35.57**	3.48**	0.34	8.62	2.32
GWL-12 x GWL-17	-1.30	-6.75**	-1.68	-3.83**	22.00**	-11.43**	36.91**	-31.64**	-1.35	-1.01	-5.91	-11.37
GWL-14 x GWL-17	2.01	-6.75**	-1.68	-3.83**	33.37**	-4.00	39.93**	-13.35**	2.79*	-0.34	5.44	-5.57
Range of Heterosis	-7.55to 23.45	-10.43 to 9.82	-8.56to 15.12	-7.65to 8.20	14.73to 78.42	-28.02 to -0.92	6.59 to 89.96	-37.74 to -5.15	-2.65 to 10.45	-3.04 to 7.09	-15.16 to 28.50	-11.37 to 19.72
S. E. (±)	0.95	0.95	0.88	0.88	5.50	5.50	3.12	3.12	1.23	1.23	1.02	1.02

Contd..... Table 1

Table 1 contd....

Hybrids / crosses	Ear girth (cm)		Number of grain rows per ear		Number of grains per row		100-kernal weight		Grain yield per plant	
	BP	Check	BP	Check	BP	Check	BP	Check	BP	Check
CML-260 x CML-264	9.39*	2.45	4.12	-4.36	-8.39	-9.66	4.62	3.03	-15.31	-7.30
CML-260 x GWL-2	-5.44	-4.09	-16.79**	-9.15	7.23	5.75	3.08	1.52	-7.65	1.08
CML-260 x GWL-3	8.73	1.84	14.16**	4.40	6.29	4.83	-3.08	-4.55	-15.31	-7.30
CML-260 x GWL-8	-7.20	-7.77	-2.05	-4.76	3.26	1.84	2.90	7.58	5.19	15.14
CML-260 x GWL-12	9.07*	3.27	0.00	3.21	2.80	1.38	1.54	0.00	-3.21	5.95
CML-260 x GWL-14	3.25	-2.45	4.12	-4.36	-4.66	-5.98	-4.62	-6.06	-9.88	-1.35
CML-260 x GWL-17	-1.31	-7.57	1.96	-6.75	0.70	-0.69	13.85	12.12	12.59	23.24**
CML-264 x GWL-2	-5.65	-4.29	-8.03	0.42	1.41	-9.08	-6.35	-10.61	-12.01	-8.92
CML-264 x GWL-3	6.38	-4.50	7.16	-1.57	15.25	-6.21	3.08	1.52	10.79	-5.68
CML-264 x GWL-8	-2.67	-3.27	0.00	-2.77	23.16**	0.23	2.90	7.58	4.10	2.97
CML-264 x GWL-12	7.78	2.04	-1.16	2.01	17.25*	0.00	6.25	3.03	5.28	-2.97
CML-264 x GWL-14	4.33	-1.43	8.89	0.02	10.50	-8.05	6.35	1.52	1.10	-1.08
CML-264 x GWL-17	5.86	-3.89	3.69	-4.76	26.27**	2.76	0.00	-4.55	33.77**	9.19
GWL-2 x GWL-3	-1.21	0.20	-9.85*	-1.57	-0.77	-11.03	7.69	6.06	1.83	5.41
GWL-2 x GWL-8	-1.21	0.20	-5.47	3.21	15.38*	3.45	17.39*	22.73**	21.93*	26.22**
GWL-2 x GWL-12	8.47*	10.02*	-7.30	1.22	18.72*	6.44	25.00**	21.21**	44.91**	50.00**
GWL-2 x GWL-14	-1.01	0.41	-13.14**	-5.16	15.38*	3.45	12.70	7.58	12.27	16.22
GWL-2 x GWL-17	-1.81	-0.41	-15.33**	-7.55	4.87	-5.98	17.46*	12.12	8.62	12.43
GWL-3 x GWL-8	-3.91	-4.50	-3.28	-5.96	31.03**	4.83	-11.59	-7.58	2.19	1.08
GWL-3 x GWL-12	10.58*	4.70	4.25	7.59	24.26**	5.98	1.54	0.00	27.57**	17.57*
GWL-3 x GWL-14	2.16	-3.48	8.46	-0.38	24.59**	3.68	-1.54	-3.03	4.42	2.16
GWL-3 x GWL-17	10.14*	0.00	12.72*	2.41	27.63**	-2.30	3.08	1.52	26.67*	7.84
GWL-8 x GWL-12	2.47	1.84	0.39	3.61	11.59	-4.83	5.80	10.61	21.04*	19.73*
GWL-8 x GWL-14	-1.23	-1.84	-4.51	-7.15	15.47	-3.91	4.35	9.09	11.75	10.54
GWL-8 x GWL-17	-5.97	-6.54	-4.51	-7.15	17.24*	-6.21	-8.70	-4.55	1.64	0.54
GWL-12 x CWL-14	6.70	1.02	-1.16	2.01	4.04	-11.26	15.63	12.12	1.38	-0.81
GWL-12 x CWL-17	-4.54	-9.61*	-7.34	-4.36	-1.89	-16.32	7.81	4.55	3.23	-4.86
GWL-14 x CWL-17	8.23	2.25	3.25	-5.16	2.21	-14.94	6.35	1.52	4.70	2.43
Range of Heterosis	-7.20 to 10.58	-9.61 to 10.02	-16.79 to 14.16	-9.15 to 7.59	-8.39 to 31.03	-16.32 to 6.44	-11.59 to 25.00	-10.61 to 22.73	-15.31 to 44.91	-8.92 to 50.00
S. E. (±)	0.69	0.69	0.80	0.80	2.01	2.01	1.79	1.79	11.00	11.00

* and ** indicates significant of values at P0.05 and 0.01, respectively

and Singh (1981), Murthy *et al.* (1981), Nagda *et al.* (1995), Nagesh Kumar *et al.* (1999), Koirala and Gurung (2002) and Devi and Prodhan (2004).

It is clear from the above discussion that four crosses *viz.*, GWL-2 x GWL-12, GWL-2 x GWL-8, GWL-3 x GWL-12 and GWL-8 x GWL-12 could be further evaluated and exploited for commercial cultivation and these all hybrids GWL-2 x GWL-12, GWL-2 x GWL-8, GWL-3 x GWL-12 and GWL-8 x GWL-12 showed significant heterosis over Narmada Moti for grain yield and other desirable traits.

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