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Heterosis studies in chilli (*Capsicum annuum* L.) for earliness, growth and green fruit yield

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Chilli is an important vegetable and spice crop grown in almost all parts of tropical and subtropical regions of the world. Exploitation of hybrid vigour to increase the yield has become an important technique in vegetable breeding. But the conventional hand emasculation and pollination method used for hybrid seed production in chilli is highly uneconomical as it is a labours process. Early flowering is generally an indication of early yield which is most preferred by the growers to fetch the high market prices prevailing in the early cropping season and also to reduce the risk of crop maintenance in late season. Even though India ranks first in area and production of chilli, its productivity is very low as compared to foreign countries like Japan (3.6 t/ha) and Korea (2.0 t/ha.). One of the options to achieve quantum jump in yield is heterosis. Heterosis breeding provides an opportunity in productivity, earliness and yield attributing characters. Hence, present investigation was undertaken to study the magnitude of heterosis for earliness, growth and green fruit yield in chilli.

The experimental material consisted of eight parents viz., Phule Joyti (P_1), Phule Mukta (P_2), AC-2 (P_3), Surakta (P_4), AC-8 (P_5), Guntur-2 (P_6), Delhi Heart-2 (P_7) and Agnirekha (P_8). These parents were crossed according to diallel mating design without reciprocal to get 28 F_1 hybrids. All the eight parents, 28 hybrids and one commercial hybrid were transplanted on 5th March, 2007 and spaced 75 x 60 cm apart in randomized block design with three replications. All the cultural practices and plant protection measures were followed as and when required. The observations were recorded on days to 50 % flowering, plant height (cm), fruit length (cm), fruit diameter (cm), number of branches/plant, number of fruits/plant and yield of green fruit/plant (kg). The mean over the replications for all parents and hybrids for each of characters was calculated and used in the estimation of heterosis. The Magnitude of heterosis was calculated as per cent increase or decrease in F1 over means of better parent (BP) and commercial hybrid (SH).

Data revealed that there were significant differences for all the characters. The parent AC-2 (P_3) was found best for days to 50% flowering (42.67) and number of branches per plant, Delhi Heart-2 (P_7) for plant height (75.266 cm), number of branches per plant (9.60) and length of fruit (11.55 cm), AC-8 (P_5) and Agnirekha (P_8) for fruit diameter (0.91 cm), Phule Jyoti (P_1) for number of fruits per plant (521.58) and green fruit yield per plant (1.146 kg).

Commercial exploitation of hybrid vigour is feasible only if the vigour is in excess of prevailing commercial hybrid and the better parent. In practical plant breeding, superiority of F_1 over mid parent is of no consequence since it does not offer any advantage over better parent. In most of the cases, mid parent of hybrid may be inferior to commercial hybrid. Therefore, in this context, emphasis has been given to study heterosis over the better parent and commercial hybrid.

Among the 28 hybrid evaluated, Phule Mukta x AC-2 (P_2xP_3) was found best for earliness (43.00 days) and green fruit yield per plant (1.932 kg), Delhi Heart-2 x Agnirekha (P_7xP_8) for plant height (77.87cm), AC-2 x Delhi Heart-2 (P_3 x P_7) for primary branches per plant (9.73) and fruit length (11.87cm), Phule Jyoti x AC-8 (P_1xP_5) for fruit diameter (1.03 cm), Phule Jyoti x Delhi Heart-2 (P_1xP_7) for number of fruits per plant. It can be concluded that the crosses involving Phule Mukta and AC-2 either of the male or female parent performed better for earliness, yield and yield contributing traits like number of branches per plant and fruit length.

The heterosis for various growth, yield and yield contributing traits over better parent and commercial hybrid (Table 1) revealed that, 6 hybrids each expressed

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Table 1. Percent heterosis over better parent and commercial hybrid for different characters in 8 x 8 half diallel of chilli.

Sr. No.	Characters	Days to 50% flowering		Plant height (cm)		No. of primary branches/ plant	
		BP	SH	BP	SH	BP	SH
1	1x2	-6.92*	-0.66	7.75**	2.48	18.75**	-2.53
2	1x3	20.31**	3.36	6.29*	0.23	-13.89**	-9.12*
3	1x4	-7.88*	2.03	-13.82**	-18.73**	3.57	-15.05
4	1x5	9.88**	19.47**	-8.67**	-13.87**	5.36	-13.51**
5	1x6	16.44**	14.12**	3.07	-0.48	12.50**	-7.69*
6	1x7	-3.27	-0.66	3.28	4.81*	-3.47	1.87
7	1x8	14.73**	-0.66	5.05	-0.93	3.42	-11.32**
8	2x3	0.78	-13.41**	-13.52**	-17.74**	-2.78	2.53
9	2x4	-5.66	0.68	-20.79**	-24.66**	4.50	-15.05**
10	2x5	-17.61**	-12.06**	-22.68**	-26.47**	5.71	-18.68**
11	2x6	-2.05	-4.00	-2.05	-5.43*	14.29**	-12.08**
12	2x7	-15.03**	-12.75**	2.75	4.27	-8.33*	-3.30
13	2x8	3.88	-10.05**	1.89	-3.09	6.84	-8.46*
14	3x4	5.47	-9.38**	-3.56	-17.30**	-11.81**	-6.92
15	3x5	14.06**	-1.99	4.09	-10.73**	-5.56	-0.33
16	3x6	16.41**	0.02	-7.17**	-10.37**	-13.19**	-8.46*
17	3x7	14.06**	-1.99	-10.63**	-9.30**	1.39	6.92
18	3x8	16.41**	0.02	6.98*	-3.55	-16.67**	-12.09**
19	4x5	-8.64**	-0.66	-6.66*	-20.62**	-9.91	-26.70**
20	4x6	2.74	0.68	-22.35**	-25.02**	-5.41	-23.08**
21	4x7	-1.31	1.35	-22.05**	-20.89**	-23.61**	-19.45**
22	4x8	17.05**	1.35	-3.59	-13.07**	-12.82**	-25.27**
23	5x6	1.37	-0.66	-1.30	-4.70*	12.38*	-13.52**
24	5x7	-13.73**	-11.40**	-10.81**	-9.48**	-8.33*	-3.30
25	5x8	37.21**	18.80**	0.90	-9.02**	8.55	-6.92
26	6x7	8.90*	6.72	-0.89	0.59	-14.58**	-9.89*
27	6x8	16.28**	0.68	-10.24**	-13.33**	-10.26*	-23.08**
28	7x8	25.58**	8.74*	3.45	4.99*	-5.56	-0.33
	S.E.D.	1.68	1.68	1.90	1.90	0.34	0.34
	L.S.D. 5 %	3.35	3.35	3.79	3.79	0.68	0.68
	L.S.D. 1 %	4.45	4.45	5.04	5.03	0.91	0.91

Sr. No	Characters	Length of fruit (cm)		Diameter of fruit (cm)		No of fruits/ plant		Green fruit yield/ plant (Kg)	
		BP	BP	BP	SH	BP	SH	BP	SH
1	1x2	15.97**	-19.76**	10.66**	-6.25	76.50**	31.73**	49.59**	25.73*
2	1x3	-6.76**	-8.71**	0.00	-15.62	49.74**	11.75*	38.74**	16.91
3	1x4	-1.99	-32.21**	-12.30**	-26.04	40.28**	4.69	12.01	-5.88
4	1x5	14.17**	-21.07**	13.24**	7.29	-27.06*	-45.57**	-31.30*	-41.91**
5	1x6	2.34	-26.40**	-12.30**	-26.04	16.66	-12.93	-13.47	-27.20*
6	1x7	-14.02**	-7.02**	-5.93*	-11.45	87.17**	39.69**	66.03**	39.85**
7	1x8	-18.16**	-22.47**	-15.44**	-19.79	16.80	-12.83	-11.34	-25.00*
8	2x3	7.71**	5.52*	4.20	-13.54	85.37**	31.42**	90.57**	41.91**
9	2x4	11.19**	-33.61**	8.40**	-10.42	-26.19	-57.75**	-24.49	-63.23**
10	2x5	32.41**	-28.56**	-1.47	-7.29	31.91	-38.70**	14.21	-44.85**
11	2x6	1.48	-27.06**	-2.52	-19.79	35.97	-37.50**	21.91	-44.11**
12	2x7	-24.75**	-18.63**	-8.89**	-14.58	46.69**	-13.70	12.19	-12.50
13	2x8	-26.43**	-30.34**	-13.97**	-18.75	68.06**	-29.12**	83.44**	-27.21*
14	3x4	-4.78	-6.74**	2.56	-16.67	15.04	-18.43	15.71	-13.97
15	3x5	-13.77**	-15.54**	-11.03**	-15.62	65.39**	17.26	78.70**	33.09**
16	3x6	-13.77**	-15.54**	-4.27	-21.87	34.83*	-4.40	7.53	-19.85
17	3x7	2.77	11.14**	-13.33**	-18.75	5.82	-24.97*	13.13	-11.76
18	3x8	-0.13	-2.15	-19.85**	-23.96	40.44**	-0.15	38.49*	2.94
19	4x5	11.19**	-33.61**	-8.82**	-13.54	1.50	-41.91**	2.02	-50.73**
20	4x6	-10.85**	-35.86**	9.40**	-11.46	-21.81	-55.25**	-23.99	-63.23**
21	4x7	-24.06**	-17.88**	-16.30**	-21.87	-19.44	-52.60**	-35.37*	-49.26**

22	4x8	-15.43**	-19.94**	12.50**	6.25	-20.42	-54.45**	-13.28	-58.09**
23	5x6	22.83**	-11.70**	-13.97**	-18.75	-7.73	-57.12**	-15.49	-59.56**
24	5x7	-16.33**	-9.46**	7.35**	1.04	29.18	-23.99*	0.31	-21.54
25	5x8	-18.06**	-22.38**	-6.62*	-11.46	-17.10	-61.47**	-21.19	-61.76**
26	6x7	-18.81**	-12.17**	-20.00**	-25.00	27.52	-24.97*	-8.52	-28.68*
27	6x8	-8.37**	-13.20**	-25.00**	-29.17	25.02	-42.54**	13.43	-48.53**
28	7x8	-6.23**	1.40	2.94	-3.12	-3.38	-43.15**	-6.23	-27.20*
	S.E.D.	0.27	0.27	2.28	2.28	7.00	7.00	0.16	0.16
	L.S.D. 5 %	0.53	0.53	4.55	4.55	13.96	13.96	0.32	0.32
	L.S.D. 1 %	0.70	0.70	6.05	6.05	18.53	18.53	0.43	0.43

negative heterosis over better parent and commercial hybrid, respectively for days to 50% flowering. The significant positive heterosis was reflected in 3 and 2 hybrids for plant height, 3 and 2 for fruit length, 10 and 3 number of fruits per plant. However, 4 and 6 hybrids exhibited significant positive heterosis over better parent and none of the hybrids expressed superiority over commercial hybrid for primary branches per plant and fruit diameter, respectively. These results are in agreement with those of Ram and Lal (1989), Gaddagimath (1992) , Lohithaswa (1997), Gandhi *et al*. (2000), Linganagauda (2000) and Shankarnag *et al*.(2006) who also got heterotic crosses of high frequency over the better parent and commercial hybrid for earliness, growth and yield traits.

For green fruit yield per plant seven hybrids exhibited heterosis over better parent and ranged from -35.37 (P_4x P_7) to 90.57 (P_2x P_3). However, 4 hybrids showed positive heterosis over commercial hybrid and ranged from -63.23 (P_4x P_6) to 41.49 (P_2x P_3) per cent. These results are in conformity with those of Joshi *et al*. (1995) and Linganagouda (2000) in chilli. In present study, the most heterotic crosses for the green fruit yield per plant was P_2x P_3 followed by P_1x P_7. These crosses have not performed better for the fruit yield per plant but also for the earliness and yield traits. The *per se* performance of these hybrids, i.e. P_2x P_3 (1.932 kg) and P_1x P_7 (1.903 kg) over commercial hybrid (1.360 kg) was also far superior. Hence, there is a great scope for commercial exploitation of these hybrids after further evaluation tests.

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