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Studies on heterosis in male sterile based hybrids in chilli (*Capsicum annum* L.)

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ABSTRACT

Three cytoplasmic genic male sterile lines of chilli were crossed with seven diversified pollen parents in a line x tester design. All the 21 hybrids along with their parents and a commercial check hybrid were grown in randomized block design in three replications. The extent of heterobeltiosis and economic heterosis, respectively was 37.22 and 55.10 per cent for plant height, 51.85 and 55.61 per cent for plant spread (east-west), 59.46 and 46.32 per cent for plant spread (north-south), 27.95 and 14.41 per cent for number of tertiary branches, -26.15 and –17.94 per cent for days to first flowering, 9.16 and –14.13 per cent for fruit length, 44.53 and 10.83 per cent for fruit diameter, 94.63 and 84.25 per cent for number of fruit per plant and 181.10 and 27.43 per cent for total green fruit yield. The cross L5 x T14 manifested maximum heterosis for fruit number and total green fruit yield.

Key words: Chilli, Male sterile lines, Heterobeltiosis, Economic heterosis

INTRODUCTION

Chilli (*Capsicum annuum* L.) has its unique place in human diet as vegetable and spice component. Exploitation of hybrid vigour to increase the yield has become one of the most important techniques in vegetable breeding. Several workers, Mishra et al*.* (1976), Patel et al*.* (1997) and Singh and Hundal (2001) have reported the exploitation of heterosis in chilli. But only few F_1 hybrids have been released from the public institutions. This is mainly due to the problem associated F_1 seed production employing conventional hand emasculation and pollination, which is laborious thereby increasing the cost of F_1 seeds. The use of male sterility existing in the chilli could help to overcome these problems as being practiced in a few other vegetables. Therefore, the present study was undertaken to work out the heterosis in male sterile based hybrids on yield and its related components.

MATERIALS AND METHODS

The present study consisted of 21 F_1 hybrids developed by crossing three male sterile lines with seven diversified pollen parents in line x tester design. All the 21 F_1 hybrids along with their parents and a commercial check hybrid (BSS-270 Savitri) were evaluated during rabi 2003-2004 in randomized block design with three replications in the experimental blocks of Olericulture unit, Kittur Rani Channamma College of Horticulture, Arabhavi (Karnataka). Each entry was represented by a single row of 15 plants spaced at 75cm between rows and 45cm within a row between plants. Observations were recorded on five plants selected at random from each replication for yield and its nine attributing characters *viz*., plant height (cm), plant spread in both (east-west and north-south) directions (cm), number of tertiary branches, days to first flowering, fruit length (cm), fruit diameter (cm), average fruit weight (g), number of fruits per plant and total green fruit yield (g/plant). The F_1 hybrid heterosis was estimated over better parents (heterobeltiosis) and over the commercial check hybrid (economic heterosis) and test of significance was carried out (Fonseca and Patterson, 1968).

RESULTS AND DISCUSSION

The data regarding heterobeltiosis and economic heterosis for yield and its related components is presented in Table 1 and 2, respectively. The heterobeltiosis for plant height was found to be in the range –32.12 to 37.22 per cent with 9 crosses registering significant positive heterobeltiosis. Almost all the crosses (except L1 x T12 and T1 x T15) registered the significant positive economic heterosis and it ranged from –17.33 to 55.10 per cent. The higher heterosis values were observed in L3 x T15, L1 x T17 and L1 x T14. For plant spread (east-west) heterobeltiosis and economic heterosis varied from –37.83 to 51.85 and –21.60 to 55.61 per cent, respectively with 12 crosses each exhibiting significant positive heterobeltiosis and economic heterosis, while in other (north-south) direction the heterobeltiosis ranged from –32.16 to 59.46 per cent with 16 crosses registering the significant heterobeltiosis. The economic heterosis ranged from –27.49 to 46.32 per cent with 14 crosses registering the significant economic heterosis. The promising crosses with highly spreading nature were L3 x T16, L3 x T15 and L3 x T14.The heterobeltiosis ranged from –10.87 to 27.95 per cent with 11 crosses exhibiting significant positive heterobeltiosis, while economic heterosis ranged from –16.66 to 14.41 per cent, with five crosses exhibiting significant positive economic heterosis for the trait number of tertiary branches. The crosses with highly branching habit were L3 x T16, L1 x T14 and L1 x T12. Heterosis for these growth attributes was also reported by earlier workers viz*.,* Ram and Lal (1989), Lohithaswa (1997) and Gandhi et al*.*, (200).

For days to first flowering the variation for heterobeltiosis was from –26.15 to 7.50 per cent with 11 crosses recording significant negative (desired) heterosis, while for economic heterosis variation was from –17.94 to 11.10 per cent with eight crosses recording the significant desired negative heterosis. The promising crosses for earliness were L1 x T14, L1 x T13 and L1 x T18. These results are in line with the findings of Lakshmi et al*.* (1988) and Patel et al*.* (1997).

For fruit length the heterobeltiosis and economic heterosis was observed in the range of –36.07 to 9.16 and –49.74 to –14.13 per cent, respectively. None of the crosses (except L3 x T12 and L3 x T14 over better parent) noted the significant positive heterobeltiosis and economic heterosis. The promising crosses for this trait were L3 x T12, L3 x T14, L3 x T17 and L5 x T15. Narasimhaprasad et al*.* (2003) also reported the negative heterosis for fruit length, while in contrast Thiruvelavan et al*.* (2002) reported the positive heterosis for fruit length. The heterobeltiosis ranged from –36.54 to 44.53 per cent with six crosses exhibiting significant positive heterobeltiosis for fruit diameter. Three crosses reflected the significant positive economic heterosis and the economic heterosis ranged from –34.16 to 10.83 per cent. The most heterotic crosses for the trait were L1 x T15, L5 x T18, L3 x T13 and L5 x T15. Thiruvelavan et al*.* (2002) also reported the heterosis for fruit diameter in male sterile based hybrids. For average fruit weight, seven crosses expressed the significant positive heterobeltiosis and none of the crosses were positively significant for economic heterosis. This was due to very large fruit size (15.78 cm length and 1.20 cm diameter) of check hybrid. The heterobeltiosis and economic heterosis for this trait ranged from –61.18 to 112.56 and –74.86 to –24.77 per cent, respectively. The crosses found promising in the order of merit were L1 x T15, L3 x T13, L3 x T18 and L5 x T15. These results are in agreement with the

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Table 1 : Heterobeltiosis (%) for yield and its related components in chilli

Crosses	Plant height	Plant spread (east-west)	Plant spread (north-south)	No. of tertiary branches	Days to first flowering	Fruit length	Fruit diameter	Average fruit weight	Number of fruits per plant	Total gre fruit yie
L1 x T12	-20.02**	0.99	13.18**	7.39**	0.81	-7.66**	-34.34**	-61.18**	-17.88**	-32.16**
L1 x T13	20.70**	37.08**	26.64**	-5.11**	-19.69**	-4.49**	-3.57**	-21.75**	24.48**	27.49**
L1 x T14	21.14**	7.78**	16.10**	27.67**	-26.15**	-18.67**	-29.67**	-46.14**	-14.56**	-27.87**
L1 x T15	-32.12**	-37.83**	-32.16**	-8.70**	-11.57**	-5.51**	9.89**	1.42**	-49.80**	-34.31**
L1 x T16	-7.13**	25.60**	1.15	-4.97**	0.78	-36.07**	-2.75**	-41.67**	6.83**	0.37
L1 x T17	22.94**	-16.22**	0.00	2.96**	-1.65	-32.28**	-36.54**	-61.18**	94.63**	-0.62
L1 x T18	1.20	34.59**	4.22**	-4.91**	-14.17**	-12.08**	-31.53**	-26.42**	18.01**	-5.48
L3 x T12	-8.24**	-3.64**	10.85**	-5.68**	2.44*	9.16**	-25.00**	-36.79**	-42.23**	-27.42**
L3 x T13	-15.76**	22.15**	-14.23**	4.55**	0.00	-3.20**	2.75**	-2.03**	19.72**	52.57**
L3 x T14	15.20**	21.44**	45.44**	-5.66**	-14.62**	8.35**	-12.64**	-7.72**	36.32**	116.79**
L3 x T15	27.37**	19.63**	36.91**	-0.54	-6.61**	-21.68**	-9.34**	-36.34**	46.73**	59.87**
L3 x T16	19.29**	51.85**	59.46**	27.95**	-7.75**	-23.18**	-12.09**	-47.15**	56.90**	42.87**
L3 x T17	14.41**	-4.68**	6.59**	3.55**	-9.92**	-16.53**	-21.15**	-26.63**	23.40**	-2.41
L3 x T18	-7.07**	9.32**	5.03**	7.98**	-7.50**	-8.81**	-16.47**	-2.03**	-23.47**	-29.35**
L5 x T12	37.22**	25.79**	18.21**	-5.68**	5.69**	-22.50**	3.40**	31.50**	-11.90**	33.81**
L5 x T13	0.36	8.39**	15.33**	-3.98**	-8.66**	-6.61**	19.00**	15.93**	23.80**	107.33**
L5 x T14	-1.29	-1.91*	9.84**	5.66**	-10.00**	-7.56**	-2.77**	44.49**	44.31**	165.81**
L5 x T15	-9.93**	-26.83**	1.99*	-10.87**	4.96**	-0.65**	44.53**	112.56**	15.72**	181.10**
L5 x T16	-12.82**	-20.93**	30.02**	8.07**	0.00	-29.03**	-22.11**	-16.50**	-3.15	-19.93
L5 x T17	15.48**	-2.50**	28.55**	6.51**	-1.65	-24.34**	14.87**	7.94**	-3.34	67.70**
L5 x T18	-13.06**	7.66**	0.16	3.68**	7.50**	-22.13**	-11.29**	30.46**	-42.28**	19.20
S.Em±	0.62	0.63	0.60	0.34	0.73	0.14	0.02	0.06	1.99	7.23
C. D at 5%	1.76	1.78	1.71	0.96	2.08	0.40	0.06	0.17	5.63	20.44
C. D. at 1%	2.33	2.37	2.28	1.28	2.77	0.53	0.07	0.22	7.48	27.19

* and ** indicate significance of values at p=0.05 and p=0.01, respectively

Table 2 : Economic heterosis (%) for yield and its related components in chilli

Crosses	Plant height	Plant spread (east-west)	Plant spread (north-south)	No. of tertiary branches	Days to first flowering	Fruit length	Fruit diameter	Average fruit weight	Number of fruits per plant	Total green fruit yield
L1 x T12	-4.17**	0.81	3.28**	5.00**	5.97**	-27.37**	-33.33**	-71.24**	17.59**	-62.35**
L1 x T13	44.61**	34.82**	13.60**	-7.25**	-12.82**	-24.90**	-2.50**	-41.95**	9.08**	-29.24**
L1 x T14	45.16**	21.11**	6.23**	12.75**	-17.94**	-36.05**	-29.16**	-60.03**	-6.53**	-59.97**
L1 x T15	-17.33**	-21.60**	-27.49**	-6.66**	-8.53**	-25.66**	10.83**	-24.77**	-45.86**	-63.54**
L1 x T16	11.95**	28.71**	-13.40**	-15.00**	11.10**	-49.74**	-1.66**	-56.78**	16.23**	-44.30**
L1 x T17	47.31**	-11.38**	-3.09**	-3.33**	1.71	-30.41**	-35.83**	-71.24**	46.30**	-44.84**
L1 x T18	25.00**	23.93**	5.08**	-13.91**	-11.97**	-24.96**	-19.16**	-45.47**	-10.40**	-47.54**
L3 x T12	9.93**	-3.78**	1.15	-7.75**	7.69**	-14.13**	-24.16**	-53.16**	-17.27**	-59.71**
L3 x T13	0.94	20.12**	-23.07**	2.25**	8.53**	-23.89**	4.16**	-27.39**	4.93	-15.33
L3 x T14	38.04**	36.46**	33.07**	-16.66**	-5.12**	-14.76**	-11.66**	-31.55**	49.47**	20.30
L3 x T15	55.10**	50.81**	46.32**	1.66**	-3.41**	-38.40**	-8.33**	-52.80**	58.22**	-11.27
L3 x T16	43.81**	55.61**	36.50**	14.41**	1.71	-39.60**	-10.83**	-60.84**	70.71**	-20.71*
L3 x T17	37.09**	0.81	3.28**	-2.75**	-6.84**	-14.25**	-20.00**	-45.56**	-7.23*	-45.84**
L3 x T18	14.77**	0.66	5.89**	-2.25**	-5.12**	-22.18**	-1.66**	-27.39**	-41.89**	-60.79**
L5 x T12	37.76**	25.56**	7.85**	-7.75**	11.10**	-39.35**	-15.83**	-60.39**	26.15**	-42.37**
L5 x T13	11.95**	6.60**	8.43**	-6.08**	-0.84	-26.86**	-7.50**	-52.80**	58.06**	-11.47
L5 x T14	13.30**	10.22**	0.49	-6.66**	0.00	-27.62**	-12.50**	-42.76**	84.25**	27.43**
L5 x T15	9.67**	-7.74**	9.01**	-8.91**	8.53**	-21.22**	-0.83**	-31.10**	47.74**	20.03
L5 x T16	5.10**	-18.98**	11.29**	-3.33**	10.25**	-44.42**	-34.16**	-74.86**	23.65**	-65.80**
L5 x T17	37.35**	3.14**	24.55**	0.00	1.71	-22.24**	-14.16**	-49.18**	23.40**	-28.39**
L5 x T18	7.39**	-2.64**	0.98	-6.08**	10.25**	-33.52**	5.00**	-31.55**	-26.29**	-49.10**
S.Em±	0.62	0.63	0.60	0.34	0.73	0.14	0.02	0.06	1.99	7.23
C. D at 5%	1.76	1.78	1.71	0.96	2.08	0.40	0.06	0.17	5.63	20.44
C. D. at 1%	2.33	2.37	2.28	1.28	2.77	0.53	0.07	0.22	7.48	27.19

* and ** indicate significance of values at p=0.05 and p=0.01, respectively

findings of Patel et al. (1997).

Significant and positive heterobeltiosis for number of fruits per plant was noticed in 12 crosses and the heterobeltiosis ranged from –49.80 to 94.63 per cent. The economic heterosis ranged from –45.86 to 84.25 per cent with 13 crosses exhibiting significant positive economic heterosis. The most heterotic combinations were L5 x T14, L3 x T16, L3 x T15 and L5 x T13. These findings are in conformity with those of Mishra et al*.* (1988) and Lohithaswa (1997).

For total green fruit yield the heterobeltiosis varied from –34.31 to 181.10 per cent with 11 crosses reflecting the significant positive heterobeltiosis. The range was from –65.80 to 27.43 per cent for economic heterosis with only one cross reflecting the significant positive economic heterosis. Some of the most promising crosses were L5 x T14, L3 x T14, L5 x T15 and L3 x T15. Patel et al*.* (1997) and Singh and Hundal (2001) reported the high heterosis for total green fruit yield.

The hybrids performed better over the better parent and commercial check hybrid. The cross L5 x T14 was the most heterotic for number of fruits per plant and total green fruit yield, could be exploited commercially after further trials. Hence, the results reveals the possibility of development of hybrids and their popularization for commercial cultivation as the hybrid seed production cost could be low when male sterile line were used as the female parent.

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