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Heterobeltiosis and inbreeding depression in tomato (*Lycopersicon esculentum* Mill.)

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SUMMARY

The studies were conducted on five crosses of tomato *viz*., Feb 4 x KS 17, GT 2 x KS 17, Sel 14 x KS 118, GT 2 x GT 1 and SL 120 x Angur Lata ; involving eight parents, five F_1s and F_2s of tomato. Heterosis over superior parent and inbreeding depression were found to be substantially high in both positive and negative directions depending on the nature of characters. This clearly suggests that due to preponderance of non-additive genetic variances, exploitation of heterosis breeding would be of importance for genetic improvement of tomato crop.

Key words : Heterobeltiosis, Inbreeding depression in tomato, *Lycopersicon esculentum* Mill.

The success of hybridization depends upon the selection of suitable parental genotypes and performance of their cross combinations. Exploitation of heterosis is proving an efficient approach for the improvement of tomato. Due to their high yielding potential, the hybrid varieties of tomato are now gaining popularity among growers. Hence, a study was conducted to determine magnitude of heterosis and to explore the possibilities of utilizing the hybrid vigour at commercial level.

MATERIALS AND METHODS

Eight parents of tomoto *viz*., Feb 4, KS 17, GT 1, GT 2, Sel 14, KS 118, SL 120 and Angur Lata were used and five hybrids *viz*., Feb 4 x KS 17, GT 2 x KS 17, Sel 14 x KS 118, GT 2 x GT 1 and SL 120 x Angur Lata were developed. The seedling of parents, F_1s and F_2s were planted at spacing at 90 x 75 cm in randomized block design with three replications during *Rabi* 2005-06, at MVRS, Anand Agricultural University, Anand. Recommended package of practices were followed to raise a good crop. The observations were recorded on five randomly selected plants of parents and F_1s and 20 plants of F_2s from each plot in each replication. Data on days to flower initiation, days to first picking, primary branches per plant, plant height (cm), fruit length (cm), fruit girth (cm), locules per fruit, pericarp thickness (mm), fruit weight (g), fruits per plant, fruit yield per plant (kg per plant) and total soluble solids (%) were recorded. Heterosis expressed as per cent increase or decrease of F_1 hybrid over its better parent (heterobeltiosis, as termed by Fonseca and Patterson, 1968) as well as inbreeding depression were computed for all the above characters.

RESULTS AND DISCUSSION

Heterosis estimates over superior parent for different character and inbreeding depression as the reduction in F_2 means from F_1 means for characters under study are presented in Table 1. The estimates of heterosis over superior parent ranged from -7.05 to 45.00 per cent for days to flower initiation, -3.21 to 4.93 per cent for days to first picking, -7.37 to 25.49 per cent for primary branches per plant, -25.17 to 11.45 per cent for plant height, -20.42 to 18.96 per cent for fruit length, -19.10 to 16.75 per cent for fruit girth, -35.69 to 42.91 per cent for locules per fruit, -6.66 to 3.10 for pericarp thickness, -24.05 to 19.02 per cent for fruit weight, -12.95 to 6.45 per cent for fruits per plant, -16.92 to 28.43 per cent for fruit yield per plant and -22.56 to 6.17 per cent for total soluble solids. Inbreeding depression varied for various characters such as for days to flower initiation (-17.83 to 23.05 %), days to first picking (-8.07 to 11.77 %), primary branches per plant (5.63 to 15.36 %), plant height (-2.39 to 11.14 %), fruit length (-10.51 to 10.82 %), fruit girth (-10.00 to 10.05 %), locules per fruit (-40.97 to 35.91 %), pericarp thickness (-0.64 to 8.80 %), fruit weight (-3.35 to 26.81 %), fruits per plant (-3.57 to 11.10 %), fruit yield per plant

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Table 1 : Mean, heterobeltiosis (%) and inbreeding depression (%) of five crosses in tomato

Cross	Mean		Estimates (%)	
	F_1	F_2	Heterobeltiosis	Inbreeding depression
Days to flower initiation				
Feb 4 x KS 17	41.33	48.70	0.14	-17.83
GT 2 x KS 17	38.73	44.48	-7.05*	-14.85**
Sel 14 x KS 118	52.20	40.17	45.00**	23.05**
GT 2 x GT 1	39.87	42.85	-6.99**	-7.47**
SL 120 x Angur Lata	42.80	43.12	8.44**	-0.75
Days to first picking				
Feb 4 x KS 17	91.33	98.70	0.06	-8.07**
GT 2 x KS 17	88.73	94.48	-3.21**	-6.48**
Sel 14 x KS 118	102.20	90.17	4.93**	11.77**
GT 2 x GT 1	89.87	92.63	-3.08**	-3.07**
SL 120 x Angur Lata	92.80	93.12	3.72**	-0.34
Primary branches per plant				
Feb 4 x KS 17	12.80	11.23	25.49**	12.26**
GT 2 x KS 17	14.00	11.85	5.03	15.36**
Sel 14 x KS 118	14.00	12.62	4.48*	9.86**
GT 2 x GT 1	15.33	13.35	8.49*	12.91**
SL 120 x Angur Lata	14.20	13.40	-7.37**	5.63*
Plant height				
Feb 4 x KS 17	125.07	125.07	2.85	0.00
GT 2 x KS 17	124.87	127.85	-25.17**	-2.39
Sel 14 x KS 118	110.93	108.83	11.45**	1.89
GT 2 x GT 1	180.87	168.45	-3.69**	6.87**
SL 120 x Angur Lata	131.80	117.12	2.07	11.14**
Fruit length				
Feb 4 x KS 17	7.47	6.83	14.39**	8.57**
GT 2 x KS 17	7.53	6.92	18.96**	8.10**
Sel 14 x KS 118	7.60	7.27	1.74	4.34
GT 2 x GT 1	6.47	7.15	-20.42**	-10.51*
SL 120 x Angur Lata	6.93	6.18	5.00	10.82**
Fruit girth				
Feb 4 x KS 17	14.73	13.80	12.19**	6.31**
GT 2 x KS 17	15.33	13.85	16.75**	9.65**
Sel 14 x KS 118	15.13	14.52	1.75	4.03
GT 2 x GT 1	13.00	14.30	-19.10**	-10.00**
SL 120 x Angur Lata	13.93	12.53	5.53	10.05**
Locules per fruit				
Feb 4 x KS 17	3.73	3.75	1.63	-0.53
GT 2 x KS 17	4.40	2.82	22.22**	35.91
Sel 14 x KS 118	3.53	2.92	42.91**	17.28**
GT 2 x GT 1	2.27	3.20	-35.69**	-40.97**
SL 120 x Angur Lata	2.87	3.02	-18.50**	-5.23
Pericarp thickness				
Feb 4 x KS 17	4.69	4.29	-2.90**	8.53**
GT 2 x KS 17	4.67	4.38	-3.31**	6.21**
Sel 14 x KS 118	3.11	3.13	-2.20	-0.64
GT 2 x GT 1	4.32	3.94	3.10**	8.80**
SL 120 x Angur Lata	4.34	4.32	-6.66**	0.46
Fruit weight				
Feb 4 x KS 17	46.93	34.35	19.02**	26.81**
GT 2 x KS 17	38.86	33.51	6.90**	13.77**
Sel 14 x KS 118	26.27	26.90	-24.05**	-2.40**
GT 2 x GT 1	34.02	35.16	-21.70**	-3.35**
SL 120 x Angur Lata	28.91	28.74	1.90**	0.59
Fruits per plant				
Feb 4 x KS 17	33.67	33.75	-11.56**	-0.24
GT 2 x KS 17	33.60	29.87	-0.80	11.10**
Sel 14 x KS 118	35.13	31.77	6.45**	9.56**
GT 2 x GT 1	31.87	32.48	2.81**	-1.91**
SL 120 x Angur Lata	31.40	32.52	-12.95**	-3.57**
Fruit yield per plant				
Feb 4 x KS 17	1.58	1.16	5.33**	26.58**
GT 2 x KS 17	1.31	0.98	28.43**	25.19**
Sel 14 x KS 118	0.92	0.85	-8.00**	7.61**
GT 2 x GT 1	1.08	1.14	-16.92**	-5.55**
SL 120 x Angur Lata	0.91	0.94	-10.78**	-3.30*
Total soluble solids				
Feb 4 x KS 17	3.09	3.51	-22.56**	-13.59**
GT 2 x KS 17	3.43	3.56	-7.55**	-3.79**
Sel 14 x KS 118	4.05	3.55	1.25	12.34**
GT 2 x GT 1	3.96	3.67	6.17**	7.32**
SL 120 x Angur Lata	4.00	3.63	1.78	9.25**

Contd.... Table 1

Table 1 contd...

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

(-5.55 to 26.58 %) and total soluble solids (-13.59 to 12.34 %).

Negative heterobeltiosis is a desirable attribute for days to flower initiation and days to first picking in most of the crop including tomato. The cross GT 2 x KS 17 and GT 2 x GT 1 were observed to be superior as they showed significant desired values of heterobeltiosis for days to flower initiation and days to first picking, which confirm with the work of Ghosh *et al.* (1997), Rai *et al.* (1998) and Bhatt *et al.* (1999). In the present study, most of the cross combinations exhibited positive heterosis over superior parent for plant height and primary branches per plant. These findings are in conformity with the results of Rai *et al.* (1998). The major components of yield in tomato are number of fruits per plant, fruit length, fruit girth and

fruit weight. The observed high heterosis for yield seems to be due to increase in fruit length, fruit girth and fruit weight rather than increase in the number of fruits. Similar findings were reported by Singh *et al*. (1978) and Rai *et al*. (1998). The results of fruit quality characters like pericarp thickness and total soluble solids indicated that the cross GT 2 x GT 1 had significant values of heterobeltiosis in positive direction.

A close relationship between the heterosis response and inbreeding depression was observed *i.e*. crosses showing high heterosis showed high inbreeding depression. This could be due to high magnitude of non-additive gene effects. However, some cross combinations exhibited high heterobeltiosis with low inbreeding depression. This indicates towards accumulation of favorable additive genes for these traits. In the present study negative inbreeding was also observed in some cases. This might be due to appearance of large number of transgressive segregants in the experimental population utilized for taking observation.

The crosses Feb 4 x KS 17 and GT 2 x KS 17 may be exploited for heterotic effects for fruit yield and its component traits. The cross GT 2 x GT 1 was found promising to improve the fruit quality and earliness through heterosis breeding.

The significant and desirable magnitude of inbreeding depression in cross Sel 14 x KS 118 for days to flower initiation, days to first picking and fruit weight; GT 2 x GT 1 for fruit yield per plant; Feb 4 x KS 17 and GT 2 x KS 17 for total soluble solids content indicates possibilities to obtain the desirable segregants for improving these traits.

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