

Original Research Article

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Exploitation of Heterobeltiosis in Tomato (*Solanum lycopersicum* L.)

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ABSTRACT

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Heterobeltiosis analysis was undertaken using ten diverse lines and their 45 F₁ hybrids of tomato developed through diallel fashion excluding reciprocals. The experimental material was evaluated in a randomized complete block design with three replications at the Main Vegetable Research Station, Anand Agricultural University, Anand, during kharif-rabi, 2018-19. Among 45 hybrids tested, 14 exhibited significant positive heterobeltiosis for fruit yield per plant. Out of these the best three heterotic hybrids in order were ATL-17-05 × 2016/TODVAR-3 (202.80%), GAT-5 × 2014/TOLCVRES-1 (178.21%) and GAT-5 × DVRT-2 (132.76%).

Introduction

Tomato (*Solanum lycopersicum* L.) is an important and one of the most widely grown vegetable crops of both tropics and sub tropics of the world (Kalloo, 1988). Tomato ranks third in priority after potato and onion in India but ranks second after potato in the world. India ranks second in the area (814 thousand hectares) and production (20515 thousand metric tons) in the world (Anonymous 2018). This crop exhibits rich

genetic diversity for various horticultural traits and has a scope for its improvement. In tomato, the comparative ease of emasculation, high percentage of fruit setting and good number of seeds per fruit also facilitate the exploitation of heterosis.

The major objective in the most tomato breeding programmes is to improve the genetic potential for fruit yield and quality. Yield being a complex quantitative character in tomato can be improved through improving

its contributing traits, i.e. mean fruit weight, number of fruits per plant, fruit length, and breadth and plant vigour. Heterosis for various fruit quantitative and quality characters has been reported by Rajan(2014) and Panchal *et al.*, (2017) in tomato. An added advantage of the diallel analysis is that it provides an overall genetic picture of experimental material in a single generation. Hence, present investigation was carried out at Main Vegetable Research Station, Anand Agricultural University, Anand, Gujarat during kharif-rabi, 2018-19 to assess the heterosis levels expressed by hybrids over their better parents for Yields and yield attributing traits taken under consideration and also to identify best heterotic combinations for the same.

Materials and Methods

The experimental material comprised of 10 diverse lines viz., ATL-17-02 ATL-17-06 ATL-17-05, ATL-16-07, GAT-5, DVRT-2, 2014/TOLCVRES-1, 2016/TODVAR-2, 2016/TODVAR-3 and 2014/TOLCVRES-3 of tomato. The crosses were made in diallel fashion excluding reciprocals, during *kharif-rabi* 2017-18. The 45 F₁ hybrids along with their 10 parents were evaluated in a randomized complete block design with three replications at the Main Vegetable Research Station, Anand Agricultural University, Anand, during *kharif-rabi* 2018-19.

Each experimental unit was represented by a single row of 3.6 m length accommodating eight plants with inter and intra row spacing of 90 cm and 45 cm, respectively. The recommended cultural practices and plant protection measures obligatory to raise healthy crop were followed. Observations were recorded on randomly selected five plants in each experimental unit for eight maturity characters viz., days to initiation of flowering, plant height (cm), days to first fruit

ripening, average fruit weight, fruit yield per plant, 1000 seed weight (g), number of fruits per plant, and number of locules per fruit.

Statistical analysis

Heterobeltiosis (HB):

The estimation of heterosis over better parent and over standard check is more realistic. Hence, in present investigation, heterosis was estimated over better parent (BP) referred to as heterobeltiosis (HB).

Heterosis expressed in percentage will be calculated as the deviation of F₁ over better parent (Fonseca and Patterson, 1968) by following formulae:

$$\text{Heterobeltiosis (\%)} = \frac{\bar{F}_1 - \bar{BP}}{\bar{BP}} \times 100$$

Where,

\bar{F}_1 = Mean performance of F₁

\bar{BP} = Mean value of better parent of respective cross combination

Results and Discussion

The study of heterobeltiosis provide only the percent increase of F₁ over the better parent, thus helps in identifying the best crosses but fails to identify the possible causes for superiority of hybrids. It is an effective tool in improving the yield and component traits of different crop species. The heterosis breeding has been extensively utilized in improving yield particularly in tomato crop. The heterobeltiosis for seed yield and its components in linseed are presented in Table 1.

Days to initiation of flowering

For this trait, negative heterobeltiosis is of main interest to the breeder because it is always desirable to incorporate earliness,

hence more attention was given towards negative heterobeltiosis. The heterobeltiosis of this trait ranged from -18.02% (ATL-17-05 × 2016/TODVAR-3) to 31.52% (2014/TOLCVRES-1 × 2016/TODVAR-3). One hybrid out of forty five hybrid *viz.*, ATL-17-02 × ATL-16-07 (-13.73%) registered significant and negative heterobeltiosis.

The results are in agreement with the findings of Baishya *et al.*, (2001), Joshi and Thakur (2003), Duhan *et al.*, (2005), Singh (2005), Hannan *et al.*, (2007a), Ahmad *et al.*, (2015) and Chauhan *et al.*, (2014) for heterobeltiosis in positive as well as in negative direction.

Plant height

The positive heterosis is desirable for this character. The heterobeltiosis varied from -48.21% (ATL-17-06 × 2016/TODVAR-3) to 62.16% (2016/TODVAR-2 × 2014/TOLCVRES-3). Out of 45 hybrids, total 6 hybrids had significant positive heterobeltiosis for this trait. The best three hybrids 2016/ TODVAR-2 × 2014/TOLCVRES-3 (62.16%), ATL-17-02 × 2016/TODVAR-2 (36.92%) and GAT-5 × 2016/TODVAR-2 (36.13%), had registered significant heterosis in desirable direction over respective better parent.

For plant height, the results are in agreement with the findings of Tiwari and Lal (2004), Duhan *et al.*, (2005), Singh (2005), Ahmad *et al.*, (2015), Kumari and Sharma (2011), Yadav *et al.*, (2013) and Bhalala (2018) for heterobeltiosis in negative as well as in positive direction.

Days to first fruit ripening

For earliness, heterotic effects in negative direction are desirable. The heterobeltiosis ranged from -18.60% (2016/TODVAR-2 × 2014/TOLCVRES-3) to 48.79% (ATL-17-06

× 2016/ TODVAR-3). One hybrid *viz.*, 2016/TODVAR-2 × 2014/TOLCVRES-3 (-18.60%) documented significant and negative heterobeltiosis.

The results are in conformity with the reports of Singh (2005), Hannan *et al.*, (2007a), and Bhalala (2018) for heterobeltiosis in negative direction as well as in positive directions.

Average fruit weight

The positive heterobeltiosis is desirable for this character. The heterobeltiosis was varied from -62.55% (ATL-17-05 × 2014/TOLCVRES-3) to 45.16% (ATL-16-07 × GAT-5). Out of 45 hybrids, 6 had significant positive heterobeltiosis for this trait. The best three hybrids ATL-16-07 × GAT-5 (45.16%), ATL-17-02 × DVRT-2 (38.78%) and GAT-5 × 2014/TOLCVRES-3 (31.91%), had registered significant heterosis in desirable direction over respective better parent.

The findings are in concordant with the reports of Singh (2005), Kumari and Sharma (2011), Yadav *et al.*, (2013), Dagade *et al.*, (2015a), Kumar *et al.*, (2016) and Triveni *et al.*, (2017) for heterobeltiosis in negative direction as well as in positive directions.

Number of fruits per plant

The positive heterobeltiosis is desirable for this character. The heterobeltiosis varied from -92.29% (GAT-5 × 2014/TOLCVRES-3) to 237.95% (GAT-5 × DVRT-2). Out of 45 hybrids, 13 hybrids had shown significant positive heterobeltiosis for this trait. The best three hybrid combinations were GAT-5 × DVRT-2 (237.95%), ATL-17-05 × 2014/TOLCVRES-3 (88.79%) and DVRT-2 × 2016/TODVAR-2 (61.18%).

The results are in agreement with the findings

of Baishya *et al.*, (2001), Joshi and Thakur (2003) (HB), Singh *et al.*, (2012), Ahmad *et al.*, (2015), Aisyah *et al.*, (2016), Kumar *et al.*, (2016) for heterobeltiosis in negative as well as in positive direction.

Fruit yield per plant

The positive heterobeltiosis is desirable for this character. The heterobeltiosis was varied from -91.85% (ATL-17-05 × ATL-16-07) to 202.80% (ATL-17-05 × 2016/TODVAR-3). Out of 45 hybrids, 14 had significant positive heterobeltiosis for this trait. The best three hybrids ATL-17-05 × 2016/TODVAR-3 (202.80%), GAT-5 × 2014/TOLCVRES-1 (178.21%) and GAT-5 × DVRT-2 (132.76%), had registered significant heterosis in desirable direction over respective better parent.

The findings are in agreement with the reports of Singh (2005), Hannan *et al.*, (2007a), Kumari and Sharma (2011), Yadav *et al.*, (2013), Kumar *et al.*, (2016), Triveni *et al.*, (2017) and Bhalala (2018) for heterobeltiosis in negative direction as well as in positive directions.

1000 seed weight

1000 seed weight is also one of the important traits and positive heterosis is desirable for this trait. The heterosis over better parent varied from -32.78% (ATL-16-07 × DVRT-2) to 33.00% (ATL-17-02 × ATL-17-05). Out of 45 hybrids, only 2 hybrids ATL-17-02 × ATL-17-05 (33.00%) and ATL-16-07 × 2014/TOLCVRES-1 (9.38%) had registered significant positive heterobeltiosis for this trait.

Significant estimates of heterosis for 1000 seed weight in tomato has been reported by Patwary *et al.*, (2013) and Bhalala (2018) which shows heterobeltiosis in negative direction as well as in positive directions.

Pericarp thickness

The positive heterosis is desirable for this character. The heterobeltiosis was varied from -34.15% (ATL-17-06 × 2014/TOLCVRES-1) to 20.29% (GAT-5 × 2014/TOLCVRES-3). Out of 45 hybrids only three hybrids GAT-5 × 2014/TOLCVRES-3 (20.29%), ATL-17-02 × GAT-5 (17.18%) and ATL-17-06 × 2016/TODVAR-3 (10.37%), had taped significant positive heterobeltiosis for this trait.

For pericarp thickness, the results are in agreement with the findings of Kumari and Sharma (2011), Kumar *et al.*, (2013) Rajan (2014), Dagade *et al.*, (2015a) Sharma and Bhardwaj, (2016), Aisyah *et al.*, (2016), Kumar and Paliwal (2016) and Madhvi *et al.*, (2018a) for heterobeltiosis in negative as well as in positive direction.

Number of locules per fruit

The positive heterosis is desirable for this character. The heterobeltiosis varied from -45.07% (ATL-17-05 × 2014/TOLCVRES-1) to 78.00% (2016/TODVAR-2 × 2014/TOLCVRES-3). Out of 45 hybrids, 18 had shown significant positive heterobeltiosis for this trait.

The best three hybrid combinations were 2016/TODVAR-2 × 2014/TOLCVRES-3 (78.00%), 2016/TODVAR-3 × 2014/TOLCVRES-3 (57.41%) and ATL-17-02 × 2014/TOLCVRES-3 (42.22%).

For number of locules the findings are in concordant to the reports of Singh and Singh (2003), Joshi *et al.*, (2005), Ahmad *et al.*, (2011), Singh *et al.*, (2012), Sharma and Bhardwaj (2014), Savita and Singh (2015) and Aisyah *et al.*, (2016) for heterobeltiosis in negative as well as in positive direction.

Table.1.1 Estimate of heterobeltiosis (HB) in per cent for yield and its attributing characters

Sr. No.	Hybrids	Days to initiation of flowering	Plant height	Days to first fruit ripening	Average fruit weight
	(1)	(2)	(3)	(4)	(5)
1	ATL-17-02 × ATL-17-06	5.15	-40.18**	14.11*	-33.68**
2	ATL-17-02 × ATL-17-05	-6.86	-4.88	0.00	-17.64*
3	ATL-17-02 × ATL-16-07	-13.73*	-20.96**	-4.04	-10.81
4	ATL-17-02 × GAT-5	10.78	-23.96**	12.50	29.86**
5	ATL-17-02 × DVRT-2	17.39*	-30.27**	7.95	38.78**
6	ATL-17-02 × 2014/TOLCVRES-1	-7.61	-19.45**	-4.41	-1.32
7	ATL-17-02 × 2016/TODVAR-2	-9.81	36.92**	-2.94	-8.42**
8	ATL-17-02 × 2016/TODVAR-3	2.94	-21.01*	30.88**	4.90**
9	ATL-17-02 × 2014/TOLCVRES-3	-4.90	-36.49**	-0.37	-42.93*
10	ATL-17-06 × ATL-17-05	11.34	-30.51**	14.92	26.62**
11	ATL-17-06 × ATL-16-07	17.53	-26.43**	32.26**	-43.31**
12	ATL-17-06 × GAT-5	23.71*	-38.05	25.40*	0.59
13	ATL-17-06 × DVRT-2	9.28	-17.53*	8.06	-21.85*
14	ATL-17-06 × 2014/TOLCVRES-1	0.00	-33.46**	2.82	-13.99
15	ATL-17-06 × 2016/TODVAR-2	-3.09	-3.92**	12.10	-50.29**
16	ATL-17-06 × 2016/TODVAR-3	7.22	-48.21*	48.79**	-29.38**
17	ATL-17-06 × 2014/TOLCVRES-3	23.71*	-28.20	25.81*	-30.21**
18	ATL-17-05 × ATL-16-07	19.23**	-29.31**	17.98*	-24.03*
19	ATL-17-05 × GAT-5	-5.50	-10.35**	23.44**	-10.89
20	ATL-17-05 × DVRT-2	15.22*	-3.75**	-6.82	-13.23
21	ATL-17-05 × 2014/TOLCVRES-1	8.70	-2.21	-2.25	-7.70
22	ATL-17-05 × 2016/TODVAR-2	6.12	-16.30*	15.36*	-34.69**
23	ATL-17-05 × 2016/TODVAR-3	-18.02	9.44**	-6.74	-24.91**
24	ATL-17-05 × 2014/TOLCVRES-3	3.60	-6.80**	-3.37	-62.55**
25	ATL-16-07 × GAT-5	28.85**	-14.45*	18.75**	45.16**
26	ATL-16-07 × DVRT-2	14.13	-40.59	7.95	-39.62**
27	ATL-16-07 × 2014/TOLCVRES-1	13.04	-8.97	10.26	19.24
28	ATL-16-07 × 2016/TODVAR-2	12.24	-46.41*	6.35**	-51.55**
29.	ATL-16-07 × 2016/TODVAR-3	7.69	-36.60	15.00*	-0.01
30	ATL-16-07 ×	17.31**	-5.39**	7.69**	-35.03**

	2014/TOLCVRES-3				
31	GAT-5 × DVRT-2	1.09	-0.54	2.73	22.39**
32	GAT-5 × 2014/TOLCVRES-1	-5.43	7.24	3.91	9.11
33	GAT-5 × 2016/TODVAR-2	19.39**	36.13**	16.41	-41.02**
34	GAT-5 × 2016/TODVAR-3	-12.84	10.44**	1.56	-17.69*
35	GAT-5 × 2014/TOLCVRES-3	-9.17	-9.13	15.23	31.91**
36	DVRT-2 × 2014/TOLCVRES-1	5.43	-27.92*	-2.65	-11.51
37	DVRT-2 × 2016/TODVAR-2	2.17	-7.77*	-3.79	-39.17**
38	DVRT-2 × 2016/TODVAR-3	8.70	6.96**	2.27	-6.98
39	DVRT-2 × 2014/TOLCVRES-3	11.96	-15.03	3.03	-9.16
40	2014/TOLCVRES-1 × 2016/TODVAR-2	-1.09	-16.04**	-4.03	-45.00**
41	2014/TOLCVRES-1 × 2016/TODVAR-3	31.52**	-36.13	16.85**	-16.03*
42	2014/TOLCVRES-1 × 2014/TOLCVRES-3	9.78	-33.37	-6.96	-33.75**
43	2016/TODVAR-2 × 2016/TODVAR-3	20.41*	29.11**	14.64*	-28.96
44	2016/TODVAR-2 × 2014/TOLCVRES-3	4.08	62.16**	-18.60**	-6.27**
45	2016/TODVAR-3 × 2014/TOLCVRES-3	5.17**	-1.25	0.00	-18.54
Range	Min.	-18.02	-48.21	-18.60	-62.55
	Max.	31.52	62.16	48.79	45.16
No. of significant crosses	Positive	11	6	15	6
	Negative	1	24	1	23
	Total crosses	12	30	16	29
S. E. ±		2.38	13.92	5.6	4.61

Table 1.2

Sr. No.	Hybrids	Number of fruits per plant	Fruit yield per plant	1000 seed weight	Pericarp thickness
	(1)	(2)	(3)	(4)	(5)
1	ATL-17-02 × ATL-17-06	-52.91**	-46.85**	-13.60*	-0.61
2	ATL-17-02 × ATL-17-05	71.39**	65.43**	33.00**	-7.98
3	ATL-17-02 × ATL-16-07	45.83**	40.06**	-11.13	0.00
4	ATL-17-02 × GAT-5	-58.77**	-50.96**	-25.75**	17.18**
5	ATL-17-02 × DVRT-2	-30.50**	-28.47**	-4.91	0.00
6	ATL-17-02 × 2014/TOLCVRES-1	-25.53**	-16.78*	-6.13	-7.98
7	ATL-17-02 × 2016/TODVAR-2	-1.71	15.70	-7.36	-1.84
8	ATL-17-02 × 2016/TODVAR-3	-12.86	-34.79**	-14.60*	-11.66*
9	ATL-17-02 × 2014/TOLCVRES-3	-10.08	-28.18	-22.30**	-18.40**
10	ATL-17-06 × ATL-17-05	-65.45**	-54.55**	8.96	0.61
11	ATL-17-06 × ATL-16-07	78.80**	37.01**	-31.24**	-18.29**
12	ATL-17-06 × GAT-5	-73.46**	-58.53**	-13.91	-18.90
13	ATL-17-06 × DVRT-2	-49.89**	-17.82*	-20.65**	-21.34**
14	ATL-17-06 × 2014/TOLCVRES-1	1.97	0.00	-17.89**	-34.15**
15	ATL-17-06 × 2016/TODVAR-2	12.42*	-6.39	-4.39	-8.54
16	ATL-17-06 × 2016/TODVAR-3	-14.31	-66.37**	16.42	10.37**
17	ATL-17-06 × 2014/TOLCVRES-3	-29.85**	-37.59**	-19.46**	-7.93
18	ATL-17-05 × ATL-16-07	-89.36**	-91.85**	9.48	-15.95**
19	ATL-17-05 × GAT-5	15.36*	-28.40**	-7.68**	-1.23
20	ATL-17-05 × DVRT-2	35.09**	38.54**	17.29	-13.50*
21	ATL-17-05 × 2014/TOLCVRES-1	41.85**	42.65**	-6.15**	-3.07
22	ATL-17-05 × 2016/TODVAR-2	-64.05**	-57.91**	4.10	4.29
23	ATL-17-05 × 2016/TODVAR-3	77.52**	202.80**	-2.43*	-29.45**
24	ATL-17-05 × 2014/TOLCVRES-3	88.79**	75.02**	-19.58**	-6.13
25	ATL-16-07 × GAT-5	-65.52**	-46.99**	-22.89*	0.00

26	ATL-16-07 × DVRT-2	-16.31	-4.86	-32.78**	20.25
27	ATL-16-07 × 2014/TOLCVRES-1	40.12**	-4.23	9.38**	-15.63
28	ATL-16-07 × 2016/TODVAR-2	-51.26**	-56.25**	-14.02	-1.87
29.	ATL-16-07 × 2016/TODVAR-3	-53.21**	-65.55**	-28.56**	-6.87
30	ATL-16-07 × 2014/TOLCVRES-3	-15.42	10.82	-18.76	-10.00
31	GAT-5 × DVRT-2	237.95**	132.76**	-4.69	-11.66*
32	GAT-5 × 2014/TOLCVRES-1	-42.85	178.21**	0.34	-8.12
33	GAT-5 × 2016/TODVAR-2	86.70	-10.90	-11.68	-10.74
34	GAT-5 × 2016/TODVAR-3	37.98	-19.42	-30.46**	-23.08**
35	GAT-5 × 2014/TOLCVRES-3	-92.29**	-25.45	-1.06	20.29**
36	DVRT-2 × 2014/TOLCVRES-1	-57.28*	5.40	7.14	-21.47**
37	DVRT-2 × 2016/TODVAR-2	61.18**	44.89**	12.95	-8.59
38	DVRT-2 × 2016/TODVAR-3	-19.79*	-24.08**	6.70	-9.20
39	DVRT-2 × 2014/TOLCVRES-3	10.79	68.50**	-5.80	-1.84
40	2014/TOLCVRES-1 × 2016/TODVAR-2	27.88**	21.00**	-13.25*	10.00
41	2014/TOLCVRES-1 × 2016/TODVAR-3	-19.51	-28.54*	-19.82**	-12.50**
42	2014/TOLCVRES-1 × 2014/TOLCVRES-3	-3.21*	3.84	-8.61	-6.25
43	2016/TODVAR-2 × 2016/TODVAR-3	-28.29**	-31.99**	-11.79*	10.07
44	2016/TODVAR-2 × 2014/TOLCVRES-3	10.67	42.40**	3.58	9.40
45	2016/TODVAR-3 × 2014/TOLCVRES-3	62.14	77.01**	10.14	13.29
Range	Min.	-92.29	-91.85	-32.78	-34.15
	Max.	237.95	202.80	33.00	20.29
No. of significant crosses	Positive	13	14	2	3
	Negative	18	19	19	12
	Total crosses	31	33	21	15
S. E. ±		8.83	0.41	0.20	0.03

Table 1.3

Sr. No.	Hybrids	Number of locules per fruit
	(1)	(2)
1	ATL-17-02 × ATL-17-06	-9.80
2	ATL-17-02 × ATL-17-05	-14.29**
3	ATL-17-02 × ATL-16-07	-42.97**
4	ATL-17-02 × GAT-5	17.78**
5	ATL-17-02 × DVRT-2	-28.99**
6	ATL-17-02 × 2014/TOLCVRES-1	-15.49**
7	ATL-17-02 × 2016/TODVAR-2	2.00
8	ATL-17-02 × 2016/TODVAR-3	-16.67**
9	ATL-17-02 × 2014/TOLCVRES-3	42.22**
10	ATL-17-06 × ATL-17-05	-5.88
11	ATL-17-06 × ATL-16-07	-40.58**
12	ATL-17-06 × GAT-5	-3.92
13	ATL-17-06 × DVRT-2	-31.88**
14	ATL-17-06 × 2014/TOLCVRES-1	-40.85**
15	ATL-17-06 × 2016/TODVAR-2	13.73**
16	ATL-17-06 × 2016/TODVAR-3	-5.56
17	ATL-17-06 × 2014/TOLCVRES-3	-13.73
18	ATL-17-05 × ATL-16-07	-23.19**
19	ATL-17-05 × GAT-5	-8.16
20	ATL-17-05 × DVRT-2	-28.99**
21	ATL-17-05 × 2014/TOLCVRES-1	-45.07**
22	ATL-17-05 × 2016/TODVAR-2	-24.00**
23	ATL-17-05 × 2016/TODVAR-3	-27.78**
24	ATL-17-05 × 2014/TOLCVRES-3	2.04
25	ATL-16-07 × GAT-5	-28.99
26	ATL-16-07 × DVRT-2	-24.64**
27	ATL-16-07 × 2014/TOLCVRES-1	-26.76**
28	ATL-16-07 × 2016/TODVAR-2	-31.88
29.	ATL-16-07 × 2016/TODVAR-3	-28.99
30	ATL-16-07 × 2014/TOLCVRES-3	-33.33
31	GAT-5 × DVRT-2	-7.25
32	GAT-5 × 2014/TOLCVRES-1	-19.72**
33	GAT-5 × 2016/TODVAR-2	38.00**
34	GAT-5 × 2016/TODVAR-3	-14.81**
35	GAT-5 × 2014/TOLCVRES-3	8.89
36	DVRT-2 × 2014/TOLCVRES-1	-15.94**
37	DVRT-2 × 2016/TODVAR-2	14.00**
38	DVRT-2 × 2016/TODVAR-3	9.26

39	DVRT-2 × 2014/TOLCVRES-3	22.22**
40	2014/TOLCVRES-1 × 2016/TODVAR-2	-36.62
41	2014/TOLCVRES-1 × 2016/TODVAR-3	-35.21
42	2014/TOLCVRES-1 × 2014/TOLCVRES-3	-36.62
43	2016/TODVAR-2 × 2016/TODVAR-3	7.41**
44	2016/TODVAR-2 × 2014/TOLCVRES-3	78.00**
45	2016/TODVAR-3 × 2014/TOLCVRES-3	57.41**
Range	Min.	-45.07
	Max.	78.00
No. of significant crosses	Positive	18
	Negative	9
	Total crosses	27
S. E. ±	0.18	

Assessing the heterotic effect over better parent in the crosses derived from genetically diverse parent, in terms of yield, its various attributing traits had been one of the objectives of the present study. It may be positive or negative in direction. Heterobeltiosis in negative direction is generally preferred for the characters like days to initiation of flowering and days to first fruit ripening in tomato. So, for days to initiation of flowering and for days to first fruit ripening ATL-17-02 × ATL-16-07 and 2016/TODVAR-2 × 2014/TOLCVRES-3 respectively, recorded highest heterobeltiosis.

Then coming to positive heterobeltiosis which is desirable for characters like plant height, average fruit weight, number of fruits per plant, fruit yield per plant, etc., So, for plant height (2016/TODVAR-2 × 2014/TOLCVRES-3), average fruit weight (ATL-16-07 × GAT-5), number of fruits per plant (GAT-5 × DVRT-2), fruit yield per plant (hybrids ATL-17-05 × 2016/TODVAR-3), 1000 seed weight (ATL-17-02 × ATL-17-05), pericarp thickness (GAT-5 × 2014/TOLCVRES-3), number of locules per fruit (2016/TODVAR-2 × 2014/TOLCVRES-3)

these crosses are recorded with highest heterobeltiosis.

The results indicated that the crosses exhibited high heterobeltotic effect for yield and its important attributes, might possibly be useful in heterosis breeding programmes for further improvement. These crosses with high heterobeltotic effect also gave an idea to consider these heterotic effects for the production of superior lines.

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