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# Exploitation of heterosis for yield and yield related traits in okra (*Abelmoschus esculentus* (L.) Moench)

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**Abstract**
The present study was conducted in okra to estimate the magnitude of heterosis and to identify superior cross combinations for yield and its component traits. Thirty six F1s were developed by crossing 6 lines *viz.,* Pusa Sawani ($L_1$), Parbhani Kranti ($L_2$), Arka Abhay ($L_3$), Arka Anamika ($L_4$), AE 65 ($L_5$) and 14/11 ($L_6$) and 6 testers *viz.,* AE 64 ($T_1$), AE 66 ($T_2$), AE 17 ($T_3$),14/4 ($T_4$), 14/5 ($T_5$) and 14/10 ($T_6$) of okra in line x tester design during summer of 2018. All the 36 F1s along with their 12 parents (6 lines and 6 testers) and one standard check (Bhendi Hybrid CO 4) were evaluated in a randomized complete block design with two replications at Department of Vegetable Crops, Tamil Nadu Agricultural University, Coimbatore. Significance of mean squares due to treatments revealed the presence of considerable amount of genetic variability among the parents and cross combinations for all yield and yield attributing traits. The relative heterosis recorded the highest of 39.71 per cent in $L_3$ x $T_2$ (Arka Abhay x AE 66) in which twenty one cross combinations were positive and significant. Heterobeltiosis (dii) registered the highest of 28.65 per cent in Pusa Sawani x 14/4 ($L_1$ x $T_4$) in which eighteen cross combinations were significant and positive. The standard heterosis (diii) over check hybrid Bhendi Hybrid CO 4 recorded the highest of 37.12 per cent in Arka Anamika x 14/10 ($L_4$ x $T_6$) and twenty hybrids are positive and significant. Based on the results of the heterosis studies, it is clear that none of the 36 F1 hybrids of okra exhibited any consistency in terms of the direction and degree of heterosis over three bases *viz.,* relative heterosis, heterobeltiosis and standard heterosis for all the characters studied. In the present study, the magnitude of standard heterosis was found to be highly variable in direction and magnitude for all the characters under study. Negative heterosis was desirable for the traits *viz*., days to first flowering, days to 50 per cent flowering, internodal length and per cent disease incidence in respect to yield while positive heterosis was considered to be desirable for the remaining traits *viz*., plant height, number of branches per plant, fruit length, fruit girth, fruit weight, number of fruits per plant and yield per plant. Arka Anamika x AE 17 ($L_4$ x $T_3$) expressed significant and positive standard heterosis over the standard parent Bhendi Hybrid CO 4 for eleven traits. The same cross combination Arka Anamika x AE 17 ($L_4$ x $T_3$) recorded significant and negative standard heterosis over the standard check for days to first flowering, days to 50 per cent flowering and per cent disease incidence. Similarly, the cross combination Arka Anamika x 14/10 ($L_4$ x $T_6$) recorded significant standard heterosis over the standard parent Bhendi Hybrid CO 4 for eleven characters. The cross combination of 14/11 x 14/4 ($L_6$ x $T_4$) also noted significant standard heterotic effect over the standard parent for ten traits. AE 65 x 14/4 ($L_5$ x $T_4$) is another best hybrid in terms of heterotic effect over the standard check in which it revealed significant values for nine traits. Considering the above facts, the above mentioned hybrids i.e., Arka Anamika x AE 17 ($L_4$ x $T_3$), Arka Anamika x 14/10 ($L_4$ x $T_6$), 14/11 x 14/4 ($L_6$ x $T_4$) and AE 65 x 14/4 ($L_5$ x $T_4$) could be selected for further improvement in yield and yield attributing components.

**Keywords:** *Abelmoschus esculentus,* standard heterosis, yield, line x tester

## Introduction
Okra (*Abelmoschus esculentus* (L.) Moench) belong to the family Malvaceae is an economically important vegetable crop widely cultivated in tropical and sub-tropical regions of the world. It is commonly known as bhendi or lady's finger or gumbo. The immature and tender okra pods are used as vegetable in India, Brazil, West Africa and many other nations. (Wammanda *et al*., 2010) [21]. It has a vital source of fat, carbohydrate, fiber, calcium, phosphorous, iron, ascorbic acid, carotene, thiamin and riboflavin (Benchasri, 2012) [3].

Heterosis or hybrid vigour is the phenomenon in which F1 shows increase or decrease vigour over the parents. It was referred as the phenomenon for stimulation of heterozygosity (Shull, 1908) [17]. The adoption of heterosis breeding has been the most successful approach in enhancing the productivity in many cross pollinated crops. Okra is one often-cross pollinated vegetable crop and heterosis was first reported by Vijayaraghavan and Warier, 1946 [20]. Heterosis breeding for yield and its components were extensively studied. Several workers have reported the occurrence of heterosis in fruit yield of okra and its attributing traits (Mehta *et al.*, 2007; Jindal *et al.*, 2009) [11, 6].

The exploitation of heterosis is largely dependent on the screening and identification of diverse genotypes that could be produced by better combinations of important yield and yield contributing traits. Identification of suitable parental lines is the first and foremost step for any breeding programme. Parents are usually selected based on their phenotypic performance but it is essential that they should be selected on the basis of their combining ability as well. The estimation of heterosis gives an idea on the choice of desirable parental lines for the development of cross combinations with superior performance. In this way, hybrid vigour can be properly exploited. The present study aims to study the direction and magnitude of relative heterosis, heterobeltiosis and standard heterosis for yield and its component traits in 6 x 6 Line X Tester mating design for utilization of existing genetic diversity to develop heterotic F1 hybrids in okra.

## Materials and Methods

The experimental materials comprised of twelve diverse okra genotypes [(six lines *viz.*, Pusa Sawani ($L_1$), Parbhani Kranti ($L_2$), Arka Abhay ($L_3$), Arka Anamika ($L_4$), AE 65 ($L_5$) and 14/11 ($L_6$) and (six testers *viz.*, AE 64 ($T_1$), AE 66 ($T_2$), AE 17 ($T_3$),14/4 ($T_4$), 14/5 ($T_5$) and 14/10 ($T_6$)] which were crossed line x tester mating design to developed thirty six cross combinations. The thirty six cross combinations along with their parents and one standard check (Bhendi Hybrid CO 4) were evaluated in a randomized complete block design in two replications. The entire study was carried out at the College Orchard, Department of Vegetable Crops, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. The experiment was conducted during summer of 2018 for crossing the genotypes in Line x Tester fashion and the evaluation of the resulting hybrids was done during the summer of 2019. The standard horticultural practices were followed during the entire crop duration. Biometric data were recorded for eleven quantitative characters *viz.*, days to first flowering, days to 50 per cent flowering, plant height (cm), number of branches per plant, internodal length (cm), fruit length (cm), fruit girth (cm), fruit weight (g), number of fruits per plant, per cent disease incidence of *Yellow vein mosaic virus* disease (per cent). Relative heterosis, heterobeltiosis and standard heterosis were determined as percent increase (+) or decrease (-) of F1 over mid parent (MP), better parent (BP) and standard check (SC) using the formulae (F1-MP/MP × 100), (F1-BP/BP × 100) and (F1-SC/SC × 100), respectively (Singh, 1973). The statistical significance of heterosis, heterobeltiosis and standard heterosis was assessed by t-test.

## Results and Discussion

In the present study, the analysis of variance of 12 parents (6 lines and six testers) and their 36 $F_1$s for line x tester analysis revealed that the mean squares due to treatments have highly significant differences for all the characters understudy. Based on this, it imply that there is a sufficient amount of genetic variability among the parents and the crosses. (Table 1)

**Table 1:** Analysis of Variance of Line x tester analysis for various traits in okra.

| Source of Variation | df | Days to first flowering | Days to 50 per cent flowering | Plant height (cm) | Number of branches per plant | Internodal length (cm) | Fruit length (cm) | Fruit girth (cm) | Fruit weight (g) | Number of fruits per plant | Per cent disease incidence of YVMV | Yield per plant (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Replication | 1 | 6.5104 | 32.6667 | 26.0521 | 0.0023 | 0.006 | 0.0384 | 0.0051 | 0.0128 | 0.0088 | 58.2817 | 359.7551 |
| Treatments | 47 | 3.1859** | 6.7863** | 922.6796** | 0.1999** | 0.8555** | 1.6012** | 0.2567** | 6.1883** | 19.7658 | 1945.1621** | 3775.7487** |
| Error | 47 | 0.5104 | 0.4752 | 4.4814 | 0.0276 | 0.0121 | 0.0239 | 0.0064 | 7.3888 | 0.322 | 1.3656 | 74.1701 |

*, **Significant at $P \leq 0.05$ and $P \leq 0.01$ levels, respectively

The range of heterosis and the number of crosses displaying significantly positive and negative heterosis over standard control (Bhendi Hybrid CO 4) are presented in Table 2 to Table 7. There was considerable amount of variation in heterotic effects as they varied differently for different traits.

**Table 2:** Heterosis (per cent) over the mid parent (di), better parent (dii) and the standard parent (diii) for days to first flowering and days to 50 per cent flowering

| Hybrids | Days to first flowering, | | | Days to 50 per cent flowering | | |
|---|---|---|---|---|---|---|
| | Relative Heterosis (di) | Heterobeltiosis (dii) | Standard parent Heterosis (diii) | Relative Heterosis (di) | Heterobeltiosis (dii) | Standard parent Heterosis (diii) |
| $L_1$ x $T_1$ | 3.11* | 2.34 | -2.32 | 7.06** | 2.25 | 3.51 |
| $L_1$ x $T_2$ | -6.1** | -7.23** | -6.53** | 2.82** | 1.05 | 1.15 |
| $L_1$ x $T_3$ | -1.25 | -4.82** | -7.2** | 2.35 | -1.15 | -0.25 |
| $L_1$ x $T_4$ | -5.21** | -7.93** | -7.23** | 1.14 | 0.23 | 1.87 |
| $L_1$ x $T_5$ | -1.25 | -4.82** | -6.2** | -1.71 | -3.37* | -5.37* |
| $L_1$ x $T_6$ | -1.36 | -12.05** | -13.05** | 8.05** | 5.62** | 4.12** |
| $L_2$ x $T_1$ | 3.18* | 2.53 | -2.41 | 12.88** | 12.2** | 3.37* |
| $L_2$ x $T_2$ | -1.45 | -4.94** | -8.03** | 5.88** | 2.27 | 1.12 |
| $L_2$ x $T_3$ | -3.85* | -5.06** | -9.64** | 14.11** | 13.41** | 5.19** |
| $L_2$ x $T_4$ | -10** | 2.56 | -1.21 | 5.33** | 2.3 | 0.78 |
| $L_2$ x $T_5$ | -1.28 | -2.53 | -1.23 | 10.71** | 8.14** | 12.9** |
| $L_2$ x $T_6$ | 5.13** | 3.8* | -1.2 | 7.78** | 5.88** | 1.12 |

| | | | | | | |
|---|---|---|---|---|---|---|
| $L_3$ x $T_1$ | 5.66** | 3.7* | 1.5 | 4.82** | 2.35 | -2.25 |
| $L_3$ x $T_2$ | -4.94** | -5.9** | -6.34** | -1.73 | -3.41* | -4.49** |
| $L_3$ x $T_3$ | -5.06** | 2.59 | -9.64** | -2.41 | -4.71** | -8.99** |
| $L_3$ x $T_4$ | -1.30 | -1.90 | -2.41 | 1.16 | 2.17 | -2.25 |
| $L_3$ x $T_5$ | -2.01 | -2.47 | -4.82** | -1.75 | -2.33 | -5.62** |
| $L_3$ x $T_6$ | -1.26 | -2.01 | -5.21 | -2.35 | -2.35 | -6.74** |
| $L_4$ x $T_1$ | 7.1** | 6.41** | 4.12** | 5.95** | 2.3 | -2.1 |
| $L_4$ x $T_2$ | -1.27 | -3.7* | -6.02** | -7.43** | -7.95** | -10.99** |
| $L_4$ x $T_3$ | -8.75** | -7.41** | -9.3** | -3.57* | -6.78** | -8.09** |
| $L_4$ x $T_4$ | -2.53 | 2.85 | -1.22 | -5.75** | -5.75** | -7.87** |
| $L_4$ x $T_5$ | -1.03 | 1.87 | -7.03** | -6.36** | -6.9** | -9.19** |
| $L_4$ x $T_6$ | -3.75* | -4.94** | -6.23** | -5.81** | -6.1** | -8.64** |
| $L_5$ x $T_1$ | 2.53 | 1.25 | -2.41 | 5.45** | 3.57* | -2.25 |
| $L_5$ x $T_2$ | -1.86 | -2.47 | -4.92** | 0.58* | -1.15 | -3.37* |
| $L_5$ x $T_3$ | 3.18* | 1.25 | -2.41 | 3.03* | 1.19 | -1.9 |
| $L_5$ x $T_4$ | -4.35** | -4.94** | -0.8 | -3.49* | -5.68** | -6.74** |
| $L_5$ x $T_5$ | -1.91 | -3.75* | -5.13** | -2.35 | -3.49* | -7.4** |
| $L_5$ x $T_6$ | 0.64 | -1.25 | -1.48 | -1.78 | -2.35 | -8.76** |
| $L_6$ x $T_1$ | 3.85* | 3.85* | -2.41 | 4.29** | 3.66* | -4.81** |
| $L_6$ x $T_2$ | -0.63 | -2.47 | -3.82 | -2.35 | -7.68** | -6.74** |
| $L_6$ x $T_3$ | 1.89 | 3.85* | -2.41 | 4.29** | 3.56* | -4.19** |
| $L_6$ x $T_4$ | -4.52** | -6.11** | -7.42** | -2.99* | -4.71** | -2.4 |
| $L_6$ x $T_5$ | 1.94 | 1.28 | -2.11 | -1.19 | -3.49* | -6.74** |
| $L_6$ x $T_6$ | 1.82 | 1.20 | -3.22** | 1.78 | -1.15 | -3.37* |

*, **Significant at $P \leq 0.05$ and $P \leq 0.01$ levels, respectively

**Table 3:** Heterosis (per cent) over the mid parent (di), better parent (dii) and the standard parent (diii) for plant height (cm) and number of Brnches per plant.

| Hybrids | Plant height | | | Number of branches per plant | | |
|---|---|---|---|---|---|---|
| | Relative Heterosis (di) | Heterobeltiosis (dii) | Standard parent Heterosis (diii) | Relative Heterosis (di) | Heterobeltiosis (dii) | Standard parent Heterosis (diii) |
| $L_1$ x $T_1$ | 18.74** | 26.49** | 39.16** | 4.4 | 5.82 | 5.82 |
| $L_1$ x $T_2$ | -9.87** | -19.5** | -18.7** | 16.4** | 19.2** | 22..24** |
| $L_1$ x $T_3$ | 15.84** | 23.56** | -6.39 | 9.58* | 11.66** | 17.71** |
| $L_1$ x $T_4$ | 11.55** | 18.3** | -3.57 | 7.86* | 9.28* | 20.19* |
| $L_1$ x $T_5$ | 36.13** | 42.59** | 28.04** | 22.6** | 14.81** | 24.4** |
| $L_1$ x $T_6$ | 26.57** | 33.7** | 17.74** | 17.91** | 15.8** | 14.48** |
| $L_2$ x $T_1$ | 38.94** | 39.14** | 54.79** | 12.68** | 16.36** | 11.39** |
| $L_2$ x $T_2$ | -15.56** | -23.39** | -5.95** | 2.76 | 0.12 | 5.82 |
| $L_2$ x $T_3$ | 34.54** | -34.63** | -19.74* | 0.31 | 4.79 | 0.87 |
| $L_2$ x $T_4$ | 26.12** | 27.55** | -11.05 | 4.36 | 16.71** | 11.76** |
| $L_2$ x $T_5$ | 32.53** | -3.22 | -1.31 | 5.84 | 14.37** | 9.28* |
| $L_2$ x $T_6$ | 28.89** | 29.26** | -12.23 | 11.44** | 16.36** | 11.39** |
| $L_3$ x $T_1$ | -9.93** | -10.66** | 10.39** | 0.42 | 6.88 | 3.84 |
| $L_3$ x $T_2$ | 12.28** | 2.33 | 24.38** | 4.04 | 8.99* | 1.49 |
| $L_3$ x $T_3$ | 3.78** | 3.4* | 26.61** | 9.7** | 1.66 | 5.07 |
| $L_3$ x $T_4$ | 2.38 | 1.03 | 22.8** | 2.49 | 8.88* | 1.61 |
| $L_3$ x $T_5$ | 1.08 | -0.45 | 24.77** | 6.87 | 4.99 | 5.94 |
| $L_3$ x $T_6$ | -1.01 | -2.02 | 21.57** | 0.6 | 8.32* | 2.23 |
| $L_4$ x $T_1$ | -24.45** | 25.18** | -7.55** | 1.17 | 4.19 | 0.99 |
| $L_4$ x $T_2$ | 14.29** | -0.96 | 26.39** | 2.37 | 0.72 | 4.08 |
| $L_4$ x $T_3$ | 3.65** | 13.11* | 26.25** | 13.12** | 8.14* | 13.37** |
| $L_4$ x $T_4$ | 0.22 | 2.76 | 24.51** | 0.37 | 2.75 | 0.5 |
| $L_4$ x $T_5$ | 3.22** | 1.51 | 27.22** | 2.21 | 5.99 | 2.85 |
| $L_4$ x $T_6$ | 14.1** | 18.3** | 22.89** | 4.26 | 8.5* | 5.45 |
| $L_5$ x $T_1$ | 16.02** | 6.63** | 3.02 | 10.47** | 11.47** | 12.13** |
| $L_5$ x $T_2$ | 10.42** | 10.55** | 22.45** | 4.47 | 4.83 | 4.83 |
| $L_5$ x $T_3$ | -3.34 | -3.6 | 1.08 | 0.32 | 2.37 | 3.09 |
| $L_5$ x $T_4$ | 4.52** | 20.91* | 25.33** | 11.55** | 12.59** | 13.24** |
| $L_5$ x $T_5$ | 0.42 | -1.05 | 24.07** | 1.26 | 5.11 | 5.82 |
| $L_5$ x $T_6$ | -0.55 | -1.47 | 22.25** | 8.77* | 11.1* | 11.76** |
| $L_6$ x $T_1$ | 20.05** | 21.14** | 12.55** | 9.17* | 11.69** | 9.28* |
| $L_6$ x $T_2$ | 13.68** | 1.46 | 25.1** | 4.27 | 5.54 | 14.48** |
| $L_6$ x $T_3$ | -0.14 | -1.05 | 21.06** | 6.01 | 3.01 | 5.82 |
| $L_6$ x $T_4$ | 11.51* | 14.13** | 3.02 | 15.7** | 11.45** | 2.97 |
| $L_6$ x $T_5$ | -2.09 | -4.09** | -10.91 | 8.43* | 3.78 | 2.2 |
| $L_6$ x $T_6$ | 1.17 | -0.4 | 26.95** | 1.45 | 5.54 | 1.06 |

*, **Significant at $P \leq 0.05$ and $P \leq 0.01$ levels, respectively

**Table 4:** Heterosis (per cent) over the mid parent (di), better parent (dii) and the standard parent (diii) for internodal length (cm) and fruit length (cm)

| Hybrids | Internodal length | | | Fruit length | | |
|---|---|---|---|---|---|---|
| | Relative Heterosis (di) | Heterobeltiosis (dii) | Standard parent Heterosis (diii) | Relative Heterosis (di) | Heterobeltiosis (dii) | Standard parent Heterosis (diii) |
| $L_1$ x $T_1$ | 30.2** | 9.13** | 29.1 | 3.35** | -3.17** | 10.8 |
| $L_1$ x $T_2$ | -0.78 | -0.69 | -0.70 | -0.1 | 0.76 | 1.56 |
| $L_1$ x $T_3$ | 10.94 | 3.4 | 2.1 | -2.49 | -9.51** | 5.72** |
| $L_1$ x $T_4$ | 0.68 | -6.12** | 0.19 | -4.84** | -11.96** | 3.55** |
| $L_1$ x $T_5$ | -15.07** | -17.09** | -18.01** | 5.07** | -2.59* | 14.03** |
| $L_1$ x $T_6$ | -16.57** | -20.67** | -12.04** | -10.87** | -19.63** | 0.04 |
| $L_2$ x $T_1$ | -13.82** | -14.41** | -14.66** | -1.34 | -7.7 | -6.46 |
| $L_2$ x $T_2$ | -19.11** | -19.22** | -29.2** | -0.3 | -1.78 | -1.22 |
| $L_2$ x $T_3$ | -12.68** | -18.5** | -18.74** | -8.13** | -8.67** | -6.7** |
| $L_2$ x $T_4$ | -15.43** | -21.03** | -21.26** | -7.53** | -8.38** | 7.77** |
| $L_2$ x $T_5$ | -16.33** | -18.21** | -17.4** | -5.07** | -5.72** | 0.37 |
| $L_2$ x $T_6$ | -18.95** | -23.03** | -14.66** | -8.56** | -11.87** | 9.7** |
| $L_3$ x $T_1$ | 13.88** | 12.14 | 10.29 | -5.58** | -5.79** | 7.8** |
| $L_3$ x $T_2$ | -9.44** | -10.55** | -18.41** | 16.27** | -0.2 | 24.36** |
| $L_3$ x $T_3$ | -11.22** | -15.38** | -19.32** | 7.89** | 6.55** | 24.48** |
| $L_3$ x $T_4$ | 5.07 | 0.2 | -4.47* | 3.34** | 1.71 | 19.63** |
| $L_3$ x $T_5$ | -18.08** | -19.13** | -21.94** | -0.89 | -2.22* | 14.47** |
| $L_3$ x $T_6$ | -21.15** | -33.19** | -25.92** | -0.26 | -4.5** | 18.88** |
| $L_4$ x $T_1$ | 3.13 | 2.03 | 2.52 | -5.43** | -5.9** | 8.75** |
| $L_4$ x $T_2$ | -22.62** | -22.8** | -22.43** | 0.34 | 8.08** | 24.91** |
| $L_4$ x $T_3$ | -7.01** | -13.53** | 16.11** | 15.89** | 9.17** | 16.59** |
| $L_4$ x $T_4$ | -1.66 | 8.5** | -8.06** | -1.45 | -2.31* | 14.9** |
| $L_4$ x $T_5$ | -18.15** | -20.29** | -19.9** | 7.93** | -3.52** | 25.54** |
| $L_4$ x $T_6$ | -28.16** | -31.52** | -24.08** | 8.21** | 7.89** | 15.33** |
| $L_5$ x $T_1$ | 6.01 | 3.99 | 6.31 | -6.95** | -7.55** | 7.17** |
| $L_5$ x $T_2$ | -14.55** | -15.48** | -13.59** | -3.91** | 0.78 | 16.83** |
| $L_5$ x $T_3$ | -8.29** | 1.38 | -13.5** | 1.07 | 0.67 | -5.89* |
| $L_5$ x $T_4$ | 0.93 | -6.84** | 4.76* | 6.85** | 6.33** | 17.07** |
| $L_5$ x $T_5$ | 12.29 | 8.45 | 10.87 | 0.25 | -0.47 | 1.63 |
| $L_5$ x $T_6$ | -5.33** | 0.17 | 0.87 | -0.48 | -3.89** | -0.15 |
| $L_6$ x $T_1$ | 28.02** | 23.33 | 30.87** | -11.27** | -12.26** | 0.67 |
| $L_6$ x $T_2$ | 1.84 | -1.1 | 4.95* | -3.28** | 0.2 | -17.26** |
| $L_6$ x $T_3$ | -1.87 | -10.98** | -5.53* | -2.48** | -2.56* | -14.03** |
| $L_6$ x $T_4$ | -0.2 | -9.42** | -3.88 | 8.06** | 7.24** | 13.48** |
| $L_6$ x $T_5$ | -21.22** | -25.25** | -2.11 | -0.02 | -0.03 | -17.03** |
| $L_6$ x $T_6$ | -21.7** | -1.05 | 15.05** | -0.24 | -1.07 | -4.43** |

*, **Significant at $P \leq 0.05$ and $P \leq 0.01$ levels, respectively

**Table 5:** Heterosis (per cent) over the mid parent (di), better parent (dii) and the standard parent (diii) for fruit girth (cm) and fruit weight (g)

| Hybrids | Fruit girth | | | Fruit weight | | |
|---|---|---|---|---|---|---|
| | Relative Heterosis (di) | Heterobeltiosis (dii) | Standard parent Heterosis (diii) | Relative Heterosis (di) | Heterobeltiosis (dii) | Standard parent Heterosis (diii) |
| $L_1$ x $T_1$ | -13.73** | -16.61** | -10.65** | -12.07** | -17.92** | -5.32** |
| $L_1$ x $T_2$ | -4.62** | -4.62** | -4.62** | -14.85** | -10.5** | -11.16** |
| $L_1$ x $T_3$ | 1.48 | 0.32 | 0.99 | -7.06** | -7.82** | -6.3** |
| $L_1$ x $T_4$ | -4.83 | -1.65 | 0.52 | -11.47** | -18.42** | -3.23 |
| $L_1$ x $T_5$ | -1.45 | -0.02 | 1.58 | -9.06** | -12.89** | -4.88** |
| $L_1$ x $T_6$ | 1.25 | 0.43 | -11.08* | -17.16** | -21.95** | -11.75** |
| $L_2$ x $T_1$ | 2.45 | 1.38 | -1.90 | -20.56** | -22.34** | -6.23** |
| $L_2$ x $T_2$ | -0.17 | -0.61 | 0.26 | -20.44** | -27.27** | -12.19** |
| $L_2$ x $T_3$ | 2.04 | -1.61 | 2.89 | -18.18** | -24.65** | -9.02** |
| $L_2$ x $T_4$ | 7.2** | 2.2 | 13.7** | -31.58** | -22.18** | -12.1** |
| $L_2$ x $T_5$ | -1.61 | 5.78** | -3.84** | -19.81** | -23.65** | -7.81** |
| $L_2$ x $T_6$ | -9.92** | -14.06** | -4.54** | -30.47** | -32.68** | -18.72** |
| $L_3$ x $T_1$ | -14.98** | -15.64** | -9.6** | -8.95** | -8.96** | 5.02** |
| $L_3$ x $T_2$ | 6.75** | 3.97** | 9.69** | 12.12** | 4.67** | 20.71** |
| $L_3$ x $T_3$ | 2.77* | 1.29 | 10.03** | 15.24** | 8.41** | 25.02** |
| $L_3$ x $T_4$ | -0.56 | -3.14* | 7.77** | -5.64** | -6.95** | 10.37** |
| $L_3$ x $T_5$ | -1.62 | -3.72** | 6.11** | 7.47** | 4.61** | 20.64** |
| $L_3$ x $T_6$ | 0.64 | -1.89 | 8.99** | 4.79** | 3.77* | 19.66** |
| $L_4$ x $T_1$ | -6.04** | 6.19** | 0.52 | -14.74** | -15.47** | -2.49 |
| $L_4$ x $T_2$ | -3.85** | 4.66** | 0.58 | 16.87** | 9.98** | 24.68** |
| $L_4$ x $T_3$ | 9.96** | -0.94 | 13.7** | 13.84** | 7.96** | 22.39** |

| | | | | | | |
|---|---|---|---|---|---|---|
| $L_4$ x $T_4$ | -7.24** | -9.1** | 1.13 | -3.34* | -5.48** | -12.12** |
| $L_4$ x $T_5$ | -1.88 | -3.77** | -5.93** | 12.62** | 10.54** | 25.32** |
| $L_4$ x $T_6$ | 6.63** | 4.99** | -5.71* | -3.67* | -3.8* | 9.06** |
| $L_5$ x $T_1$ | -12.5** | -12.78** | 6.89** | -9.43** | -10.16** | 3.64* |
| $L_5$ x $T_2$ | -0.53 | 0.73 | 1.92 | -4.78** | -10.44** | 1.65 |
| $L_5$ x $T_3$ | 0.6 | 2.41 | 11.26** | 10.27** | 4.51** | 18.62** |
| $L_5$ x $T_4$ | 2.78* | 6.45** | -0.32 | -5.92** | 7.95** | 9.19** |
| $L_5$ x $T_5$ | 1.88 | 0.79 | 11.08** | 1.54 | -0.39 | 13.06** |
| $L_5$ x $T_6$ | -0.68 | -2.12 | 8.73** | -4.12** | -4.3** | 8.62** |
| $L_6$ x $T_1$ | -15.94** | -11.48** | -9.34** | -6.72** | -7.65** | -6.53** |
| $L_6$ x $T_2$ | -3.01* | -6.83** | 1.13 | 13.27** | 6.73** | 20.67** |
| $L_6$ x $T_3$ | -4.86** | -4.9** | 3.32* | 11.62** | 5.99** | -12.29** |
| $L_6$ x $T_4$ | 3.37** | 4.55** | 6.2** | -3.07* | 5.34** | 19.83** |
| $L_6$ x $T_5$ | -0.76 | -1.5 | 8.55** | 1.74 | 2.11 | 13.06** |
| $L_6$ x $T_6$ | 2.42* | -3.53** | 7.16** | 2.03 | 2.03 | 15.35** |

*, **Significant at $P \leq 0.05$ and $P \leq 0.01$ levels, respectively

**Table 6:** Heterosis (per cent) over the mid parent (di), better parent (dii) and the standard parent (diii) for number of fruits per plant and per cent disease incidence of *yellow vein mosaic virus*

| Hybrids | Number of fruits per plant | | | Per cent disease incidence of *yellow vein mosaic virus* | | |
|---|---|---|---|---|---|---|
| | Relative Heterosis (di) | Heterobeltiosis (dii) | Standard parent Heterosis (diii) | Relative Heterosis (di) | Heterobeltiosis (dii) | Standard parent Heterosis (diii) |
| $L_1$ x $T_1$ | 29.49** | 27.9** | 41.86** | 53.55** | 35.63** | 67.78** |
| $L_1$ x $T_2$ | 6.27** | -4.46 | -22.29** | 65.69** | 70.88** | 56.65** |
| $L_1$ x $T_3$ | 2.27 | -16.62** | -12.21** | 54.03** | 76.19** | 63.68** |
| $L_1$ x $T_4$ | -5.86* | -22.01** | -18.68** | 62.88** | 51.44** | 61.12** |
| $L_1$ x $T_5$ | -3.44 | -19.83** | 21.39** | 22.53** | 34.11 | 45.27** |
| $L_1$ x $T_6$ | -33.5** | -15.87** | -13.79** | 24.79** | 45.21 | 46.92** |
| $L_2$ x $T_1$ | -6.68** | -9.38** | -44.29** | 32.13** | 51.11** | 29.12** |
| $L_2$ x $T_2$ | -1.1 | -19.49** | -28.18** | -46.33** | -9.67** | -39.91** |
| $L_2$ x $T_3$ | -18.12** | -18.28** | -30.11** | -39.23** | -42.10** | -45.13** |
| $L_2$ x $T_4$ | -26.98** | -28.6** | -13.68** | -25.10** | -5.76** | -39.20** |
| $L_2$ x $T_5$ | -20.53** | -22.48** | -23.43** | 47.32** | 58.93** | 71.34** |
| $L_2$ x $T_6$ | -5.43** | -0.87 | 2.82 | -28.76** | -35.12** | -56.36** |
| $L_3$ x $T_1$ | -27.92** | -28.67** | -9.29* | -22.57** | -28.23** | 49.32** |
| $L_3$ x $T_2$ | -2.06 | 0.45 | 2.12 | -20.99** | -51.18** | -34.84** |
| $L_3$ x $T_3$ | 7.22** | -2.71 | 7.14* | 15.04** | 24.73** | 37.57** |
| $L_3$ x $T_4$ | 5.26* | 4.9 | 15.71** | -37.15** | -45.12** | -27.5** |
| $L_3$ x $T_5$ | -2.46 | -3.03 | 1.01 | 60.57** | 27.02** | 60.44** |
| $L_3$ x $T_6$ | 0.11 | -1.79 | 12.45** | 34.73** | 6.06 | 19.32** |
| $L_4$ x $T_1$ | -9.5 | -1.03 | -8.14 | -19.37** | -59.68** | 0.41 |
| $L_4$ x $T_2$ | 3.28 | 2.7 | -5.11 | -17.27** | -58.64** | 22.23** |
| $L_4$ x $T_3$ | 28.51** | 15.24* | 22.86** | -51.57** | -24.21** | -47.86** |
| $L_4$ x $T_4$ | -5.2* | 6.61* | 26.43** | -30.72** | 9.45 | 13.45** |
| $L_4$ x $T_5$ | 4.29 | 2.51 | 1.71 | 4.06 | -47.97** | -11.67** |
| $L_4$ x $T_6$ | 24.06** | 6.29* | 40.23** | -28.06** | -44.03** | -41.27** |
| $L_5$ x $T_1$ | -29.42** | -30.7** | 7.86 | 12.19** | 13.05** | 23.29** |
| $L_5$ x $T_2$ | 1.24 | 1.88 | 18.57** | -39.02** | -41.07** | 24.12** |
| $L_5$ x $T_3$ | -3.16 | -4.05 | -22.14** | -16.54** | -13.67** | 11.96** |
| $L_5$ x $T_4$ | 20.33** | 5.41* | 1.43 | -41.44** | -29.28** | -54.91** |
| $L_5$ x $T_5$ | 3.75 | 2.34 | 9.29** | 29.14** | 4.34 | 37.57** |
| $L_5$ x $T_6$ | -2.02 | -3.14 | 4.29** | 11.85** | -10.09** | 47.81** |
| $L_6$ x $T_1$ | -34.56** | -36.61** | 1.43 | -48.45** | -48.13** | -28.82** |
| $L_6$ x $T_2$ | -1.6 | -2.23 | 26.43** | -49.9** | -53.69** | 36.84** |
| $L_6$ x $T_3$ | -1.35 | -1.79 | -18.72** | 4.31 | 8.89 | 18.20** |
| $L_6$ x $T_4$ | 28.63** | 12.29** | 32.86** | -29.81** | -47.2** | -40.77** |
| $L_6$ x $T_5$ | 2.75 | 2.42 | 10.12** | 53.29** | 28.53** | 52.32** |
| $L_6$ x $T_6$ | -6.04** | -6.25* | 0.67 | 19.11** | -1.03 | -0.21 |

*, **Significant at $P \leq 0.05$ and $P \leq 0.01$ levels, respectively

**Table 7:** Heterosis (per cent) over the mid parent (di), better parent (dii) and the standard parent (diii) for yield per plant

| Hybrids | Relative Heterosis (di) | Heterobeltiosis (dii) | Standard parent Heterosis (diii) |
|---|---|---|---|
| $L_1$ x $T_1$ | 9.76** | 9.81** | 10.89** |
| $L_1$ x $T_2$ | -13.44** | -29.46** | -23.46** |
| $L_1$ x $T_3$ | 11.17** | 16.04** | 5.71* |
| $L_1$ x $T_4$ | 21.61** | 28.65** | 13.01** |
| $L_1$ x $T_5$ | 19.79** | 21.96** | 17.49** |
| $L_1$ x $T_6$ | 5.95* | 8.76** | -2.97 |
| $L_2$ x $T_1$ | 1.91 | -2.22 | -2.5 |
| $L_2$ x $T_2$ | 11.59** | 2.59 | 5.99* |
| $L_2$ x $T_3$ | 18.38** | 25.89** | 16.77** |
| $L_2$ x $T_4$ | 8.06** | 5.36* | 15.39** |
| $L_2$ x $T_5$ | -0.28 | -6.92* | -1.59 |
| $L_2$ x $T_6$ | 14.51** | 6.59* | 13.35** |
| $L_3$ x $T_1$ | -19.23** | -22.34** | -22.57** |
| $L_3$ x $T_2$ | 39.71** | 28.2** | 17.97** |
| $L_3$ x $T_3$ | 23.98** | 12.79** | 26.10** |
| $L_3$ x $T_4$ | 5.67* | 17.24** | 0.92 |
| $L_3$ x $T_5$ | 1.14 | -5.42 | 0.56 |
| $L_3$ x $T_6$ | 13.85** | 6.18* | 12.91** |
| $L_4$ x $T_1$ | 19.48** | 22.16** | 16.84** |
| $L_4$ x $T_2$ | 2.73 | 0.23 | 12.56** |
| $L_4$ x $T_3$ | 37.48** | 18.19** | 29.27** |
| $L_4$ x $T_4$ | -3.37 | -9.35** | 10.53** |
| $L_4$ x $T_5$ | -1.14 | -1.37 | 5.38 |
| $L_4$ x $T_6$ | 29.01** | 21.34** | 37.12** |
| $L_5$ x $T_1$ | -17.36** | -18.37** | -18.61** |
| $L_5$ x $T_2$ | 16.05** | 3.88 | 1.03 |
| $L_5$ x $T_3$ | -4.56 | -10.95** | -21.14** |
| $L_5$ x $T_4$ | 10.46** | 13.28** | 25.73* |
| $L_5$ x $T_5$ | 4.78* | 0.58 | 6.34* |
| $L_5$ x $T_6$ | 1.43 | -2.91 | 3.25 |
| $L_6$ x $T_1$ | -20.46** | -22.38** | -22.6** |
| $L_6$ x $T_2$ | 1.71 | -7.97** | -12.65** |
| $L_6$ x $T_3$ | -3.52 | 1.91 | 2.01 |
| $L_6$ x $T_4$ | 9.19** | 19.25** | 31.02** |
| $L_6$ x $T_5$ | -0.61 | -5.69* | -0.29 |
| $L_6$ x $T_6$ | 13.04** | 6.96* | 13.75** |

*, **Significant at $P \leq 0.05$ and $P \leq 0.01$ levels, respectively

Negative heterosis was considered to be better for some of the traits studied *viz*., days to first flowering, days to 50 per cent flowering, internodal length and per cent disease incidence of *yellow vein mosaic virus* in respect to the yield while positive heterosis was considered to be desirable for the remaining traits *viz*., plant height, number of branches per plant, fruit length, fruit girth, fruit weight, number of fruits per plant and yield per plant.

Days to first flowering recorded the minimum and maximum relative heterosis (di) of -8.75 ($L_4$ x $T_3$) and 5.66 ($L_3$ x $T_1$) respectively in which ten hybrids out of thirty six hybrids expressed negative and significant heterosis over mid parent for this trait. Heterobeltiosis (dii) ranged from -12.05 ($L_1$ x $T_6$) to 6.41 ($L_4$ x $T_1$) in which twelve cross out of thirty six combination expressed negative and significant heterosis over the better parent. The standard heterosis (diii) over check hybrid Bhendi Hybrid CO 4 recorded the lowest and highest in $L_1$ x $T_6$ (-13.05) and $L_4$ x $T_1$ (4.12) respectively in which eighteen hybrids out of thirty six hybrids expressed negative and significant values. Similar results were reported by Bendale *et al.* (2004) [4], Medagam *et al.* (2012) [10] and Kumar *et al.* (2019) [8].

For days to 50 per cent flowering, the relative heterosis (di) recorded a ranged of -7.43 ($L_4$ x $T_2$) to 14.11 ($L_2$ x $T_3$). Out of thirty six hybrids seven cross combinations expressed negative and significant heterosis over mid parent. The heterobeltiosis (dii) ranged from -7.95 ($L_4$ x $T_2$) to 13.41 ($L_2$ x $T_3$) in which thirteen out of thirty six cross combination recorded significance and negative heterosis over better parent. The standard heterosis (diii) over check hybrid Bhendi Hybrid CO 4 recorded the highest and lowest in $L_4$ x $T_2$ (-10.99) and $L_2$ x $T_5$ (12.9) respectively in which nineteen out of thirty six cross combination recorded significance and negative heterosis over standard parent. The results are in line with the findings of Verma and Sood (2015) [19] and Ali *et al*. (2013) [1].

For plant height the heterosis over mid parent (di) recorded the minimum of -24.45 ($L_4$ x $T_1$) and a maximum of 38.94 ($L_2$ x $T_1$). Out of thirty six hybrids, twenty two hybrids were positive and significant. The heterosis over better parent (dii) ranged from -34.63 ($L_2$ x $T_3$) to 42.59 ($L_1$ x $T_5$) in which seventeen out of thirty six cross combinations noted to be positive and significant. The range of standard heterosis (diii) over check hybrid Bhendi Hybrid CO 4 recorded the highest and lowest in $L_2$ x $T_3$ (-19.74) and $L_2$ x $T_1$ (54.79) respectively in which twenty three cross combination recorded significance and positive heterosis over standard parent. These findings are in collaboration with the findings of Ali *et al*. (2013) [1] and Kerure and Pitchaimuthu (2019) [7].

For number of branches per plant the relative heterosis (di) recorded the maximum and minimum in $L_5$ x $T_3$ (0.32) and $L_1$ x $T_5$ (22.6) respectively and fifteen hybrids expressed positive and significant heterosis over the mid parent. The heterobeltiosis (dii) ranged from 0.12 ($L_2$ x $T_2$) to 19.2 ($L_1$ x $T_2$) and nineteen hybrids expressed positive and significant heterosis over the better parent. The standard heterosis (diii) over check hybrid Bhendi Hybrid CO 4 recorded the highest and lowest in $L_4$ x $T_4$ (0.5) and $L_1$ x $T_5$ (24.4) respectively and fifteen cross combination recorded significance and positive heterosis over standard parent. Wammanda *et al.* (2010) [21], Pradeep and Singh (2012) [13] and Medagam *et al.* (2012) [10] also reported hetrotic effects of similar magnitude for number of branches per plant;

For internodal length the relative heterosis (di) was found to be the minimum in $L_4$ x $T_6$ (-28.16) and maximum in $L_1$ x $T_1$ (30.2) in which twenty one cross combinations showed negative and significance heterosis over the mid parent. The range of heterobeltiosis (dii) was from -33.19 ($L_3$ x $T_6$) to 9.13($L_1$ x $T_1$) in which twenty two cross combinations were negative and significant. The standard heterosis (diii) over check hybrid Bhendi Hybrid CO 4 ranged from -29.2 ($L_2$ x $T_2$) to 30.87 ($L_6$ x $T_1$) and twenty hybrids noted significant and negative. These findings are in line with the reports of Medagam *et al.* (2012) [10] Rewale *et al.* (2003) [14], Wammanda *et al*. (2010) [21] and Verma and Sood (2015) [19].

For fruit length the range of relative heterosis (di) was observed from -10.87 ($L_1$ x $T_6$) to 16.27 ($L_3$ x $T_2$) in which ten cross combinations were positive and significant. The heterobeltiosis (dii) exhibited the minimum and maximum of -19.63 ($L_1$ x $T_6$) and 9.17 ($L_4$ x $T_3$) respectively and six out of thirty six hybrids were positive and significant. The standard heterosis (diii) over check hybrid Bhendi Hybrid CO 4 was found to be significant and positive in twenty one cross combinations and the ranged existed between -17.26 ($L_6$ x $T_2$) to 25.54 ($L_4$ x $T_5$). Amutha *et al.* (2007) [2], Senthilkumar and Sreeparvathy (2010) [15], Wammanda *et al.* (2010) [21] and Medagam *et al.* (2012) [10] also reported similar findings.

For fruit girth, eight hybrids exhibited significant positive relative heterosis (di) in which the minimum and maximum values were $L_6$ x $T_1$ (-15.94) and $L_4$ x $T_3$ (9.96).

Heterobeltiosis (dii) ranged from -16.61($L_1$ x $T_1$) to 6.45 ($L_5$ x $T_4$) in which seven cross combination noted significant and positive values. The range of standard heterosis (diii) over check hybrid Bhendi Hybrid CO 4 existed between -1.08 ($L_1$ x $T_6$) to 15.71 ($L_4$ x $T_6$) and fourteen hybrids expressed positive and significant values. Such extent of heterotic effects for fruit girth were reported by Borgaonkar *et al.* (2006) [5], Senthilkumar and Sreeparvathy (2010) [15], Kumar *et al.* (2019) [8] and Medagam *et al*, (2012) [10].

For fruit weight the heterosis over mid parent (di) recorded the minimum of -31.58 ($L_2$ x $T_4$) and a maximum of 16.87 ($L_4$ x $T_2$) in which ten hybrids expressed positive and significant values. Ten hybrids exhibited significant positive heterobeltiosis (dii) for fruit weight and the minimum and maximum value were -32.68 ($L_2$ x $T_6$) and 10.54 ($L_4$ x $T_5$) respectively. The standard heterosis (diii) over check hybrid Bhendi Hybrid CO 4 was minimum in $L_2$ x $T_6$ (-18.72) and maximum in $L_4$ x $T_5$ (25.32) and eighteen hybrids exhibited significant positive heterosis over standard parent. These heterosis estimates for fruit weight are in line with those of Senthilkumar and Sreeparvathy (2010) [15], Verma and Sood (2015) [19], Kerure and Pitchaimuthu (2019) [7] and Kumar *et al.* (2019) [8].

For number of fruits per plant, eight hybrids recorded positive and significance heterosis over the mid parent (di) in which the range was from -34.56 ($L_6$ x $T_1$) to 29.49 ($L_1$ x $T_1$). The range of heterobeltiosis (dii) was minimum in $L_6$ x $T_1$ (-36.61) and maximum $L_1$ x $T_1$ (27.9) and six cross combinations exhibited significant positive heterosis over better parent. Fourteen hybrids expressed positive and significant heteosis (diii) for standard heterosis over check hybrid Bhendi Hybrid CO 4 in which the range was observed from -44.29 ($L_2$ x $T_1$) to 40.23 ($L_4$ x $T_6$). Similar magnitude of heterosis were reported by Medagam *et al.* (2012) [10], Mistry *et al.* (2012) [12] Verma and Sood (2015) [19] and Kerure and Pitchaimuthu (2019) [7] for number of fruits per plant.

For per cent disease incidence of yellow vein mosaic virus, the range of relative heterosis (di) recorded from -51.57 ($L_4$ x $T_3$) to 65.69 ($L_1$ x $T_2$) and there were eighteen hybrids which are negative and significant. Heterobeltiosis (dii) exhibited the lowest and minimum values from -59.68 ($L_4$ x $T_1$) to 76.19 ($L_1$ x $T_3$) in which eighteen hybrids are negative and significant. The standard heterosis (diii) over check hybrid Bhendi Hybrid CO 4 ranged from -56.36 ($L_2$ x $T_6$) to 71.34 ($L_2$ x $T_5$) and there are twelve hybrids which noted negative and significant values. Seth *et al.* (2016) [16] and Mahalik (2018) [9] also reported similar heterotic effects for per cent disease incidence of okra yellow vein mosaic virus.

For yield per plant the relative heterosis (di) recorded the lowest in $L_6$ x $T_1$ (-20.46) and highest in $L_3$ x $T_2$ (39.71) in which twenty one cross combinations were positive and significant. Heterobeltiosis (dii) ranged from -29.46 ($L_1$ x $T_2$) to 28.65 ($L_1$ x $T_4$) in which eighteen cross combinations were significant and positive. The standard heterosis (diii) over check hybrid Bhendi Hybrid CO 4 ranged from -23.46 ($L_1$ x $T_2$) to 37.12 ($L_4$ x $T_6$) and twenty hybrids are positive and significant. These findings are in line with the findings of Kerure and Pitchaimuthu (2019) [7], Singh and Singh (2012) [18] and Pradeep and Singh (2012) [13] for yield per plant.

Based on the results of the heterosis studies, it is clear that none of the 36 F1 hybrids of okra exhibited any consistency in terms of the direction and degree of heterosis over three bases *viz.*, relative heterosis, heterobeltiosis and standard heterosis for all the characters studied. Among the hybrids, some of them manifested positive heterosis while others exhibited negative heterosis which suggests the extent of genetic diversity among the parents of different cross combinations for the component traits. In the present study, the magnitude of standard heterosis was found to be highly variable in direction and magnitude for all the characters under study. Similar findings in the variation of heterosis for different characters was reported by and Jindal *et al.* (2009) [6].

The heterosis analysis revealed that among the thirty six hybrids, Arka Anamika x AE 17 ($L_4$ x $T_3$) expressed significant and positive standard heterosis over the standard parent Bhendi Hybrid CO 4 for eleven traits *viz.*, plant height, number of branches per plant, fruit length, fruit girth, fruit weight, number of fruits per plant, total phenol, peroxidase activity, polyphenol oxidase activity, per cent disease incidence and yield per plant. The same cross combination Arka Anamika x AE 17 ($L_4$ x $T_3$) recorded significant and negative standard heterosis over the standard check for days to first flowering, days to 50 per cent flowering and per cent disease incidence.

Similarly, the cross combination Arka Anamika x 14/10 ($L_4$ x $T_6$) recorded significant standard heterosis over the standard parent Bhendi Hybrid CO 4 for eleven characters *viz.*, days to first flowering, days to 50 per cent flowering, plant height, intermodal length, fruit length, fruit girth, fruit weight, number of fruits per plant, polyphenol oxidase activity, per cent disease incidence and yield per plant.

The cross combination of 14/11 x 14/4 ($L_6$ x $T_4$) also noted significant standard heterotic effect over the standard parent for ten traits *viz.*, days to first flowering, fruit length, fruit girth, fruit weight, number of fruits per plant, total phenol, polyphenol oxidase activity, per cent disease incidence and yield per plant.

AE 65 x 14/4 ($L_5$ x $T_4$) is another best hybrid in terms of heterotic effect over the standard check in which it revealed significant values for nine traits *viz.*, days to 50 per cent flowering, plant height, number of branches per plant, fruit length, fruit weight, peroxidase activity, polyphenol oxidase activity, per cent disease incidence and yield per plant.

Considering the above facts, the above mentioned hybrids i.e., Arka Anamika x AE 17 ($L_4$ x $T_3$), Arka Anamika x 14/10 ($L_4$ x $T_6$), 14/11 x 14/4 ($L_6$ x $T_4$) and AE 65 x 14/4 ($L_5$ x $T_4$) could be selected for further improvement in yield and yield attributing components.

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