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# Heterosis studies in okra (*Abelmoschus esculentus* (L.) Moench) for yield and yield contributing characters

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## Abstract
Heterosis studies for forty-five hybrids of okra along with their ten horticulturally sound and diverse parental lines in 10 x 10 half diallel fashion were evaluated to assess the heterosis effect over better parent and one standard hybrid check (Radhika) in Randomized Block Design with two replications in both summer and *kharif* seasons (2021 and 2022) for yield and yield contributing twelve characters of okra (*Abelmoschus esculentus* (L.) Moench). The $F_1$ hybrids $P_1$ x $P_8$ (RHOK 03 x RHOK 30), $P_2$ x $P_{10}$ (RHOK 12 x Phule Vimukta), $P_2$ x $P_4$ (RHOK 12 x RHOK 17), $P_4$ x $P_6$ (RHOK 17 x RHOK 23) and $P_2$ x $P_9$ (RHOK 12 x RHOK 31) displayed the significant positive heterosis for most of the traits in both summer and *kharif* season. The negative heterotic crosses $P_2$ x $P_{10}$ (RHOK 12 x Phule Vimukta), $P_3$ x $P_{10}$ (RHOK 14 x Phule Vimukta), $P_4$ x $P_6$ (RHOK 17 x RHOK 23) and $P_6$ x $P_7$ (RHOK 23 x RHOK 26) exhibited significant negative heterosis under summer and *kharif* season for length of inter-node and first fruiting node.

**Keywords:** $F_1$ hybrids, okra, heterosis, yield contributing characters, half diallel crosses

## Introduction
Okra (*Abelmoschus esculentus* (L.) Moench) is a warm season and annual vegetable crop belongs to the family *Malvaceae*, genus-*Abelmoschus* an amphidiploids having 2n=130 chromosomes and propagated by seed. It is commonly known as lady's finger as well as by several vernacular names, including Okra, Bhindi, Gumbo etc. being a native of tropical Africa. It is an often cross pollinated crop has a prominent position in olericulture because of its high nutritive value, wider adaptability and round the year export potential. The entire plant is edible and is used to make several foods (Lim, 2012 and Jain *et al.*, 2012) [19, 12]. In Ayurveda, Okra is used as an edible infusion and in different preparation for diuretic effect (Maramag, 2013) [20]. Immature tender fresh and green pods are consumed as vegetables. Often the extract obtained from the fruit is added to different recipes like soups, stews and sauces to increase the consistency. (Hadiya *et al.*, 2018) [9]. The immature pods are used in making pickle, stem and root mucilage in jaggery preparation and crude fiber from mature fruits and stem in paper industry. The dry seeds of okra are a good source of edible oil along with high unsaturated fats like oleic & linolic acids (Sidapara *et al.*, 2021) [32].
Okra is a cost-effective and economically affordable natural source with ample reservoirs of carbohydrates, proteins, fatty acids, vitamins, fiber and minerals with various other bio-active phytochemicals those are important for human health. It's having specific mechanism of action against different diseases. (Elkhalifa *et al.*, 2021) [7]. The nutritive values of okra have 88% moisture, 7.7% carbohydrates, 2.2% protein, 1.5% iron, 1.1% fiber, 0.7% mineral matter, 0.09% calcium, 0.2% fat, 0.08% phosphorous & of 41 (Kcal) calorific value. The vitamin content in okra *viz.* vitamin A-58 IU, vitamin B-0.06 mg, Nicotinic acid-0.6 mg, Riboflavin-0.06 mg and vitamin C-13 mg (Devi *et al.*, 2017) [6]. Okra cortex is one of the potential source of mucilage (Girase *et al.*, 2003) [8].
India ranks first in the world in production of okra with 64.66 lakh metric tonnes of production obtained from an area of 5.31 lakh hectare with productivity of 12.2 metric tonnes per hectare during 2021-22. The area under the crop in Maharashtra during 2021-22 was 15.40 thousand hectares with the production 1.56 lakh metric tonnes. However, Maharashtra's productivity 10.17 MT/ha is much lower than that of the country which is 12.02 MT/ha (Anon,2022) [2].
Relative ease of hybridization in okra due to its monadelphous nature, higher degree of fruit set and fairly large number of seeds per fruits are the plus points for commercial hybrid seed production.

Selected lines in this experiment are at near homozygous state and can be assessed for exploitation of heterosis. Hence an investigation was carried out with an objective of assessing the magnitude of heterosis for yield and yield attributing parameters.

## Materials and Methods

The present investigation entitled "Genetic studies in okra (*Abelmoschus esculentus* (L.) Moench.)", was conducted at All India Coordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India during 2021-22. The experimental field has an altitude of 532 m above MSL, latitude of 19°47' to 19°57' N and a longitude of 74°82' to 74°91' E. The parental material consisted of 10 diverse genotypes *viz.*, ($P_1$) RHOK 03, ($P_2$) RHOK 12, ($P_3$) RHOK 14, ($P_4$) RHOK 17, ($P_5$) RHOK 22, ($P_6$) RHOK 23, ($P_7$) RHOK 16, ($P_8$) RHOK 30, ($P_9$) RHOK 31 and ($P_{10}$) Phule Vimukta were crossed in half diallel fashion and one standard check (Radhika) were evaluated in a randomized block design with two replications during summer and *kharif* season 2021-2022. Seeds of these genotypes obtained from Senior Vegetable Breeder, All India Coordinated Research Project on Vegetable Crops, Mahatma Phule Krishi Vidyapeeth, Rahuri. In each replication each genotype 20 plants were grown at spacing 60 x 30 cm. Recommended agronomic practices and plant protection measures were carried out. Observations were recorded on parameters *viz.*, plant height (cm), number of branches per plant, number of nodes per plant, length of internode (cm), days to 50% flowering, days required for first harvesting, first fruiting node, number of fruits per plant, average weight of fruit (g), fruit length (cm), fruit diameter (cm), yield per hectare (q). Five randomly selected plants from each plot replication were used for recording yield and yield contributing characters. Heterosis was calculated as percent increase or decrease over better parent and standard check (Radhika) values as per Rai, (1979) [28].

## Formulas for heterosis estimation

Heterosis over better parent = ($F_1$-BP/ BP) x 100

Heterosis over Standard check = ($F_1$-Std. Check/ Std. Check) x 100

## Results and Discussion

The acquirement of maximum crop yield is the crucial objective in most of the breeding programmes and the major key factor in okra breeding is development of improved varieties. The hybrids performed significantly better than the respective parents. Significant heterosis was observe for most of the characters. Mean performance range of parents, hybrids and standard check is given in table number 1 and 2 respectively. Better parent heterosis and standard heterosis in hybrids varied significantly and could be due to genetic diversity of parents used to generate hybrids. All the parents showed significant difference for the characters studied, which indicated sufficient variability among the parents. Heterosis for growth and yield parameters are presented in Table 3.

## Mean performance

From the average mean performance of the genotypes, it is revealed that normally the mean values of $F_1$ hybrids were desirably higher than those of the parents for plant height (cm), number of branches per plant, number of fruits per plant, Average weight of fruit (g), Fruit length (cm), Fruit diameter (cm) and Yield/ha (q), while the mean values of hybrids were desirably lower than those parents for inter nodal length (cm), days to 50% flowering, days to first harvesting and first fruiting node. From the average mean values of hybrids and their parents, it is evident that the crosses in general, had significantly higher or lower average mean values than their parents registered the presence of heterosis for growth, earliness and yield contributing characters.

The range of average mean performance of 10 parents and 45 hybrids are presented in table 1 and 2. In general, the range of mean values of parents was highest for plant height (111.15 to 145.05, 159.55 to 209.00 cm), number of branches per plant (2.80 to 3.65, 3.05 to 3.80), number of nodes per plant (25.26 to 36.70, 34.66 to 39.70), number of fruits per plant (23.92 to 33.41, 34.60 to 38.07), Average weight of fruit (10.05 to 10.15, 10.95 to 11.30 g), fruit length (8.86 to 10.56, 9.45 to 10.85 cm), fruit diameter (1.24 to 1.50, 1.16 to 1.52 cm) and yield per ha. (156.35 to 195.76, 188.20 to 223.88 q/ha) during summer and *kharif* season respectively. In similar fashion the range of mean values of crosses was highest for plant height (99.70 to 151.64, 184.25 to 220.00 cm), number of branches per plant (2.70 to 3.70, 2.30 to 4.18), number of nodes per plant (22.56 to 39.10, 36.83 to 45.34), number of fruits per plant (20.66 to 38.36, 34.63 to 44.59), Average weight of fruit (9.20 to 12.10, 9.70 to 12.10 g), fruit length (8.34 to 10.35, 9.20 to 10.82 cm) and yield per ha. (139.71 to 240.77, 203.62 to 256.30 q/ha) during summer and *kharif* season respectively. The range of mean values of parents was significantly lowest for inter nodal length (7.37 to 9.38, 9.88 to 11.56 cm), days to 50% flowering (48.50 to 50.50, 49.50 to 52.25), days required for first harvest (50.50 to 55.50, 53.00 to 57.00) and first fruiting node (1.90 to 2.90, 1.90 to 2.90) during summer and *kharif* season respectively. Similarly, the range of mean values of crosses was significantly lowest for inter nodal length (7.19 to 9.56, 9.80 to 12.48 cm), days to 50% flowering (47.00 to 52.00, 46.50 to 53.50), days required for first harvest (49.50 to 57.00, 48.50 to 56.00) and first fruiting node (1.60 to 2.90, 1.60 to 2.90) during summer and *kharif* season respectively. The results are in proximity of Medagam *et al.*, 2012 [21] and Reddy *et al.* 2012 [21].

## Heterosis

### 1. Plant height (cm)

Out of 45 crosses, 23 cross combinations over better parent and 21 over standard hybrid check recorded the significant positive heterosis during summer season, while in *kharif* season 39 crosses over better parent and 43 crosses over standard hybrid check registered the significant positive heterosis. Heterosis over better parents ranged from-26.77% to 32.70% and over standard hybrid check were-16.43% to 27.11% during the summer season. On other hand range of heterosis over better parent was-1.61% to 32.37% and 5.59% to 26.07% over standard hybrid check during *kharif* season.

The cross combination in summer $P_3$ x $P_9$ (32.70%) exhibited significantly the highest percentage of positive heterosis over the better parent and the cross $P_2$ x $P_{10}$ (27.11%) found significant positive heterosis over standard hybrid check. During *kharif* the cross $P_6$ x $P_{10}$ (32.37%) exhibited highest significant positive heterosis over better parent, and the cross $P_8$ x $P_9$ (26.07%) over standard hybrid check. Plant height is one of the most important yield contributing trait along which influence the yield. The taller the plant maximum branches on the main stem, the higher is the number of fruits per plant because maximum nodes can be accommodated for a given inter nodal length and ultimately leads to higher pod yield. Hence, positive heterosis is desirable for plant height. Better parent heterosis and standard heterosis in $F_1$ hybrids varied significantly could be due to genetic diversity of the genotypes. The results were in correspondence with Singh *et al.*, (2013), Punia *et al.*, (2017), Devi *et al.*, (2017), Tiwari *et al.*, (2015), Bhatt *et al.*, (2016) Hadiya *et al.*, (2018) and Chavan *et al.*, (2021).

**2. Number of branches per plant**

Heterosis data on the number of branches per plant resulted that, 3 crosses over better parent and none of the crosses over standard check during summer season. However, during *kharif* season 3 crosses over better parent, only 2 cross over standard check showed positive heterosis. Heterosis over better parent ranged from-23.29 to 28.07% and heterosis range over standard hybrid check were-20.59 to 8.82 during the summer season. On other hand range of heterosis over better parent was-35.31 to 16.61% and-31.34 to 24.78 over standard hybrid check during *kharif* season.

The crosses $P_1$ x $P_6$ (19.67%, 7.35%), $P_2$ x $P_{10}$ (28.07%, 7.35%) and $P_6$ x $P_7$ (19.35%, 8.82%) recorded significantly highest and positive heterosis over better parent and only positive over standard check in summer season, while during *kharif* season the cross combinations $P_4$ x $P_6$ (16.61%, 7.91%), $P_4$ x $P_7$ (16.13%, 7.46%) and $P_5$ x $P_7$ (13.87%, 5.37%) displayed highest and positive heterosis over better parent and positive heterosis over standard check respectively. Vegetative growth is essential for higher yield and the number of branches directly related to the number of fruits per plant hence significant and positive heterosis is desirable for number of branches per plant. The result obtained is in consonance with Meheta *et al.*, (2007) [22], Senthilkumar and Sreeparvathy, (2010) [31], Kumar *et al.*, (2013) [18], Singh *et al.*, (2013) [33], Aware *et al.*, (2014) [3], Tiwari *et al.*, (2015) [35], Bhatt *et al.*, (2016) [4], Punia *et al.*, (2017) [27] and Devi *et al.*, (2017) [6].

**3. Number of nodes per plant**

Amid of 45 crosses, no cross combination displayed significant positive heterosis over better parent and one cross expressed significant positive heterosis over standard hybrid check in summer season. While 15 cross combinations displayed significant positive heterosis over better parent and none of the cross combination displayed the significant positive heterosis over standard hybrid check in *kharif* season. Heterosis over better parents ranged from-35.33% to 19.60% and heterosis range over standard hybrid check were-42.64% to-0.56% during the summer season. While range of heterosis over better parent was-7.09% to 21.80%, over top parent-7.09% to 21.80% and-14.45% to 5.33% over standard hybrid check during *kharif* season.

The cross combination $P_1$ x $P_2$ and $P_2$ x $P_{10}$ (14.90%) showed highest positive heterosis over better parent, while $P_3$ x $P_7$ (20.69%) combination showed positively significant heterosis over standard hybrid check during summer season. On the other hand, $P_7$ x $P_{10}$ (21.80%), $P_7$ x $P_9$ (17.25%), $P_7$ x $P_8$ (16.13%) and $P_1$ x $P_5$ (16.02%) showed highest significant positive heterosis over better parent and none of the cross combination found positively significant heterosis over standard hybrid check during *kharif* season. Number of nodes per plant directly related to the number of fruits per plant hence significant and positive heterosis is desirable for this character. Similar result was obtained by Kumar *et al.*, (2013) [18], Singh *et al.*, (2013) [33], Bhatt *et al.*, (2016) [4] and Punia *et al.*, (2017) [27].

**4. Inter nodal length (cm)**

A cultivar having less inter-nodal length is immense value in breeding programme. Out of 45 crosses, 6 cross combinations displayed significant negative heterosis over better parent, 25 top parent and one on standard hybrid check in summer season. While in *kharif* season no cross combinations found negatively significant over better parent, standard check and top parent. Heterosis over better parents ranged from-19.94% to 19.34% and heterosis range over standard hybrid check were-9.34% to-20.63% during the summer season. While range of heterosis over better parent was-10.50% to 23.28% and over standard hybrid check-3.92% to 22.35% during *kharif* season.

The cross combination $P_6$ x $P_7$ (-19.94%) and $P_1$ x $P_4$ (-15.41%) showed negatively significant heterosis over better parent, and $P_6$ x $P_7$ (-9.34%) showed negatively significant heterosis over standard hybrid check during summer season. Length of inter node is inversely proportional to the number of nodes per plant The shorter distance between nodes accommodates more number of nodes on main stem which will ultimately leads to maximum number of fruits per plant and fruit yield. Hence, negative heterosis is desirable for this character. Better parent heterosis and standard heterosis in $F_1$ hybrids varied significantly could be due to genetic diversity of the genotypes. Similar results were obtained by Kumar *et al.*, (2013) [18], Javia (2013) [15], Medagam *et al.*, (2012) [21], Bhatt *et al.*, (2016) [4], Sabesan *et al.*, (2016) [30] and Chavan *et al.*, (2021) [5].

**5. Days to 50% flowering**

The range of heterosis was from-6.93% to 5.05% and over standard hybrid check were-3.29% to-7.00% during the summer season. While range of heterosis over better parent was-9.71% to 8.08% and-7.92 to 5.94% over standard hybrid check during *kharif* season.

Out of 45 crosses, 12 cross combinations displayed significant negative heterosis over better parent and 3 cross combination over standard check displayed significant negative heterosis during summer season. Where as in *kharif* season 2 crosses over better parent and one cross over standard check hybrid displayed significant negative heterosis.

The crosses $P_2$ x $P_{10}$ (-5.05%), $P_4$ x $P_6$ (-6.47%) and $P_7$ x $P_9$ (-6.93%) on better parent and $P_2$ x $P_{10}$, $P_4$ x $P_6$ and $P_7$ x $P_9$ (-3.29%) over standard hybrid check in summer season. While $P_6$ x $P_8$ (-7.77%) and $P_8$ x $P_{10}$ (-9.71%) crosses displayed significant negative heterosis over better parent and $P_8$ X $P_{10}$ (-7.92) over standard hybrid check in *kharif* season had negative heterosis for days to 50% flowering. The minimum days required for days to 50% of flowering is directly proportional to the earliness. Early flowering not only gives early pickings and better returns but also increases fruiting period of the okra plant, so that negative heterosis is highly desirable for this character under study. The desirable negative estimates of better parent heterosis and standard heterosis for earliness revealed that the presence of dominant genes for the development of earliness in okra. These results are in proximity with Meheta *et al.*, (2007) [22], Weerasekara *et al.*, (2008) [36], Khanorkar and Katharia (2010) [17], Senthilkumar and Sreeparvathy, (2010) [31], Reddy *et al.*, (2012) [29], Adiger *et al.*, (2013) [1], Punia *et al.*, (2017) [27] and Chavan *et al.*, (2021) [5].

**6. Days required for first harvesting**

A cultivar which requires less number of days to first harvesting is favoured by the farmer. Thus, heterosis in the negative direction is considered desirable for this character. The range of heterosis for cross was from-10.81% to 8.74% for better parent and the heterosis range over standard check were-7.48% to 6.54% during the summer season. While range of heterosis range over better parent was-11.82% to 3.77% and-3.96% to 10.89% over standard hybrid check during *kharif* season. Out of 45 crosses, only 6 cross combination displayed significant negative heterosis over better parent, and 10 crosses over standard hybrid check in summer season. Similarly, only 9 cross combination displayed significant negative heterosis over better parent and none of the cross over standard hybrid check in *kharif* season.

The cross combination $P_5$ x $P_6$ (-10.81%) and $P_6$ x $P_7$ (-8.18%) displayed highest significant negative heterosis over better parent, $P_5$ x $P_6$ (-7.48%) and $P_6$ x $P_7$ (-5.61%) over standard hybrid check in summer season. Similarly, combination $P_4$ x $P_5$ (-11.82%) and $P_4$ x $P_6$ (-10.91%) displayed significant negative heterosis over better parent in *kharif* season. These results are in accordance with Sidapara *et al.,* (2021) [32] and Chavan *et al.*, (2021) [5].

**7. First fruiting node**

As regards to the first fruiting node, heterosis ranges from over better parents ranged from-37.93% to 11.54% heterosis and over standard hybrid check was-20.00% to 45.00% during the summer where as in *kharif* season over better parent-37.93% to 11.54% heterosis and heterosis range over standard hybrid check was-41.82% to 5.45%.

Out of 45 crosses, 20 cross combinations displayed significant negative heterosis over better parent and none of cross displayed the significant negative heterosis over standard hybrid check in summer season. While 23 cross combinations displayed significant negative heterosis over better parent and 38 over standard hybrid check in *kharif* season, among that cross $P_1$ x $P_{10}$ (-41.82%) showed highest negative heterosis over standard hybrid check during *kharif* season. Lower first fruiting node is desirable for minimum days to 50% flowering and indicator of the earliness in okra and it is indicating that cent percent fruit set in the early stage of the flowering. These results are in consonance with Jindal *et al.*, (2009) [13], Medagam *et al.*, (2012) [21], Reddy *et al.*, (2012) [29] and Kavya *et al.,* (2019) [16].

**8. Number of fruits per plant**

Out of 45 crosses, 2 cross combinations displayed significant positive heterosis over better parent and 3 cross combination displayed the positive heterosis over standard hybrid check in summer season. While 12 cross combinations displayed significant positive heterosis over better parent and 17 cross combination displayed the positive heterosis over standard hybrid check in *kharif* season. Heterosis over better parent ranged from-31.09% to 22.61% and ranged over standard hybrid check was-37.92% to 15.28% during the summer where as in *kharif* season over better parent ranged from-5.74% to 21.78% heterosis and heterosis range over standard hybrid check was-14.07% to 10.65%.

The cross combination $P_4$ x $P_6$ (22.61%) followed by $P_2$ x $P_{10}$ (20.12%) displayed highest significant positive heterosis and $P_1$ x $P_8$ (18.33%) displayed positive heterosis over better parent and the cross combination $P_2$ x $P_{10}$ (15.28%) and $P_4$ x $P_6$ (12.31%) displayed highest positive heterosis over standard hybrid check, during summer season. In *kharif* season, the cross combination $P_1$ x $P_8$ (19.07%), $P_5$ x $P_6$ (17.10%) and $P_7$ x $P_{10}$ (21.78%) displayed highest significant positive heterosis over better parent, while none of cross combination displayed significant positive heterosis over standard hybrid check.

This is the most important yield contributing character which is directly related with enhancement in yield per unit area hence significantly positive heterosis effect is highly desirable for this character. Due to presence of desirable genes in parents. Similar results were obtained by Senthilkumar and Sreeparvathy, (2010) [31], Thirupathi *et al.,* (2012) [34], Jagan *et al.*, (2013) [11], Adiger *et al.*, (2013) [1], Kumar *et al.*, (2013) [18], Singh *et al.,* (2013) [33], Aware *et al.*, (2014) [3], Bhatt *et al.*, (2016) [4], Punia *et al.*, (2017) [27], Devi *et al.*, (2017) [6], Kavya *et al.,* (2019) [16] and Chavan *et al.*, (2021) [5].

**9. Average weight of fruit (g)**

In the group of 45 crosses, 5 cross combination displayed significant positive heterosis over better parent and 10 crosses over standard hybrid check in summer season. While 1 cross combinations displayed significant positive heterosis over better parent and 10 cross combinations displayed the significant positive heterosis over standard hybrid check in *kharif* season.

Heterosis over better parents ranged from-13.21% to 13.08% and range over standard hybrid check were-10.24% to 18.05% during the summer, where as in *kharif* season over better parents heterosis ranged from-11.01% to 11.01% and over standard hybrid check were-5.37% to 18.05%. During summer season, the cross combination $P_1$ x $P_9$ (9.80%) displayed highest significant positive heterosis over better parent. While $P_2$ x $P_5$ (18.05%) cross combination displayed significant positive heterosis over standard hybrid check, during *kharif* season.

Weight of fruit is directly related with increment in yield hence significantly positive heterosis effect would be highly desirable. In the present study it is apparent that highly positive heterosis for average fruit weight may probably be due to the dominance nature of genes present in cross combination. Correspondence result for significant positive heterosis for average weight of fruit in okra were also reported by Jindal *et al.*, (2010) [14], Kumar *et al.*, (2013) [18], Adiger *et al.*, (2013) [1] Tiwari *et al.*, (2015) [35], Bhatt *et al.*, (2016) [4], Punia *et al.*, (2017) [27], Devi *et al.*, (2017) [6] and Mulge and Khot, (2018) [23].

**10. Fruit length (cm)**

Out of 45 crosses, none of the cross combination displayed significant positive heterosis over better parent, while 9 crosses over standard hybrid check in summer season. Whereas 11 cross combinations displayed significant positive heterosis over better parent and standard hybrid check in *kharif* season.

Heterosis over better parents ranged from-18.4% to 0.99% and heterosis range over standard hybrid check were-9.54% to

12.26% during the summer where as in *kharif* season over better parents ranged from-12.88% to 14.21% heterosis and heterosis range over standard hybrid check were-11.54% to 4.04%. During summer season, the cross combination $P_2$ x $P_{10}$ (12.26%) displayed highest significant positive heterosis over standard hybrid check. While $P_3$ x $P_7$ (14.21) cross combination displayed significant positive heterosis over better parent during *kharif* season. Fruit length is the most crucial character in accordance with yield, maximum the fruit length higher the yield. In present investigation the manifestation of negative heterosis observed in some of the crosses for summer season it was due to the combination of the unfavorable genes of the parents. It is similar to earlier findings of Jindal *et al.*, (2010) [14], Adiger *et al.*, (2013) [1], Kumar *et al.*, (2013) [18], Singh *et al.*, (2013) [33], Aware *et al.*, (2014) [3], Bhatt *et al.*, (2016) [4], Punia *et al.*, (2017) [27], Devi *et al.*, (2017) [6] and Chavan *et al.*, (2021) [5].

**11. Fruit diameter (cm)**

Among 45 crosses, one cross combination displayed significant positive heterosis over better parent and no cross over standard hybrid check displayed the significant positive heterosis in summer season. 2 cross combinations displayed significant positive heterosis over better parent and no cross combinations standard hybrid check displayed the significant positive heterosis in *kharif* season.

Heterosis over better parents ranging from-20.33% to 10.23% heterosis and heterosis range over standard hybrid check were-18.98% to 1.36% during the summer where as in *kharif* season over better parents ranged from-25.41% to 15.11% heterosis and heterosis range over standard hybrid check were-27.33% to 2.89%.

The cross combination $P_1$ x $P_5$ (10.23%) displayed highest significant positive heterosis over better parent during summer season. Where as in *kharif* season, the cross combination $P_6$ x $P_7$ (15.11%) followed by $P_5$ x $P_6$ (13.77%) displayed highest significant positive heterosis over better parent.

Fruit diameter is the most important yield contributing character, maximum the fruit diameter higher the pod yield hence heterosis in positive direction is desirable. In present investigation the manifestation of positive as well as negative heterosis observed in some of the crosses, it was may be due to the combination of the favorable and unfavorable genes of the parents. The results obtained for diameter of fruit were in agreement with results obtained by Jindal *et al.*, (2010) [14], Kumar *et al.*, (2013) [18], Adiger *et al.*, (2013) [1], Singh *et al.*, (2013) [33], Thirupathi *et al.*, (2012) [34], Devi *et al.*, (2017) [6], Mulge and Khot, (2018) [23] and Chavan *et al.*, (2021) [5].

**12. Yield per hectare (q)**

From 45 crosses, 6 cross combinations displayed significant positive heterosis over better parent and 7 cross combinations displayed the significant positive heterosis over standard hybrid check in *summer* season. While 18 cross combinations displayed significant positive heterosis over better parent and 6 cross combinations displayed the significant positive heterosis over standard hybrid check in *kharif* season Heterosis ranges from over better parents ranging from-28.65% to 10.23% heterosis and heterosis range over standard hybrid check were-25.26% to 28.83% during the summer where as in *kharif* season over better parents ranged from-9.06 to 18.56% heterosis and heterosis range over standard hybrid check were-12.89% to 9.69%.

In summer the cross $P_2$ x $P_{10}$ (26.57%) followed by $P_1$ x $P_8$ (24.63%) showed significant positive heterosis over better parent and the crosses $P_1$ x $P_8$ (21.88%) & $P_2$ x $P_{10}$ (28.86%) showed significant positive heterosis over standard hybrid check. In *kharif*, the crosses $P_1$ x $P_8$ (18.55%) followed by $P_2$ x $P_{10}$ (16.71%) showed highest significant positive heterosis over better parent and the crosses $P_1$ x $P_8$ and $P_2$ x $P_{10}$ (9.69%) followed by $P_4$ x $P_6$ (8.40%) and $P_2$ x $P_9$ (8.35%) showed significant positive heterosis over standard hybrid check.

Fruit yield is a complex trait and it's a multiplicative product of several other contributing characters, like average weight of fruit and number of fruits per plant, fruit length and diameter. Farmers prefer to grow early and high yielding hybrids of okra in order to get maximum profit and to avoid market glut hence, positive and significant heterosis value is desirable for exploitation of hybrid vigour in breeding programme. The present study evident that presence of desirable magnitude and direction of heterosis over better parent and standard hybrid due to existence of dominance gene action in parents. The results are alike on significantly positive heterosis for yield per plot and yield per hectare with the findings of Hosamani *et al.*, (2008) [10], Adiger *et al.*, (2013) [1], Nagesh *et al.*, (2014) [24], Patel (2015) [26], Bhatt *et al.*, (2016) [4], Nimbalkar *et al.*, (2017) [25], Hadiya *et al.*, (2018) [9] and Kavya *et al.*, (2019) [16].

**Table 1:** Average mean performance and range of parent

| Sr. No. | Name of character | Avg. mean | | Range | |
|---|---|---|---|---|---|
| | | Summer | *Kharif* | Summer | *Kharif* |
| 1 | Plant height (cm) | 125.96 | 186.17 | 111.15-145.05 | 159.55-209.00 |
| 2 | Number of branches/plant | 3.06 | 3.29 | 2.80-3.65 | 3.05-3.80 |
| 3 | Number of nodes/plant | 31.75 | 37.65 | 25.26-36.70 | 34.66-39.64 |
| 4 | Inter-nodal length(cm) | 8.29 | 10.88 | 7.34-9.38 | 9.88-11.56 |
| 5 | Days to 50% flowering | 50.03 | 50.76 | 48.50-50.50 | 49.50-52.25 |
| 6 | Days required for 1st harvest | 53.85 | 55.65 | 50.50-55.50 | 53.00-57.00 |
| 7 | First fruiting node | 2.27 | 2.27 | 1.9 0-2.90 | 1.90-2.90 |
| 8 | Number of fruits/plant | 29.72 | 36.19 | 23.92-33.41 | 34.60-38.07 |
| 9 | Average weight of fruit (g) | 10.42 | 10.74 | 10.05-10.15 | 10.95-11.30 |
| 10 | Fruit length (cm) | 9.61 | 10.12 | 8.86-10.56 | 9.45-10.85 |
| 11 | Fruit diameter (cm) | 1.36 | 1.37 | 1.24-1.50 | 1.16-1.52 |
| 12 | Yield/ha. (q) | 185.01 | 218.95 | 156.35-195.76 | 188.20-223.88 |

**Table 2:** Average mean performance and range of Hybrids and standard check

| Sr. No. | Name of character | Mean of hybrid | | Mean of standard check | | Range | |
|---|---|---|---|---|---|---|---|
| | | Summer | *Kharif* | Summer | *Kharif* | Summer | *Kharif* |
| 1 | Plant height (cm) | 126.48 | 202.8 | 119.3 | 174.5 | 99.70-151.64 | 184.25-220 |
| 2 | No. of branches/ plant | 3.25 | 3.29 | 3.40 | 3.35 | 2.70-3.70 | 2.30-4.18 |
| 3 | No. of nodes/ plant | 33.18 | 41.79 | 39.32 | 43.05 | 22.56-39.10 | 36.83-45.34 |
| 4 | Inter-nodal length (cm) | 8.58 | 10.9 | 7.93 | 10.2 | 7.19-9.56 | 9.80-12.48 |
| 5 | Days to 50% flowering | 49.05 | 50.44 | 48.60 | 50.5 | 47.00-52.00 | 46.50-53.50 |
| 6 | Days required for 1st harvest | 53.34 | 53.21 | 53.50 | 50.5 | 49.50-57.00 | 48.50-56.00 |
| 7 | First fruiting node | 2.09 | 2.08 | 2.00 | 2.75 | 1.60-2.90 | 1.60-2.90 |
| 8 | No. of fruits/plant | 31.04 | 40.03 | 33.27 | 40.3 | 20.66-38.36 | 34.63-44.59 |
| 9 | Average weight of fruit (g) | 10.71 | 10.76 | 10.25 | 10.25 | 9.20-12.10 | 9.70-12.10 |
| 10 | Fruit length (cm) | 9.19 | 10.29 | 9.22 | 10.40 | 8.34-10.35 | 9.20-10.82 |
| 11 | Fruit diameter (cm) | 1.35 | 1.40 | 1.48 | 1.56 | 1.20-1.50 | 1.13-1.60 |
| 12 | Yield/ha (q) | 191.46 | 234.16 | 186.84 | 233.69 | 139.71-240.77 | 203.62-256.3 |

**Table 3:** Heterosis (%) over better parent and standard hybrid check 10 x10 half diallel in okra

| Crosses | Plant height (cm) | | | | Number of branches/plant | | | |
|---|---|---|---|---|---|---|---|---|
| | Summer | | Kharif | | Summer | | Kharif | |
| | B. P. | S. H. | B. P. | S. H. | B. P. | S. H. | B. P. | S. H. |
| 1 x 2 | 4.74 | 1.40 | 13.63 ** | 7.51 * | 8.07 | -9.41 | 7.14 | 11.94 |
| 1 x 3 | 26.14 ** | 17.52 ** | 23.78 ** | 24.38 ** | 13.39 | 5.88 | 1.43 | 5.97 |
| 1 x 4 | 17.75 ** | 14.00 * | 11.26 ** | 11.81 ** | 10.53 | -7.35 | 10.00 | 14.93 * |
| 1 x 5 | 18.53 ** | 14.75 ** | 20.16 ** | 20.74 ** | 7.46 | 5.88 | -7.14 | -2.99 |
| 1 x 6 | 22.42 ** | 18.52 ** | 23.07 ** | 23.67 ** | 19.67 * | 7.35 | -12.86 * | -8.96 |
| 1 x 7 | 11.26 * | 7.71 | 17.48 ** | 18.05 ** | 9.68 | 0.00 | -10.00 | -5.97 |
| 1 x 8 | 22.47 ** | 18.57 ** | 10.49 ** | 11.03 ** | -1.51** | 5.74 | 11.27 | 17.91 ** |
| 1 x 9 | -8.96 | -11.86 * | 14.00 ** | 14.56 ** | 6.78 | -7.35 | 10.29 | 15.22 * |
| 1 x 10 | -10.48 | -13.34 * | 15.48 ** | 5.59 | 12.28 | -5.88 | -0.26 | 13.13 * |
| 2 x 3 | 13.54 * | 5.78 | 30.95 ** | 23.90 ** | 0.79 | -5.88 | -7.58 | -8.96 |
| 2 x 4 | 4.99 | 5.74 | 23.20 ** | 16.56 ** | 8.77 | -8.82 | 6.06 | 4.48 |
| 2 x 5 | -19.64 ** | -13.00 * | 30.83 ** | 23.78 ** | -4.48 | -5.88 | -28.79 ** | -29.85 ** |
| 2 x 6 | -18.76 ** | -11.06 * | 29.44 ** | 22.46 ** | -11.48 | -20.59 * | -4.55 | -5.97 |
| 2 x 7 | -13.40 ** | -5.20 | 21.44 ** | 14.90 ** | 0.00 | -8.82 | 1.52 | 0.00 |
| 2 x 8 | 11.83 * | 10.90 * | 25.68 ** | 18.91 ** | -9.59 | -2.94 | 0.00 | 5.97 |
| 2 x 9 | 18.17 ** | 22.93 ** | 22.74 ** | 16.13 ** | 6.78 | -7.35 | 10.61 | 8.96 |
| 2 x 10 | 20.83 ** | 27.11 ** | 25.29 ** | 14.56 ** | 28.07 ** | 7.35 | 10.00 | 24.78 ** |
| 3 x 4 | 28.30 ** | 19.53 ** | 9.08 * | 16.33 ** | 7.09 | 0.00 | -11.11 | -16.42 ** |
| 3 x 5 | 19.57 ** | 11.40 * | 4.25 | 11.17 ** | -1.49 | -2.94 | 4.76 | -1.49 |
| 3 x 6 | 8.68 | 1.26 | 14.19 ** | 21.78 ** | 7.09 | 0.00 | -4.76 | -10.45 |
| 3 x 7 | -1.75 | -8.47 | 11.32 ** | 16.33 ** | 16.54 | 8.82 | 1.59 | -4.48 |
| 3 x 8 | 26.41 ** | 17.77 ** | 6.66 | 13.75 ** | -16.44 * | -10.29 | 1.41 | 7.46 |
| 3 x 9 | 32.70 ** | 23.64 ** | 11.77 ** | 19.20 ** | -8.66 | -14.71 | 1.54 | -1.49 |
| 3 x 10 | -10.30 | -16.43 ** | 18.46 ** | 8.31 * | -11.81 | -17.65 * | -11.84 * | 0.00 |
| 4 x 5 | -8.28 | -7.63 | 7.00 * | 16.05 ** | 7.46 | 5.88 | 8.20 | -1.49 |
| 4 x 6 | 14.94 ** | 15.76 ** | -1.61 | 8.31 * | 11.48 | 0.00 | 16.61 * | 7.91 |
| 4 x 7 | 8.20 | 8.97 | 8.03 * | 12.89 ** | 3.23 | -5.88 | 16.13 * | 7.46 |
| 4 x 8 | -0.34 | -1.17 | -1.09 | 8.88 * | -9.59 | -2.94 | -4.23 | 1.49 |
| 4 x 9 | 7.28 | 8.05 | 0.62 | 10.77 ** | 18.64 | 2.94 | 0.00 | -2.99 |
| 4 x 10 | 10.20 | 10.98 * | 21.28 ** | 10.89 ** | 15.79 | -2.94 | -7.89 | 4.48 |
| 5 x 6 | -9.72 | -2.26 | 14.40 ** | 24.07 ** | -5.97 | -7.35 | -1.61 | -8.96 |
| 5 x 7 | 13.90 ** | 23.30 ** | 16.15 ** | 21.38 ** | 8.36 | 6.76 | 13.87 * | 5.37 |
| 5 x 8 | 3.55 | 2.68 | 13.34 ** | 22.92 ** | -17.81 * | -11.76 | -21.13 ** | -16.42 ** |
| 5 x 9 | 16.28 ** | 20.96 ** | 8.32 * | 17.48 ** | -4.48 | -5.88 | -16.92 ** | -19.40 ** |
| 5 x 10 | 12.27 * | 18.11 ** | 23.47 ** | 12.89 ** | -1.49 | -2.94 | -18.42 ** | -7.46 |
| 6 x 7 | -26.77 ** | -14.00 * | 9.65 ** | 14.58 ** | 19.35 * | 8.82 | -8.06 | -14.93 * |
| 6 x 8 | -9.04 | -9.81 | 7.98 * | 20.92 ** | -12.33 | -5.88 | -15.49 ** | -10.45 |
| 6 x 9 | 9.99 | 14.42 ** | 0.24 | 19.20 ** | 1.64 | -8.82 | -12.31 | -14.93 * |
| 6 x 10 | 6.77 | 12.32 * | 32.37 ** | 21.03 ** | -1.64 | -11.76 | -18.42 ** | -7.46 |
| 7 x 8 | -15.38 ** | -16.09 ** | 11.98 ** | 17.02 ** | -15.07 | -8.82 | -16.90 ** | -11.94 |
| 7 x 9 | -11.36 * | -7.80 | 16.26 ** | 21.49 ** | -6.45 | -14.71 | -4.62 | -7.46 |
| 7 x10 | -5.90 | -1.01 | 17.20 ** | 7.16 | 0.00 | -8.82 | -9.21 | 2.99 |
| 8 x 9 | -2.70 | -3.52 | 12.59 ** | 26.07 ** | -13.70 | -7.35 | -35.21 ** | -31.34 ** |
| 8 x 10 | 20.03 ** | 19.03 ** | 21.28 ** | 10.89 ** | -23.29 ** | -17.65 * | -17.11 ** | -5.97 |
| 9 x 10 | 15.87 ** | 20.54 ** | 19.71 ** | 9.46 * | 11.86 | -2.94 | 2.24 | 15.97 * |
| S. E. D. ± | 6.39 | 6.39 | 6.39 | 6.39 | 0.29 | 0.29 | 0.20 | 0.20 |
| C. D. 5% | 12.82 | 12.82 | 12.83 | 12.83 | 0.59 | 0.59 | 0.40 | 0.40 |
| C. D. 1% | 17.07 | 17.07 | 17.08 | 17.08 | 0.73 | 0.73 | 0.53 | 0.53 |

| Crosses | Number of nodes/plant | | | | Inter-nodal length (cm) | | | |
|---|---|---|---|---|---|---|---|---|
| | Summer | | Kharif | | Summer | | Kharif | |
| | B. P. | S. H. | B. P. | S. H. | B. P. | S. H. | B. P. | S. H. |
| 1 x 2 | 14.90 | -21.34** | -0.41 | -9.87 | -4.64 | 12.87** | 8.45 | 5.05 |
| 1 x 3 | 19.60 | -10.52 | 12.03 * | 2.25 | -2.35 | 15.58 ** | 11.78 * | 14.41 * |
| 1 x 4 | 10.52 | -8.72 | 6.46 | -3.38 | -15.41 ** | 0.13 | 3.21 | 2.40 |
| 1 x 5 | 8.55 | -8.60 | 16.02 * | -4.83 | -2.35 | 15.58 ** | 5.10 | 13.24 * |
| 1 x 6 | 9.58 | -2.81 | 6.98 | -1.50 | -3.20 | 14.57 ** | 0.45 | 8.24 |
| 1 x 7 | -6.76 | -22.34** | 11.89 * | -5.22 | 1.92 | 20.63 ** | 2.91 | 9.17 |
| 1 x 8 | 15.22 | -6.35 | 10.23 | -0.14 | -11.51 ** | 4.73 | -5.37 | 1.96 |
| 1 x 9 | 1.65 | -5.14 | 3.24 | -9.20 | -2.51 | 15.39 ** | 13.56 * | 22.35 ** |
| 1 x 10 | 3.32 | -10.58 | 4.87 | -11.65 * | -5.81 | 11.48 * | 11.28 * | 18.04 ** |
| 2 x 3 | -7.75 | -30.98** | 2.67 | -6.28 | 12.83 ** | 19.31 ** | 17.66 ** | 13.97 * |
| 2 x 4 | 8.25 | -10.59 | 5.70 | -4.08 | 1.79 | 7.63 | 1.87 | -1.32 |
| 2 x 5 | -21.73** | -34.09** | -0.41 | -9.87 | -0.73 | 11.10 * | 19.23 ** | 15.49 ** |
| 2 x 6 | -35.33** | -42.64** | 2.09 | -5.99 | 4.79 | 18.68 ** | 18.02 ** | 14.31 * |
| 2 x 7 | -6.40 | -22.04 | 4.79 | -5.17 | -4.30 | 1.20 | 13.77 * | 10.20 |
| 2 x 8 | 12.78 | -8.33 | 7.67 | -2.46 | 2.57 | 8.45 | 23.28 ** | 19.41 ** |
| 2 x 9 | 3.94 | -3.00 | 9.59 | -0.82 | -5.07 | 0.38 | 7.34 | 3.97 |
| 2 x 10 | 14.90 | -0.56 | 13.82 * | 3.01 | -5.19 | 0.25 | 1.82 | -1.37 |
| 3 x 4 | 5.43 | -12.92 | 5.01 | -4.15 | 2.92 | 4.48 | 1.58 | 0.78 |
| 3 x 5 | -3.35 | -1.62 | 3.09 | -5.90 | 5.07 | 17.60 ** | 4.12 | 6.57 |
| 3 x 6 | -17.06 | -26.44** | 5.84 | -2.54 | 6.13 | 20.19 ** | 4.60 | 7.06 |
| 3 x 7 | -4.78 | -20.69* | 11.82 * | 2.07 | 1.63 | 6.44 | -1.34 | 0.98 |
| 3 x 8 | 0.63 | -18.21* | 6.90 | -2.43 | 7.77 | 9.40 * | 8.24 | 10.78 |
| 3 x 9 | 3.00 | -3.88 | 7.44 | -1.93 | 11.68 ** | 15.21 ** | 6.90 | 9.41 |
| 3 x 10 | -23.14* | -33.48** | -2.42 | -10.93 * | -1.62 | -0.13 | 7.66 | 10.20 |
| 4 x 5 | -3.44 | -18.69* | 12.10 * | 1.73 | -7.67 | 3.34 | 3.75 | 2.94 |
| 4 x 6 | 10.87 | -1.67 | 10.13 | 1.41 | -8.41 * | 3.72 | 4.45 | 3.63 |
| 4 x 7 | 6.23 | -11.52 | 8.84 | -1.22 | -2.89 | 1.70 | 8.99 | 8.14 |
| 4 x 8 | -10.01 | -25.67** | 10.64 | 0.41 | 15.14 ** | 14.20 ** | 0.30 | -0.49 |
| 4 x 9 | -8.19 | -14.32 | 4.65 | -5.03 | 8.93 * | 12.37 ** | 4.74 | 3.92 |
| 4 x 10 | 13.58 | -1.70 | 11.76 * | 1.43 | 3.17 | -1.45 | 2.77 | 1.96 |
| 5 x 6 | -6.04 | -16.66* | 14.39 ** | 5.33 | -12.20 ** | -0.57 | -7.28 | 1.76 |
| 5 x 7 | 11.13 | -6.42 | 8.78 | -7.85 | -6.20 | 4.98 | -2.77 | 3.14 |
| 5 x 8 | -7.25 | -21.90** | 14.01 * | 3.29 | -3.61 | 7.89 | -10.50 | -1.76 |
| 5 x 9 | 1.81 | -4.98 | 3.99 | -8.54 | -3.27 | 8.26 | -5.85 | 3.33 |
| 5 x 10 | 6.04 | -8.23 | 6.73 | -10.08 * | -0.62 | 11.23 * | 2.63 | 8.87 |
| 6 x 7 | -0.42 | -11.67 | -7.09 | -14.45 ** | -19.94 ** | -9.34 * | 7.76 | 14.31 * |
| 6 x 8 | -5.45 | -16.14* | 11.39 * | 2.57 | -18.44 ** | -7.63 | -9.31 | 1.72 |
| 6 x 9 | -11.12 | -17.05 | 3.97 | -4.26 | 2.17 | 15.71 ** | -6.34 | 5.05 |
| 6 x 10 | -12.43 | -22.33** | 11.34 * | 2.52 | 4.29 | 18.11 ** | 0.83 | 6.96 |
| 7 x 8 | -18.24 | -31.90** | 16.13 ** | 5.20 | -2.47 | 2.15 | 2.59 | 8.82 |
| 7 x 9 | -26.33** | -31.24** | 17.25 ** | 3.12 | 3.01 | 7.89 | -3.42 | 2.45 |
| 7 x10 | -1.66 | -14.89 | 21.80 ** | 3.18 | -6.02 | -1.58 | -9.43 | -3.92 |
| 8 x 9 | -15.11 | -20.78* | 9.31 | -0.98 | 4.22 | 7.51 | -1.60 | 11.27 |
| 8 x 10 | -8.54 | -20.84* | 12.75 * | 2.14 | 19.34 ** | 18.36 ** | -3.51 | 2.35 |
| 9 x 10 | 5.14 | -1.88 | 1.94 | -10.34 * | -0.49 | 2.65 | 1.57 | 7.75 |
| S. E. ± | 3.10 | 3.10 | 2.12 | 2.12 | 0.34 | 0.34 | 0.58 | 0.58 |
| C. D. 5% | 6.23 | 6.23 | 4.26 | 4.26 | 0.69 | 0.69 | 1.17 | 1.17 |
| C. D. 1% | 8.23 | 8.23 | 5.67 | 5.67 | 0.92 | 0.92 | 1.56 | 1.56 |

| Crosses | Days to 50% flowering | | | | Days required for 1st harvest | | | |
|---|---|---|---|---|---|---|---|---|
| | Summer | | Kharif | | Summer | | Kharif | |
| | B. P. | S. H. | B. P. | S. H. | B. P. | S. H. | B. P. | S. H. |
| 1 x 2 | 2.06 | 1.85 | 2.02 | 0.00 | 5.83 ** | 1.87 | -0.94 | 3.96 |
| 1 x 3 | 4.12 ** | 3.91 ** | 1.01 | -0.99 | 5.83 ** | 1.87 | -1.89 | 2.97 |
| 1 x 4 | -0.93 | -1.13 | 2.02 | 0.00 | 0.29 | -3.46 | 2.83 | 7.92 * |
| 1 x 5 | 2.06 | 1.85 | 8.08 * | 5.94 | 7.77 ** | 3.74 | 3.77 | 8.91 * |
| 1 x 6 | 4.12 ** | 3.91 ** | 0.00 | -1.98 | 7.77 ** | 3.74 | -2.83 | 1.98 |
| 1 x 7 | 3.09 ** | 2.88 * | 4.04 | 1.98 | 8.74 ** | 4.67 * | 2.83 | 7.92 * |
| 1 x 8 | -2.06 | -2.26 | -1.52 | -3.47 | -0.73 | -4.44 * | 1.89 | 6.93 |
| 1 x 9 | 2.06 | 1.85 | 2.02 | 0.00 | 6.93 ** | 0.93 | 3.77 | 8.91 * |
| 1 x 10 | 1.03 | 0.82 | 6.06 | 3.96 | 5.83 ** | 1.87 | 2.83 | 7.92 * |
| 2 x 3 | -4.00 ** | -1.23 | 5.05 | 2.97 | 0.92 | 2.80 | -4.42 | 6.93 |
| 2 x 4 | -1.49 | 1.85 | -1.94 | 0.00 | 0.00 | 0.00 | -0.91 | 7.92 * |
| 2 x 5 | 5.05 ** | 7.00 ** | 3.03 | 0.99 | 1.83 | 3.74 | -8.77 ** | 2.97 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2 x 6 | -0.99 | 2.88 * | 0.00 | 1.98 | 1.83 | 3.74 | -6.31 | 2.97 |
| 2 x 7 | -1.98 | 1.85 | 4.04 | 1.98 | -1.83 | 0.00 | -7.96 * | 2.97 |
| 2 x 8 | -2.97 ** | 0.82 | 3.88 | 5.94 | 0.94 | 0.00 | 1.83 | 9.90 ** |
| 2 x 9 | -2.87 * | 0.93 | -1.56 | 0.00 | 6.93 ** | 0.93 | -2.75 | 4.95 |
| 2 x 10 | -5.05 ** | -3.29 ** | -6.80 | -4.95 | -6.48 ** | -5.61 ** | -7.68 * | 4.21 |
| 3 x 4 | -1.00 | 1.85 | -2.02 | -3.96 | 3.74 | 3.74 | -6.36 | 1.98 |
| 3 x 5 | -0.25 | 1.59 | 2.02 | 0.00 | 0.00 | 3.74 | -8.85 ** | 1.98 |
| 3 x 6 | -2.00 | 0.82 | 1.01 | -0.99 | 0.00 | 3.74 | -6.31 | 2.97 |
| 3 x 7 | 0.25 | 3.14 ** | 2.02 | 0.00 | -0.91 | 1.87 | -3.54 | 7.92 * |
| 3 x 8 | -2.00 | 0.82 | 4.04 | 1.98 | 4.72 * | 3.74 | -0.92 | 6.93 |
| 3 x 9 | -2.00 | 0.82 | 7.07 | 4.95 | 4.95 * | -0.93 | 0.92 | 8.91 * |
| 3 x 10 | -1.01 | 0.82 | 3.03 | 0.99 | -1.85 | -0.93 | -7.96 * | 2.97 |
| 4 x 5 | 0.00 | 1.85 | 3.03 | 0.99 | -2.80 | -2.80 | -11.82 ** | -3.96 |
| 4 x 6 | -6.47 ** | -3.29 ** | -4.85 | -2.97 | -4.67 * | -4.67 * | -10.91 ** | -2.97 |
| 4 x 7 | -1.49 | 1.85 | -1.01 | -2.97 | -6.54 ** | -6.54 ** | -1.82 | 6.93 |
| 4 x 8 | -3.48 ** | -0.21 | 0.00 | 1.98 | -3.77 | -4.67 * | 0.00 | 7.92 * |
| 4 x 9 | -2.49 * | 0.82 | -3.51 | -1.98 | 0.99 | -4.67 * | -1.83 | 5.94 |
| 4 x 10 | -1.01 | 0.82 | 1.94 | 3.96 | -6.54 ** | -6.54 ** | 1.82 | 10.89 ** |
| 5 x 6 | -2.02 | -0.21 | 1.01 | -0.99 | -10.81 ** | -7.48 ** | -4.50 | 4.95 |
| 5 x 7 | -4.04 ** | -2.26 | -1.01 | -2.97 | -2.73 | 0.00 | -3.54 | 7.92 * |
| 5 x 8 | -4.04 ** | -2.26 | 4.04 | 1.98 | -3.77 | -4.67 * | 0.00 | 7.92 * |
| 5 x 9 | 1.01 | 2.88 * | 2.02 | 0.00 | 3.96 | -1.87 | -1.83 | 5.94 |
| 5 x 10 | 2.02 | 3.91 ** | 2.02 | 0.00 | 5.56 ** | 6.54 ** | -5.26 | 6.93 |
| 6 x 7 | -4.95 ** | -1.23 | 1.01 | -0.99 | -8.18 ** | -5.61 ** | -7.21 * | 1.98 |
| 6 x 8 | -4.95 ** | -1.23 | -7.77 * | -5.94 | -0.94 | -1.87 | -4.59 | 2.97 |
| 6 x 9 | -1.98 | 1.85 | -3.51 | -1.98 | 5.94 ** | 0.00 | -6.42 | 0.99 |
| 6 x 10 | -4.04 ** | -2.26 | -4.85 | -2.97 | -2.78 | -1.87 | -3.60 | 5.94 |
| 7 x 8 | -1.98 | 1.85 | 3.03 | 0.99 | 0.94 | 0.00 | 2.75 | 10.89 ** |
| 7 x 9 | -6.93 ** | -3.29 ** | 1.01 | -0.99 | 5.94 ** | 0.00 | -7.34 * | 0.00 |
| 7 x10 | 0.00 | 1.85 | 2.02 | 0.00 | 0.93 | 1.87 | -4.42 | 6.93 |
| 8 x 9 | -1.98 | 1.85 | -1.56 | 0.00 | 6.93 ** | 0.93 | 0.92 | 8.91 * |
| 8 x 10 | 0.00 | 1.85 | -9.71 * | -7.92 * | 0.00 | -0.93 | -4.59 | 2.97 |
| 9 x 10 | 0.00 | 1.85 | -1.56 | 0.00 | 5.94 ** | 0.00 | 0.00 | 7.92 * |
| S. E. ± | 0.55 | 0.55 | 1.91 | 1.91 | 1.12 | 1.12 | 1.83 | 1.83 |
| C. D. 5% | 1.12 | 1.12 | 3.84 | 3.84 | 2.24 | 2.24 | 3.68 | 3.68 |
| C. D. 1% | 1.49 | 1.49 | 5.11 | 5.11 | 2.99 | 2.99 | 4.90 | 4.90 |

| **Crosses** | **1st fruiting node** | | | | **Number of fruits/plant** | | | |
|---|---|---|---|---|---|---|---|---|
| | **Summer** | | **Kharif** | | **Summer** | | **Kharif** | |
| | **B. P.** | **S. H.** | **B. P.** | **S. H.** | **B. P.** | **S. H.** | **B. P.** | **S. H.** |
| 1 x 2 | 10.00 | 10.00 | 10.00 | -20** | 18.49 | -11.48 | 5.93 | -2.85 |
| 1 x 3 | 0.00 | 0.00 | 0.00 | -27.27** | 9.41 | -9.83 | 7.57 | -4.45 |
| 1 x 4 | -5.00 | -5.00 | -5.00 | -30.91** | 11.53 | 2.16 | 4.27 | -1.50 |
| 1 x 5 | -22.22 * | 5.00 | -22.22 * | -23.64 * | 14.33 | 6.22 | 5.01 | -3.55 |
| 1 x 6 | -24.14 ** | 10.00 | -24.14 ** | -20.00 * | 16.65 | 5.09 | 9.43 | -0.24 |
| 1 x 7 | 5.26 | 0.00 | 5.26 | -27.27 ** | -5.31 | -6.93 | 12.25 | -3.71 |
| 1 x 8 | -26.92 ** | -5.00 | -25.49 * | -30.91 ** | 18.33 | 7.98 | 19.07 ** | 10.65 |
| 1 x 9 | -23.08 * | 0.00 | -23.08 * | -27.27 ** | -4.62 | -0.83 | -0.47 | -7.97 |
| 1 x 10 | -23.81 | -20.00 | -23.81 * | -41.82 ** | 0.27 | -3.77 | 5.09 | -9.59 |
| 2 x 3 | -15.00 | -15.00 | -15.00 | -38.18 ** | 0.07 | -17.52 * | 4.56 | -4.11 |
| 2 x 4 | -5.00 | -5.00 | -5.00 | -30.91 ** | -0.72 | -9.06 | 3.48 | -2.25 |
| 2 x 5 | -33.33 ** | -10.00 | -33.33 ** | -34.55 ** | -8.72 | -15.19 | -0.04 | -8.19 |
| 2 x 6 | -34.48 ** | -5.00 | -34.48 ** | -30.91 ** | -31.09 ** | -37.92 ** | 4.36 | -4.29 |
| 2 x 7 | 0.00 | 0.00 | 0.00 | -27.27 ** | -12.37 | -13.87 | 5.05 | -3.66 |
| 2 x 8 | -23.08 * | 0.00 | -21.57 * | -27.27 ** | 4.91 | -4.27 | 6.78 | -0.77 |
| 2 x 9 | -30.77 ** | -10.00 | -30.77 ** | -34.55 ** | -2.50 | 1.38 | 9.74 | 1.48 |
| 2 x 10 | -4.76 | 0.00 | -4.76 | -27.27 ** | 20.12 * | 15.28 | 16.14 * | 6.51 |
| 3 x 4 | -5.00 | -5.00 | -5.00 | -30.91 ** | 12.68 | 3.22 | 3.40 | -2.32 |
| 3 x 5 | -22.22 * | 5.00 | -22.22 * | -23.64 * | -3.27 | -10.13 | 3.77 | -4.69 |
| 3 x 6 | -31.03 ** | 0.00 | -31.03 ** | -27.27 ** | -10.18 | -19.07 * | 8.75 | -0.86 |
| 3 x 7 | 10.00 | 10.00 | 10.00 | -20.00 * | -11.36 | -12.88 | 16.61 * | 3.57 |
| 3 x 8 | -23.08 * | 0.00 | -21.57 * | -27.27 ** | -0.66 | -9.35 | 6.82 | -0.73 |
| 3 x 9 | -19.23 | 5.00 | -19.23 * | -23.64 * | 0.46 | 4.46 | 7.66 | -0.45 |
| 3 x 10 | -4.76 | 0.00 | -4.76 | -27.27 ** | -8.69 | -12.37 | 1.54 | -9.82 |
| 4 x 5 | -29.63 ** | -5.00 | -29.63 ** | -30.91 ** | -2.72 | -9.62 | 10.05 | 3.96 |
| 4 x 6 | -37.93 ** | -10.00 | -37.93 ** | -34.55 ** | 22.61 * | 12.31 | 12.57 * | 6.34 |
| 4 x 7 | 0.00 | 0.00 | 0.00 | -27.27 ** | 2.89 | 1.13 | 6.45 | 0.56 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4 x 8 | -19.23 | 5.00 | -17.65 | -23.64 * | -10.99 | -18.47 * | 8.03 | 2.05 |
| 4 x 9 | -23.08 * | 0.00 | -23.08 * | -27.27 ** | -8.40 | -4.75 | 2.14 | -3.51 |
| 4 x 10 | -4.76 | 0.00 | -4.76 | -27.27 ** | 0.53 | -3.52 | 9.44 | 3.39 |
| 5 x 6 | -31.03 ** | 0.00 | -31.03 ** | -27.27 ** | -0.45 | -7.51 | 17.10 ** | 7.56 |
| 5 x 7 | -14.81 | 15.00 | -14.81 | -16.36 | 4.13 | 2.34 | 14.10 * | 4.80 |
| 5 x 8 | -24.07 * | 2.50 | -24.07 * | -25.45 ** | -7.28 | -13.86 | 13.26 * | 5.25 |
| 5 x 9 | -25.93 ** | 0.00 | -25.93 ** | -27.27 ** | 2.21 | 6.28 | 0.30 | -7.26 |
| 5 x 10 | -11.11 | 20.00 | -11.11 | -12.73 | 5.50 | 1.25 | -1.90 | -9.90 |
| 6 x 7 | -24.14 ** | 10.00 | -24.14 ** | -20.00 * | -0.52 | -2.22 | -5.74 | -14.07 * |
| 6 x 8 | -6.90 | 35.00 ** | -10.34 | -5.45 | -0.28 | -9.00 | 10.96 | 3.11 |
| 6 x 9 | -10.34 | 30.00 * | -10.34 | -5.45 | -13.24 | -9.78 | 3.62 | -4.18 |
| 6 x 10 | -24.14 ** | 10.00 | -24.14 ** | -20.00 * | -11.24 | -14.82 | 14.14 * | 4.06 |
| 7 x 8 | 0.00 | 30.00 * | 1.96 | -5.45 | -26.07 ** | -27.34 ** | 13.99 * | 5.93 |
| 7 x 9 | -19.23 | 5.00 | -19.23 * | -23.64 * | -27.92 ** | -25.05 ** | 13.50 * | 4.95 |
| 7 x10 | 4.76 | 10.00 | 4.76 | -20.00 * | -4.39 | -6.03 | 21.78 ** | 4.76 |
| 8 x 9 | 11.54 | 45.00** | 11.54 | 5.45 | -18.34 * | -15.09 | 6.09 | -1.41 |
| 8 x 10 | -23.08 * | 0.00 | -21.57 * | -27.27 ** | -8.78 | -12.46 | 12.07 * | 4.14 |
| 9 x 10 | -3.85 | 25.00 | -3.85 | -9.09 | -1.59 | 2.33 | 11.50 | 3.10 |
| S. E. ± | 0.25 | 0.25 | 0.24 | 0.24 | 2.79 | 2.79 | 2.23 | 2.23 |
| C. D. 5% | 0.50 | 0.50 | 0.48 | 0.48 | 5.61 | 5.61 | 4.48 | 4.48 |
| C. D. 1% | 0.67 | 0.67 | 0.65 | 0.65 | 7.47 | 7.47 | 5.97 | 5.97 |

| Crosses | Average fruit weight (g) | | | | Fruit length (cm) | | | |
|---|---|---|---|---|---|---|---|---|
| | Summer | | Kharif | | Summer | | Kharif | |
| | B. P. | S. H. | B. P. | S. H. | B. P. | S. H. | B. P. | S. H. |
| 1 x 2 | -5.48 | 0.98 | -9.35 * | -5.37 | -6.27 ** | 10.30 ** | 2.04 | 0.96 |
| 1 x 3 | 2.94 | 2.44 | -0.90 | 6.83 | -4.77 * | 3.90 | 5.15 | 4.04 |
| 1 x 4 | 0.00 | 3.41 | 1.90 | 4.39 | -4.73 * | 4.88 * | -6.71 | -7.69 |
| 1 x 5 | 1.87 | 6.34 | 1.83 | 8.29 | -14.19 ** | -4.88 * | -3.21 | -4.23 |
| 1 x 6 | 1.86 | 6.83 | 1.83 | 8.29 | -13.00 ** | -4.18 | -4.08 | -5.10 |
| 1 x 7 | 5.88 | 5.37 | 2.29 | 8.78 | -14.37 ** | -4.34 * | -1.65 | -2.69 |
| 1 x 8 | -0.49 | -0.98 | -0.48 | 0.98 | -0.45 | 8.41 ** | 0.09 | 1.63 |
| 1 x 9 | 9.80 * | 9.27 | 4.72 | 8.29 | -8.96 ** | -3.04 | 3.01 | 1.92 |
| 1 x 10 | 6.60 | 10.24 * | -9.29 * | 0.00 | -3.07 | 6.29 ** | 1.65 | 0.58 |
| 2 x 3 | 5.02 | 12.20 * | 4.07 | 12.20 * | -16.41 ** | -1.63 | 10.49 * | 0.29 |
| 2 x 4 | -1.37 | 5.37 | 4.21 | 8.78 | -17.97 ** | -3.47 | 2.22 | -7.21 |
| 2 x 5 | 9.59 * | 17.07 ** | 11.01 * | 18.05 ** | -13.82 ** | 1.41 | 0.63 | -7.21 |
| 2 x 6 | 2.28 | 9.27 | 3.21 | 9.76 * | -13.55 ** | 1.74 | 0.10 | -0.96 |
| 2 x 7 | 1.37 | 8.29 | 2.29 | 8.78 | -18.34 ** | -3.90 | 2.22 | -7.21 |
| 2 x 8 | -8.68 | -2.44 | 0.00 | 4.39 | -15.94 ** | -1.08 | -7.77 | -6.35 |
| 2 x 9 | 0.91 | 7.80 | 4.21 | 8.78 | -7.28 ** | 9.11 ** | 5.07 | -2.31 |
| 2 x 10 | 6.85 | 14.15 ** | 0.44 | 10.73 * | -4.61 * | 12.26 ** | 8.96 * | 4.04 |
| 3 x 4 | 4.72 | 8.29 | 1.81 | 9.76 * | -11.72 ** | -2.82 | 10.87 * | -1.92 |
| 3 x 5 | -1.87 | 2.44 | -4.98 | 2.44 | -18.40 ** | -9.54 ** | 11.57 * | 2.88 |
| 3 x 6 | 3.26 | 8.29 | 1.81 | 9.76 * | -13.24 ** | -4.45 * | 2.04 | 0.96 |
| 3 x 7 | 3.45 | 2.44 | -3.17 | 4.39 | -15.34 ** | -5.42 * | 14.21 ** | 0.48 |
| 3 x 8 | 6.40 | 5.37 | -0.90 | 6.83 | -11.13 ** | -3.04 | -1.04 | 0.48 |
| 3 x 9 | 11.33 * | 10.24 * | 2.26 | 10.24 * | -14.71 ** | -6.94 ** | 10.44 * | 2.69 |
| 3 x 10 | 8.49 | 12.20 * | 1.77 | 12.20 * | -9.69 ** | -0.98 | 6.45 | 1.63 |
| 4 x 5 | 13.08 ** | 18.05 ** | -1.38 | 4.88 | -12.13 ** | -2.60 | 12.30 ** | 3.56 |
| 4 x 6 | 11.63 * | 17.07 ** | 4.04 | 10.63 * | -0.25 | 9.87 ** | -1.94 | -2.98 |
| 4 x 7 | -8.49 | -5.37 | -7.34 | -1.46 | -8.06 ** | 2.71 | 12.83 ** | -0.19 |
| 4 x 8 | -7.55 | -4.39 | -4.29 | -1.95 | -11.43 ** | -2.49 | -0.85 | 0.67 |
| 4 x 9 | -2.83 | 0.49 | -2.36 | 0.98 | -15.17 ** | -6.62 ** | 9.82 * | 2.12 |
| 4 x 10 | 4.25 | 7.80 | -5.75 | 3.90 | 0.99 | 11.17 ** | 1.51 | -3.08 |
| 5 x 6 | -5.58 | -0.98 | -5.96 | 0.00 | -12.62 ** | -3.15 | 1.17 | 0.10 |
| 5 x 7 | 2.34 | 6.83 | -1.38 | 4.88 | -6.12 ** | 4.88 * | 10.95 * | 2.31 |
| 5 x 8 | -7.48 | -3.41 | -4.13 | 1.95 | -14.19 ** | -4.88 * | -12.88 ** | -11.54 ** |
| 5 x 9 | -0.93 | 3.41 | 0.00 | 6.34 | -13.70 ** | -4.34 * | 10.65 * | 2.88 |
| 5 x 10 | -7.48 | -3.41 | -10.62 * | -1.46 | -17.22 ** | -8.24 ** | -1.81 | -6.25 |
| 6 x 7 | 5.12 | 10.24 * | 4.59 | 11.22 * | -10.97 ** | -0.54 | -0.10 | -1.15 |
| 6 x 8 | -12.56 ** | -8.29 | -11.01 * | -5.37 | -10.39 ** | -1.30 | -4.45 | -2.98 |
| 6 x 9 | -0.47 | 4.39 | -0.92 | 5.37 | -11.96 ** | -3.04 | 1.26 | 0.19 |
| 6 x 10 | 5.12 | 10.24 * | -6.19 | 3.41 | -13.24 ** | -4.45 * | 0.58 | -0.48 |
| 7 x 8 | -1.98 | -3.41 | -7.34 | -1.46 | -14.17 ** | -4.12 | -2.27 | -0.77 |
| 7 x 9 | 0.00 | -1.46 | -3.21 | 2.93 | -11.94 ** | -1.63 | 7.96 | 0.38 |
| 7 x10 | 1.89 | 5.37 | -5.31 | 4.39 | -9.13 ** | 1.52 | 7.65 | 2.79 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8 x 9 | 0.50 | -0.98 | -1.89 | 1.46 | -5.08 * | 3.36 | -0.85 | 0.67 |
| 8 x 10 | -13.21 ** | -10.24 * | -10.62 * | -1.46 | -6.92 ** | 2.06 | -3.79 | -2.31 |
| 9 x 10 | -6.60 | -3.41 | -10.18 * | -0.98 | -11.77 ** | -3.25 | 3.32 | -1.35 |
| S. E. ± | 0.49 | 0.49 | 0.47 | 0.47 | 0.19 | 0.19 | 0.43 | 0.43 |
| C. D. 5% | 0.99 | 0.99 | 0.94 | 0.94 | 0.39 | 0.39 | 0.88 | 0.88 |
| C. D. 1% | 1.32 | 1.32 | 1.26 | 1.26 | 0.53 | 0.53 | 1.17 | 1.17 |

| Crosses | Fruit diameter (cm) | | | | Yield / ha. (q) | | | |
|---|---|---|---|---|---|---|---|---|
| | Summer | | Kharif | | Summer | | Kharif | |
| | B. P. | S. H. | B. P. | S. H. | B. P. | S. H. | B. P. | S. H. |
| 1 x 2 | -9.00* | -7.46* | 1.81 | -9.65 ** | 17.87 * | 14.22 | 12.39 ** | 5.62 |
| 1 x 3 | 3.14 | -10.85** | 0.00 | -9.32 ** | 23.53 * | 5.90 | 3.24 | -2.55 |
| 1 x 4 | 4.14 | -6.10 | 0.36 | -10.93 ** | 15.61 | 16.15 * | 12.30 ** | 6.59 |
| 1 x 5 | 10.23 * | -1.36 | -0.36 | -11.58 ** | 6.88 | 5.01 | 7.03 | 2.54 |
| 1 x 6 | 1.81 | -4.41 | 3.62 | -8.04 * | 2.87 | 5.08 | 1.16 | -3.74 |
| 1 x 7 | 6.55 | -0.68 | -0.72 | -11.25 ** | -12.50 | -8.32 | 6.80 | -4.40 |
| 1 x 8 | -3.65 | -10.51 ** | 3.26 | -8.36 * | 24.63 ** | 21.88 ** | 18.55 ** | 9.67 ** |
| 1 x 9 | -1.14 | -11.53 ** | -2.51 | -12.54 ** | 10.60 | 14.30 | 13.32 ** | 6.36 |
| 1 x 10 | -9.18 * | -9.49 ** | -3.96 | -6.43 * | 8.71 | 10.65 | 9.82 * | 2.26 |
| 2 x 3 | -14.00 ** | -12.54 ** | 0.00 | -9.32 ** | -10.24 | -13.02 | 1.67 | -4.04 |
| 2 x 4 | -18.00 ** | -16.61 ** | -1.47 | -13.83 ** | 17.46 * | 18.01 * | 13.92 ** | 8.14 * |
| 2 x 5 | -20.33 ** | -18.98 ** | -1.81 | -12.86 ** | -12.55 | -14.08 | -0.21 | -4.40 |
| 2 x 6 | -14.33 ** | -12.88 ** | 4.04 | -9.00 ** | -2.15 | -0.05 | 2.42 | -2.55 |
| 2 x 7 | -9.00 * | -7.46 * | 3.60 | -7.40 * | -10.05 | -5.75 | 8.06 * | 1.54 |
| 2 x 8 | -16.67 ** | -15.25 ** | 5.07 | -6.75 * | 4.20 | 1.90 | 7.95 * | 1.44 |
| 2 x 9 | -17.33 ** | -15.93 ** | 0.36 | -9.97 ** | 14.34 | 18.16 * | 15.29 ** | 8.35 * |
| 2 x 10 | -11.00 ** | -9.49 ** | -5.61 | -8.04 * | 26.60 ** | 28.86 ** | 16.71 ** | 9.68 ** |
| 3 x 4 | -6.77 | -15.93 ** | 2.13 | -7.40 * | 8.66 | 9.17 | 0.09 | -4.99 |
| 3 x 5 | 3.79 | -7.12 * | 3.55 | -6.11 | 0.74 | -1.02 | -0.10 | -4.29 |
| 3 x 6 | 5.05 | -1.36 | 3.19 | -6.43 * | -7.46 | -5.47 | 3.35 | -1.66 |
| 3 x 7 | 2.55 | -4.41 | 0.00 | -9.32 ** | -14.28 | -10.19 | 2.17 | -3.57 |
| 3 x 8 | -5.11 | -11.86 ** | 1.77 | -7.72 * | -1.93 | -4.09 | 4.19 | -1.66 |
| 3 x 9 | 4.55 | -6.44 | -3.19 | -12.22 ** | 0.47 | 3.82 | 6.71 | 0.71 |
| 3 x 10 | -8.84 * | -9.15 * | -3.96 | -6.43 * | -19.53 * | -18.09 * | 5.11 | -0.79 |
| 4 x 5 | -6.02 | -15.25 ** | 2.54 | -9.00 ** | 7.18 | 7.69 | 6.11 | 1.66 |
| 4 x 6 | -7.58 * | -13.22 ** | 2.58 | -10.61 ** | 17.86 * | 20.39 * | 13.93 ** | 8.40 * |
| 4 x 7 | -2.91 | -9.49 ** | 2.16 | -8.68 ** | 5.83 | 10.88 | 7.54 * | 2.08 |
| 4 x 8 | 1.09 | -6.10 | 1.45 | -9.97 ** | -1.26 | -0.79 | 3.50 | -1.75 |
| 4 x 9 | 4.51 | -5.76 | 1.08 | -9.32 ** | -6.11 | -2.98 | 0.75 | -4.36 |
| 4 x 10 | 1.70 | 1.36 | -7.92 * | -10.29 ** | 6.53 | 8.43 | 3.28 | -1.96 |
| 5 x 6 | 1.08 | -5.08 | 13.77 ** | 0.96 | -9.27 | -7.32 | 6.55 | 2.08 |
| 5 x 7 | 5.45 | -1.69 | 2.88 | -8.04 * | 11.72 | 17.05 * | 12.55 ** | 7.83 * |
| 5 x 8 | -3.65 | -10.51 ** | 0.72 | -10.61 ** | 0.30 | -1.46 | -0.89 | -5.05 |
| 5 x 9 | -1.52 | -11.86 ** | 5.02 | -5.79 | 6.36 | 9.91 | 1.07 | -3.17 |
| 5 x 10 | -12.24 ** | -12.54 ** | -2.31 | -4.82 | -2.73 | -1.00 | -9.05 * | -12.87 ** |
| 6 x 7 | -5.78 | -11.53 ** | 15.11 ** | 2.89 | 4.16 | 9.13 | -1.57 | -6.35 |
| 6 x 8 | -6.50 | -12.20 ** | -15.94 ** | -25.40 ** | -16.99 * | -15.21 | 0.55 | -4.33 |
| 6 x 9 | 0.72 | -5.42 | -17.56 ** | -26.05 ** | -6.72 | -3.61 | 2.87 | -2.12 |
| 6 x 10 | -7.48 * | -7.80 * | -25.41 ** | -27.33 ** | 5.13 | 7.39 | 2.60 | -2.38 |
| 7 x 8 | 4.00 | -3.05 | -18.35 ** | -27.01 ** | -3.11 | 1.51 | 7.79 * | -0.29 |
| 7 x 9 | -3.64 | -10.17 ** | -5.02 | -14.79 ** | -28.63 ** | -25.23 ** | 7.94 * | 1.31 |
| 7 x10 | -4.42 | -4.75 | -6.27 | -8.68 ** | 0.37 | 5.16 | 8.93 * | 1.43 |
| 8 x 9 | -3.65 | -10.51 ** | 3.23 | -7.40 * | -18.08 * | -15.35 | 4.57 | -1.86 |
| 8 x 10 | -10.88 ** | -11.19 ** | -4.29 | -6.75 * | -21.60 ** | -20.20 * | 8.17 * | 0.71 |
| 9 x 10 | -3.40 | -3.73 | -3.96 | -6.43 * | 10.10 | 13.78 | 12.81 ** | 5.88 |
| S. E. ± | 0.05 | 0.05 | 0.04 | 0.04 | 14.81 | 14.81 | 8.29 | 8.29 |
| C. D. 5% | 0.10 | 0.10 | 0.09 | 0.09 | 29.70 | 29.70 | 16.63 | 16.63 |
| C. D. 1% | 0.13 | 0.13 | 0.13 | 0.13 | 39.55 | 39.55 | 22.14 | 22.14 |

*and **significant at 5% and 1% respectively

## Conclusion

The data on heterosis calculated over better parent and standard hybrid check Radhika revealed that superiority of some outstanding cross combinations. $P_1$ x $P_8$ (RHOK 03 x RHOK 30), $P_2$ x $P_4$ (RHOK 12 x RHOK 17), $P_2$ x $P_9$ (RHOK 12 x RHOK 31), $P_2$ x $P_{10}$ (RHOK 12 x Phule Vimukta), $P_4$ x $P_6$ (RHOK 17 x RHOK 23) and $P_5$ x $P_7$ (RHOK 22 x RHOK 26) found to be most promising for fruit yield and other desirable traits, hence could be further evaluated to exploit the heterosis or utilized in future breeding programme to obtain desirable segregants for the development of superior genotypes.

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