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Heterosis, heterobeltiosis and inbreeding depression study in okra (*Abelmoschus esculentus* (L.) Moench)

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Abstract
The experiment comprised the study of heterosis and inbreeding depression using P_1, P_2, F_1, F_2, B_1 and B_2 generations of four crosses *viz*., (Parbhani Kranti X VROR-159, Parbhani Kranti X Kashi Pragati, Kashi Satadhari X VROR-159 and Kashi Satadhari X BO-2) along with two checks i.e. Mahyco Bhindi No.10 and Pusa Sawani were used to study relative heterosis heterobeltiosis, standard heterosis and inbreeding depression for Plant height (cm), Internodal length (cm), Number of nodes on main stem, Number of branches per plant, Days to first flowering. Days to 50% flowering, first fruiting node. Fruit length (cm), Fruit diameter (cm), Fruit weight (gm), Number of ridges per fruit, Number of fruits per plant, Marketable Fruit yield per plant (gm) Yield per plot (Kg), Yield (q/ha.), Incidence of Fruit and shoot borer. (%) and Incidence of Yellow vein mosaic (%) in okra (*A. esculentus* (L.) Moench). In heterosis and inbreeding study of F_1 and F_2 generation, relative heterosis ranges from -46.29% for first fruiting nodes to 44.41% for number of nodes on main stem. The highest relative heterosis for fruit yield per plant in F_1 hybrid cross Kashi Satadhari × BO-2 (18.83%) followed by Parbhani Kranti × VROR-159 (15.81%) were recorded over mid parent. However, highest heterobeltiosis in Kashi Satadhari × BO-2 (15.00%) and Parbhani Kranti × VROR-159 (11.68%) and highest standard heterosis observed in Parbhani Kranti × VROR-159 over Pusa Sawani (24.04%) and Mahyco Bhindi No.(19.31%). However, highest positive relative heterosis recorded in Kashi Satadhari × BO-2 (44.41%) for first fruiting nodes and negative relative heterosis observed in Kashi Satadhari × VROR-159 (-46.29%). Inbreeding depression ranges from -106.89% for first fruiting nodes in cross Kashi Satadhari × VROR-159 to 25.81% for internodal length in cross kashi Satadhari × BO-2. However, Inbreeding depression for marketable fruit yield per plant (g) was highest observed in Parbhani Kranti × Kashi Pragati (12.45%) followed by Parbhani Kranti × VROR-159 (12.07%).

Keywords: Heterosis, inbreeding depression, okra and standard heterosis

Introduction
Okra is one of the important vegetables grown for its immature non-fibrous edible pods in tropical and sub-tropical parts of the world. Study of magnitude heterosis and subsequent inbreeding depression is of prime importance in formulating breeding methods used for crop improvement programme as it focus attention on nature of gene action involved in inheritance of various quantitative characters. In self-pollinated crops, an approach based on generation mean analysis has particular suitability as it estimates the heterosis as well as inbreeding depression present. In present investigation, an attempt has been made to estimate heterosis and inbreeding depression for fruit yield per plant and other yield contributing characters in four inter varietals crosses. Okra (*Abelmoschus esculentus* (L.) Moench) is an important vegetable crop grown in the tropical, sub-tropical low altitude regions of Asia, Africa, America and temperate regions of the Mediterranean basin. In India, It is commercially grown in states of Maharashtra, Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu. The prominent position of okra among Indian vegetables can be due to its easy cultivation, dependable and regular yield, wide adaptability and year round cultivation. However, the average productivity of okra in India is still not as good as that of other okra growing countries of the world. India is leader in the world in area and production of okra with 6145.97 metric tons of production obtained from an area of 528.37 lakh hectare under the crop (Anonymous, 2018) [1, 2]. The area under the crop in Maharashtra during year 2016-17 was 14.43 lakh hectares. The state ranks thirteenth in the country with production of 148.09 metric tons. However, Maharashtra's productivity is much lower than that of the country (Anonymous, 2018) [1, 2]. Okra is a self-pollinated crop even though it has a suitable mechanism to produce hybrid seed at a commercial scale. Hence, heterosis per se is commercially useful. However, heterosis that has superiority over better parent (heterobeltiosis) is useful in deciding the direction of future

hybrid breeding programme. It also identifies the cross combinations which are promising in conventional breeding programme. Heterosis leads to increase in yield, reproductive ability adaptability, biotic and abiotic resistance, general vigour and quality.

The wide range of heterosis observed by various workers in okra may not be of much practical value unless it is manifested as increase over standard commercial varieties. In some cases over-dominance was observed for days to first flowering, fruit length and weight, plant height and yield per plant. Thus it suggest, that hybrid vigour can be exploited in okra for increasing pod yield through early flowering, increased plant height, fruit length and weight. The potential of this approach is evident from the reports where more than 100% increase in yield over better parent has been recorded and also presence of dominance gene effects for yield and yield contributing traits. Inbreeding depression defines to decrease in fitness and vigour due to inbreeding effect. It increases homozygosity in the genotype by continuous selfing. It results due to fixation of undesirable recessive genes in F_2. While in case of heterosis, favourable dominant genes of one parent are masking the effect of recessive genes of other parent

Materials and Methods

The experimental material comprised of six generations along with check Pusa Sawani and Mahyco Bhindi No.10 *viz.*, P_1, P_2, F_1, F_2, B_1 and B_2 of each of four different okra crosses were sown during *kharif*, 2017 in Randomized Block Design in replication. Each plot consisted two row of P_1, P_2, F_1, B_1 and B_2 and check and four rows of F_2. Row length was three meter long. The row to row and plant to plant distance was kept as 60 cm and 30 cm, respectively. The data was recorded on five plants for parents and F1s, ten plants for backcrosses and twenty plants for F2s in each replication. The observations were recorded on Plant height (cm), Internodal length (cm), Number of nodes on main stem, Number of branches per plant, Days to first flowering. Days to 50% flowering, First fruiting node, Fruit length (cm), Fruit diameter (cm), Fruit weight (gm), Number of ridges per fruit, Number of fruits per plant, Marketable fruit yield per plant (gm) Yield per plot (Kg), fruit yield (q/ha.), Incidence of Fruit and shoot borer (%) and Incidence of Yellow vein mosaic (%). The formula given by Fonseca and Patterson (1968) was used for estimation of heterosis, standard heterosis and heterobeltiosis, while the formula given by Matzinger *et al*. (1962) was used to estimate inbreeding depression.

Result and Discussion

Analysis of variance for yield and yield components showed highly significant differences among the crosses studied for all the character except for days to flowering in a cross Kashi Satadhari × VROR-159 and Kashi Satadhari × BO-2 and 50% flowering in Kashi Satadhari × BO-2 which indicated the presence of substantial variability in the material under study. (Table-1).

Mean performance of six generation of each of four crosses revealed that among the parents, Parbhani Kranti was found superior for plant height, fruit weight, marketable fruit yield per plant, fruit yield per plot and Fruit yields per hectare, Parent VROR-159 was found superior for number of branches per plant, number of nodes on main stem, internodal length, fruit length, days to first flowering and days to 50% flowering, parent Kashi Pragati was superior in Incidence of yellow vein mosaic and Incidence of fruit and shoot borer, parent BO-2 was superior in first fruiting nodes and fruit diameter, parent kashi Satadhari superior in number of ridges per fruit. Whereas, check Mahyco Bhindi No 10 was superior for plant height, Internodal length and Pusa Sawani for earliness.

However, cross Parbhani kranti x VROR-159 was found better in Fruit weight, Number of fruit per plant, Marketable fruit yield per plant, Fruit yield per plot and Fruit yield per hectare, Number of branches per plant, Number of nodes on main stem, Fruit length and Incidence of yellow vein mosaic (%), the cross kashi Satadhari x VROR-159 was found superior for plant height, first fruiting nodes and incidence of fruit and shoot borer. However, cross Kashi Satadhari x BO-2 was found superior for earliness, fruit diameter and incidence of fruit and shoot borer. While cross Parbhani Kranti x Kashi Pragati superior for days to 50% flowering and internodal length.

Heterosis, heterobeltiosis, standard heterosis and inbreeding depression of traits were shown in table 3.

The estimates of heterosis over better parent were positive and significant for plant height recorded in Kashi Satadhari × BO-2, Kashi Satadhari × VROR-159 and Parbhani Kranti × VROR-159, similar result was reported by Hosamani *et al*. (2008) [8] for plant height. Highest significant Standard heterosis observed in Kashi Satadhari × VROR-159 over standard check Pusa Sawani and Kashi Satadhari × BO-2 over Hybrid Mahyco Bhindi No.10. The results suggested the involvement of dominance gene effects. These findings are in agreement with earlier findings (Pawar *et al.* 1999) [25] in okra. Further, significance of inbreeding depression estimates for plant height observed in Kashi Satadhari × VROR-159 followed by Parbhani Kranti × VROR-159 indicated the operation of non-additive gene action. The negative and significant inbreeding depression for plant height is desirable in okra breeding programme. However, none of the cross exhibited significant inbreeding depression in desirable direction indicated the operation of non-additive gene action. Hence, heterosis breeding or reciprocal recurrent selection would be more fruitful for getting higher plant height. Both negative and positive inbreeding depression was reported for plant height by Patel (2006) [21]. The results are in the harmony of Aware *et al.* (2014) [4], Medagam *et al.* (2013) [16], Khanpara *et al.* (2009) [11] and Hosamani *et al.* (2008) [8] for plant height.

Shorter internodes are preferred because it restricts plant height from extra tall and imparts suitable height. Heterosis over better parent was significant and positive in cross Parbhani Kranti × Kashi Pragati and Kashi Satadhari × VROR-159 indicates involvement of dominance effects. However, negative heterosis was observed in Parbhani Kranti × VROR-159 which is desirable for internodal length to accommodate more number of nodes and to get higher fruit yield in okra. Whereas, Significant heterosis over better parent was reported by Hosamani *et al*. (2008) [8] for internodal length on main stem. Highest significant Standard heterosis observed in Kashi Satadhari × VROR-159 over standard check Pusa Sawani and Parbhani Kranti × Kashi Pragati over Hybrid Mahyco Bhindi No.10. Whereas, significant and positive inbreeding depression observed in Kashi Satadhari × BO-2 and Kashi Satadhari × VROR-159 indicated the operation of non-additive gene action. This finding is in accordance with Tiwari *et al.* (2015) [32] and Bhatt *et al*. (2016) [5].

All four crosses recorded significant and positive relative heterosis for number of nodes on main stem. Maximum relative heterosis observed in Kashi Satadhari × BO-2 followed by Parbhani Kranti × Kashi Pragati similar result has been reported by Patel *et al.* (2010a) [23]. All crosses exhibited highly significant Heterobeltosis for the number of nodes on main stem. However, highly significant and positive heterobeltosis observed in cross Kashi Satadhari × BO-2 and Parbhani Kranti × VROR-159. Similar results earlier reported by Dhaduk and Mehta (2003) [7], Rewale *et al.* (2003b) [27], Javia (2013) [10], Bhatt *et al.* (2016) [5] and Sabesan *et al.* (2016) [28]. Significant Standard heterosis observed in Parbhani Kranti × VROR-159 and Parbhani Kranti × Kashi Pragati over standard check Pusa Sawani and Parbhani Kranti × VROR-159 and Parbhani Kranti × Kashi Pragati over Hybrid Mahyco Bhindi No. 10. It indicates preponderance of non-additive type of gene action. Similar results earlier reported by Dhaduk and Mehta (2003) [7], Singh *et al.* (2004) [29] Patel *et al.* (2010a) [23] and Verma & Sood (2015b) [33]. Whereas, inbreeding depression was significant and positive observed in Kashi Satadhari × VROR-159 and Parbhani Kranti × VROR-159. Moderate to high amount of inbreeding depression was observed for this trait by Patel *et al.* (2010a) [23] and Sabesan *et al.* (2016) [28].

Maximum relative heterosis observed in Parbhani Kranti × Kashi Pragati followed by Parbhani Kranti × VROR-159 for number of branches per plant. Whereas in Kashi Satadhari × BO-2 heterosis in negative direction. Three crosses exhibited highly significant heterobeltiosis for the number of branches per plant. However, highest positive and significant heterosis over better parent was recorded in a cross Parbhani Kranti × Kashi Pragati. While, in cross Kashi Satadhari × VROR-159 recorded in negative direction. Highest significant Standard heterosis observed in Parbhani Kranti × VROR-159 followed by Kashi Satadhari × VROR-159 over standard check Pusa Sawani and Kashi Satadhari × BO-2 over Hybrid Mahyco Bhindi No.10. Number of branches per plant was found highly significant, confirming the role of non-additiveness. Significant inbreeding depression was observed in Kashi Satadhari × VROR-159 in negative direction. Similar finding reported by Rewale *et al.* (2003) [27] and Singh *et al.* (2004) [29]. The above observation indicate that the heterosis result in large part from multiplicative interaction of the two parents.

Negative heterosis is desirable for Days to first flowering because early maturing genotypes better results. The early flowering that gives early yield also widens the fruiting span of the plant resulting in higher fruit yield in hybrids. Maximum relative heterosis observed in Parbhani Kranti × Kashi Pragati but in negative direction which is desirable for this trait. Only Parbhani Kranti × VROR-159 exhibited highly significant heterobeltiosis for the days to flowering similar finding reported by Deshmukh *et al.* (2005) [6]. However, highest significant Standard heterosis observed in Parbhani Kranti × VROR-159 over Pusa Sawani. Whereas, in Kashi Satadhari × BO-2 and Kashi Satadhari × VROR-159 over Hybrid Mahyco Bhindi No.10. Significant Standard heterosis but in negative direction which is desirable for this trait. Therefore, this trait may be exploited through heterosis breeding for earliness. Significant inbreeding depression observed in Parbhani Kranti × VROR-159 in negative direction. Similar findings reported by Ashwini Kumar *et al.* (2013) [3], Kishor *et al.* (2013) [12] and Medagam *et al.* (2013) [16].

Significant and negative relative heterosis observed in Parbhani Kranti × Kashi Pragati and Kashi Satadhari × BO-2 which desirable for days to 50% flowering. None of the cross shows significant better parent heterosis. Highest significant standard heterosis observed in Parbhani Kranti × VROR-159 over Pusa Sawani and cross Parbhani Kranti × Kashi Pragati followed by Kashi Satadhari × BO-2 and Kashi Satadhari × VROR-159 over Hybrid Mahyco Bhindi No.10. Significant inbreeding depression observed in Parbhani Kranti × VROR-159 in negative direction for days to 50% flowering. Similar results reported by Jagan *et al.* (2013a) [9], Kishor *et al.* (2013) [12], Medagam *et al.* (2013) [16], Aware *et al.* (2014) [4], Tiwari *et al.* (2015) [32] and Prakash Kerure *et al.* (2019) [26].

Fruiting at lower nodes is helpful in increasing the number of fruits per plant as well as getting early yields. Maximum relative heterosis observed in Kashi Satadhari × VROR-159 followed by Parbhani Kranti × VROR-159 but in negative direction which is highly desirable for all these three attributes of earliness. Significant and maximum better parent heterosis observed in Kashi Satadhari × VROR-159 followed by Parbhani Kranti × VROR-159. Highest significant Standard heterosis observed in Kashi Satadhari × VROR-159 followed by Parbhani Kranti × VROR-159 and Kashi Satadhari × BO-2 over Pusa Sawani and Kashi Satadhari × VROR-159 followed by Parbhani Kranti × VROR-159 and Kashi Satadhari × BO-2 over Hybrid Mahyco Bhindi No.10. This indicated the presence of dominance type of interaction. Hence, character can be improved by exploitation of hybrid vigour. The present results are in accordance with results of Medagam *et al.* (2013) [16]. Significant inbreeding depression observed in Kashi Satadhari × VROR-159 followed by Parbhani Kranti × VROR-159 in negative direction and significant positive inbreeding depression observed in Parbhani Kranti × Kashi Pragati similar finding reported by Singh *et al.* (2004) [29], Medagam *et al.* (2012a) [15] and Medagam *et al.* (2013) [16].

Out of four crosses only Kashi Satadhari × VROR-159 shown significant negative relative heterosis and better parent heterosis for fruit length. Highest significant Standard heterosis observed in Parbhani Kranti × VROR-159 followed by Parbhani Kranti × Kashi Pragati over Pusa Sawani and none of the cross shows significant standard heterosis over Hybrid Mahyco Bhindi No.10. Significant and positive inbreeding depression observed in Parbhani Kranti × VROR-159 for the the fruit length. Similar finding reported by Patel *et al.* (2010a) [23], Medagam *et al.* (2012a) [15], Kumar *et al.* (2013a) [3] and Mulge *et al*. (2018) [18].

Fruit weight is considered to be associated directly with total yield per plant, for which positive heterosis is desirable. Maximum relative and better parent heterosis observed in Parbhani Kranti × Kashi Pragati but non-significant. All four crosses observed significant standard heterosis. However, highest significant Standard heterosis observed in Parbhani Kranti × VROR-159 followed by Parbhani Kashi Satadhari × VROR-159 over Pusa Sawani and Parbhani Kranti × VROR-159 shows significant standard heterosis over Hybrid Mahyco Bhindi No.10. Significant inbreeding depression observed in Parbhani Kranti × Kashi Pragati followed by Kashi Satadhari × BO-2. Similar results reported by Tiwari *et al.* (2015) [32], Verma and Sood (2015b) [33], Bhatt *et al*. (2016) [5], Sabesan *et al.* (2016) [28].

Significant and maximum relative heterosis observed in Kashi Satadhari × VROR-159 followed by Parbhani Kranti × VROR-159 for Fruit diameter but in negative direction. Maximum better parent heterosis observed in Parbhani Kranti

× VROR-159 followed by Kashi Satadhari × VROR-159. None of the cross shows significant standard heterosis over Pusa Sawani and Mahyco Bhindi No. 10. Highest inbreeding depression observed in Kashi Satadhari × VROR-159 similar finding reported by Soher *et al.* (2013) [30], Nagesh *et al.* (2014) [19], Tiwari *et al.* (2015) [32], Patel (2015) [32], Sabesan *et al.* (2016) [28] and Mulge *et al*. (2018) [18].

Among the four crosses, three crosses observed significant relative heterosis for Number of fruits per plant. However, maximum relative heterosis observed in Kashi Satadhari × VROR-159 followed by Parbhani Kranti × VROR-159. Significant and maximum better parent heterosis observed in Kashi Satadhari × VROR-159 and Parbhani Kranti × VROR-159. Highest significant Standard heterosis observed in Parbhani Kranti × VROR-159 followed by Kashi Satadhari × VROR-159 over Pusa Sawani and cross Parbhani Kranti × VROR-159 shows significant standard heterosis over Hybrid Mahyco Bhindi No.10 indicating involvement non additive gene effect for this trait. Significant inbreeding depression observed in Parbhani Kranti × VROR-159 followed by Kashi Satadhari × BO-2. Similar results reported by Aware *et al.* (2014) [4], Nagesh *et al.* (2014) [19], Neetu *et al.* (2015) [20], Tiwari *et al.* (2015) [32] and Sabesan *et al.* (2016) [28].

Among the four crosses, two crosses observed significant relative heterosis in Kashi Satadhari × VROR-159 and Kashi Satadhari × BO-2 for Number of ridges per fruit. However, better parent heterosis observed in Kashi Satadhari × VROR-159 and Kashi Satadhari × BO-2. Highest significant standard heterosis observed in Kashi Satadhari × VROR-159 and Kashi Satadhari × BO-2 over Pusa Sawani and Kashi Satadhari × VROR-159 and Kashi Satadhari × BO-2 cross shows significant standard heterosis over Hybrid Mahyco Bhindi No.10. Highest inbreeding depression observed in Parbhani Kranti × VROR-159 but in negative direction which is desirable for these traits indicates additive effect more contribution for the expression of this trait. Similar results reported by Akotkar *et al.* (2014) and Mulge *et al*. (2018) [18].

Among the four crosses, three crosses were shown significant relative heterosis for fruit yield per plant (g). However, Maximum relative heterosis observed in Kashi Satadhari × BO-2 followed by Parbhani Kranti × VROR-159. Significant and maximum better parent heterosis observed in Kashi Satadhari × BO-2 followed by Parbhani Kranti × VROR-159. Highest significant Standard heterosis observed in Parbhani Kranti × VROR-159 followed by Kashi Satadhari × VROR-159 over Pusa Sawani and Parbhani Kranti × VROR-159 followed by Kashi Satadhari × VROR-159 cross shows significant standard heterosis over Hybrid Mahyco Bhindi No.10. Highest significant inbreeding depression observed in Parbhani Kranti × Kashi Pragati followed by Parbhani Kranti × VROR-159. This indicated the presence of dominance type of interaction involved for this character can be improved by exploitation of hybrid vigour. Similar finding reported by Bhatt *et al*. (2016) [5], Sabesan *et al.* (2016) [28] and Mulge *et al*. (2018) [18].

Maximum relative heterosis observed in Kashi Satadhari × BO-2 followed by Parbhani Kranti × VROR-159 for fruit yield per plot (Kg). Significant and maximum better parent heterosis observed in Kashi Satadhari × BO-2 (16.16%) followed by Kashi Satadhari × VROR-159. Highest significant Standard heterosis observed in Parbhani Kranti × VROR-159 followed by Kashi Satadhari × BO-2 over Pusa Sawani and Parbhani Kranti × VROR-159 followed by Kashi Satadhari × BO-2 cross shows significant standard heterosis over Hybrid Mahyco Bhindi No. 10. Highest significant inbreeding depression observed in Parbhani Kranti × Kashi Pragati followed by Parbhani Kranti × VROR-159. Similar result was reported by Mulge *et al*. (2018) [18]. This indicated the presence of dominance gene effect for these traits can be improved by heterosis breeding.

Among the four crosses, Maximum relative heterosis observed in Kashi Satadhari × BO-2 followed by Parbhani Kranti × VROR-159 for Fruit yield per ha. (q). Significant and maximum better parent heterosis observed in Kashi Satadhari × BO-2 followed by Kashi Satadhari × VROR-159. Highest significant Standard heterosis observed in Parbhani Kranti × VROR-159 followed by Kashi Satadhari × BO-2 over Pusa Sawani and Parbhani Kranti × VROR-159 followed by Kashi Satadhari × BO-2. Cross shows significant standard heterosis over Hybrid Mahyco Bhindi No. 10. Highest significant inbreeding depression observed in Parbhani Kranti × Kashi Pragati (12.81%) followed by Parbhani Kranti × VROR-159 (11.38%) similar finding reported by Mulge *et al*. (2018) [18]. This indicated the presence of dominance gene effect for this trait can be exploited by heterosis breeding.

Among the four crosses, maximum and significant relative heterosis observed in Parbhani Kranti × Kashi Pragati and negative heterosis observed in Kashi Satadhari × VROR-159 but non-significant for Incidence of fruit and shoot borer (%). However, negative heterosis is desirable for this trait. Maximum and significant better parent heterosis observed in Kashi Satadhari × BO-2 and Parbhani Kranti × VROR-159. Highest significant Standard heterosis observed in Parbhani Kranti × Kashi Pragati over Pusa Sawani and Parbhani Kranti × Kashi Pragati followed by Kashi Satadhari × VROR-159 cross shows significant standard heterosis over Hybrid Mahyco Bhindi No. 10. All the crosses were shown negative standard heterosis over both checks. Negative heterosis phenomenon can be exploited for development of resistance hybrids for fruit and shoot borer. Highest inbreeding depression observed in Parbhani Kranti × Kashi Pragati. A similar result was reported by Medagam *et al.* (2012a) [15].

Among the four crosses, three crosses were shown negative heterosis which is desirable for incidence of yellow vein mosaic (%). However, maximum relative heterosis observed in Parbhani Kranti × VROR-159 followed by Kashi Satadhari × BO-2. None of the cross shows significant better parent heterosis. Highest significant Standard heterosis observed in Parbhani Kranti × VROR-159 followed by Kashi Satadhari × BO-2 over Pusa Sawani and none of the cross shows significant standard heterosis over Hybrid Mahyco Bhindi No.10. Highest inbreeding depression observed in Parbhani Kranti × VROR-159. Similar results reported by Medagam *et al.* (2012a) [15] and Medagam *et al.* (2013) [16].

Table 1: Analysis of variance of the six generation in four crosses

Characters	Treatment df	Error df	Mean square (MS)			
			Parbhani Kranti x VROR-159	Parbhani Kranti x Kashi Pragati, 2	Kashi Satadhari X VROR-159	Kashi Satadhari x BO
Plant height (cm)	5	10	255.63*	755.42**	1304.65**	691.91**
Internodal length (cm)	5	10	1.09**	1.78**	1.53**	1.79**
Number of nodes on main stem	5	10	17.60**	16.85**	19.62**	21.44**
Number of branches per plant	5	10	0.44**	0.36**	1.07**	0.30**
Days to first flowering	5	10	8.62**	4.10**	1.650 NS	1.55 NS
Days to 50% flowering	5	10	7.12**	6.48**	4.35**	1.94 NS
First fruiting node.	5	10	0.98**	0.66**	1.94**	0.704**
Fruit length (cm)	5	10	2.25*	2.52*	4.70**	2.62*
Fruit diameter (cm)	5	10	0.027**	0.018*	0.020**	0.039**
Fruit weight (gm)	5	10	27.05**	14.76**	15.68**	21.03**
Number of ridges per fruit	5	10	0.027**	0.07**	3.50**	3.77**
Number of fruits per plant	5	10	2.17**	2.40**	6.23**	1.97**
Marketable fruit yield per plant (gm)	5	10	896.07**	984.32**	1454.60**	1992.71**
Yield per plot (Kg)	5	10	1.64**	1.57**	2.44**	2.90**
Fruit yield (q/ha.)	5	10	315.77**	303.43**	470.49**	560.35**
Incidence of Fruit and shoot borer (%)	5	10	3.08**	5.09**	9.61**	2.06**
Incidence of Yellow vein mosaic (%)	5	10	123.48**	52.82**	352.92**	192.24**

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

Table 2: Mean performance of six generation in four crosses for 17 characters

Crosses	P1	P2	F1	F2	BC1	BC2	Pusa sawani	Mahyco bhindi No. 10
Plant height (cm)								
C1 (Parbhani Kranti × VROR-159)	155.66 ± 1.21	151.40 ± 1.46	170.26 ± 0.51	151.00 ± 0.19	143.23 ± 0.30	160.60 ± 0.22	115.73 ± 1.20	163.60 ± 1.05
C2 (Parbhani Kranti × Kashi pragati)	155.66 ± 1.21	116.46 ± 0.61	160.80 ± 0.55	144.81 ± 0.16	153.23 ± 0.30	141.20 ± 0.30	115.73 ± 1.20	163.60 ± 1.05
C3 (Kashi Satadhari × VROR-159)	110.93 ± 0.81	151.40 ± 1.46	170.80 ± 0.55	136.70 ± 0.13	124.30 ± 0.31	139.56 ± 0.37	115.73 ± 1.20	163.60 ± 1.05
C4 (Kashi Satadhari × BO2)	110.93 ± 0.81	131.40 ± 1.41	151.80 ± 0.55	137.55 ± 0.25	126.50 ± 0.22	146.73 ± 0.38	115.73 ± 1.20	163.60 ± 1.05
Internodal length (cm)								
C1 (Parbhani Kranti × VROR-159)	6.74 ± 0.10	6.88 ± 0.08	6.31 ± 0.09	6.58 ± 0.03	5.22 ± 0.05	6.64 ± 0.06	5.15 ± 0.6	6.93 ± 0.12
C2 (Parbhani Kranti × kashi pragati)	6.74 ± 0.10	4.91 ± 0.06	5.75 ± 0.07	5.24 ± 0.02	5.87 ± 0.04	6.81 ± 0.06	5.15 ± 0.6	6.93 ± 0.12
C3 (Kashi Satadhari × VROR-159)	6.09 ± 0.14	6.88 ± 0.085	6.86 ± 0.084	7.73 ± 0.03	7.05 ± 0.05	5.73 ± 0.02	5.15 ± 0.6	6.93 ± 0.12
C4 (Kashi Satadhari × BO2)	6.093 ± 0.14	5.51 ± 0.08	5.94 ± 0.07	4.40 ± 0.03	6.73 ± 0.03	5.67 ± 0.02	5.15 ± 0.6	6.93 ± 0.12
Number of nodes on main stem								
C1 (Parbhani Kranti × VROR-159)	17.93 ± 0.35	18.80 ± 0.24	24.53 ± 0.22	20.25 ± 0.12	18.50 ± 0.17	20.96 ± 0.28	14.73 ± 0.24	18.60 ± 0.16
C2 (Parbhani Kranti × kashi pragati)	17.93 ± 0.22	16.33 ± 0.35	23.33 ± 0.18	20.25 ± 0.07	19.53 ± 0.14	20.13 ± 0.24	14.73 ± 0.24	18.60 ± 0.16
C3 (Kashi Satadhari × VROR-159)	13.26 ± 0.42	18.80 ± 0.24	20.93 ± 0.19	16.85 ± 0.11	16.43 ± 0.15	17.50 ± 0.19	14.73 ± 0.24	18.60 ± 0.16
C4 (Kashi Satadhari × BO2)	13.26 ± 0.42	16.00 ± 0.28	21.13 ± 0.21	18.48 ± 0.10	16.46 ± 0.19	18.30 ± 0.14	14.73 ± 0.24	18.60 ± 0.16
Number of branches per plant								
C1 (Parbhani Kranti × VROR-159)	2.86 ± 0.05	3.60 ± 0.04	3.66 ± 0.025	3.91 ± 0.013	3.30 ± 0.03	3.80 ± 0.03	3.00 ± 0.05	3.47 ± 0.06
C2 (Parbhani Kranti × kashi pragati)	2.86 ± 0.05	2.46 ± 0.06	3.40 ± 0.04	3.03 ± 0.02	2.90 ± 0.01	2.50 ± 0.04	3.00 ± 0.05	3.47 ± 0.06
C3 (Kashi Satadhari × VROR-159)	2.60 ± 0.04	3.60 ± 0.04	2.80 ± 0.04	4.20 ± 0.01	3.00 ± 0.01	3.53 ± 0.03	3.00 ± 0.05	3.47 ± 0.06
C4 (Kashi Satadhari × BO2)	2.60 ± 0.04	3.2 ± 0.04	2.60 ± 0.04	2.56 ± 0.01	3.23 ± 0.02	2.63 ± 0.02	3.00 ± 0.05	3.47 ± 0.06
Days to flowering								
C1 (Parbhani Kranti × VROR-159)	43.66 ± 0.12	39.66 ± 0.25	41.66 ± 0.12	43.33 ± 0.06	44.33 ± 0.08	42.00 ± 0.15	40.00 ± 0.23	43.67 ± 0.18
C2 (Parbhani Kranti × kashi pragati)	43.66 ± 0.12	41.33 ± 0.25	40.66 ± 0.12	41.66 ± 0.06	41.33 ± 0.08	40.33 ± 0.08	40.00 ± 0.23	43.67 ± 0.18
C3 (Kashi Satadhari × VROR-159)	40.33 ±	39.66 ±	40.33 ±	41.66 ±	41.00 ±	41.33 ±	40.00 ±	43.67 ± 0.18

	0.33	0.25	0.12	0.06	0.15	0.17	0.23	
C4 (Kashi Satadhari × BO2)	40.33 ± 0.33	41.66 ± 0.12	40.00 ± 0.21	41.00 ± 0.10	41.33 ± 0.17	41.00 ± 0.15	40.00 ± 0.23	43.67 ± 0.18
Days to 50% flowering								
C1 (Parbhani Kranti × VROR-159)	46.66 ± 0.33	43.00 ± 0.21	44.33 ± 0.12	47.00 ± 0.10	46.00 ± 0.15	44.66 ± 0.31	42.67 ± 21	45.67 ± 16
C2 (Parbhani Kranti × Kashi Pragati)	46.66 ± 0.33	44.33 ± 0.12	43.00 ± 0.21	45.00 ± 0.10	45.00 ± 0.15	42.66 ± 0.08	42.67 ± 21	45.67 ± 16
C3 (Kashi Satadhari × VROR-159)	46.00 ± 0.21	43.00 ± 0.21	43.66 ± 0.25	45.66 ± 0.06	43.66 ± 0.08	44.66 ± 0.23	42.67 ± 21	45.67 ± 16
C4 (Kashi Satadhari × BO2)	46.00 ± 0.21	44.66 ± 0.12	43.66 ± 0.12	44.33 ± 0.12	44.66 ± 0.23	44.33 ± 0.08	42.67 ± 21	45.67 ± 16
First fruiting nodes								
C1 (Parbhani Kranti × VROR-159)	3.80 ± 0.07	3.40 ± 0.04	2.40 ± 0.04	3.95 ± 0.03	3.23 ± 0.05	3.80 ± 0.03	4.67 ± 0.06	3.13 ± 0.04
C2 (Parbhani Kranti × Kashi Pragati)	3.80 ± 0.07	3.00 ± 0.08	3.00 ± 0.04	2.73 ± 0.01	3.86 ± 0.03	3.50 ± 0.03	4.67 ± 0.06	3.13 ± 0.04
C3 (Kashi Satadhari × VROR-159)	3.80 ± 0.04	3.40 ± 0.04	1.93 ± 0.06	4.00 ± 0.01	4.13 ± 0.03	3.23 ± 0.038	4.67 ± 0.06	3.13 ± 0.04
C4 (Kashi Satadhari × BO2)	3.80 ± 0.04	2.86 ± 0.02	2.40 ± 0.04	2.90 ± 0.02	3.20 ± 0.03	2.66 ± 0.04	4.67 ± 0.06	3.13 ± 0.04
Fruit length (cm)								
C1 (Parbhani Kranti × VROR-159)	13.80 ± 0.29	15.60 ± 0.28	14.22 ± 0.23	12.91 ± 0.06	13.66 ± 0.10	13.40 ± 0.13	11.76 ± 16	14.87 ± 12
C2 (Parbhani Kranti × Kashi Pragati)	13.80 ± 0.29	14.09 ± 0.23	13.80 ± 0.16	13.92 ± 0.10	14.00 ± 0.19	11.66 ± 0.11	11.76 ± 16	14.87 ± 12
C3 (Kashi Satadhari × VROR-159)	14.31 ± 0.22	15.60 ± 0.28	13.42 ± 0.15	12.39 ± 0.03	12.46 ± 0.10	14.45 ± 0.15	11.76 ± 16	14.87 ± 1 2
C4 (Kashi Satadhari × BO2)	14.31 ± 0.22	12.08 ± 0.30	13.16 ± 0.21	13.33 ± 0.07	11.69 ± 0.11	12.97 ± 0.10	11.76 ± 16	14.87 ± 1 2
Fruit weight (gm)								
C1 (Parbhani Kranti × VROR-159)	23.53 ± 0.19	23.20 ± 0.15	23.60 ± 0.08	21.41 ± 0.06	17.20 ± 0.13	17.46 ± 0.17	18.47 ± 0.14	21.47 ± 0.16
C2 (Parbhani Kranti × Kashi Pragati)	23.53 ± 0.19	20.13 ± 0.26	22.60 ± 0.20	19.36 ± 0.09	17.96 ± 0.15	18.70 ± 0.12	18.47 ± 0.14	21.47 ± 0.16
C3 (Kashi Satadhari × VROR-159)	21.93 ± 0.33	23.20 ± 0.15	23.33 ± 0.13	21.41 ± 0.06	17.16 ± 0.17	20.33 ± 0.23	18.47 ± 0.14	21.47 ± 0.16
C4 (Kashi Satadhari × BO2)	21.93 ± 0.33	19.86 ± 0.33	21.60 ± 0.11	18.65 ± 0.06	18.13 ± 0.18	14.73 ± 0.16	18.47 ± 0.14	21.47 ± 0.16
Fruit diameter (cm)								
C1 (Parbhani Kranti × VROR-159)	1.87 ± 0.02	2.07 ± 0.01	1.85 ± 0.01	1.85 ± 0.012	1.83 ± 0.01	1.82 ± 0.01	1.96 ± 0.03	1.98 ± 0.08
C2 (Parbhani Kranti × Kashi Pragati)	1.87 ± 0.017	2.04 ± 0.012	1.93 ± 0.013	1.90 ± 0.004	1.82 ± 0.009	1.84 ± 0.011	1.96 ± 0.03	1.98 ± 0.08
C3 (Kashi Satadhari × VROR-159)	2.04 ± 0.01	2.07 ± 0.01	1.87 ± 0.02	1.97 ± 0.005	1.88 ± 0.008	2.00 ± 0.009	1.96 ± 0.03	1.98 ± 0.08
C4 (Kashi Satadhari × BO2)	2.04 ± 0.01	2.14 ± 0.02	2.05 ± 0.01	2.02 ± 0.006	1.94 ± 0.01	1.80 ± 0.007	1.96 ± 0.03	1.98 ± 0.08
No of ridges per fruit								
C1 (Parbhani Kranti × VROR-159)	5.00 ± 0.00	5.00 ± 0.00	5.06 ± 0.02	5.20 ± 0.005	5.20 ± 0.01	5.16 ± 0.008	5.00 ± 00	5.20 ± 0.01
C2 (Parbhani Kranti × Kashi Pragati)	5.00 ± 00	5.40 ± 0.04	5.00 ± 00	5.10 ± 0.005	5.20 ± 0.01	5.00 ± 0.00	5.00 ± 00	5.20 ± 0.01
C3 (Kashi Satadhari × VROR-159)	7.73 ± 0.06	5.00 ± 0.00	7.00 ± 0.04	7.16 ± 0.01	8.1 ± 0.03	6.73 ± 0.02	5.00 ± 00	5.20 ± 0.01
C4 (Kashi Satadhari × BO2)	7.73 ± 0.06	5.00 ± 0.00	6.86 ± 0.05	6.72 ± 0.01	8.10 ± 0.03	6.10 ± 0.04	5.00 ± 00	5.20 ± 0.01
Fruit yield per plant (gm)								
C1 (Parbhani Kranti × VROR-159)	280.60 ± 2.42	260.60 ± 3.31	313.40 ± 3.03	275.56 ± 0.37	280.76 ± 1.36	279.80 ± 2.27	252.67 ± 1.46	264.93 ± 1.12
C2 (Parbhani Kranti × Kashi Pragati)	280.60 ± 2.42	277.13 ± 1.79	283.20 ± 3.41	247.93 ± 0.82	266.33 ± 1.94	239.90 ± 1.56	252.67 ± 1.46	264.93 ± 1.12
C3 (Kashi Satadhari × VROR-159)	255.46 ± 1.06	260.60 ± 3.31	294.40 ± 0.74	276.15 ± 2.31	228.50 ± 1.14	259.10 ± 0.98	252.67 ± 1.46	264.93 ± 1.12
C4 (Kashi Satadhari × BO2)	255.46 ± 1.06	239.00 ± 1.37	293.80 ± 1.98	263.81 ± 0.63	282.30 ± 1.37	227.00 ± 1.01	252.67 ± 1.46	264.93 ± 1.12
Fruit yield per plot (Kg)								
C1 (Parbhani Kranti × VROR-159)	11.17 ± 0.10	10.15 ± 0.14	12.47 ± 0.10	11.04 ± 0.01	11.25 ± 0.05	11.19 ± 0.08	10.11 ± 0.12	10.60 ± 0.15

C2 (Parbhani Kranti × Kashi Pragati)	11.17 ± 0.10	11.08 ± 0.07	11.36 ± 0.15	9.91 ± 0.03	10.66 ± 0.07	9.60 ± 0.06	10.11 ± 0.12	10.60 ± 0.15
C3 (Kashi Satadhari × VROR-159)	10.14 ± 0.03	10.15 ± 0.14	11.75 ± 0.04	11.11 ± 0.10	9.13 ± 0.04	10.36 ± 0.04	10.11 ± 0.12	10.60 ± 0.15
C4 (Kashi Satadhari × BO2)	10.14 ± 0.03	9.45 ± 0.04	11.78 ± 0.08	10.52 ± 0.02	11.29 ± 0.05	9.33 ± 0.07	10.11 ± 0.12	10.60 ± 0.15
Fruit yield per hectare (q)								
C1 (Parbhani Kranti × VROR-159)	155.18 ± 1.50	141.00 ± 1.95	173.14 ± 1.51	153.42 ± 0.18	156.27 ± 0.74	155.46 ± 1.23	140.37 ± 1.46	147.18 ± 1.24
C2 (Parbhani Kranti × Kashi Pragati)	155.18 ± 1.50	153.96 ± 0.99	157.85 ± 2.09	137.63 ± 0.47	148.09 ± 1.06	133.35 ± 0.89	140.37 ± 1.46	147.18 ± 1.24
C3 (Kashi Satadhari × VROR-159)	140.96 ± 0.51	141.00 ± 1.95	163.25 ± 0.59	154.34 ± 1.48	126.83 ± 0.64	143.88 ± 0.59	140.37 ± 1.46	147.18 ± 1.24
C4 (Kashi Satadhari × BO2)	140.96 ± 0.51	131.29 ± 0.60	163.70 ± 1.10	146.13 ± 0.40	156.85 ± 0.77	129.55 ± 1.04	140.37 ± 1.46	147.18 ± 1.24
Number of fruits per plant								
C1 (Parbhani Kranti × VROR-159)	16.40 ± 0.20	15.26 ± 0.20	17.86 ± 0.15	16.00 ± 0.02	16.53 ± 0.07	16.26 ± 0.11	15.00 ± 0.15	16.20 ± 0.13
C2 (Parbhani Kranti × Kashi Pragati)	16.40 ± 0.20	16.46 ± 0.17	16.53 ± 0.21	15.46 ± 0.05	16.33 ± 0.12	14.26 ± 0.10	15.00 ± 0.15	16.20 ± 0.13
C3 (Kashi Satadhari × VROR-159)	13.80 ± 0.13	15.26 ± 0.20	16.73 ± 0.06	16.00 ± 0.02	13.06 ± 0.12	13.80 ± 0.05	15.00 ± 0.15	16.20 ± 0.13
C4 (Kashi Satadhari × BO2)	13.80 ± 0.13	15.36 ± 0.20	16.20 ± 0.11	14.51 ± 0.03	15.26 ± 0.08	15.20 ± 0.12	15.00 ± 0.15	16.20 ± 0.13
Incidence of shoot and fruit borer (%)								
C1 (Parbhani Kranti × VROR-159)	17.59 ± 0.24 (24.78)	21.02 ± 0.20 (27.27)	19.41 ± 0.10 (26.13)	20.67 ± 0.03 (27.03)	18.16 ± 0.05 (25.21)	18.47 ± 0.09 (25.44)	19.69 ± 0.36 (26.32}	21.54 ± 0.25 (27.62)
C2 (Parbhani Kranti × Kashi Pragati)	17.59 ± 0.24 (24.78)	15.82 ± 0.13 (23.42)	18.19 ± 0.17 (25.23)	19.41 ± 0.05 (26.13)	18.40 ± 0.10 (25.39)	21.06 ± 0.10 (27.30)	19.69 ± 0.36 (26.32}	21.54 ± 0.25 (27.62)
C3 (Kashi Satadhari × VROR-159)	16.69 ± 0.12 (24.10)	21.02 ± 0.20 (27.27)	17.93 ± 0.05 (25.05)	18.35 ± 0.14 (25.34)	23.02 ± 0.14 (28.66)	21.75 ± 0.05 (27.79)	19.69 ± 0.36 (26.32}	21.54 ± 0.25 (27.62)
C4 (Kashi Satadhari × BO2)	16.69 ± 0.12 (24.10)	18.41 ± 0.22 (25.39)	18.53 ± 0.09 (25.49)	18.75 ± 0.02 (25.65)	19.67 ± 0.07 (26.32)	19.77 ± 0.11 (26.39)	19.69 ± 0.36 (26.32}	21.54 ± 0.25 (27.62)
Incidence of yellow vein mosaic (%)								
C1 (Parbhani Kranti × VROR-159)	35.16 ± 1.14 (36.27)	19.00 ± 0.58 (25.77)	16.33 ± 0.64 (23.74)	18.83 ± 0.16 (25.69)	35.83 ± 1.16 (36.58)	14.16 ± 0.46 (21.99)	48.67 ± 1.36 (44.22)	18.17 ± 0.35 (25.20)
C2 (Parbhani Kranti × Kashi Pragati)	35.16 ± 1.14 (36.27)	17.66 ± 1.05 (24.62)	21.83 ± 0.61 (27.78)	22.50 ± 0.25 (28.26)	18.00 ± 0.36 (25.04)	22.00 ± 0.45 27.89)	48.67 ± 1.36 (44.22)	18.17 ± 0.35 (25.20)
C3 (Kashi Satadhari × VROR-159)	19.33 ± 0.37 (26.05)	19.00 ± 0.58 (25.77)	24.33 ± 0.52 (29.51)	21.41 ± 0.22 (27.52)	63.33 ± 0.68 (52.78)	16.30 ± 0.47 24.11)	48.67 ± 1.36 (44.22)	18.17 ± 0.35 (25.20)
C4 (Kashi Satadhari × BO2)	19.33 ± 0.37 (26.05)	27.66 ± 0.35 (31.71)	15.33 ± 0.52 (22.98)	13.5 ± 0.36 (21.41)	45.33 ± 0.92 (42.27)	14.66 ± 0.31 22.46)	48.67 ± 1.36 (44.22)	18.17 ± 0.35 (25.20)

Table 3: Heterosis over mid parent, better parent, over standard check and inbreeding depression over various characters

Cross no.	Hybrids	Plant height (cm)				
		Heterosis (%)	Heterobeltiosis	Standard heterosis over check 1	Standard heterosis over check 2	Inbreeding depression (%)
1	Parbhani kranti X VROR-159	10.899**	9.37**	47.12**	4.07*	10.92**
2	Parbhani Kranti X Kashi Pragati	18.17**	3.29 NS	38.94**	-1.71NS	9.94*
3	Kashi Satadhari X VROR-159	30.21**	12.81**	47.58**	4.40*	19.96**
4	Kashi Satadhari X BO2	25.28**	15.52**	31.16**	-7.21**	9.38*
Internodal length (cm)						
1	Parbhani kranti X VROR-159	-7.293**	-6.33**	22.67**	-8.94**	-4.35
2	Parbhani Kranti X Kashi Pragati	-1.2 NS	17.09**	11.79**	-17.24**	8.92*
3	Kashi Satadhari X VROR-159	5.75 NS	12.58**	33.29**	-1.06ns	-12.73*
4	Kashi Satadhari X BO2	2.35 NS	7.73 NS	15.41**	-14.33**	25.81**
No. of nodes on main stem						
1	Parbhani kranti X VROR-159	33.57**	30.49**	66.52**	31.90**	17.45*
2	Parbhani Kranti X Kashi Pragati	36.18**	30.11**	58.37**	25.45**	13.21*
3	Kashi Satadhari X VROR-159	30.56**	11.34*	42.08**	12.54**	19.50**
4	Kashi Satadhari X BO2	44.41**	32.08**	43.44**	13.62**	12.53*

No. of branches per plant						
1	Parbhani kranti X VROR-159	13.40**	1.852NS	22.22**	5.77NS	-6.81
2	Parbhani Kranti X Kashi Pragati	27.50**	18.60**	13.33*	-1.92NS	10.78*
3	Kashi Satadhari X VROR-159	-9.67**	-22.22**	20.00**	3.85NS	-50.00**
4	Kashi Satadhari X BO2	-10.34**	-18.75**	-13.33**	-25.00**	1.28
Days to flowering						
1	Parbhani kranti X VROR-159	0.00 NS	5.04**	4.17*	-4.58**	-4.00
2	Parbhani Kranti X Kashi Pragati	-4.3**	-1.61 NS	1.67NS	-6.87**	-2.45
3	Kashi Satadhari X VROR-159	0.83 NS	1.68 NS	0.83NS	-7.63**	-3.30
4	Kashi Satadhari X BO2	-2.39 NS	-0.82 NS	0.00NS	-8.40**	-2.50
Days to 50% flowering						
1	Parbhani kranti X VROR-159	-1.11NS	3.10NS	3.91*	-2.92NS	-6.01
2	Parbhani Kranti X Kashi Pragati	-5.49**	-3.00NS	0.78NS	-5.84**	-4.65
3	Kashi Satadhari X VROR-159	-1.87NS	1.55NS	2.34NS	-4.38*	-4.58
4	Kashi Satadhari X BO2	-3.67*	-2.23NS	2.34NS	-4.38*	-1.52
First fruiting nodes						
1	Parbhani kranti X VROR-159	-33.33**	-29.41**	-48.57**	-23.40*	-64.58**
2	Parbhani Kranti X Kashi Pragati	-11.76NS	00NS	-35.71**	-4.26NS	8.88
3	Kashi Satadhari X VROR-159	-46.29**	-43.13**	-58.57**	-38.30**	-106.89**
4	Kashi Satadhari X BO2	-28..00**	-16.27*	-48.57**	-23.40**	-20.83*
Fruit length (cm)						
1	Parbhani kranti X VROR-159	-3.24NS	-8.80NS	20.98**	-4.30NS	9.23*
2	Parbhani Kranti X Kashi Pragati	-1.075NS	-2.08NS	17.35*	-7.17NS	-0.87
3	Kashi Satadhari X VROR-159	-10.23*	-13.23*	14.17*	-9.69NS	7.72
4	Kashi Satadhari X BO2	-0.27NS	-8.05NS	11.90NS	-11.48NS	-1.34
Fruit Weight (g)						
1	Parbhani kranti X VROR-159	0.99NS	0.28NS	27.80**	9.94*	9.25*
2	Parbhani Kranti X Kashi Pragati	3.51NS	-3.96NS	22.38**	5.28NS	14.30**
3	Kashi Satadhari X VROR-159	3.39NS	0.57NS	26.35**	8.70NS	8.21
4	Kashi Satadhari X BO2	3.34NS	-1.52NS	16.97**	0.62NS	13.65*
Fruit diameter (cm)						
1	Parbhani kranti X VROR-159	-6.081*	-10.75**	-5.60NS	-5.71NS	0.00
2	Parbhani Kranti X Kashi Pragati	-1.36NS	-5.54NS	-170NS	-2.69NS	1.55
3	Kashi Satadhari X VROR-159	-8.90**	-9.63**	-4.41NS	-5.38NS	-5.32
4	Kashi Satadhari X BO2	-2.07NS	-4.35NS	4.41NS	3.36NS	1.46
Number of fruits per plant						
1	Parbhani kranti X VROR-159	12.84**	8.94**	19.11**	10.29**	10.44*
2	Parbhani Kranti X Kashi Pragati	0.60 NS	0.40	10.22*	2.06NS	6.45
3	Kashi Satadhari X VROR-159	15.38**	9.60*	11.56**	3.29NS	4.38
4	Kashi Satadhari X BO2	11.46**	6.11 NS	8.00*	-0.00NS	10.39*
No. of Ridges per Fruit						
1	Parbhani kranti X VROR-159	1.33NS	1.33NS	1.33NS	-2.56NS	-2.63
2	Parbhani Kranti X Kashi Pragati	-3.84NS	0.00NS	0.00NS	-1.32NS	-2.00
3	Kashi Satadhari X VROR-159	9.94**	40.00**	40.00**	34.62**	-2.38
4	Kashi Satadhari X BO2	7.85**	-11.33**	37.33**	32.05**	2.08
Fruit yield per plant (g)						
1	Parbhani kranti X VROR-159	15.81**	11.68**	24.04**	19.31**	12.07*
2	Parbhani Kranti X Kashi Pragati	1.55 NS	0.92 NS	12.08**	7.82*	12.45*
3	Kashi Satadhari X VROR-159	14.09**	12.97**	16.52**	12.08**	6.19
4	Kashi Satadhari X BO2	18.83**	15.00**	16.28**	11.85**	10.20*
Fruit yield per plot (Kg)						
1	Parbhani kranti X VROR-159	16.94**	11.57**	23.38**	17.64**	11.41
2	Parbhani Kranti X Kashi Pragati	2.08NS	1.67NS	12.43**	8.57*	12.79*
3	Kashi Satadhari X VROR-159	15.84**	15.82**	16.33**	10.91**	5.47
4	Kashi Satadhari X BO2	20.27**	16.16**	16.62**	16.19**	10.73*
Fruit yield per ha (q)						
1	Parbhani kranti X VROR-159	16.91**	11.57**	23.35**	17.64**	11.38*
2	Parbhani Kranti X Kashi Pragati	2.12NS	1.71NS	12.46**	7.25*	12.81*
3	Kashi Satadhari X VROR-159	15.80**	15.78**	16.31**	10.92**	5.46
4	Kashi Satadhari X BO2	20.25**	16.13**	16.63**	11.22**	10.73*
Incidence of Fruit and shoot borer infestation (%)						
1	Parbhani kranti X VROR-159	0.54NS	10.34**	-0.72 NS	-5.38 NS	-6.49*
2	Parbhani Kranti X Kashi Pragati	8.88*	14.98**	-11.00**	-15.18**	-6.70*
3	Kashi Satadhari X VROR-159	-4.90NS	7.42 *	-4.84 NS	-9.30*	-2.34
4	Kashi Satadhari X BO2	5.58 NS	11.02**	-3.15NS	-7.70*	-1.64
Incidence of yellow vein mosaic (%)						
1	Parbhani kranti X VROR-159	-39.69**	-14.05 *	-46.31**	-5.78 NS	-15.30*
2	Parbhani Kranti X Kashi Pragati	-17.34 *	23.61 *	-44.31**	-2.27 NS	-3.06

3	Kashi Satadhari X VROR-159	26.95*	28.05 *	-33.26**	17.12 NS	12.00*
4	Kashi Satadhari X BO2	-34.75**	-20.69 *	-48.02**	-8.78 NS	11.93

*Significant at 0.05% level; **Significant at 0.001% level; NS-Non Significant

Conclusion

The present investigation suggests that the cross Parbhani kranti x VROR-159 is promising as it depicted heterotic performance for fruit yield per plant and other important yield contributing traits. However, Inbreeding depression for marketable fruit yield per plant (g) was highest observed in Parbhani Kranti × Kashi Pragati (12.45%) followed by Parbhani Kranti × VROR-159 (12.07%).

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