Plant Archives Vol. 25, Supplement 1, 2025 pp. 3052-3067 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-1.417

COMBINING ABILITY AND GENE ACTION ANALYSIS IN OKRA (*ABELMOSCHUS ESCULENTUS* L. MOENCH) OVER DIFFERENT ENVIRONMENTS

Rajeshri G. Vekariya*, Nitin B. Patel, Pranay C. Patel, Disha R. Patel, Ravi D. Patel, Kavan B. Joshi and Prakashbhai Ravat

Department of Genetics and Plant Breeding, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar-385 506, Gujarat, India

*Corresponding author Email: rajeshrivekariya@gmail.com

(Date of Receiving : 07-11-2024; Date of Acceptance : 09-01-2025)

ABSTRACT

This study aimed to determine the general combining ability of the parents and the specific combining ability of crosses over the environments for various traits of okra [*Abelmoschus esculentus* (L.) Moench]. The crossing programme was conducted during Summer 2022 at Horticultural Instructional Farm, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar, Gujarat, India. The experiment was conducted at three different environments during *Kharif* 2022 (E_1), Summer 2023 (E_2) and *Kharif* 2023 (E_3). The experimental material consisted of eleven parents (7 lines and 4 testers) and their twenty-eight resulting crosses with a one standard check GJOH-4 was evaluated in a randomized block design with three replications by using line × tester analysis under three different environments. Analysis of variance for combining ability over the environments revealed that mean squares due to environments were highly significant for majority of the traits. The ratio of σ^2gca/σ^2sca is less than unity for most of traits under majority of environments as well as pooled which indicated the preponderance of non-additive gene action in the inheritance of those traits. Which also favoured heterosis breeding. Among parents, line JOL-14-10 was good general combiner for early flowering, picking and fruit yield per plant as well as yield attributing traits *viz*., number of primary branch per plant, number of fruit per plant, fruit length, fruit diameter and average fruit weight under majority of environments as well as pooled. Out of eleven parents under study, line JDNOL-11-03 was good general combiner for chlorophyll A, chlorophyll B, total chlorophyll content, mucilage content, crude fiber content and moisture content under majority of environments. The crosses IC 111443 × GO 6 and JOL-14-10 × GO 6 showed significant positive *sca* effects for number of fruit per plant. The cross JOL-14-10 × GO 6 proved to be a good specific combiner for fruit yield per plant and its attributing traits *viz*., fruit length, fruit diameter, average fruit weight, days to last picking under majority of environments. Also, this cross is best specific combiner for quality traits like, chlorophyll A, chlorophyll B, total chlorophyll content, mucilage content, crude fiber content and moisture content over the environments. Hence, this cross could be suggested from this study for further evaluation in further breeding program with the aim of commercial exploitation of hybrid under the diverse climatic condition. The F_2 population of this cross was need to put into the generation advancement for getting good transgressive segregant in future breeding program.

Keywords: L × T analysis, General combining ability, Specific combining ability, Gene action, Environments

Introduction

Vegetables are considered as 'Protective supplementary food' as they contain large quantities of minerals, vitamins and essential amino acids which are required for normal function of the human metabolic process. *Abelmoschus esculentus* (L.) Moench, the cultivated species, is a member of the *malvaceae* family, which is part of the malvales order, the genus *Abelmoschus* has been separated from the genus *Hibiscus*. Okra originated somewhere around the Ethiopia and was cultivated by the ancient Egyptians

by the 12th century B. C. Its cultivation spread throughout Middle East and North Africa (Singh *et al*., 2014). There are significant variations in the chromosome numbers and ploidy levels of different species in the genus *Abelmoschus*. The chromosome number within *A. esculentus*, 2n = 72, 108, 120, 132 and 144 are in regular series of polyploids with n = 12 (Zate, 2019). Okra flowers are often cross-pollinated crop with somatic chromosome number 2n = 8x =130 and is considered to be an amphidiploid of *A. tuberculatus* (2n = 58) and an unknown species with 2n = 72 (Pawar *et al*., 2020). India is the largest okra producing country in the world comprising of 73.25 per cent of total area under okra (Anonymous, 2022). In India, it is cultivated in the area of 0.52 M hectares with an annual production of 6.46 M tonnes with productivity of 12.17 tonnes per hectare (Anonymous, 2023[a]). Okra fruit is principally consumed fresh or cooked and is a major source of vitamins A, B, C, minerals, iron and iodine and important vegetable source of viscous fiber but it is reportedly low in sodium saturated fat and cholesterol. Presence of Fe, Zn, Mn and Ni also has been reported (Gemede *et al*., 2015).

Line × tester analysis technique provides a systematic approach for identification of superior parents and crosses, which is the basic requirement on which the success of a breeding programme (Singh *et al*., 2006 and Khatik *et al*., 2012). The studies intended to determine the combining ability is not only for information regarding the choice of parents but also for the production of superior lines or hybrids. The general combining ability and specific combining ability effects are the foundations for any fruitful breeding programme (Wakode *et al*., 2016). The common approach of selecting the parents on the basis of *per se* performance is not a good indicator of their superior combining ability (Allard, 1960). The knowledge of nature of gene action governing the expression of various quantitative traits could be helpful in predicting the effectiveness of selection. The magnitude of gene action controlling fruit yield and its components are very useful for development of the sound breeding procedures to be followed for crop improvement. A successful variety in any vegetable crop must meet minimal criteria for numerous traits that are potentially valued in the markets. Superiority for multiple 'yield' and 'quality' traits are essential for economic sustainability of a variety (Reddy *et al*., 2013). An estimate of combining ability is known to be greatly influenced by the environment. The results of combining ability analysis based on single environment do not take into account genotype by environment interaction and thus the results obtained might be highly biased. Therefore, the results based on several environments would be more realistic, which took into account the stability of gene action. Therefore, this study was undertaken to study the combining ability estimates, combining ability × environment interaction and nature and extent of gene action in okra.

Material and Methods

The present investigation was carried out with the aim to study the general combining ability of the parents and the specific combining ability of crosses over the environments for various characters under study. The crossing program was conducted at Horticultural Instructional Farm, C. P. College of Agriculture, S.D. Agricultural University, Sardarkrushinagar during Summer 2022. The experiment was conducted at three different environments of Horticultural Instructional Farm (E_1) and Centre for Vegetable Research (E_2 and E_3), C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *Kharif* 2022 (E_1), Summer 2023 (E_2) and *Kharif* 2023 (E_3).The experimental materials comprised of 40 genotypes including 11 parents (7 lines and 4 testers), 28 crosses generated through line × tester mating design and one standard check (GJOH 4) under three different environments. The experiment was laid out in randomized block design with three replications.

The observations were recorded for twenty different quantitative and qualitative characters including days to first flowering, days to 50 % flowering, days to first picking, plant height (cm), number of primary branch per plant, number of node per plant, internodal length (cm), number of fruit per plant, fruit length (cm), fruit diameter (mm), average fruit weight (g), days to last picking, number of picking, fruit yield per plant (g), chlorophyll A (5 g/g F.W.), chlorophyll B (5 g/g F.W.), total chlorophyll content (5 g/g F.W.), mucilage content (g/kg), crude fiber content (%) and moisture content (%).

Results and Discussion

Analysis of variance

Analysis of variance for combining ability under individual as well as pooled over environments showing the mean sum of squares for twenty yield and its contributing traits is presented in Table 1 and 2. Analysis of variance for combining ability over the environments revealed that mean squares due to environments were highly significant for all the traits (except for chlorophyll B and total chlorophyll content) indicating considerable differences among the environments under the study. The analysis of variance

for combining ability revealed that the significant difference was observed among the lines, testers and crosses for majority of characters under individual as well as over the environments. The mean square due to line × tester interaction was significant for all the traits in pooled over environments which indicate that experimental material possessed considerable variability and there are possibilities to improvement of various traits under study through heterosis breeding. The mean square due to lines × environments were highly significant for plant height and fruit diameter. The mean square due to testers × environments were significant for days to 50 % flowering, days to first picking and number of picking. The mean square due to lines *vs*. testers × environments were highly significant for all the characters except fruit diameter under study which indicates that the estimate of SCA variance were highly influenced by environments for these traits. The ratio of σ^2gca/σ^2sca was found less than unity for most of characters under majority of environments as well as pooled. Such type of result is indicative of prime role of non-additive gene action for inheritance as well as expression of these characters *viz*., days to first flowering, days to 50 % flowering, days to first picking, plant height, number of primary branch per plant, internodal length, number of fruit per plant, fruit length, fruit diameter, average fruit weight, days to last picking, number of picking, fruit yield per plant, mucilage content, crude fiber content and moisture content. Thus, heterosis breeding is useful for the exploitation of such traits.

General combing ability

Among seven lines and four testers, none of the parents were good general combiners for all the traits under study (Table 3). Line JOL-14-10 was observed good general combiner for days to first flowering, days to 50 % flowering and days to first picking in at least one environment as well as pooled over environments. While, tester Kashi Kranti found a good general combiner for days to first flowering, days to 50 % flowering and days to first picking in at least one environment. Line JOL-75-10 was recorded good general combiner for plant height and internodal length in one environment as well as pooled. Out of 4 testers under study, GO-6 was found to be a good general combiner for plant height under individual as well as pooled over environments and internodal length under majority of environments as well as pooled.

Among the lines, JOL-14-10 was recorded good general combiner for fruit yield per plant under individual as well as pooled and at least one environment as well as pooled for yield attributing components *viz*., number of primary branch per plant, fruit length. Line JOL-16-06 was possessed good general combiner for number of node per plant, number of fruit per plant, fruit yield per plant in at least one environment as well as pooled and also found a good general combiner under individual as well as pooled for fruit length, average fruit weight. For number of fruit per plant, line JDNOL-11-03 exhibited good general combiner under individual as well as pooled over environments. Out of 4 testers, GO-6 was found a good general combiner for fruit yield per plant under majority of environments as well as pooled and also yield attributing traits *viz*., number of primary branch per plant, number of fruit per plant, fruit length, fruit diameter, average fruit weight. Tester, Hisar Naveen was observed good general combiner for number of primary branch per plant under all environments as well as pooled. For days to last picking and number of picking, line JDNOL-11-03 and tester Hisar Naveen were found a good general combiner in one of the environment under study as well as pooled. The results are in line with the finding of Abinaya *et al.* (2020), Das *et al.* (2020[a]), Javiya *et al.* (2020), Pithiya *et al.* (2020), Vekariya *et al.* (2020), Mudhalvan and Senthilkumar (2021), Nanthakumar *et al.* (2021), Narkhede *et al.* (2021), Rajani *et al.* (2021), Mundhe *et al.* (2023), Premsagar *et al.* (2023), Radadiya *et al.* (2023), Limbani *et al.* (2023) and Ranga *et al.* (2024).

Among parents under seasonal study, lines JDNOL-11-03, JDNOL-11-47 and testers GO-6, Kashi Kranti were recorded good general combiner for chlorophyll A, chlorophyll B, total chlorophyll content under individual as well as pooled over environments. Line JDNOL-11-03 was observed good general combiner for mucilage content and crude fiber content under majority of environments as well as pooled. Line JDNOL-11-47 was found a good general combiner for mucilage content under all the environments as well as pooled. For crude fiber content in individual as well as pooled over environments, tester GO-6 was possessed good general combiner. Line JDNOL-11-03 and tester GO-6 were found to be good general combiner for moisture content under all environments as well as pooled over environments. Similar results have been reported by Bhatt (2011), Budha ram (2015), Hadiya *et al.* (2018[b]) and Das *et al.* (2020[b]).

Specific combing ability

The estimates of specific combining ability did not show any specific pattern but varied from cross to cross. However, the comparison of *sca* effects with *per se* performance of crosses revealed that, along with high *sca* effect, at least one good or average general combiner parent is necessary for better *per se*

performance of cross. The cross JOL-75-01 × Kashi Kranti for days to first flowering, days to 50 % flowering, days to first picking, number of node per plant, internodal length; IC 111443 × Kashi Lalima for plant height; JDNOL-11-47 × Kashi Lalima for number of primary branch per plant; IC 111443 × GO 6, JOL-14-10 × GO 6 for number of fruit per plant; JOL-14-10 × GO 6 for fruit yield per plant and its attributing traits *viz*., fruit length, fruit diameter, average fruit weight, days to last picking, IC 111443 × GO 6 for number of picking showed significant *sca* effect in desired direction under individual as well as pooled over environments. Similar results have been reported by Vekariya *et al.* (2020), Nanthakumar *et al.* (2021), Narkhede *et al*. (2021), Rajani et *al.* (2021), Premsagar *et al*. (2023), Radadiya *et al.* (2023), Limbani *et al.* (2023) and Ranga *et al.* (2024).

The crosses JOL-14-10 × GO 6, JDNOL-11-47 × Kashi Kranti for chlorophyll A and total chlorophyll content; JOL-14-10 × GO 6, JOL-75-01 × Kashi Lalima and JOL-75-10 × Hisar Naveen for chlorophyll B; JOL-14-10 × GO 6, JDNOL-11-47 × Kashi Lalima and JOL-75-10 × Hisar Naveen for mucilage content; JOL-14-10 × GO 6, JDNOL-11-47 × Kashi Lalima for crude fiber content and JOL-14-10 × GO 6, JOL-75-10 × Kashi Lalima for moisture content were recorded best specific combiner under individual as well as pooled over environments. The results are in line with the finding of Bhatt (2011), Budha ram (2015), Hadiya *et al.* (2018[b]), Rajani *et al.* (2021[b]) and Ranga *et al.* (2024). The crosses IC-111443 × GO-6 and JOL-14-10 × GO 6 registered significant *sca* effects for fruit yield per plant and its component traits in desired direction along with good *per se* performance. (Fig. 2)

Conclusion

Analysis of variance for combining ability over the environments revealed that mean squares due to environments were highly significant for all the traits (except for chlorophyll B and total chlorophyll content). The ratio of σ^2gca/σ^2sca was found less than unity for most of characters under majority of environments as well as pooled. Which indicate that prime role of non-additive gene action for inheritance as well as expression of these characters. Among parents, line JOL-14-10 and tester Kashi Kranti were good general combiner for early flowering as well as picking. Line JOL-14-10 and tester GO-6 were good general combiner for fruit yield per plant and yield attributing traits *viz*., number of primary branch per plant, number of fruit per plant, fruit length, fruit diameter, average fruit weight under majority of environments as well as pooled. Out of eleven parents under study, line JDNOL-11-03 was good general combiner for chlorophyll A, chlorophyll B, total chlorophyll content, mucilage content, crude fiber content and moisture content under majority of environments. These parents are useful in hybridization programs for the improvement of such traits. The cross JOL-14-10 × GO 6 possessed good *sca* effects and *per se* performance for fruit yield per plant and its attributing traits *viz*., number of fruit per plant, fruit length, fruit diameter, average fruit weight, days to last picking, chlorophyll A, chlorophyll B, total chlorophyll content, crude fiber content, mucilage content and moisture content under individual as well as pooled over environments. Thus, best specific combiner should be exploited to develop commercial high yielding genotype.

Table 1: Analysis of variance for combining ability under individual environments for different characters in okra

Source of variation	d.f.	Days to first flowering			Days to 50% flowering			Days to first picking			Plant height		
		E_1	E_2	E_3	E_1	E_2	E_3	E_1	E_2	E_3	E_1	E_2	E_3
Replications	**2**	28.73**	3.09	2.90	7.66	4.16	8.83*	12.00*	4.54	3.59	128.06	440.54**	462.59*
Crosses	**27**	11.35**	15.91**	7.67**	8.91**	12.98**	3.92*	9.03**	13.29**	5.10	276.91**	212.77**	311.79**
Lines	**6**	18.64**	9.06	18.19**	19.48**	7.25	8.46**	19.93**	9.71**	8.04	522.27**	206.22*	558.57**
Testers	**3**	21.57**	18.12**	2.16	13.99*	16.94**	0.49	13.83**	25.31**	1.00	427.87**	272.27*	681.15**
Line X testers	**18**	7.22*	17.83**	5.08	4.54	14.22**	2.97	4.59	12.47**	4.81	169.96**	205.04**	167.97
Errors	**54**	3.53	4.17	3.14	3.52	3.47	2.10	3.17	3.02	4.45	52.43	83.23	130.63
Variance components													
σ^2 gca		0.79*	-	0.31	0.74*	-	0.10	0.75*	0.31	-	18.50*	2.08	27.39*
σ^2 sca		1.23*	4.56**	0.65	0.34	3.59**	0.30	0.48	3.16**	0.12	39.18**	40.61**	12.45
σ^2 gca / σ^2 sca		0.64	-	0.48	2.20	-	0.32	1.57	0.10	-	0.48	0.06	2.21

Table 1 Conti…

Source of variation	d.f.	Number of primary branch per plant			Number of node per plant			Internodal length			Number of fruit per plant		
		E_1	E_2	E_3	E_1	E_2	E_3	E_1	E_2	E_3	E_1	E_2	E_3
Replications	**2**	0.21	0.01	0.09	1.69	6.53*	2.71	0.13	1.70*	2.97**	9.54**	3.71	6.52
Crosses	**27**	1.91**	0.25**	4.55**	2.28*	2.33	10.00**	2.49**	0.80**	2.01**	9.27**	44.51**	20.91**
Lines	**6**	2.34**	0.28*	6.33**	1.63	2.52	10.49**	3.63**	1.33**	1.75**	10.35**	78.36**	16.68**
Testers	**3**	4.49**	0.28	4.10**	2.72	1.20	4.55	4.20**	1.17*	1.03*	7.61**	39.00**	40.65**
Line X testers	**18**	1.34**	0.23*	4.03**	2.42*	2.46	10.75**	1.83**	0.57	2.25**	9.18**	34.15**	19.03**
Errors	**54**	0.22	0.12	0.13	1.12	1.57	1.98	0.29	0.35	0.30	1.28	2.98	2.88

Variance components													
σ^2 gca		0.13	0.01	0.08	-	-	-	0.13	0.05	-	-	1.49	0.59
σ^2 sca		0.38**	0.04*	1.30**	0.44*	0.30	2.93**	0.52**	0.08	0.66**	2.64**	10.39**	5.39**
σ^2 gca / σ^2 sca		0.34	0.08	0.06	-	-	-	0.25	0.56	-	-	0.15	0.11

Table 1 Conti…

Source of variation	d.f.	Fruit length			Fruit diameter			Average fruit weight			Days to last picking		
		E_1	E_2	E_3	E_1	E_2	E_3	E_1	E_2	E_3	E_1	E_2	E_3
Replications	**2**	0.24	0.53	1.49	1.91	2.37	1.57	1.06	0.49	0.41	7.00	5.45	73.29
Crosses	**27**	4.62**	3.07**	4.63**	1.93	2.20*	2.09	2.22**	6.06**	9.21**	41.51**	198.34**	117.83*
Lines	**6**	4.45**	5.39**	6.02**	1.92	3.77**	1.81	3.22**	3.87**	15.39**	45.54**	172.63**	119.75
Testers	**3**	7.91**	5.14**	11.76**	3.06	2.90	8.11**	4.57**	8.77**	4.78	32.61*	347.89**	71.81
Line X testers	**18**	4.13**	1.95**	2.98**	1.75	1.56	1.18	1.50	6.35**	7.88**	41.65**	181.98**	124.85*
Errors	**54**	0.89	0.42	0.73	1.51	1.19	1.53	0.99	0.83	1.96	11.67	27.51	56.11
Variance components													
σ^2 gca		0.13	0.21*	0.36*	0.05	0.11	0.23*	0.15	-	0.14	-	4.75	-
σ^2 sca		1.09**	0.52**	0.76**	0.08	0.13	-0.12	0.17	1.84**	1.98**	10.00**	51.50**	22.92*
σ^2 gca / σ^2 sca		0.12	0.40	0.48	0.59	0.87	-	0.87	-	0.07	-	0.10	-

Table 1 Conti…

Source of variation	d.f.	Number of picking			Fruit yield per plant			Chlorophyll A			Chlorophyll B		
		E_1	E_2	E_3	E_1	E_2	E_3	E_1	E_2	E_3	E_1	E_2	E_3
Replications	**2**	0.87	1.40	1.23	1566.65**	59.01	2187.05	8.64	3.48	8.97	80.15	103.11*	127.85**
Crosses	**27**	2.44**	9.50**	7.91**	2677.16**	10375.59**	7459.15**	91008.04**	91022.88**	90673.88**	17120.97**	17128.90**	17169.61**
Lines	**6**	3.11**	10.95**	5.30	2959.19**	17724.83**	7776.30**	51599.42**	112631.04**	86412.40**	29384.68**	40592.60**	42726.66**
Testers	**3**	0.99	25.29**	15.32**	2158.53**	11813.70**	15427.30**	391709.02**	372914.19**	326979.31**	31607.18**	22854.32**	20499.53**
Line X testers	**18**	2.46**	6.39**	7.54**	2669.59**	7686.16**	6025.40**	54027.42**	36838.28**	52710.13**	10618.69**	8353.43**	8095.61**
Errors	**54**	0.71	1.83	3.06	240.28	646.73	693.74	3.05	1.94	6.88	29.10	23.11	42.05
Variance components													
σ^2 gca		-	0.72*	0.17	-	429.28	337.97	10159.21*	12480.87**	9332.47*	1204.69*	1416.37**	1425.31**
σ^2 sca		0.59**	1.52**	1.50**	809.77**	2346.48**	1777.23**	18008.13**	12278.79**	17567.76**	3529.87**	2776.78**	2684.52**
σ^2 gca / σ^2 sca		-	0.47	0.12	-	0.19	0.20	0.57	1.02	0.54	0.35	0.52	0.54

Table 1 Conti…

Source of variation	d.f.	Total chlorophyll content			Mucilage content			Crude fiber content			Moisture content		
		E_1	E_2	E_3	E_1	E_2	E_3	E_1	E_2	E_3	E_1	E_2	E_3
Replications	**2**	71.33	139.34**	149.41*	0.41*	0.18	0.20	0.06	0.24*	0.09	0.48*	0.40	0.82**
Crosses	**27**	163883.56**	163867.95**	163876.96**	2.46**	2.44**	2.34**	0.54**	0.48**	0.52**	12.26**	12.92**	12.80**
Lines	**6**	147217.39**	277836.16**	239499.46**	3.20**	3.79**	2.98**	0.48**	0.48**	0.81**	12.94**	13.05**	11.39**
Testers	**3**	621056.64**	566738.54**	498418.32**	1.15**	1.22**	0.43**	0.40**	0.72**	0.42**	27.50**	3.05**	4.27**
Line X testers	**18**	93243.44**	58733.45**	82912.56**	2.42**	2.20**	2.44**	0.59**	0.44**	0.44**	9.49**	14.53**	14.69**
Errors	**54**	26.16	20.78	41.65	0.12	0.08	0.07	0.06	0.07	0.06	0.15	0.29	0.14
Variance components													
σ^2 gca		17629.92*	22033.57**	17336.15**	-	0.02	-	-	0.01	0.02	0.66	-	-
σ^2 sca		31072.43**	19570.89**	27623.64**	0.77**	0.71**	0.79**	0.18**	0.13**	0.13**	3.12**	4.75**	4.86**
σ^2 gca / σ^2 sca		0.57	1.13	0.63	-	0.03	-	-	0.08	0.09	0.21	-	-

Here, E_1, E_2 and E_3 are different environments *viz*., *Kharif* 2022, Summer 2023 and *Kharif* 2023, respectively
* and ** indicate significant at 5 per cent and 1 per cent levels of significance, respectively
Where, '-' indicates -ve estimates

Table 2: Analysis of variance for combining ability in pooled over the environments for different characters in okra

Source of variation	d.f.	Days to first flowering	Days to 50 % flowering	Days to first picking	Plant height	Number of primary branch per plant	Number of node per plant	Internodal length	Number of fruit per plant	Fruit length	Fruit diameter
Replications	**2**	18.68**	15.38**	12.19*	452.55**	0.06	4.51	0.73	6.85	0.75	0.11
Environments (E)	**2**	225.58**	67.05**	44.93**	194570.90**	31.99**	585.28**	189.72**	467.84**	140.96**	257.14**
Crosses (C)	**27**	14.23**	10.96**	12.51**	320.82**	2.58**	4.27**	1.94**	39.71**	5.77**	3.15**
Lines (L)	**6**	22.49	22.87*	21.49	419.24*	4.83**	3.16	3.28**	65.48	10.73**	2.09
Testers (T)	**3**	6.33	2.28	4.79	1046.89**	6.36**	2.10	5.63**	38.66	15.51**	10.14**
Lines × Testers	**18**	12.78**	8.44**	10.79**	167.01*	1.20**	5.00**	0.88**	31.30**	2.49**	2.33
C × E	**54**	10.35**	7.41**	7.45**	240.31**	2.06**	5.16**	1.67**	17.48**	3.27**	1.53
L×E	**12**	11.69	6.15	8.09	433.90**	2.06	5.73	1.70	19.95	2.56	2.70**
T×E	**6**	17.75	14.56*	17.66**	167.19	1.25	3.17	0.38	24.30	4.64	1.96

L× T×E	**36**	8.67**	6.64**	5.53*	187.97**	2.19**	5.30**	1.88**	15.52**	3.28**	1.07
Pooled error	**162**	3.61	3.03	3.54	88.76	0.15	1.55	0.31	2.37	0.67	1.41
Variance components											
σ^2 gca		-	0.01	-	9.16	0.10	-0.03	0.10	0.29	0.21	0.05
σ^2 sca		0.46	0.20	0.59*	-	-	-0.03	-	1.75*	-	0.14*
σ^2 Env.		1.75**	0.45	0.21	1659.47**	0.26**	4.97**	1.62**	3.75**	1.17**	2.17**
σ^2gca / σ^2sca		-	0.05	-	-	-	1.00	-	0.17	2.33	0.36

Table 2 Conti…

Source of variation	d.f.	Average fruit weight	Days to last picking	Number of picking	Fruit yield per plant	Chlorophyll A	Chlorophyll B	Total chlorophyll content	Mucilage content	Crude fiber content	Moisture content
Replications	**2**	0.68	25.79	1.19	1046.79	12.53*	6.53	6.11	0.60**	0.07	0.20
Environments (E)	**2**	140.17**	585.48**	742.69**	156486.80**	226.84**	63.66	87.75	1.24**	0.43**	0.08
Crosses (C)	**27**	9.49**	158.62**	7.96**	11811.61**	249052.00**	41562.37**	432911.40**	6.21**	0.95**	29.21**
Lines (L)	**6**	14.12	162.65	10.74	19757.87*	233191.30	103270.30**	615298.10**	9.61	1.15	29.47
Testers (T)	**3**	13.12	170.87	15.10	17026.11	1081711.00**	73112.62**	1667012.00**	1.17	1.04	22.51
Lines × Testers	**18**	7.34**	155.24**	5.85**	8293.77**	115562.30**	15734.69**	166432.40**	5.91**	88.00**	30.24**
C × E	**54**	3.99**	99.52**	5.94**	4350.14**	11826.42**	4928.55**	29358.52**	0.51**	0.29**	4.38**
L×E	**12**	4.17	87.63	4.31	4351.22	8725.76	4716.81	24627.43	0.17	0.30	3.94
T×E	**6**	2.49	140.71	13.24*	6186.70	4945.82	924.20	9600.67	0.80	0.24	6.15
L× T×E	**36**	4.18**	96.61**	5.26**	4043.68**	14006.73**	5666.52**	34228.53**	0.57**	0.29**	4.23**
Pooled error	**162**	1.26	31.76	1.86	526.91	3.95	31.42	29.53	0.09	0.06	0.19
Variance components											
σ^2 gca		0.14	-	0.07	179.24	11092.11**	1521.27**	20037.12**	-	0.01	-
σ^2 sca		0.35	6.51	0.06	472.23*	11083.96**	1118.69**	14689.32**	0.59**	0.07**	2.87**
σ^2 Env.		1.18**	3.88	6.24**	1281.99**	4.80	0.76	0.75	0.01	0.01	-
σ^2gca / σ^2sca		0.40	-	1.17	0.38	1.00	1.36	1.36	-	0.14	-

and** indicate significant at 5 per cent and 1 per cent levels of significance, respectively
Where, '-' indicates -ve estimates

Table 3: Estimates of general combining ability (*gca*) effects of parents for different characters under individual and pooled over environments

Sr. No.	Parents	Days to first flowering				Days 50 % flowering				Days to first picking				Plant Height			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
LINES																	
1	**JOL-14-10**	-0.58	-0.55	-2.48**	-1.20**	-1.08*	-0.71	-1.76**	-1.19**	-1.10*	-0.65	-1.49*	-1.08**	-2.28	2.76	-1.77	-0.43
2	**JOL-16-06**	0.42	0.70	0.36	0.49	0.67	0.62	0.15	0.48	0.65	0.60	-0.07	0.39	-8.18**	3.06	-3.01	-2.71
3	**JOL-75-01**	1.25*	0.95	0.86	1.02	1.33*	1.20*	0.74	1.09**	1.40**	1.35**	0.68	1.14**	0.58	1.70	12.68**	4.99*
4	**JOL-75-10**	-2.25**	-0.38	1.19*	-0.48*	-1.33*	-0.38	0.74	-0.33	-1.35*	-0.74	0.76	-0.44	-8.21**	-4.24	-0.95	-4.47*
5	**IC-111443**	0.75	1.04	0.44	0.74*	0.83	0.54	0.07	0.48	0.82	0.85	-0.65	0.34	5.19*	-0.43	4.83	3.20
6	**JDNOL-11-03**	-0.67	-1.05	0.27	-0.48	-1.58**	-0.80	0.07	-0.77*	-1.60**	-0.82	0.26	-0.72	8.82**	-6.94**	-8.39*	-2.17
7	**JDNOL-11-47**	1.08*	-0.71	-0.64	-0.09	1.17*	-0.46	-0.01	0.23	1.15*	-0.57	0.51	0.37	4.08	4.11	-3.39	1.60
S.Em. ±		0.54	0.58	0.51	0.54	0.32	0.54	0.42	0.29	0.51	0.50	0.61	0.31	2.09	2.63	3.30	1.57
TESTERS																	
8	**GO-6**	-0.61	-0.88	0.10	-0.46	-0.26	-0.63	0.13	-0.25	-0.23	-0.76*	-0.11	-0.36	-6.61**	-4.87*	-5.55*	-5.68**
9	**Hisar Naveen**	0.44	-0.17	-0.10	0.06	0.07	-0.01	-0.15	-0.03	0.06	0.19	-0.06	0.06	1.17	3.27	-4.18	0.08
10	**Kashi Kranti**	-1.04*	1.31**	0.38	0.22	-0.88*	1.27**	0.13	0.18	-0.89*	1.48**	0.32	0.30	1.94	-0.46	3.93	1.80
11	**Kashi Lalima**	1.20**	-0.26	-0.38	0.19	1.07*	-0.63	-0.11	0.11	1.06**	-0.90*	-0.15	0.00	3.51*	2.06	5.80*	3.79**
S.Em. ±		0.41	0.43	0.39	0.41	0.24	0.41	0.32	0.22	0.39	1.48	0.46	0.24	1.58	1.99	2.49	1.19
Range	**Min.**	-2.25	-1.05	-2.48	-1.20	-1.58	-0.8	-1.76	-1.19	-1.60	-0.90	-1.49	-1.08	-8.21	-6.94	-8.39	-5.68
	Max.	1.25	1.31	1.19	1.02	1.33	1.27	0.74	0.23	1.40	1.48	0.76	1.14	8.82	4.11	12.68	4.99
Positive		6	4	7	6	6	4	7	6	6	5	5	7	7	6	4	6
No. of +ve significant		3	1	1	2	3	2	0	1	3	2	0	1	3	0	2	2
Negative		5	7	4	5	5	7	4	5	5	6	6	4	4	5	7	5
No. of -ve significant		2	0	1	2	4	0	1	2	4	2	1	1	3	2	2	2

Table 3 Conti…

Sr. No.	Parents	Number of primary branch per plant				Number of node per plant				Internodal length				Number of fruit per plant			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
LINES																	
1	JOL-14-10	0.12	0.15	0.75**	0.34**	0.21	-0.56	0.69	0.11	-0.51**	-0.12	-0.31	-0.31**	0.15	0.95	0.72	0.61*
2	JOL-16-06	0.47**	-0.13	0.29**	0.21*	-0.06	0.04	1.69**	0.56*	-0.80**	0.53**	-0.03	-0.10	0.85*	0.34	0.76	0.65*
3	JOL-75-01	0.42**	-0.08	0.15	0.16*	-0.08	0.02	-1.24**	-0.43	0.24	0.05	0.31	0.20	-0.50	-1.81**	-2.21**	-1.51**
4	JOL-75-10	-0.49**	0.12	-0.85**	-0.40**	0.02	0.22	-0.27	-0.01	-0.22	-0.53**	-0.08	-0.28*	-0.08	1.10*	-0.91	0.04
5	IC-111443	-0.69**	0.00	-0.53**	-0.41**	0.12	-0.01	-0.32	-0.07	0.80**	0.26	0.49**	0.52**	-1.07**	-1.25*	0.02	-0.76*
6	JDNOL-11-03	0.16	0.17	0.95**	0.43**	0.49	-0.50	-0.16	-0.06	0.13	-0.04	-0.62**	-0.18	1.50**	4.33**	1.16*	2.33**
7	JDNOL-11-47	0.01	-0.22*	-0.76**	-0.33**	-0.71*	0.80*	-0.39	-0.10	0.38*	-0.15	0.23	0.15	-0.87**	-3.66**	0.46	-1.36**
S.Em. ±		0.13	0.10	0.10	0.06	0.30	0.36	0.41	0.21	0.16	0.17	0.16	0.09	0.33	0.50	0.49	0.26
TESTERS																	
8	GO-6	0.46**	-0.06	0.26**	0.22**	0.23	0.18	-0.68*	-0.09	-0.15	-0.26*	-0.26*	-0.36**	0.86**	-0.40	1.88**	0.78**
9	Hisar Naveen	0.30**	0.16*	0.49**	0.31**	0.32	0.14	0.36	0.27	0.24*	-0.07	-0.07	-0.10	-0.05	0.54	0.20	0.23
10	Kashi Kranti	-0.20	0.00	-0.36**	-0.19**	-0.48*	0.02	0.21	-0.08	0.46**	0.04	0.06	0.11	-0.46	1.52**	-0.86*	0.07
11	Kashi Lalima	-0.55**	-0.10	-0.39**	-0.35**	-0.07	-0.34	0.11	-0.10	-0.51**	0.30*	0.27*	0.34**	-0.36	-1.67**	-1.22**	-1.08**
S.Em. ±		0.10	0.07	0.08	0.05	0.23	0.27	0.31	0.29	0.12	0.13	0.12	0.07	0.25	0.38	0.37	0.20
Range	Min.	-0.69	-0.22	-0.85	-0.41	-0.71	-0.56	-1.24	-0.43	-0.80	-0.53	-0.62	-0.36	-1.07	-3.66	-2.21	-1.51
	Max.	0.47	0.17	0.95	0.43	0.49	0.80	1.69	0.16	0.80	0.53	0.49	0.52	1.50	4.33	1.88	2.33
Positive		7	6	6	6	6	7	5	3	6	5	5	5	4	6	7	7
No. of +ve significant		4	1	5	6	0	1	1	1	4	2	2	2	3	3	2	4
Negative		4	5	5	5	5	4	6	8	5	6	6	6	7	5	4	4
No. of -ve significant		3	1	5	5	2	0	2	0	3	2	2	3	2	4	2	4

Table 3 Conti….

Sr. No.	Parents	Fruit length				Fruit diameter				Average fruit weight				Days to last picking			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
LINES																	
1	JOL-14-10	0.50	0.43*	0.08	0.33*	0.00	0.40	0.26	0.22	0.31	-0.01	0.60	0.30	-0.99	-0.49	3.55	0.69
2	JOL-16-06	1.08**	0.71**	1.21**	1.00**	0.81*	-0.52	0.54	0.28	0.59*	0.79**	1.07**	0.82**	0.10	0.68	1.05	0.61
3	JOL-75-01	0.00	-0.91**	-1.01**	-0.64**	-0.02	-0.15	-0.30	-0.16	0.15	0.07	-1.02*	-0.27	1.01	-5.82**	-4.79*	-3.20**
4	JOL-75-10	-0.59*	-0.75**	-0.07	-0.47**	-0.33	0.25	-0.63	-0.24	-1.05**	-0.48	-0.96*	-0.83**	0.43	1.76	-4.12	-0.64
5	IC-111443	-0.18	-0.12	0.29	0.00	-0.40	0.40	0.17	0.06	-0.09	-0.11	1.58**	0.46*	-1.99*	1.51	1.21	0.24
6	JDNOL-11-03	-0.16	0.76**	-0.64*	-0.01	0.09	0.56	-0.14	0.17	0.17	0.59*	0.04	0.26	3.51**	5.85**	1.71	3.69**
7	JDNOL-11-47	-0.64*	-0.13	0.14	-0.21	-0.15	-0.95**	0.10	-0.33	-0.08	-0.85**	-1.31**	-0.75**	-2.07*	-3.49*	1.38	-1.39
S.Em. ±		0.27	0.18	0.25	0.14	0.35	0.31	0.36	**0.21**	**0.29**	0.26	0.40	0.19	1.97	3.03	2.16	0.94
TESTERS																	
8	GO-6	0.77**	0.55**	0.55**	0.62**	0.50	0.48*	0.54*	0.51**	0.35	0.76**	0.55	0.55**	1.24	-1.70	2.33	0.62
9	Hisar Naveen	0.00	0.23	0.28	0.17	0.08	0.04	0.07	0.07	0.08	0.25	-0.51	-0.06	0.57	3.73**	0.62	1.64*
10	Kashi Kranti	-0.73**	-0.57**	0.28	-0.34**	-0.23	-0.40	0.28	-0.12	0.25	-0.28	0.23	0.07	-1.67*	2.92*	-1.29	-0.01
11	Kashi Lalima	-0.03	-0.21	-1.11**	-0.45**	-0.36	-0.13	-0.89**	-0.46**	-0.68**	-0.73**	-0.27	-0.56**	-0.14	-4.94**	-1.67	-2.25**
S.Em. ±		0.21	0.14	0.18	0.10	0.27	0.24	0.27	0.16	0.22	0.20	0.31	0.14	1.39	2.14	1.63	0.71
Range	Min.	-0.73	-0.91	-1.11	-0.64	-0.40	-0.95	-0.89	-0.46	-1.05	-0.85	-1.31	-0.83	-2.07	-5.82	-4.79	-3.20
	Max.	1.08	0.76	1.21	1.00	0.81	0.56	0.54	0.51	0.59	0.79	1.58	0.82	3.51	5.85	3.55	3.69

Positive	5	5	7	5	5	6	7	6	7	5	6	6	6	6	7	6
No. of +ve significant	2	4	2	3	1	1	1	1	1	3	2	3	1	3	0	2
Negative	6	6	4	6	6	5	4	5	4	6	5	5	5	5	4	5
No. of -ve significant	3	3	3	4	0	1	1	1	2	2	3	3	3	3	1	2

Table 3 Conti…

Sr. No.	Parents	Number of picking				Fruit yield per plant				Chlorophyll A				Chlorophyll B			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
LINES																	
1	**JOL-14-10**	-0.21	-0.08	0.02	-0.09	9.87*	22.66**	22.93**	18.49**	-57.33**	-92.62**	-57.85**	-69.27**	-33.58**	-29.80**	-33.24**	-32.21**
2	**JOL-16-06**	0.37	0.25	0.69	0.44	14.38**	-2.23	29.69**	13.94**	19.50**	-53.32**	-52.61**	-28.81**	7.42**	-51.81**	-52.51**	-32.30**
3	**JOL-75-01**	0.04	-1.08**	-1.23*	-0.76*	-15.21**	-26.11**	-39.06**	-26.79**	-36.45**	-37.13**	-37.82**	-37.14*	10.71**	10.96**	10.98**	10.88**
4	**JOL-75-10**	0.04	0.25	-0.31	-0.01	-5.88	-8.83	-26.77**	-13.83**	2.52**	2.63**	4.14**	3.10**	-15.05**	-15.09**	-15.68**	-15.27**
5	**IC-111443**	-0.63*	0.17	-0.14	-0.20	-14.43**	-16.95*	-3.84	-11.74*	-87.44**	-87.33**	-88.15**	-87.64**	-66.41**	-66.45**	-66.18**	-66.35**
6	**JDNOL-11-03**	0.87**	1.67**	0.27	0.94**	23.49**	74.05**	14.82	37.45**	95.08**	130.08**	95.07**	106.74**	93.52**	89.86**	93.93**	92.44**
7	**JDNOL-11-47**	-0.46	-1.17**	0.69	-0.31	-12.23**	-42.58**	2.23	-17.53**	64.12**	137.70**	137.24**	113.02**	3.39*	62.34**	62.70**	42.81**
S.Em. ±		0.24	0.39	0.50	0.41	4.47	7.34	7.60	3.83	0.50	0.40	0.76	0.33	1.56	1.39	1.87	0.93
TESTERS																	
8	**GO-6**	0.24	-0.65*	1.08**	0.22	13.13**	-2.39	32.06**	14.27**	114.58**	102.67**	82.12**	99.79**	50.90**	39.34**	35.19**	41.81**
9	**Hisar Naveen**	0.05	1.15**	0.27	0.49*	2.36	19.89**	12.56*	11.61**	-189.60**	-189.61**	-169.21**	-182.81**	-40.99**	-40.99**	-36.89**	-39.62**
10	**Kashi Kranti**	-0.29	0.68*	-0.58	-0.06	-10.02**	15.05**	-18.94**	-4.63	82.60**	82.19**	104.96**	89.92**	4.93**	5.08**	13.66**	7.89**
11	**Kashi Lalima**	0.00	-1.18**	-0.77*	-0.65**	-5.48	-32.55**	-25.68**	-21.24**	-7.58**	4.75**	-17.87**	-6.90**	-14.83**	-3.43**	-11.96**	-10.08**
S.Em. ±		0.18	0.29	0.38	0.31	3.38	5.55	5.75	2.89	0.38	0.30	0.57	0.25	1.18	1.05	1.41	0.71
Range	**Min.**	-0.63	-1.18	-1.23	-0.76	-15.21	-42.58	-39.06	-26.79	-189.60	-189.61	-169.21	-182.81	-66.41	-66.45	-66.18	-66.35
	Max.	0.87	1.67	1.08	0.94	23.49	74.05	32.06	37.45	114.58	137.70	137.24	113.02	93.52	89.86	93.93	92.44
Positive		7	6	6	4	5	4	6	5	6	6	5	5	6	5	5	5
No. of +ve significant		1	3	1	2	4	4	4	5	6	6	5	5	6	5	5	5
Negative		4	5	5	7	6	7	5	6	5	5	6	6	5	6	6	6
No. of -ve significant		1	4	2	2	4	4	4	5	5	5	6	6	5	6	6	6

Table 3 Conti…

Sr. No.	Parents	Total chlorophyll Content				Mucilage content				Crude fiber content				Moisture content			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
LINES																	
1	**JOL-14-10**	-90.91**	-122.43**	-91.24**	-101.52**	-0.16	-0.20*	0.15*	-0.07	0.07	-0.06	0.25**	0.08	-0.12	0.18	-0.48**	-0.14
2	**JOL-16-06**	26.92**	-105.13**	-105.10**	-61.10**	-0.09	-0.30**	-0.19*	-0.19**	0.19**	-0.19*	-0.20**	-0.07	-1.54**	0.27	0.27*	-0.33**
3	**JOL-75-01**	-25.75**	-26.17**	-26.82**	-26.25**	-0.45**	-0.46**	-0.43**	-0.45**	-0.25**	-0.23**	-0.29**	-0.26**	0.40**	0.76**	0.42**	0.52**
4	**JOL-75-10**	-12.53**	-12.46**	-11.52**	-12.17**	-0.24*	-0.25**	-0.43**	-0.31**	-0.19**	0.15*	-0.11	-0.05	1.70**	1.35**	1.36**	1.47**
5	**IC-111443**	-153.85	-153.78**	-154.31**	-153.98**	-0.31**	-0.32**	-0.33**	-0.32**	-0.16*	-0.08	-0.14*	-0.12*	0.26*	-1.08**	-0.08	-0.30**
6	**JDNOL-11-03**	188.6	219.94**	189.02**	199.19**	0.17	0.43**	0.31**	0.30**	0.09	0.33**	0.42**	0.28**	-0.96**	-1.68**	-1.80**	-1.48**
7	**JDNOL-11-47**	67.51	200.04**	199.97**	155.84**	1.08**	1.10**	0.92**	1.03**	0.25**	0.07	0.07	0.13*	0.26*	0.20	0.31**	0.26**
S.Em. ±		1.45	1.32	1.86	0.91	0.10	0.09	0.07	0.05	**0.07**	0.08	0.07	0.04	0.11	0.15	0.11	0.07
TESTERS																	
8	**GO-6**	165.48**	142.01**	117.33**	141.61**	0.23**	0.01	-0.04	0.07	0.20**	0.18**	0.13*	0.17**	-1.66**	-0.26*	-0.52**	-0.81**
9	**Hisar Naveen**	-230.60**	-230.60**	-206.07**	-222.42	0.05	0.24**	-0.17**	0.04	-0.02	0.14*	-0.11*	0.00	0.15	0.06	-0.20*	0.00

10	**Kashi Kranti**	87.53**	87.27**	118.65**	97.82**	-0.32**	-0.33**	0.05	-0.20**	-0.10*	-0.19**	-0.13**	-0.14**	0.70**	-0.32**	0.23**	0.20**
11	**Kashi Lalima**	-22.41**	1.32	-29.91**	-17.00**	0.04	0.09	0.16**	0.10*	-0.07	-0.12*	0.11*	-0.03	0.81**	0.51**	0.49**	0.61*
S.Em. ±		1.12	0.99	1.41	0.68	0.07	0.07	0.06	0.04	0.05	0.06	0.05	0.03	0.08	0.12	0.08	0.05
Range	**Min.**	-230.60	-230.60	-206.07	-222.42	-0.45	-0.46	-0.43	-0.45	-0.25	-0.23	-0.29	-0.26	-1.66	-1.68	-1.80	-0.25
	Max.	188.60	219.94	199.97	199.19	1.08	1.10	0.92	1.03	0.25	0.33	0.42	0.28	1.70	1.35	1.36	0.25
Positive		5	5	4	4	5	5	5	5	5	5	5	5	7	7	6	6
No. of +ve significant		5	4	4	4	2	3	4	3	3	4	4	3	6	3	6	5
Negative		6	6	7	7	6	6	6	6	6	6	6	6	4	4	5	5
No. of -ve significant		6	6	7	7	4	6	5	5	4	4	5	3	3	4	4	4

Table 4: Estimates of specific combining ability (sca) effects of crosses for different characters under individual and pooled over environments in okra

Sr. No.	Crosses	Days to first flowering				Days to 50 % flowering				Days to first picking			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
1	**JOL-14-10 × GO-6**	-1.23	0.55	-1.76	-0.81	-0.49	0.05	0.62	0.06	-0.52	-0.15	0.11	-0.19
2	**JOL-14-10 × Hisar Naveen**	1.06	-1.50	-0.24	-0.23	2.18*	-1.24	-0.43	0.17	2.19*	-0.44	-0.94	0.27
3	**JOL-14-10 × Kashi Kranti**	-0.13	0.02	0.62	0.17	-0.54	-0.19	-0.05	-0.26	-0.52	-0.73	-0.32	-0.52
4	**JOL-14-10 × Kashi Lalima**	0.30	0.93	1.38	0.87	-1.15	1.38	-0.14	0.03	-1.14	1.32	1.15	0.44
5	**JOL-16-06 × GO-6**	0.11	-1.04	0.40	-0.18	-0.90	-1.29	-0.30	-0.83	-0.94	-1.07	0.36	-0.55
6	**JOL-16-06 × Hisar Naveen**	-1.27	-0.42	-0.40	-0.70	0.10	-0.90	-0.68	-0.49	0.11	-1.36	-1.36	-0.87
7	**JOL-16-06 × Kashi Kranti**	2.20*	4.44**	-0.88	1.92*	1.05	4.14**	0.04	1.74*	1.06	3.36**	-0.07	1.45*
8	**JOL-16-06 × Kashi Lalima**	-1.04	-2.99*	0.88	-1.05	-0.24	-1.95	0.94	-0.42	-0.23	-0.93	1.07	-0.03
9	**JOL-75-01 × GO-6**	0.94	2.71*	-0.10	1.19	0.43	2.46*	0.45	1.11	0.64	2.51*	0.94	1.37
10	**JOL-75-01 × Hisar Naveen**	1.56	2.33	1.43	1.77*	-0.24	2.18*	1.07	1.00	-0.31	2.56*	1.89	1.38
11	**JOL-75-01 × Kashi Kranti**	-0.96	-4.48**	-0.38	-1.94*	0.05	-4.11**	0.12	-1.31	-0.02	-4.06**	-1.49	-1.86*
12	**JOL-75-01 × Kashi Lalima**	-1.54	-0.57	-0.95	-1.02	-0.24	-0.54	-1.64	-0.81	-0.31	-1.01	-1.35	-0.89
13	**JOL-75-10 × GO-6**	0.77	-0.29	0.90	0.46	0.10	0.05	0.79	0.31	0.06	0.60	1.19	0.62
14	**JOL-75-10 × Hisar Naveen**	-2.61*	0.00	-0.24	-0.95	-1.57	-0.24	-0.26	-0.69	-1.56	-0.69	0.14	-0.70
15	**JOL-75-10 × Kashi Kranti**	0.20	-1.48	-0.71	-0.66	-0.62	-1.19	-0.55	-0.79	-0.61	-0.98	-0.90	-0.83
16	**JOL-75-10 × Kashi Lalima**	1.63	1.76	0.05	1.15	2.10	1.38	0.02	1.17	2.11*	1.07	-0.43	0.92
17	**IC-111443 × GO-6**	-0.89	-2.70*	0.65	-0.98	-0.07	-2.20*	0.12	-0.72	-0.11	-1.65	-0.73	-0.83
18	**IC-111443 × Hisar Naveen**	0.06	-1.08	-0.49	-0.50	-0.07	-0.82	-0.60	-0.49	-0.06	-1.27	-0.11	-0.48
19	**IC-111443 × Kashi Kranti**	-0.13	4.44**	-0.96	1.11	0.21	3.89**	-0.88	1.07	0.23	3.77**	-0.15	1.28
20	**IC-111443 × Kashi Lalima**	0.96	-0.65	0.80	0.37	-0.07	-0.87	1.36	0.14	-0.06	-0.85	0.99	0.03
21	**JDNOL-11-03 × GO-6**	-1.81	0.05	-0.51	-0.76	-0.99	-0.20	-0.88	-0.69	-1.02	-0.99	-1.64	-1.22
22	**JDNOL-11-03 × Hisar Naveen**	2.14	0.33	-0.65	0.61	0.35	0.85	-0.26	0.31	0.36	0.39	-0.02	0.24
23	**JDNOL-11-03 × Kashi Kranti**	-0.71	-1.14	0.20	-0.55	-0.70	-1.11	0.12	-0.56	-0.69	-0.23	1.26	0.11
24	**JDNOL-11-03 × Kashi Lalima**	0.38	0.76	0.96	0.70	1.35	0.46	1.02	0.94	1.36	0.82	0.40	0.86
25	**JDNOL-11-47 × GO-6**	2.11	0.71	0.40	1.08	1.93	1.13	-0.80	0.75	1.89	0.76	-0.23	0.81
26	**JDNOL-11-47 × Hisar Naveen**	-0.94	0.33	0.60	0.00	-0.74	0.18	1.15	0.20	-0.73	0.81	0.39	0.16
27	**JDNOL-11-47 × Kashi Kranti**	-0.46	-1.81	2.12*	-0.05	0.55	-1.44	1.20	0.10	0.56	-1.14	1.68	0.36
28	**JDNOL-11-47 × Kashi Lalima**	-0.70	0.76	-3.12**	-1.02	-1.74	0.13	-1.56	-1.06	-1.73	-0.43	-1.85	-1.33
S.Em.±		1.09	1.18	1.02	0.63	1.08	1.07	0.84	0.58	1.03	1.02	1.23	0.63
Range	**Min.**	-2.61	-4.48	-3.12	-1.94	-1.74	-4.11	-1.64	-1.31	-1.73	-4.06	-1.85	-1.86
	Max.	2.20	4.44	2.12	1.92	2.18	4.14	1.36	1.74	2.19	3.77	1.89	1.45
Positive		14	15	14	13	12	13	14	15	14	11	15	16
No. of +ve significant		1	3	1	2	1	4	0	1	2	4	0	1
Negative		14	15	14	15	16	15	14	13	14	17	13	12
No. of -ve significant		1	3	1	1	0	2	0	0	0	1	0	1

Table 4 Conti…

Sr. No.	Crosses	Plant height				Number of primary branch per plant				Number of node per plant			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
1	**JOL-14-10 × GO-6**	-3.90	-5.33	-3.85	-4.36	0.41	0.17	-0.01	0.19	0.84	0.34	-0.17	0.34
2	**JOL-14-10 × Hisar Naveen**	-9.34*	-9.98	5.73	-4.53	0.30	-0.04	-0.10	0.05	0.15	0.37	-2.01*	-0.50
3	**JOL-14-10 × Kashi Kranti**	5.37	5.99	4.02	5.13	-0.13	-0.08	0.08	-0.05	-1.12	0.30	-0.93	-0.58
4	**JOL-14-10 × Kashi Lalima**	7.88	9.31	-5.90	3.76	-0.58*	-0.05	0.04	-0.20	0.14	-1.01	3.11**	0.75
5	**JOL-16-06 × GO-6**	6.74	10.82*	-12.05	1.83	-0.14	0.26	1.59**	0.57**	0.97	-0.53	0.30	0.25
6	**JOL-16-06 × Hisar Naveen**	-7.22	3.40	-4.37	-2.73	0.09	-0.23	0.36	0.07	1.08	-0.76	1.06	0.46
7	**JOL-16-06 × Kashi Kranti**	2.28	-8.08	11.23	1.81	0.38	0.33	-1.39**	-0.22	-1.25*	0.83	-1.80*	-0.74
8	**JOL-16-06 × Kashi Lalima**	-1.79	-6.14	5.20	-0.91	-0.33	-0.37	-0.56**	-0.42*	-0.80	0.46	0.44	0.03
9	**JOL-75-01 × GO-6**	0.06	1.61	-0.89	0.26	-0.49	-0.19	-0.61**	-0.43*	-0.68	-0.71	-3.64**	-1.68**

10	**JOL-75-01 × Hisar Naveen**	2.14	-2.22	4.55	1.49	1.54**	-0.08	-0.90**	0.19	-0.77	-0.61	0.06	-0.44
11	**JOL-75-01 × Kashi Kranti**	-9.50*	-2.94	0.40	-4.01	-0.23	-0.05	0.88**	0.20	0.76	0.45	3.67**	1.63**
12	**JOL-75-01 × Kashi Lalima**	7.29	3.55	-4.06	2.26	-0.81**	0.32	0.64**	0.05	0.69	0.88	-0.09	0.49
13	**JOL-75-10 × GO-6**	2.02	7.42	1.19	3.54	0.03	-0.07	-0.61**	-0.22	-0.38	0.89	-0.54	-0.01
14	**JOL-75-10 × Hisar Naveen**	2.76	-8.16	-2.40	-2.60	-0.21	0.11	1.16**	0.36*	-0.34	-0.48	0.69	-0.04
15	**JOL-75-10 × Kashi Kranti**	3.09	1.70	-1.67	1.04	0.42	-0.19	-0.39	-0.05	1.06	0.11	-0.90	0.09
16	**JOL-75-10 × Kashi Lalima**	-7.87	-0.96	2.88	-1.98	-0.23	0.14	-0.16	-0.09	-0.35	-0.52	0.74	-0.04
17	**IC-111443 × GO-6**	1.40	-11.89*	6.36	-1.38	-0.04	0.19	0.74**	0.30	-0.01	1.12	1.31	0.81
18	**IC-111443 × Hisar Naveen**	6.09	16.49**	7.88	10.16*	-0.35	-0.16	-1.49**	-0.67	-0.24	0.62	0.88	0.42
19	**IC-111443 × Kashi Kranti**	2.80	-1.78	-10.08	-3.02	0.35	0.20	-0.57**	-0.01	0.70	-0.72	-0.78	-0.27
20	**IC-111443 × Kashi Lalima**	-10.30*	-2.82	-4.16	-5.76	0.04	-0.23	1.32**	0.38*	-0.45	-1.02	-1.41	-0.96*
21	**JDNOL-11-03 × GO-6**	-12.04**	-1.33	7.39	-1.99	0.18	0.16	-0.88**	-0.18	-0.58	0.14	0.61	0.06
22	**JDNOL-11-03 × Hisar Naveen**	4.80	7.28	-12.30	-0.07	-0.93**	0.07	1.56**	0.24	-0.20	0.97	-0.69	0.03
23	**JDNOL-11-03 × Kashi Kranti**	-2.72	-0.71	-4.00	-2.48	-0.30	-0.37	1.34**	0.23	-0.67	-1.10	1.32	-0.15
24	**JDNOL-11-03 × Kashi Lalima**	9.95*	-5.24	8.91	4.54	1.05**	0.13	-2.03**	-0.28	1.45*	-0.01	-1.24	0.07
25	**JDNOL-11-47 × GO-6**	5.72	-1.30	1.85	2.09	0.06	-0.52**	-0.23	-0.23	-0.18	-1.23	2.11*	0.24
26	**JDNOL-11-47 × Hisar Naveen**	0.77	-6.80	0.91	-1.71	-0.45	0.32	-0.59**	-0.24	0.33	-0.13	0.01	0.07
27	**JDNOL-11-47 × Kashi Kranti**	-1.32	5.82	0.10	1.53	-0.48	0.15	0.06	-0.09	0.53	0.13	-0.58	0.03
28	**JDNOL-11-47 × Kashi Lalima**	-5.17	2.29	-2.85	-1.91	0.87**	0.05	0.75**	0.56**	-0.68	1.23	-1.54	-0.33
S.Em.±		**4.18**	**5.27**	**6.60**	**3.14**	0.27	0.19	0.20	0.13	0.61	0.72	0.81	0.42
Range	**Min.**	-12.04	-11.89	-12.30	-5.76	-0.93	-0.52	-2.03	-6.67	-1.25	-1.23	-3.64	-1.68
	Max.	9.95	16.49	11.23	10.16	1.54	0.33	1.59	0.57	1.45	1.23	3.67	1.63
Positive		17	12	15	14	14	20	14	18	13	16	15	19
No. of +ve significant		1	2	0	1	3	0	9	4	1	0	3	1
Negative		11	16	13	14	14	8	14	10	15	12	13	9
No. of -ve significant		4	1	0	0	3	1	10	3	1	0	3	2

Table 4 Conti…

Sr. No.	Crosses	Internodal length				Number of fruit per plant				Fruit length			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
1	**JOL-14-10 × GO-6**	-0.08	-0.38	-0.42	-0.29	1.65*	3.09**	2.75**	2.49**	0.34	0.88*	0.80	0.67*
2	**JOL-14-10 × Hisar Naveen**	-0.14	-0.31	2.27**	0.61*	-2.38**	-2.12*	-3.00**	-2.50**	-0.94	0.30	-1.13*	-0.59
3	**JOL-14-10 × Kashi Kranti**	0.08	0.21	-0.06	0.08	0.47	0.70	0.50	0.56	0.49	-0.37	0.05	0.06
4	**JOL-14-10 × Kashi Lalima**	0.14	0.48	-1.79**	-0.39	0.26	-1.67	-0.24	-0.55	0.12	-0.81*	0.27	-0.14
5	**JOL-16-06 × GO-6**	0.81*	0.37	-0.39	0.26	-0.25	-4.39**	-1.72	-2.12**	-2.35**	-0.39	-0.27	-1.00**
6	**JOL-16-06 × Hisar Naveen**	0.01	0.05	-0.81*	-0.25	1.92**	0.46	3.45**	1.94**	1.02	0.89*	0.15	0.69*
7	**JOL-16-06 × Kashi Kranti**	-0.13	0.06	0.35	0.10	1.27	4.12**	-1.28	1.37*	1.23*	-0.56	-0.51	0.06
8	**JOL-16-06 × Kashi Lalima**	-0.69*	-0.49	0.85**	-0.11	-2.94**	-0.19	-0.45	-1.19*	0.10	0.06	0.63	0.26
9	**JOL-75-01 × GO-6**	-0.08	0.32	-0.29	-0.01	-0.20	-3.61**	-0.18	-1.33*	0.32	-0.12	-0.15	0.02
10	**JOL-75-01 × Hisar Naveen**	0.32	-0.03	-0.24	0.02	2.34**	1.78	2.41*	2.18**	2.12**	-0.87*	0.62	0.62
11	**JOL-75-01 × Kashi Kranti**	-0.91**	0.17	-0.18	-0.31	-1.05	-4.33**	-1.93	-2.43**	-1.45**	0.50	0.97*	0.00
12	**JOL-75-01 × Kashi Lalima**	0.66*	-0.46	0.71	0.30	-1.09	6.16**	-0.31	1.59*	-0.98	0.49	-1.44**	-0.64*
13	**JOL-75-10 × GO-6**	-0.67*	-0.04	0.26	-0.15	-2.02**	-0.16	-0.59	-0.93	0.82	-1.08**	-1.04*	-0.43
14	**JOL-75-10 × Hisar Naveen**	0.48	0.00	-0.52	-0.02	1.02	0.66	0.69	0.79	-0.09	0.11	0.65	0.23
15	**JOL-75-10 × Kashi Kranti**	0.77*	0.32	-0.08	0.34	1.40*	0.68	-0.76	0.44	0.52	0.87*	-0.50	0.30
16	**JOL-75-10 × Kashi Lalima**	-0.57	-0.28	0.34	-0.17	-0.40	-1.19	0.67	-0.30	-1.25*	0.10	0.89	-0.09
17	**IC-111443 × GO-6**	-0.01	-0.38	0.74*	0.11	0.40	5.02**	5.13**	3.52**	-0.21	1.10**	-0.01	0.29
18	**IC-111443 × Hisar Naveen**	-0.15	0.05	-0.68*	-0.26	-1.12	-1.59	-2.98**	-1.90**	-0.31	-0.17	-0.20	-0.23
19	**IC-111443 × Kashi Kranti**	-0.77*	0.06	-0.06	-0.25	-1.01	-0.83	-1.09	-0.97	0.41	-0.06	-1.03*	-0.23
20	**IC-111443 × Kashi Lalima**	0.92**	0.27	0.00	0.40	1.72**	-2.60*	-1.07	-0.65	0.11	-0.86*	1.24*	0.16
21	**JDNOL-11-03 × GO-6**	-1.30**	0.07	0.37	-0.29	-0.14	3.02**	-3.78**	-0.30	0.82	0.59	0.66	0.69*
22	**JDNOL-11-03 × Hisar Naveen**	0.20	0.58	-0.25	0.18	-0.16	-0.59	0.69	-0.02	-0.87	-0.11	-0.07	-0.35
23	**JDNOL-11-03 × Kashi Kranti**	0.90**	-0.28	-0.47	0.05	0.42	-3.17**	2.92**	0.06	-0.74	-1.08**	1.39**	-0.14
24	**JDNOL-11-03 × Kashi Lalima**	0.21	-0.37	0.35	0.06	-0.12	0.75	0.16	0.27	0.79	0.60	-1.97**	-0.19
25	**JDNOL-11-47 × GO-6**	1.33**	0.04	-0.27	0.37	0.57	-2.97**	-1.60	-1.33*	0.27	-0.97*	0.01	-0.23
26	**JDNOL-11-47 × Hisar Naveen**	-0.72*	-0.35	0.23	-0.28	-1.62*	1.39	-1.26	-0.50	-0.91	-0.16	-0.02	-0.36
27	**JDNOL-11-47 × Kashi Kranti**	0.06	-0.55	0.49	0.00	-1.51*	2.84**	1.63	0.99	-0.46	0.70	-0.38	-0.04
28	**JDNOL-11-47 × Kashi Lalima**	-0.67*	0.85*	-0.46	-0.09	2.56**	-1.26	1.23	0.84	1.11*	0.43	0.39	0.64*
S.Em.±		0.31	0.34	0.31	0.19	0.65	0.10	0.98	0.51	0.54	0.37	0.49	0.27
Range	**Min.**	-1.30	-0.55	-1.79	-0.39	-2.94	-4.39	-3.78	-2.50	-2.35	-1.08	-1.97	-1.00
	Max.	1.33	0.85	2.27	0.61	2.56	6.16	5.13	3.52	2.12	1.10	1.39	0.69
Positive		17	18	15	17	13	13	12	14	17	15	17	16
No. of +ve significant		6	1	4	1	6	6	5	6	3	4	3	4
Negative		11	10	13	11	15	15	16	14	11	13	11	12
No. of -ve significant		7	0	3	0	5	7	3	7	3	6	5	2

Table 4 Conti…

Sr. No.	Crosses	Fruit diameter				Average fruit weight				Days to last picking			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
1	JOL-14-10 × GO-6	1.63*	0.75	0.75	1.04*	1.74**	1.48**	1.51	1.58**	2.85	9.87**	4.83	5.85*
2	JOL-14-10 × Hisar Naveen	-0.58	-0.22	-0.02	-0.27	-0.69	-1.76**	-0.21	-0.89*	-3.82	1.11	0.55	-0.72
3	JOL-14-10 × Kashi Kranti	-0.41	-0.33	-0.76	-0.50	-0.23	0.85	-1.00	-0.13	4.42*	-4.75	-4.88	-1.74
4	JOL-14-10 × Kashi Lalima	-0.64	-0.19	0.03	-0.27	-0.82	-0.57	-0.31	-0.56	-3.44	-6.23*	-0.50	-3.39
5	JOL-16-06 × GO-6	-0.51	-0.37	-0.34	-0.41	-0.34	-0.73	-0.84	-0.63	-2.57	-11.30**	-6.67	-6.85**
6	JOL-16-06 × Hisar Naveen	0.88	0.17	0.08	0.37	0.16	-0.55	0.28	-0.04	2.10	2.27	9.71*	4.70*
7	JOL-16-06 × Kashi Kranti	0.06	-0.79	-0.07	-0.27	0.11	1.22*	2.46**	1.27**	5.00*	5.75	-1.71	3.01
8	JOL-16-06 × Kashi Lalima	-0.43	0.99	0.33	0.30	0.07	0.05	-1.90*	-0.59	-4.52*	3.27	-1.33	-0.86
9	JOL-75-01 × GO-6	0.09	1.21	-0.25	0.35	-0.14	-0.34	-1.76*	-0.75	0.51	-1.46	-0.17	-0.37
10	JOL-75-01 × Hisar Naveen	0.84	-0.36	0.61	0.36	0.43	1.21*	0.36	0.67	2.85	3.77	4.88	3.83
11	JOL-75-01 × Kashi Kranti	-0.01	0.54	0.36	0.30	-0.59	-1.77**	1.53	-0.28	-4.92*	-10.08**	-6.55	-7.18**
12	JOL-75-01 × Kashi Lalima	-0.92	-1.39*	-0.72	-1.02*	0.30	0.91	-0.12	0.36	1.56	7.77*	1.83	3.72
13	JOL-75-10 × GO-6	-0.94	-0.51	-0.21	-0.55	-1.25*	-1.28*	-0.12	-0.88*	-2.90	0.62	1.17	-0.37
14	JOL-75-10 × Hisar Naveen	-0.41	-0.05	-0.17	-0.21	0.55	-0.78	-0.96	-0.40	3.10	-7.14*	0.88	-1.05
15	JOL-75-10 × Kashi Kranti	0.77	0.32	-0.34	0.25	0.96	-0.16	-0.84	-0.01	1.00	5.67	-4.55	0.70
16	JOL-75-10 × Kashi Lalima	0.58	0.24	0.71	0.51	-0.26	2.23**	1.93*	1.30**	-1.19	0.86	2.50	0.72
17	IC-111443 × GO-6	0.25	-0.10	0.32	0.16	-0.25	0.43	2.99**	1.06*	-2.82	10.20**	8.50	5.29*
18	IC-111443 × Hisar Naveen	-0.03	-0.10	-0.19	-0.11	0.05	0.68	-0.29	0.15	-0.15	-0.23	-7.79	-2.72
19	IC-111443 × Kashi Kranti	-0.51	0.47	-0.27	-0.11	-0.32	0.87	-1.17	-0.21	-0.92	-0.08	0.79	-0.07
20	IC-111443 × Kashi Lalima	0.29	-0.26	0.14	0.05	0.52	-1.98**	-1.54	-1.00*	3.89	-9.89**	-1.50	-2.50
21	JDNOL-11-03 × GO-6	0.12	-0.22	0.15	0.02	0.16	-0.07	-2.06*	-0.66	1.35	4.54	-8.67*	-0.93
22	JDNOL-11-03 × Hisar Naveen	-0.77	-0.04	0.52	-0.10	-0.63	2.48**	1.56	1.14*	-0.32	0.77	1.05	0.50
23	JDNOL-11-03 × Kashi Kranti	0.13	-0.58	0.51	0.02	0.13	-1.29*	-0.42	-0.53	-0.75	-4.75	6.29	0.26
24	JDNOL-11-03 × Kashi Lalima	0.52	0.85	-1.18	0.06	0.34	-1.13*	0.92	0.04	-0.27	-0.56	1.33	0.17
25	JDNOL-11-47 × GO-6	-0.64	-0.77	-0.43	-0.62	0.08	0.50	0.28	0.29	3.60	-12.46**	1.00	-2.63
26	JDNOL-11-47 × Hisar Naveen	0.08	0.62	-0.83	-0.05	0.13	-1.27*	-0.75	-0.63	-3.74	-0.56	-9.29	-4.53*
27	JDNOL-11-47 × Kashi Kranti	-0.03	0.38	0.57	0.31	-0.06	0.28	-0.56	-0.11	-3.83	8.25**	10.62	5.01*
28	JDNOL-11-47 × Kashi Lalima	0.60	-0.23	0.69	0.35	-0.15	0.49	1.02	0.45	3.98*	4.77	-2.33	2.14
S.Em.±		0.71	0.63	0.71	0.40	0.57	0.52	0.81	0.37	1.97	3.03	4.32	1.88
Range	Min.	-0.94	-1.39	-1.18	-1.02	-1.25	-1.98	-2.06	-1.00	-4.92	-12.46	-9.29*	-7.18
	Max.	1.63	1.21	0.75	1.04	1.74	2.48	2.99	1.58	5.00	10.20	10.62*	5.85
Positive		17	13	16	16	16	15	11	13	13	16	15	14
No. of +ve significant		1	0	0	1	1	5	3	5	3	4	2	4
Negative		11	15	12	12	12	13	17	15	15	12	13	14
No. of -ve significant		0	1	0	1	1	7	3	3	2	6	2	3

Table 4 Conti…

Sr. No.	Crosses	Number of picking				Fruit yield per plant			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
1	JOL-14-10 × GO-6	0.26	0.32	1.17	0.58	34.43**	53.84**	49.80**	46.02**
2	JOL-14-10 × Hisar Naveen	-0.88	-0.49	-0.02	-0.47	-41.81**	-40.72**	-57.53**	-46.69**
3	JOL-14-10 × Kashi Kranti	0.79	0.32	-0.83	0.09	5.97	7.51	10.16	7.88
4	JOL-14-10 × Kashi Lalima	-0.17	-0.15	-0.31	-0.21	1.40	-20.63	-2.43	-7.22
5	JOL-16-06 × GO-6	-0.32	-1.35	-1.17	-0.94	-7.15	-57.22**	-20.63	-28.33**
6	JOL-16-06 × Hisar Naveen	0.87	0.18	1.31	0.79	39.15**	20.60	63.81**	41.19**
7	JOL-16-06 × Kashi Kranti	0.87	0.99	-0.83	0.34	18.53*	41.46**	-34.17*	8.61
8	JOL-16-06 × Kashi Lalima	-1.42**	0.18	0.69	-0.18	-50.54**	-4.84	-9.01	-21.46*
9	JOL-75-01 × GO-6	-0.32	-1.01	1.08	-0.08	-8.22	-64.84**	-4.17	-25.74**
10	JOL-75-01 × Hisar Naveen	0.87	1.18	0.89	0.98	33.14**	31.51*	38.83*	34.49**
11	JOL-75-01 × Kashi Kranti	-0.46	-2.35**	-1.92	-1.58**	-6.64	-49.64**	-26.81	-27.70**
12	JOL-75-01 × Kashi Lalima	-0.08	2.18**	-0.06	0.68	-18.28*	82.97**	-7.86	18.95*
13	JOL-75-10 × GO-6	-0.99*	0.32	0.50	-0.06	-36.02**	5.35	-11.41	-14.03
14	JOL-75-10 × Hisar Naveen	0.87	-0.49	0.64	0.34	17.11	-1.53	21.12	12.23
15	JOL-75-10 × Kashi Kranti	0.54	0.99	-1.17	0.12	24.53**	22.59	-18.84	9.43
16	JOL-75-10 × Kashi Lalima	-0.42	-0.82	0.02	-0.41	-5.61	-26.41	9.13	-7.63
17	IC-111443 × GO-6	-0.32	2.40**	2.00*	1.36*	-4.87	78.90**	84.64**	52.89**
18	IC-111443 × Hisar Naveen	-0.46	-0.07	-1.86	-0.80	-15.74	-45.31**	-50.19**	-37.08**
19	IC-111443 × Kashi Kranti	-0.46	-0.26	0.33	-0.13	-15.09	0.46	-14.33	-9.66
20	IC-111443 × Kashi Lalima	1.25*	-2.07**	-0.48	-0.43	35.70**	-34.04*	-20.12	-6.15
21	JDNOL-11-03 × GO-6	0.51	0.90	-3.08**	-0.56	7.04	40.03**	-68.76**	-7.23
22	JDNOL-11-03 × Hisar Naveen	-0.30	-0.57	0.73	-0.05	-9.76	15.49	12.87	6.20
23	JDNOL-11-03 × Kashi Kranti	-0.30	-1.43	1.92	0.07	1.76	-59.98**	50.18**	-2.68
24	JDNOL-11-03 × Kashi Lalima	0.08	1.10	0.44	0.54	0.95	4.46	5.71	3.71

25	**JDNOL-11-47 × GO-6**	1.18*	-1.60*	-0.50	-0.31	14.79	-56.05**	-29.47	-23.58*
26	**JDNOL-11-47 × Hisar Naveen**	-0.96*	0.26	-1.69	-0.80	-22.11*	19.96	-28.91	-10.35
27	**JDNOL-11-47 × Kashi Kranti**	-0.96*	1.74*	2.50*	1.09*	-29.06**	37.60*	33.80*	14.12
28	**JDNOL-11-47 × Kashi Lalima**	0.75	-0.40	-0.31	0.01	36.37**	-1.51	24.57	19.81*
S.Em.±		0.49	0.78	1.01	0.45	8.95	14.68	15.21	7.65
Range	**Min.**	-1.42	-2.35	-3.08	-1.58	-50.54	-64.84	-68.76	-46.69
	Max.	1.25	2.40	2.50	1.36	39.15	82.97	84.64	52.89
Positive		13	15	16	16	14	15	12	13
No. of +ve significant		2	3	2	2	7	7	6	6
Negative		15	13	12	12	14	13	16	15
No. of -ve significant		4	3	1	1	6	8	4	7

Table 4 Conti…

Sr. No.	Crosses	Chlorophyll A				Chlorophyll B				Total chlorophyll content			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
1	**JOL-14-10 × GO-6**	209.64**	116.18**	242.32**	189.38**	44.70**	67.39**	60.33**	57.47**	254.34**	183.57**	302.79**	246.90**
2	**JOL-14-10 × Hisar Naveen**	-15.55**	19.02**	-36.58**	-11.04**	47.50**	43.99**	43.62**	45.04**	31.94**	63.01**	7.19	34.05**
3	**JOL-14-10 × Kashi Kranti**	-137.10**	-101.29**	-159.25**	-132.55**	-41.15**	-45.12**	-49.96**	-45.41**	-178.25**	-146.41**	-209.07**	-177.91**
4	**JOL-14-10 × Kashi Lalima**	-56.99**	-33.91**	-46.48**	-45.80**	-51.05**	-66.26**	-54.00**	-57.10**	-108.03**	-100.17**	-100.91**	-103.04**
5	**JOL-16-06 × GO-6**	74.64**	-132.23**	-112.80**	-56.80**	120.58**	-45.46**	-40.31**	11.61**	195.22**	-177.69**	-153.14**	-45.20**
6	**JOL-16-06 × Hisar Naveen**	-33.62**	39.32**	17.79**	7.83**	-62.20**	-3.00	-6.11	-23.77**	-95.82**	36.32**	11.65**	-15.95**
7	**JOL-16-06 × Kashi Kranti**	-65.90**	7.43**	-11.95**	-23.47**	-27.80**	31.24**	19.67**	7.70**	-93.70**	38.68**	7.70*	-15.78**
8	**JOL-16-06 × Kashi Lalima**	24.87**	85.47**	106.96**	72.44**	-30.58**	17.22**	26.75**	4.47*	-5.70	102.69**	133.78**	76.92**
9	**JOL-75-01 × GO-6**	-121.23**	-109.42**	-88.60**	-106.42**	-30.60**	-19.00**	-14.57**	-21.39**	-151.83**	-128.43**	-103.19**	-127.82**
10	**JOL-75-01 × Hisar Naveen**	7.15**	7.94**	-13.28**	0.60	-43.81**	-44.11**	-49.06**	-45.66**	-36.67**	-36.16**	-62.36**	-45.06**
11	**JOL-75-01 × Kashi Kranti**	32.19**	33.12**	10.62**	25.32**	0.64	0.29	-8.01*	-2.36	32.83**	33.42**	2.60	22.95**
12	**JOL-75-01 × Kashi Lalima**	81.89**	68.36**	91.25**	80.50**	73.78**	62.82**	71.63**	69.41**	155.67**	131.18**	162.95**	149.93**
13	**JOL-75-10 × GO-6**	-2.11*	9.81**	28.43**	12.04**	-52.34**	-40.78**	-35.74**	-42.96	-54.45**	-30.98**	-7.33	-30.92**
14	**JOL-75-10 × Hisar Naveen**	-60.47**	-60.46**	-75.09**	-65.34**	66.87**	66.86**	60.09**	64.61**	6.39*	6.40*	-15.03**	-0.74
15	**JOL-75-10 × Kashi Kranti**	108.66**	109.07**	84.37**	100.70**	11.62**	11.47**	3.79	8.96**	120.29**	120.54**	88.13**	109.65**
16	**JOL-75-10 × Kashi Lalima**	-46.08**	-58.41**	-37.71**	-47.40**	-26.15**	-37.55**	-28.13**	-30.61**	-72.23**	-95.96**	-65.77**	-77.98**
17	**IC-111443 × GO-6**	99.33**	112.09**	131.44**	114.29**	17.03**	28.27**	32.32**	25.88**	116.36**	140.37**	163.74**	140.16**
18	**IC-111443 × Hisar Naveen**	85.72**	85.73**	65.73**	79.06**	-10.09**	-10.09**	-14.16**	-11.45**	75.64**	75.64**	51.54**	67.61**
19	**IC-111443 × Kashi Kranti**	-83.85**	-84.29**	-106.66**	-91.60**	2.85	3.01	-5.53	0.11	-81.00**	-81.28**	-112.21**	-91.50**
20	**IC-111443 × Kashi Lalima**	-101.20**	-113.53**	-90.51**	-101.75**	-9.80**	-21.20**	-12.63**	-14.54**	-111.00**	-134.73**	-103.07**	-116.27**
21	**JDNOL-11-03 × GO-6**	2.26*	34.25**	-190.54**	-51.34**	12.51**	-67.22**	-83.19**	-45.97**	14.77**	-32.97**	-273.76**	-97.32**
22	**JDNOL-11-03 × Hisar Naveen**	81.47**	46.60**	199.95**	109.34**	-6.87*	-3.25	20.18**	3.35	74.61**	43.35**	220.10**	112.69**
23	**JDNOL-11-03 × Kashi Kranti**	-122.35**	-158.06**	11.58**	-89.61**	-3.91	0.01	49.60**	15.23**	-126.26**	-158.05**	61.16**	-74.39**
24	**JDNOL-11-03 × Kashi Lalima**	38.62**	77.21**	-20.99**	31.61**	-1.73	70.46**	13.42**	27.38**	36.88**	147.67**	-7.50*	59.02**
25	**JDNOL-11-47 × GO-6**	-262.54**	-30.68**	-10.24**	-101.15**	-111.87**	76.80**	81.16**	15.36**	-374.41**	46.12**	70.89**	-85.80**
26	**JDNOL-11-47 × Hisar Naveen**	-64.70**	-138.16**	-158.52**	-120.46**	8.60**	-50.39**	-54.56**	-32.12**	-56.10**	-188.55**	-213.10**	-152.58**

27	**JDNOL-11-47 × Kashi Kranti**	268.35**	194.01**	171.28**	211.21**	57.75**	-0.91	-9.56*	15.76**	326.10**	193.10**	161.70**	226.97**
28	**JDNOL-11-47 × Kashi Lalima**	58.89**	-25.18**	-2.52	10.40**	45.52**	-25.50**	-17.04**	1.00	104.41**	-50.67**	-19.48**	11.42**
S.Em.±		1.05	0.80	1.51	0.66	**3.11**	**2.77**	3.74	1.87	2.95	2.63	3.73	1.81
Range	**Min.**	-262.54	-158.06	-190.54	-132.55	-111.87	-67.22	-83.19	-57.10	-374.41	-188.55	-273.76	-177.91
	Max.	268.35	194.01	242.32	211.21	120.58	76.80	81.16	69.41	326.10	193.10	302.79	246.90
Positive		14	16	12	14	**13**	**13**	12	16	14	15	14	12
No. of +ve significant		14	16	12	13	**11**	**10**	11	13	14	15	12	12
Negative		14	12	16	14	**15**	**15**	16	12	14	13	14	16
No. of -ve significant		14	12	15	14	**13**	**12**	14	10	13	13	13	15

Table 4 Conti…

Sr. No.	Crosses	Mucilage content				Crude fiber content				Moisture content			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
1	**JOL-14-10 × GO-6**	0.99**	0.95**	1.95**	1.30**	0.58**	0.75**	0.57**	0.64**	-2.03**	-1.64**	-4.19**	-2.62**
2	**JOL-14-10 × Hisar Naveen**	-0.40*	-0.40*	-0.39*	-0.40**	-0.29*	-0.40**	-0.08	-0.26*	0.62**	0.23	1.27**	0.71**
3	**JOL-14-10 × Kashi Kranti**	0.10	0.15	-0.52**	-0.09	-0.32*	-0.20	-0.21	-0.24*	0.51*	0.65*	1.38**	0.85**
4	**JOL-14-10 × Kashi Lalima**	-0.69**	-0.70**	-1.05**	-0.81**	0.03	-0.16	-0.29*	-0.14	0.89**	0.76*	1.54**	1.06**
5	**JOL-16-06 × GO-6**	0.62**	-0.14	-0.13	0.12	0.40**	-0.11	0.03	0.11	-1.91**	1.99**	1.80**	0.63**
6	**JOL-16-06 × Hisar Naveen**	-0.32	-0.30	0.07	-0.18	-0.56**	0.10	0.01	-0.15	3.79**	2.02**	2.40**	2.74**
7	**JOL-16-06 × Kashi Kranti**	0.09	0.31	-0.12	0.09	0.53**	0.19	-0.03	0.23*	-0.97**	-0.52	-0.85**	-0.78**
8	**JOL-16-06 × Kashi Lalima**	-0.39*	0.13	0.18	-0.03	-0.38**	-0.18	-0.01	-0.19*	-0.91**	-3.49**	-3.35**	-2.58**
9	**JOL-75-01 × GO-6**	-0.51**	-0.29	-0.38*	-0.40**	-0.33*	-0.04	-0.09	-0.15	1.10**	-0.67*	0.05	0.16**
10	**JOL-75-01 × Hisar Naveen**	0.05	-0.14	0.32*	0.08	0.11	-0.09	0.12	0.05	-2.95**	-2.43**	-2.79**	-2.72**
11	**JOL-75-01 × Kashi Kranti**	0.44*	0.44**	0.10	0.33*	0.10	0.34*	-0.02	0.14	-0.14	0.54	0.45*	0.28
12	**JOL-75-01 × Kashi Lalima**	0.03	-0.01	-0.04	-0.01	0.12	-0.21	-0.01	-0.03	1.99**	2.56**	2.30**	2.28**
13	**JOL-75-10 × GO-6**	0.36	0.58**	0.44**	0.46**	-0.39**	-0.46**	-0.50**	-0.45**	1.44**	0.41	0.78**	0.88**
14	**JOL-75-10 × Hisar Naveen**	0.83**	0.64**	0.60**	0.69**	0.60**	0.22	-0.02	0.27*	0.56*	1.69**	1.45**	1.23**
15	**JOL-75-10 × Kashi Kranti**	-0.49*	-0.49**	-0.61**	-0.53**	-0.01	-0.10	-0.01	-0.04	-0.09	1.20**	0.77**	0.63**
16	**JOL-75-10 × Kashi Lalima**	-0.69**	-0.74**	-0.43**	-0.62**	-0.19	0.34*	0.53**	0.23*	-1.92**	-3.30**	-3.00**	-2.74**
17	**IC-111443 × GO-6**	-0.35	-0.13	0.01	-0.16	-0.05	-0.21	0.63**	0.12	0.74**	0.63*	0.01	0.46*
18	**IC-111443 × Hisar Naveen**	-0.67**	-0.85**	-0.36*	-0.63**	-0.03	-0.12	-0.23	-0.13	-1.04**	1.32**	-0.14	0.05
19	**IC-111443 × Kashi Kranti**	0.68**	0.69**	0.23	0.53**	0.09	0.49**	-0.11	0.16	0.33	-3.67**	-0.73**	-1.36**
20	**IC-111443 × Kashi Lalima**	0.34	0.30	0.12	0.25*	-0.01	-0.16	-0.28*	-0.15	-0.02	1.72**	0.86**	0.86**
21	**JDNOL-11-03 × GO-6**	0.69**	0.63**	-0.61**	0.24*	0.48**	0.36*	-0.24	0.20*	-1.07**	-1.23**	1.01**	-0.43**
22	**JDNOL-11-03 × Hisar Naveen**	-0.30	0.42*	0.52**	0.21	-0.33*	0.14	0.43**	0.08	-0.08	-2.08**	-1.59**	-1.25**
23	**JDNOL-11-03 × Kashi Kranti**	0.10	-0.25	0.78**	0.21	-0.11	-0.32*	0.27*	-0.05	-0.31	0.73*	-2.01**	-0.53**
24	**JDNOL-11-03 × Kashi Lalima**	-0.49*	-0.80**	-0.68**	-0.66**	-0.04	-0.18	-0.47**	-0.23*	1.45**	2.58**	2.59**	2.21**
25	**JDNOL-11-47 × GO-6**	-1.80**	-1.59**	-1.29**	-1.56**	-0.69**	-0.29	-0.40**	-0.46**	1.73**	0.51	0.54*	0.93**
26	**JDNOL-11-47 × Hisar Naveen**	0.82**	0.62**	-0.76**	0.23*	0.50**	0.14	-0.24	0.14	-0.91**	-0.75*	-0.60**	-0.75**
27	**JDNOL-11-47 × Kashi Kranti**	-0.91**	-0.85**	0.13	-0.54*	-0.28*	-0.41**	0.12	-0.19*	0.67**	1.08**	1.01**	0.92**
28	**JDNOL-11-47 × Kashi Lalima**	1.89**	1.82**	1.91**	1.87**	0.46**	0.55**	0.52**	0.51**	-1.49**	-0.84**	-0.95**	-1.09**
S.Em.±		0.19	0.16	0.15	0.10	0.14	0.15	0.13	0.08	0.22	0.31	0.21	0.14
Range	**Min.**	-1.80	-1.59	-1.29	-1.56	-0.69	-0.46	-0.50	-0.46	-2.95	-3.67	-4.19	-2.74
	Max.	1.89	1.82	1.95	1.87	0.6	0.75	0.63	0.64	3.79	2.58	2.59	2.74
Positive		15	14	15	17	17	13	18	16	16	17	17	17
No. of +ve significant		8	8	7	10	7	6	6	6	12	13	15	14
Negative		13	14	13	11	11	15	10	12	12	11	11	11
No. of -ve significant		10	8	11	9	9	4	5	7	7	10	10	11

Here, E_1, E_2 and E_3 are different environments *viz.*, *Kharif* 2022, Summer 2023 and *Kharif* 2023, respectively

*and** indicate significant at 5 per cent and 1 per cent levels of significance, respectively

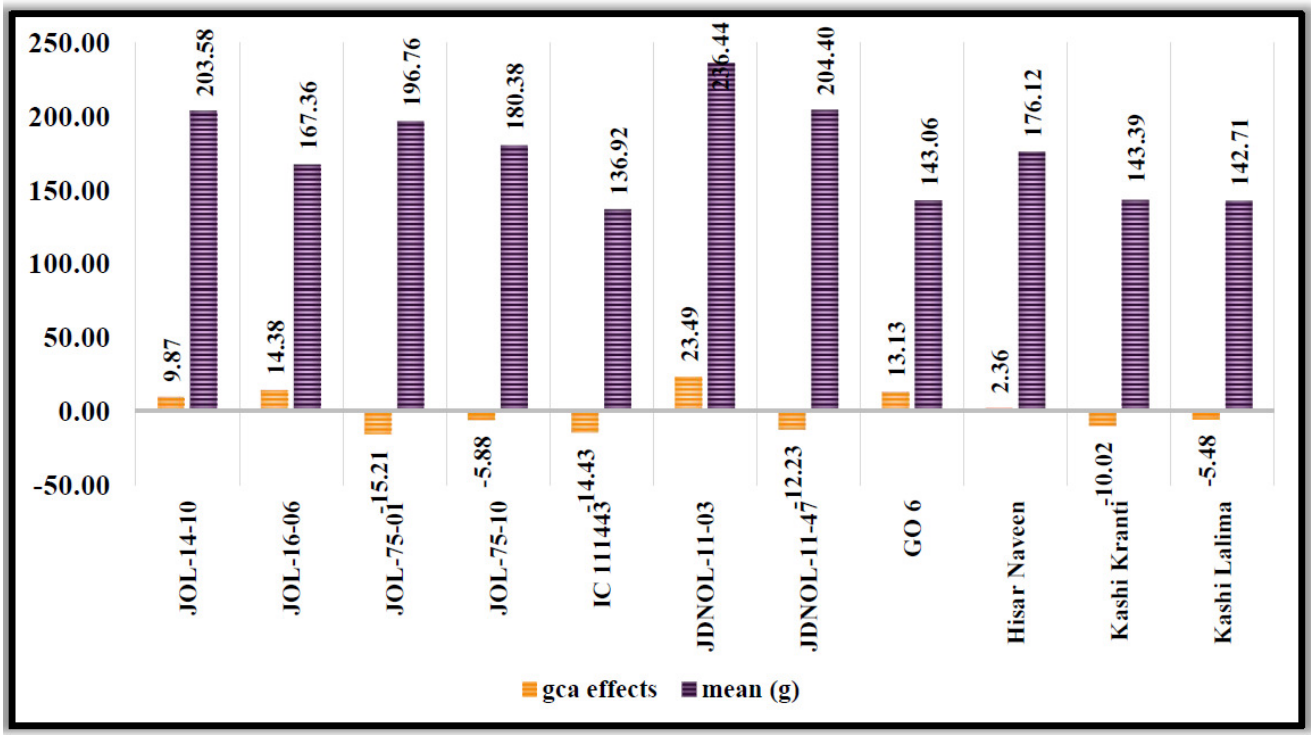

Fig. 1 : Graphical representation of *gca* effects and *per se* performance of parents in pooled over environments for fruit yield per plant

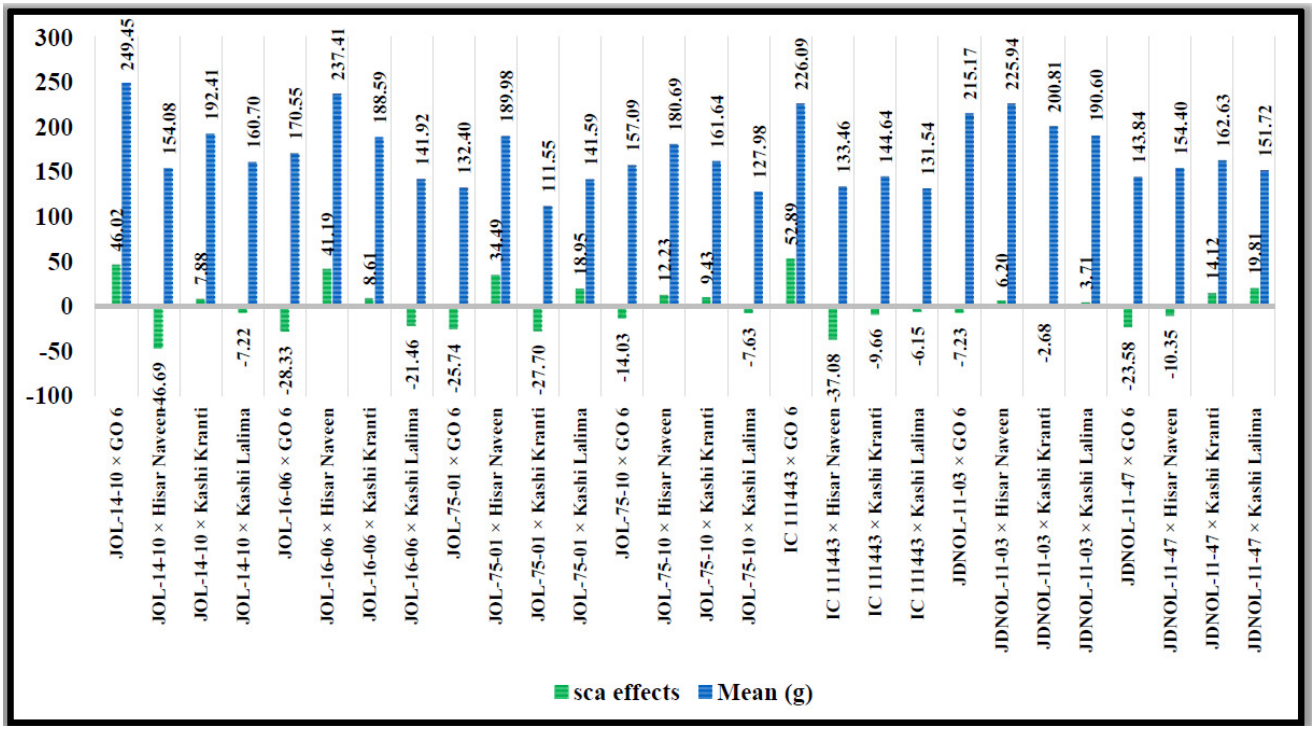

Fig. 2 : Graphical representation of *sca* effects and *per se* performance of crosses in pooled over environments for fruit yield per plant

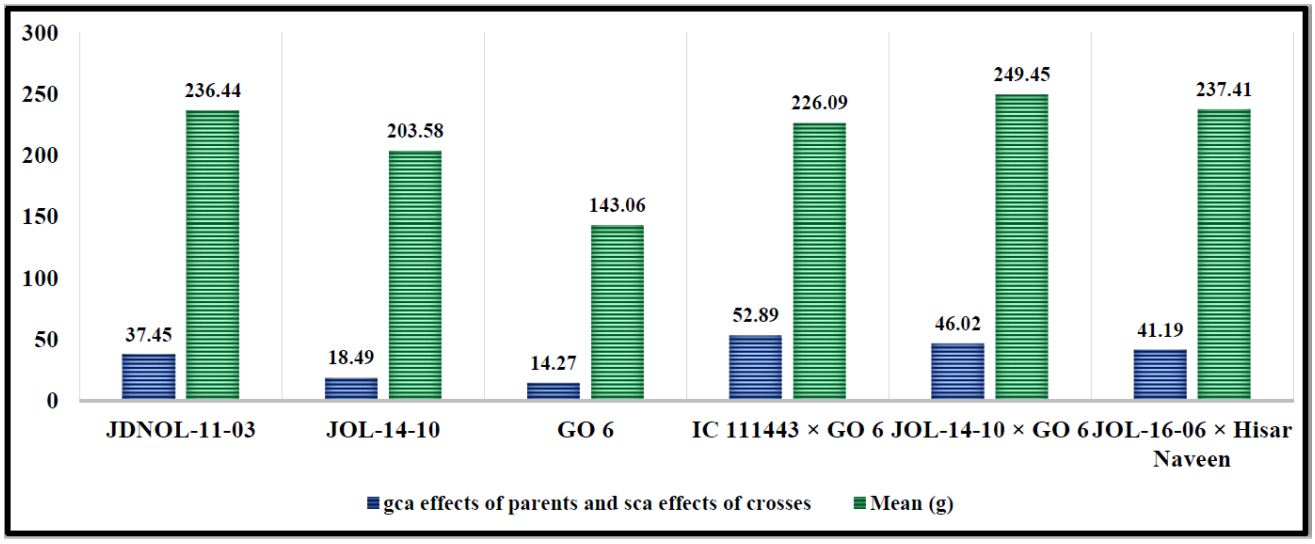

Fig. 3 : Best parents based on *gca* effects, crosses based on *sca* effects and *per se* performance in pooled over environments for fruit yield per plant

Acknowledgment

To acknowledge the Professor and Head and entire team of Department of Genetics and Plant Breeding, C.P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Banaskantha, Gujarat, India for their constant encouragement and moral support during the research work.

References

Abinaya, S., Saravanan, K.R., Thangavel, P., Madhubala, R. and Pushpanathan, K.R. (2020). Studies heterosis and combining ability analysis in okra [*Abelmoschus esculentus* (L.) Moench]. *Plant Archives*. **20**(1): 1340-1342.

Allard, R. W. (1960). Principles of Plant Breeding, John Willey and Sons. Inc.

Anonymous (2022). Report of okra conference. National Horticulture Board, Ministry of Agriculture and Farmers Welfare, Department of Agriculture, Cooperation and Welfare, Government of India, New Delhi.

Anonymous (2023[a]). Indian Horticulture Database. National Horticulture Board, Ministry of Agriculture and Farmers Welfare, Department of Agriculture, Cooperation and Welfare, Government of India, New Delhi. Retrieved from June, 2023 http://nhb.gov.in/

Bhatt, J. P. (2011). Diallel analysis for fruit yield, its components and quality traits in okra [*Abelmoschus esculentus* (L.) Moench]. [M. Sc. (Agri.) thesis, Anand Agricultural University, Anand, Gujarat.].

Budha Ram (2015). Diallel analysis in okra [*Abelmoschus esculentus* (L.) Moench]. [M.Sc. (Agri.) thesis, Anand Agricultural University, Anand, Gujarat]. Retrived from http://krishikosh.egranth.ac.in/handle/1/96732.

Das, A., Yadav, R., Bhardwaj, R., Choudhary, H., Talukdar, A., Khade, Y. P. and Chandel, R. (2020[b]). Combining ability and gene action studies to select okra [*Abelmoschus esculentus* (L.) Monech] inbred for carbohydrate, vitamins and antioxidant traits. *Indian Journal of Agricultural Sciences*. **90**(10): 2006–13.

Das, A., Yadav, R., Choudhary, H., Singh, S., Khade, Y. P. and Chandel, R. (2020[a]). Determining genetic combining ability, heterotic potential and gene action for yield contributing traits and Yellow Vein Mosaic Virus (YVMV) resistance in Okra [*Abelmoschus esculentus* (L.) Monech]. *Plant Genetic Resources: Characterization and Utilization*. 1-14.

Gemede, H. F., Negussie R., Gulelat D. H., Woldegiorgis A. Z. and Fekadu B. (2015). Nutritional quality and health benefits of okra [*Abelmoschus esculentus* (L.) Moench]. *International Journal of Nutrition and Food Science*. **4**(2): 208-215.

Hadiya, D. N., Mali, S. C., Gamit, A. M. and Sangani, J. L. (2018[b]). Combining ability studies in okra [*Abelmoschus esculentus* (L.) Moench]. *Journal of Pharmacognosy and Phytochemistry*. **7**(5): 2525-2528.

Javiya, U. R., Mehta, D. R., Sapovadiya, M. H. and Pansuriya, D. J. (2020). Selection of parents and breeding methods based on combining ability and gene action for fruit yield and its contributing characters in okra [*Abelmoschus esculentus* (L.) Moench]. *Journal of Pharmacognosy and Phytochemistry*. **9**(5): 1936-1939.

Khatik, K. R., Chaudhary, R. and Khatik, C. L. (2012). Heterosis studies in okra. *Annals of Horticulture*. **5**(2): 213 - 218.

Limbani, H. B. (2023). Heterosis, combining ability and gene action for fruit yield and its component traits in okra (*Abelmoschus esculentus* (L.) Moench) over environments. Ph.D. (Agri.) thesis Unpublished. Junagadh Agricultural University.

Limbani, H., Mehta, D. R. and Sagar, J. (2023). Combining ability analysis of genotype through half diallel method in okra [*Abelmoschus esculentus* (L.) Moench] over different environments. *The Pharma Innovation*. **12**(12): 3110-3114.

Mudhalvan, S. and Senthilkumar, N. (2021). Combining ability, reciprocal effects and heterosis for fruit yield characters in

okra [*Abelmoschus esculentus* (L.) Moench]. *Journal of Pharmacognosy and Phytochemistry.***10**(1): 96-101.

Mundhe, S. S., Pole, S. P. and Khandebharad, P. R. (2023). Diallel analysis for yield and yield component traits in okra [*Abelmoschus esculentus* (L.) Moench]. *The Pharma Innovation Journal.* **12**(1): 2981-2987.

Nanthakumar, S., Kuralarasu, C. and Gopikrishnan, A. (2021). Heterosis and combining abilities studies in okra [*Abelmoschus esculentus* (L.) Moench]. *Current Journal of Applied Science and Technology*. **40**(30): 25-33.

Narkhede, G. W., Thakur, N. R. and Ingle, K. P. (2021). Studies on combining ability for yield and contributing traits in okra (*Abelmoschus esculentus* L. Moench). *Electronic Journal of Plant Breeding.* **12**(2): 403-412.

Pawar, Y., Sarode, S. B., Shaikh, A. B., and Kharad, D. A. (2020). Phenotypic and genotypic path coefficient analysis studies in okra [*Abelmoschus esculentus* (L.) Moench]. *Journal of Pharmacognosy and Phytochemistry.* **9**(5): 488-493.

Pithiya, D. J., Jethava, A. S., Zinzala, S. N. and Vachhani, J. H. (2020). Study on combining ability in okra [*Abelmoschus esculentus* (L.) Moench] *International Journal of Chemical Studies*. **8**(1): 676-679.

Prem Sagar, S. P., Dushyanthakumar, B. M., Kalleshwaraswamy, C. M., Satish, K. M., Diwan, J. R., Raghavendra, V. C., Swathy, V. and Channabasava. (2023). Diallel approach for estimating hybrid superiority and combining ability of indigenous advanced breeding lines in okra [*Abelmoschus esculentus* (L.)]. *Genetic Resources Crop Evolution*.

Radadiya, C., Mehta, D. R. and Rathod, R. (2023). Genetic behaviour of earliness traits in okra [*Abelmoschus esculentus* (L.) Moench]. *The Pharma Innovation Journal.* **12**(12): 2233-2241.

Rajani, A., Naram Naidu, L., Reddy, R. V. S. K., Srikanth, D., Kumari, N. R. and Ratna Babu, D. (2021[b]). Studies on combining ability for yield and quality attributing traits in okra [*Abelmoschus esculentus* (L.) Moench]. *The Pharma Innovation Journal.* **10**(10): 1398-1400.

Rajani, A., Naram Naidu, L., Reddy, R.V. S. K., Kumari, N., Srikanth, D. and Ratna Babu, D. (2021[a]). Studies on heterosis for growth and yield attributing characters in okra [*Abelmoschus esculentus* (L.) Moench]. *The Pharma Innovation Journal*. **10**(10): 1380-1387.

Ranga, A. D., Vikram, A., Kumar, A., Dogra, R. K., Sharma, R., and Kumar Bairwa, M. (2024). Genetic assessment and potence ratio of various traits of okra [*Abelmoschus esculentus* (L.) Moench] in mid hills of Himachal Pradesh. *Indian Journal of Agricultural Sciences.* **94**(1): 026–032.

Singh, P., Chauhan, V., Tiwari, B. K., Chauhan, S. S., Simon, S. and Abidi, A. B. (2014). An overview on okra and it's importance as a nutritive vegetable in the world. *International Journal of Pharmacy and Biological Science.* **4**(2): 227-233.

Singh, S., Singh, B. and Pal, A. K. (2006). Line × Tester analysis of combining ability in okra. *Indian Journal of Horticulture*. **63**(4): 397-401.

Vekariya, R. D., Patel, A. I., Modha, K. G., Kapadiya, C. V., Mali, S. C. and Patel, A. A. (2020). Estimation of heterosis, gene action and combining ability over environments for improvement of fruit yield and its related traits in okra [*Abelmoschus esculentus* (L.) Moench]. *International Journal of Current Microbiology and Applied Sciences.* **9**(9): 866-881.

Wakode, M. M., Bhave, S. G., Navhale, V. C., Dalvi, V. V., Devmore, J. P. and Mahadik, S. G. (2016). Combining ability studies in okra [*Abelmoschus esculentus* (L.) Moench]. *Electronic Journal Plant Breeding*. **7**(4): 1007-1013.

Zate, D. K. (2019) Generation mean analysis studies in okra [*Abelmoschus esculentus* (L.) Moench] M.Sc. (Agri.) thesis (unpublished). Vasantrao Nail Marathwada Krishi Vidyapith, Parbhani, Maharashtra.