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Combining ability studies in okra [*Abelmoschus esculentus* (L.) Moench] for growth and earliness parameters through line x tester analysis

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Abstract

Combining ability effects were estimated for different characters in a line x tester crossing programme comprising 36 hybrids produced by crossing 3 lines and 12 testers. Parents and hybrids differed significantly for gca and sca effects, respectively. Among the lines, Korchhi, AKO-1-P-2 and among the testers AKO-74, AKO-Red were found to be the best general combiners for growth character plant height and the line Korchhi and testers AKO-74 and AKO-73 were found to be the best general combiners for earliness characters. Cross-combinations viz., Korchhi x AKO-10, AKO-1-P-2 x Phule Vimukta and Kokan Bhendi x AKO-11 were found to be the best specific crosses for growth character plant height. For earliness characters Cross-combinations viz., Kokan Bhendi x AKO-10 and Korchhi x AKO-11 for internodal length, AKO-1-P-2 x IC-42472 and Kokan Bhendi x AKO-7 for node at which first flower appeared, Korchhi x Arka Anamika and AKO-1-P-2 x AKO-7 for days to 50% flowering, AKO-1-P-2 x AKO-73 and Kokan Bhendi x AKO-2 for days to initiation of first flower and AKO-1-P-2 x AKO-73 and AKO-1-P-2 x AKO-10 for days to first harvest were found to be the best specific combiners.

Keywords: Combining ability, GCA, SCA, okra, line x tester

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] also commonly known as ladies' finger or bhindi is an important vegetable crop originated from tropical Africa. The world biggest producer of okra is India. One of the major issues in okra cultivation in India is lack of specific to location high yielding varieties. In often cross-pollinated crops like okra, improvement in the past was based on selection in locally adapted populations. During recent past, exploitation of hybrid vigour and selection of parents on the basis of combining ability effects have opened a new line of approach in crop improvement. Line×Tester analysis technique suggested by (Kempthorne 1957) ^[1] stands as one of the most recognized and systematic methodologies for identifying and selection of superior parents and crosses. This approach serves as a fundamental prerequisite for success in any breeding initiative. Application of biometrical techniques like line x tester analysis has appeared to be the best and vastly useful breeding tool, which gives generalized picture of genetics of the characters under study. Breeding programs focus on selection of better genotypes and hybrids to maximize crop productivity, especially in mineral-rich foods crucial for human diets (Shiri *et al.*, 2024) ^[2]. The selection of appropriate breeding practices relies on understanding general combining ability (GCA) and specific combining ability (SCA) to capitalize on additive and non-additive gene actions, respectively, as outlined by (Sprague and Tatum, 1942) ^[3].

Materials and Methods

The present research was carried out during *Kharif* 2022 (Crossing Block), *Kharif* 2023 and 2024 (Evaluation Trial I and II) at the Department of Vegetable Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Maharashtra state. 15 genotypes of okra (3 lines and 12 testers) and one standard check Radhika evaluated in randomized block design with 3 replications by line x tester method developed 36 F₁s. Each treatment or a genotype in each replication was represented by one row each accommodating 20 plants at a row to row

to row spacing of 60cm and 45cm from plant to plant. Five plants were randomly selected for each genotype from each replication and evaluated for the quantitative characters and the replicated mean values of various characters of parents and hybrids were subjected to Line x Tester analysis.

Result and Discussions

General Combining Ability

The estimates of gca effects indicated that the parent, AKO-74 (50.78) followed by AKO-Red (16.61), Korchhi (6.43) and AKO-10 (3.98) had maximum positive and significant gca effect for growth character plant height. Maximum positive GCA is important for inheritance of plant height character in okra, the result indicated that parents having positive good general combining ability for the same trait. Similar results of significant and positive GCA were also obtained by Keerthana *et al.* (2024) ^[4] in okra.

The parent AKO-74 (0.64) followed by IC-42472 (0.57) and EC-3293384 had maximum positive and significant gca effect for number of branches per plant. The character number of branches per plant in okra breeding desired in positive direction for inheritance of trait. In okra Kumar *et al.* (2021) ^[5] also identified good general combiners for the number of branches per plant.

The parent AKO-2 (-0.69) followed by Kokan Bhendi (-0.61) and EC-3293384 (-0.50) recorded the maximum negative and significant gca effect for earliness character internodal length. The results evident that negative combining ability effect for inheritance of inter nodal length. In okra Sayed *et al.* (2024) ^[6] also identified good general combiners for the length of inter node.

AKO-74 (-2.54) followed by AKO-73 (-1.62), AKO-10 (-1.62) and Korchhi (-1.12) recorded the maximum negative and significant gca effect for earliness character days to initiation of first flower. Negative GCA effect is highly desirable for days to initiation of first flower in okra crop and desirable combining ability parental lines are considered for further crossing program. In okra Keerthana *et al.* (2024) ^[4] also identified good general combiners for the days to initiation of first flower.

The parents AKO-10 (-1.96) followed by Korchhi (-1.79), AKO-73 (-1.79) and AKO-74 (-1.79) recorded the maximum negative and significant gca effect for earliness character days to 50% flowering. Negative combining ability effect is highly desirable for the earliness of 50 percent flowering in okra. In okra Pathania *et al.* (2024) ^[7] also identified good general combiners for days to 50 percent flowering.

The parents AKO-74 (-3.66) followed by AKO-73 (-1.50) and Korchhi (-1.22) recorded the maximum negative and significant gca effect for earliness character days to first harvesting on the basis of pooled season. Negative GCA effect is desirable for this character and present study evident the same result. In okra Keerthana *et al.* (2024) ^[4] also identified good general combiners for the days to first harvesting.

Specific Combining Ability

The cross Korchhi x AKO-10 (36.07) exhibited highest positive significant SCA effects followed by AKO-1-P-2 x Phule Vimukta (33.81), Kokan Bhendi x AKO-11 (30.74). Positively significant SCA effect is good combiner for inheritance of desirable character. Similar results of significant and positive SCA were also obtained by Maurya *et al.* (2022) ^[8] and Keerthana *et al.* (2024) ^[4] in okra.

Kokan Bhendi x AKO-10 (-1.84) recorded the highest negative SCA effects followed by Korchhi x AKO-11 (-1.27), AKO-1-P-2 x IC-42472 (-0.90), AKO-1-P-2 x EC-3293384 (-0.89) and Korchhi x AKO-Red (-0.88) in pooled. Negatively significant SCA effect is good combiner for inheritance of inter nodal length. In okra Sayed *et al.* (2024) ^[6] also identified good general combiners for length of internode.

The cross combinations Korchhi x IC-42472 (1.69) recorded the highest negative SCA effects followed by AKO-1-P-2 x AKO-2 (1.50) and AKO-1-P-2 x AKO-11 (1.24). The predominance of SCA variance for branches per plant implied that non additive gene action was important in the genetic background for this character. In okra Kumar *et al.* (2021) ^[5] also identified good general combiners for the number of branches per plant.

The cross AKO-1-P-2 x IC-42472 (-0.88) exhibited highest negative significant SCA effects followed by Kokan Bhendi x AKO-7 (-0.82), AKO-1-P-2 x AKO-74 (-0.77) and Kokan Bhendi x Phule Vimukta (-0.72). In okra Keerthana *et al.* (2024) ^[4] also identified high negative significant SCA effects for node at which first flower appear.

The cross AKO-1-P-2 x AKO-73 (-2.56) exhibited highest negative significant SCA effects followed by Kokan Bhendi x AKO-2 (-2.47) and Korchhi x Arka Anamika (-2.20). In okra Pathania *et al.* (2024) ^[7] and Keerthana *et al.* (2024) ^[4] also identified high SCA effects for days to initiation of first flower.

The cross Korchhi x Arka Anamika (-1.78) exhibited highest negative significant SCA effects followed by AKO-1-P-2 x AKO-7 (-1.74) and AKO-1-P-2 x AKO-10 (-1.41). Crosses registered significant and negative SCA effects for days to 50 percent flowering. All the best performer crosses for earliness involve at least one good general combiner. The crosses showing high SCA effects not always involve parents with high GCA effects, suggesting that the inter-allelic interactions are important for 50 percent flowering. These findings are in conformity with the findings of Pathania *et al.* (2024) ^[7] in okra.

The cross AKO-1-P-2 x AKO-73 (-3.50) exhibited highest negative significant SCA effects followed by AKO-1-P-2 x AKO-10 (-2.83) and Kokan Bhendi x AKO-1 (-2.39). The result indicated that most of the heterotic hybrids exhibit negatively significant for earliness that is days required for first harvest in present study, which indicates non-additive gene action for the inheritance of the character. Keerthana *et al.* (2024) ^[4] also observed SCA for days required for first harvesting in okra.

Table 1: Estimation of general combining ability (GCA) effects of lines for different characters

Sr. No.	Parents	Plant height (cm)			Internodal Length (cm)			Number of Branches per plant		
		2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
	Lines									
1.	Korchi	6.43**	3.75**	5.09**	-0.14**	-0.18**	-0.16	-0.29**	-0.18**	-0.24**
2.	AKO-1-P-2	-1.32	7.96**	3.31**	0.78**	0.77**	0.77**	0.37**	0.34**	0.35**
3.	Kokan Bhendi	-5.10**	-11.71**	-8.41**	-0.63**	-0.59**	-0.61**	-0.07*	-0.15**	-0.11**
	Testers									
4.	Phule Vimukta	-29.98**	1.61	-14.18**	0.44**	0.18*	0.31**	-0.47**	-0.40**	-0.44**
5.	Arka Anamika	2.81	0.61	1.71	0.68**	0.77**	0.72**	-1.17**	-1.20**	-1.19**
6.	Red Var.	20.28**	12.95**	16.61**	0.46**	0.36**	0.41**	0.34**	-0.13**	-0.24**
7.	Ako-11	0.24	2.88	1.56	0.01	0.28**	0.15**	-0.21**	-0.13**	-0.17**
8.	Ako-1	-2.91	-4.11*	-3.51**	0.49**	0.46**	0.47**	-0.17**	-0.006	-0.09**
9.	Ako-2	-3.61*	-20.85**	-12.23**	-0.51**	-0.88**	-0.69**	0.38**	0.52**	0.45**
10.	Ako-7	-14.58**	-8.98	-11.78**	-0.91**	-0.78**	-0.84**	0.32**	0.12**	0.22**
11.	Ako-10	3.81*	4.15*	3.98**	-0.12	-0.35**	-0.23**	0.55**	0.26**	0.40**
12.	F7-3	-16.18**	-19.98**	-18.08**	-0.10	-0.13	-0.12**	-0.67**	-0.67**	-0.67**
13.	F7-4	55.28**	46.28**	50.78**	-0.31**	0.51**	0.09*	0.68**	0.59**	0.64**
14.	IC-42472	-11.15**	-9.18**	-10.16**	0.30**	0.14	0.22**	0.68**	0.46**	0.57**
15.	EC-3293384	-3.98*	-5.38**	-4.68**	-0.43**	-0.57**	-0.50**	0.42**	0.59**	0.50**
	SE±(Lines)	0.82	0.81	0.60	0.05	0.04	0.20	0.04	0.02	0.03
	C.D. at 5%	1.63	0.61	1.19	0.10	0.09	0.39	0.08	0.05	0.06
	SE±(Testers)	1.65	1.63	1.20	0.10	0.09	0.04	0.08	0.05	0.06
	C.D. at 5%	3.27	3.23	2.39	0.21	0.18	0.08	0.16	0.11	0.12

Sr. No.	Parents	Days to initiation of 1 st flower			Days to 50% flowering			Days to first harvest		
		2023	2023	2023	2024	Pooled	Pooled	2023	2024	Pooled
	Lines									
1.	Korchi	-1.72**	-0.52	-1.12**	-2.16**	-1.43**	-1.79**	-1.73**	-0.72	-1.22**
2.	AKO-1-P-2	1.94**	1.01**	1.47**	2.29**	1.86**	2.07**	1.80**	1.02*	1.41**
3.	Kokan Bhendi	-0.22	-0.48	-0.35	-0.12	-0.43	-0.27	-0.06	-0.30	-0.18
	Testers									
4.	Phule Vimukta	-0.55	-0.36	-0.45	-0.16	-0.43	-0.29	-0.06	0.06	0.00
5.	Arka Anamika	1.44**	-0.69	0.37	1.33**	-0.26	0.53	0.76	-1.43	-0.33
6.	Red Var.	-0.88	-1.02	-0.95*	0.33	0.73	0.53	-0.06	-0.26	-0.16
7.	Ako-11	-0.22	1.80**	0.79	-0.16	1.40*	0.61	-0.90*	1.40	0.25
8.	Ako-1	-1.05	0.47	-0.29	-1.50**	0.06	-0.71	-0.56	0.56	0.00
9.	Ako-2	2.94**	4.30**	3.62**	2.83**	2.73**	2.78**	1.59**	1.40	1.50**
10.	Ako-7	1.77**	2.13**	1.95**	2.16**	2.56**	2.36**	2.76**	3.40**	3.08**
11.	Ako-10	-0.55	-2.02**	-1.29**	-1.16**	-2.76**	-1.96**	-0.56	-1.26	-0.91
12.	F7-3	-1.38*	-1.86**	-1.62**	-1.83**	-1.76**	-1.79**	-0.90*	-2.09*	-1.50**
13.	F7-4	-2.55**	-2.52**	-2.54**	-2.16**	-1.43*	-1.79**	-3.73**	-3.59**	-3.66**
14.	IC-42472	0.27	-0.69	-0.20	0.16	-0.93	-0.38	0.43	0.23	0.33
15.	EC-3293384	0.77	0.47	0.62	0.16	0.06	0.11	1.26**	1.56	1.41*
	SE±(Lines)	0.27	0.27	0.24	0.22	0.32	0.23	0.22	0.41	0.27
	C.D. at 5%	0.54	0.53	0.47	0.45	0.64	0.47	0.45	0.81	0.55
	SE±(Testers)	0.55	0.54	0.48	0.45	0.64	0.47	0.45	0.82	0.55
	C.D. at 5%	1.09	1.07	0.95	0.90	1.28	0.94	0.90	1.63	1.10

*, ** denotes significance at 5% and 1% respectively.

Table 2: Estimation specific combining ability (SCA) for Plant height (cm), Internodal length and Number of branches per plant over the Year and pooled

Sr. No.	Genotypes	Plant height (cm)			Internodal length (cm)			Number of branches per plant		
		2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
1.	Korchi x Phule Vimukta	12.76**	-16.88**	-2.05	0.08	-0.01	0.03	-0.20	-0.47**	-0.34**
2.	Korchi x Arka Anamika	-0.63	8.11**	3.74	-0.40*	0.18	-0.11	-0.50**	-0.67**	-0.59**
3.	Korchi x Ako-Red	-23.29**	-24.41**	-23.85**	-0.45*	-1.31**	-0.88**	0.46**	0.25**	0.35**
4.	Korchi x Ako-11	-31.66**	-25.15**	-28.40**	-0.89**	-1.66**	-1.27**	-0.97**	-0.94**	-0.95**
5.	Korchi x Ako-1	-16.09**	-11.35**	-13.72**	0.88**	0.54**	0.71**	-0.50**	-0.27**	-0.39**
6.	Korchi x Ako-2	16.70**	14.98**	15.84**	0.24	0.24	0.24	-0.27	-0.41**	-0.34**
7.	Korchi x Ako-7	14.96**	14.71**	14.84**	-0.10	0.04	-0.03	0.59**	0.58**	0.59**
8.	Korchi x Ako-10	34.16**	37.98**	36.07**	1.31	1.59**	1.45**	0.56**	0.65**	0.60**
9.	Korchi x Ako-73	12.76**	5.71*	9.24**	-0.36*	-0.30	-0.33*	-0.00	-0.21*	-0.10
10.	Korchi x Ako-74	-8.09**	-6.15*	-7.12**	-1.28	1.09**	-0.09	-0.37**	-0.47**	-0.42**
11.	Korchi x IC-42472	-6.56*	3.91	-1.32	0.60**	-0.18	0.21	1.52**	1.85**	1.69**
12.	Korchi x EC-3293384	-5.03	-1.48	-3.25	0.38*	-0.21	0.08	-0.30*	0.12	-0.09
13.	AKO-1-P-2 x Phule Vimukta	4.72	62.90**	33.81**	0.84**	0.83**	0.83**	0.22	0.18*	0.20*
14.	AKO-1-P-2 x Arka Anamika	30.92**	25.30**	28.11**	1.15**	0.89**	1.02**	0.22	0.38**	0.30**
15.	AKO-1-P-2 x Ako Red	18.96**	14.16**	16.56**	0.42*	1.31**	0.86**	-0.40**	-0.27**	-0.34**
16.	AKO-1-P-2 x Ako-11	2.49	-7.16*	-2.33	0.09	0.57**	0.33*	1.16**	1.32**	1.24**
17.	AKO-1-P-2 x Ako-1	10.66**	6.03*	8.34**	-1.09**	-0.45*	-0.77**	0.02	-0.01	0.00
18.	AKO-1-P-2 x Ako-2	-8.83**	-12.03**	-10.43**	-0.46*	-0.65**	-0.56**	1.56**	1.45**	1.50**
19.	AKO-1-P-2 x Ako-7	10.52**	9.10**	9.81**	-0.31	-0.20	-0.26	0.12	0.25**	0.19
20.	AKO-1-P-2 x Ako-10	-17.87**	-23.66**	-20.75**	0.42*	0.36*	0.39**	0.09	-0.47**	-0.19
Sr. No.	Genotypes	Plant height (cm)			Internodal length (cm)			Number of branches per plant		
		2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
21.	AKO-1-P-2 x Ako-73	-11.47**	-7.10*	-9.28**	0.75**	0.47**	0.61**	-0.67**	-0.54**	-0.60**
22.	AKO-1-P-2 x Ako-74	-16.53**	-18.76**	-17.65**	0.15	-1.58**	-0.67**	0.56**	0.58**	0.57**
23.	AKO-1-P-2 x IC-42472	-7.10*	-14.70**	-10.90**	-0.90**	-0.98**	-0.90**	-2.13**	-1.87**	-2.00**
24.	AKO-1-P-2 x EC-3293384	-16.47**	-34.10**	-25.28**	-1.06**	-0.72**	-0.89**	-0.77**	-1.01**	-0.89**
25.	Kokan Bhendi x Phule Vimukta	-17.49**	-46.01**	-31.75**	-0.92**	-0.81**	-0.86**	-0.02	0.28**	0.13
26.	Kokan Bhendi x Arka Anamika	-30.29**	-33.41**	-31.85**	-0.74**	-1.08**	-0.91**	0.27	0.28**	0.28**
27.	Kokan Bhendi x Ako-Red.	4.33	10.25**	7.29**	0.02	0.01	0.01	-0.05	0.02	-0.01
28.	Kokan Bhendi x Ako-11	29.16**	32.31**	30.74**	0.79**	1.08**	0.93**	-0.18	-0.37**	-0.28**
29.	Kokan Bhendi x Ako-1	5.43	5.31	5.37*	0.20	-0.09	0.05	0.47**	0.28**	0.38**
30.	Kokan Bhendi x Ako-2	-7.86**	-2.95	-5.40*	0.22	0.41	0.31*	-1.28**	-1.04**	-1.16**
31.	Kokan Bhendi x Ako-7	-25.49**	-23.81**	-24.65**	0.42*	0.16	0.29*	-0.72**	-0.84**	-0.78**
32.	Kokan Bhendi x Ako-10	-16.29**	-14.35**	-15.32**	-1.73**	-1.95**	-1.84**	-0.65**	-0.17	-0.41**
33.	Kokan Bhendi x Ako-73	-1.29	1.38	0.04	-0.39*	-0.16	-0.27	0.67**	0.75**	0.71**
34.	Kokan Bhendi x Ako-74	24.63**	24.91**	24.77**	1.12**	0.40	0.76**	-0.18	-0.11	0.15
35.	Kokan Bhendi x IC-42472	13.66**	10.78**	12.22**	0.30	1.08**	0.69**	0.61**	0.02	0.31**
36.	Kokan Bhendi x EC-3293384	21.50**	35.58**	28.54**	0.68**	0.94**	0.81**	1.07**	0.88**	0.98**
SE±(sca)		4.04	3.99	2.96	0.26	0.23	0.20	0.20	0.13	0.14
CD at 5% (sca)		8.02	7.93	5.87	0.52	0.46	0.39	0.40	0.27	0.29

Table 3: Estimation specific combining ability (SCA) for Number of nodes per plant, Node at which first flower appear and days to initiation of first flower over the Year and pooled

Sr. No.	Genotypes	Days to initiation of first flower			Days to 50% flowering			Days to first harvest		
		2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
1.	Korchi x Phule Vimukta	-0.94	-1.30	-1.12	0.16	0.43	0.29	-2.26**	-2.44	-2.35*
2.	Korchi x Arka Anamika	-2.94**	-1.47	-2.20**	-2.83**	-0.73	-1.78*	-2.59**	-0.94	-1.77
3.	Korchi x Ako-Red	-0.11	1.36	0.62	0.66	1.76	1.21	-0.26	1.38	0.56
4.	Korchi x Ako-11	0.22	3.02**	1.62	-0.83	2.09**	0.63	1.06	4.22**	2.64**
5.	Korchi x Ako-1	0.55	-0.63	-0.04	1.00	-0.56	0.21	2.23**	1.55	1.89*
6.	Korchi x Ako-2	0.55	1.02	0.79	0.66	-1.73*	-0.53	0.06	-2.27	-1.10
7.	Korchi x Ako-7	0.22	-0.30	-0.04	1.33	0.93	1.13	-1.09	-1.77	-1.43
8.	Korchi x Ako-10	2.05*	0.36	1.20	2.16**	0.76	1.46	2.23**	0.38	1.31
9.	Korchi x Ako-73	-0.61	-0.80	-0.70	-1.16	0.26	-0.45	-0.93	-0.27	-0.60
10.	Korchi x Ako-74	0.55	-0.13	0.20	-1.33	-1.56*	-1.45	0.90	0.22	0.56
11.	Korchi x IC-42472	0.72	-0.47	0.12	0.33	-1.06	-0.36	0.73	-0.11	0.31
12.	Korchi x EC-3293384	-0.27	-0.63	-0.45	-0.16	-0.56	-0.36	-0.09	0.05	-0.02
13.	AKO-1-P-2 x Phule Vimukta	2.38*	1.65	2.02*	0.70	-0.86	-0.07	2.19**	1.30	1.75
14.	AKO-1-P-2 x Arka Anamika	4.38**	2.48**	3.43**	3.20**	0.97	2.09*	4.36**	2.30	3.33**
15.	AKO-1-P-2 x Ako Red	0.22	-1.68	-0.72	-0.79	-1.52	-1.16	1.19	-0.86	0.16
16.	AKO-1-P-2 x Ako-11	-0.94	-1.01	-0.97	-0.29	-0.69	-0.49	-0.47	-1.02	-0.75
17.	AKO-1-P-2 x Ako-1	-0.11	1.31	0.60	-0.95	0.13	-0.41	-0.30	1.30	0.50
18.	AKO-1-P-2 x Ako-2	1.38	1.98*	1.68*	0.20	1.47	0.84	1.52	3.47*	2.50**
19.	AKO-1-P-2 x Ako-7	-1.44	-0.84	-1.14	-2.12**	-1.36	-1.74*	-0.13	-0.02	-0.08
20.	AKO-1-P-2 x Ako-10	-1.61	-0.68	-1.14	-1.79*	-1.02	-1.41*	-2.80**	-2.86*	-2.83**
Sr. No.	Genotypes	Days to initiation of first flower			Days to 50% flowering			Days to first harvest		
		2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
21.	AKO-1-P-2 x Ako-73	-2.77**	-2.34*	-2.56**	-0.62	-1.02	-0.82	-3.97**	-3.02*	-3.50**
22.	AKO-1-P-2 x Ako-74	-2.11*	-0.68	-1.39	-0.29	1.63*	0.67	-2.63**	-1.02	-1.83
23.	AKO-1-P-2 x IC-42472	-0.44	-0.51	-0.47	1.37	1.63	1.50	-0.30	-0.36	-0.33
24.	AKO-1-P-2 x EC-3293384	1.05	0.31	0.68	1.37	0.63	1.00	1.36	0.80	1.08
25.	Kokan Bhendi x Phule Vimukta	-1.44	-0.34	-0.89	-0.87	0.43	-0.22	0.06	1.13	0.60
26.	Kokan Bhendi x Arka Anamika	-1.44	-1.01	-1.22	-0.37	-0.23	-0.30	-1.76*	-1.36	-1.56
27.	Kokan Bhendi x Ako-Red.	-0.11	0.31	0.10	0.12	-0.23	-0.05	-0.93	-0.52	-0.72
28.	Kokan Bhendi x Ako-11	0.72	-2.01*	-0.64	1.12	-1.40	-0.13	-0.59	-3.19*	-1.89*
29.	Kokan Bhendi x Ako-1	-0.44	-0.68	-0.56	-0.04	0.43	0.19	-1.93*	-2.86*	-2.39**
30.	Kokan Bhendi x Ako-2	-1.94*	-3.01**	-2.47**	-0.87	0.26	-0.30	-1.59*	-1.19	-1.39
31.	Kokan Bhendi x Ako-7	1.22	1.15	1.18	0.79	0.43	0.61	1.23	1.80	1.52
32.	Kokan Bhendi x Ako-10	-0.44	0.31	-0.06	-0.37	0.26	-0.05	0.56	2.47	1.52
33.	Kokan Bhendi x Ako-73	3.38**	3.15**	3.27**	1.79*	0.76	1.27	4.90**	3.30*	4.10**
34.	Kokan Bhendi x Ako-74	1.55	0.81	1.18	1.62*	-0.06	0.77	1.73*	0.80	1.27
35.	Kokan Bhendi x IC-42472	-0.27	0.98	0.35	-1.70*	-0.56	-1.13	-0.43	0.47	0.02
36.	Kokan Bhendi x EC-3293384	-0.77	0.31	-0.22	-1.20	-0.06	-0.63	-1.26	-0.86	-1.06
SE±(sca)		1.34	1.32	1.18	1.11	1.58	1.16	1.12	2.02	1.35
CD at 5% (sca)		2.67	2.62	2.35	2.21	3.15	2.30	2.22	4.01	2.69

Conclusion

It was concluded that highly significant variances were observed for both general and specific combining ability for all the characters studied. Considering higher earliness parents Korchi and Kokan Bhendi was found as good general combiner. For earliness purpose the cross combination Kokan Bhendi x AKO-10, Kokan Bhendi x AKO-1 for Internodal length, Korchi x AKO-Red, Korchi x AKO-1 and Kokan Bhendi x Phule Vimukta for Node at which first flower appeared, AKO-1-P-2 x AKO-73, Korchi x AKO-73, AKO-1-P-2 x AKO-74 and Korchi x AKO-74 for days to initiation of first flower, Korchi x EC-3293384, Korchi x AKO-74, AKO-1-P-2 x AKO-10 and Korchi x AKO-73 for days to 50% flowering and AKO-1-P-2 x AKO-74, Korchi AKO-74 for days to first harvest found negatively significant heterosis for the earliness traits. It is suggested that breeding techniques that can accumulate detectable genetic effects while maintaining substantial heterozygosity to take advantage of dominant gene effects have proven to be most beneficial for improving the population studied.

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References

1. Kempthorne O. An introduction to genetics statistics. New York: John Wiley and Sons; 1957. p. 453-471.
2. Shiri T, Gaurav SS, Singh SK, Jain S. Study of genotypic and phenotypic variation in F₂ segregating generation of okra [*Abelmoschus esculentus* (L.) Moench]. Agric Sci Dig. 2024;8(1):182-185.
3. Sprague GF, Tatum LA. General vs. specific combining ability in single crosses of corn. J Am Soc Agron. 1942;34:927-932.
4. Keerthana S, Dubey N, Delvadiya IR, Patel DD, Ginoya AV. Combining ability and gene action studies for fruit yield and its component traits in okra

- [*Abelmoschus esculentus* (L.) Moench]. Indian J Agric Res. 2024;6246:1-7.
5. Kumar A, Gaurav SS, Shiri T. Combining ability studies in okra (*Abelmoschus esculentus* (L.) Moench) through diallel analysis for yield and yield attributing characters. Pharma Innov J. 2021;10(5):480-485.
 6. Syed MR, Tauseef A, Saad J, Faiz UR, Muhammad AS, Zahid H, *et al.* Combining ability and genetic analysis of morphological and yield related traits in *Abelmoschus esculentus* L. Sarhad J Agric. 2024;40(1):11-21.
 7. Pathania R, Mehta DK, Bhardwaj RK, Dogra RK, Singh K, Kaplex A, *et al.* Exploitation of heterosis, combining ability and gene action potential for improvement in okra (*Abelmoschus esculentus*). Indian J Agric Sci. 2024;94(12):1340-1348.
 8. Maurya BK, Neetu, Dwivedi SV, Singh DP, Maurya SK. Combining ability studies for growth, yield and its related traits in okra [*Abelmoschus esculentus* (L.) Moench]. Biol Forum. 2022;14(3):62-69.