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Combining Ability for Yield and Its Attributing Traits in Okra [*Abelmoschus esculentus* (L.) Moench]

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A B S T R A C T

The experiment was undertaken to study the combining ability for yield and its attributing traits in okra. Information on the magnitude of combining ability was obtained for fruit yield per plant and its related components following line x tester mating design involving 15 diverse varieties/strains (10 lines and 5 testers). The 15 parents and their 50 resultant F_1s were sown in a Randomized Block Design with three replications. Combining ability analysis revealed that the magnitude of non-additive variance was higher for fruit yield per plant and its contributing traits indicating the predominant role of non-additive gene action in the inheritance of the traits. Among females, JOL-08-7 (24.60) while, among males, Parbhani Kranti (8.11) were good general combiners for fruit yield per plant and related traits. The hybrid, JOL-08-7 x Parbhani Kranti (37.08) having high *sca* effects for fruit yield per plant also registered desirable *sca* effects for a number of branches per plant, internodal length, fruit girth and days to 50 per cent flowering.

Introduction

Okra (*Abelmoschus esculentus* (L.)Moench) belonging to the family Malvaceae is an important vegetable crop of the tropics and subtropics. Okra is specially valued for its tender, delicious green fruits which are cooked, canned and consumed in various forms in different parts of the country. Major areas of cultivation in India are Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh, Gujarat, Karnataka and Assam. Okra is a polyploid, belonging to the family Malvaceae with 2n = 8x = 72 or 144 chromosomes and a self-pollinated crop, the occurrence of out crossing to an extent of 4–19% with the maximum of 42.2% is noticed with the insect assisted pollination (Kumar, 2006). India is a major okra producing country in the world comprising of 72 % of total area under okra (FAOSTAT, 2013). The area under okra cultivation in India is 503.68 (‘000 ha) with the production of 5708.69 (‘000 mt) and productivity of 11.5 mt/ha, containing 5.7 per cent of the total area under vegetable crops and 3.9 per cent of total vegetable production (Anonymous, 2015). It is also an important vegetable crop in Gujarat state and is mainly grown in Banaskantha, Bhavnagar, Junagadh,

Navsari, Surat, Tapi and Vadodara Districts. It occupies an area of 73.84 ('000 ha) with a production of 857.49 ('000 mt) having the average productivity of 11.5 mt/ha. West Bengal is a leading okra producing state with 14 per cent of production share, while Gujarat comprised of 12 per cent production share (Anonymous, 2015). The knowledge of nature of gene action governing the expression of various traits could be helpful in predicting the effectiveness of selection. The combining ability is the important genetic tool, which provides a guideline for an assessment of the relative breeding potential of the parents or identifying the best combiners, which may be hybridized either to exploit heterosis or to accumulate fixable genes (Singh *et al.,* 1991). Several approaches are available for assessing the parents and cross combinations with respect to combining ability. Among these, Line x 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 rests (Singh *et al.,* 2006 and Khatik *et al.,* 2012). In any sound breeding programmes, the proper choice of parents based on their combining ability is a prerequisite. 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).

Materials and Methods

The experimental material consisted 10 female parents (lines) *viz.*, JDNOL-11-1 (L1), JDNOL-11-3 (L2), JDNOL-11-11 (L3), JDNOL-11-12 (L4), JDNOL-11-14 (L5), AOL-07-9 (L6), AOL-08-5 (L7), JOL-6k-2 (L8), JOL-08-7 (L9), JOL-08-12 (L10) and 5 male parents (testers) namely, Arka Anamika (T1), Pusa Sawani (T2), Arka Anamika (T3), GO-2 (T4) and VRO-6 (T5). These parental lines were selected on the basis of per se performance, adoption and geographical diversity and crossed in the line x tester design for producing 50 hybrids. All the 50 F_1s and their 15 parents alone with one check (GJOH-3) were grown in randomised block design with three replications at Seed Spices Research Station, S. D. Agricultural Universtiy, Jagudan in *kharif* 2014. The seeds were sown in a single row of 3.6 m length keeping 60 cm distance between row and 45 cm within the row for easy movement. All packages of cultivation practices were followed to raise a healthy crop. The observations were recorded on all the five plant chosen at random in each genotype and in each replication and following observations were recorded for yield and its contributing traits *viz.*, days to 50 per cent flowering, days to first picking, fruit length (cm), fruit girth (cm), number of branches per plant, internodal length(cm), plant height(cm), total number of fruits per plant, fruit yield per plant (g), total number of seeds per fruit and days to last picking. Data was analyzed to work out the combining ability of the parents as well as the crosses (Kempthrone, 1957).

Results and Discussion

In the present study, line x tester method was applied to develop 50 experimental hybrids from 10 lines (females) and 5 testers (males), which were evaluated under *kharif* season. Analysis of variance (mean squares) and variance estimates for combining ability for different traits are presented in table 1. A perusal of variance components revealed that the mean squares due to crosses were highly significant for all the traits except days to last

picking. A perusal of variance components revealed that the mean squares due to lines and testers were non-significant for all the characters except fruit yield per plant in lines.

The mean squares due to line x tester were significant for all the characters except number of seeds per fruit and days to the last picking signifying that both females and males had considerable general combining ability (*gca)* towards these traits and contributed towards additive genetic variance. Highly significant mean squares due to females x males were manifested by all the traits reflecting its significant contribution in favour of specific combining ability (*sca*) and non-additive variances. An assessment of *gca*of females (σ^2 females) and *gca* of males (males) for their contribution towards *gca* (average *gca*) revealed that for all the traits females contributed largely towards *gca*, emphasizing the importance of additive and non-additive gene actions in the inheritance of these traits. This is expected since the divergent material was included in the study. Same results were obtained by Sood and Kalia (2001). The additive and non-additive gene effects could be exploited in okra by the use of good general combiners in hybridization and selecting desirable segregants from segregating generations.

However, a perusal of *gca/sca* ratio revealed a preponderance of non-additive gene action for all the traits. As preponderance of non-additive gene action and high heterosis is apparent for fruit yield and majority of yield contributing traits, it is recommended that heterosis breeding could be used for exploitation of hybrid vigour on a commercial scale. The importance of non-additive genetic variances for fruit yield per plant has been reported by several workers such Jayprakashnarayan *et al.,* (2008), Singh *et al.,* (2009), Wammanda *et al.,* (2010), Khatik *et al.,* (2012), Medagam *et al.,* (2012), Obiadalla Ali *et al.,* (2013), Jethava (2014) and Katagi *et al.,* (2015).

The character wise estimates of general combining ability effects for each parent are presented in table 2 and indicates that the merit of the parents differs significantly for different characters. Analysis of data revealed that among parents, line AOL-08-5 (-1.69) and JOL-08-12 (1.08) showed significant negative *gca* effect for days to 50 per cent flowering which is desirable and contribute for earliness in crosses. Whereas none of the testers found with negative significant gca effect. In the case of number of seeds per fruit desired highest *gca* effects in the desired direction (significant negative) were exhibited by line JDNOL-11-1 (-1.86). In case of a number of branches per plant and fruit yield per plant desired highest *gca* effects in the desired direction (significant positive) were exhibited by line JOL-08-7 and JOL-08-12 are good combiners for these traits. As far as fruit length and fruit girth are yields attributing traits, female parent, JDNOL-11-14 (0.54) exhibited higher *gca* effects for fruit length. Among parents, female parent, JDNOL-11-3 (0.44) exhibited significant *gca* effects for the trait fruit girth whereas, none of the male parents exhibited significant *gca* effects for traits fruit length and fruit girth.

In case of days to first picking and days to last picking line, JOL-08-7 (-2.72) showed significant *gca* effects for days to first picking while none of the line or tester exhibit significant gca effect in the desired direction. Among parents line, AOL-07-9 (-9.00) and tester, GO-2 (-6.29) for plant height and line JDNOL-11-11 (1.14) exhibited significant *gca* effect in desired direction for traits plant height and number of fruits per plant. Among all 15 parents, line, JOL-08-7 and JOL-08-12 proved to be the best general combiner for yield and yield attributing characters.

Table.1 Analysis of variance (mean squares) and variance estimates for combining ability for different trait

Traits												
Sources	**d.f.**	**Days to 50 % flowering**	**Days to first picking**	**Fruit length (cm)**	**Fruit girth (cm)**	**Number of branches per plant**	**Internodal length (cm)**	**Plant height (cm)**	**Fruit yield per plant (g)**	**Number of fruits per plant**	**Number of seed per fruit**	**Days to last picking**
Replication	2	6.22	8.37	0.14	0.15	0.04	0.91	852.38**	1405.00*	0.16	1.08	9.89
Hybrids	49	15.70**	23.35**	1.07**	1.59**	0.21**	3.05**	685.16**	1916.34**	10.79**	14.95*	59.92
Line (F)	9	13.21	32.34	1.42	1.28	0.25	4.97	641.07	3667.24*	7.62	22.27	96.22
Tester (M)	4	34.45	20.19	1.92	1.32	0.21	1.44	860.04	902.07	7.12	15.94	33.53
Line x Tester	36	14.24**	21.45**	0.89**	1.70**	0.19**	2.75**	676.76**	1591.32**	11.99**	13.01	53.78
Error	98	4.68	8.80	0.31	0.15	0.03	1.19	58.66	382.70	2.99	9.35	41.42
Estimates												
σ^2 Females	-	0.58	1.62	0.07	0.07	0.01	0.26	35.07	214.47 *	0.31	0.87	3.37
σ^2 Males	-	1.00	0.40	0.05	0.03	0.006	0.01	24.83	15.06	0.14	0.22	-0.40
σ^2gca	-	0.86**	0.81*	0.06**	0.05	0.009*	0.09*	28.25*	81.53 **	0.20	0.43**	0.85*
σ^2sca	-	3.26**	4.49**	0.19**	0.51**	0.05**	0.59**	187.29**	80.37 **	3.04**	1.26	2.74
σ^2 gca/ σ^2sca	-	0.26	0.18	0.31	0.09	0.16	0.16	0.15	0.21	0.06	0.34	0.31

* And ** significant at 5 % and 1 % level of probability, respectively.

Table.2 Estimates of general combining ability (gca) effects for different traits in okra

Traits											
Genotypes	**Days to 50 % flowering**	**Days to first picking**	**Fruit length (cm)**	**Fruit girth (cm)**	**Number of branches per plant**	**Internodal length (cm)**	**Plant height (cm)**	**Fruit yield per plant (g)**	**Number of fruits per plant**	**Number of seed per fruit**	**Days to last picking**
Lines											
JDNOL-11-1	0.69	0.47	-0.05	-0.09	-0.15**	0.04	-7.02*	-24.95**	0.13	-1.86*	-2.97
JDNOL-11-3	-0.61	1.49*	-0.01	0.44**	0.04	-0.56*	-6.59*	0.70	0.28	-0.67	-0.04
JDNOL-11-11	0.10	-0.40	0.19	-0.09	-0.09*	0.81**	7.62**	-12.25*	1.14*	0.40	2.38
JDNOL-11-12	0.71	1.25	-0.16	-0.05	-0.06	-0.51*	-0.006	-0.02	-0.39	-0.48	1.45
JDNOL-11-14	-0.46	-1.74*	0.54**	0.18	0.17**	0.78**	1.57	4.76	0.47	0.44	1.72
AOL-07-9	0.71	1.44*	-0.03	-0.55**	-0.20**	-0.36	-9.00**	-6.03	-0.35	-1.10	-4.88 **
AOL-08-5	-1.69**	-0.45	0.17	0.32**	0.04	0.04	7.55**	12.59*	-0.19	1.90*	2.85
JOL-6k-2	1.29*	1.38	-0.52**	-0.27*	-0.02	-0.86**	-3.65	-17.07**	-1.55**	-0.84	-2.14
JOL-08-7	0.31	-2.72**	0.24	0.15	0.13**	0.15	0.62	24.60**	0.45	1.73*	1.10
JOL-08-12	-1.08*	-0.73	-0.36*	-0.03	0.14**	0.45	8.90**	17.66**	0.002	0.48	0.51
$S.E.g_i$	1.08	1.44	0.28	0.20	0.08	0.50	5.49	10.87	0.86	1.55	3.45
Testers											
ArkaAnamika	1.87**	1.28*	-0.26*	-0.22**	-0.12**	-0.02	0.59	-6.15	-0.49	-0.35	0.25
PusaSawani	-0.63	-0.57	0.18	0.17*	0.01	0.26	-2.22	-0.95	0.38	-0.19	1.36
ParbhaniKranti	-0.75	-0.76	0.09	0.21**	0.07*	-0.18	8.27**	8.11*	0.09	0.60	-1.43
GO-2	-0.31	0.28	-0.27**	-0.21**	-0.04	-0.23	-6.39**	2.24	-0.51	-0.92	-0.57
VRO-6	-0.16	-0.22	0.25*	0.05	0.07*	0.17	-0.25	-3.25	0.52	0.86	0.39
$S.E.g_i$	0.76	1.02	0.20	0.14	0.06	0.35	3.88	7.68	0.61	1.09	2.44

* And ** significant at 5 % and 1 % level of probability, respectively.

Table.3 Estimates of specific combing ability (sca) effects for different characters in okra

Traits											
Hybrids	**Days to 50 % flowering**	**Days to first picking**	**Fruit length (cm)**	**Fruit girth (cm)**	**Number of branches per plant**	**Internodal length (cm)**	**Plant height (cm)**	**Fruit yield per plant (g)**	**Number of fruits per plant**	**Number of seed per fruit**	**Days to last picking**
JDNOL-11-1 x ArkaAnamika	-2.23	1.94	0.01	0.73**	0.28**	1.79**	13.82*	-11.86	0.72	0.26	-4.87
JDNOL-11-1 x PusaSawani	-1.17	1.60	0.04	0.10	0.18	0.55	-3.25	22.45	0.16	2.34	1.42
JDNOL-11-1 x ParbhaniKranti	0.63	-1.49	0.33	1.31**	0.15	-0.86	9.82	12.08	-0.32	0.73	3.45
JDNOL-11-1 x GO-2	-2.10	1.27	0.74*	-0.48*	-0.01	-0.4	-23.13**	25.30*	-1.18	-0.68	2.65
JDNOL-11-1 x VRO-6	1.30	0.76	0.006	0.02	0.18	-0.74	-10.30	-40.72**	-2.84**	-2.53	-0.50
JDNOL-11-3 x ArkaAnamika	3.04*	-0.84	1.01**	-0.58*	-0.01	0.02	14.49*	23.42	0.76	1.59	8.42*
JDNOL-11-3 x PusaSawani	-1.52	2.79	-0.009	-0.81**	-0.05	-1.08	-5.19	9.34	1.43	-2.85	-1.64
JDNOL-11-3 x ParbhaniKranti	-0.72	1.16	-0.95**	0.48*	-0.06	0.15	7.10	-21.19	1.81	1.19	3.25
JDNOL-11-3 x GO-2	2.02	-2.26	-0.69*	0.04	-0.24*	-0.41	1.96	-11.13	0.005	-1.61	-8.57*
JDNOL-11-3 x VRO-6	0.74	-4.95**	-0.49	-0.82**	-0.40**	0.96	-5.33	-7.70	-0.56	1.53	-3.61
JDNOL-11-11 x ArkaAnamika	-0.56	-2.43	0.05	0.83**	-0.01	-0.39	10.46	27.91*	0.05	-0.5	1.67
JDNOL-11-11 x PusaSawani	1.20	-3.21	-0.37	-0.63**	-0.22*	-0.36	-20.09**	1.79	-0.24	-1.74	-6.70
JDNOL-11-11 x ParbhaniKranti	0.24	3.41*	-0.65*	-0.85**	-0.06	1.01	8.36	-46.01**	2.23*	-3.69*	-1.50
JDNOL-11-11 x GO-2	2.99*	-0.98	-0.17	0.46	-0.05	-0.20	-8.27	-17.22	-0.28	0.41	0.30
JDNOL-11-11 x VRO-6	-0.17	-1.64	0.07	0.77**	0.12	1.22*	-14.24*	-1.55	-1.35	3.41	0.53

JDNOL-11-12 x ArkaAnamika	-2.00	3.69*	0.26	-0.18	0.04	0.08	-13.63*	5.38	-0.98	-1.51	6.00
JDNOL-11-12 x PusaSawani	1.15	0.35	-0.31	0.31	-0.16	-0.14	13.77*	5.16	1.21	3.79*	0.25
JDNOL-11-12 x ParbhaniKranti	0.15	3.09	0.42	-0.25	-0.02	0.22	16.38**	-3.28	-1.47	-1.13	-0.32
JDNOL-11-12 x GO-2	1.02	-0.22	0.56	0.09	0.28**	-0.66	12.82*	2.42	-0.47	0.31	2.05
JDNOL-11-12 x VRO-6	-4.02**	-2.05	0.13	-0.55*	0.10	-0.77	-5.55	25.39*	1.31	0.64	-2.29
JDNOL-11-14 x ArkaAnamika	-1.76	1.51	-0.08	-0.16	-0.24*	0.15	-9.45	-6.56	-0.4	-1.56	-0.32
JDNOL-11-14 x PusaSawani	-0.16	1.12	0.64*	0.39	0.50**	0.93	20.00**	14.06	3.00**	3.09	5.40
JDNOL-11-14 x ParbhaniKranti	0.27	0.32	-0.15	-0.80**	-0.25*	-2.02**	-5.55	8.91	-0.58	0.97	-2.68
JDNOL-11-14 x GO-2	0.18	1.61	0.34	0.67**	0.22*	0.69	-7.76	-21.95	1.84	-0.68	-0.86
JDNOL-11-14 x VRO-6	0.90	0.47	-0.30	0.11	-0.20 *	-0.45	4.62	33.01**	-0.95	1.22	0.33
AOL-07-9 x ArkaAnamika	1.47	-1.17	-0.31	-0.77**	-0.25*	0.20	2.51	-14.38	1.12	-0.31	-7.31
AOL-07-9 x PusaSawani	1.37	-0.52	0.22	0.11	0.36**	1.02	0.26	-12.25	-2.69**	-0.03	2.31
AOL-07-9 x ParbhaniKranti	-2.43*	-3.61*	-0.42	-0.02	0.005	0.11	-3.62	10.50	-2.53*	-0.18	-5.50
AOL-07-9 x GO-2	0.77	0.14	-0.15	0.66**	0.21*	-1.14*	3.50	18.53	0.90	0.50	1.20
AOL-07-9 x VRO-6	-0.61	0.12	0.22	-0.20	-0.35**	0.49	-4.52	-29.82*	0.29	-3.008	7.42
AOL-08-5 x ArkaAnamika	-0.67	-3.25*	-0.16	-0.06	0.02	-0.78	16.47**	13.002	-1.01	1.24	1.04
AOL-08-5 x PusaSawani	0.09	1.12	0.001	0.009	-0.04	-0.41	-14.00*	-48.62**	-1.74	-2.22	1.32
AOL-08-5 x ParbhaniKranti	0.64	0.73	-0.04	-0.81**	-0.20*	0.01	-19.35**	-12.07	-2.46*	-1.77	-1.39

AOL-08-5 x GO-2	-1.31	0.55	-1.07**	-0.26	0.005	0.25	25.69**	-9.70	2.97**	2.24	1.15
AOL-08-5 x VRO-6	-1.92	-3.71*	0.09	0.51*	-0.34**	1.27*	12.45*	12.59	1.81	-0.88	2.99
JOL-6k-2 x ArkaAnamika	-0.26	-2.47	0.30	0.49*	0.08	-0.55	-12.09	3.91	-2.84**	1.68	-4.99
JOL-6k-2 x PusaSawani	-0.96	0.92	0.37	0.69**	-0.05	0.36	10.78	10.99	0.89	0.60	1.88
JOL-6k-2 x ParbhaniKranti	4.07**	2.18	0.97**	-0.56*	0.26**	-0.29	-12.51*	20.07	0.50	1.13	-0.59
JOL-6k-2 x GO-2	-3.83**	-0.05	-0.09	-0.53*	-0.14	0.32	-15.15*	10.10	2.87**	-0.62	3.39
JOL-6k-2 x VRO-6	4.15**	3.98*	-0.36	0.53*	0.42**	-0.18	7.71	-0.28	-0.98	-1.40	-4.81
JOL-08-7 x ArkaAnamika	5.23**	2.23	0.17	-1.34**	-0.05	-0.77	-31.30**	-22.49	0.63	0.54	2.47
JOL-08-7 x PusaSawani	0.039	-0.64	-0.31	0.13	-0.40**	-0.70	17.35**	10.31	-1.18	-1.47	-1.45
JOL-08-7 x ParbhaniKranti	-1.79	-2.97	0.51	1.16**	0.37**	1.86**	6.70	37.08**	1.13	3.75*	2.13
JOL-08-7 x GO-2	0.23	-2.45	0.17	-0.39	-0.15	-0.34	13.47*	23.58	-3.33**	-1.29	-3.24
JOL-08-7 x VRO-6	-0.10	4.12*	0.13	-1.43**	0.23*	-1.30*	7.47	-3.33	3.33**	-1.22	-3.35
JOL-08-12 x ArkaAnamika	-2.24	0.80	-1.27**	1.04**	0.14	0.23	8.71	-18.34	1.95*	-1.45	-2.11
JOL-08-12 x PusaSawani	-0.04	-3.55*	-0.27	-0.31	-0.08	-0.15	-19.63 **	-13.21	-0.84	-1.51	-2.80
JOL-08-12 x ParbhaniKranti	-1.06	-2.83	-0.01	0.36	-0.17	-0.20	-7.35	-6.09	1.68	-1.01	3.16
JOL-08-12 x GO-2	0.01	2.40	0.38	-0.27	-0.10	1.89**	-3.13	-19.92	-3.30**	1.42	1.91
JOL-08-12 x VRO-6	-0.27	2.90	0.51	1.05**	0.22*	-0.50	7.70	12.42	-0.05	2.23	3.29
S.E.s_{ij}	2.41	3.23	0.64	0.46	0.19	1.12	12.27	24.30	1.94	3.47	7.73

* And ** Significant at 5 % and 1 % level of probability, respectively.

The estimates of specific combining ability (*sca*) effects of 50 hybrids are presented in table 3. The *sca* effects for days to 50 per cent flowering and days to first picking ranged from -4.02 (JDNOL-11-12 x VRO-6) to 5.23 (JOL-08-7 x ArkaAnamika) and -4.95 (JDNOL-11-3 x VRO-6) to 4.12 (JOL-08-7 x VRO-6), respectively. Three hybrids registered significant negative *sca* effect for days to 50 per cent flowering, while, 5 crosses had significant negative *sca* effects in case of days to first picking. JDNOL-11-12 x VRO-6 (- 4.02) was the top performing hybrid, while in case of first flowering node JDNOL-11-3 x VRO-6 (- 4.95) was the best performing hybrid. In the case of fruit length and fruit girth, *sca* effects varied from -1.27 (JOL-08-12 x ArkaAnamika) to 1.01 (JDNOL-11-3 x ArkaAnamika) and -1.43 (JOL-08-7 x VRO-6) to 1.31 (JDNOL-11-1 x ParbhaniKranti), respectively. However, JDNOL-11-3 x ArkaAnamika (1.01) was top performing hybrid for fruit length whereas; JDNOL-11-1 x ParbhaniKranti (1.31) was top performing hybrid for fruit girth.

The *sca* effects for number of branches per plant and number of fruits per plant ranged from -0.40 (JDNOL-11-3 x VRO-6) to 0.50 (JDNOL-11-14 x PusaSawani) and from -3.33 (JOL-08-7 x GO-2) to 3.33 (JOL-08-7 x VRO-6), respectively. Eleven and six hybrids recorded highest significant positive *sca* effects, respectively. JDNOL-11-14 x PusaSawani (0.50) and JOL-08-7 x VRO-6 (3.33) were the top performing hybrids for the traits number of branches per plant and number of fruits per plant, respectively.

For fruit yield per plant and days to last picking, *sca* effects ranged from -48.62 (AOL-08-5 x PusaSawani) to 37.08 (JOL-08-7 x ParbhaniKranti) and -8.57 (JDNOL-11-3 x GO-2) to 8.42 (JDNOL-11-3 x ArkaAnamika), respectively, while, the numbers of hybrids revealing good (significant positive) specific combining effects were five and one for both the traits, respectively. JOL-08-7 x ParbhaniKranti (37.08) and JDNOL-11-3 x ArkaAnamika (8.42) was the best performing hybrids for the traits fruit yield per plant and days to last picking, respectively. The sca effects for stem internodal length ranged from -2.02 (JDNOL-11-14 x ParbhaniKranti) to 1.89 (JOL-08-12 x GO-2). Five hybrids exhibit significant positive *gca* effect. Whereas, JOL-08-12 x GO-2 (1.89) was the top promising hybrid recorded significant positive gca effect. Ten and one crosses recorded significant negative *sca* effects in plant height and number of seeds per fruit, respectively. For this trait *sca* effects varied from -31.30 (JOL-08-7 x ArkaAnamika) to 25.69 (AOL-08-5 x GO-2) and -3.69 (JDNOL-11-11 x ParbhaniKranti) to 3.79 (JDNOL-11-12 x PusaSawani). JOL-08-7 x ArkaAnamika (-31.30) and JDNOL-11-11 x ParbhaniKranti (-3.69) were the top performing hybrids for this trait, respectively.

It can be seen that the crosses exhibiting desirable and significant *sca* effects for fruit yield per plant and total fruit yield were also associated with high and favourable*sca* effects for multiple yields contributing traits. The highest fruit yielding hybrid JOL-08-7 x ParbhaniKranti (Good x Good) had significant desirable *sca* effect for fruit yield and some of the yield components, followed by a cross, JDNOL-11-12 x VRO-6. Corresponding to these findings, Das *et al.*, (2013) reported that positive *sca* effects were discernible in the hybrids involving both the parents possessing significant positive *gca* effects. These good x good combinations could result in the capitalization of non-additive (Dominance x dominance variance) effects over the super structure of the additive gene effects. Hybrids involving both the parents possessing significant positive *gca* effects (good x good) with higher significant *sca* effects for number of fruits per plant and

fruit yield per plant in okra have been earlier reported by Raghuvanshi*etal.*, (2011), Wammanda*et al.*, (2010), Singh, (2011), Aulakh*et al.*, (2012), Medagam*et al.*, (2012), Das *etal.*, (2013), Atotkar*et al.*, (2014) and Katagi*et al.*, (2015).

The *gca* effects of the parents indicated that parent JOL-08-7 was good general combiner for fruit yield and other yield attributing traits. SCA effects of the hybrid revealed that hybrid JOL-08-7 x ParbhaniKranti (Good x Good) was found to be the best combination for fruit yield per plant and other yield attributing traits like a number of branches, internodal length and fruit girth.

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