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COMBINING ABILITY ANALYSIS IN CHICKPEA (*CICER ARIETINUM* L.)

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Line x Tester analysis in chickpea was carried out at Pulses Research Unit, Dr. PDKV, Akola during *rabi*, 2000. Twenty one F_1's crosses alongwith their parents were evaluated for general combining and specific combining ability. The parent AKG-52 was the best general combiner for number of pods plant^{-1}, number of seeds pod^{-1}, 100 seed weight, harvest index and seed yield plant^{-1}. The cross AKG-52 x Vishal had high sca effects having high x high general combiner parents for seed yield plant^{-1}, 100 seed weight and number of pods plant^{-1}. The cross ICCV-37 x Vishal showed high positive significant sca and having high x high general combiner parents for seed yield plant^{-1} and number of pods plant^{-1}.

Keywords : Chickpea; General combining ability; Line x tester analysis; Seed yield; Specific combining ability.

Chickpea is grown in tropical, subtropical and temperate regions. Chickpea is valued for its nutritive seeds with high protein content 25.3 to 28.9 per cent, after dehulling. Yield is complex character comprising of a number of components each of which polygenically controlled and influenced by environmental fluctuations. The improvement in chickpea is oriented to develop new varieties which have high yielding potential, high protein content, wider adaptability and resistance to pests and diseases. The technique of line x tester analysis has been found to be useful for estimation of combining ability[1]. The parents possessing good general combining ability for yield and yield components would be utilized in hybridization programme for further improvement. The knowledge of specific combining ability (sca) is also useful to isolate best crosses for further exploitation of heterosis. The present investigation, was undertaken to identify the good combiners on the basis of their general combining ability (gca) for various quantitative traits in chickpea.

The experimental material comprised of seven lines (females *viz.*, AKG-46, AKG-52, JAKI-9218, BDN-9-3, BCP-15, BCP-41 and ICCV-37) and three testers (males *viz.*, Vishal, Vijay and ICCV-10) were crossed in line x tester fashion during *rabi* 1999-2000. Thus 21 F_1's (crosses) alongwith their ten parents were grown in a single row in a randomized complete block design with three replication at Pulses Research Unit, Dr. PKDV, Akola during *rabi* 2000-01. The observations were recorded on days to 50 per cent flowering plant, height, number of branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1} 100 seed weight, protein content, harvest index and seed yield plant^{-1}. The data were subjected for estimation of general and specific combining ability[1].

The estimates of general and specific combining ability are presented in Table 1 and 2, respectively. The estimates of general combining ability effects ranged from – 5.19 to 3.96. The parent ICCV-37 had the highest positive gca effects for days to 50 per cent flowering. The parents with negative gca are JAKI 9218, BCP-15 and Vijay. They may act as a good material for breeding early genotypes of chickpea. Results of similar nature were reported by Gowda and Bahl[2] and Singh[3] in chickpea.

Two parents *viz.*, Vishal and JAKI 9218 showed high positive significant gca effects for plant height. The parents which had high negative significant gca are Vijay, ICCV-37, BDN 9-3 and ICCV- 10. The similar results were reported by Yadavendra and Kumar[4], Dumbre *et.al*[5]., and Mandal and Bahl[6] for number of pods plant^{-1} in chickpea. Ten crosses showed positive significant sca effects while nine crosses showed significant negative sca effects.

Normally, there are one to two seeds in a pod of chickpea. Exceptionally, there are more than two seeds in few pods. The ability to bear the particular number of seeds in the pod is a genetic character influenced by the environment which normally decide the sinksance relationship. The crosses could not surpass the highest value of the parent and all the crosses had less than 1.92 seeds per pod^{-1}. Thus there had been no good combining in the crosses which has been reflected in very low value of gca (-0.04 to 0.21).

The parents *viz.*, AKG-52, BCP-41 and Vishal had better combining ability for 100 seed weight and had positive gca effects while four parents *viz.* BDN-9-3, ICCV-37, ICCV-10 and Vijay showed negative gca effects. The

Table 1. General combining ability of parents in chickpea.

Parent	Days to 50 percent flowering	Plant height (cm)	Number of branches/ plant	Number of pods / plant	Number of seeds/ pod	100 seed weight (g)	Protein content (%)	Harvest Index (%)	Seed yield / plant (g)
Female (Lines)									
AKG-46	0.78**	-0.05	1.43**	-3.70**	-0.12**	0.27	0.84**	-5.80**	-1.96**
AKG-52	1.95 **	-0.16	-1.14**	11.11**	0.21**	6.62**	-0.19**	4.49**	4.46**
JAKI-9218	-5.19**	3.15**	0.68**	-2.99**	-0.04**	-0.01	0.43**	0.81	-0.18
BDN – 9-3	1.85 **	-1.51 **	-0.58 **	-5.16**	-0.04**	-6.71**	-1.06**	-7.33**	-4.14**
BCP-15	-4.51 **	0.14	0.44**	-6.84**	-0.08**	-0.8	-0.14**	4.28**	0.01
BCP-41	1.16**	-0.02	-0.70**	-3.36**	-0.06**	3.67**	-0.06*	2.49**	0.17
ICCV-37	3.96**	-1.55**	-0.12	10.93**	0.13**	-3.05**	0.18**	1.08	1.64**
SE (gi)	0.04	0.29	0.2	0.28	0.01	0.68	0.03	0.57	0.2
CD at 5%	0.08	0.58	0.4	0.56	0.02	1.37	0.06	1.15	0.4
CD at 1%	0.1	0.78	0.53	0.75	0.027	1.83	0.081	1.54	0.54
Male (Testers)									
ICCV-10	1.11**	-1.07**	-1.00**	3.41**	0.08**	-3.17**	-1.02**	-1.11**	-1.65**
Vijay	-1.84**	-2.13**	-0.72**	-10.03**	-0.17**	-2.24**	-0.58**	-0.34	-3.22**
Vishal	0.74**	3.20**	1.72**	6.62**	0.09**	5.41**	1.59**	1.45**	4.87**
SE (gi)	0.02	0.17	0.12	0.16	0.01	0.39	0.02	0.33	0.12
CDat 5%	0.04	0.34	0.24	0.32	0.02	0.78	0.04	0.66	0.24
CD at 1%	0.05	0.45	0.32	0.43	0.027	1.05	0.05	0.89	0.32

*, ** significant at 5% and 1 % level of significance

Table 2. Specific combining ability effects of crosses in chickpea.

Parent	Days to 50 percent flowering	Plant height (cm)	Number of branches/ plant	Number of pods / plant	Number of seeds/ pod	100 seed weight (g)	Protein content (%)	Harvest Index (%)	Seed yield / plant (g)
Crosses									
AKG-46 x ICCV-10	-0.67**	-1.23**	-0.74*	2.27**	0.05**	4.11**	0.07	-3.91**	-0.63**
AKG 46 X Vijay	1.10 **	-1.72**	1.45**	-1.25**	-0.06**	-0.87	0.74**	-4.82**	-2.26**
AKG-46 x Vishal	-0.43**	2.95**	-0.70**	-1.02*	0.01	-3.24**	-0.80**	8.73**	2.89**
AKG-52 X ICCV-10	-0.71**	-0.30	0.36	5.86 **	-0.02*	-1.94**	0.11 **	-2.71**	0.88**
AKG-52 X Vijay	1.08 **	1.07 *	-1.03 **	3.82 **	0.16 **	1.77	0.12**	3.02**	1.48 **
AKG-52 x Vishal	0.37**	0.77	0.07**	-9.69**	-0.14**	0.17	-0.23**	-0.31	-0.60*
JAKI-9218 X ICCV-10	2.30 **	0.79	-0.03	-1.56**	0.03**	2.51*	-0.62 **	0.87	0.23
JAKI-9218 x Vijay	-1.81 **	-0.05	-0.52	4.10**	-0.03**	-0.46	0.22**	-2.84**	-1.11**
JAKI 9218 x Vishal	-0.49**	-0.74	0.55	-2.54**	-0.01	-2.05	0.41**	1.97**	0.88**
BDN 9-3 x ICCV-10	0.39**	-0.12	0.16	-1.29**	-0.05**	-1.12	0.01 **	-2.20**	0.82**
BDN 9-3 x Vijay	-0.08	1.29 **	0.37	1.44 **	0.00	-0.53	-1.26**	-5.44**	-1.58**
BDN 9-3 X Vishal	0.31**	-1.17 **	-0.53	-0.15	0.05 **	1.65	1.26 **	7.64 **	0.76 **
BCP-15 X ICCV-10	0.47**	0.44	0.01	-5.50**	-0.05**	-3.70**	0.07	5.29**	-0.05
BCP-15 X Vijay	-3.19**	0.49	-0.02	1.22**	0.01	-0.57	-0.16**	1.05	-0.10
BCP-15 x Vishal	2.72**	0.05	0.01	4.28**	0.04**	4.26 **	0.09 **	-6.34**	0.15
BCP-41 X ICCV-10	-1.83 **	0.29	-0.07	-2.91**	-0.05**	-3.21**	0.09**	1.37	0.50
BCP-41 x Vijay	2.69 **	0.59	-0.31	-0.66	-0.02*	1.77	0.17**	7.39**	2.88**
BCP-41 X Vishal	-0.86 **	-0.88	0.39	3.57**	0.06**	1.44	-0.23**	-8.76**	-3.39**
ICCV-37 X ICCV-10	0.06	0.14	0.32	3.13**	0.07**	3.35**	0.28**	1.30	0.02
ICCV-37 X Vijay	0.20**	-0.69	0.07	-8.67**	-0.06**	-1.11	0.20**	1.63**	0.68**
ICCV-37 X Vishal	-0.27**	0.55	-0.39	5.54**	-0.02**	-2.23*	-0.48**	-2.93**	-0.70**
SE (Sij)	0.06	0.41	0.29	0.40	0.01	0.96	0.04	0.81	0.28

*, ** significant at 5% and 1 % level of significance

estimates of sca effects ranged from 0.57 to 4.26. Four corsses showed positive significant sca effects and fix crosses estimates of sca effects ranged from -0.05 to 2.95. Three crosses *viz.* AKG 46 X Vishal, BDN-9-3 X Vijay and AKG 46 x Vijay showed positive significant sca effects and four crosses showed negative significant sca effects. These results are in conformity with Kamatar[7].

Number of branches is one of important yield contributing trait. It is useful to develop a sink capacity in the plant to decide the yield potential which may be decided through an interaction with the environment. The parent JAKI 9218 had positive gca effects which indicates predominance of additive gene action for the trait. The parents Vishal and AKG 46 were good general combiner. These results were corroborated with the results of Malhotra *et.al.*[8] and Katiyar *et.al.*[9], in chickpea.

The parents ICCV-37, Vishal and ICCV-10 possessed 54.70 to 60.58 pods plant^{-1} and were the top three parents had high number of pods plant^{-1}. The gca effects ranged from -10.03 to 11.11, The parents *viz.*, ICCV-37, Vishal, ICCV-10 showed positive significant gca effects. Four crosses showed positive significant sca effects and six croses showed negative sca effects.

For harvest index, the good combiners with significant positive gca effects were AKG 52, BCP-15, BCP-41, and Vishal. In crosses, the maximum harvest index was in BCP-41 x Vijay (61.92%) followed by BCP-15 x ICCV-10 (60.83%), AKG-52 x Vijay (59.55%) and AKG 52 x Vishal (58.01%).

Chickpea, being a food legume, the protein content in chickpea seed is important from the point of nutrition. Four parents *viz.* AKG-46, JAKI 9218, ICCV-37 and Vishal showed positive significant gca effects while remaining six parents showed negative gca effects. Thus breeding for high protein content, attention is needed towards selection of parents with positive general combining ability so that the selection in segregating generation will be effective.

Seed yield plant^{-1} is a complex trait which is governed by complex interaction of genotype and environment. Seven crosses expressed significant positive sca effects. The crosses AKG 56 x Vishal, BCP-41 x Vijay and AKG-52 x Vijay had comparatively high sca effects with high gca of their parents. Results of similar nature were also reported by Gowda and Bahl[2], Kamatar[7] and Katiyar *et al.*[9], in chickpea. In the present studies, the cross AKG 46 x Vishal and BCP-41 x Vijay were the best combinations for seed yield with high sca effects (2.89 & 2.88, respectively). These crosses showed additive x additive component predominantly. The segregating generation of these two crosses may be useful for improvement of seed yield to chickpea.

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