RESEARCH PAPER

ADVANCE RESEARCH JOURNAL OF
CROP IMPROVEMENT
Volume 7 | Issue 1 | June, 2016 | 151-154
e ISSN-2231-640X

DOI :
10.15740/HAS/ARJCI/7.1/151-154
Visit us: *www.researchjournal.co.in*

Heterosis and combining ability analysis in chickpea (*Cicer arietinum* L.)

■ S.B. SARODE, G.P. NAGARGOJE[1] AND D.K. PATIL[1]

AUTHORS' INFO
Associated Co-author :
[1]Agricultural Research Station (V.N.M.K.V.), Badnapur, JALNA (M.S.) INDIA

Author for correspondence:
S.B. SARODE
Agricultural Research Station (V.N.M.K.V.), Badnapur, JALNA (M.S.) INDIA
Email: shri_sarode@yahoo.com

ABSTRACT : The experiment was conducted at Agricultural Research Station, Badnapur. In this study, three lines were crossed with five male parents and fifteen hybrids were developed. These fifteen hybrids along with their parental lines and check *viz.*, BDNG 797 were grown during *Rabi* season of 2014. The parental lines BDNGK 798 exhibited high GCA effect for plant height and 100 seed weight, VIJAY for number of primary and secondary branches per plant, DIGVIJAY for number of pods per plant and seed yield per plant. The cross BDNGK 798 x SAKI 9516 recorded high significant and desirable SCA effect for number of pods per plant and seed yield per plant and the cross BDNGK 9-3 x ICC 14871 for seed yield per plant. Out of 15 crosses, nine crosses recorded standard significant heterosis over BDNG 797. The range of standard heterosis was 12 to 31.65 per cent. The cross VIJAY x BCP 49 exhibited highest significant standard heterosis (31.65%) followed by BDNG 9-3 x DIGVIJAY (26.63%) for seed yield per plant.

KEY **W**ORDS : Heterosis, Combining ability, Chickpea

How to cite this paper : Sarode, S.B., Nagargoje, G.P. and Patil, D.K. (2016). Heterosis and combining ability analysis in chickpea (*Cicer arietinum* L.). *Adv. Res. J. Crop Improv.,* **7** (1) : 151-154, **DOI : 10.15740/HAS/ARJCI/7.1/151-154**.

Paper **H**istory : **Received :** 23.02.2016; **Revised :** 28.04.2016; **Accepted :** 24.05.2016

Chickpea is one of the important food legumes in the World. Chickpea is the only cultivated species under the genus '*Cicer*', and has 2n = 2x = 16 chromosomes with relatively small genome size of 738.09 Mbp (Varshney *et al.,* 2013). *Macrospora* (*Kabuli*) and *Microspora* (Desi) are the two distinct types of chickpea with the production share of 25 per cent and 75 per cent, respectively (Soregaon, 2011). India, a major pulse producing country, accounts roughly 33 per cent of the total world production. Pulses are grown both during *Kharif* and *Rabi* seasons. Out of the total area and production under pulses, the area of *Kharif* and *Rabi* pulses accounts 45 and 55 per cent, respectively.

The area of chickpea in 2013-14 in India was about 10.22 million ha with production 9.88 million tones and productivity 967 kg/ha while in Maharashtra area was 18.19 lakh ha, production 16.22 lakh tones and productivity 891 kg/ha. In Marathwada, in 2013-2014, the area of chickpea was 6.58 lakh ha with production 6.64 lakh tones and productivity 918 kg/ha.Through, India is the largest producer of this crop; its productivity is low when compared to that in countries like Italy, Turkey, Iran, Sudan etc. The important genetic factors like, photo and thermo sensitivity, low harvest index, flower drop, poor stability of present cultivar, susceptibility to disease and pest, management factors like predominantly cultivated on receding soil moisture and marginal land, inadequate plant protection, low use of organic and inorganic fertilizer and inadequate availability of quality seeds limits the productivity of chickpea in this country.Among the factors listed above susceptibility to major biotic factors namely *Fusarium wilt*, pod borer and abiotic factors namely drought, heat, salt and cold are the most important stresses which need immediate attention of the plant breeder.

Exploitation of heterosis is an important approach towards the improvement of crop. The phenomenon of heterosis is of wide spread occurrence in field of biological sciences. Hybrid vigour was first observed by Koelreuter in 1673 in tobacco and was studied by numerous other workers (Singh, 1996) and the clear approach to the concept of heterosis was made by Shull (1914). In chickpea many workers studied heterosis. A study of combining ability helps in identifying the useful parental lines and the desirable specific cross combination which could be further exploited in development of improved varieties. Such studies are essential in choosing the appropriate breeding and selection methodologies for further improvement of crop. Combining ability analysis is frequently employed to identify the desirable parents and crosses. Therefore, it is urgently required to identify the best combiners and desirable crosses. Line x Tester analysis is an extension of top cross method in which several testers are used (Kempthorne, 1957) which provides information about general and specific combining ability of parents and at the same time it is helpful in identifying best heterotic crosses.

RESEARCH PROCEDURE

The experiment was conducted at Agricultural Research Station, Badnapur. In this study, three lines were crossed with five male parents and fifteen hybrids were developed. The total 15 Chickpea hybrids along with 8 parents and one check BDNG 797 in three replications were grown during *Rabi* of 2014-15 at the Agriculture Research Station, Badnapur. One row each of P_1, P_2 and F_1 were grown in Randomized Block Design with three replications. Data were recorded on ten randomly selected plants from each row excluding border plants. Each row consisted of 4m length and row to row and plant to plant distance was 30 cm and 10 cm, respectively. All the agronomic practices were followed to raise a good crop. Data in each experiment of all entries was subjected to analysis of variance (Panse and Sukhatme, 1967) for testing the significance of treatments. Combining ability analysis and the testing of significance of different genotypes was based on the procedure given by Kampthorne (1957). Heterosis was calculated by standard procedure.

RESEARCH ANALYSIS AND REASONING

The results obtained are presented in Tables 1 to 3.

Exploitation of heterosis is an important approach towards the improvement of crop. A study of combining ability helps in identifying the useful parental lines and the desirable specific cross combination which could be further exploited in development of improved varieties. Such studies are essential in choosing the appropriate breeding and selection methodologies for further improvement of crop. Combining ability analysis are frequently employed to identify the desirable parents and

Table 1 : General combining ability effects of parents in chickpea

Sr. No.	Parents	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of primary branches per plant	No. of secondary branches per plant	No. of pods per plant	No. of seed per pod	100 seed wt. (g)	Seed yield per plant (g)	Protein (%)
Female parents											
1.	BDNGK 798	-0.86	-0.45	12.76**	-0.18	-1.59**	6.08	-0.56*	3.88**	1.51	-0.13
2.	BDNG 9-3	1.24	0.67	-6.31**	-0.45**	-0.45	-5.77	0.09**	-2.57**	-0.88	0.12
3.	VIJAY	-0.37	-0.21	-6.45**	0.63**	2.05**	-0.31	-0.04*	-1.31*	-0.62	0.009
Male parents											
4.	DIGVIJAY	0.40	0.28	1.27	-0.50*	-1.16**	10.42*	0.26**	-0.04	3.75**	0.72*
5.	BCP 49	0.14	0.48	-1.97*	-0.33	-0.67	3.20	-0.03	0.35	1.42	-0.01
6.	GJG-0906	1.56	0.14	-025	-0.05	-0.07	8.97	0.01	1.07	1.75	-0.20
7.	SAKI 9516	0.48	0.91	0.73	0.10	-0.06	-12.44**	-0.12**	3.11**	-2.80**	0.56
8.	ICC 14871	-2.59*	-1.82*	0.21	0.78**	1.84**	-10.35	-0.12**	-4.50**	-4.13**	0.05
	S.E.± Gi (line)	0.77	0.60	0.67	0.14	0.29	1.56	0.02	0.52	0.41	0.22
	S.E.± Gj (tester)	0.99	0.77	0.87	0.18	0.38	2.02	0.01	0.68	0.52	0.29

*and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 2: Specific combining ability effects in chickpea

Sr. No	Crosses	Days to 50 % flowering.	Days to maturity	Plant height (cm)	No. of primary branches per plant	No. of secondary branches per plant	No. of pods per plant	Seed per pod	100 seed wt. (g)	Seed yield per plant (g)	Protein (%)
1.	BDNGK 798 × DIGVIJAY	-1.31	0.97	1.41	0.34	0.38	9.24*	0.00	-1.14	1.37	0.731
2.	BDNGK 798 × BCP 49	-3.42	-0.88	-1.74	-0.49	-0.10	5.80	-0.03	0.55	-1.95	-0.50
3.	BDNGK 798 × SAKI 9516	0.86	-0.92	1.63	-0.23	-0.07	16.35**	-0.07	-0.50	2.04*	-0.48
4.	BDNGK 798 x GJG 0906	0.14	-2.15	-0.71	0.27	-0.01	-13.75**	0.05	1.86	-0.06	-0.41
5.	BDNGK 798 x ICC 14871	3.72*	2.98*	-0.59	0.11	-0.19	-17.64**	0.05	-0.76	-1.40	0.66
6.	BDNG 9-3 x DIGVIJAY	-0.21	-2.44	-1.74	-0.12	-0.55	17.44**	-0.05	-1.99	1.44	0.01
7.	BDNG 9-3 X BCP 49	-0.26	-0.21	0.63	0.30	-0.24	-13.33**	0.08	2.23	-1.22	1.04
8.	BDNG 9-3 x SAKI 9516	-1.34	0.45	-0.25	0.69*	1.15	-14.77**	0.16**	-2.55*	-2.55**	-0.03
9.	BDNG 9-3 X GJG-0906	-0.76	0.21	1.78	-0.56	0.41	3.44	-0.09*	0.24	6.73**	0.26
10.	BDNG 9-3 X ICC 14871	2.58	1.99	-0.42	-0.31	-0.76	7.22*	-0.09	2.06	2.33*	-1.28*
11.	VIJAY × DIGVIJAY	1.52	1.47	0.32	-0.21	0.17	-26.68**	0.05	3.14*	-2.82**	-0.742
12.	VIJAY ×BCP 49	3.68*	1.10	1.10	0.18	0.34	7.53*	-0.04	-2.78*	3.17**	-0.542
13.	VIJAY × SAKI 9516	0.47	0.47	-1.38	-0.45	-1.08	-1.57	-0.09	3.05*	0.51	0.513
14.	VIJAY x GJG 0906	0.61	1.93	-1.07	0.28	-0.39	10.31**	0.04	-2.11	0.06	0.14
15.	VIJAY x ICC 14871	-6.30*	-4.98**	1.01	0.19	0.96	10.42**	0.04	-1.30	-0.93	0.62
	S.E.±	1.72	1.34	1.52	0.32	0.66	3.50	0.04	1.17	0.91	0.51

*and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 3 : Estimation of standard heterosis (%) in chickpea

Sr. No.	Crosses	Days to 50 % flowering	Days to maturity	Plant height (cm)	No. of primary branches per plant	No. of secondary branches per plant	No. of pods per plant	Seed per pod	100 seed wt. (g)	Seed yield per plant (g)	Protein (%)
1.	BDNGK 798 × DIGVIJAY	-11.65**	-2.12	27.34**	-19.72**	-26.84**	49.24**	33.33**	-3.60	27.27**	5.72
2.	BDNGK 798 × BCP 49	-15.69**	-3.64*	12.63**	-29.11**	-26.84**	32.99**	0.00	5.48	7.95	-3.66
3.	BDNG K 798 × SAKI 9516	-5.97	-3.98*	24.35**	-21.60**	-22.33**	57.87**	0.00	4.03	22.73**	-4.45
4.	BDNGK 798 x GJG 0906	-9.04*	-4.40	21.21**	-12.21	-20.90**	-20.30*	0.00	23.05**	0.00	-5.88
5.	BDNGK 798 x ICC 14871	-8.19	-2.22	20.29**	-4.69	-9.50	-23.35**	0.00	-21.18**	-9.09*	2.23
6.	BDNG 9-3 x DIGVIJAY	-6.20	-4.22	-23.74**	-30.05**	-25.42**	49.74**	43.33**	-35.16**	29.63**	3.50
7.	BDNG 9-3 X BCP 49	-6.71	-2.00	-25.73**	-21.60**	-19.71**	-10.58	26.67**	-15.13*	20.00**	4.93
8.	BDNG 9-3 x SAKI 9516	-6.14	-1.70	-23.81**	-12.21	-5.46	-3.70	40.00**	-32.71**	16.00*	-1.11
9.	BDNG 9-3 X GJG-0906	-6.99	-1.21	-16.85**	-27.70**	-9.74	-8.47	0.00	.11.82	8.00	-1.43
10.	BDNG 9-3 X ICC 14871	-6.54	-2.09	-23.12**	-14.55*	-5.46	0.53	0.00	-36.89**	12.00*	-5.88
11.	VIJAY × DIGVIJAY	-5.97	-1.46	-19.30**	-15.96*	-2.38	-22.69**	40.00**	-7.49	14.81**	-0.64
12.	VIJAY ×BCP 49	-2.73	-1.61	-24.96**	-7.98	2.38	14.81*	0.00	-31.41**	31.65**	-3.18
13.	VIJAY × SAKI 9516	-5.80	-2.49	-26.72**	-13.15	-3.56	10.19	0.00	-3.03	22.78**	0.95
14.	VIJAY x GJG 0906	-7.39	-0.46	-23.74**	-0.47	2.38	-2.78	0.00	-16.57*	3.80	-2.54
15.	VIJAY x ICC 14871	-24.45**	-9.26**	-20.14**	7.98	24.70**	0.00	0.00	-45.97**	-5.06	2.70
	S.E. ±	2.43	1.90	2.14	0.46	0.94	4.95	0.06	1.66	1.29	0.72
	C.D. (P=0.05)	4.99	3.90	4.40	0.94	1.93	10.15	0.13	3.41	2.65	1.48
	C.D. (P=0.01)	6.73	5.26	5.94	1.27	2.61	13.70	0.18	4.61	3.58	2.00

* and ** indicate significance of values at P=0.05 and 0.01, respectively

crosses. Therefore, it is urgently required to identify the best combiners and desirable crosses. Line x Tester analysis is an extension of top cross method in which several testers are used (Kempthorne, 1957) which provides information about general and specific combining ability of parents and at the same time it is helpful in identifying best heterotic crosses. The parental lines BDNGK 798 exhibited high GCA effect for plant height and 100 seed weight, VIJAY for number of primary and secondary branches per plant, DIGVIJAY for number of pods per plant and seed yield per plant. The cross BDNGK 798 x SAKI 9516 recorded high significant and desirable SCA effect for number of pods per plant and seed yield per plant and the cross BDNGK 9-3 x ICC 14871 for seed yield per plant. Out of 15 crosses, nine crosses recorded standard significant heterosis over BDNG 797. The range of standard heterosis was 12 to 31.65 per cent. The cross VIJAY x BCP 49 exhibited highest significant standard heterosis (31.65%) followed by BDNG 9-3 x DIGVIJAY (26.63%) for seed yield per plant.

LITERATURE CITED

Kempthorne, O. (1957). An introduction to genetic statistics, John Wiley and Son Inc. Newyork, Champman and Hall Ltd. London, 468-470 pp.

Panse, V.C. and Sukhatme, P.V. (1967). *Statistical method for Agric workers*. Second Enlarged Edn. ICAR.NEW DELHI, INDIA.

Shull, G. H. (1914). Duplicate genes form in Bursa pastoris. Zeitcheir Inductive Abstamme.Vererbunglehra.12:97-149. In heterosis (Gawen.J.W. edn.) Haffer. Inc. NEW YORK, U.S.A.

Singh, B. D. (1996). *Plant breeding principles and methods.* Kalyani Publishers. Ludhiana (PUNJAB) INDIA.

Soregaon, C. D. (2011). Mapping molecular marker linked to H_2 locus of wilt resistance in chickpea and to locate QTLs linked to other quantitative traits. Ph. D. Thesis, University of Agricultural Sciences, Dharwad, KARNATAKA, (INDIA).

Varshney, R.K., Mohan, S.M., Gaur, P.M., Gangarao, N.V., Pandey, M.K., Bohra, A., Sawargaonkar, S.L., Chitikineni, A., Kimurto, P. K., Janila Pasupuleti., Saxena, K.B., Firke Asnake, Sharma Mamta, Rathore, A., Pratap Aditya, Tripathi Shailesh, Datta Subhojit, Chaturvedi, S. K., Mallikarjuna Nalini, Anuradha G., Babbar Anita and Choudhary, A. K. (2013). Achievements and prospects of genomics-assisted breeding in three legume crops of the semi-arid tropics. *Biotech. Adv.,* **31**:1120-1134.