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Original Research Article

Heterosis Analysis in Chickpea (*Cicer arietinum* L.)

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A B S T R A C T

The experiment was conducted at Agricultural Research Station, Badnapur. In this study, four lines were crossed with five male parents and twenty hybrids were developed. These twenty hybrids along with their parental lines and two checks *viz.*, BDNG 797 and PG 08108 were grown during *Rabi* season of 2016. Out of 20 crosses, eleven crosses recorded standard significant heterosis over both checks *viz.*, BDNG 797 and PG 08108. The cross, SAKI 9516 x JG 315 exhibited highest significant standard heterosis (65.89% and 74.56%) followed by Vijay x BDNG 804 (50.99% & 58.89%) for seed yield per plant over the both checks *viz.*, BDNG 797 and PG 08108.

Keywords

Heterosis, Chickpea

Introduction

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 2014-15 in India was about 8.25 million ha with production 7.33 million tones and productivity 889 kg/ha while in Maharashtra is grown on 14.52 lakh ha area with total production of 7.76 lakh tonnes and average productivity of 539 kg/ha during 2015-16. In Marathwada (2015-16), it is grown on 4.50 lakh ha area with total production of 1.29 lakh tonnes and average productivity of 286 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.

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.

Materials and Methods

The experiment was conducted at Agricultural Research Station, Badnapur. In this study, four lines were crossed with five male parents and twenty hybrids were developed. The total 20 Chickpea hybrids along with 9 parents and two checks BDNG 797 and PG 08108 in two replications were grown during *Rabi* of 2016-17 at the Agriculture Research Station, Badnapur.

One row each of P1, P2 and F1 were grown in Randomized Block Design with two 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 45 cm and 15 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. Heterosis was calculated by standard procedure.

Results and Discusion

The results obtained are presented in Tables 1. Exploitation of heterosis is an important approach towards the improvement of crop.

Line x Tester analysis is an extension of top cross method in which several testers are used (Kempthorne, 1957) which provides information in identifying best heterotic crosses.

Out of 20 crosses, eleven crosses recorded standard significant heterosis over both checks *viz.,* BDNG 797 and PG 08108.

The cross, SAKI 9516 x JG 315 exhibited highest significant standard heterosis (65.89% & 74.56%) followed by Vijay x BDNG 804 (50.99% & 58.89%) for seed yield per plant over the both checks *viz.*, BDNG 797 and PG 08108.

Table.1 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	
		BDNG 797	PG 08108	BDNG 797	PG 08108	BDNG 797	PG 08108	BDNG 797	PG 08108
1	Digvijay x BDNG 804	-1.74	0.89	-2.83	-4.19 **	-11.04 **	-16.28 **	-16.86	3.62
2	Digvijay x BDNG 801	-2.61	0	-3.77 *	-5.12 **	-5.94	-11.49 **	5.81	31.88 *
3	Digvijay x JG 315	3.48	6.25 *	-3.77 *	-5.12 **	-15.07 **	-20.08 **	-6.98	15.94
4	Digvijay x AKG 1109	0	2.68	-6.13 **	-7.44 **	-12.74 **	-17.88 **	9.3	36.23 *
5	Digvijay x AKG 1303	-2.61	0	-7.55 **	-8.84 **	-7.43 *	-12.89 **	-13.95	7.25
6	Vijay x BDNG 804	-1.74	0.89	-3.77 *	-5.12 **	-9.34 *	-14.69 **	-25.58 *	-7.25
7	Vijay x BDNG 801	-1.74	0.89	-5.19 **	-6.51 **	-28.66 **	-32.87 **	-19.77	0
8	Vijay x JG 315	0.87	3.57	-3.30 *	-4.65 **	-30.79 **	-34.87 **	-26.16 *	-7.97
9	Vijay x AKG 1109	1.74	4.46	0.47	-0.93	-39.92 **	-43.46 **	-9.88	12.32
10	Vijay x AKG 1303	3.48	6.25 *	-5.66 **	-6.98 **	-21.02 **	-25.67 **	-4.65	18.84
11	JAKI 9218 x BDNG 804	4.35	7.14 *	-3.77 *	-5.12 **	-3.4	-9.09 *	8.14	34.78 *
12	JAKI 9218 x BDNG 801	-0.87	1.79	-2.36	-3.72 *	-16.14 **	-21.08 **	-16.28	4.35
13	JAKI 9218 x JG 315	7.83 **	10.71 **	-8.02 **	-9.30 **	-19.32 **	-24.08 **	-5.23	18.12
14	JAKI 9218 x AKG 1109	1.74	4.46	-3.30 *	-4.65 **	-17.41 **	-22.28 **	-16.28	4.35
15	JAKI 9218 x AKG 1303	0	2.68	-4.72 **	-6.05 **	-12.10 **	-17.28 **	-6.4	16.67
16	SAKI 9516 x BDNG 804	-1.74	0.89	-1.42	-2.79	-12.53 **	-17.68 **	-4.65	18.84
17	SAKI 9516 x BDNG 801	-1.74	0.89	-5.66 **	-6.98 **	-12.10 **	-17.28 **	0.58	25.36
18	SAKI 9516 x JG 315	-3.48	-0.89	-7.55 **	-8.84 **	-14.44 **	-19.48 **	4.07	29.71
19	SAKI 9516 x AKG 1109	-1.74	0.89	-8.49 **	-9.77 **	-20.17 **	-24.88 **	-8.14	14.49
20	SAKI 9516 x AKG 1303	1.74	4.46	-5.19 **	-6.51 **	8.28 *	1.9	-9.88	12.32
	S.E. ±	1.41	1.41	1.49	1.49	1.66	1.66	1.02	1.02
	C.D. 5%	2.96	2.96	3.12	3.12	3.47	3.47	2.13	2.13
	C.D. 1%	4.05	4.05	4.27	4.27	4.75	4.75	2.92	2.92

*, ** indicated significance at 5 and 1 per cent respectively.

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Sr. No.	Crosses	No. of secondary branches per plant		No. of pods per plant		No. of seeds per pod	
		BDNG 797	PG 08108	BDNG 797	PG 08108	BDNG 797	PG 08108
1	Digvijay x BDNG 804	-21.75 *	8.3	-20.75	-13.38	0	10
2	Digvijay x BDNG 801	-12.5	21.11	5.44	15.24	-9.09	0
3	Digvijay x JG 315	10	52.25 **	27.89	39.78 *	36.36 **	50.00 **
4	Digvijay x AKG 1109	1.75	40.83 **	51.70 **	65.80 **	18.18	30.00 **
5	Digvijay x AKG 1303	-37.00 **	-12.8	-8.5	0	-9.09	0
6	Vijay x BDNG 804	-38.25 **	-14.53	61.90 **	76.95 **	0	10
7	Vijay x BDNG 801	-16.75	15.22	69.73 **	85.50 **	-9.09	0
8	Vijay x JG 315	-21.50 *	8.65	-2.72	6.32	-9.09	0
9	Vijay x AKG 1109	-13	20.42	24.15	35.69 *	0	10
10	Vijay x AKG 1303	-8.5	26.64 *	70.07 **	85.87 **	-9.09	0
11	JAKI 9218 x BDNG 804	2.5	41.87 **	52.04 **	66.17 **	27.27 **	40.00 **
12	JAKI 9218 x BDNG 801	-28.75 **	-1.38	54.08 **	68.40 **	-9.09	0
13	JAKI 9218 x JG 315	-19.75 *	11.07	-24.49	-17.47	-9.09	0
14	JAKI 9218 x AKG 1109	-20.50 *	10.03	19.39	30.48	0	10
15	JAKI 9218 x AKG 1303	-18.75 *	12.46	26.53	38.29 *	-9.09	0
16	SAKI 9516 x BDNG 804	-6.5	29.41 *	64.63 **	79.93 **	-9.09	0
17	SAKI 9516 x BDNG 801	-22.50 *	7.27	49.32 **	63.20 **	-9.09	0
18	SAKI 9516 x JG 315	-3.25	33.91 **	62.24 **	77.32 **	-9.09	0
19	SAKI 9516 x AKG 1109	-15.5	16.96	44.90 **	58.36 **	-9.09	0
20	SAKI 9516 x AKG 1303	-11.75	22.15	32.65 *	44.98 **	-9.09	0
	S.E. ±	1.64	1.64	20.86	20.86	0.09	0.09
	C.D. 5%	3.43	3.43	43.66	43.66	0.20	0.20
	C.D. 1%	4.69	4.69	59.68	59.68	0.28	0.28

*, ** indicated significance at 5 and 1 per cent respectively.

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Sr. No.	Crosses	Seed yield per plant (g)		100 seed weight (g)		Harvest index (%)		Protein content (%)	
		BDNG 797	PG 08108	BDNG 797	PG 08108	BDNG 797	PG 08108	BDNG 797	PG 08108
1	Digvijay x BDNG 804	-17.05	-12.72	-5.11	4.5	-32.14 **	-15.71 *	-18.02 **	-6.05
2	Digvijay x BDNG 801	10.93	16.72	-34.56 **	-27.93 **	2.31	27.07 **	-12.75 *	0
3	Digvijay x JG 315	22.52	28.92 *	-27.20 **	-19.82 **	28.03 **	59.02 **	-22.20 **	-10.83
4	Digvijay x AKG 1109	37.42 **	44.60 **	-26.79 **	-19.37 **	-15.64 **	4.78	-13.41 *	-0.76
5	Digvijay x AKG 1303	39.57 **	46.86 **	-29.04 **	-21.85 **	-42.31 **	-28.34 **	-18.46 **	-6.55
6	Vijay x BDNG 804	50.99 **	58.89 **	-19.43 **	-11.26 **	-5.81	16.99 *	-10.99	2.02
7	Vijay x BDNG 801	45.36 **	52.96 **	-23.52 **	-15.77 **	-33.25 **	-17.09 *	-20.22 **	-8.56
8	Vijay x JG 315	3.15	8.54	-27.40 **	-20.05 **	-47.69 **	-35.03 **	-26.59 **	-15.87 *
9	Vijay x AKG 1109	42.55 **	50.00 **	-26.79 **	-19.37 **	-30.51 **	-13.69 *	-15.16 *	-2.77
10	Vijay x AKG 1303	34.11 *	41.11 **	-16.56 **	-8.11 *	-28.12 **	-10.72	-5.27	8.56
11	JAKI 9218 x BDNG 804	50.50 **	58.36 **	-19.43 **	-11.26 **	21.88 **	51.38 **	-15.16 *	-2.77
12	JAKI 9218 x BDNG 801	34.60 *	41.64 **	-7.36 *	2.03	-30.51 **	-13.69 *	-5.05	8.82
13	JAKI 9218 x JG 315	-4.14	0.87	-9.20 *	0	-35.13 **	-19.43 **	-15.16 *	-2.77
14	JAKI 9218 x AKG 1109	6.62	12.2	-6.75	2.7	-26.92 **	-9.24	-13.19 *	-0.5
15	JAKI 9218 x AKG 1303	22.52	28.92 *	-3.07	6.76	-24.02 **	-5.63	-22.20 **	-10.83
16	SAKI 9516 x BDNG 804	48.51 **	56.27 **	-14.93 **	-6.31	-23.76 **	-5.31	-8.35	5.04
17	SAKI 9516 x BDNG 801	19.87	26.13	-26.99 **	-19.59 **	-36.07 **	-20.59 **	-10.99	2.02
18	SAKI 9516 x JG 315	65.89 **	74.56 **	-31.08 **	-24.10 **	-23.93 **	-5.52	-24.18 **	-13.10 *
19	SAKI 9516 x AKG 1109	45.70 **	53.31 **	-32.52 **	-25.68 **	-6.67	15.92 *	-7.91	5.54
20	SAKI 9516 x AKG 1303	45.70 **	53.31 **	-26.18 **	-18.69 **	-32.14 **	-15.71 *	-5.05	8.82
	S.E. ±	3.87	3.87	0.78	0.78	2.85	2.85	1.22	1.22
	C.D. 5%	8.10	8.10	1.65	1.65	5.96	5.96	2.55	2.55
	C.D. 1%	11.07	11.07	2.25	2.25	8.15	8.15	3.49	3.49

*, ** indicated significance at 5 and 1 per cent respectively.

References

Kempthorne, O. (1957). An introduction to genetic statistics, John Wiley and Son Inc. New York, 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 H2 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.