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Original Research Article

Combining Ability Analysis in Chickpea (*Cicer arietinum* L.)

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Keywords

Combining ability, Chickpea

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. The parental lines AKG 1303 exhibited high GCA effect for plant height, VIJAY for number of primary and JG 315 for secondary branches per plant, JAKI 9218 for 100 seed weight, SAKI 9516 for number of pods per plant and seed yield per plant. The cross SAKI 9516 x JG 315 recorded high significant and desirable SCA effect for seed yield per plant and number of pods per plant and the cross Digvijay x AKG 1109 for number of pods per plant.

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, in 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.

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, 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. Combining ability analysis and the testing of significance of different genotypes was based on the procedure given by Kampthorne (1957).

Research analysis and reasoning

The results obtained are presented in Tables 1 and 2. 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 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. The parental lines AKG 1303 exhibited high GCA effect for plant height, VIJAY for number of primary and JG 315 for secondary branches per plant, JAKI 9218 for 100 seed weight, SAKI 9516 for number of pods per plant and seed yield per plant. The cross SAKI 9516 x JG 315 recorded high significant and desirable SCA effect for seed yield per plant and number of pods per plant and the cross Digvijay x AKG 1109 for number of pods per plant.

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	Seed Yield Per Plant (g)	100 seed wt. (g)	Harvest Index (%)	Protein (%)
	Female parents											
1	DIGVIJAY V	-0.55	-022	2.17**	0.31	0.64	-32.12**	0.10**	-3.50*	-0.94**	5.36**	-0.55
2	VIJAY	0.15	1.17*	-5.12**	0.78*	-0.89	17.07*	-0.04	1.50	-0.50	-4.65**	-0.25
3	JAKI 9218	1.35**	0.17	0.65	0.08	-0.38	-11.02	0.02	-2.49	2.82**	1.27	0.08
4	SAKI 9516	-0.95*	-1.12*	2.29**	0.39	0.64	26.07**	-0.08*	4.49**	-1.38**	-1.98*	0.73
	Male parents											
5	BDNG 804	-0.27	1.75**	2.82**	-0.13	-0.17	9.47	0.07	0.89	1.46**	6.53**	0.31
6	BDNG 801	-1.15*	0.37	-0.30	0.06	-1.00	17.10*	-0.08*	-0.77	-0.59*	-1.90	0.51
7	JG 315	1.10*	-1.12*	-2.28**	-0.03	1.29*	-25.40**	0.04	-2.54	-0.74*	0.84	-1.71**
8	AKG 1109	0.1	0.25	-3.53**	0.16	0.66	2.97	0.04	0.84	-0.61*	0.69	0.47
9	AKG 1303	0.2	-1.25*	3.29**	-0.05	-0.77	-4.15	-0.08*	1.57	0.48	-6.15**	0.40
	SE ±Gi (line)	0.63	0.66	0.74	0.45	0.73	9.33	0.04	1.73	0.35	1.27	0.54
	SE ±Gj (tester)	0.70	0.74	0.83	0.51	0.82	10.43	0.04	1.93	0.39	1.42	0.61

*, ** Significant at 5% and 1 %, 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	No. of seeds per pod	Seed yield per plant (g)	100 seed weight (g)	Harvest index (%)	Protein content (%)
1	Digvijay x BDNG 804	-0.32	0.35	-3.10*	-0.92	-1.79	-56.37**	-0.15*	-11.68**	3.29**	-18.34**	-0.55
2	Digvijay x BDNG 801	0.05	0.72	2.42	0.82	0.88	-25.50	-0.10	-1.56	-1.86**	10.24**	0.44
3	Digvijay x JG 315	1.30	2.22*	0.10	-0.17	3.08*	50.00**	0.27**	3.70	0.09	22.54**	0.52
4	Digvijay x AKG 1109	0.30	-1.65	2.45	1.02	2.07	56.62**	0.07	4.81	0.06	-2.85	0.33
5	Digvijay x AKG 1303	-1.32	-1.65	-1.87	-0.76	-4.24**	-24.75	-0.10	4.73	-1.58*	-11.60**	-0.74
6	Vijay x BDNG 804	-1.02	-2.05	5.00**	-0.8	-3.55**	15.92	-0.01	3.86	-0.65	7.08**	0.74
7	Vijay x BDNG 801	-0.15	-2.17	-0.97	-0.28	1.57	19.80	0.04	3.83	0.40	-0.53	-1.55
8	Vijay x JG 315	-0.90	1.32	0.00	0.73	-1.67	-44.20**	-0.08	-7.15*	-0.40	-11.73**	-0.78
9	Vijay x AKG 1109	0.60	3.95**	-3.05*	0.46	0.66	-33.07*	0.01	1.36	-0.37	-1.53	-0.36
10	Vijay x AKG 1303	1.47	-1.05	-0.97	1.13	2.99*	41.55*	0.04	-1.91	1.02	6.71**	1.95*
11	JAKI 9218 x BDNG 804	1.27	-1.05	2.02	1.45	4.08**	29.52	0.23**	7.70*	-3.97**	17.35**	-0.54
12	JAKI 9218 x BDNG 801	-0.85	1.82	-0.85	-0.84	-1.33	24.90	-0.02	4.57	1.03	-4.86*	1.55
13	JAKI 9218 x JG 315	1.90	-2.67*	-0.38	0.20	-1.83	-48.10*	-0.14	-5.36	0.73	-10.31**	1.48
14	JAKI 9218 x AKG 1109	-0.60	0.95	1.77	-0.94	-1.35	-11.97	-0.04	-5.49	1.20*	-5.36*	-0.25
15	JAKI 9218 x AKG 1303	-1.72	0.95	-2.55*	0.10	0.43	5.65	-0.02	-1.42	1.00	3.18	-2.23*
16	SAKI 9516 x BDNG 804	0.07	2.75*	-3.92**	0.04	1.25	10.92	-0.07	0.12	1.33*	-6.09**	0.35
17	SAKI 9516 x BDNG 801	0.95	-0.37	-0.59	0.29	-1.11	-19.20	0.08	-6.85*	0.43	-4.85*	-0.44
18	SAKI 9516 x JG 315	-2.30*	-0.87	0.28	0.69	0.43	42.30**	-0.04	8.81**	-0.42	-0.50	-1.22
19	SAKI 9516 x AKG 1109	-0.30	-3.25**	-1.17	-0.55	-1.38	-11.57	-0.04	-0.67	-0.89	9.74**	0.29
20	SAKI 9516 x AKG 1303	1.57	1.75	5.40**	-0.49	0.80	-22.45	-0.08	-1.40	-0.44	1.69	1.01
	SEij	1.41	1.49	1.66	1.02	1.64	20.86	0.09	3.87	0.78	2.85	1.22

*, ** Significant at 5% and 1 %, respectively.

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