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Heterosis in chickpea (*Cicer arietinum* L.) for seed yield and its components

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Abstract

Heterosis was estimated in 36 hybrids produced through line x tester mating design. Maximum Heterosis over mid parent was observed for 100-seed weight (86.94%) followed by pods per plant (85.97%). Significantly positive heterosis was observed for seed yield per plant (66.21%), seeds per pod(57.89%), branches per plant (45.45%), harvest index (39.83%), days to maturity (24.30%), plant height (22.84%). Significant negative heteorsis was observed for days to flowering (-18.44%) and in case of protein content, only one cross depicted significant heterosis (13.34%). The characters such as pods per plant, branches per plant, seeds per pod and 100-seed weight appeared to be contributing for grain yield per plant. The exploitation of heterosis for yield and its components has been discussed

Introduction

Chickpea (*Cicer arietinum* L.) is a multipurpose grain legume extensively cultivated arid and semi arid regions of Asia, Europe and Africa from ancient times. Chickpea is a highly self pollinated crop and the scope for exploitation of hybrid vigour will depend on the direction and magnitude of heteorsis, biological feasibility and the type of gene action involved in the inheritance of various traits. A knowledge of type of gene effects and their magnitude is of fundamental importance. The line x taster analysis has been extensively used in almost all the major field cops to study the extent of heteorsis for yield ad its attributing characters. Compared to cereals and other legume corps, yield in chickpea is very low. One of the important reasons to such a low yield is the non-availability of high yielding varieties and hybrids. Therefore, present investigation was undertaken.

Materials and methods

Fifty one treatments involving 15 parents viz., GG-1, Dahod yellow, GG-2, GCP-105, GCP-106, GCP-9504, GCP-9514, GCP-9516, GCP-9601, GCP-9695, GCP-9626, GCP-9629, GCP-9630, GCP-9707 and GCP-9709 and 36 hybrids produced through line x tester (3 x 12) mating design. All the treatments were laid out in randomized complete block design with three replications during *rabi* 2001 at N. M. College of Agriculture, GAU, Navsari. Each genotype was represented by a row 3.6 m length with 45 x 30 cm spacing. All the agronomical practices and plant protection measures were adopted as per package of practices. Observations on yield and yield attributing characters were recorded from randomly selected five plants from each treatment. Heterosis over mid parent (MP) and better parent (BP) was calculated as per Kempthorne (1).

Results and discussion

Highly significant differences were observed in hybrids for all the characters. Parents differed significantly for yield attributing characters. Parents vs. hybrid comparison indicated that mean squares due to hybrids were significantly different from the mean squares due to parents for all the cataracts except days to 50 per cent flowering, plant height, branches per plant, seeds per pod and 100-seed weight. Variation among parents and hybrids observed for all the characters indicated wide range of variability among the parents chosen for study (Table 1).

The range of hetrosis for seed yield was from -21.04 to 66.21 % (over MP) and from 33.89 to 77.33 % (over BP) (Table-2). Similar results were reported by Ramanujam *et al.* (2), Deshmukh and Bhapkar (3),

Table 1. Analysis of variance for yield and its component characters in chickpea

Source of variation	d.f.	Days to 50% lowering	Days to maturity	Plant height (cm)	Branches per plant	Pods per plant	Seeds per pod	100-seed weight (g)	Seed yield per plant (g)	Harvest index (%)	Protein content (%)
Parents	14	107.040	56.373**	44.458**	0.289	465.563**	0.0675	81.069**	16.531**	55.898	3.170
Hybrids	35	52.7429**	98.710**	45.405**	0.988**	589.569**	0.0883**	132.487**	24.100**	70.009*	2.966*
Parents vs hybrids	1	4.531	4715.06**	0.617	0.00201	885.414**	0.0648	14.052	45.307**	805.718**	0.0175
Error	100	5.597	14.482	15.595	0.253	28.270	0.0451	5.684	4.769	38.055	1.946

* Significant at 5% level ** Significant at 1% level

Kamatar (4) and Sarode *et al.* (5). For days to 50 % flowering, the per cent heteorsis ranged from -6.49 to -18.44 % and -7.49 to -20.28 % over mid and better parent, respectively. In case of days to maturity, the range of heteorsis per cent was 5.05 to 24.30 % over (MP) and 5.57 to 25.22 % (Over BP). Majority of the crosses recorded significant heteorsis for this trait which indicates involvement of additive and non-additive type of gene action.

The range of heteorsis over mid parent was -23.80 to 22.84 % and over better parent was -31.74 to 20.60 %. For plant height, the heterotic value for branches per plant ranged from -25.86 to 45.45 % (over MP) and 30.19 to 50.94 % (over BP), respectively. For pods per plant, 50 % crosses showed significant heteorsis. The range of heteorsis per cent over mid and better parent was 20.28 to 85.97 % and 27.78 to 100.98 %, respectively. Similar findings were reported by Kamatar (4), Rao and Chopra (6) and Kamatar *et al.* (7).

In case of seeds per pod and 100-seed weight, the range of heteorsis was -20.0 to 57.89 %, 27.72 to 86.94 % over mid parent and 35.29 to 76.47 %, -20.55 to 109.98 % over better parent respectively. In these characters, half of the crosses exhibited significant heteorsis. The range of heteorsis for harvest index was 22.62 to 39.83 (over MP) and 24.02 to 51.50 % (over BP). For protein content, only one cross exhibited significant heteorsis over mid parent i.e., 13.34 per cent and for better parent the range of heteorsis per cent was -12.0 to 17.25 per cent, respectively (Table 2).

Simple dominance in respect of yield components may lead to expression of heteorsis in respect of yield. Out of 15 parents used in the study, the hybrids involving 9 parents viz., GG-1, GG-2, GCP-9516, GCP-9514, GÇP-9601, GCP-9629, GCP-9709, GCP-9707 and GCP-9630 exhibited high heterotic vigour for most of the characters in various combinations as listed in Table 2. In majority of hybrids heteorsis for seed yield was associated with heteorsis for branches per plant, pods per plant, seeds per pod, 100-seed weight and harvest index. These findings are agreement with Kamatar (4), Rao and Chopra (6), Kamatar *et al.* (7) and Sarode *et al.* (5). The per se performance of crosses was in general, related to the heterotic response in majority of the characters. This indicated that selection of cross either on the basis of their mean performance or one the basis of magnitude of heterotic effects would be

Table-2. Range of mean and Heterosis, most heterotic F_1 over mid and better parent

Particular	Range of mean		Range of heterosis		Most heterotic F_1 over	
	Parents	Cross	MP	BP	MP	BP
Days to 50% flowering	46.33 - 63.67	48.67 - 65.67	-6.47 to -18.44	-7.49 to -20.28	GG-1 x GCP-9516	GG-x GCP-9516
Days to maturity	110.33 - 124.00	118.00 - 140.67	5.05 to 24.30	5.57 to 25.22	GG-1 x GCP-9514	GG-1 x GCP-9514
Plant height (cm)	35.49 - 49.70	33.69 - 47.90	-23.80 to 22.84	-31.74 to 20.26	GG-1 x GCP-9601	GG-1 x GCP-9601
Branches per plant	3.00 - 4.27	2.87 - 5.33	-25.86 to 45.45	30.19 to 50.94	GG-2 x GCP-9629	GG-2 x GCP-9707
Pods per plant	33.27 - 70.87	17.87 - 72.60	20.28 to 85.97	28.78 to 100.92	GG-2 x GCP-9709	GG-2 x GCP-9630
Seeds per pod	1.00 - 1.60	1.13 - 2.00	-20.00 to 57.89	35.29 to 76.47	GG-2 x GCP-9630	Dahod Yellow x GCP-9514
100-seed weight (g)	15.63 - 36.23	14.10 - 39.17	22.72 to 86.94	-20.55 to 109.88	GG-1 x GCP-106	GG-2 x GCP-97047
Seed yield per plant (g)	9.51 - 18.53	10.74 - 20.96	-21.04 to 66.21	33.89 to 77.33	GG-1 x GCP-9707	GG-2 x GCP-9707
Harvest index (%)	32.74 - 49.20	34.09 - 53.36	22.62 to 39.83	24.02 to 51.50	GG-2 x GCP-9709	GG-2 x GCP9707
Protein content (%)	18.12 - 21.67	17.91 - 21.67	13.34	12.00 to 17.25	13.34	GG-2 x GCP-9601

equally important. Though the substantial amount of heterosis for seed yield and yield attributing characters was reported by earlier workers and in the present study, but its commercial exploitations not feasible because of limitation in the production of chickpea hybrids seeds. Therefore, plant breeders can lay an emphasis on yield attributing characters for its improvement by applying selection pressure in succeeding generations.

Conclusion

Combining ability analysis involving 3 lines and12 tester was made in gram for yield and yield attributing characters. Combining ability analysis revealed that both gca and sca variances were important for inheritance of various traits. However, sca variances were higher than gca variances for all the characters, which indicated the preponderance of non-additive gene action in the expression of various traits. The estimates of gca effects indicated that GG-2, GCP-9707 and GCP-9632 were good general combiners for seed yield per plant and some of the yield components. The best specific crosses were the combinations of good x good, average x good and good x average combiners.

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