

Estimation of heterosis in Fieldpea (*Pisum sativum* L. var *arvense*) for yield attributes

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ABSTRACT

Twenty eight cross combinations were developed by 8 x 8 diallel analysis during *rabi* 2012-13. 28 F₁'s and 8 parents were evaluated during *rabi* 2013-14. Thirteen and fifteen crosses manifested significant and positive heterobeltiosis and standard heterosis, respectively, for seed yield per plant. The range of heterobeltiosis and standard heterosis for seed yield was varied from -71.02 % (KPMR 400 x NDP-1) to 153.44 % (PRAKASH x IPFD 10-13) and -61.58 % (KPMR 400 x NDP-1) to 71.31 % (ADARSH x APARNA), respectively. The hybrid PRAKASH x IPFD 10-13 expressed the highest heterobeltiosis (153.44 %) for seed yield. The cross combination (PRAKASH x IPFD 10-13) expressed highest level of heterosis over better parent (18.09 %) for test weight (%). The crosses viz, ADARSH x APARNA (71.31 %) and PRAKASH x IPFD 10-13 (67.01 %) expressed the highest level of heterosis over standard check (DF 1) for seed yield and undesired direction for its contributing characters.

Key words : Diallel, heterobeltiosis, standard heterosis, fieldpea

Heterosis has been successfully exploited both in cross-pollinated and self-pollinated crops. Exploitation of hybrid vigour has been recognized as an important tool for genetic improvement of yield and may serve as a major fruitful technique to break existing yield barriers, to get better transgressive segregants. East (1908) and Shull (1908) studied the effects of cross and self fertilization in maize and finally Shull (1910) summarized the effects of inbreeding and cross breeding in it. The aim of heterosis in the present study was to spot out the best combination of parents giving high degree of useful heterosis. Information about heterosis for the identification of potential crosses, which can offer maximum chances of isolating transgressive segregants, is crucial in self-pollinated crops.

Economic heterosis has the most practical utility, which would be compared with a standard variety as check (Meredith and Bridge, 1972) while heterosis has relatively limited importance and is of more academic interest than that of practical utility. In practical plant breeding, the heterosis measured over better parent and popular cultivar is more realistic and is of more practical importance.

MATERIALS AND METHODS

The eight diverse parental genotypes of Fieldpea and their twenty-eight F₁'s (excluding reciprocals). The parental genotypes viz., DF-1, KPMR 400, VIKAS, PRAKASH, ADARSH, IPFD 10-13, NDP-1, APARNA were selected from germplasm maintained at Centre of Excellence for Research on pulses, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Dist. Banaskantha, during *rabi*, 2012-13 to create a diallel set. The complete set of 36 genotypes (eight parents + 28

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hybrids) were evaluated in Randomized Block Design (RBD) with three replication. DF-1 (Dantiwada Fieldpea-1) was used as standard check. The observations were recorded both as visual assessment (Days to 50% flowering and days to maturity) and measurement on randomly selected five competitive individual plants (plant height, number of primary branches per plant, number of pods per plant, number of seeds per pod, seed yield per plant (g), test weight (g), protein content (%) and harvest index (%)). The heterosis over better parent was estimated based on formulae given by Fonseca and Patterson (1968).

RESULTS AND DISCUSSION

The degree of heterosis varied from cross to cross for all the characters. Considerably high heterosis values in certain crosses and low in other crosses revealed that nature of gene action varied with the genetic architecture of parental material. Out of 28 crosses thirteen crosses manifested heterobeltiosis for seed yield per plant. The range of heterobeltiosis for seed yield was varied from -71.02 % to 153.44 %. The best three hybrids which recorded significant and high positive heterosis over better parent for seed yield were, PRAKASH x IPFD 10-13 (153.44%), ADARSH x APARNA (114.98%) and PRAKASH x ADARSH (97.89%). The standard heterosis varied from -61.58 per cent (KPMR 400 x NDP-1) to 71.31 per cent (ADARSH x APARNA). The best three hybrids which recorded highly significant and positive heterosis over standard check were ADARSH x APARNA (71.31%), PRAKASH x IPFD 10-13 (67.01%) and DF-1 x ADARSH (66.56%)(Table 1 and Table 2). Medium to high heterobeltiosis for seed yield in fieldpea has also been reported by Borah (2009), Singh *et al.* (2012) and Punia *et al.* (2013).

For number of pods per plant, twelve crosses showed significant and positive heterobeltiosis ranged from -46.41 per cent (KPMR 400 x NDP-1) to 161.69 per cent (ADARSH x APARNA). Eighteen hybrids showed significant and positive standard heterosis, ranged from -32.88 per cent (KPMR 400 x IPFD 10-13) to 67.58 per cent (ADARSH x APARNA). For number of seeds per pod, fifteen

crosses showed significant and positive heterobeltiosis which ranged from -37.73 per cent (DF-1 x NDP-1) to 43.11 per cent (ADARSH x APARNA). Thirteen hybrids showed significant and positive standard heterosis. It ranged from -37.73 per cent (DF-1 x NDP-1) to 38.28 per cent (ADARSH x APARNA). These findings are in agreement with the earlier report of Borah (2009), Punia *et al.* (2013), Kosev *et al.* (2012).

For test weight (%), eight hybrids manifested significant and positive heterobeltiosis. The spectrum of variation of heterosis over better parent ranged from -20.78 per cent (KPMR 400 x VIKAS) to 18.09 per cent (PRAKASH x IPFD 10-13). Fifteen hybrids showed significant and positive standard heterosis. The standard heterosis varied from -8.21 per cent (IPFD 10-13 x APARNA) to 23.23 per cent (ADARSH x APARNA). For protein content (%), only one hybrid showed significant and positive standard heterosis. The standard heterosis varied from -12.77 per cent (KPMR 400 x IPFD 10-13) to 4.42 per cent (IPFD 10-13 x APARNA). For harvest index (%), eight hybrids manifested significant and positive heterobeltiosis. The spectrum of variation of heterosis over better parent was observed ranged from -44.21 per cent (IPFD 10-13 x APARNA) to 77.53 per cent (PRAKASH x IPFD 10-13). Four hybrids showed significant and positive standard heterosis. The standard heterosis varied from -65.58 per cent (IPFD 10-13 x APARNA) to 29.67 per cent (ADARSH x APARNA). Similar results were obtained by Singh *et al.* (2010), Punia *et al.* (2013) and Singh *et al.* (2012).

The crosses viz., PRAKASH X IPFD 10-13 and ADARSH X APARNA exhibited significant and desirable heterosis for seed yield and its contributing traits Viz., number of pods per plant, test weight and harvest index.

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Table 1 Heterosis in percentage in F_1 hybrid over better parent [BP] and standard check (DF-1) [SC] for Yield and its components in Field pea.

Sr No.	Hybrids	Seed yield		Number of pods		Number of seeds		Test weight (g)		Protein content (%)		Harvest index (%)	
		BP	SC	BP	SC	BP	SC	BP	SC	BP	SC	BP	SC
1.	DF 1 x KPMR 400	45.79**	45.80**	41.28**	41.28**	26.20**	26.20**	1.79	12.92**	-4.46**	-4.00*	2.29	2.30
2.	DF 1 x VIKAS	1.3	1.30	-34.62**	-22.94**	3.07	3.07	-16.34**	2.12	1.31	1.80	-16.41**	-16.41**
3.	DF 1 x PRAKASH	58.05**	58.04**	39.72**	58.94**	27.06**	27.06**	10.71**	10.71**	-9.37**	-8.93**	6.32	6.32
4.	DF 1 x ADARSH	66.56**	66.56**	62.32**	62.32**	31.17**	31.17**	0.13	10.68**	-10.30**	-9.87**	24.39**	24.39**
5.	DF 1 x IPFD 10-13	11.75	11.75	-10.78	-10.78	19.02**	19.02**	4.34	4.34	-5.80**	-1.54	-21.14**	-21.13**
6.	DF 1 x NDP-1	9.39	45.01**	9.65	48.49**	-37.73**	-37.73**	15.98**	15.98**	-3.32*	-2.85	0.99	0.99
7.	DF 1 x APARNA	43.93**	43.94**	47.57**	47.57**	-9.51	-9.51	15.37**	15.37**	-1.36	-0.88	-4.04	-4.04
8.	KPMR 400 x VIKAS	-17.72	-23.49**	-35.63**	-24.13**	-14.47*	-20.25**	-20.78**	-3.29	-6.78**	-6.62**	-14.78**	-27.39**
9.	KPMR 400 x PRAKASH	55.53**	38.37**	24.80**	41.97**	32.69**	26.99**	5.24	16.75**	-7.49**	-8.25**	22.10**	-14.09**
10.	KPMR 400 x ADARSH	61.77**	43.92**	68.40**	47.39**	-15.87*	-18.71**	8.61**	20.49**	0.88	0.05	17.01**	-14.12**
11.	KPMR 400 x IPFD 10-13	-55.34**	-60.27**	-23.31**	-32.88**	-33.66**	-37.73**	-16.67**	-7.56*	-16.55**	-12.77**	13.72	-31.27**
12.	KPMR 400 x NDP 1	-71.02**	-61.58**	-46.41**	-27.43**	-32.89**	-37.42**	-12.28**	-2.69	-0.53	-1.35	-3.65	-27.95**
13.	KPMR 400 x APARNA	-1.48	-12.35	-6.03	-17.75**	-16.45*	-22.09**	-11.50**	-1.82	-10.28**	-11.01**	17.55*	-27.49**
14.	Vikas x PRAKASH	50.67**	40.10**	22.20**	44.04**	-13.46	-17.18**	-10.69**	9.02**	-8.22**	-8.07**	0.61	-14.28**
15.	Vikas x ADARSH	65.84**	54.20**	36.09**	60.41**	17.84**	13.87**	-6.71*	13.88**	-3.69*	-3.52*	34.84**	14.88**
16.	Vikas x IPFD 10-13	44.12**	34.02**	14.69*	35.18**	19.93**	12.58*	-3.77	17.47**	-10.18**	-6.11**	7.53	-8.38
17.	Vikas x NDP 1	-32.47**	-10.47	-36.25**	-13.67	16.91*	-2.45	-10.78**	8.91**	-1.98	-1.81	-18.73**	-30.76**
18.	Vikas x APARNA	-46.37**	-50.13**	-36.18**	-24.77**	-24.29**	-34.97**	-20.34**	-2.76	-9.62**	-9.46**	-37.31**	-46.59**
19.	Prakash x ADARSH	97.89**	57.70**	37.54**	56.47**	-31.11**	-33.44**	-2.26	8.03*	-6.80**	-9.45**	-0.97	-27.31**
20.	Prakash x IPFD 10-13	153.44**	67.01**	42.74**	62.39**	18.27**	13.19*	18.09**	17.73**	-13.77**	-9.87**	77.53**	24.91**
21.	Prakash x NDP 1	-24.94**	-0.49	-9.65	22.36**	20.77**	15.58*	0.36	-1.14	-4.82**	-7.40**	7.82	-19.38**
22.	Prakash x APARNA	53.69**	1.28	5.52	20.04**	26.92**	21.47**	0.21	-1.29	-3.74*	-6.47**	-6.48	-34.20**
23.	Adarsh x IPFD 10-13	-38.47**	-50.96**	27.48	-29.36**	-21.02**	-23.68**	-14.49**	-5.48	-13.65**	-9.74**	-20.93**	-41.96**
24.	Adarsh x NDP 1	2.64	36.08**	1.69	37.71**	19.37**	15.34*	-5.1	4.90	-1.51	-4.19**	17.17**	-12.38**
25.	Adarsh x APARNA	114.98**	71.31**	161.69**	67.58**	43.11**	38.28**	11.49**	23.23**	-1.71	-4.73**	76.66**	29.67**
26.	IPFD 10-13 x NDP 1	-1.71	30.31**	0.26	35.78**	18.95**	11.66	7.94*	7.60*	-8.13**	-3.97*	-15.25*	-36.63**
27.	IPFD 10-13 x APARNA	11.11	-58.86**	10.32	-29.36**	-18.95**	-23.93**	-7.92*	-8.21*	-0.1	4.42**	-44.21**	-65.58**
28.	NDP 1 x APARNA	-28.19**	-4.82	-12.64*	18.30*	33.57**	14.72*	6.96*	4.97	-1.05	-3.74*	12.23	-16.07**
Range of heterosis		-71.02 to 153.44	-61.58 to 71.31	-46.41 to 161.69	-32.88 to 67.58	-37.73 to 43.11	-37.73 to 38.28	-20.78 to 18.09	-8.21 to 23.23	-3.32 to -16.55	-12.77 to 4.42	-44.21 to 77.53	-65.58 to 29.67

BP=Better Parent; SC= Standard Check(DF-1)

** and * indicates significant at P=0.05 and P= 0.01 levels, respectively.

Table 2 Top three of the parents and hybrids for heterosis estimates

Characters	Magnitude of heterosis over	
	Better parents	Standard check
Seed yield per plant (g)	PRAKASH x IPFD 10-13	ADARSH x APARNA
	ADARSH x APARNA	PRAKASH x IPFD 10-13
	PRAKASH x ADARSH	DF- 1 x ADARSH
Number of pods per plant	ADARSH x APARNA	ADARSH x APARNA
	KPMR 400 x ADARSH	PRAKASH x IPFD 10-13
	DF- 1 x ADARSH	DF- 1 x ADARSH
Number of seeds per pod	ADARSH x APARNA	ADARSH x APARNA
	NDP-1 x APARNA	DF- 1 x ADARSH
	KPMR 400 x PRAKASH	DF- 1 x PRAKASH
Test weight (g)	PRAKASH x IPFD 10-13	ADARSH x NDP-1
	DF-1 x NDP-1	PRAKASH x IPFD 10-13
	ADARSH x APARNA	DF-1 x NDP-1
Protein content (%)	DF-1 x NDP-1	IPFD 10-13 x APARNA
	-	-
	-	-
Harvest index (%)	PRAKASH x IPFD 10-13	ADARSH x APARNA
	ADARSH x APARNA	PRAKASH x IPFD 10-13
	VIKAS x ADARSH	DF- 1 x ADARSH

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