

Genetic analysis for seed yield and its related parameters in Fieldpea (*Pisum sativum* L. var *arvense*)

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ABSTRACT

Combining ability analysis was carried out in 8x8 parental diallel progenies for seed yield and its related traits in Fieldpea. General combining ability and specific combining ability variances were highly significant for all the characters indicated that both additive and non-additive gene effects involved in the inheritance of the characters under study. The ratio of GCA & SCA genetic variance showed predominance of non-additive gene action for the expression of all the traits. An overall consideration of gca effects indicated that the parents DF-1, ADARSH and PRAKASH appeared to be good general combiners for seed yield per plant and harvest index. For seed yield per plant, the crosses PRAKASH X IPFD 10-13, ADARSH X APARNA and VIKAS X IPFD 10-13 recorded the highest sca effects.

Key words : Diallel, combining ability, GCA, SCA, fieldpea

Pulses occupy an important place in meeting the protein needs of people in the developing countries. Pulses are essential supplement to cereal based diet in India. The development of high-yielding varieties through hybridization requires knowledge of combining ability of the parents, particularly information on the nature and magnitude of gene effects controlling quantitative traits. For improving the genetic yield potential of the varieties and hybrids, choice of right type of parents for hybridization is important. This emphasizes the importance of testing the parents for their combining ability and their hybrids for manifestation of hybrid vigour. In self-fertilized crops where utilization of heterosis at commercial level is not realistic, the breeder will primarily be interested in higher magnitude of additive genetic variance for establishing superior genotypes. This analysis is a powerful tool to discriminate good as well as poor combiners and choose appropriate parental material in breeding programme. (Patil and Shete, 1986).

The present investigation aims at identification of superior parents, cross combinations and evaluation

of type of gene action for seed yield and its component traits.

MATERIALS AND METHODS

The eight diverse parental genotypes of Fieldpea viz., DF-1, KPMR 400, VIKAS, PRAKASH, ADARSH, IPFD 10-13, NDP-1 and APARNA were selected from germplasm maintained at Centre of Excellence for Research on pulses, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, District: Banaskantha, during *rabi*, 2012-13 to create a diallel set. The complete set of 36 genotypes (8 parents + 28 hybrids) were evaluated in Randomized Block Design (RBD) with three replications. The observations were recorded both as visual assessment (days to flowering, 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 (%). All recommended agronomic practices along with plant protection measures were followed. Combining ability analysis was carried out according to the procedure given by Griffing (1956) as per Method 2 and Model I.

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RESULTS AND DISCUSSION

Analysis of variance for combining ability (Table 1) showed that general and specific combining ability variances were highly significant for all the characters suggested importance of both additive and non-additive type of gene actions in the inheritance of characters. The ratio of $gca : sca$ variance (σ^2gca/σ^2sca) was less than unity for all the characters under study. This indicated that non-additive type of gene action was primarily involved in the expression of these characters. Similar results were also reported by Dagla *et al.* (2013), Esposito *et al.* (2013), Kosev *et al.* (2013), Rebica *et al.* (2013) and Singh *et al.* (2013). The presence of predominantly large amount of non-additive gene action would be necessitate the maintenance of heterozygosity in the population.

The parent DF-1 ranked first as it was good general combiner for all the characters except plant height. The parent ADARSH was good combiner for days to maturity, number of pods per plant, number of seeds per pod, number of primary branches, seed yield, test weight, protein content and harvest index. The parent PRAKASH had good combiner for plant height, number of pods per plant, number of seeds per pod, number of primary branches, seed yield and harvest index. The parent NDP-1 was found to be good general combiner for number of pods per plant, seed yield per plant and protein content (Table 2).

Three best crosses selected on the basis of sca effects for each of the characters are presented in Table 3. A perusal of data revealed that none of the crosses had high ranking sca effects for all the characters. The sca for most of the characters were accompanied by top ranking *per se* performance also indicated predominant role of non-additive gene effects in expression of seed yield and its components. For seed yield per plant, it was observed that the crosses PRAKASH X IPFD 10-13, ADARSH X APARNA, VIKAS X IPFD 10-13 and VIKAS X ADARSH expressed top ranking sca effects for seed yield per plant had also top ranking in *per se* performance and they involved good x poor, good x poor, poor x poor and poor x good gca of the parents, respectively. The cross IPFD 10-13 X APARNA expressed the highest sca effects for seed protein (Table 3).

These crosses may be need for further improvement of genotype by utilizing biparental matting design to get superior transgressive segregates from advance generation in future.

Table 1 Analysis of variance for combining ability for various characters in Fieldpea

Source of variation	d.f.	Days to flowering	Days to maturity	Plant height	Number of primary branches per plant	Number of pods per plant	Number of seeds per pod	Seed yield per plant	Test weight	Protein content	Harvest index
GCA	7	39.39 **	73.03 **	4940.4 **	1.12 **	245.09 **	1.01 **	129.17 **	2.54 **	0.85 **	178.85 **
SCA	28	15.82 **	25.64 **	1103.8 **	0.34 **	157.04 **	1.53 **	74.53 **	2.60 **	0.92 **	92.01 **
Error	70	1.08	4.45	23.12	0.02	3.75	0.06	1.64	0.16	0.05	2.50
σ^2gca		3.83	6.85	491.72	0.11	24.13	0.09	12.75	0.23	0.07	17.63
σ^2sca		14.73	21.19	1080.71	0.32	153.28	1.47	72.88	2.44	0.86	89.51
σ^2gca/σ^2sca		0.26	0.32	0.45	0.34	0.15	0.06	0.17	0.09	0.09	0.19

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

Table 2 Estimation of general combining ability (GCA) effects associated with each parental genotype in Fieldpea

Parents	Days to flowering	Days to maturity	Plant height	Number of primary branches per plant	Number of pods per plant	Number of seeds per pod	Seed yield per plant	Test weight	Protein content	Harvest index
DF-1	-3.30**	-4.37**	4.85**	0.36**	3.60**	0.46**	4.54**	0.27*	0.34**	7.63**
KPMR 400	0.56	1.92**	-16.58**	-0.30**	-4.44**	-0.38**	-2.44**	-0.00	-0.09	-2.92**
VIKAS	-1.10 **	-0.34	-23.40 **	-0.06	-1.30 *	-0.28**	-0.64	0.58**	0.17 *	0.18
PRAKASH	0.96 **	0.99	-8.72 **	0.40**	7.55**	0.38**	2.85**	-0.00	-0.48**	1.22 *
ADARSH	-0.53	-1.87 **	37.57 **	0.37**	3.18**	0.22**	3.81**	0.72**	-0.13	4.05**
IPFD 10-13	-0.46	-1.00	5.32**	-0.40**	-6.80**	-0.08	-4.62**	-0.57**	0.23 **	-4.79**
NDP-1	0.16	-0.07	23.87 **	-0.07	2.42**	-0.22**	0.81 *	-0.43**	0.23 **	-1.50 **
APARNA	3.70 **	4.75**	-22.91**	-0.28**	-4.21**	-0.1	-4.31**	-0.56**	-0.27**	-3.88**
S.E. ₍₉₎ ±	0.30	0.62	1.42	0.04	0.57	0.07	0.37	0.11	0.07	0.46

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

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Table 3 Sca effects of three best crosses along with per se performance and gca combination for each traits in Fieldpea

Characters	Per se performance		Mean of Hybrids	Combining ability analysis		
	Parents	Hybrids		Hybrids	SCA effects	GCA of the parents
Days to flowering	KPMR 400 ADARSH NDP-1	DF-1 X VIKAS DF-1 X ADARSH DF-1 X NDP-1	51.33 52.00 56.33	DF-1 X VIKAS DF-1 X ADARSH VIKAS X IPFD 10-13	6.71** 6.61** 4.54**	GXG GXA GXA
Days to maturity	ADARSH IPFD 10-13 PRAKASH	DF-1 X ADARSH DF-1 X VIKAS VIKAS X IPFD 10-13	98.67 100.33 105.33	DF-1 X ADARSH DF-1 X VIKAS VIKAS X IPFD 10-13	7.42** 7.29** 5.65**	GXG GXA AXA
Plant height (cm)	APARNA VIKAS KPMR 400	KPMR 400 X IPFD 10-13 VIKAS X APARNA VIKAS X IPFD 10-13	19.40 60.65 72.07	KPMR 400 X IPFD 10-13 PRAKASH X NDP-1 KPMR 400 X NDP-1	78.39** 63.55** 44.27**	GXP GXP GXP
Number of primary branches per plant	ADARSH DF-1 KPMR 400	ADARSH X APARNA PRAKASH X IPFD 10-13 VIKAS X ADARSH	4.47 4.37 4.27	ADARSH X APARNA PRAKASH X IPFD 10-13 VIKAS X ADARSH	1.13** 1.11** 0.70**	GXP GXP PXG
Number of pods per plant	NDP-1 VIKAS PRAKASH	ADARSH X APARNA PRAKASH X IPFD 10-13 VIKAS X ADARSH	60.89 59.00 58.28	ADARSH X APARNA PRAKASH X IPFD 10-13 VIKAS X IPFD 10-13	20.51** 16.83** 14.99**	GXP GXP GXP
Number of seeds per pod	DF-1 ADARSH PRAKASH	ADARSH X APARNA DF-1 X ADARSH DF-1 X PRAKASH	7.51 6.23 6.90	ADARSH X APARNA NDP-1 X APARNA KPMR 400 X PRAKASH	2.10** 1.27** 1.62**	GXP PXP PXG
Seed yield per plant (g)	NDP-1 DF-1 VIKAS	ADARSH X APARNA PRAKASH X IPFD 10-13 VIKAS X ADARSH	36.01 36.04 28.90	PRAKASH X IPFD 10-13 ADARSH X APARNA VIKAS X IPFD 10-13	14.74** 14.41** 11.13**	GXP GXP PXP
Test weight (g)	VIKAS KPMR 400 ADARSH	ADARSH X APARNA DF-1 X VIKAS KPMR 400 X ADARSH	22.32 21.32 21.27	ADARSH X APARNA PRAKASH X IPFD 10-13 VIKAS X IPFD 10-13	2.90** 2.64** 2.00**	GXP PXP GXP
Protein content (%)	IPFD 10-13 DF-1 VIKAS	IPFD 10-13 X APARNA DF-1 X VIKAS KPMR 400 X ADARSH	22.44 21.50 21.88	IPFD 10-13 X APARNA KPMR 400 X ADARSH DF-1 X VIKAS	1.97** 1.22** 0.85**	GXP PXP GXG
Harvest index (%)	DF-1 VIKAS NDP-1	ADARSH X APARNA PRAKASH X IPFD 10-13 DF-1 X ADARSH	61.70 64.05 56.74	PRAKASH X IPFD 10-13 ADARSH X APARNA VIKAS X ADARSH	24.76** 23.38** 12.01**	GXP GXP AXG

G = Good; A = Average; P = Poor.

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