

Combining ability for yield related characters in fieldpea [*Pisum sativum* (L.) *Var arvense*.]

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ABSTRACT

The combining ability analysis for yield and its contributing traits was performed in fifty five genotypes of fieldpea including ten parents and their forty five F_1 's developed through half diallel mating design. Among the parents, DF-1, IPFD 10-13 and GCO-703 were good general combiners for grain yield and important yield contributing traits which can be utilized in hybridization programme. Three crosses DF-1 x HFP-4, HUDP 954 x LFP 477 and LFP 477 x IPFD 10-13 were found to be most promising for grain yield with respect to high and significant *sca* effects to through transgressive segregants in fieldpea.

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

Fieldpea [*Pisum sativum* (L.) *var arvense*.] is a highly nutritive *rabi* season legume with high yield levels. It provides protein-rich food for humans. It also aids to soil health and provides quality forage for animals. It belongs to family *Papilionaceae* and is grown all over India and Indian subcontinent. Fieldpea is consumed as green vegetable, chat (spicy-dish), chhola (whole grain), dhal (pulses) and flour and thus contributing significantly to market economy. Combining ability analysis on the basis of diallel mating system is one of the most appropriate methods to identify the best combiners, which can be utilized for hybridization programme. It gives information about nature of gene action and the relative magnitudes of fixable (additive) and non-fixable (non-additive/dominance) genetic variations. The present investigation was, therefore, undertaken to get information on the combining ability of ten cultivars of fieldpea and their forty five hybrids in respect of yield and yield components.

MATERIALS AND METHODS

The experimental material comprised of fifty five fieldpea genotypes including ten parents viz., DF-1, HFP-4, HUDP 954, KPMR 400, HFP 715, Pant P

167, IPFD-1-10, LFP 477, IPFD 10-13, and GCO-703 and their forty five F_1 's developed through half diallel mating design. The experimental material was grown in randomized block design with three replications with 45 x 10 cm row and plant to plant spacing, respectively during *rabi*, 2012 at Centre of Excellence for Research on Pulses, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. All the management practices were followed as per recommendations to raise the normal crop. The observations were recorded on five randomly taken plants from each genotype in each replication for grain yield and its contributing characters viz., number of pods per plant, number of seeds per pod, number of primary branches, test weight and harvest index in fieldpea. The data were analyzed for combining ability by using Model I and Method II of Griffing (1956).

RESULTS AND DISCUSSION

The analysis of variance for combining ability exhibited that mean squares due to general combining ability and specific combining ability were found significant for all the traits except *gca* for number of primary branches. This indicated that additive and non-additive genetic component of variation involved in the expression of these attributes. However, the ratio of *gca* / *sca* genetic variance indicated that non-additive type of genetic variation was more important in the

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Table 1 Analysis of variance for combining ability for different characters in fieldpea

Source of variation	d.f	Mean Squares					Grain yield per plant (g)
		Number of pods per plant	Number of seeds per pod	Number of primary branches	Test weight (g)	Harvest index (%)	
General combining ability(gca)	9	83.42**	1.10**	0.07	9.00**	433.12**	10.89**
Specific combining ability (sca)	45	52.87**	0.64**	0.12**	2.87**	176.35**	10.49**
Error	108	0.77	0.20	0.06	0.49	9.53	0.27
σ^2_{gca}		6.88	0.07	0.001	0.70	35.29	0.88
σ^2_{sca}		52.10	0.44	0.057	2.38	166.8	10.21
$\sigma^2_{gca}/\sigma^2_{sca}$		0.13	0.16	0.01	0.29	0.21	0.08

** P=0.001 level

expression of all the characters under study (Table 1). On the basis of mean performance of the parents, DF-1, HFP 715 and IPFD 10-13 showed high *per se* performance for grain yield per plant and all the characters. In addition to that IPFD 10-13 also emerged as excellent as it exhibited highest performance for rest of yield contributing characters under study viz., number of seeds per pod, grain yield per plant, test weight and harvest index.

The parental line DF-1 was also found to be good general combiner for grain yield per plant and harvest index. On the other hand, HFP 715 was also found good general combiner for number of primary branches, test weight, and harvest index, whereas, the parent KPMR 400 had good general combining ability effect for number of pods per plant and number of primary branches (Table-2). Three hybrids viz., DF-1 x HFP -4, HFP-4 x IPFD 10-13 and LFP 477 x IPFD 10-13 were found best performing based on their *per se* performance for grain yield per plant. Moreover, these hybrids were also superior in *per se* performance for one and more yield contributing traits studied (Table-2). Similar findings have been reported for one or more characters in fieldpea by Sofi Parvez *et al.* (2006), Sharma *et al.*, (2007), Ercan Ceyhan *et al.*, (2008), Borah (2009), Singh *et al.*, (2010), Punia *et al.*, (2011) and Abbas (2012).

The best cross combinations namely; DF-1 x HFP -4, HFP-4 x IPFD 10-13 and LFP 477 x IPFD 10-13 expressed maximum sca effects along with *per se* performance for grain yield per plant. Further, these

hybrids also exhibited significantly higher sca effects for one or more yield contributing characters.

A comparative study of most of the crosses showing high sca effects for different characters which produced maximum yield, had at least one parent as good combiner for grain yield and its contributing traits. An overview of the results suggested that parental lines DF-1, KPMR 400 and IPFD 10-13 were found to be common good general combiners for grain yield and its component traits. These lines can be utilized in future for fieldpea hybrid breeding programmes. Besides this, the parents showing good general combining ability for particular components may be utilized in component breeding for effective improvement in particular components, resulting in the improvement of seed yield itself.

The F_1 hybrids, such as DF-1 x HFP-4, HFP-4 x IPFD 10-13 and LFP 477 x IPFD 10-13 showed potential to produce transgressive segregants in further segregating generation. The non additive gene action was predominately responsible for the inheritance of all the traits; heterosis breeding could be the best breeding method for improvement of grain yield in fieldpea. Since, non-availability of male sterility system at commercial level both additive and non-additive genetic variances are important in fieldpea. To take advantage of both types of gene action, reciprocal recurrent selection or biparental mating followed by modified recurrent selection has been suggested for the improvement of the yield and yield related traits for the development of high yielding stable genotypes of fieldpea.

Table 2 Best performing parents and hybrids with SCA effects in fieldpea

Character	Best Performing Parents (per se performance)	Best combiners	Best Performing hybrids (per se performance)	Hybrids with SCA effects	SCA effects
Number of pods per plant	DF-1 KPMR 400 HUDP 954	DF-1	HFP-4 x HFP715 HFP-4 x IPFD 10-13 HFP-4 x KPMR 400	HFP-4 x HFP 715 IPFD-1-10 x IPFD 10-13 HFP-4 x IPFD 10-13	21.57** 10.37** 9.39**
Number of seeds per pod	GCO-703 HFP 715 IPFD-1-10	IPFD-1-10	HFP 715 x IPFD-1-10 DF-1 x GCO-703 IPFD-1-10 x GCO-703	HFP 715 x IPFD-1-10 DF-1 x GCO-703 Pant P 167 x LFP 477	1.75** 1.40** 1.17**
Number of primary branches	GCO-703 KPMR 400 LFP477	KPMR 400	DF-1 x Pant P 167 KPMR 400 x LFP 477 HFP 715 x IPFD-1-10	DF-1 x Pant P 167 KPMR 400 x LFP 477 HFP-4 x Pant P 167	0.76** 0.49** 0.48**
Test weight (g)	Pant P 167 HFP 715 IPFD 10-13	HFP 715	HUDP 954 x KPMR 400 HFP 715 x GCO-703 Pant P 167 x IPFD-1-10	KPMR 400 x LFP 477 HFP 715 x GCO-703 DF-1 x LFP 477	5.36** 3.26** 2.66**
Harvest index (%)	DF-1 HFP 715 HUDP 954	DF-1 HFP 715	HFP 715 x IPFD 10-13 DF-1 x IPFD-1-10 HFP-4 x IPFD 10-13	HFP 715 x IPFD 10-13 LFP 477 x IPFD 10-13 HUDP 954 x GCO-703	48.39** 20.85** 19.34**
Grain yield per plant (g)	DF-1 HFP 715 IPFD 10-13	DF-1 HFP 715	DF-1 x HFP-4 HFP-4 x IPFD 10-13 LFP 477 x IPFD 10-13	DF-1 x HFP-4 HUDP 954 x LFP 477 LFP 477 x IPFD 10-13	6.21** 5.68** 5.34**

** Significant at 1% level.

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