Studies on direct selection parameters in Fieldpea (*Pisum sativum* L.)

Abstract

In the present study, 22 field pea genotypes were evaluated for estimation of variability, heritability and genetic advance. The Fieldpea genotypes were sown in, Randomized Block Design with three replications at the experimental farm of department of Genetics and Plant Breeding, Faculty of Agriculture, Kamla Nehru Institute of Physical and Social Sciences Sultanpur 228118 (U.P.) India, during Rabi, season 2022-2023. Phenotypic data were recorded for nine characters viz. days to 50% flowering, days to maturity, plant height, number of branches per plant, number of pods per plant, 100-grain weight, grain yield per plant and biological yield per plant. It was reported that in general the value of PCV is slightly higher than the value of GCV indicating the importance of environment in the phenotypic performance of the genotypes studied. The maximum value of GCV was observed for plant height (31.94), grain yield per plant (20.02). High estimates of heritability in broad sense (h^2b) were recorded for plant height (97.28), days to 50% flowering (83.96), 100-grain weight (78.48) and days to maturity (64.83). High estimates of genetic advance as percent of mean were recorded for plant height (64.89), 100-grain weight (25.28) and grain yield per plant (25.15). Thus, the characters (plant height, days to 50% flowering, 100-grain weight etc) having high value of GCV, heritability as well as genetic advance may be exploited in Fieldpea breeding program for further improvement in grain yield.

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Introduction

Fieldpea (*Pisum sativum* L.) is one of the most popular types of pulse crops worldwide. It belongs to family Leguminosae (Fabaceae) with chromosome no. 2n= 14.

It is the third most important pulse crop at global level, after common bean and chickpea and third most popular Rabi pulse of India after chickpea and lentil.

India occupy fourth position in area (10.53 %) and 5th position in production (6.96 %) (**FAO Stat., 2021**).In India field pea is grown over an area of 7.5 lakh ha with a production of about 9. 10 lakh tonnes during period (**Anonymous, 2021**). Uttar Pradesh is the major field pea growing state. It alone produces about (46%) of pea produced in India. Besides, Uttar Pradesh, Madhya Pradesh, Jharkhand and Assam are the major pea producing states (**Anonymous, 2021**).

It is a rich source of protein, amino acids and carbohydrates. Peas are used alone and mixed with other vegetables. Pea is of Mediterranean origin, the Near East and Ethiopia are considered as its secondary center of origin (**Blixt 1970**). Peas are mainly utilized as a pulse. Besides, it is also consumed in a vegetable form. Sometimes, field pea is grown for forage, green manure and the pods are sometimes fed to farm animals. Pea haulms form a nutritive fodder. Being a leguminous vegetable, significant for fixing environmental nitrogen into the soil and perceived for keeping up fruitfulness of soil and for improving its physical properties. There are two sub species in the genus *Pisum*, namely *Pisum sativam_var. arvense* known as field pea having coloured flowers and (*Pisum sativam var. hortense)* white flowered horticultural or vegetable pea which is also known as sweet pea.

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It is a herbaceous winter annual; having angular stem, glaucous, alternate leaves, distichous, rachis terminates into a simple or branched tendril, 1-3 flowers per raceme, white, pink or purple corolla, diadelphous stamens, straight or curved pods, and smooth or wrinkled seeds.

Material and methods

The present investigation was carried out at Genetics and Plant Breeding Research Farm of Kamla Nehru Institute of Physical and Social Sciences, Sultanpur 228118 (U.P.) India. The used materials and methods are being described under the following heads.

Experimental site

The experiment under present investigation entitled "**Studies on direct selection parameters in Fieldpea (*Pisum sativum* L.)**" was conducted during Rabi 2022-23 at experimental field of, Department of Genetics and Plant Breeding, Faculty of Agriculture, Kamla Nehru Institute of Physical and Social Sciences Sultanpur 228118 (U.P.) India. The collections of 22 germplasm comprising indigenous genotypes, constituted the experimental materials for the study. The genotypes were obtained from the pulse section, Department of Genetics and Plant Breeding, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, 224229 (U.P.) India.

Fieldpea genotypes used in the study as experimental material

Observations: Five plants from each plot were randomly selected for recording of observations on nine characters. Averages of the data from selected plants of each plot in respect of different characters were used for various statistical analyses. The data were recorded for the following characters.

Days to 50% flowering, days to maturity, number of branches per plant, plant height (cm), number of pods per plant, 100-grain weight (g), biological yield per plant (g), grain yield per plant (g) and harvest index (%)

Statistical Analysis: Replication wise mean data of 22 genotypes for 9 characters was used for statistical and biometrical analysis for the following parameters.

- Analysis of variance for Replicated Block Design was done as per the formula given by **Panse and Sukhatme (1961).**
- Estimation of variability as per suggested by **Burton and De vane (1953).**
- Heritability was estimated as suggested by **Hanson *et al.* (1956).**
- Genetic advance was suggested by **Johnson *et al.* (1955).**

Result and discussion

Analysis of variance for the design of experiment

The analysis of variance for the design of experiment involved 22 field pea germplasm including four checks and three replications for the nine characters in Randomized Block Design. The mean squares resulting from replications, treatments, and error for all characters are shown in (**Table-1**).The variation due to treatments were found to be highly significant for all the characters, whereas, the variation due to replications were found non-significant for all characters.

Mean performance of genotypes:

The means of 22 genotypes, range, GCV, PCV, heritability and genetic advance for 9 characters are presented in (**Table-2)** and described as follows.

Days to 50% flowering: The general mean for days to 50% flowering was 67.15 days. The mean values for days to 50% flowering ranged from 57 days (IPFD 20 - 2) to 77 days (HUDP 15).Twelve genotypes out of 22 showed statistically earlier flowering. Best three were IPFD 20-2(57 Days), Pant P 509(63.33 Days) and IPFD 21-7(64 Days).

Days to maturity: The general mean for days to maturity was 85.15 days. Days to maturity showed wide range from 80 days (508) to 94 days (HUDP 15).Thirteen genotypes out of 22 showed earliest days to maturity. Top three performing genotypes Pant P 508 (80 Days), IPFD 20-2 (83 Days) and IPFD 21-4 (82.33 Days).

Plant height: The general mean for plant height was observed 81.15 cm. The mean values for plant height ranged from 60 (IPFD 18-3) to 190 cm (KPMR 954). Genotype

IPFD 18-3 (60 cm) followed by plant Pant P 508 (61 cm) and HFP 1426 (61.9 cm) were identified as tall plants than the best check HUDP 15 (60 cm).

Branches per plant: The average mean for branches per plant was 3.15. The mean values for number branches per plant ranged from 1.66 (Pant P 455) to 5.6 (IPFD 20-2). Total 8 genotypes showed higher value than the best check HFP 4 (4). Three best performing genotypes were IPFD 20-2(5.6), IPFD 18-3 (5.33) and Pant P 514 (4.5). **Pods per plant**: The general mean for pods per plant was 23.80. The mean values for pods per plant ranged from 14.20 (IPFD 21- 4) to 43.8 (IPFD 20-2). Nine genotypes were recorded to have significantly higher number of pods per plant than the best check Pant P 462 (2).The top three significant group for higher numbers of pods per plant, were *viz*, Pant P 514 (43.6), IPFD 20-2,(40.6), IPFD 18-3(39.3).

100-grain weight: The general mean for 100-seed weight was 19.0162 g. Large extend of variation was observed for 100-seed weight and mean values ranged from 11.50 g -(HUDP 1802) to 24.9 g (Pant P 480). The significant group of higher 100-grain weight were Pant P 480 (24.9 g), Pant P 514 (23.8 g),HFP 1817 (23.8 g).

Biological yield per plant (g): The general mean for this was 34. 65.33 g. It ranged from 18.80 g (Pant P 455) to 61.5 g (HFP 18-3). The top significant group of higher biological yield per plant was constituted of 7 genotypes when compared to check KPMR 954 (42.5 g), from them top 5 significant genotypes were HFP 18-3 (61.5 g), Pant P 508 (57.16 g), Pant P 514 (59.5 g), Pant P 508 (56.16 g).

Harvest index (%): The general mean for Harvest index (%) was 52.1506 %. The minimum Harvest index was recorded in case of Pant P 514 (32.73%) while maximum in case of HFP 1817 (88.33%). Out of 22 genotypes, 10 genotypes possessed significantly higher harvest index than the best check HFP 4 (48.82%).The best four among them were HFP 1817 (88.33%), Pant P 509 (65.82%), HFP 1426 (61.06%), IPFD 18-3(61.4%).

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Grain yield per plant (g): The general mean for grain yield per plant was 17.72 g. Mean values of seed yield per plant ranged from 10 g (GNG 2340) to 33.33 g (CSJ 887). The top significant group of higher seed yield per plant was constituted of 11 genotypes compare to the best check Pant P 462 (20 g). So, the top 4 significant genotypes from the 22 genotypes for higher seed yield per plant were Pant P 508 (33.33 g), Pant P 509 (29.5g), IPFD 18-3 (32.33 g).

Table 1: Analysis of variance of randomized block design for different characters in Fieldpea genotypes

		Days of 50% flowering	Days to maturity	Plant height (cm)	Pods / plant	branches / plant	100-Seed weight (g)	Biological yield / plant (g)	grain Yield /plant (g)	Harvest index (%)
Treatments	21	48.245	26.7193	2033.83	51.120	0.59976	22.7272	139.34	59.023	124.697
Replication	2	5.015	1.4091	65.83	129.523	2.10335	0.4482	576.35	95.083	18.883
ERROR	42	2.888	4.0916	18.75	44.058	0.44715	1.9033	77.64	21.264	52.513

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Table-2: Range, mean, GCV, PCV, heritability and genetic advance estimates for different character in Fieldpea

Characters	Range (Min-Max)	Mean Value	Coefficient of variation (%)		Heritability in broad sense	Genetic advance	Genetic advance in percent of mean (5%)
			PCV (%)	GCV (%)			
Days to 50% flowering	57-77	67.15	6.32	5.79	83.96	7.3395	10.93
Days to maturity	80-94	85.14	4.01	3.23	64.83	4.5553	5.35
Plant height (cm)	60-190	81.15	32.38	31.94	97.28	0.9728	64.89
Number of branches/ plant	1.66-5.6	3.16	22.34	7.14	10.22	0.1486	4.70
Number of pods/ plant	14.20-43.8	23.81	28.61	6.44	05.07	0.7118	2.99
100-seed weight (g)	11.50-24.9	19.01	15.64	13.85	78.48	4.8080	25.28
Grain yield/plant (g)	10-33.33	17.72	32.83	20.02	37.18	4.4565	25.15
Biological yield/plant^{-1}(g)	18.80-61.5	34.65	28.59	13.09	20.94	4.2752	12.33
Harvest index (%)	32.73-88.33	52.15	16.78	9.41	31.42	5.6643	10.86

Coefficient of variation, heritability and genetic advance

Genotypic coefficient of variation (GCV) estimates the total amount of genetic variability present in a material while; phenotypic coefficient of variation (PCV) estimates the amount of genotypic and environmental variability present in the material. Heritability measures how much of this genotypic diversity is passed down from parents to next generation. Broad Sense Heritability was given by **Lush (1949)**. Our ability to utilize genotypic variability in breeding programs is determined by this factor. Gene frequency influence genotypic variance and its components. Due to varying gene frequencies between population estimates of heritability also varies between populations for a given character.

Coefficient of variability analysis

The phenotypic coefficient of variation, genotypic coefficient of variation and environmental coefficient of variation was also recorded for all the character under study. In general the phenotypic coefficient of variation was found higher than the genotypic coefficient of variation for all the traits. The highest value of Phenotypic Coefficient of Variation was observed in seed yield per plant followed by plant height, pods per plant, biological yield per plant, no. of branches per plant moderate value was observed for no. of branches per plant, harvest index, 100 seed weight, days to 50 % flowering while lowest value are recorded for days to maturity. The highest value of Genotypic coefficient of variation was observed in plant height followed by grain yield per plant, 100 seed weight and biological yield per plant moderate values were observed for harvest index, seeds per pods, branches per plant while lowest values was observed for days to 50% flowering and days to maturity. Findings are in accordance with earlier workers (**Kumar *et al*., 2012**) and (**Nizama, 2013**).

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I) Heritability

Highest estimates of broad sense heritability (h^2b) was recorder for plant height (97.28%), days to 50 % flowering (83.96 %), 100 grain-weight (78.48 %), days to maturity (64.83 %), grain yield per plant (37.18 %), harvest index (31.42%), biological yield per plant(20.94%), number of branches per plant (10.22) and number of per plant (05.07 %) heritability in broad sense, respectively. Similar findings were reported earlier by **Yadav *et. al*., 2015; Kumar *et al*., 2016; Tiwari *et. al*., 2016; Anusha *et al*., 2020).**

II) Genetic advance

Individual genotype selection does not provide any indication of how much genetic change will occur based on heritability alone. As a result, understanding genetic development and heritability is critical. Genetic progress is an improvement over the base population in the mean of selected families (**Lush 1949** and **Johnson *et al*. 1955**). It can also be expressed as a shift in gene frequency towards the superior side as a result of selection pressure. Genetic advance in percent of mean were estimated for all the 9 characters and are presented in **Table 2**. The genetic advance in per cent of mean varied from 0.1486-7.3395 for no. of branches per plant and days to 50 % flowering respectively. Highest genetic advance (Ga) was found for days to 50 % flowering (7.3395) followed by for harvest index (5.6643), 100-grain weight (4.8080), days to maturity (4.553), grain yield per plant (4.4565), biological yield per plant (4.2752), number of branches per plant (0.1486) and no. of pod per plant (0. 7118). Similar findings were reported earlier by **Kuldeep *et al*., 2014; Tiwari *et. al*., 2016; Arora *et. al*., 2018**.

References

Anonymous. (2021). Directorate of economics and statistics, Govt. of India.

Anusha, T.; Reddy, A. T.; Jayalakshmi, V. and Ahammed, S. K. (2020). Genetic variability studies for yield and quality traits in Chickpea (*Cicer arietinum* L.). International Journal of Current Microbiology and Applied Sciences, 9(9): 2995-3000.

Arora, R.; Krishan, K. and Manav. (2018). Genetic variability studies for yield contributing traits in kabuli chickpea (*Cicer arietinum* L.). Journal of Pharmacognosy and Phytochemistry, 7(2): 2675-2677.

Blixt, S. (1970). The pea p. 181-221. In: Hand book of genetics, [R.C. King (ed.)]. vol. 2, Plenum Press, New York.

Burton, G. W. and de Vane, E. W. (1953). Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. *Agron J*. 45: 478-481.

FAO. 2021. World Food and Agriculture - Statistical Yearbook 2021. Rome. https://doi.org/10.4060/cb4477en

Hanson, C. H., Robinson, H. F., and Comstock, R. E. (1956). Biometrical studies of yield in segregating population of Korean lespedeza. *Agronomy journal*, 48(6):268-272.

Johnson, H.W., Robinson, H.F. and Comstock, R.E., (1955). Estimates of genetic and environmental variability in soyabean. *Agronomy Journal*, 47: 314-18.

Kuldeep, R.; Pandey, S.; Babbar, A. and Mishra, D.K. (2014). Genetic variability, character association and path coefficient analysis in chickpea grown under heat stress conditions. *Electronic J. Pl. Breeding*, 5(4): 812-819.

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Kumar, A.; Shiva Nath; Yadav, A. K.; Kumar, B.; Kumar, A. and Yadav, P. K. (2016). Estimation of genetic variability in chickpea (Cicer arietinum L.) germplasm. *Res. in Environmental and Life Sci*., 9 (3): 362-364.

Lush, J.L, (1949). Heritability of quantitative traits in farm animals. Proceeding of 8th international congress genetic Heridos (suppl.): 3 36-357.

Nizama, J. R. (2013). Genetic variability and heritability among quantitative traits in chickpea under tropical region. *Asian Resonance*, 5(2): 45-48.

Panse, V.G. and Sukhatme, P.V., (1961). Statistical methods for agricultural workers, ICAR, New Delhi. pp.1 52-161.

Tiwari, A.; Babbar, A. and Pal, N. 2016. Genetic variability, correlation and path analysis in yield and yield components in chickpea (Cicer arietinum L.) cultivars under late sown conditions. *International Journal of Agriculture Sciences*, 8(54):2884- 2886.

Yadav, P.; Tripathi, D.K.; Khan, K.K. and Yadav, A.K. 2015. Determination of genetic variation and heritability estimates for morphological and yield traits in chickpea (Cicer arietinum L.) under late sown conditions. *The Indian J. Agril. Sci*., 85(7): 157- 162.

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