Studies on Analysis of Correlationcoefficient and Path Coefficient for Certain Quantitative Traits in Fieldpea(*Pisum sativum* L. *var. arvense*).

Abstract

The experiment was conducted with twentytwo(22) genotypes of fieldpea including four (4) checks in Randomized Block Design with three replications at the experimental farm ofdepartment 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, Plant height, Branches per plant, Number of pods per plant, Days to maturity, Harvest index, 100-seed weight,Biological yield per plant and Grain yield per plant. It was expressed in general Correlation coefficient, provide an indication of the type and extent of the relationship between yield and yield contributing components by measuring the magnitude of linear relationships between two variables and path coefficient analysis partitions the observed correlation coefficient into direct and indirect effects on grain yield. The maximum value of highly significant positive genotypic correlation was observed for days to 50% flowering with days to maturity (0.88), biological yield per plant with grain yield per plant (0.84), number of branches per plant with 100-seed weight (0.84) respectively. The high direct positive genotypic effect on grain yield per plant were exerted by days to 50 % flowering (0.78) followed by biological yield per plant (0.40). The very high indirect positive genotypic effects on grain yield per plant by harvest index via biological yield per plant (1.47).Correlation coefficientgives an indication of the type and degree of the relationship between yield and yield contributing traits by measuring the magnitude of linear relationship between two variables, that's why it leads us in selection of yield and other desirable characteristics of plant in crop improvement program and path analysis has emerged as animportant and widely used technique for understanding the direction of contribution of traits on grain yield. It contributes either directly orindirectly to the total grain yield of the plantand this technique provides information to breeders for selection of yield contributing traits for improvement of crop in plant breeding.

Keywords:Fieldpea genotypes; Correlation; Path analysis; Direct effect; Indirect effect.

1. INTRODUCTION

“Fieldpea (*Pisum sativum* L. *var. arvense*) is a mediterranean origin, the Near East and Ethiopia are considered as its secondary centre of origin” plant famous as pulse crop worldwide[1]. It is one of the most important pulsecrop in India and 3rdmost important pulse crop at global level, after Kidney bean and Bengal gram and 3rdmost popular Rabi pulse of India after Bengal gram and lentil” India holds4thrank in area (10.53 %) and 5thrank in production (6.96 %)” [2]. “In India it is cultivated over an area of 7.45 lakh ha with a production of about 9. 10 lakh tonnes during the period of 2016-17 to 2020-21 [3]. “Uttar Pradesh holds first rank as fieldpea growing state. It aloneshares about (46%) of fieldpea production of India. Besides, Uttar Pradesh, Madhya Pradesh, Rajasthan, Jharkhand and Assam are the important fieldpea growing states” [4].

Fieldpea belongs to Leguminosae (Fabaceae) family having 2n=14 number of chromosomes. It hastap root system, herbaceous and weak stem, compound leaf with tendrilsand stipules are well developed forphotosynthesis, inflorescenceis solitary terminal and axial type with zygomorphic bisexual flowers and fruit type is legume [6].

“Fieldpea is a rich source of protein (20-23%), amino acids and carbohydrates. It is consumed alone and mixed with other vegetables but it is mainly utilized as a pulse and vegetables. It keepsspecial position in crop rotation with cereals because their cultivation breaks cereal disease cycles, facilitates weed control and improves soil condition and fertility by fixing atmospheric nitrogen into the soil” [7].

“Fieldpea has high genetic yielding potential but due to various climatic factors the overall production is not good therefore it is important to identify such kind of genotypes those are able to provide maximum yield under various ecological conditions. Estimation of correlation coefficient between the yield and yield contributing traits arenecessary to understand the direction of selection. Prediction of relationship between yield and yield contributing traits areindispensable to understand the direction of selection. “The measurements which estimate the relation between factorsare called as correlation coefficient”. It quantifies the relation between various plant traits and decides the constituent parameters by them yield could be improved through selection. Yield of the crop can be improved by indirect selection of highly heritable traits, which are related with the yield (Singh 1983).

“Path coefficient analysis is a crucial means for division of correlation coefficient into direct and indirect effects of independent variables on dependent variable. It also has been used for those characters which have vast impact on yield and correlated traits for potential use in crop improvement programmes.

2. MATERIAL AND METHODS

The experiment under relevance 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 22 collections of germplasm comprising of indigenous genotypes, varieties and advance breeding lines constituted the experimental materials for the experiment. 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. We randomly selected five plants from each plot for recording of data on all the nine characters. Average of the data from selected plants of each plot in respect of different characters were used for various statistical analysis. The data were recorded for the following characters. Days to 50% flowering, Plant height, Branches per plant, Number of pods per plant, Days to maturity, Harvest index, 100-seed weight, Biological yield per plant and Grain yield per plant.

3. STATISTICAL ANALYSIS

Replication wise mean data of 22 entries for 9 characters was used for statistical and biometrical analysis for the following parameters.

- Analysis of variance for Randomized Block Design was done as per the formula given by **Panse and Sukhatme (1967)** [8].
- Estimation of correlation coefficient as per suggested by **Al-ji-bouri et al. (1958)** [9].
- Estimation of path coefficient as per suggested by **Dewey and Lu (1959)** [10].

4. RESULTS AND DISCUSSION

The analysis of variance for the design of experiment involved 22 fieldpea genotypes including 4 checks with 3 replications for the 9 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. Jaiswal et al., 2015 also reported highly significant variation in Fieldpea for the studied characters.

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

S.V.	d f	Days of 50% flowering	Days to maturity	Plant height (cm)	Number of Pods/plant	Number of branches/ plant	100- Seed weight (g)	Biological yield/plant(g)	Seed yield (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

The estimates of Correlation coefficient and Path coefficient are presented in **Table 2**. Correlation coefficient estimates the actual relation of certain quantitative traits either significant or non-significant for grain yield. It also suggests that quantitative characters how's related to each other either positive or negative which give us direction of selection of characters in breeding programme. The correlation coefficient estimation done as per concept of **Al-ji-bouri *et al.* (1958)** [11].

Grain yield is a complex character because it is a consequence of interaction between number of plant characters. Various yield components interact directly or indirectly with each other to produce the genetic architecture of grain yield in Fieldpea and other crops. In other words, choosing plants based on their yield alone would not matter much, unless selection in conjunction with various characteristics than that condition of the plant. Therefore, identification of the important yield contributing traits and their association with grain yield with each other is essential for developing an efficient breeding strategy in development of high yielding varieties. Correlation coefficient provide an indication of the type and degree of the relationship between yield and yield contributing traits by measuring the direction of linear relationship between two variables.

The days to 50% flowering showed highly significant positive correlations with days to maturity, biological yield per plant with grain yield per plant, branches per plant with 100-seed weight, harvest index with grain yield per plant, 100-seed weight with harvest index, 100-seed weight with biological yield per plant respectively. Significant positive correlation was found for 100-seed weight with grain yield per plant and pods per plant with biological yield per plant respectively. Characters that shown positive and significant correlation with other charactersprovide the information about contribution of characters in grain yield per plant in breeding programme.

"Path coefficient analysis partitions the observed correlation coefficient into direct and indirect effects on grain yield. Analysis of direction, provides a good understanding of character interactions to formulate an effective selection strategy. In contrast to a simple correlation, the route coefficient emphasizes the causes and their relative importance, while the latter testsmerely the reciprocal relationship, which lacks causation. **Sewal Wright (1921)** introduced the idea of a path coefficient analysis and **Dewey and Lu (1959)** first used thepath coefficient analysis technique in selection of plants for crop improvement. To access the relative value of the different yield

contributing characteristics, path coefficient analysis is animportant and widely used technique for understanding the direction of contribution of traits on grain yield. It contributes either directly or indirectly to the grain yield of a plant.

"The high direct effect on grain yield per plant were exerted by days to 50 % flowering followed by biological yield per plant.The very high indirect positive effects on grain yield per plant by harvest index via biological yield per plant, followed by biological yield per plant via days to maturity. High indirect positive effect on grain yield 100-grain weight via biological yield per plant. The moderate, low and very low estimates of direct and indirect effects recorded in case of remaining characters indicated that their direct & indirect contribution to grain yield was too low to be considered of any consequence. All these characters had showed direct and indirect positive effect on grain yield give us direction for selection of characters in breeding programme therefore estimates of path coefficient between characters is very much important in breeding programme.

Table 2. Analysis of simple genotypic correlation coefficient

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of Branches/ plant	Number of Pods / Plant	100-Seed weight	Biological Yield/ plant	Harvest Index (%)	Seed Yield/ plant (g)
Days to 50% flowering	1 **	0.8844**	0.1449 NS	-0.4238 *	-0.7244 **	-0.3342 NS	-0.4089 NS	-0.6625 **	-0.5027 *
Days to maturity		1 **	0.3615 NS	-0.3581 NS	0.1127 NS	-0.5584 **	-0.1947 NS	-0.9555 **	-0.4792 *
Plant height(cm)			1 **	-0.3322 NS	0.3966 NS	0.0011 NS	0.3308 NS	-0.4889 *	-0.0099 NS
Branches/ plant				1 **	-1.5011 **	0.8275 **	0.4168 NS	0.3565 NS	0.3736 NS
Pods/plant					1 **	0.203 NS	0.4941 *	-0.2112 NS	0.3964 NS
100- seed weight (g)						1 **	0.5568 **	0.6231 **	0.5222 *
Biological yield/ plant(g)							1 **	0.2754 NS	0.8425 **
Harvest index (%)								1 **	0.7442 **
Seed Yield/plant (g)									1 **

Table 3. Analysis of path coefficient at genotypic level.

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches / Plant	No. of Pods / plant	100-seed weight (g)	Biological yield / plant(g)	Harvest index (%)	Seed yield / plant(g)
Days to 50% flowering	**0.78433**	-1.22693	-0.06023	0.17275	0.08089	0.05964	-0.60348	0.29037	**- 0.5027**
Days to maturity	0.69370	**-1.38722**	-0.15021	0.14599	-0.01258	0.09964	-0.28726	0.41874	**- 0.4792**
Plant height (cm)	0.11369	-0.50144	**-0.41554**	0.13543	-0.04428	-0.00020	0.48821	0.21426	**- 0.0099**
No. of branches /plant	-0.33239	0.49683	0.13806	**-0.40763**	0.16761	-0.14766	-0.15623	0.61504	**0.3736**
Pods / plant	-0.56820	-0.15631	-0.16480	0.61189	**-0.11166**	-0.03623	0.72919	0.09254	**0.3964**
100-seed weight (g)	-0.26213	0.77458	-0.00046	-0.33732	-0.02267	**-0.17844**	0.82169	-0.27308	**0.5222**
Biological yield / plant(g)	-0.51966	1.32542	0.20316	-0.14531	0.02358	-0.11119	**0.40646**	-0.43826	**0.8425**

Harvest index (%)	-0.32074	0.27002	-0.13747	-0.16988	-0.05517	-0.09936	1.47577	**-0.12071**	**0.7442**

5. CONCLUSION

Positive and highly significant association of grain yield per plant was found with biological yield per plant and harvest index. Positive significant association with 100- grain weight while negative non – significant with plant height. Negative significant association with days to 50% flowering and days to maturity. Positive and non- significant association with branches per plant and number of pods per plant. On the basis of result, some traits considered as yield contributing traits which usher us towards selection of best yield contributing traits in our breeding programme.Plant breeder can utilize such technique for the genetic improvement of crops by selection of good yield contributing traits.

"Days to 50 % flowering exhibited highly positive direct contribution followed by biological yield per plant (g) to grain yield per plant while pods per plant, 100-grain weight, and harvest index via biological yield per plant exhibited highly indirect effect for grain yield per plant. Those characters identified above as direct and indirect components of yield give us right direction in the formulation of effective selection strategy in field pea for developing high yielding varietiesoffieldpea in breeding program.

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Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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1.

2.

3.

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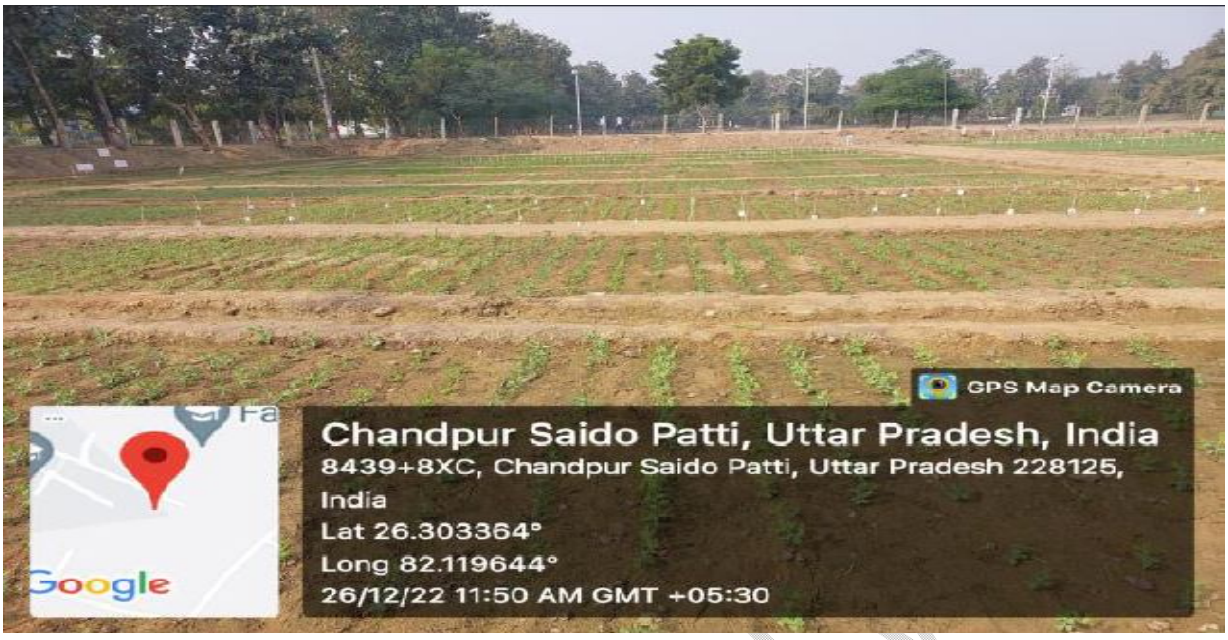

Fig 1- Field study at Chandpur, Uttar Pradesh, India