Original Research Article

Estimation of Correlation Coefficient and Path analysis in Field Pea (*Pisum sativum*L.)

Abstract

The present study was conducted during the rabi season of 2021-22 at Crop Cafeteria farm of Shoolini University, Solan (H.P.). The experiment consisted of 245 genotypes of pea with three check varieties viz., PB-89, PP and Arkel. The present investigation was carried out in order to find yield and its contributing traits in pea germplasm.As per correlation analysis and path analysis, the results indicated that seed yield/plant (g) exhibited positive and high significant correlations with 100-seed weight (g), biological yield/plant(g), harvest index (%) and number of pods/plant. Path analysis identified biological yield per plant (g) and harvest index (%) as important direct components for seed yield per plant. High yielding genotypes are- SHP 21, SHP73, JCR/JV-29, JCR/JV-39, IC 107452, 6363/P-3342, IC-629738, P-2236, P-2380, SHP 19, SHP17, SHP 51.

Key words: *Pisum sativum*, germplasm, correlation, path analysis

Introduction

Pisumsativum is a member of the family Fabaceae and the genus *Pisum*. It is the fourth-most widely grown pulse crop in the world, with three types of farmed peas: dry peas, green peas, and foraging peas. The most widely grown crop is dried pea, which was once mostly used as animal feed but is now often consumed by humans. According to the Food and Agriculture Organization, the Asia-Pacific region dominates the production of dried peas, followed by Europe. China is the main producer of peas, followed by India and the United States. In terms of both area and pea output, India is second in the globe. Globally, field pea is grown on over 6.27 million hectares with 11.16 million tons production and productivity of 1779 kg/ha.

Domesticated *Pisumsativum* has morphological characteristics that vary greatly, particularly in terms of pod quantity, pod form, pod length, seed number, pod maturity, and quality qualities. Correlation studies offer the chance to examine the strength and direction of correlation of one character with another. Path-coefficient analysis divides correlation into direct and indirect effects of yield components on seed yield, which gives a clearer picture of character association for creating an effective selection strategy. Understanding the correlations between the features is crucial for the development of a breeding project. Path analysis has been researched in the majority of causal interactions since simple correlation analysis is unable to promote complete information about the relationship between dependent variables and predictor factors. Consequently, it is more beneficial to analyze the features that contribute to yield to study correlation together with path coefficient analysis.

Materials and methods

The experiment was conducted to evaluate 248 germplasm lines of pea with three popular check varieties viz., PB-89, PP and ARKEL. The experimental material was evaluated at Crop Cafeteria farm in Augmented Block Design (Federer 1961) during rabi (2021-22). The experimental field was divided into 7 blocks of equal size. Thirty-seven

entries including checks were accommodated in each block. Each block consisted of a single row of 5m length, inter and intra–row spacing of 30 cm and 10 cm respectively. The crop was raised following standard package of practices. Randomly, five plants from each plot were chosen to record observations on various characters. For various statistical studies, averages of the data of randomly chosen plants from each line in relation to various characters were considered. The following quantitative traits recorded were**:** Plant height (cm), Days to first flowering, Days to 50% flowering, Days to maturity, Days of pod initiation, Number of pods/plant, Number of seeds/pod, 100-seed weight(g), Biological yield/plant (g), Seed yield/plant(g), Harvest index (%).The correlation coefficients were calculated following Pearson algorithm (Spearman) (1904) andPath coefficient was analysed as per Dewey and Lu (1959).

Results

Correlation Coefficients

The estimate of simple correlation coefficient among 11 characters under study are given in table 1(p-value= .05). Days to first flower showed positive and highly significant correlation with days to pod initiation. Positive significant correlations were observed with days to 50 per cent flowering and days to maturity.The days to pod initiation showed positive and highly significant correlations with days to 50 per cent flowering. Positive significant correlations of days to pod initiation was observed for days to maturity. Pod initiation showed negative significant correlations with number of biological yield per plant per plant (g), 100-seed weight (g), seed yield per plant (g). The days to 50 per cent flowering showed positive and highly significant correlations with days to maturity. Days to maturity showed positive significant correlations with days to 50 per cent flowering, days to first flower, days to pod initiation and showed negative significant correlation with 100-seed weight and seed yield. Pods/plant exhibited positive and highly significant associations with biological yield/plant (g), 100-seed weight (g) and seed yield (g). Biological yield/plant/plant (g) showed positive and significant correlations with seed yield/plant (g), 100-seed weight (g), harvest index (%) and number of pods/plant and showed negative significant correlations were found with days to pod initiation. Harvest index showed positive and significant correlations with seed yield/plant, biological yield/plant and100-seed weight (g). Seedyield/plant exhibited positive and significant correlations with biological yield/plant, harvest index, number of pods/plant and 100-seed weight and exhibited negative significant associations of seed yield/plant with days to pod initiation.100-seed weight (g) showed positive and highly significant correlations with seed yield/plant (g), harvest index (%), biological yield/plant (g), number of pods/plant and exhibited highly negative significant association with days of pod initiation and plant

height (cm).

Table 1: Estimates of simple correlation coefficients between eleven characters in pea genotypes

	Days to first flower	Days of pod initiation	Days to 50 per cent flowering	Days to maturity	Plant height(cm)	Numberof pods/plant	Number of seeds/pod	Biological yield/plant (g)	100-seed weight (g)	Harvest index (%)	Seed yield(g)
Days to first flower	1.000	0.742*	0.375*	0.323*	0.006	-0.019	0.008	-0.132	-0.120	-0.012	-0.116
Days of pod initiation		1.000	0.647*	0.591*	-0.030	-0.064	0.028	-0.164*	-0.145*	-0.008	-0.143*
Days to 50 percent flowering			1.000	0.866*	-0.024	0.017	0.007	-0.131	-0.137	-0.085	-0.134
Days to maturity				1.000	-0.051	0.026	0.019	-0.054	-0.054	-0.010	-0.049
Plant height(cm)					1.000	0.037	0.043	-0.132	-0.149*	-0.130	-0.147*
Number of pods/plant						1.000	-0.144	0.194*	0.193*	0.104	0.195*
Number of seeds/pod							1.000	-0.098	-0.104	-0.084	0.105
Biological yield/plant (g)								1.000	0.977*	0.443*	0.975*
100-seed weight (g)									1.000	0.608*	0.997*
Harvest index (%)										1.000	0.629*
Seed yield(g)											1.000

*** Significant at 5% probability level**

Path coefficient analysis

Estimates of direct and indirect effects of different traits on seed yield/plant in path coefficient analysis using simple correlations are given in Table 2 and phenotypic path diagram for seed yield per plant in Figure 1.

According to the study, the highest positive and substantial direct effects on seed yield/plant were exerted by biological yield/plant (0.7602) followed by harvest index (0.2179) and 100-seed weight (0.1210). However, other characters having positive direct effect on seed yield were number of seeds/pod (0.00130), days to maturity (0.002), number of pods/plant (0.0017). The negative direct effects on seed yield/plant were exerted by days to pod initiation (-0.0009), days to 50% flowering (-0.0008), plant height (-0.0008).

100-seed weight (0.74270), harvest index (0.33670) and number of pods/plant (0.14770) had an indirect significant correlation on yield/plant via biological yield/plant; biological yield/plant (0.09650), 100-seed weight (0.13260) and number of pods/plant (0.02270) had an indirect significant correlation on yield/plant via harvest index; days to pod initiation (0.00120), days to first flower (0.00070) and days to 50 percent flowering (0.00180) via days to maturity showed positive indirect effects on seed yield.

On the other hand, plant height (-0.0180), number of pods/plant (-0.0125) and days to pod initiation (-0.0176) had an indirect correlation on yield/plant via 100-seed weight; days to pod initiation (-0.0001), number of seed/pod (-0.0002) via number of pods/plant; days to first flower (-0.0007) and days to 50 per cent flowering (-0.0006) had an indirect correlation on yield/plant via days to pod initiation. The estimates of indirect effects on the path coefficient were low to be considered important. The residual factor effects (0.1989) were recorded positive.High yielding genotypes are- SHP 21, SHP73, JCR/JV-29, JCR/JV-39, IC 107452, 6363/P-3342, IC-629738, P-2236, P-2380, SHP 19, SHP17, SHP 51.

Table 2: Estimates of genotypic direct and indirect effects of 10 characters in pea germplasm

Traits	Days to first flowering	Days to pod initiation	Days to 50 percent flowering	Days to maturity	Plant height (cm)	Number of pods/plant	Number of seeds/pod	Biological yield/plant (g)	100Seed weight (g)	Harvest index (%)	Seed yield/ plant(g)
Days to first flowering	**0.00100**	-0.00070	-0.00030	0.00070	0.00001	0.00001	0.00001	-0.10000	-0.01450	-0.00250	-0.116
Days to pod initiation	0.00080	**-0.00090**	-0.00050	0.00120	0.00001	-0.00010	0.00001	-0.12440	-0.01760	-0.00170	-0.143*
Days to 50 percent flowering	0.00040	-0.00060	**-0.00080**	0.00180	0.00001	0.00001	0.00001	-0.09940	-0.01650	-0.01840	-0.134
Days to maturity	0.00030	-0.00050	-0.00070	**0.00200**	0.00001	0.00001	0.00001	-0.04110	-0.00650	-0.00220	-0.049
Plant height (cm)	0.00001	0.00000	0.00001	-0.00010	**-0.00080**	0.00010	0.00010	-0.10000	-0.01800	-0.02830	-0.147*
Number of pods/plant	0.00001	0.00010	0.00001	0.00010	0.00000	**0.00170**	-0.00020	0.14770	0.02340	0.02270	0.195*
Number of seeds/pod	0.00001	0.00001	0.00001	0.00000	0.00000	-0.00020	**0.00130**	-0.07470	-0.01250	-0.01830	0.105
Biological yield/plant (g)	-0.00010	0.00010	0.00010	-0.00010	0.00010	0.00030	-0.00010	**0.76020**	0.11820	0.09650	0.975*
100Seed weight (g)	-0.00010	0.00010	0.00010	-0.00010	0.00010	0.00030	-0.00010	0.74270	**0.12100**	0.13260	0.997*

Harvest index (%)	0.00001	0.00001	0.00010	0.00000	0.00010	0.00020	-0.00010	0.33670	0.07360	**0.21790**	0.629*

*** Significant at 5% probability level**

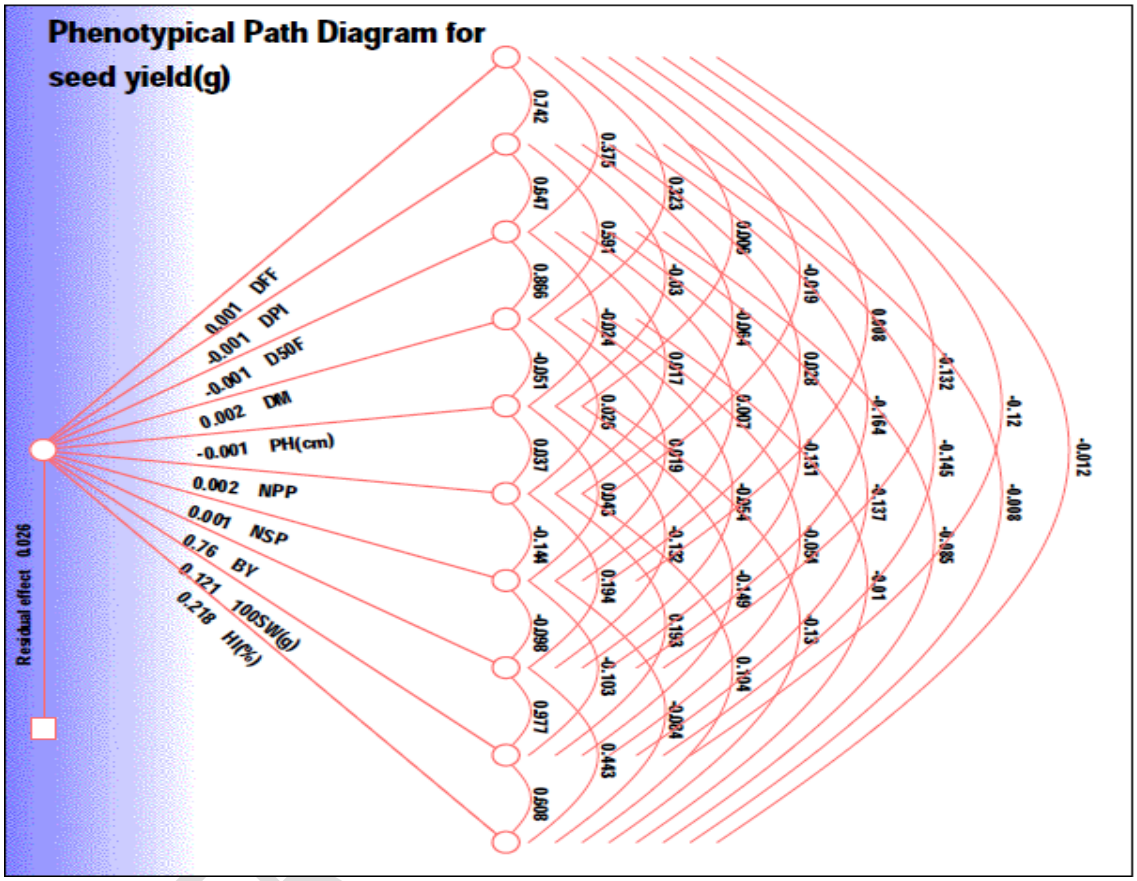

Figure 1: Phenotypic path diagram for seed yield of pea germplasm

Discussion

Correlation Coefficients

Correlation coefficient helps to describe the extent of the interaction between the yield and its component traits by providing a symmetrical estimate of the degree of interaction between two features. It described the importance of understanding the interactions between seed yield and a related quality is a requirement for developing a successful selection strategy with the goal of increasing seed yield(Pratap *et al.*, 2021).

In earlier findings, it was found that grainyield/plant was positivelyand significantly correlated with number of primary branches/plant, plant height and numberof pods/plant. Path analysis

revealed that plant height had high positive and direct effect ongrainyield/plant. It was found that days to 50% flowering and pod length were directlyaffectedgrainyield/plant and had positive significant association (Parihar *et al.,* 2014)**.**

In earlier study it was found that the key traits for selection for pea yield improvement namely the number of leaves at the vegetative stage, number of leaves, days to first flowering, plant height (cm) at flowering stage, number of seeds/pod, individual seed weight, individual pod weight, pod coat weight, leaf area and 100-seed weight (g) (Rajangam*et al.,* 2014). In some earlier studies it was found (Meena *etal*., 2022; Bahadur and Devi 2021; Tiwari *etal*., 2020; Asha *etal*., 2020)similar traits were identified as the most critical components determining pea seed yield. The high positive connection of seed production with the characteristics has already been documented in peas.

The majority of the correlation coefficients established in this study are essentially consistent with prior findings in pea (Tiwari *et* al., 2020); Srivastava *et al*., 2018; Jeberson*et al*., 2016; Mishra 2014; Parihar *et al.,* 2014). Their selection practiced for employing these traits individually or simultaneously would bring improvement in other due to correlated response. Thus, selection will be efficient for these characters.

Path-coefficient analysis

Biological yield/plant, harvest index, number of seeds/pod, days to maturity and 100-seed weight all contributed significantly to seed output/plant. These characteristics have also been found in the literature as an important direct factors to pea seed yield/plant (Rajangam*et al.,* 2014; Vartika *etal*., 2012; Manggoel*et al.,* 2012; Parihar *et al.,* 2014; Sanwal*etal*., 2021).

The direct contribution of days to pod initiation, days to 50% flowering had a negative influence on seed output/plant. 100-seed weight (0.74270), harvest index (0.33670) and number of pods/plant (0.14770) showed positive and significant association with yield/plant via indirect effect of biological yield/plant; biological yield/plant (0.09650), 100-seed weight (0.13260) and number of pods/plant (0.02270) via harvest index showed high order positive indirect effect on seed yield/plant. Days to pod initiation (0.00120), days to first flower (0.00070) and days to 50 per cent flowering (0.00180) showed positive and significant association with yield/plant via indirect effect of days to maturity. The findings presented above are roughly consistent with the report of (Tiwari *etal*., 2020; Srivastava *et al*., 2018; Jebersonet *al*., 2016; Rathi and Dhaka 2007).

In addition to their strong positive direct correlation to pods/plant, 100-seed weight, seeds/pod, biological yield/plant, harvest index and plant height also had a significant positive indirect influence on seed output.

Highest positive and significant direct effects on seed yield/plant were exerted by biological yield/plant (0.76020) followed by harvest index (0.21790) and 100-seed weight (0.12100). The negative and substantial direct effects on seed yield/plant were exerted by days to pod initiation (-0.0009), days to 50% flowering (-0.0008), plant height (-0.0008). Whereas, plant height (-0.01800), number of pods/plant (-0.01250) and days to pod initiation (-0.01760) showed negative indirect effects on seed yield/plant via 100- seed weight; days to pod initiation (-0.0001), number of seed/pod (-0.0002) showed negative indirect effects on seed yield/plant via number of pods/plant; days to first flower (-0.0007) and days to 50 per cent flowering (-0.0006) showed negative indirect effects on seed yield/plant via days to pod initiation.

Path analysis indicated biological yield/plant (g), harvest index (%), days to maturity, plant height (cm) and number of seeds/pod as essential direct yield contributing characters, which were also discovered to be beneficial indirect contributors. The most important indirect yield components were biological yield/plant (g), harvest index (%) and plant height (cm). The characteristics described above should be taken into account when establishing a selection strategy for generating high yielding pea varieties.

Conclusion

The study evaluated 248 pea genotypes for different features during rabi (2021-22) using Augmented Block Design. The experimental material comprised of 245 germplasm lines and three check varieties viz., PB-89, PP and ARKEL. High seed yield was produced by IC 629710 followed by SHP 42 and P-3132. Positive and highly significant associations were found between biological yield/plant and seed yield/plant followed by (g), harvest index (%) and 100-seed weight (g). Seed yield/plant (g) had negative significant correlations with days to plant height, days to first flower, days to pod initiation, days to 50 percent flowering and days to maturity. Path analysis identified harvest index (%) and biological yield/plant (g) as significant direct components for seed yield/plant (g). The indirect effects of 100-seed weight (g), harvest index (%) and number of pods/plant had a positive indirect effect on yield/plant via biological yield/plant. The traits were recognized as significant direct and indirect components that should be taken into account when formulating an efficient selection strategy for pea in order to create

high yielding varieties.

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