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Original Research Article

Evaluation of Correlation and Path Coefficients Analysis for Yield Attributing Traits in Garden Pea (*Pisum sativum* L.) under Tarai tract of Uttarakhand

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A B S T R A C T

Fifty four genotypes of garden pea were evaluated at Vegetable Research Centre, GBPUA&T, Pantnagar, Uttarakhand, for twelve parametres through correlation at genotypic and phenotypic levels along with path coefficient analysis were studied for various yield and its component characters. Analysis of variance revealed significant difference for all the characters including the presence amount of variability in the genotypes studied. Correlation studies revealed that green pod yield per plant was positively and significantly associated with number of pods per plant. Path coefficient analysis revealed that traits like weight of green seed per pod, pod diameter, number of seed per pod, shelling percentage and plant height were the important characters for selection of high yielding genotypes as they exerted high positive direct effect with green pod yield per plant. The result suggested that these traits could be considered as major yield contributing traits in pea.

Keywords

Food,
Garden Pea
Pisum sativum

Introduction

Pea, *Pisum sativum* L. also called garden pea, herbaceous annual plant, grown virtually worldwide for its edible seeds. All the wild and cultivated types of Genus *Pisum* contain same chromosome number of 2n=14 (Yarnell, 1962). According to Kay (1979) and Makasheva (1983) pea probably originated in South Western Asia, possibly North Western India, Pakistan or adjacent areas of former USSR and Afganistan and thereafter spread to the temperate zones of the Europe before 3000 BC. There are mainly four centres of origin, namely, Central Asia, the Near East, Abyssinia and the Mediterranean based on genetic diversity (Gritton, 1980). (Smart, 1990) reported that in Mediterranean region pea was originally cultivated as winter crop. Peas are refined for the fresh green seeds, tender green pods, occasionally dried seeds and foliage (Duke, 1981). According to Davies *et al*., 1985 green peas are consumed as vegetable and are marketed fresh, canned, or frozen while ripe dried fruits are eaten as whole, split, or made into flour. The natural protein of peas is almost entirely digested in the small intestine and increased secretion of endogenous protein based on protein digestibility of peas in broilers (Huisman and Van der Poil, 1994). Pea seeds are two types, among them wrinkled seeded garden peas are sweeter than

smooth seeded types. Peas can be used for making contraceptive, ecbolic, spermicide and fungistatic as the seeds contain trypsin and chymotrypsin compound (Duke, 1981). Pea is a major source of minerals (Choudhury, 1967). One hundred gram edible portion of pea seed contains around 72.0 g moisture, 7.2 g protein, 0.1 g fat, 15.8 gm carbohydrate, 4.0 g fibre, 139 I.U. vitamin A and 9 mg Vitamin C (Aykroyd, 1963). Carbohydrate considered as largest chemical component in pea seed constituting around 56.6% of total seed weight (Bressani and Elias, 1988). Worldwide it is grown in around 6.51 million hectares area with annual production of 10.95 million tonnes. India contributes around 21 percent production of peas worldwide from an area of 554 thousand hectares with average annual production of 5524 thousand metric tonnes. In Uttarakhand pea is cultivated in around 11822.76 ha area with an annual production of 5452 thousand mt.

Being most important economic crop in India, its pace of genetic development still remained slow. Farmers have to face many constraints in its production due to reduction in yield potential of subsisting varieties, low productivity and quality. Hence, for a breeder the main objective is to increase yield and productivity per unit area to achieve the demand throughout the year. Correlation coefficient is a statistical measure which is used to find out the degree and direction of relationship between two or more variables. It measures the mutual relationship between various plant characters and determines the component characters on which selection can be exercised for genetic improvement in yield. Path coefficient analysis (Wright, 1921) is an important tool for partitioning the correlation coefficient into direct and indirect effects of independent variables on dependent variables. It has been widely used to identify traits that that have significant effect on yield for potential use in selection. Keeping in view the study was conducted to find out correlation at genotypic and phenotypic levels and path coefficient analysis for yield and its contributing traits in pea.

Materials and Methods

The experiment was carried out at Vegetable Research Centre (VRC), G.B. Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar, Uttarakhand in Rabi season, 2018-2019. The experimental material comprised of 3 check verities and total number of 54 germplasm lines received from vegetable pea improvement programme running at Pantnagar.

The experiment was laid out in Augmented Block Design with 3 blocks, each block comprising 18 genotypes and 3 checks. The seeds are sown at a spacing of 30cm × 10 cm. Recommended agronomic practices and plant protection measures were allowed to maintain optimum plant stand. The whole investigation was done under the scientific management practices. during the study, days to 50% germination, days to 1st picking, numbers of pods per plant, avg. pod weight (g), pod diameter (mm), pod length (cm), numbers of seeds per pod, weight of green seed per pod (g), shelling percentage (%), plant height (cm), pod yield per hectare (q/ha), TSS (total soluble solids) were recorded . The data were averged and statistically analyzed or analysis of variance as per the method suggested by Panse and Sukhatme (1995). The genotypic and phenotypic correlation coefficients were calculated from the genotypic and phenotypic covariances as described by Singh and Choudhary (1977) and as per formula given by Johnson *et al.* (1995). The estimates direct and indirect effect were calculated by the path coefficient analysis as suggested by Wright (1921) and elaborated by Dewey and Lu (1959) at both phenotypic and genotypic levels.

Results and Discussion

The analysis of variance indicated significant differences among the genotypes for all the observed characters which indicated that high amount of genetic variability was present in the genetic material.

The correlation study revealed that in general estimates of genotypic correlation coefficient were higher than the corresponding phenotypic correlation coefficients, which indicated a strong inherent association among different traits under study (Table 1). The lower phenotypic values might be due to environmental interactions. A significant positive correlation of pod yield per plant was observed with number of pods per plant at environmental level, which suggested that these characters could be considered as major green pod yield contributing character in pea. Similar results were earlier obtained by Chaudhary and Sharma (2003), Sureja and Sharma (2004), Chudhary *et al.,* (2004), Singh and Singh (2005), Nawab *et al.,* (2008) and Guleria *et al.,* (2009).

Pod yield per plant registered highly significant and negative correlation with pod length, days to 50% flowering both at genotypic level and phenotypic level and weight of green seeds per pod and shelling percentage (-0.1676) at environmental level, which indicated that selection could be practicised for less days to flowering high pod length weight of green seeds per pod shelling percentage. The results are in accordance with the findings of Choudhary and Sharma (2003), Choudhary *et al.,* (2004) and Sureja and Sharma (2004).

Therefore, it can be concluded that, during selection high yielding genotypes in pea major emphasis should be given on number of pods per plant pod length, days to 50% flowering weight of green seeds per pod shelling percentage as these are significantly associated with pod yield hence, these characters could be considered reliable indices for selection, to enhance the pod yield.

Path coefficient analysis revealed that , maximum direct effect on yield per hectare was mediated through weight of green seed per pod (0.5675) followed by pod diameter (0.1459), plant height (0.0849), shelling percentage (0.0582) and number of seed per pod (0.05) at genotypic level and through weight of green seed per pod (0.5689) followed by pod diameter (0.1287), plant height (0.0887), shelling percentage (0.0643) and number of seed per pod (0.0301) at phenotypic level. The present findings was in close proximately to the earlier work done by Singh *et al.,* (2014), Rahman *et al.* (2019), Ton *et al.* (2018), Shrivastava *et al.* (2018), Kumar *et al.* (2018), Katoch *et al.* (2016). The highest negative direct effect was exerted by days to 1st picking (-0.2076) and total soluble solid (0.1658), followed by days to 50% flowering (-0.0167), number of pods per plant (-0.027), pod weight (-0.0276) and pod length (-0.095). These results were in partial accordance with these of Sureja and Sharma (2004) for appearance of first flower , by Sharma *et al.,* (2007) for TSS.

Days to 50% flowering imposed a positive indirect effect on yield per hectare through weight of green seed per pod, pod length, plant height, shelling percentage and number of pods per plant. Days to 1st picking had a Maximum positive indirect effect was imposed through total soluble solid, number of pods per plant, pod length and weight of green seed per pod. Number of pods per plant exerted a maximum positive indirect effect on yield per hectare through pod weight, number of seeds per pod, weight of green seed per pod, days to 1st picking, plant height and days to 50% flowering (Table 2).

Table.1 Genotypic (above diagonal) and phenotypic (below diagonal) correlation for yield and its component characters in garden pea

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	**1**	0.0588	−0.0046	0.1176	0.124	−0.0898	0.0853	−0.2086**	−0.0263**	−0.0274	0.1401	−0.1466
2	0.0649	**1**	−0.1008	0.3442**	0.0429	−0.0732	0.1327	−0.063	0.0391	0.031	−0.139	−0.2033
3	-0.0074	-0.0867	**1**	−0.1628*	0.1345	0.0677	−0.1366	−0.1025	0.1128	−0.0589	0.0724	-0.0637
4	0.1153	0.3130**	-0.1588*	**1**	0.1572*	−0.0841	−0.1521	−0.1054	0.1126	−0.0059	−0.09	-0.1122
5	0.1124	0.0379	0.1404	0.1561*	**1**	−0.1841*	−0.1723*	0.1602*	−0.0809	0.003	0.1237	0.2018
6	-0.0835	-0.0869	0.0581	-0.0833	-0.1952*	**1**	0.0817	0.105	0.1023	−0.3759**	−0.2135**	-0.0316
7	0.0842	0.1063	-0.1322	-0.1479	-0.1635*	0.0859	**1**	0.1758*	−0.0273	−0.0501	0.1424	0.0664
8	-0.2029**	-0.0583	-0.1042	-0.1017	0.1537*	0.0993	0.1737*	**1**	−0.0489	−0.1204	0.0392	0.5924
9	-0.0191	0.0321	0.1062	0.1076	-0.0884	0.1092	-0.0319	-0.0535	**1**	−0.1089	−0.027	-0.011
10	-0.0145	0.0347	-0.0548	-0.0083	0.007	-0.3668**	-0.0495	-0.1249	-0.1034	**1**	0.0614	0.0295
11	0.1178	-0.1323	0.0784	-0.0883	0.1228	-0.2029**	0.1351	0.0337	-0.0317	0.0604	**1**	-0.0674
12	-0.1375	-0.1875	-0.07	-0.1119	0.1839	-0.0239	0.0639	0.5862	-0.0055	0.0271	-0.0713	**1**

Significance level if correlation r at 0.01 =0.1965, 0.05 =0.1501, 0.005=0.2137 0.001=0.2495

** Significant at 1% *Significant at 5%

1. Days to 50% flowering
2. Days To 1st picking
3. Number of pods per plant
4. Avg. pod weight
5. Pod diameter
6. Pod length
7. Number of seeds per pod
8. Weight of green seed per pod
9. Shelling percentage
10. Plant height
11. Total soluble solid
12. Yield per hectare

Table.2 Direct (diagonal) and indirect phenotypic and genotypic path coefficient values of different characters on yield of garden pea

CHR	D5OF	DFP	NPPP	PODWT	PD	PL	NSPP	WGSPP	SHELLING	PH	TSS
D5OF	**-0.0167**	-0.001	0.0001	-0.002	-0.0021	0.0015	-0.0014	0.0035	0.0004	0.0005	-0.0023
DFP	-0.0122	**-0.2076**	0.0209	-0.0714	-0.0089	0.0152	-0.0275	0.0131	-0.0081	-0.0064	0.0289
NPPP	0.0001	0.0027	**-0.027**	0.0044	-0.0036	-0.0018	0.0037	0.0028	-0.003	0.0016	-0.002
PODWT	-0.0032	-0.0095	0.0045	**-0.0276**	-0.0043	0.0023	0.0042	0.0029	-0.0031	0.0002	0.0025
PD	0.0181	0.0063	0.0196	0.0229	**0.1459**	-0.0269	-0.0251	0.0234	-0.0118	0.0004	0.0181
PL	0.0085	0.007	-0.0064	0.008	0.0175	**-0.095**	-0.0078	-0.01	-0.0097	0.0357	0.0203
NSPP	0.0043	0.0066	-0.0068	-0.0076	-0.0086	0.0041	**0.05**	0.0088	-0.0014	-0.0025	0.0071
WGSPP	-0.1184	-0.0357	-0.0582	-0.0598	0.0909	0.0596	0.0998	**0.5675**	-0.0277	-0.0683	0.0223
SHELLING	-0.0015	0.0023	0.0066	0.0066	-0.0047	0.006	-0.0016	-0.0028	**0.0582**	-0.0063	-0.0016
PH	-0.0023	0.0026	-0.005	-0.0005	0.0003	-0.0319	-0.0043	-0.0102	-0.0092	**0.0849**	0.0052
TSS	-0.0232	0.023	-0.012	0.0149	-0.0205	0.0354	-0.0236	-0.0065	0.0045	-0.0102	**-0.1658**
YIELD	**-0.1466**	**-0.2033**	**-0.0637**	**-0.1122**	**0.2018**	**-0.0316**	**0.0664**	**0.5924**	**-0.011**	**0.0295**	**-0.0674**
Partial R^2	0.0025	0.0422	0.0017	0.0031	0.0294	0.003	0.0033	0.3362	-0.0006	0.0025	0.0112

R Square = 0.4345 Residual Effect = 0.7520

D50F= Days to 50% flowering, DFP= Days to 1st picking, NPPP= Number of pods per plant, PODWT= Pod weight, PD= Pod diameter, PL= Plant length, NSPP= Number of seeds per pod, WGSPP= Weight of green seeds per pod, Shelling= shelling Percentage, PH= Plant height, TSS= Total soluble solid and Yield = Green pod yield quintal per hectare

Positive indirect effect of pod weight on yield per hectare was noticed via number of pods per plant, number of seeds per pod , weight of green seed per pod , total soluble solid , pod length and plant height . Pod diameter was observed to have a positive indirect effect on yield per hectare through pod weight, weight of green seeds per pod, number of pods per plant, days to 50% flowering, total soluble solid, days to 1st picking and plant height. There exist a positive indirect effect of pod length on yield per hectare through plant height, pod diameter, days to 50% flowering , pod weight , days to 1st picking and total soluble solid. The number of seeds per pod exerted positive indirect effect on yield per hectare through weight of green seed per pod, total soluble solid, days to 1st picking, days to 50% flowering and pod length. Weight of green seed per showed maximum indirect positive effect was observed through number of seeds per pod, pod diameter, pod length and total soluble solid. Shelling percentage showed maximum positive direct effect on yield per hectare through number of pods per plant, pod weight, pod length and days to 1st picking. Plant height imparted maximum indirect positive indirect effect was exerted through total soluble solid, days to 1st picking and pod diameter. Total soluble solid exerted maximum positive indirect effect on pod length, pod weight, shelling percentage and days to 1st picking.

The residual effect at phenotypic (0.7636) and genotypic (0.7520) levels was very low which indicated that the green pod yield per plant was ultimately the traits under study having adequate variability.

Hence concluded, keeping in view, the estimates correlation coefficient and direct and indirect contribution component traits toward pod yield per plant, indirect selection practices on the basis of days to 50% germination, days to 1st picking, numbers of pods per plant, avg. pod weight pod diameter pod length numbers of seeds per pod, weight of green seed per pod shelling percentage, plant height (total soluble solids) would be regarding in the genotypes under study enhancing the pd yield per plant as well as per hectare.

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