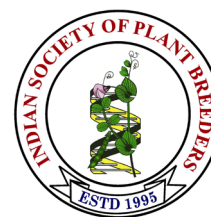


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Research Note

Genetic variability and correlation study for yield and yield attributing characters of garden pea (*Pisum sativum* L. var. *hortense* Asch.) under valley conditions in Garhwal

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Abstract

Genetic variability and heritability of a character are necessary for a successful exploitation in breeding programme. These parameters help to identify relation between traits and characters affecting the yield that are important for improvement of varieties through breeding programme. The study was carried out during winter season 2023-2024 at Horticultural Research Centre, Department of Horticulture, School of Agriculture and Allied Sciences, Chauras Campus, Hemvati Nandan Bahuuguna Garhwal University, Srinagar Garhwal, Uttarakhand. Twenty-eight genotypes were used including one check cultivar. The study on components of genetic variability showed high heritability and genetic advance over mean for traits such as plant height, number of primary branches, average pod weight, and seed index, indicating considerable variation. A positive correlation of yield of green pods per plot with plant height, average pod weight and seed index was obtained showing their importance in selection for yield improvement and breeding programmes of garden peas.

Keywords: Peas, correlation, genetic variability, path analysis

Fruits and vegetables are important part of human diet. Both fruit and vegetable add diversity and nutrition to human diet but vegetables are needed in daily basis especially in Indian households as most of the population is vegetarian. Vegetables are the key source of vitamins, minerals, antioxidant, fibres and roughage. Different food crops provide variety of nutrition and taste for human diet. But the protein requirement of humans especially in vegetarian population is fulfilled by pulses and the major family of pulse crop is Leguminaceae, which provide a wide range of food items, medicine as well as enrich soil fertility. One of the members of the leguminaceae family is 'Pea' (*Pisum sativum* L.). From the points of genetics, pea plant has been of importance since the foundation of genetics was laid by Mendel. It is one of the oldest domesticated crops in the history of mankind. Garden pea is an annual crop grown all over the world for its green pods. In India, it is grown widely in the states of Uttar Pradesh, Bihar, Himachal Pradesh, Haryana, Punjab,

Orissa, and Karnataka (Ram, 2015). The total production of peas in India during the year 2021-2022 was 6000 metric tonnes and the area under the crop was 5000 hectare (PIB India, 2022).

The main objectives of pea breeding are high seed yield, more numbers of pods per plant, resistance to biotic and abiotic stresses and better quality. Though globally, many high yielding cultivars have been developed in pea, now the research focuses on producing such varieties that are tolerant to climate change and can adapt easily in the changing environmental condition of the near future. Therefore, the assessment of traits that enhances the yield with the changing climatic conditions becomes an important objective for breeding programmes (Sanwal *et al.*, 2024). The variability components, including the phenotypic and genotypic coefficients of variation, heritability, and genetic advance, act as essential tools for measuring diversity within a population, thereby aiding

in the evaluation and selection process for improvement (Mawblei *et al.*, 2022). The greater the amount of heritable variation, the higher the capacity for modifying traits through selection processes (Sharma and Bora, 2013). Heritability and genetic advance are key parameters for selection. Estimates of heritability combined with genetic advance are generally more effective in predicting the gains from selection than heritability estimates alone (Sandhiya and Saravanan, 2018). Yield, as a complex trait, is controlled by multiple polygenes that show low heritability, making direct selection for yield quite limited. Therefore, selection efficiency can be enhanced by identifying the relationships between yield and other plant traits, which can act as straightforward indicators for identifying high-yielding plants (Sivan *et al.*, 2022). Yield is a crucial trait, so it is important to understand that when two traits are correlated, selecting for one trait leads to the improvement of the other. Thus, choosing such correlated traits aids in selecting germplasm with high yield, and a strong correlation with yield indicates the simultaneous enhancement of both traits (Aruna *et al.*, 2023). Correlation analysis assists plant breeders in determining the relative significance of various plant traits and offers a solid foundation for selection. Depending on the traits studied, correlation can be either positive or negative. (Sivan *et al.*, 2022). Therefore, this experiment was performed to study genetic variation among the present genotypes with heritability and correlation of the given traits with yield and to analyse characters that can be selected in yield improvement programmes.

The study was carried out during rabi season of 2023-2024 at Horticultural Research Centre of Department of Horticulture, School of Agriculture and Allied Science, Chauras Campus, Hemvati Nandan Bahuguna Garhwal University, Srinagar Garhwal, Uttarakhand. The experiment was carried out in RCBD with three replication with a plot size of 2.10 m x 2 m. Twenty-eight genotypes were used including one check cultivar. The details of genotypes are furnished in the **Table 1**.

Observations were recorded for nine yield attributing traits viz., plant height (cm), number of primary branches, days taken to first flowering, days taken to first pod formation, average pod weight (g), average pod length (cm), average pod diameter (mm), yield of green pod per plot (kg) and seed index (g). Random selection of five plants from each replication was done. The mean of each replication was calculated, and subjected to statistical analysis. The analysis of variance (ANOVA) and critical difference (CD) test at 5% level of significance was applied as suggested by Panse and Sukhatme (1984) to assess the significance of variation among the treatments. The genotypic and phenotypic coefficients of variation were estimated by adopting the formula of Burton and De vane (1953). The heritability in a broad sense was calculated according to Hansen *et al.* (1956), genetic advance and genetic advance as a percentage over mean according to Johnson *et al.* (1955). The genotypic and phenotypic

correlation coefficients were estimated as per the formula of Al-Jibouri *et al.* (1958).

The ANOVA for traits the nine traits among the 28 genotypes indicated that the mean sum of square due to genotypes were highly significant for all the characters. This specifies presence of considerable variability among the material studied. The mean sum of squares due to genotypes were highly significant at 5% level of significance for all the characters studied, which revealed the existence of a good range of variability among the genotypes, which is desirable for future breeding purposes. Similar findings were also obtained by Bishnoi *et al.* (2021) and Alam *et al.* (2023) in peas. The estimates of phenotypic and genotypic coefficients of variation (table 2) gave a clear picture of the variations present in the available germplasm. For all the characters studied, phenotypic coefficients of variation (PCV) were higher in magnitude than genotypic coefficients of variation (GCV). Similar finding was also reported by Gupta *et al.* (2020) in pea and Ali *et al.* (2011) in chickpea. This showed that the studied traits were less influenced by environmental factors. GCV and PCV were found to be high for number of primary branches per plant (20.98%, 24.93%), yield of green pod per plot (21.9%, 25.7%), seed index (20.36%, 21.17%) indicating that there was considerable variation among the genotypes for the studied characters which could be further utilized in pea breeding programmes. Similar finding was also reported by Gupta *et al.* (2020) in pea. The GCV and PCV were moderate for plant height (12.95%, 14.34%) and average pod weight (17.13%, 19.99%), similar findings were observed by Georgieva *et al.* (2016), Gudadinni *et al.* (2017) and Gupta *et al.* (2020) in pea.

However, the traits viz., days taken to first flowering (5.5%, 6.38%), days taken to first pod formation (4.17%, 4.34%), average pod length (7.78%, 8.66%) and average pod diameter (1.68%, 1.91%) revealed low GCV and PCV indicating that these traits are highly influenced by environment factors as observed in findings reported by Kumar *et al.* (2013) and Katoch *et al.* (2016).

The estimates of heritability (broad sense) varied from 70.824 % to 92.48 % (**Table 2**). High heritability (in broad sense) was observed for the characters plant height (81.59%), days taken to first flowering (74.14%), days taken to first pod formation (92.17%), average pod length (80.95%), average pod diameter (77.3%), average pod weight (73.36%), yield of green pod per plot (72.51%), and seed index (92.48%). Moderate heritability was estimated in number of primary branches per plant (70.8%). The results suggest that these traits are heavily influenced by genetic factors and can be used reliably selected for breeding programmes of pea. Similar findings were also reported by Ali *et al.* (2021) and Alam *et al.* (2023). Genetic advance as percentage of means was found high for plant height (24.1%), average pod weight (30.22%), yield of green pod per plot (38.44%) and seed index (40.31%). It

Table 1. List of green pea genotypes used for study

S. No.	Genotypes	Procured	S. No.	Genotypes	Procured
1	Arkel	Srinagar, Uttarakhand	15	GS-10	Jaipur, Rajasthan
2	Ankur	Jaipur, Rajasthan	16	Himani	Jaipur, Rajasthan
3	AP-3*	Jaipur, Rajasthan	17	Krishna	Jaipur, Rajasthan
4	AS-10	Jaipur, Rajasthan	18	Maharaja-10	Jaipur, Rajasthan
5	Badal	NCR, New Delhi	19	MK-10	Jaipur, Rajasthan
6	BKS-10	Jaipur, Rajasthan	20	PSM-3	Pantnagar, Uttarakhand
7	CBK-10J	Dehradun, Uttarakhand	21	Quality 101	Jaipur, Rajasthan
8	Chamatkar	Jaipur, Rajasthan	22	Rajshree Goldie	Jaipur, Rajasthan
9	DS-10	Jaipur, Rajasthan	23	Ruhani 111	Jaipur, Rajasthan
10	EG-10	Kota, Rajasthan	24	S-10	Jaipur, Rajasthan
11	G-10	Kota, Rajasthan	25	Salimar (Gold)	Jaipur, Rajasthan
12	Goldie	Kota, Rajasthan	26	Titan	Dehradun, Uttarakhand
13	GreenPearl SW10	Dehradun, Uttarakhand	27	Venezuela Green	Jaipur, Rajasthan
14	Green Star	Jaipur, Rajasthan	28	VL-3	Pantnagar, Uttarakhand

*- check variety

Table 2. Estimates of genetic variability components for different characters of garden pea genotypes.

Characters	Mean	Heritability	GCV (%)	PCV (%)	Genetic advance	Genetic advance as % mean
Plant height (cm)	84.23	81.586	12.95	14.337	20.297	24.096
Number of primary branches	2.17	70.824	20.977	24.926	0.791	36.366
Days taken to first flowering	73.03	74.142	5.498	6.385	7.123	9.752
Days taken to first pod formation	83.35	92.173	4.171	4.344	6.875	8.249
Average pod weight (g)	5.51	73.362	17.127	19.996	1.665	30.219
Average pod length (cm)	8.73	80.946	7.787	8.656	1.26	14.433
Average pod diameter (mm)	10.11	77.294	1.681	1.912	0.308	3.044
Yield of green pod per plot (Kg)	2.08	72.549	21.894	25.705	0.8	38.416
Seed index (g)	19.36	92.48	20.358	21.169	7.807	40.329

was found to be moderate for average pod length (14.4%). However, traits viz., days taken to first flowering (9.75%), days taken to first pod formation (8.24%) and average pod diameter (3.04%) recorded low genetic advance as percentage of means. Similar findings were observed by Kumar *et al.* (2021), Singh *et al.* (2011) and Katoch *et al.* (2016) in pea.

High heritability coupled with high genetic advance as percentage of means was observed for traits like plant height, number of primary branches, average pod weight, number of pods per plant, yield of green pod per plot and seed index, which indicates that the traits were under influence of additive gene action and direct selection can be done for these traits. High heritability estimates coupled with moderate genetic advance as percentage of mean was observed for average pod length. These results agree with the findings of Alam *et al.* (2023), Georgieva *et al.* (2016), Singh *et al.* (2019) and Bishnoi *et al.* (2021). Study of correlation among traits showed a high genotypic

correlation coefficient than phenotypic correlation coefficient (**table 3**) which signifies less environmental influence on the traits. Similar findings were observed by Chaudhary and Sharma, (2003) and Sharma *et al.* (2023). Environment can influence responses of traits both positively and negatively. At genotypic level, yield of green pod per plot had positive correlation with average pod weight (0.549), number of primary branches (0.297) and plant height (0.227). The trait was found negatively correlated with days taken to first flowering (-0.486), days taken to first pod formation (-0.370) and seed index (-0.272). Similar findings were obtained by Katoch *et al.* (2016) Kumar *et al.* (2015) and Sharma *et al.* (2023) in pea.

Thus the study showed that traits such as plant height, number of primary branches, pod weight and seed index, showing considerable variations and high heritability and genetic advance over mean. This implies the importance of these traits in further crop improvement programme.

Table 3. Phenotypic and genotypic correlation between yield and component traits

Characters	Yield of green pod per plot (kg)	Plant height (cm)	Number of primary branches	Days taken to first flowering	Days taken to first pod formation	Average pod length (cm)	Average pod weight (g)	Average pod diameter (mm)	Seed index (g)
Yield of green pod per plot (kg)	1	0.227*	0.297**	-0.487**	-0.370**	-0.121	0.548**	0.163	-0.272*
Plant height (cm)	0.155	1	0.401**	-0.385**	-0.477**	-0.119	-0.066	0.071	-0.522**
Number of primary branches	0.202	0.306**	1	-0.13	-0.178	-0.250*	-0.231*	-0.03	-0.185
Days taken to first flowering	-0.381**	-0.334**	-0.059	1	0.902**	0.175	-0.460**	-0.458**	0.272*
Days taken to first pod formation	-0.320**	-0.433**	-0.099	0.793**	1	0.164	-0.262*	-0.339**	0.274*
Average pod length (cm)	-0.117	-0.06	-0.16	0.166	0.175	1	0.270*	0.572**	-0.134
Average pod weight (g)	0.359**	-0.009	-0.204	-0.374**	-0.242*	0.225*	1	0.583**	-0.383**
Average pod diameter (mm)	0.046	0.105	-0.052	-0.344**	-0.280**	0.439**	0.462**	1	-0.298**
Seed index (g)	-0.247*	-0.450**	-0.12	0.223*	0.258*	-0.122	-0.334**	-0.234*	1

** = Significant at 1 % and * = Significant at 5 % level of significance

The values above the diagonal represent genotypic correlations, while the values below the diagonal indicate phenotypic correlations.

A positive correlation of yield of green pods per plot with plant height, number of primary branches, average pod weight and seed index reveals that direct selection of these traits will be beneficial for garden pea breeding programmes aimed at yield improvement.

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