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Studies on Genetic Variability, Heritability and Genetic Advance in Garden Pea (*Pisum sativum* L.) Genotypes under the Central Dry Zone of Karnataka, India

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ABSTRACT

A field experiment was carried out to determine the genetic variability, heritability and Genetic advance present in twenty-two genotypes of garden pea during *Rabi* season 2021-22 at ICAR-Krishi Vigyan Kendra, Babbur farm, Hiriyur. The experiment was laid out in Randomized Complete Block Design with two replications. Observations were recorded on various yield and yield contributing characters. In general, the magnitude of the phenotypic coefficient of variation (PCV) was greater than that of the genotypic coefficient of variation (GCV) and the narrow difference between them indicates less environmental influence on the expression of the trait. High PCVand GCV (>20%) were recorded on plant height, number of branches per plant, pod thickness, number of pods per plant and non-reducing sugars which indicates the presence of high genetic variation and scope for effective improvement. All the characters studied in this experiment showed high heritability (>60%) in a broad sense coupled with high genetic advance as per cent over a mean (>20%) except for days to first flowering, days to 50 per cent flowering and days taken for first picking. This indicates the existence of additive gene action and the need for population improvement through selection. The genotypes that exhibit specific traits can be used in a hybridization programme.

Key words : Garden pea, Variability, Heritability and Genetic Advance.

Introduction

The pea (*Pisum sativum* L.) is a highly nutritious leguminous vegetable grown all over the world for food and fodder. This crop is widely distributed due to its high digestibility, balanced amino acid composition, high protein content, and relative greater yield levels when compared to other pulses.

Garden Pea (2n = 2x = 14) is an important annual herbaceous legume vegetable crop belongs to the

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family Fabaceae. It is native to Europe and West Asia, but its wild prototype originated in Ethiopia (De Candolle, 1886). Peas are valued for their high protein (20–30%), high vitamin A (5%) and high beta carotene (4%). It is a cool season crop and is mainly grown as a *Rabi* crop in plains and summer crop in hills of India for both fresh and dried seeds. It plays an important role in nitrogen fixation. Short-duration and early varieties of peas have the potential to provide premium returns to the farmers as they can fetch a better price and can be used for multi-cropping. A large proportion of peas are processed (canned, frozen, or dehydrated) for off-season consumption.

Estimating variability parameters, particularly heritability and genetic advance, are important indicators for character improvement through selection, whereas selection for highly heritable character is more effective for a successful breeding programme. Considering this, the present investigation attempted to assess the magnitude of variability, heritability, and genetic advance for various pea characters.

Materials and Methods

The experiment has been conducted at the research field unit of ICAR-Krishi Vigyan Kendra, Babbur

farm, Hiriyur of Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka during Rabi season 2021-22. The experiment material consisted of total twentytwo pea genotypes which are grown in Randomized Complete Block Design with two replications. Standard agronomic practices have been followed to raise the crop. Observations were recorded on five randomly selected plants from each treatment for various qualitative and quantitative characters in each replication. The data recorded on five plants per treatment was averaged and subjected to statistical analysis. Phenotypic and genotypic coefficients of variation were estimated according to Burton and De vane (1866) and heritability in a broad sense was estimated as per the formula given by Weber and Moorthy (1952). The expected genetic advance and Genetic advance as per cent over a meanfor each character was predicted by the formula given by Johnson et al. (1955).

Results and Discussion

The findings were considerably interpreted and listed in Table 1 based on the observations recorded in the present research.

Estimates of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) for quantitative and qualitative traits.

Table 1. Variability parameters for yield and yield attributing characters in garden pea genotypes

Sl. No.	Characters	GCV (%)	PCV (%)	Heritability in a broad sense (%)	Genetic advance	Genetic advance as per cent over mean (%)
1	Plant height (cm) @ 90 DAS	29.86	29.95	99.40	50.23	61.32
2	Number of branches per plant @ 90 DAS	21.84	21.92	99.21	14.91	44.80
3	Node at first flower appears	17.21	7.78	93.68	4.52	34.32
4	Days to first flowering	7.89	8.12	60.69	5.40	12.66
5	Days to 50 per cent flowering	7.98	8.98	78.86	6.76	14.59
6	Days taken for first picking	6.92	7.09	95.26	7.83	13.90
7	Pod length (cm)	19.11	19.82	92.93	2.95	37.94
8	Pod width (mm)	16.30	16.51	97.45	4.39	33.15
9	Pod thickness (mm)	27.19	27.83	95.51	3.77	54.75
10	No. of seeds per pod	15.37	16.08	91.35	2.04	30.26
11	No. of pods per plant	33.33	34.12	95.46	21.78	67.09
12	Pod yield per plant (g)	16.49	17.21	91.79	19.57	32.54
13	TSS (°Brix)	15.56	15.68	98.40	6.55	40.73
14	Reducing sugars (%)	14.98	15.10	98.40	1.30	39.22
15	Non-Reducing sugars (%)	24.52	24.57	99.50	3.35	64.57
16	Total sugars (%)	12.94	13.07	98.10	2.88	33.84
17	Dry matter content (%)	7.98	8.39	90.30	3.63	20.01

DAS- Days after sowing

The magnitude of the phenotypic coefficient of variation (PCV) was greater than the genotypic coefficient of variation (GCV) for all of the characters studied, indicating an additive gene effect influenced by the environment on trait expression. Similar findings were also reported by Pandey *et al.* (2017) and Barcchiya *et al.* (2018).

Results from the present study in this context indicated that PCV and GCV were high (>20%) observed for plant height at 90 DAS, number of branches per plant at 90 DAS, podthickness, number of pods per plantand non-reducing sugars. This reveals the influence of the environment on these characters is negligible and the role of genotypic performance for the full expression of the phenotype. These findings are following Gupta et al. (2020), Ali et al. (2021) and Priyanka and Lal (2021). While moderate (11-20%) for length of a pod, width of a pod, number of seeds per pod, pod yield per plant, total soluble solids, reducing sugars and total sugars. Similar results were also obtained by Lal et al. (2018), Asha (2019) and Yadav et al. (2021) indicating the equal importance of additive and non-additive gene action and low (0-10%) for days to first flowering, Days to fifty per cent flowering, days taken for first picking, PCV is greater than GCV indicating the effect of the environment on the expression of the characters. Thus, the selection based on phenotypic performance will be reliable. Results are under the findings of Lal et al. (2018); Asha (2019) and Fatah et al. (2020).

Estimates of heritability in a broad sense for all the studied characters

Heritability is an index of transmissibility and is of primary interest to a breeder. The higher the heritable value of a character, the less will be the environmental influence on the expression of that character, thereby giving a way for selecting a good individual.

In the present experiment, heritability was highest for all the parameters studied (>90 %) except Days to first flowering (60.69 %) and Days to 50 per cent flowering (78.86 %). The high heritability estimates for these characters revealed the lesser influence of the environment and selecting genotypes based on such characters would be worthwhile in garden pea improvement.Similar results were noticed by Ali *et al.* (2021), Priyanka and Lal (2021), Yadav *et al.* (2021) and Uhlarik *et al.* (2022).

Estimates of genetic advance along with heritability in a broad sense for all studied characters

The heritability of quantitative characters and their genetic and environmental variances considered together might be useful for improving the efficiency of selection. For an effective selection programme, knowledge of estimates of heritability alone is not sufficient and it is therefore used full to study genetic advance along with heritability. The genetic advance may or may not be in proportion to genetic variability and heritability estimates because both high heritability and high genetic variability are important to obtain higher genetic gain.

In the present study, high heritability coupled with high genetic advance as per cent over mean observed for plant height, number of branches per plant, node at first flower appears, length of pod, width of pod, thickness of pod, number of seeds per pod, number of pods per plant, pod yield per plant, TSS, reducing sugars, non-reducing sugars, total sugars and dry matter content. These results suggested that the inheritance of the characters is mainly governed by additive gene action and therefore improvement could be brought about by phenotypic selection.Some of these characteristics have also been reported earlier byAli *et al.* (2021), Priyanka and Lal (2021) and Yadav *et al.* (2021).

Higher heritability coupled with moderate genetic advanceas per cent mean over was observed fordays to first flowering, days to 50 per cent flowering and days taken for first picking which suggests that there was an equal contribution of additive and non-additive gene action, such character can only partially be improved by the selection method. The earlier researchers have also reported similar findings for days to 50 per cent flowering and days taken for first picking (Asha, 2019).

This study concluded that PCV and GCV were high for plant height, number of branches per plant, thickness of the pod, number of pods per plant and non-reducing sugars, indicating that these characters have a high degree of variability and suggesting the possibility of increasing yield through the selection of these traits.

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Conflict of Interest

The authors have declared that no conflict of interest exists.

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