



P-ISSN: 2349-8528

E-ISSN: 2321-4902

IJCS 2018; 6(4): 2291-2294

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Received: 13-05-2018

Accepted: 17-06-2018

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Studies on genetic variability in pea (*Pisum sativum* L.) under organic cultivation

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Abstract

The present investigation was conducted during 2017-18 at LPU field, Phagwara (Punjab), with ten diverse genotypes of garden pea (*Pisum sativum* L.). The experiment was laid out in RBD (Randomized Block Design) with three replications. Genetic variability was studied for growth parameters viz., plant height at 90 DAS, primary branches at 90 DAS, number of leaves at 90 DAS, days to 1st flowering, days to 1st picking, yield and yield parameters viz., pods per plant, pod length, pod width, pod weight, pod yield per plant, pod yield per hectare. Data was analyzed statistically for their analysis of variance, mean performance, genetic variability, and coefficient of variation, heritability % and genetic advance as % of mean.

Keywords: Coefficient of variation, genetic advance, genotypes, heritability and pea

Introduction

Garden pea (*Pisum sativum* L.), $2n=14$, belong to family Leguminaceae is a herbaceous winter annual and self-pollinated crop. In terms of nutritive value pea contains high percentage of digestible proteins and good content of vitamins, minerals and carbohydrates. Pea can be grown in wide range of agro- climatic zones which provides a tremendous scope and potential for cultivation of this crop. However, low productivity of this crop has created the necessity to breed new high yielding varieties, which may fulfill the needs of the growers and enhance the productivity. Various planning's and execution for a breeding programme for the improvement of the various quantitative traits depend to a great extent, upon the magnitude of genetic variability existing in the population. The genetic variability forms the basis of the entire breeding programme. Selection cannot be effective in population without variability. To give a better insight of ancillary characters under selection, genetic variability analysis is the tool, which is being effectively used for determining the rate of various yield components in different crops, leading to the selection superior genotypes. Therefore, for a rational approach to the improvement of vegetable yield, it is imperative to have information on the association among different yield and its component. Existence of sufficient variability in the genetic stock is a pre-requisite for initiation of any breeding programme. On the basis of above points the present study was conducted to estimate the genetic parameters for growth and yield parameters in pea.

Materials and Method

The experiment includes 10 varieties of the garden pea viz., Diamond 10, Ganga, GS-12, AP-3, AP-6, G-10, PB-89, Nirmal pencil, AP-1 and Patel collected from different sources. The seeds were treated in Rhizobium solution + water for 24 hours after that they were dried and sowing was done on the next day of treatment at spacing of 30×10 cm during October month 2017 at research farm of LPU, Phagwara, Punjab. The varieties were evaluated in randomized block design (RBD) with 3 replications. Vermicompost@ 100 kg was incorporated at the time of sowing. Observations were recorded for all characters viz., plant height at 90 DAS, primary branches at 90 DAS, number of leaves at 90 DAS, days to 1st flowering, days to 1st picking, yield and yield parameters viz. pods per plant, pod length, pod width, pod weight, pod yield per plant and pod yield per hectare. Data on the above component traits were subjected to statistical procedures viz., analysis of variance (Panse and Sukhatme 1967) [18], phenotypic and genotypic co-efficient of variation (Burton, 1952) [8], heritability % (Hanson *et al.* 1956) [8] and GA as % of mean (Johnson *et al.* 1955) [11].

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Results and Discussion

Analysis of Variance

The analysis of variance among all the characters under study is presented in Table 1. The results showed highly significant differences for all characters under study viz., plant height at 90 DAS, number of primary branches at 90 DAS, number of

leaves at 90 DAS, days to 1st flowering, days to 1st picking, yield and yield parameters viz., pods per plant, pod length, pod width, pod weight, pod yield per plant and pod yield per hectare. Nawab *et al.* (2008) [16], Choudhary *et al.* (2010) [5], Lal *et al.* (2011) [5] and Fikreselassie (2012) [6] also reported similar findings.

Table 1: Analysis of variance for characters of pea

Source of variation	Mean Sum Of Square		
	Replication d.f	Treatment d.f	Error d.f
	2	9	18
Plant Height at 90 DAS	0.29	30.09**	0.64
Plant primary branches at 90 DAS	0.043	0.478**	0.189
Number of Leaves at 90 DAS	0.044	250.538**	0.102
Days to 1 st Flowering	0.022	20.898**	0.196
Days to 1 st picking	0.021	427.87**	0.178
Pods per Plant	1.43	0.668**	0.144
Pod Length (cm)	0.14	1.35**	0.68
Pod Width (cm)	0.0002	0.004*	0.001
pod wt(g)	45.2	220.64*	67.13
Pod yield per plant (g)	309.3	426.69*	1321.03
Total yield per ha (q)	120.66	4216.63*	1162.12

Where, *= significant at 5% level, **= significant at 1% level

Table 2: Mean performance of 10 garden pea varieties for various characters

Genotype	Plant Height(cm) at 90 DAS	No. of Primary Branches at 90 DAS	No. of Leaves at 90 DAS	Days to 1 st flowering	Days to 1 st picking	Pods per plant	Pod length (cm)	Pod width (cm)	Pod weight (g)	Pod yield per plant (g)	Pod yield per ha (q)
D10	48.73	8.6	54.06	39.53	75.93	4.36	9.16	1.03	14.96	67.99	88.35
Ganga	56.33	8.93	65.13	37.4	53.66	5.6	8.08	1.12	29.51	169.76	179.19
GS12	49	8.53	58.2	40.93	74.86	4.33	9.11	1.07	18.69	73.98	111.56
AP3	54.2	7.83	60.5	40.26	67.93	4.23	8.21	1.05	15.82	68.87	99.78
AP6	51.27	8.6	54.86	46.4	77.53	4.8	8.36	1.07	15.71	78.08	95.82
G10	54.63	8.5	58.6	41.4	80.46	4.9	9.6	1.04	26.49	122.15	117.98
PB89	57	9	64.46	39.93	84.27	5.26	9.76	1.04	27.09	102.13	132.72
Nirmal pencil	51	9.07	64.4	42.26	76.8	4.7	9.32	1.02	15.07	68.49	95.29
AP1	54.73	9	45.8	39.46	54.3	4.7	8.36	1.09	19.24	78.29	125.85
Patel	57.13	9.2	80.53	37.06	52.93	5.43	7.92	1.12	41.15	153.32	200.56
Mean	57.41	8.73	60.66	40.47	69.87	4.83	8.79	1.06	22.37	98.31	124.71
S.E.	0.46	0.25	0.18	0.25	0.24	0.48	0.16	0.02	4.73	20.78	19.68
C.D. 5%	1.38	0.75	0.55	0.76	0.72	NA	0.48	0.06	14.05	62.35	58.48
C.V	1.51	4.98	0.53	1.09	0.6	7.02	3.2	3.44	36.62	36.97	27.33

Mean performance for various characters

The mean performances of 10 genotypes of pea for various characters are presented in Table 2. The plant height varied from 57.13 to 48.73 cm and with an overall mean performance of 57.41 at 90 DAS. The maximum plant height, 57.13cm was observed in the genotype Patel and genotype D10 exhibited the minimum plant height, 48.73 cm at 90 DAS. The number of primary branches ranged from 7.83 to 9.20 and with in overall mean performance of 8.73 at 90 DAS. Genotype Patel recorded the maximum number of primary branches (9.20) at 90 DAS. Whereas, AP3 exhibited the minimum number of primary branches (7.83) at 90 DAS. The number of leaves per plant ranged from 45.80 to 80.53 and within overall mean performance of 60.66. The maximum number of leaves per plant (80.53) was noted in genotype Patel, while minimum numbers of leaves per plant (45.80) was exhibited in genotype AP1 at 90 DAS. The days to first flowering varied from 37.07 to 46.40 days with the average days being 40.47. Earliest flowering was observed in genotype Ganga (37.4 days), while the genotype AP6 (46.4 days) took longest days to flowering. The days to first picking ranged from 52.93 to 84.27 days. Genotype Patel was earliest

for days to 1st picking, while PB89 took the maximum number of days for the same. The mean calculated was 69.87 days. The maximum number of pods per plant (5.60) was observed in Patel, while it was least in genotype AP3 (4.23). The mean calculated number of pods per plant was 4.83. The pod length varied from 7.76 to 9.76 cm with mean value of 8.79 cm. Genotype PB89 produced considerably the maximum pod length (9.76 cm) and minimum in Patel (7.92cm). The pod width ranged from 1.02 to 1.12 cm and the average was calculated to be 1.06 cm. Pod width was observed maximum in Patel and Ganga (1.12cm) and it was recorded least in Nirmal pencil (1.02cm). The heaviest pod weight was observed in genotype Patel (41.15 g) and they were lowest in Diamond 10 (14.96 g). The pod weight ranges between 14.96 g to 41.15 g, while the average weight of fruit was 23.37 g. The maximum pod yield per plant was recorded in Ganga (169.76 g). The genotypes Diamond 10 (67.99 g) was poor yielder. The average yield per plant was 98.31 g and it ranged from 67.99g to 169.76g. The average pod yield per hectare did vary significantly in different varieties with the significantly maximum yield (200.56 q.) recorded in Patel followed by Ganga (179.19 q.). The minimum pod yield per

hectare (88.35q.) was recorded in Diamond 10. The mean yield per hectare was 124.71q. Similar observations on the variability of wide range for all the character were reported by

Saleem *et al.* (2008) ^[19], Jitendra *et al.* (2010) ^[10] and Kumar *et al.* (2013) ^[14].

Table 3: Co-efficient of variation (GCV, PCV), heritability and GA as % of mean

Character	GCV	PCV	Heritability % (BS)	GA as % of mean
Plant height 90 DAS(cm)	5.86	6.05	94	11.7
Primary branches 90 DAS	3.55	6.12	34	4.26
no Leaf per plant 90DAS	15.06	15.07	99	31.01
Days for 1 st flowering	6.49	6.58	97	13.19
Days for 1 st picking	17.09	17.1	99	35.18
No. of pods per plant	1.48	17.04	08	-0.27
Pod length(cm)	7.43	8.09	84	14.06
Pod width(cm)	2.81	4.44	40	3.66
Pod weight (g)	31.97	48.61	43	43.3
Pod yield per plant(kg)	31.86	48.80	43	42.84
Total yield per hac(q)	25.58	37.44	47	36.02

Genetic Parameters

The data pertaining to various genetic parameters is presented in Table 3. The result indicated that the value of PCV was higher than GCV for all characters showing that the environment had an important role in influencing the expression of the characters. The phenotypic coefficient varied from 4.44 % pod per plant to 48.80% for pod yield per plant. The phenotypic coefficient of variations was high in the characters viz., pod yield per plant (48.80%), pod weight (48.61%), total yield per hac (37.44). While, the parameters like days to 1st picking (17.1%), pod per plant (17.04%), number of leaves per plant at 90 DAS (15.07%) exhibited moderate PCV. The parameters like pod length (8.09%), days to 1st flowering (6.58%), number of primary branches at 90 DAS (6.12%), plant height at 90 DAS (6.05%), pod width (4.44%), exhibited low PCV. Similar observations on the wide range of PCV was also reported by Choudhary *et al.* (2010) ^[5], Singh *et al.* (2012) ^[22], Pal and Singh (2013) ^[17], Siddika *et al.* (2013) ^[21] and Ahamad *et al.* (2014) ^[2]. The genotypic coefficient of variation varied from 1.48% for number of pods per plant to 31.97 % for pod weight. High genotypic coefficient of variation was noted for total yield per hectare (25.58%). The parameters like days to 1st picking (17.09%) and number of leaves per plant at 90 DAS (15.06%) exhibited moderate GCV. While, the number of pods per plant (1.48%), pod width (2.81%), number of primary branches at 90 DAS (3.55%), plant height at 90 DAS (5.86%), days to 1st flowering (6.49%) and pod length (7.43%) exhibited lowest GCV. Similar observations on wide range of GCV for characters was also reported by Nawab *et al.* (2008) ^[16], Choudhary *et al.* (2010) ^[5], Lal *et al.* (2011) ^[15], Singh *et al.* (2012) ^[22], Afreen *et al.* (2017) ^[1], katoch *et al.* (2016) ^[12], Jaiswal *et al.* (2015) ^[9] and Guleria *et al.* (2009) ^[7].

The heritability (Broad Sense) was computed for each of the characters by the variance components for estimating their relative magnitudes of genotypic and phenotypic variability contributed through environmental factors. The heritability estimates were observed very high for number of leaves at 90 DAS, days to 1st picking and plant height at 90DAS (94%). The High heritability estimates were observed for pod length (84%). The low heritability estimation was observed for number of pods per plant (08%), number of primary branches at 90 DAS (34%), pod width (40%), pod weight (43%), pod yield per plant (43%) and total yield per hectare (47%).

Based on the estimate of heritability (BS), expected genetic advance was computed on the hypothetical selection at 5 per cent best individual (K= 2.06). Due to masking influence of

environment upon characters concerned, values of genetic advance exhibited high fluctuations. Therefore, to attain relative comparison of the characters in relation to environment genetic advance as percentage of mean was calculated to predict the genetic gain. The genetic advance as % of mean ranged from -0.27% for number of pods per plant to 43.3 % for pod weight. The moderate estimate was obtained for pod weight (43.3%), pod yield per plant (42.84%), total yield per hectare (36.02%), days to 1st picking (35.18%) and number of leaves at 90 DAS (31.01%). While, pod length (14.06%), days to 1st flowering (13.19%) and plant height at 90 DAS (11.70%), number of primary branches at 90 DAS (4.26%), pod width (3.66%) and pods per plant (-0.27%) exhibited low estimates of the same. The results are in close conformity with the findings as reported by Sardana *et al.* (2007) ^[20], Choudhary *et al.* (2010) ^[5], Guleria *et al.* (2009) ^[7] and Akhilesh *et al.* (2007) ^[2].

Conclusion

On the basis of overall findings of the present study, it was concluded that there was a wide range of variation among the germplasm lines for all the characters under study. The studies of variability present in different characters indicated that considerable scope existed for the improvement of garden pea cultivars. Out of ten genotypes, five genotypes viz., Patel (200.56q), Ganga (179.19q), PB89 (132.72q), AP1 (125.85) and G10 (117.98 q) were found promising for pod yield per ha than other genotypes. All ten genotypes had a wide range of variation for most of the characters. The traits varied in terms of their behaviors and extent of genetic parameters.

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