Variability, heritability and character association analysis in garden pea (*Pisum sativum* L.)

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Abstract

Genetic variability and character association were studied for yield and its component characters in 20 genotypes of pea (*Pisum sativum* L.) during *rabi*, 2009-10. Analysis of variance revealed significant difference for all the characters indicating the presence of good amount of variability in the genotypes studied. The estimates of GCV, heritability and genetic gain were higher for plant height, whereas, high heritability with moderate GCV and genetic gain were observed for days to first flowering, days to 50 % flowering, days to first fruit setting, days to first pod picking and number of pickings, indicating good scope for selection. Association studies revealed that green pod yield per plant was positively and significantly associated with pod length, pod weight and number of grains per pod. The result suggested that these traits could be considered as major yield contributing traits in garden pea.

Key words: Garden pea, genetic variability, heritability, genetic advance, character association.

Introduction

Pea (Pisum sativum L.) is an important crop grown throughout the world. In India, it is grown mainly as winter vegetable in the plains of North India and as summer vegetable in the hills. Pea is used as fresh vegetable, canned, processed or dehydrated and seeds are consumed as pulse. Green pods are highly nutritive, containing high percentage of digestible protein (7.2%), carbohydrates (19.8%) and minerals (0.8%) (Aykroyd, 1963). Genetic variability plays an important role in selecting best genotypes for making rapid improvement in yield and other desirable characters. Heritability is an index for calculating the relative influence of environment on expression of genotypes. The expected genetic advance is important to have an idea of effectiveness of selection. Estimates of heritability together with genetic advance predict the expected progress to be achieved through selection. Correlation coefficient is a statistical measure, which is used to find out the degree and direction of relationship between two or more variables, it also measures the mutual relationship between various plant characters and determines the component characters on which selection can be exercised for genetic improvement in yield. Keeping in view the study was conducted to find out the extent of variability, heritability, genetic advance and character association for yield and its contributing traits in garden pea.

Materials and methods

The present investigation was carried out at Experimental farm, Department of Horticulture, S.K.N. College of Agriculture, Jobner, Rajasthan during *rabi* 2009–10. The experimental material consisted of twenty diverse pea genotypes namely, VRP-5, VRP-6, VRP-7, VRP-22, AP-1, VRP-343, VRP-90, VRP-216, VRP-158, VRP-238, VRP-147, VRP-16, AP-3, Arkel, VRP-179, VRP-135, VRP-219, VRP-330, VRP-138 and EC-9126. Experiment was laid out in randomized block design with three replications. The pea seeds were sown at a spacing of 30 cm x 10 cm. Recommended agronomic practices and plant protection measures were followed to maintain optimum plant stand. The observations were recorded on five randomly selected competitive plants from each plot in every replication for plant height (cm), days to first flowering, days to 50 % flowering, days to first fruit setting, days to first pod picking, number of pods per plant, pod length (cm), pod weight (g), number of grains per pod, number of pickings, pod yield per plant (g), pod yield per hectare (q), TSS of green seeds (%) and protein content in pods (%) (A.O.A.C., 1960). The data were averaged and statistically analyzed for analysis of variance as per the method suggested by Panse and Sukhatme (1995). The genotypic and phenotypic coefficients of variation were worked out as per the method suggested by Burton and De Vane (1953). The heritability in broad sense and expected genetic advance were worked out using formulae of Hanson *et al.* (1956) and Johnson *et al.* (1955). The genotypic and phenotypic correlation coefficients were calculated from the

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genotypic and phenotypic covariances and variances as described by Singh and Choudhary (1977) and as per formula given by Johnson *et al.* (1955).

Result and discussion

The analysis of variance (Table 1) 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 extent of genotypic variability indicated the amenability of a given character for its improvement (Burton, 1952). Estimates of phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability (h²) in broad sense and genetic advance as percentage of mean for various characters are presented in table 1. The phenotypic coefficients of variation (PCV) were higher than the respective genotypic coefficients of variation (GCV) for all the characters which indicated the positive effect of environment in enhancing differences among the genotypes at phenotypic level. Phenotypic coefficient of variation (PCV) was highest for plant height (31.87%) followed by days to 50 per cent flowering (24.13%), days to first flowering (21.32%), days to first fruit setting (21.24%), pod weight (16.72%), number of pods per plant (16.42%) and days to first pod picking (15.25%) whereas, minimum value of PCV was recorded for protein content in pods (6.29%). The genotypic coefficient of variation (GCV) for plant height was maximum (30.18%), followed by days to 50 per cent flowering (23.88%), days to first flowering (20.97%), days to first fruit setting (20.94%) and days to first pod picking (15.05%) while, it was lowest for protein content in pods (4.30%). Similar results were earlier reported by Sureja and Sharma (2000) and Sardana *et al.* (2007).

High heritability (>75%) along with high genetic advance (>45%) was observed for plant height (89.65, 57.92%) and days to 50% flowering (97.94, 47.90%). Whereas, high heritability coupled with moderate genetic advance was recorded for days to first fruit setting (97.23, 41.86%), days to first flowering (96.74, 41.80%), days to first pod picking (97.40, 30.08%) and number of pickings (93.47, 28.04%). Low heritability and low genetic advance were recorded for number of grains per pod (46.23, 9.95%) and protein content (46.66, 5.97%) in the pod (Table 1). High heritability and moderate to high genetic advance for plant height, days to 50 per cent flowering, days to first fruit setting, days to first pod picking, days to first flowering and number of pickings indicated that effect of environment in expression of these traits was negligible as these traits were governed by additive gene action. Thus, these traits respond to selection owing to their high genetic variability and transmissibility. Low heritability coupled with low genetic advance was recorded for number of grains per pod and protein content in the pod indicated that expression of these traits significantly influenced by environment because, these traits were governed by non-additive gene action. These results were in close conformity with the earlier findings of Gupta *et al.* (2006), Sardana *et al.* (2007) and Sharma *et al.* (2007).

The correlation studies revealed that in general

estimates of genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients, which indicated a strong inherent association among different traits under study (Table 2). The lower phenotypic values might be due to environmental interactions. A significant positive association of pod yield per plant was observed with pod weight (0.469), pod length (0.395) and number of grains per pod (0.392) at phenotypic level and with number of grains per pod (0.763), pod length (0.663), pod weight (0.542) and number of pickings (0.376) at genotypic level, which, suggested that these characters could be considered as major green pod yield contributing characters in pea. Similar results were earlier obtained by Chaudhary and Sharma (2003), Sureja and Sharma (2004), Choudhary *et al.* (2004) and Nawab *et al.* (2008). Pod yield per plant registered significant and negative correlation with days to first flowering (-0.326) and days to first pod picking (-0.369), which, indicated that selection should be practiced for less days to flowering and first fruit setting (earliness). The results were in accordance with Chaudhary and Sharma (2003), Choudhary *et al.* (2004) and Sureja and Sharma (2004).

The present investigation revealed that wide variability existed for different morphological traits in the germplasm of pea. High heritability coupled with high genetic advance was noticed through plant height and days to 50% flowerings, suggesting that these characters could be considered reliable indices for selection, to enhance the pod yield. Correlation studies revealed that pod yield was significantly and positively associated with pod weight, pod length and number of grains per pod. Similarly a significant and negative association of pod yield was observed with days to first fruit setting and days to first flowering, which suggested that for these traits will help for improvement in pod yield in garden pea. The negative association for these two traits with pod yield suggested that selection for earliness should be practiced to improve the yield.

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Table 1. ANOVA, Mean range, genotypic and phenotypic coefficient of variation, heritability (bs) and genetic advance as percentage of mean for different characters in pea

Characters	Replication df	Genotypes df	Error df	Mean	Range	SEm±	Variance Genotypic	Variance Phenotypic	Coefficient of variation Genotypic	Coefficient of variation Phenotypic	Heritability in broad sense (%)	GA	GA as % of mean
PH	45.298	2996.769**	68.413	91.71	60.47-182.67	5.43	765.11	854.53	30.18	31.87	89.65	53.11	57.92
DFF	3.06	240.61**	2.655	42.47	32.33-62.00	0.94	79.31	81.98	20.97	21.32	96.74	17.74	41.80
50%F	5.776	424.255**	2.944	49.62	35.33-68.33	0.99	140.43	143.38	23.88	24.13	97.94	23.76	47.90
DFFS	5.0	381.705**	3.578	53.60	40.67-71.67	1.09	126.04	129.62	20.94	21.24	97.23	22.43	41.86
DFFP	0.516	319.062**	2.814	68.22	53.67-84.00	0.97	105.41	108.23	15.05	15.25	97.40	20.51	30.08
P/P	2.616	7.677**	1.082	11.04	8.93-16.07	0.60	2.19	3.28	13.42	16.42	66.76	2.48	22.52
PL	0.0086	1.166**	0.202	8.47	7.13-9.27	0.26	0.30	0.50	6.52	8.40	60.14	0.86	10.25
PW	0.253	1.541**	0.198	4.81	3.50-6.17	0.26	0.44	0.64	13.91	16.72	69.25	1.13	23.64
GP	0.151	1.197**	0.334	7.46	6.23-8.40	0.33	0.28	0.62	7.19	10.57	46.23	0.74	9.95
Pickings	0.0166	0.732**	0.0166	3.42	3.00-4.00	0.07	0.23	0.25	14.29	14.78	93.47	0.95	28.04
Y/P	12.712	49.988*	10.307	45.95	40.41-52.87	1.85	13.22	23.53	7.91	10.55	56.20	5.57	12.13
Y/ha	52.777	231.856**	44.046	95.06	79.21-110.12	3.83	62.61	106.66	8.32	10.86	58.70	12.38	13.03
TSS	1.023	19.0295**	2.430	23.39	19.63-28.50	0.90	5.53	7.96	10.05	12.06	69.48	3.97	17.02
Protein	0.0281	0.466**	0.136	8.06	7.26-8.85	0.21	0.12	0.25	4.30	6.29	46.66	0.48	5.97

PH= Plant height (cm), DFF = Days to first flowering, 50%F=Days to 50% flowering, DFFS=Days to first fruit setting, DFFP= Days to first pod picking, P/P= Number of pods per plant, PL= Pod length (cm), PW=Pod weight (g), GP= Number of grains/pod, Pickings=Number of pickings, Y/P=Yield/plant (g), Y/ha=Yield/hectare (q), Protein=Protein content in pods (%), TSS=T.SS of green seeds (%)

Table 2. Phenotypic correlation coefficients (upper diagonal) and genotypic correlation coefficients (lower diagonal) between different traits in pea

S. No.	Traits	PH	DFF	50% F	DFFS	DFPP	P/P	PL	PW	G/P	Picking	TSS	Protein	Y/P	Y/ha
1	PH	1.000	0.559**	0.657**	0.631**	0.712**	0.739**	-0.477**	-0.649**	-0.265	-0.602**	0.435**	-0.136	-0.096	-0.039
2	DFF	0.597	1.000	0.933**	0.896**	0.944**	0.274	-0.200	-0.483**	-0.0811	-0.699**	0.3643*	0.221	-0.326*	-0.251
3	50% F	0.694	0.935	1.000	0.961**	0.953**	0.437**	-0.299	-0.594**	-0.142	-0.614**	0.324*	0.166	-0.318	-0.243
4	DFFS	0.686	0.912	0.977	1.000	0.936**	0.471**	-0.349*	-0.649**	-0.220	-0.665**	0.437**	0.136	-0.369*	-0.292*
5	DFPP	0.751	0.949	0.955	0.951	1.000	0.459**	-0.304	-0.595**	-0.1159	-0.759**	0.438**	0.130	-0.271	-0.182
6	P/P	0.933	0.364	0.561	0.573	0.5782	1.000	0.517**	-0.785**	-0.345*	-0.380*	0.342*	-0.182	0.070	0.106
7	PL	-0.666	-0.293	-0.415	-0.499	-0.421	-0.779	1.000	0.602**	0.664**	0.318	-0.259	0.342*	0.395*	0.366*
8	PW	-0.828	-0.601	-0.739	-0.791	-0.734	-0.835	0.966	1.000	0.488**	0.4758**	-0.368*	0.177	0.469**	0.438**
9	G/P	-0.475	-0.140	-0.236	-0.351	-0.195	-0.527	0.815	0.776	1.000	0.225	-0.306	0.182	0.393*	0.400*
10	Picking	-0.664	-0.735	-0.643	-0.693	-0.792	-0.421	0.363	0.587	0.285	1.000	-0.632**	0.102	0.246	0.164
11	TSS	0.583	0.454	0.397	0.528	0.543	0.506	-0.325	-0.576	-0.419	0.745	1.000	-0.013	-0.151	-0.100
12	Protein	-0.255	0.308	0.216	0.194	0.172	-0.163	0.517	0.168	0.231	-0.092	-0.065	1.000	0.234	0.246
13	Y/P	-0.211	-0.488	-0.440	-0.511	-0.378	-0.017	0.664	0.542	0.764	0.377	-0.271	0.296	1.000	0.986**
14	Y/ha	-0.125	-0.329	-0.331	-0.398	-0.252	0.043	0.599	0.485	0.760	0.257	-0.188	0.310	0.977	1.000

PH = Plant height (cm). DFF = Days taken to first flowering, 50% F = Days to 50% flowering. DFFS = Days to first fruit setting. DFPP = Days to first pod picking. P/P = Number of pods/plant. PL = Pod length (cm). PW = Pod weight (g). G/P = Number of grains/pod. Pickings = Number of pickings. Y/P = Yield/plant (g). Y/ha = Yield/hectare (q). TSS = T.S.S. of green seeds (%). Protein = Protein content in pods (%).

** Significant at P = 0.01 level of significance
* Significant at P = 0.05 level of significance