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Correlation coefficient and genetic divergence analysis in pea

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ABSTRACT

The objective of the present study was to ascertain correlation, path coefficient and genetic divergence of different traits among the strains for their utilization in crop improvement programs. Days to first flower and seed yield showed the highest positive and significant correlation with seed yield, length of internodes, days to first green pod harvest, number of primary branches, length of pods, breadth of pods, number of seeds per pod, number of pods per plant, pod yield per plant. All the 12 strains were grouped into 4 clusters. Cluster I retained the maximum number of genotypes while cluster II and cluster III also had 3 genotypes of each and while cluster IV each accommodated only one genotype. The maximum value of inter cluster distance was observed for cluster I. Cluster IV showed the maximum value of cluster mean for length of pods, breadth of pods, number of seeds/pod, number of pods/plant, pod yield per plant, seed yield per plant and shelling percent. This cluster consist of only one genotype i.e. PSM-3. This strain is, thus, suitable for creating much variability for these characters in further hybridization programme.

Key words: Pea, correlation, path coefficient analysis, diversity.

INTRODUCTION

The knowledge of correlation among different traits and their partitioning into direct and indirect effects is one of approaches to understand nature and extent of such relationship. The possibility of improvement in any crop is measured by variability available in the crop. Hence, it is essential to partition overall variability into its heritable and non-heritable components with the help of genetic parameters like genetic coefficient of variation, heritability and genetic advance. Significant association between different traits were reported by Ramesh and Tewatia (11) and Chaudhary (5) whereas Chaudhary and Sharma (4) reported direct and indirect effects for different traits in peas. Therefore, the present investigation was undertaken at Horticultural Research Centre, HNB Garhwal University, Uttarakhand, India to collect the information on the character association and path coefficient for yield and its contributing characters in pea.

MATERIALS AND METHODS

The experimental materials constituted a germplasm collection of 12 varieties of pea (*Pisum sativum* L.) collected from different sources. The experiment was conducted in Rabi season, 2008-09 at Horticultural Research Centre, H.N.B. Garhwal University, Srinagar Garhwal, Uttarakhand (India) in Randomized Block Design which was replicated thrice. The entire experimental field was divided into three blocks of equal size and each block possessed 12 plots. Each plot measured 3 x 2 m^2 area. The varieties were seeded with a row-to-row distance of 45 cm and plant-to-plant distance of 30 cm. All the recommended agronomic practices were followed to raise a healthy crop. Observations were recorded on quantitative traits *viz.* days to 50% flowering, days to first green pod harvest, primary branches/plant, plant height, pod length, pods/plant, seeds/pod, seed yield/plant, protein contains breadth of pod, length of internodes, shelling percent and 100-seed weight on five randomly selected plants. The data obtained from selected plants were subjected to analysis of genotypic and phenotypic coefficients of variability, correlation and path coefficient analysis.

RESULTS AND DISCUSSION

In the present study the estimates of genotypic correlation coefficient were found higher than phenotypic correlation. Study of association revealed positive and strong correlation of seed yield with days to first flower,

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length of internodes, days to first green pod harvest, number of primary branch, length of pod, breadth of pod, number of seed per pod, number of pod per plant and pod yield per plant at genotypic level which supports the findings of Ali and Tufail (2), Pundir *et al*. (10), Kumar *et al*. (9), Singh & Pathak (14), Sharma & Talukdar (13), Byregowada *et al.* (3).The number of primary branch showed negative correlation with seed yield reflecting that selection for these traits would not be effective for the improvement of yield which is similar as discussed by Chowdhury (5). Interrelationship studies among yield contributing characters revealed that, days to first flower was found to be highly and positively associated with days to first green pod harvest both at genotypic and phenotypic level. Similar finding was also observed by Sharma & Talukdar (13), Yaqoob *et al*. (17). Days to flower showed positive but weak association with length of internodes, number of primary branch, number of pods per plant, plant height and protein contain. This suggested that these components traits had not played vital role in improvement of seed yield. Findings are in line with those of Chowdhury and Sharma. (4). Length of internodes showed and strong association with number of primary branch, number of pods per plant, pod yield per plant, seed yield per plant & plant height. On the other hand length of internodes showed negative and weak association with length of pod, breadth of pod, number of seed per pod, 100 seed weight & shelling percent. These could be understood that length of internodes reduce length of pod, breadth of pod, number of seed per pod, 100 seed weight & shelling percent. Similar finding was discussed earlier by Chowdhury (5) & Pundir *et al.* (10). The genotypic association of breadth of pod, number of seeds per pod, 100 seed weight and shelling percent found to be highly positive, while the association of number of pods per plant was found to be negative and strong. Number of primary branches having negative and weak association with length of pod, breadth of pod, number of seeds per pod, pod yield per plant, 100 seed weight & shelling percent. This could be understood that primary branches reduce length of pod, breadth of pod, number of seed per pod, pod yield per plant, 100 seed weight & shelling percent. While number of primary branch have positive but weak association with plant height. This suggested that more number of primary branches would give rise to more yields. These results are in line with those of Chowdhury and Sharma. (4) and Pundir *et al*. (10). Length of pod showed positive but weak association with breadth of pod, number of seeds per pod, pod yield per plant, 100 seed weight and shelling percent, revealed that more number of length of pod will attain, upto some extent, more number of breadth of pod, number of seeds per pod, pod yield per plant, 100 seed weight and shelling percent. Length of pod had negative and weak association with number of pods per plant and plant height. Breadth of pod showed positive but weak association with number of seeds per pod, pod yield per plant, 100 seed weight and shelling percent. Number of seed per pod showed positive association with pod yield. These findings are also in agreement with those of Chowdhury (5) in garden pea. The association of number of seed per pod and pod yield per plant was found to be highly correlated with protein contain at genotypic level. Similar results were also obtained by Trung & Yashida (16), Akhilesh *et al*. (1) and Chowdhury (5). Number of pod per plant showed positive but weak association with plant height. These findings are earlier reported by Singh *et al*. (15), Khan & Ahmad (8), Pundir *et al*. (10). Plant height was found to be highly correlated with protein contain at genotypic level. But had negative and weak association with 100 seed weight and shelling (%). It could be understood that taller plant type would attain late flowering with more number of secondary branches. Similar findings were discussed earlier by Chowdhury and Sharma. (4) and Pundir *et al*. (10). 100 seed weight, showed positive but weak association with shelling percent. While 100 seed weight showed negative and strong association with protein contain at genotypic level which support the report of Pundir *et al*. (10), Kumar *et al*. (9). Shelling percent showed negative and strong association with protein contain at genotypic level. At the phenotypic level positive and non significant associations of seed yield with days to first flower, number of primary branch, plant height, protein contain, days to first green pod harvest were observed which resulted that these characters are partially useful in breeding programmes for the yield improvement and these characters are also influenced by environmental conditions. A positive and non significant association was also found between days to first flower, days to first green pod harvest, plant height, number of primary branch and protein contain. These characters are useful for the breeding programme.

The path coefficient analysis revealed that genotypic correlation of days to first flower with seed yield was positive. This was primarily due to the positive direct effect along with positive indirect effect via breadth of pod, number of seed per pod and shelling percent. These finding are also in the agreement with those of Yaqoob *et al*. (17). The genotypic correlation of length of internodes and length of pod with seed yield was found positive. Similar finding was also observed by Islam *et al*. (7), Gill *et al*. (6), Akhilesh *et al*. (1), in garden pea.

Table 1. Genotypic and phenotypic for 14 characters in pea

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Days to 1st flower	X	0.627	33.142	0.930	-0.656	-0.870	-0.269	0.639	-0.463	0.328	0.778	-0.805	-.0.986	0.634
		(0.482)	(0.039)**	(0.427)	(-0.586)	(-0.372)	(-0.224)	(0.431)	(-0.178)	(0.228)	(0.534)	(-0.303)	(-0.758)	(0.104)
Length of internodes (cm)		X	-10.873	0.340	-0.312	-0.484	-0.133	0.684	0.031	0.791	0.958	-0.045	-0.895	22.892
			(-0.064)**	(0.060)	(-0.159)	(-0.070)	(-0.062)	(0.452)	(0.195)	(0.523)	(0.903)	(0.141)	(-0.577)	(-0.016)**
Days to 1st green pod harvest			X	-	0.765	36.630	8.603	-5.279	0.697	73.795	-13.483	39.532	22.905	-
				(0.152)	(-0.131)	(0.089)**	(0.047)**	(0.238)**	(0.017)	(0.075)**	(0.019)**	(-0.308)**	(-0.204)**	(0.071)
No. of primary branch				X	-0.664	-0.536	-0.508	0.196	-0.884	-0.290	0.465	-0.394	-0.805	-27.248
					(-0.518)	(-0.181)	(-0.217)	(0.314)	(0.240)	(-0.082)	(0.128)	(-0.314)	(-0.292)	(0.333**)
Length of pod (cm)					X	0.975	0.818	-0.994	0.637	0.080	-0.579	0.364	0.683	40.189
						(0.514)	(0.690)	(-0.552)	(0.403)	(0.151)	(-0.387)	(0.382)	(0.524)	(0.029)**
Breadth of pod (cm)						X	0.580	-0.507	1.365	0.426	-0.890	0.748	0.965	5.806
							(0.159)	(-0.249)	(0.313)	(-0.068)	(-0.186)	(0.383)	(0.499)	(-0.022)**
No. of seeds/pod							X	-0.675	0.565	0.375	-0.304	-0.383	0.270	62.340
								(-0.360)	(0.283)	(0.328)	(-0.255)	(-0.088)	(0.108)	(0.213)**
No. of pods/plant								X	-0.280	0.338	0.966	-0.478	-0.678	-47.804
									(0.405)	(0.509)	(0.539)	(-0.117)	(-0.372)	(0.064)**
Pod yield/plant (g)									X	0.717	-0.030	-0.054	0.467	5.257
										(0.741)	(0.082)	(0.412)	(0.302)	(-0.085)**
Seed yield/plant (g)										X	0.844	-0.478	-0.387	34.706
											(0.400)	(0.200)	(-0.313)	(-0.070)**
Plant height in (cm)											X	-0.208	-1.014	11.157
												(-0.055)	(-0.577)	(0.030)**
100 seed weight (g)												X	0.379	-41.071
													(0.369)	(-0.258)**
Shelling (%)													X	-13.956
														(-0.051)**
Protein contain (%)														X

1. Days to 1st flower, 2. Length of internodes (cm), 3. Days to 1st green pod harvest, 4. No. of primary branch, 5. Length of pod (cm), 6. Breadth of pod (cm), 7. No. of seeds/pod, 8. No. of pods/plant, 9. Pod yield/plant (g), 10. Seed yield/plant (g), 11. Plant height in (cm), 12. 100 seed weight (g), 13. Shelling (%), 14. Protein contain (%)

Table 2. Direct and indirect effects on main diagonal.

Characters	1	2	3	4	5	6	7	8	9	10	11	12
Day to 1st flower	0.410	-0.650	-0.196	-0.381	0.076	0.019	0.074	-0.449	0.804	-0.128	0.747	0.328
Length of internodes	0.257	-1.035	-0.072	-0.181	0.042	0.010	0.080	0.030	0.991	-o.007	0.678	0.791
No. of primary branch	0.381	-0.352	-0.211	-0.386	0.047	0.037	0.023	-0.856	0.480	-0.062	0.609	-0.290
Length of pod in cm	-0.269	0.323	0.140	0.581	-0.085	-0.059	-0.110	0.617	-0.598	0.058	-0.517	0.080
Breath of pod cm	-0.357	0.501	0.113	0.567	-0.088	-0.042	-0.059	1.323	-0.920	0.118	-0.730	0.426
No. of seed/ pod	-0.110	0.137	0.107	0.475	-0.051	-0.072	-0.079	0.547	-0.314	-0.061	-0.204	0.375
No. of pod/plant	0.262	-0.708	-0.041	-0.549	0.044	0.049	0.116	-0.271	0.999	-0.076	0.513	0.338
Pod yield per plant	-0.190	-0.032	0.186	0.370	-0.120	-0.041	-0.033	0.969	-0.031	-0.009	-0.354	0.717
Plant height	0.319	-0.992	-0.098	-0.336	0.078	0.022	0.112	-0.029	1.034	-0.033	0.767	0.844
100 seed-weight	-0.330	0.047	0.083	0.211	-0.065	0.028	-0.056	-0.053	-0.215	0.158	-0.287	-0.478
Selling %	-0.404	0.927	0.169	0.397	-0.084	-0.020	-0.079	0.452	-1.048	0.060	-0.757	-0.387

1. Day to 1stflower, 2. Length of internode, 3. No. of primary branch, 4. Lengthof pod in cm, 5. Breathof pod cm, 6. No. of seed/ pod, 7. No. of pod/plant, 8. Pod Yield per plant, 9. Plant height, 10. 100 seed- weight, 11. Selling %, 12. Seed yield/plant

Table 3. Cluster mean of four clusters in pea.

Cluster	Characters													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
I	64.54	7.23	121.19	2.87	7.35	1.54	5.46	41.34	92.08	49.31	101.33	17.76	43.66	8.49
II	75.66	7.17	127.77	2.99	6.87	1.48	5.55	50.46	91.35	57.00	112.40	15.98	38.27	8.44
III	58.99	5.24	122.77	2.77	8.08	1.51	5.85	35.35	92.51	46.33	71.88	16.37	48.75	8.41
IV	59	6.53	127	1.86	8.94	1.58	6.98	5186	147.43	70.8	93.06	15.28	49.59	6.89
CV %	12.17	14.13	2.57	19.68	11.56	2.80	11.75	17.46	26.20	19.56	18.10	6.39	11.61	9.67

1. Days to 1st flower, 2. Length of internodes (cm), 3. Days to 1st green pod harvest, 4. No. of primary branch, 5. Length of pod (cm), 6. Breadth of pod (cm), 7. No. of seeds/pod, 8. No. of pods/plant, 9. Pod yield/plant (g), 10. Seed yield/plant (g), 11. Plant height in (cm), 12. 100 seed weight (g), 13. Shelling (%), 14. Protein contain (%)

Positive genotypic correlation was found in number of seed per pod, number of pod per plant, pod yield per plant with seed yield due to the positive direct effect along with positive indirect effect. Similar observation was discussed earlier by Chowdhury (5), Singh *et al*. (15), Khan & Ahmad (8), Byregowada *et al*. (3), Sabaghpour *et al*. (12), Islam *et al.* (7). The genotypic correlation of plant height with seed yield revealed positive. This was primarily due to the positive direct effect along with positive indirect effect via days to first flower, breadth of pod, number of seed per pod, number of pod per plant and shelling percent which supports the report of Singh *et al*. (15), Sharma & Talukdar (13), Islam *et al*. (7), Akhilesh *et al*. (1) in garden pea. The positive genotypic correlation of 100 seed weight and shelling percent with seed yield was due to direct effect along with positive indirect effect via length of internodes, number of primary branch, length of pod and number of seed per pod. These finding are in agreement with those of Singh *et al*. (15), Sharma & Talukdar (13), Islam *et al*. (7).

The computed D^2 values ranged highly showing high divergence among the different genotypes. All the 12 genotypes accommodated in 4 clusters showed that genotypes within a cluster had smaller D^2 values among themselves than those belonging to two different clusters. Cluster I was largest cluster containing 5 genotypes, followed by cluster II, III and IV. Cluster II had 3 genotypes, cluster III also 3 genotypes and cluster IV containing single genotype were most divergent. Intra cluster distances ranged from 0.00 to 8.51 while inter cluster distances ranged from 9.79 to 12.39. The minimum distance (9.79) was occurred between cluster III. The maximum distance was highest (12.39) between cluster I. A comparison of cluster mean for different characters showed considerable differences between the clusters. Cluster IV showed the highest mean value for length of pod, breadth of pod, number of seeds per pod, number of pods per plant, pod yield per plant, seed yield per plant, shelling percent and lowest value for number of primary branch, 100 seed weight and protein contain percent. Maximum mean value for days to first flower, days to first green pod harvest, number of primary branch and plant height was revealed by cluster II. Cluster I had maximum length of internodes, 100 seed weight & protein contain percent. Among the characters studied, length of pod, breadth of pod, number of seed per pod, number of pods per plant, pod yield per plant, seed yield per plant and shelling percent gave enough indication of the maximum genetic distance which could be used as

Table 4. Distribution of 12 strains/varieties in different clusters

Cluster	Strains/variety	Number
I	P-1542 DDR-27 DMR-7 SWEET PEA DDR-55	5
II	DDR-80 RACHANA DDR-44	3
III	DDR-23 Arkel KPMR 522	3
IV	PSM-3	1

Table 5. Average intra and inter cluster D^2 values

Cluster	Average inter and intra cluster distance D=(/D^2) Parenthesis			
	I	II	III	IV
I	153.46 (12.39)	124.95 (11.18)	129.48 (11.38)	136.38 (11.68)
II		109.34 (10.45)	139.84 (11.82)	117.84 (10.85)
III			95.97 (9.79)	72.53 (8.51)
IV				0.00 (0.00)

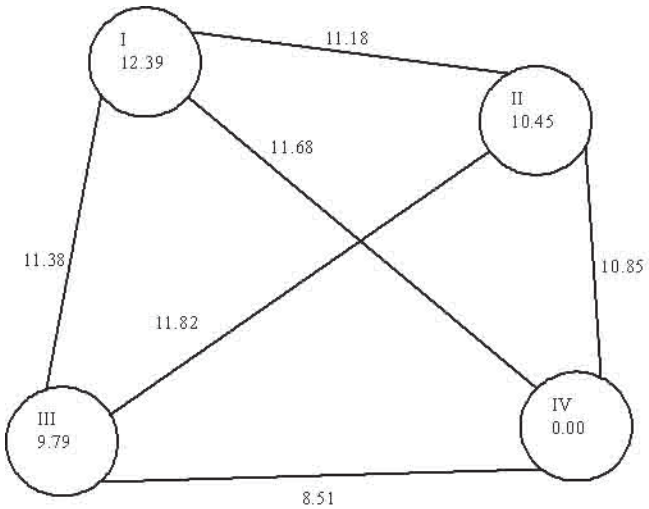

Fig. 1. Cluster Diagram

parameters in selecting genetically diverse parents for hybridization programme. The coefficient and path analysis indicated that maximum emphasis should be given to characters days to first flower, days to first green pod harvest, plant height and number of primary branch at the time of selection. Genetic divergence revealed that parents for hybridization can be selected from the cluster I crosses between the strain of cluster IV and cluster I content maximum diversity in next generation, seed yield per plant is a best contributor for divergence.

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