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Short Communication

Relationships between yield and some yield components in Pea (*Pisum sativum* ssp arvense L.) genotypes by using correlation and path analysis

Necat Togay*, Yesim Togay, Bunyamin Yildirim and Yusuf Dogan

Yüzüncü Yıl University, Faculty of Agriculture, Department of Field Crops, 65080, Van, Turkey.

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This research was carried out Yuzuncu Yil University, Agricultural Faculty experimental field in 2002-03 and 2003-04. The experiment was conducted to determine the relationship among yield and some yield components using correlation and path coefficient analysis. In the experiment 12 pea genotypes were used. The experiment was designed randomized complete blocks design with four replications. At the end of the study, positive and significant relationship were found among seed yield and pods per plant and biological yield in both years. The strongest and direct positive effects were the biological yield (p = 0.6500), numbers of pods per plant (p = 0.3137) and the seed yield. These were followed by first pod height (p = 0.2398) and number of seeds per pod (p = 0.2227).

Key words: Pea, path coefficient, correlation, yield, yield components.

INTRODUCTION

Pea is an important plant in human and animal nutrition because of its high protein level (23 - 33%) (Cousin et al., 1985). The main aim of growing pea is to obtain abundant robust product. Pea is cultivated for a lot of purpose. Pea grains are eaten fresh or processed as canned food. Sugar rate of pea grains is high. Dry pea grains are broken and used to make soup. On the other hand, the pea grains are used in animal feed.

Some pea varieties are used for the purpose of green forage production, dry forage and green manure production. These varieties are called ‘feed peas’. Nutrition values of dry pea grains (%) are higher than green pea grains. Pea is a cool climate plant and its potential is high in Turkey. If adequate pea varieties are reconsidered pea exportation will be possible (Alan, 1984).

The path coefficient analysis initially suggested by Wright (1921) and described by Dewey and Lu (1959) allows partitioning of correlation coefficient into direct and indirect effects of various traits towards dependent variable and thus helps in assessing the cause effect relationship as well as effective selection.

Path coefficient analyses usually correlates coefficients into direct and indirect effects of various yield components, based on the assumption of mutual relationships among yield components. Statistically, path coefficient is a standardized partial-regression coefficient, obtained from equations, where the yield-related variables are expressed as deviations from the means in units of standard deviation (Steel and Torrie, 1982). In these analyses, seed yield and yield components are regarded as a system of interrelated variables, with yield components considered at the same ontogenetic level. The objectives of the present research were to determine the relative importance of various yield components to final seed yield of field pea grown under conventional summerfallow and no-till wheat stubble in a semiarid environment and to assess the relationships among seed yield, yield components and the length of vegetative and reproductive growth periods of field pea using path coefficient analysis.

MATERIALS AND METHODS

This study was carried out in winter seasons during 2002-03 and 2003-04 in Van ecological conditions (longitude 43o 17´E´, latitude 38o 33´N´, and altitude 1725 m). Long period average precipitation is 385.7 mm, average temperature is 9°C. Relating to 2002-2003

*Corresponding author. E-mail: necattogay@hotmail.com. Tel: +90432-2251794. Fax: +904322251119.

Table 1. Climatic data of Van in 2002-2003 and 2003-2004 and long term.

Month	Precipitation (mm)			Average temperature (°C)			Relative humidity (%)		
	02-03	03-04	Long term	02-03	03-04	Long term	02-03	03-04	Long term
September	6.4	16.4	13.0	18.1	17.0	17.2	48.6	64.5	44.0
October	58.8	23.6	45.2	12.8	13.0	10.6	63.4	71.0	58.0
November	49.8	59.6	47.9	5.3	4.5	4.4	65.2	74.3	66.0
December	72.9	14.9	37.3	-2.6	0.2	-0.8	69.7	76.7	69.0
January	26.1	25.0	35.4	-1.3	-0.9	-3.6	68.3	78.8	68.0
February	54.5	39.6	32.5	-1.4	-0.6	-3.2	66.3	76.1	69.0
March	83.4	69.9	45.7	0.1	3.7	0.9	71.9	72.3	68.0
April	78.8	26.9	56.6	8.4	6.9	7.4	73.0	66.4	62.0
May	6.4	68.7	45.0	14.5	12.4	13.0	64.2	67.8	56.0
June	50.2	3.1	18.5	18.2	18.5	18.0	61.5	57.8	50.0
July	-	2.0	5.2	23.1	21.4	22.2	53.4	52.7	44.0
August	15.7	-	3.4	22.8	22.2	21.8	56.2	46.5	41.0
Total	503	349.7	385.7						
Average				9.8	9.9	9.0	63.5	67	57

*Taken from the Recording of Meteorological Department in Van (longitude 43°17´E´, latitude 38°33´N´, and altitude 1655 m) (Anonymous 2004).

and 2003-2004 total precipitations are 503 and 349.7. Average relative humidity is 63.5 and 67% in the first and the second vegetation periods (Anonymous, 2004) (Table 1). The soil has sandy loam texture and low organic matter; it has medium phosphorus, rich in potassium and lime content, and is strongly alkaline. The experiment included 12 peas genotypes (101917, 121918, 10431, B 6, 110121, 1101545, 1084222, 1131522, B 8, 1131556, 1103220 and 110121-1). The experiment was a randomized complete blocks design with four replications. There are 48 plots in the trial. Each parcel consists of 6 rows. Parcel area is 5 x 1.5 m = 7.5 m2. One row each was used to separate each of the two sides of the parcel. The plants were at 0.5 m in the beginning and the end of the parcel boundary. 150 kg.ha-1 diammonium phosphate was applied to each parcel (Ceylan and Sepetoğlu, 1979). The data, which consists of 8 different characters, including seed yield, plant height, first pod height, number of branches, number of pods per plant, number of seeds per pod, biological yield and 1000 seed weight were recorded. Data on seed and biological yields of pea were recorded from the whole plot, but the yield components data were recorded from randomly selected 10 plants in each plot.

Phenotypic correlations among traits were calculated in the usual manner and coefficient analysis was carried out according to the method of Dewey and Lu (1959). The path coefficient is known as a standardizing partial regression coefficient and separates the direct and indirect effects of a correlation coefficient.

Thus, the path analysis plays an important role in determining the degree of relationship between yield and yield components.

RESULTS AND DISCUSSION

In the study, simple correlation coefficients calculated among examined characteristics in pea genotypes are given Table 2. Positive significant relationships were found between seed yield and number of branches (r = 0.291*), number of pods per plant (r = 0.621*), biological yield (r = 0.853**) and 1000 seed weight (r = 0.313*). The relationship between seed yield and first pod height (r=-0.275) was significantly negative. However, the relationship between plant height and first pod height was positive (r = 0.831**) but number of branches was significantly negative (r = - 0.312*). The relationship between number of pods per plant and biological yield (r = 0.535 **) and 1000 seed weight (r = 0.381**) was positive and significant, the relationship between number of pods per plant and number of seeds per pod (r = -433**) was significantly negative (Table 2). The relationship between 1000 seed weight and number of seeds per pod was significantly negative (r = -0.638*). Ciftci et al. (2004), Erman et al. (1997) and Akdag and Sehirali (1992) have reported similar results.

The direct and indirect effects of eight examined characters on seed yield were estimated by path coefficient and shown in Table 3. Biological yield had the greatest direct effect on seed yield (p. c = 0.6500). This character was followed by number of pods per plant (p = 0.3137) and first pod height (p = 0.2398), respectively. Plant height (p = -0.3092) showed high negative direct effect on seed yield.

It is shown that, the number of pods per plant had the highest moderate indirect positive effects on seed yield via biological yieid (p = 0.3474), while 1000 seed weight had the highest moderate indirect negative effects on seed yield via number of seeds per pod (p = -0.1421) (Table 3). Similar observations have been made by Akdag and Sehirali (1992), Erman et al. (1997), Cinsoy and Yaman (1998) and Cokkizgin and Colkesen (2007) which confirmed our results.

Conclusion

In conclusion, significant ($p<0.05$) and positive phenotypic correlations were found for seed yield with pods per

Table 2. Correlation coefficients among the characteristics in 12 pea genotypes (r).

S/N	Character	1	2	3	4	5	6	7	8
1	Seed yield (kg ha^{-1})	1.00							
2	Plant height (cm)	-0.204	1.00						
3	First pod height (cm)	-0.275*	0.831**	1.00					
4	Number of branches	0.291*	-0.312*	-0.426**	1.00				
5	Number of pods per plant	0.621**	0.008	-0.060	0.101	1.00			
6	Number of seeds per pod	0.020	-0.058	-0.048	0.057	-0.433**	1.00		
7	Biological yield (kg ha^{-1})	0.853**	-0.056	-0.239	0.265	0.535**	0.052	1.00	
8	1000 seed weight (g)	0.313*	-0.147	-0.247	0.062	0.381**	-0.638**	0.262	1.00

Table 3. Path coefficients for seed yield of pea genotypes.

	Character	Direct effect	Indirect effects							Total effect
			1	2	3	4	5	6	7	
1	Plant height	-0.3092		-0.2569	0.0965	-0.0025	0.0180	0.0173	0.0456	-0.204
2	First pod height	0.2398	0.1993		-0.1022	-0.0145	-0.0116	-0.0573	-0.0594	-0.275*
3	Number of branches	0.0690	-0.0215	-0.0294		-0.0070	0.0040	0.0183	0.0043	0.291*
4	Number of pods/plant	0.3137	0.0025	-0.0189	0.0318		-0.1358	0.1677	0.1195	0.621**
5	Number of seeds/pod	0.2227	-0.0129	-0.0108	0.0128	-0.0964		0.0116	-0.1421	0.020
6	Biological yield	0.6500	-0.0364	-0.0433	0.1725	0.3474	0.0339		0.1700	0.853**
7	1000 Seed weight	0.1749	-0.0258	-0.2008	0.0109	0.0666	-0.1116	0.0457		0.313*

plant and biological yield. The relationship between seed yield and first pod height (r = - 0.275) was significantly negative. A path coefficient analysis, however, showed that number of pods per plant, first pod height, number of seeds per pod and biological yield were the main yield components having maximum direct effects on seed yield. It is concluded that these could be important for selection criteria in pea breeding.

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