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Correlation Studies in Pea (*Pisum sativum* L.)

by

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Grain yield in pea, as in other crops, is a complex character and is dependent on a number of component characters. Direct selection for this complex character is, therefore, often misleading. Hence some indirect methods such as determining the association between other less variable plant characters and yield are adapted. Selection pressure may then be exerted more easily on any of the characters which show close association with yield. Moreover, when a character is influenced by a series of other variables which are variously associated with one another, the estimation of simple correlation coefficients between any two of these does not give a true relationship between them. This suggests the necessity of working out partial correlation coefficients. Previously, total correlations in pea were studied by Singh and Pratap (1968). In the present investigation, the same material was carried forward and partial correlation coefficients were obtained. Further, multiple correlation coefficients between grain yield per plant and the five important independent variables were worked out in order to ascertain the relative importance of these components in grain yield. Partial and multiple correlations have also been studied by Bhatt *et al.* (1968) in soyabeans and by Sangha and by Sandhu (1970) in groundnut.

Material and Methods: Six plant characters *viz.* number of pods per plant, weight of green pods per plant, length of pod, fresh shoot weight per plant, number of leaves per plant and grain yield per plant were studied in respect of a T. 163 variety of pea. Twenty plants were selected at random for statistical analysis. Partial and multiple correlation coefficients were worked out by the formulae as suggested by Croxton and Cowden (1963).

Results: Partial correlation coefficients between grain yield and five important independant variables, keeping one or more component characters constant, were worked out and presented in Table 1.

In general, it has been observed that the true relationship between grain yield per plant and its five component characters tended to decrease when other variables were held constant, individually or collectively, in all possible combinations.

Between grain yield and number of pods per plant, the true relationship decreased when other variables were held constant so much so that when weight of green pods per plant with fresh shoot weight per plant and number of leaves per plant; weight of green pods per plant and length of pod with

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TABLE 1. *Partial Correlation Coefficients*

r_{12}	+.6910**	r_{13}	+.7862**	r_{14}	+.6208**	r_{15}	+.7023**	r_{16}	+.6295**
$r_{12.3}$	+.0057	$r_{13.2}$	+.6401**	$r_{14.2}$	+.5689*	$r_{15.2}$	+.6361**	$r_{16.2}$	+.5276
$r_{12.4}$	+.5197*	$r_{13.4}$	+.6503**	$r_{14.3}$	+.2060	$r_{15.3}$	+.5687**	$r_{16.3}$	+.1097
$r_{12.5}$	+.2800	$r_{13.5}$	+.6160**	$r_{14.5}$	+.1045	$r_{15.4}$	+.5807**	$r_{16.4}$	+.3176*
$r_{12.6}$	+.2017	$r_{13.6}$	+.6179**	$r_{14.6}$	+.5018*	$r_{15.6}$	+.6086**	$r_{16.5}$	+.3911
$r_{12.34}$	+.0797	$r_{13.24}$	+.1600*	$r_{14.23}$	+.2773	$r_{15.23}$	+.6777**	$r_{16.23}$	+.1741
$r_{12.35}$	−.1591	$r_{13.25}$	+.5841**	$r_{14.25}$	+.2080	$r_{15.24}$	+.1810	$r_{16.24}$	+.2250
$r_{12.36}$	−.0692	$r_{13.26}$	+.6905**	$r_{14.26}$	+.5127*	$r_{15.26}$	+.5915*	$r_{16.25}$	+.1658
$r_{12.45}$	+.5110	$r_{13.45}$	+.6961**	$r_{14.35}$	−.0222	$r_{15.34}$	+.5157*	$r_{16.34}$	+.1713
$r_{12.46}$	+.2312	$r_{13.46}$	+.4815*	$r_{14.36}$	−.2183	$r_{15.36}$	+.5505*	$r_{16.35}$	+.0157
$r_{12.56}$	+.1103	$r_{13.56}$	+.5622**	$r_{14.56}$	+.2117	$r_{15.46}$	+.1091	$r_{16.45}$	+.0356
$r_{12.345}$	−.1516	$r_{13.245}$	+.5533*	$r_{14.235}$	−.1011	$r_{15.234}$	+.5516*	$r_{16.234}$	+.1027
$r_{12.346}$	−.0452	$r_{13.246}$	+.4860	$r_{14.236}$	+.2018	$r_{15.236}$	+.56014	$r_{16.235}$	+.0111
$r_{12.356}$	−.1039	$r_{13.256}$	+.6000**	$r_{14.256}$	+.2305	$r_{15.246}$	+.1062	$r_{16.245}$	+.1525
$r_{12.456}$	+.1169	$r_{13.456}$	+.5100*	$r_{14.356}$	−.0158	$r_{15.346}$	+.1936*	$r_{16.345}$	−.0185
$r_{12.3456}$	−.1002	$r_{13.2456}$	+.5111*	$r_{14.2356}$	−.0035	$r_{15.2346}$	+.5193*	$r_{16.2345}$	−.0056

rij. klm = Correlation between ith and jth character keeping kth, lth and mth character constant

* Significant (P=0.05) ** Highly significant (P=0.01)

1 = Grain yield per plant (g)
2 = No. of pods per plant
3 = Weight of green pods per plant (g)
4 = Length of Pod in cm
5 = Fresh shoot weight per plant (g)
6 = No. of leaves per plant

fresh shoot weight per plant and are number of leaves per plant were kept constant, the association became negative, though non-significant.

Between grain yield and weight of green pods per plant or fresh shoot weight per plant, the real association lowered when the componets were allowed for individually or collectively without any effect on the nature of coefficients.

Between grain yield and length of pod, the correlation became negative when weight of green pods per plant and fresh shoot weight per plant and fresh shoot weight per plant with number of pods per plant and or number of leaves per plant were held constant.

Between grain yield per plant and number of leaves per plant, the true association decreased and became negative when weight of green pods per plant and fresh shoot weight per plant alone or with length of pod were kept constant.

Multiple correlation coefficients (Table 2) using the combined effect of number of pods per plant, length of pod, fresh shoot weight of green pods per plant, length of pod, fresh shoot weight per plant and number of leaves per plant were highly significant. The relative contribution to the sum of squares of grain yield by these component characters (as mersured by R^2 values) were also determined and are compared with their corresponding partial correlation coefficients (Table 3).

TABLE 2. *Multiple Correlation Coefficients*

R1 (23)	0.7862**	R1 (234)	0.8047**	R1 (2345)	0.8650**
R1 (24)	0.7425**	R1 (235)	0.8634**	R1 (2346)	0.8098**
R1 (25)	0.7835**	R1 (236)	0.7935**	R1 (2356)	0.8637**
R1 (26)	0.6479**	R1 (245)	0,7974**	R1 (2456)	0.8027**
R1 (34)	0.8032**	R1 (246)	0.7576**	R1 (3456)	0.8603**
R1 (35)	0.8599**	R1 (256)	0.7902**		
R1 (36)	0.7917**	R1 (345)	0.8599**	R1 (23456)	0.8632**
R1 (45)	0.7725**	R1 (346)	0.8096**		
R1 (46)	0.7416**	R1 (356)	0.8608**		
R1 (56)	0.7872**	R1 (456)	0.8031**		

Ri (jkl) = Multiple correlation coefficient showing the combined effect of jth, kth, and lth character towards ith character

** Highly significant (P=0.01)

1 = Grain yield per plant (g)
2 = No. of pods per plant
3 = Weight of green pods per plant (g)
4 = Length of pod (cm)
5 = Fresh shoot weight per plant (g)
6 = No. of leaves per plant

TABLE 3. *Relative contribution of the Five component characters to Grain yield*

Particulars	Contribution	Reduction in relative sum of squares due to eliminated character	Partial correlation coefficients
	Total		
$R1^2$ (23456)	0.7486		
Eliminated character	Relative		
2	0.7401	0.0085	r12.3456= −0.1902
3	0.6444	0.1042	r13.2456= +0.5414*
4	0.7460	0.0026	r14.2356= −0.0993
5	0.6558	0.0928	r15.2346= +0.5193*
6	0.7483	0.0003	r16.2345= +0.0355

Ri^2 (kjklmn) = Contribution of the jth, kth, lth, mth and nth variables towards ith character

* Significant (P=0.05)

1 = Grain yield per plant (g)
2 = No. of pods per plant
3 = Weight of green pods per plant (g)
4 = Length of pod (cm)
5 = Fresh shoot weight per plant (g)
6 = No. of leaves per plant

The total contribution by these five variables to grain yield per plant is $R^2_{1\,(23456)} = 0.7486$. Out of these five variables contributing to grain yield, the contribution of weight of green pods per plant was relatively the maximum, next in order of magnitude were fresh shoot weight per plant, number of plant and length of pod while number of leaves per plant contributed the least. The pattern of contribution by these five variables also is in agreement with partial correlation coefficients.

Discussion: In the present investigation it was found that the true relationship, as determined by partial correlation coefficients, between grain yield and its five components is fairly low, with number of pods per plant, length of pod or number of leaves per plant, there is no real association; but it had positive and significant true relationship with weight of green pods per plant or fresh shoot weight per plant when the effect of all other variables was eliminated collectively.

The study of multiple correlations and the pattern of relative contribution by weight of green pods per plant, fresh shoot weight pea plant were also in agreement with partial correlation values. It showed that weight of green pods per plant is a very important character followed by fresh shoot weight per plant and number of pods per plant. This suggests that while selecting for higher grain yield in pea, more selection pressure may be exerted on weight of green pods per plant, fresh shoot weight per plant and number of pods per plant. Bhatt *et al.* (1968) in soybean and Sangha and Sandhu (1970) in the erect group of groundnut found that pod number is the most important character contributing to yield.

Summary: In a variety of pea, T. 163, it was found that grain yield per plant had positive and highly significant or significant partial correlation with weight of green pods per plant, and fresh shoot weight per plant when all other variables were held constant individually or in all other possible combinations. Multiple correlations indicated that weight of green pods per plant is the most important character contributing to grain yield per plant followed by fresh shoot weight per plant and number of pods per plant indicating thereby that more stress may be laid on these variables if improvement in grain yield is aimed at.

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