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Path-coefficient study in gram

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ABSTRACT

In the winter season of 1971–72, 49 pure strains of gram (*Cicer arietinum* L.) from different parts of the country were grown and their genotypic and phenotypic correlations and path analysis were done for yield and yield components. Correlation and path studies indicated that number of pods/plant and 100-grain weight have larger effect on grain yield than any other component.

Grain yield in gram (*Cicer arietinum* L.) is a complex trait and is a final product of yield components. A successful selection programme depends upon the information on the genetic variability and association of yield components with grain yield. Correlations measure only mutual association, by which it becomes difficult to make out direct and indirect effects of the components. Path-coefficient method helps us in understanding the direct and indirect contribution of each character on yield (Wright, 1921). Hence correlation study aided by path coefficients will be a powerful tool for finding out character associations. The objectives of this investigation were to study (*i*) the association of yield-contributing characters among themselves and with grain yield, and (*ii*) the direct and indirect effects of the characters on yield through path-coefficient analysis in gram (*Cicer arietinum* L.).

MATERIALS AND METHODS

The present investigation was conducted with 49 diverse pure strains of gram obtained from different parts of the country. The experiment was conducted in a simple 7 × 7 lattice design with 2 replications at the Crop Research Centre of the Govind Ballabh Pant University of Agriculture and Technology during the *rabi* (winter) season of 1971–72. Each plot consisted of 5 rows, 30 cm apart and 5 m long. Ten competitive plants were tagged in the middle 3 rows of each plot for observations, and the means of these 10 plants were used for computation. Observations were recorded on plant height, days to flowering (initial), number of branches/plant, number of grains/pod, 100-grain weight and grain yield/plant.

The data were analysed by the randomized-block design as the sub-block differences were not significant. The coefficient of variability and correlation coefficients were computed by using variance and covariance components (Narasimharao and Rachie, 1964). Path coefficients were obtained by solving the simultaneous equation as done by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The analysis of variance showed that gram strains in the study differed significantly for all the characters studied. The range, mean and coefficient of variability for all the characters are presented in Table 1. The maximum genotypic coefficient of variability was in the 100-grain weight, followed by grain yield/plant and number of pods/plant. In all cases the phenotypic coefficient of variability was higher than the genotypic coefficient of variability. Components like the 100-grain weight, days to flowering and num-

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Table 1. Range, mean and coefficient of variability for yield and yield components in gram

Character	Range	Mean±SE	CV (%) Phenotypic	CV (%) Genotypic
Plant height	55·20–94·50	75·55± 5·89	13·16	7·16
Days to flowering	50·60–109·00	90·46± 4·00	16·54	15·31
Branches/plant	3·05–7·90	5·58± 0·88	27·06	15·49
Pods/plant	39·40–163·20	90·08±14·89	33·94	24·59
Grains/pod	1·10–2·00	1·65± 0·08	14·98	13·34
100-grain weight	9·77–36·55	15·56± 0·82	37·21	36·43
Grain yield/plant	8·50–30·55	17·42± 2·88	35·92	27·32

Table 2. Genotypic and phenotypic correlations of yield and yield components in gram

Character	Days to flowering	Branches/plant	Pods/plant	Grains/pod	100-grain weight	Grain yield
Plant height	–0·2168 (–0·0675)	–0·4426 (–0·0976)	–0·4774 (–0·2417)	–0·0390 (–0·0107)	0·1329 (0·1396)	–0·3907 (–0·2481)
Days to flowering		0·8814 (0·4702)	0·3193 (0·2716)	–0·2664 (–0·2131)	0·1781 (0·1635)	0·4271 (0·3226)*
Branches/plant			0·4880 (0·5921)**	–0·1593 (–0·1857)	0·1957 (0·1317)	0·5824 (0·5506)**
Pods/plant				0·1392 (0·0412)	–0·3791 (–0·2534)	0·6820 (0·7571)
Grains/pod					–0·7095 (–0·6065)**	–0·1659 (–0·1427)
100-grain weight						0·2216 (0·1887)

*, **Significant at 5 and 1% levels of probability respectively.

ber of grains/pod had almost similar values of phenotypic and genotypic coefficients of variability, thus indicating that these are less influenced by the environment. Hence, these characters are amenable to considerable improvement through selection. On the contrary, grain yield, number of pods, plant height and number of branches seem to be highly sensitive to environmental changes. Estimates of coefficient of variability for number of pods, days to flowering and plant height are in conformity with those reported by Chandra (1968).

Correlations

In general, genotypic correlations were higher than phenotypic correlations (Table 2). Grain yield had the highest positive and significant correlation with

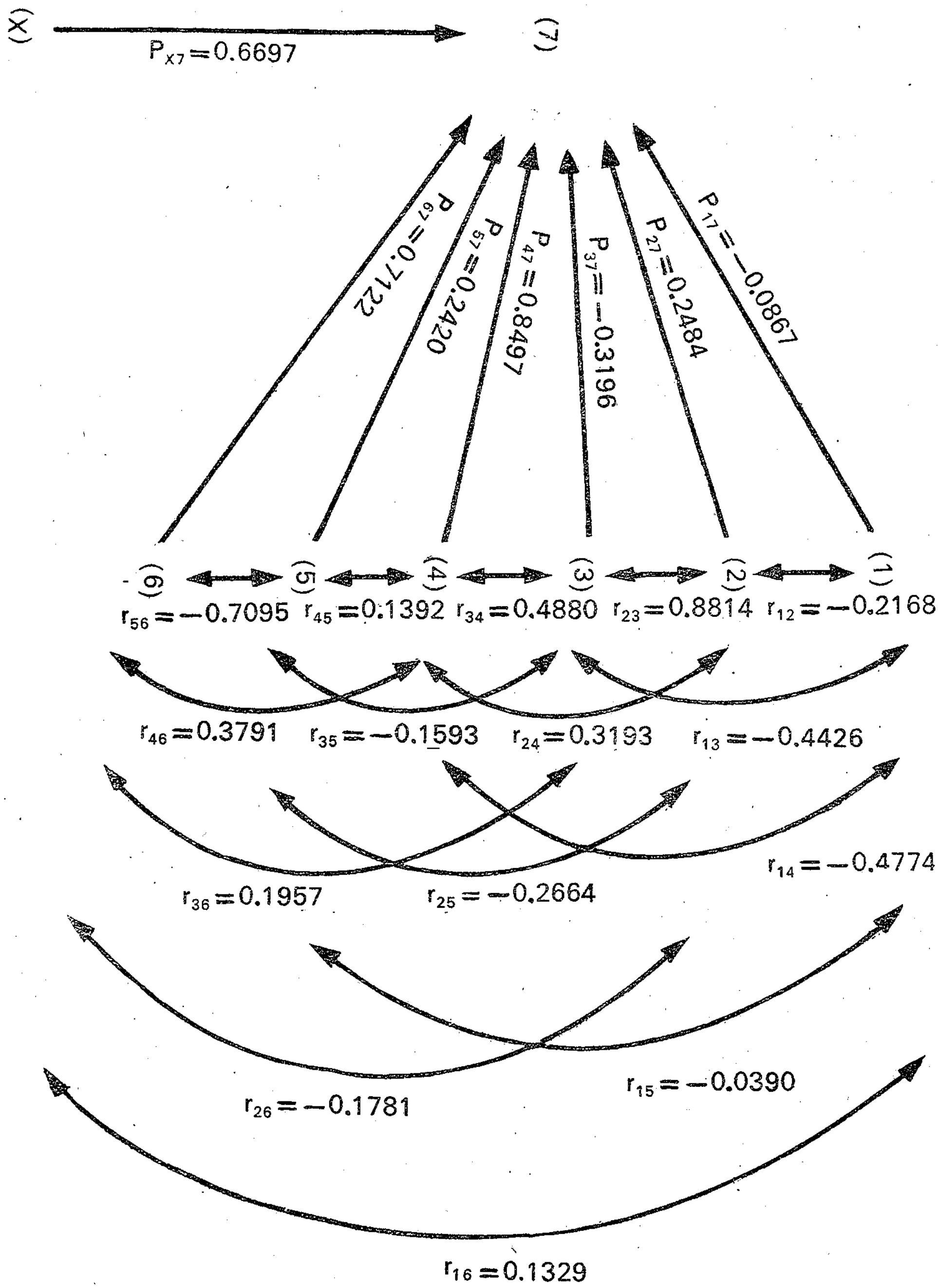

Fig. 1. Diagramatic representation of factors influencing grain yield in gram: 1, plant height; 2, days to flowering; 3, number of branches/plant; 4, number of pods/plant; 5, number of grains/pod; 6, 100-grain weight; 7, grain yield/plant; X, residual factors.

Table 3. Partition of genotypic correlation into direct and indirect effects by path-coefficient analysis in gram

Total correlation of grain yield with	Direct effect	Indirect effect via					
		Plant height	Days to flowering	Branches/ plant	Pods/ plant	Grains/ pod	100-grain weight
Plant height (r= –0·3907)	–0·0867	—	–0·0538	0·1413	–0·4756	–0·0096	0·0937
Days to flowering (r= 0·4271)	0·2484	0·0187	—	0·2016	0·2913	–0·0604	0·1307
Branches/plant (r= 0·5824)	–0·3196	0·0475	0·2389	—	0·4646	–0·0385	0·1895
Pods/plant (r= 0·6820)	0·8497	0·0414	0·0993	–0·1260	—	0·0376	–0·2200
No. of grains/pod (r= –0·1659)	0·2420	0·0034	–0·0662	0·0509	0·1133	—	0·5093
100-grain weight (r= 0·2216)	0·7122	–0·0125	0·0642	–0·0575	–0·3181	–0·1667	—

the number of pods/plant, followed by the number of branches and days to flowering. This is in agreement with the findings of Pimplikar (1945), Khan (1949), Argikar (1960), Baluch and Soomro (1968), Sharma *et al.* (1969) and Phadnis *et al.* (1970). Grain yield was negatively correlated with plant height, and this finding is in conformity with the reports of Phadnis *et al.* (1970) in gram and Kumar *et al.* (1965) in field peas. Grain yield had low positive correlation with the 100-grain weight, but was negatively correlated with the number of grains/pod.

The 100-grain weight had highly significant negative correlation with the number of grains/pod and with the number of pods/plant. Such negative correlations arise primarily from developmentally induced relationships. These developing structures of the plant body compete for a common, possibly limited, nutrient supply, and if one structure is more favourable than the other for any reason, a negative correlation may arise between them (Adams, 1967; Adams and Graffius, 1971). Similar negative correlations were reported by Anand (1962) in soybean, Athwal and Sandha (1967) in gram, and Singh and Singh (1969) in peas. The number of pods/plant had negative correlation with plant height, possibly because excessive vegetative growth may adversely affect the reproductive phase, thereby limiting pod formation. The number of branches and days to flowering were positively correlated, indicating that longer vegetative duration may provide scope for more branches to be produced.

Path analysis

The number of pods/plant had the largest direct effect on grain yield, followed by the 100-grain weight (Fig. 1, Table 3). Plant height had very little negative direct effect on grain yield but had high negative indirect effect via number of pods/plant.

The number of branches had positive correlation with grain yield, but path analysis showed that its direct effect was negative. The positive correlation was because of its positive indirect effects through number of pods/plant and days to flowering. As the number of branches increase, the pods/branch may decrease, but the total number of pods/plant increase; therefore, the direct effect was negative while the indirect effect via number of pods was positive.

The number of grains/pod had high negative effect via 100-grain weight, thus making a net negative correlation though its direct contribution was positive. The 100-grain weight was the second large contributor, but showed low correlation with grain yield because it had negative direct effects through number of pods and number of grains/pod. The residual factor (P × 7) was also high and could not be accounted fairly, suggesting the need for inclusion of more yield components like maturity and number of grains/plant. These results are in line with the reports of Phadnis *et al.* (1970) in gram, Tai (1964) and Chaudhary (1971) in soybean, Singh and Malhotra (1970) and Chandel *et al.* (1973) in greengram. From the selection point of view, analysis of correlation presents a complicated picture. Since the two major yield contributors, viz. pods/plant and 100-grain weight, influence the grain yield negatively via each other, an optimal combination between them, without affecting the total gain, has to be obtained in selection programmes.

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