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BB Dhunde
PG Student, Deptt. of Agril. Botany, College of Agriculture, Dapoli, Maharashtra, India

Dr. JP Devmore
Associate Professor (CAS), Deptt. of Agril. Botany, COA, Dapoli, Maharashtra, India

Dr. SG Mahadik
Associate Professor (CAS), Deptt. of Agril. Botany, COA, Dapoli, Maharashtra, India

MG Palshetkar
Assistant Professor (CAS), Deptt. of Agril. Botany, COA, Dapoli, Maharashtra, India

Dr. PB Vanve
Assistant Rice Specialist, Regional Rice Research Station, Karjat, Maharashtra, India

Dr. SG Bhave
Director of Extension Education, Dr. B. S. K. K. Vidyapeeth, Dapoli, Maharashtra, India

BS Thorat
Ph. D. Scholar, Deptt. of Agril. Botany, College of Agriculture, Dapoli, Maharashtra, India

Corresponding Author:
BB Dhunde
PG Student, Deptt. of Agril. Botany, College of Agriculture, Dapoli, Maharashtra, India

Correlation and path analysis studies on yield and its components in green gram [*Vigna radiata* L. Wilczek]

BB Dhunde, Dr. JP Devmore, Dr. SG Mahadik, MG Palshetkar, Dr. PB Vanve, Dr. SG Bhave and BS Thorat

Abstract
The present investigation was undertaken to estimate the correlation coefficients among twelve quantitative traits and to study the direct and indirect effects of various yield contributing traits on grain yield by path analysis in thirty five mungbean genotypes at educational and research farm, department of agricultural botany, college of agriculture, Dapoli, dist. Ratnagiri (MS), during *rabi*, 2018-19 in a randomized block design with three replications. The results of association study revealed that, grain yield per plant (g) showed highly significant and positive correlation at both genotypic and phenotypic levels with number of branches per plant, number of pods per cluster, number of clusters per plant, number of pods per plant and hundred seed weight (g) whereas it was highly significant and positively associated with days to initiation of flowering, number of grains per pod, plant height, pod length and days to fifty per cent flowering at genotypic level only indicating possibility of simultaneous improvement for these traits. Days to maturity had highly significant but negatively correlated with grain yield per plant at the genotypic level. Path analysis revealed that, number of branches per plant, pod length, plant height, number of pods per cluster and number of pods per plant recorded the highest direct effect at in desirable direction. Their association with grain yield was also significant and positive indicating true and perfect association between these traits. Therefor direct selection for these characters would help in isolating high yielding genotypes from highly segregating population.

Keywords: green gram, genotypic & phenotypic correlation coefficient, path analysis

Introduction
Green gram (*Vigna radiata* L. Wilczek) (2n=22, Leguminosae) is the third most important pulse crop of Asia after chickpea and pigeonpea and widely adapted, highly versatile, drought tolerant, legume crop having ability to improve soil fertility. High protein, easy digestibility and production of low flatulence made this crop more acceptable to the people over world (Prasanna *et al.* 2013). Being rich in nutritional profile, it is an inseparable ingredient in the diets of vast majority of population in the Indian sub continent. However, the average consumption of green gram in India is quite low which creates need for increased productivity in green gram. Grain yield is a complex character and is dependent on number of component characters. Correlation coefficient is an important statistical constant, which indicates the degree and direction of association between yield and its component traits at both genotypic and phenotypic levels. The study of inter-relationship among yield and yield contributing characters becomes more important to plant breeder for execution of effective crop improvement programme. But, the correlation coefficient does not always give precise information on the contribution of each trait towards dependent variable. To understand the characters which really contribute towards grain yield, the path analysis is obvious. Path-coefficient analysis is simply a standardized partial regression coefficient, which splits the correlation coefficient into the measures of direct and indirect effects. In mungbean, numbers of finding based on fixed genotypes have been reported but such information are lacking in segregating generations. Therefore, present investigation was undertaken to obtain information on correlation as well as the direct and indirect effects of twelve yield and yield contributing traits in F_2 generation of mungbean.

Materials and Methods
The experimental material consisted of 24 genotypes from F_2 generation of mungbean gram (*Vigna radiata* (L.) Wilczek) along with ten parents and 1 check (DPLM-26) were grown during *rabi*, 2018-19 in a randomized block design with three replications at educational and research farm, department of agricultural botany, college of agriculture, Dapoli, dist. Ratnagiri (MS).

The seed of all the 35 genotypes (24 F_2s, 10 parents, and 1 check) were sown at 30 cm distance between row to row and 10 cm distance between plant to plant. Each plot had 1.5 m x 3.0 m area with three rows for each population. Each row contains 30 plants thus there were population of 90 plants per genotype which constitute 270 plants per cross in three replications. Five plants each from two parents and twenty plants from F_2 generation were selected per treatment per replication for recording observations on yield and yield contributing traits *viz;* days to initiation of flowering, days to 50 per cent flowering, number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, number of grains per pod, pod length (cm), plant height (cm), days to maturity, 100 seed weight (g) and grain yield per plant (g). All the agronomic practices were followed to maintain good crop stand. The genotypic and phenotypic co-variances were worked out as per the formulae given by Singh and Chaudhary (1977) [15]. By using this, the phenotypic and genotypic correlation coefficients for all the characters were worked out as per procedure suggested by Johnson *et al*. (1955) [6]. Whereas, the phenotypic as well as genotypic path coefficient analysis was done as per the method suggested by Dewey and Lu (1959) [2].

Results and Discussion

The genotypic and phenotypic correlation coefficients were computed among all characters under study is presented in Table 1 and 2. In general the genotypic correlation coefficients were comparatively higher than corresponding phenotypic correlation coefficient. The grain yield per plant (g) exhibited highly significant and positive correlation with number of branches per plant, number of pods per cluster, number of clusters per plant, number of pods per plant and hundred seed weight (g) at both genotypic and phenotypic levels. It indicates that these characters strongly influenced the grain yield and hence grain yield in mungbean could be improved by making selection for these traits. These findings were in agreement with the results reported by Khanpara *et al.* (2012) [7] in mungbean. The grain yield per plant also showed highly significant positive association with days to initiation of flowering, number of grains per pod, plant height, pod length and days to fifty per cent flowering at genotypic level only while significant but negative association with days to maturity. The similar results were also reported by Gadakh *et al.*, (2013), Narasimhulu *et al.*, (2013) [10], Patel *et al.*, (2014) [11], Ahmad *et al*.,(2014) [1], Pathak *et al*.,(2014) [12], Rathor *et al.*, (2015) [13] and Hemavathy *et al.*, (2015) [5]. The rest of the characters exhibited either positive or negative but non-significant association with grain yield per plant at both phenotypic and genotypic level. Among the component characters under study, most of the characters exhibited highly significant and positively association with each other suggesting interdependence of these traits on each other at genotypic level. Similar results were also observed by Magalingam *et al.* (2013) [10] in Lablab bean.

The path coefficient is an important method for estimating the direct and indirect effect cause of association. The genotypic path coefficient analysis was also worked out and is present in Table 3. Its results revealed that, number of branches per plant, pod length, plant height, number of pods per cluster and number of pods per plant exhibited maximum significant direct effect indicating perfect relation between grain yield per plant and these characters in desirable direction. Their association with grain yield was also significant and positive indicating true and perfect association between these traits. Hence, direct selection based on these characters would help in selecting high yielding genotypes from segregating F2 population of of Raturi *et al.* (2015) [14], Garg *et al.* (2017) [4] and Muthuswamy *et al.* (2019) [9] in mungbean.

Table 1: Estimates of genotypic correlation coefficient between twelve quantitative characters in Mungbean.

Characters	Days to initiation of flowering	Days to 50 % flowering	Branches/ Plant	Clusters/ plant	Pods/ cluster	Pods/ plant	Pod length (cm)	Plant height (cm)	Days to maturity	Grains/ Pod	100 seed weight (g)	Grain yield per plant (g)
Days to initiation of flowering	1.0000	0.951**	0.364**	0.191	0.259**	0.172	0.338**	-0.069	-0.092	0.058	0.853**	0.491**
Days to 50 % flowering		1.0000	0.389**	0.352**	0.364**	0.216*	0.229*	-0.017	-0.019	0.133	0.168	0.319**
Number of Branches/plant			1.0000	-0.098	0.203*	-0.252**	0.295**	0.187	-0.471**	-0.162	0.719**	0.725**
Number of Clusters/plant				1.0000	0.702**	0.909**	0.184	-0.491**	0.321**	0.204*	-0.012	0.460**
Number of Pods/cluster					1.0000	0.444**	-0.468**	-0.103	-0.801**	0.045	0.040	0.369**
Number of Pods/plant						1.0000	0.088	-0.393**	0.220*	0.172	-0.213*	0.293**
Pod length (cm)							1.0000	-0.374**	0.192*	0.151	0.584**	0.305**
Plant height (cm)								1.0000	-0.053	0.283**	0.214*	0.352**
Days to maturity									1.0000	-0.007	-0.584**	-0.325**
Number of grains/pod										1.0000	-0.406**	0.473**
Hundred seed weight (g)											1.0000	0.644**
Grain yield/plant (g)												1.0000

≥0.1918 *Significant at 5 per cent ≥0.2504 **Significant at 1 per cent

Table 2: Estimates of phenotypic correlation coefficient between twelve quantitative characters in Mungbean.

Characters	Days to initiation of flowering	Days to 50 % flowering	Branches/ Plant	Clusters/ plant	Pods/ cluster	Pods/ plant	Pod length (cm)	Plant height (cm)	Days to maturity	Grains/ per Pod	100 seed weight (g)	Grain yield/plant (g)
Days to initiation of flowering	1.0000	0.652**	0.177	0.104	-0.038	0.061	0.103	0.181	0.032	-0.083	0.042	0.145
Days to 50 % flowering		1.0000	0.132	-0.016	-0.118	-0.077	0.136	0.068	0.073	-0.056	0.003	0.051
Number of Branches per plant			1.0000	-0.041	0.169	-0.103	0.208*	0.104	-0.294**	-0.089	0.416**	0.375**
Number of Clusters/plant				1.0000	0.375**	0.618**	-0.003	-0.152	0.158	0.027	-0.040	0.334**
Number of Pods/cluster					1.0000	0.378**	-0.171	-0.076	-0.083	0.028	-0.070	0.355**
Number of Pods/plant						1.0000	-0.002	-0.124	0.192*	0.169	-0.150	0.286**
Pod length (cm)							1.0000	-0.151	0.084	0.037	0.161	-0.015
Plant height (cm)								1.0000	0.053	0.208*	0.087	0.193*
Days to maturity									1.0000	0.109	-0.182	0.014
Number of grains/pod										1.0000	-0.190	0.209*
Hundred seed weight (g)											1.0000	0.486**
Grain yield/plant (g)												1.0000

≥0.1918 *Significant at 5 per cent level. ≥0.2504 **Significant at 1 per cent level.

Table 3: Path analysis at genotypic level for twelve quantitative characters in Mungbean.

Characters	Days to initiation of flowering	Days to 50% flowering	Branches per Plant	Clusters per Plant	Pods per cluster	Pods per plant	Pod length (cm)	Plant height (cm)	Days to maturity	Grains per Pod	100 seed weight (g)	Grain yield per plant (g)
Days to initiation of flowering	-0.358	-0.371	-0.123	-0.073	-0.100	-0.059	-0.111	0.020	0.031	-0.014	-0.302	0.347
Days to 50 % flowering	0.217	0.209	0.071	0.009	0.002	-0.014	0.079	-0.005	-0.047	-0.011	0.100	0.280
Number of Branches per plant	0.223	0.219	0.651	-0.064	0.132	-0.164	0.192	0.122	-0.306	-0.105	0.468	0.972
Number of Clusters per plant	0.002	0.001	-0.001	0.011	0.008	0.010	0.002	-0.006	0.004	0.002	0.000	0.078
Number of Pods per cluster	0.106	0.003	0.077	0.265	0.378	0.168	-0.177	-0.039	-0.303	0.017	0.015	0.387
Number of Pods per plant	0.023	-0.009	-0.035	0.126	0.062	0.139	0.012	-0.055	0.031	0.024	-0.030	-0.096
Pod length (cm)	0.154	0.188	0.147	0.091	-0.233	0.044	0.497	-0.186	0.096	0.075	0.290	0.277
Plant height (cm)	-0.022	-0.009	0.075	-0.195	-0.041	-0.157	-0.149	0.398	-0.021	0.113	0.085	0.233
Days to maturity	0.020	0.052	0.109	-0.074	0.185	-0.051	-0.045	0.012	-0.231	0.002	0.135	-0.737
Number of Grains per pod	-0.004	0.005	0.015	-0.019	-0.004	-0.016	-0.014	-0.026	0.001	-0.093	0.038	0.017
Hundred seed weight (g)	-0.015	-0.008	-0.012	0.000	-0.001	0.004	-0.010	-0.004	0.010	0.007	-0.017	0.783

Note: Bold figures indicate direct effects

Conclusion

From present investigation it can be concluded that, number of branches per plant, number of pods per cluster, number of clusters per plant, number of pods per plant and hundred seed weight were the major yield contributing characters which had positive and significant association with grain yield per plant and also exhibited high direct effect on grain yield per plant. Therefore, due emphasis should be given on these characters in the selection which would help in isolating high yielding genotypes from highly segregating population to improve yield potential of mungbean.

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