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RESEARCH ARTICLE

Association and path analysis of yield contributing traits in Indian bean (*Lablab purpureus* L.)

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Abstract

Fifty diverse genotypes of Indian bean were evaluated in a randomized block design with three replications with objective to study the association among the seed yield and its component traits in Indian bean. In general, the genotypic correlation coefficients were relatively higher than their corresponding phenotypic correlations for most of the pair of characters. Green pod yield per plant had significant and positive genotypic and phenotypic correlation with 10-green pod weight, pod width, number of picking and number of pods per plant. Path coefficient analysis revealed that number of pods per plant and 10-green pod weight exhibited high and positive direct effect on green pod yield per plant. So, the characters *viz.*, number of pods per plant and 10-green pod weight which are most important for correlation studies are also important for path analysis. Hence, these may be considered as most important yield contributing characters and due emphasis should be given on these components while breeding for high green pod yield in Indian bean.

Key words: Correlation, path coefficients, direct effect, indirect effect, Indian bean

Introduction

Lablab purpureus L. (Syn. *Dolichos lablab* L., 2n=22) is an important legume as well as vegetable crop cultivated in the tropical region of Asia, Africa and America. Indian bean is remarkably adaptable to wider area under diverse climate conditions such as arid, semi-arid, sub-tropical and humid regions where temperatures vary between 22^0 and 35^0C, low land and uplands and many types of soil with pH varying from 4.4 to 7.8. It is a drought tolerant crop, which comes up well with the rainfall between 600 and 800 mm per annum.

In India the major Indian bean growing states are Karnataka, Tamil Nadu, Andhra Pradesh and Gujarat. It is a self-pollinated crop but often cross pollination up to 6-10% may occur due to frequent movement of insects (Free, 1993). In Gujarat, it occupies an area of 0.069 million hectares with production of 0.719 million tonnes and in India it having 0.23 million hectares area with 2.278 million tonnes production (Anon., 2019).

The crop has multipurpose use. It is one of the excellent pod vegetable crops grown in India. The green pods and tender leaves are popular vegetables. Its fresh green pod contains 86.1% moisture; 3.8% protein; 6.7% carbohydrates; 0.7% fat; 0.9% mineral matter and vitamin-A 312 I.U. (Singh *et al*., 2004), while, mature dry seeds contain 23% protein; 62% carbohydrates and 340 calories per 100g of edible portion (Tindall, 1983). The ripe and dried seeds are consumed as a split pulse. Indian bean would be good for digestive system and helps in relieving constipation due to good fiber contain. It also helps in weight loss.

In addition to high nutritional value, Indian bean fodder is also palatable and the cattle are nourished well. Incorporating this crop into pastures improves the quality, palatability and digestibility of pastures. This crop can be used as an excellent green manure, as a nitrogen fixing crop, as a cover crop for effective control of soil erosion and soil protection. Being a legume, it can fix atmospheric nitrogen to the extent of 170 kg/ha (Okogun *et al*., 2005).

In plant breeding programmes, several yield attributing characters are often to be handled together by the plant breeders as most of the characters especially of fitness are correlated. Thus, the different components of green pod yield very often exhibit considerable degree of association among themselves and with green pod yield. Yield is a complex character and the multiplicative end product of many quantitative traits (Whitehouse *et al*., 1958). Therefore, selection for yield *per se* will not be desirable. Thus, to accumulate optimum combinations of yield contributing characters in a single genotype, it is essential to know the implication of the interrelationship among various plant characters.

A complex situation before a plant breeder is to improve green pod yield, which is a polygenic trait influenced by various components directly or indirectly. In the selection programme, when less number of variable are considered, correlation study alone can serve the purpose. However, when variables increase the situation becomes more complex. For overcoming this complexity, path analysis (Wright, 1921 and Dewey and Lu, 1959) method was adopted to partition the total correlation into direct and indirect effects, so that a relative merit of each trait is established and their number is reduced in selection programmes. In order to achieve a clear picture of interrelationships of various component traits with green pod yield, direct and indirect effects were calculated using path coefficients analysis at genotypic and phenotypic levels.

Materials and methods

The present investigation was conducted to assess the correlation coefficients, direct and indirect effect of path coefficient analysis in Indian bean. The trial was conducted at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh. Junagadh is situated at 21.50 N latitude and 70.50 E longitude with an elevation of 82.92 meters above the mean sea level. The soil of experimental site is medium black with pH 7.8. Fifty genotypes of Indian bean were sown in a randomized block design with three replications. Each line had ten plants of single genotype which was sown with a spacing of 75 cm × 45 cm. Data were recorded for days to first flowering on plot basis as well as days to first picking, days to last picking, number of picking, plant height, number of branches per plant, number of pods per plant, pod length, pod width, 10-green pod weight, green pod yield per plant, number of seeds per pod on five randomly selected competitive plants from each entry. Selected plants were tagged before the emergence of first flower. There were two sets of plants in each entry. First five plants were used for recording observations on green pod and the remaining plants were kept for recording observations based on seed related traits and their averages were used in the statistical analysis.

The phenotypic and genotypic correlation coefficients of all the 17 pair of characters were worked out as per Al-Jibouri *et al*., (1958). The significance of the genotypic and phenotypic correlation coefficients was tested against standardized tabulated values of ‘r’ with (n-2) error degree of freedom (Fisher and Yates, 1963).

The Political Science Department at Quinnipiac University, Connecticut suggested to use Pearson's correlation coefficients for interpreting strengths of correlations were used in the present investigation (Pearson, 1926). The phenotypic path coefficient analysis was done as per the method suggested by Dewey and Lu (1959). Phenotypic correlation coefficients of eleven variables with green pod yield were used to estimate the phenotypic path coefficient for the direct effects of various independent characters on pod yield.

Results and discussion

In the present investigation, most of the character pairs had higher values of genotypic correlations (Table 1) than their corresponding phenotypic correlations which was in accordance with Inamdar (2014), Sharma *et al.* (2014), Kamble *et al.* (2015), Singh *et al.* (2015) and Patil *et al.* (2017). Such high amount of genotypic correlations could result due to masking or modifying effect of environments. This indicates that though there was high degree of correlation between two variables at genotypic level, its phenotypic expression was deflated by the influence of environments. It was also indicated that there was strong inherent relationship between pair of characters studied.

Green pod yield per plant had significant and positive correlations with 10-green pod weight (r_g = 0.8149, r_p = 0.7532) at both genotypic and phenotypic levels (Table 2). Similar finding was also reported by Inamdar, 2014; Choudhary *et al.*, 2016 and Patil *et al.*, 2017. Pod width significantly and positively correlated (rg = 0.5911, rp = 0.5500) with green pod yield per plant at both levels. This result was in accordance with Inamdar, 2014; Sharma *et al.*, 2014; Das *et al.*, 2015; Verma *et al.*, 2015 and Patil *et al.*, 2017. Green pod yield per plant had significant and positive association with number of pods per plant, rg = 0.4048, rp=0.4646 (Das *et al.*, 2015; Singh *et al.*, 2015; Verma *et al.*, 2015 and Choudhary *et al.*, 2016) and number of picking at both levels. This indicated that these attributes were important for bringing improvement in green pod yield. Likewise, number of seeds per pod had significant and positive correlation with green pod yield per plant (Singh *et al.*, 2015 and Verma *et al.*, 2015) at genotypic level only.

On the other hand, green pod yield per plant had significant but negative correlation with days to first flowering (rg = -0.4256, rp = -0.3904) and days to first picking (rg = -0.3374, rp = -0.2994) at both genotypic and phenotypic levels. The similar results were reported by Madhu *et al.* (2014) and Verma *et al.*, (2015). This indicated that selection for early flowering is most important for increasing in green pod yield as it also gives earlier first picking.

Number of pods per plant (0.5819) and 10-green pod weight (0.7846) exhibited positive direct effects of higher magnitude on green pod yield per plant and direct selection of both traits leads to increase in pod yield (Table 2). Similar results were obtained by Inamdar (2014), Verma *et al.* (2015) and Patil *et al.* (2017). Besides, number of picking (0.0883), days to first picking (0.0769), pod width (0.0762), plant height (0.0526), pod length (0.0123) and number of seeds per pod (0.0082) had positive direct effect of very low magnitude on green pod yield per plant. Lower direct effect was observed by Kujur *et al.* (2017) for above characters.

Phenotypic path coefficient analysis revealed that the residual effect (R = 0.2787) was observed lower in magnitude (Fig. 1) indicated that the majority of the yield attributes have been included in the study of path analysis.

Table 1: Genotypic (r_g) and phenotypic (r_p) correlations coefficients among studied characters of Indian bean

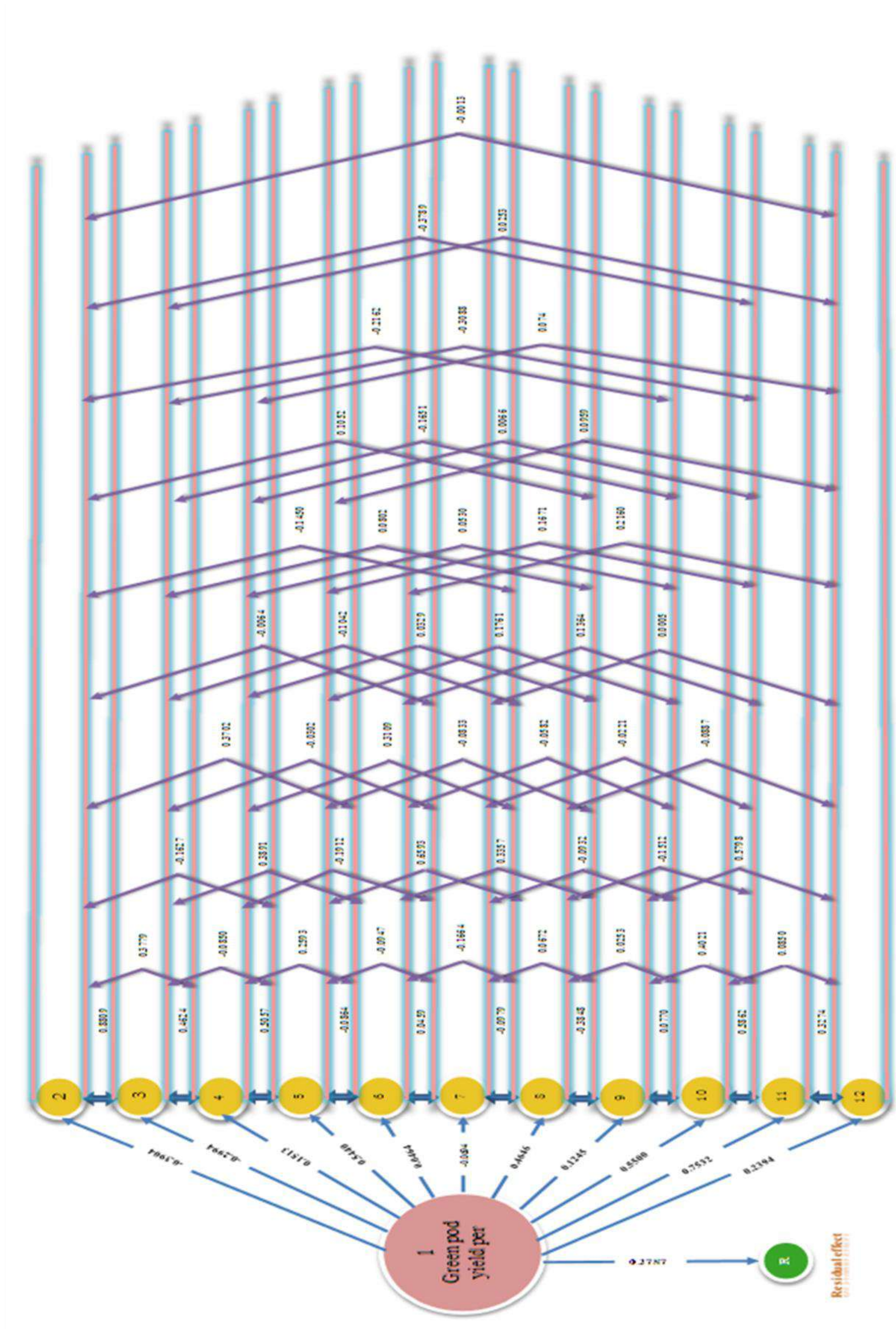
Characters		Green pod yield per plant	Days to first flowering	Days to first picking	Days to last picking	Number of picking	Plant height (cm)	Number of branches per plant	Number of pods per plant	Pod length (cm)	Pod width (cm)	10 -green pod weight (g)	Number of seeds per pod
Green pod yield per plant	r_g	1	-0.42**	-0.33*	0.15	0.58**	0.05	-0.03	0.40**	0.12	0.59**	0.81**	0.31*
	r_p	1	-0.39**	-0.29*	0.15	0.54**	0.04	-0.06	0.46**	0.12	0.55**	0.75**	0.23
Days to first flowering	r_g		1	0.96**	0.40**	-0.17	0.40**	-0.02	-0.17	0.11	-0.22	-0.39**	-0.02
	r_p		1	0.88**	0.37**	-0.16	0.37**	-0.06	-0.14	0.10	-0.21	-0.37**	0.00
Days to first picking	r_g			1	0.50**	-0.10	0.42**	-0.12	-0.11	0.08	-0.17	-0.31*	-0.01
	r_p			1	0.46**	-0.08	0.38**	-0.03	-0.10	0.08	-0.16	-0.30*	0.02
Days to last picking	r_g				1	0.56**	0.28*	-0.54**	0.34*	0.03	0.06	0.00	0.12
	r_p				1	0.50**	0.25	-0.19	0.31*	0.03	0.05	0.00	0.07
Number of picking	r_g					1	-0.09	-0.27	0.75**	-0.08	0.21	0.18	0.12
	r_p					1	-0.08	-0.09	0.65**	-0.08	0.17	0.16	0.09
Plant height (cm)	r_g						1	0.20	-0.17	0.34*	-0.05	0.14	0.29*
	r_p						1	0.04	-0.16	0.33*	-0.05	0.13	0.21
Number of branches per plant	r_g							1	-0.07	0.13	-0.20	-0.08	0.15
	r_p							1	-0.09	0.06	-0.09	-0.02	0.00
Number of pods per plant	r_g								1	-0.43**	0.02	-0.16	-0.19
	r_p								1	-0.38**	0.02	-0.15	-0.08
Pod length (cm)	r_g									1	0.07	0.40**	0.80**
	r_p									1	0.07	0.40**	0.57**
Pod width (cm)	r_g										1	0.60**	0.16
	r_p										1	0.58**	0.08
10 -green pod weight (g)	r_g											1	0.47**
	r_p											1	0.32*
Number of seed per pod	r_g												1
	r_p												1

*, ** Significant at 5 % and 1 % levels, respectively

Table 2: Phenotypic path coefficient analysis showing direct (diagonal and bold) and indirect effects of eleven characters on green pod yield per plant of Indian bean

Characters	Days to first flowering	Days to first picking	Days to last picking	Number of picking	Plant height	Number of branches per plant	Number of pods per plant	Pod length	Pod width	10-green pod weight	Number of seeds per pod	Correlation with Green Pod yield per plant
Days to first flowering	**-0.0181**	0.0677	-0.0483	-0.0144	0.0195	0.0001	-0.0844	0.0013	-0.0165	-0.2973	0.0001	-0.3904**
Days to first picking	-0.0159	**0.0769**	-0.0591	-0.0075	0.0204	0.0002	-0.0606	0.0010	-0.0126	-0.2423	0.0002	-0.2994*
Days to last picking	-0.0068	0.0355	**-0.1278**	0.0446	0.0136	0.0010	0.1809	0.0004	0.0040	0.0052	0.0006	0.1513
Number of picking	0.0029	-0.0065	-0.0646	**0.0883**	-0.0045	0.0005	0.3837	-0.0010	0.0134	0.1311	0.0008	0.5440**
Plant height	-0.0067	0.0299	-0.0331	-0.0076	**0.0526**	-0.0002	-0.0968	0.0041	-0.0044	0.1070	0.0018	0.0464
Number of branches per plant	0.0001	-0.0023	0.0244	-0.0084	0.0024	**-0.0052**	-0.0570	0.0008	-0.0071	-0.0173	0.0001	-0.0694
Number of pods per plant	0.0026	-0.0080	-0.0397	0.0582	-0.0087	0.0005	**0.5819**	-0.0047	0.0019	-0.1186	-0.0007	0.4646**
Pod length	-0.0019	0.0062	-0.0042	-0.0074	0.0176	-0.0003	-0.2240	**0.0123**	0.0059	0.3155	0.0048	0.1245
Pod width	0.0039	-0.0127	-0.0068	0.0155	-0.0031	0.0005	0.0148	0.0009	**0.0762**	0.4600	0.0007	0.5500**
10- green pod weight	0.0069	-0.0237	-0.0008	0.0148	0.0072	0.0001	-0.0880	0.0049	0.0447	**0.7846**	0.0027	0.7532**
Number of seeds per pod	0.0001	0.0019	-0.0095	0.0085	0.0114	0.0001	-0.0516	0.0071	0.0065	0.2569	**0.0082**	0.2394

Fig. 1: Phenotypic path coefficient analysis of 12 characters in Indian bean



It was apparent from path coefficient analysis that higher direct effect was exerted by number of pods per plant and 10-green pod weight as well as both of these characters also exhibited significant and positive association with green pod yield per plant. Hence, these may be considered as most important yield contributing characters and due emphasis should be given on these components while breeding for high pod yield in Indian bean. Thus, it can be suggested that correlation and path analysis study should be considered together for rapid gain for final improvement in green pod yield.

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