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Elucidation of association for yield attributing traits in country bean

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Abstract

Twenty genotypes of country bean were evaluated to explore the association between yield and yield contributing traits in country bean in field condition. Experiment was conducted at field laboratory of department of Genetics and Plant Breeding (GPB), Bangladesh Agricultural University (BAU), Mymensingh. Traits association through computing correlation coefficient and path coefficients were done both at genotypic and phenotypic levels. Among the twelve morphological traits, genotypic and phenotypic correlation studies showed number of raceme per plant and number of flower buds per raceme had significantly positive relationship with seed yield per plant. Genotypic correlation also showed significant positive relation between number of seed per plant and seed yield per plant. Path coefficient analysis revealed that days to 50 per cent flowering, number of raceme per plant, green pod length, 100 dry seed weight, green shelling percentage, dry shelling percentage showed positive effect on seed yield in genotypic level . Also in phenotypic level days to 50% flowering, days to maturity, number of flower buds per plant, green pod length, number of seed per pod, green pod yield per plant, green test weight and dry shelling percentage showed direct effect on seed yield. The association between traits revealed in the present study shall be of great help to choose parents with desirable traits for hybridization, selection method to follow, and selection criteria towards a successful breeding program. Traits with strong association with yield can be improved easily, but with weak relationship, needs more observations to obtain the better segregates.

Key words: Country bean, yield contributing traits, correlation coefficient, path coefficient.

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Introduction

Lablab bean (*Lablab purpureus* L.) is commonly known as country bean or deshi sheem in Bangladesh (Asaduzzaman et al., 2015), is a high protein containing (4.5% in green edible pods and 25.0% in dry seeds) legume and a major winter vegetable (Pervin *et al.,* 2005). Country bean can be grown in a wide range of soil with average fertility like other beans (Nath, 1976). It is considered as one of the oldest cultivated crops of the world (Bullivant, 1963), which is generally cultivated as annual or biennial crop. Although, it is assumed to have originated in Asia (Mortuza and Tzen, 2009), but some varieties also grown naturally in Africa and Australia (Maass *et al.,* 2010). In Bangladesh, Chittagong and coastal regions are, particularly reputed for its cultivation (CFLIP, 1988). The average yield of country bean in Bangladesh is very low (4.8 tons per hectare) compared to the global context (10 tons per hectare) (Salim *et al.,* 2013; Islam, 2008). The reason behind this low yield status could be due to the lack of prescribed production practices and lack of high potential varieties. Most of the varieties grown in Bangladesh are photoperiod sensitive with indeterminate growth habit (Islam, 2008). However, the country bean has a huge morphological and physiological variability for its various yield-contributing characters as well as genetic diversity among local landraces (Nasreen *et al.*, 2009). Therefore, there are scope to take a breeding program for improving the yield in country bean (Islam, 2008).

Correlation between yield and different yield contributing characters is an important feature, which should be kept in mind for planning yield improvement program through breeding. Study of correlation coefficient has been widely considered and evaluated in many breeding programs of bean by numerous researchers (Parmar *et al*., 2013; Rashid *et al*., 2013; Mohan *et al.,* 2006; Ali *et al*., 2005; Rai *et al*., 2004), as it gives a reasonable basis of trait selection for improving yield. Moreover, path coefficient analysis can be used for partitioning the direct and indirect effects to measure relative importance of all the characters (Nahar and Newaz, 2005). Path coefficient analysis has also been considered for designing breeding programs in previous studies for determining the direct and indirect effects of traits on yield (Parmar *et al*., 2013; Lal *et al*., 2011; Ali *et al*., 2005; Rai *et al*., 2004). Therefore, the present study is aimed to measure the correlation and path coefficient analysis between yield and yield contributing characters in twenty genotypes for selecting suitable plant traits and parent for future hybridization.

Materials and Methods

The experiment was conducted at the Field Laboratory, Dept. of Genetics and Plant Breeding (GPB), Bangladesh Agricultural University, Mymensingh, in a medium high land belonging to the Agro-ecological zone (AEZ-9) comprising the Old Brahmaputra Floodplain Soil (UNDP and FAO, 1988) from August, 2015 to March, 2016. Twenty advanced generation lines and local landraces of climbing type country bean genotypes (Table 1) were collected from the Field Gene Bank, Dept. of GPB, BAU and evaluated for yield traits in a Randomized Complete Block Design (RCBD) with three replications. All recommended intercultural operations such as weeding, watering and fertilizing with the supplement of nitrogen, phosphorus and potassium were performed during the experiment. Data were collected from three randomly selected plants of three replicates from three randomly selected competitive plants of each genotype. Twelve morphological traits were considered for data collection namely, days to 50 % flowering, days to maturity, number of raceme per plant, number of flower buds per raceme, pod length (cm), number of seeds per pod, green pod yield per plant (kg), green and dry test weight (g), green and dry shelling percentage and seed yield per plant (g). The correlation coefficient was computed as per Weber and Morthy (1952) and path coefficient of various characters was calculated using the formula by Dewey and Liu (1959).

Table 1. List of the country bean genotypes used in the experiment

Genotypes	Status of the genotypes
DS35, DS113, DS11, DSN12, DSN26, DSN27, DSN17, DSN25, KBS-1, KBS-2, KBS-5, CBS-S2, KBS-S4, DSN16	Advanced generation line
Ashina(p), Ipsa1, Knoldog, Kartika, Small Black, Small Red	Local land races

Results and Discussion

The analysis of variance (ANOVA) computed from the recorded data (not mentioned here) showed that the genotypes demonstrated significant variation for all the characters. Therefore, data were considered for analysis of correlation coefficient (Table 2) and path coefficient (Table 3).

Correlation coefficient analysis: Relationship between yield and yield contributing traits was studied through correlation coefficient analysis and the results are represented in Table 2. It was observed that genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients for most of the characters indicating the superiority of phenotypic expression under the influence of environmental factors (Table 2). In the genotypic correlation assessment among eleven associations, nine associations showed positive correlation to the seed yield (Table 2). The investigation revealed that seed yield per plant was positively and significantly correlated with number of raceme per plant (0.584), number of flower buds per raceme (0.552) and number of seeds per pod (0.457) (Table 2). On the other hand, all traits under study showed positive correlation to the seed yield in the phenotypic correlation assessment with significant correlation to number of raceme per plant (0.642), number of flower buds per raceme (0.599) (Table 2).

Table 2. Genotypic and phenotypic (italic) correlation among the yield contributing characters with seed yield of twenty country bean genotypes

	DM	NR	NFB	GL	NP	GPY	GW	100dsw	S%G	S%D	DSP
DF	1.247** *1.233***	1.085** *0.985***	-0.539 *-0.454*	-0.814 *-0.796*	-0.724 *-0.662*	-0.482 *-0.378*	-0.712 *-0.676*	-0.434 *-0.429*	0.330 *0.316*	-0.179 *-0.163*	0.198 *0.153*
DM		0.956** *0.956***	-0.524 *-0.524*	-0.844 *-0.844*	-0.805 *-0.805*	-0.440 *-0.440*	-0.663 *-0.663*	-0.297 *-0.297*	0.354 *0.354*	-0.254 *-0.254*	0.078 *0.078*
NR			-0.687 *-0.453*	-0.524 *-0.470*	-0.397 *-0.334*	-0.097 *-0.050*	-0.682 *-0.572*	-0.403 *-0.366*	0.389 *0.322*	-0.122 *-0.139*	0.584** *0.642***
NFB				0.457* *0.383*	0.477* *0.276*	0.348 *0.175*	0.638** *0.523**	0.337 *0.290*	-0.331 *-0.283*	-0.177 *-0.123*	0.552* *0.599***
GL					0.585** *0.526**	0.989** *0.805***	0.312 *0.309*	0.444* *0.440*	0.258 *0.245*	0.347 *0.327*	0.218 *0.327*
NP						0.067 *0.105*	-0.035 *0.105*	-0.101 *-0.081*	-0.053 *-0.062*	0.336 *0.249*	0.457* *0.322*
GPY							0.304 *0.265*	0.494* *0.408*	0.433 *0.370*	0.312 *0.253*	0.392 *0.276*
GW								0.458* *0.442*	-1.065 *-0.972*	0.202 *0.194*	-0.033 *0.016*
100dsw									-0.102 *-0.091*	0.026 *0.035*	0.237 *0.199*
S%G										-0.144 *-0.112*	0.067 *0.029*
S%D											-0.141 *-0.131*

Note: * indicates significant at 0.05 probability, **indicates significant at 0.01 probability; DF = Days to flowering, DM = Days to maturity, NR = Number of raceme per plant, NFB = Number of flower buds per raceme, GL = Green pod length, NP = Number of seeds per pod, GPY = Green pod yield per plant, GW = Green test weight, 100 dsw= 100 dry seed weight, S%F = Shelling percentage (Green), S%D = Shelling percentage (Dry), DSP = Seed yield per plant.

Previous study showed similar correlation among yield traits of country bean such as significant and positive genotypic correlation was noted between pod weight at harvest and pod diameter, and yield per plant; and pod weight at harvest, pod length, number of inflorescence per plant. Yield per plant exhibited significant positive phenotypic correlation with pod length and number of inflorescence per plant (Ali *et al.,* 2005). Another similar study showed maximum positive significant association between pod yield per plant with number of pods per plant at both genotypic and phenotypic levels in country bean (Singh *et al.,* 2011). Another study showed positive and significant correlation between seed yield per plant with days to maturity, number of raceme per plant, raceme length, pod length, green pod yield per plant, green test weight and shelling percentage. This positive and significant association between those traits suggested additive genetic model thereby less affected by the environmental fluctuation. Significant negative correlation with days to maturity, number of seeds per pod and protein content at both phenotypic and genotypic levels in country bean was also reported in the same study (Asaduzzaman *et al.,* 2014). This positive and significant association between those traits suggested additive genetic model thereby less affected by the environmental fluctuation.

Table 3. Partitioning of genotypic and phenotypic (italic) correlations into direct (bold) and indirect effects of yield contributing traits on seed yield of country bean by path analysis

Traits	DF	DM	NR	NFB	GL	NP	GPY	GW	100dsw	S%G	S%D	DSP
DF	**0.251**	-0.108	0.795	0.158	-1.000	0.652	0.527	0.111	-0.347	0.014	-0.051	0.198
	0.007	*0.121*	*0.002*	*-0.036*	*-0.316*	*-0.136*	*-0.190*	*-0.167*	*0.342*	*0.415*	*0.123*	*0.153*
DM	0.302	**-0.090**	0.700	0.155	-1.037	0.724	0.484	0.103	-0.234	0.015	0.037	0.078
	0.008	***0.101***	*-0.083*	*-0.047*	*-0.661*	*-0.143*	*-0.230*	*-0.198*	*0.337*	*0.287*	*0.134*	*0.078*
NR	0.272	-0.085	**0.737**	0.206	-0.642	0.353	0.099	0.106	-0.323	0.032	-0.036	0.584**
	0.009	*0.015*	***-0.554***	*-0.045*	*-0.359*	*-0.120*	*-0.095*	*-0.023*	*0.291*	*0.356*	*0.123*	*0.642***
NFB	-0.133	0.047	-0.508	**-0.298**	0.556	-0.426	-0.374	-0.098	0.266	-0.027	-0.051	0.552*
	-0.002	*-0.034*	*0.183*	***0.137***	*0.218*	*0.093*	*0.078*	*0.077*	*-0.265*	*-0.287*	*-0.107*	*0.599***
GL	-0.204	0.075	-0.383	-0.134	**1.235**	-0.525	-1.077	-0.048	0.355	0.021	0.101	0.218
	-0.003	*-0.095*	*0.283*	*0.043*	***0.703***	*-0.070*	*0.150*	*0.360*	*0.153*	*-0.435*	*0.092*	*0.182*
NP	-0.181	0.072	-0.287	-0.140	0.716	**-0.905**	-0.066	0.005	-0.081	-0.004	0.098	0.457*
	-0.003	*-0.037*	*0.172*	*0.033*	*-0.127*	***0.387***	*-0.009*	*0.045*	*-0.003*	*0.079*	*-0.023*	*0.322*
GPY	-0.121	0.039	-0.066	-0.101	1.210	-0.054	**-1.099**	-0.047	0.395	0.036	0.092	0.392
	-0.048	*-0.081*	*0.183*	*0.037*	*0.366*	*-0.012*	***0.288***	*0.144*	*-0.133*	*-0.396*	*0.142*	*0.276*
GW	-0.179	0.059	-0.501	-0.188	0.383	0.027	-0.330	**-1.156**	0.363	-0.099	0.060	-0.033
	-0.003	*-0.044*	*0.028*	*0.023*	*0.562*	*0.039*	*0.092*	***0.450***	*-0.138*	*-0.435*	*-0.371*	*0.016*
100dsw	-0.108	0.026	-0.295	-0.098	0.543	0.091	-0.538	-0.070	**0.807**	-0.008	0.006	0.237
	-0.005	*-0.067*	*0.316*	*0.071*	*0.211*	*0.002*	*0.075*	*0.122*	***-0.510***	*-0.010*	*-0.034*	*0.199*
S%G	0.083	-0.031	0.280	0.098	0.309	0.045	-0.473	0.171	-0.081	**0.041**	-0.042	0.067
	-0.003	*-0.029*	*0.200*	*0.040*	*0.309*	*-0.031*	*0.115*	*0.198*	*-0.005*	***-0.999***	*0.073*	*0.029*
S%D	-0.043	0.022	-0.088	0.051	0.420	-0.299	-0.341	0.031	0.016	-0.012	**0.298**	-0.141
	0.002	*0.035*	*-0.177*	*-0.038*	*0.169*	*0.023*	*0.107*	*-0.437*	*0.046*	*-0.188*	***0.383***	*-0.131*

Residual value = 0.539 (genotypic); *0.5017* (phenotypic); DF = Days to flowering, DM = Days to maturity, NR = Number of raceme per plant, NFB = Number of flower buds per raceme, GL = Green pod length, NP = Number of seeds per pod, GPY = Green pod yield per plant, GW = Green test weight, 100 dsw= 100 dry seed weight, S%F = Shelling percentage (Green), S%D = Shelling percentage (Dry), DSP = Seed yield per plant.

Path coefficient analysis: The correlation coefficient value denotes only the nature and extent of association existing between pairs of traits. However, estimation of direct and indirect effect of each yield contributing traits is mandatory to evaluate the overall relationship between yield traits and yield per plant. In the present study, all traits under study were analyzed for path coefficient at both genotypic and phenotypic level and the results are represented in Table 3. In genotypic level days to 50 per cent flowering (0.2514), number of raceme per plant (0.7365), green pod length (1.2347), 100 dry seed weight (0.8065), green shelling percentage (0.0414), dry shelling percentage (0.2980) showed positive direct effect on seed yield (Table 3). In phenotypic level, days to 50% flowering (0.0073), days to maturity (0.1008), number of flower buds per plant (0.1373), green pod length (0.7029), number of seeds per pod (0.3874), green pod yield per plant (0.2879), green test weight (0.4501), dry shelling percentage (0.3828) showed direct effect on seed yield (Table 3). Similar results of positive direct effect of number of pods per plant and pod length on pod yield per plant in country bean been was observed by Singh *et al.* (2011), Raffi and Nath (2004) and Asaduzzaman *et al*. (2014) also have found that 100 dry seed weight has direct and positive effect on seed yield of country bean.

Conclusion

The knowledge on the association of yield and yield contributing characters helps in better improvement of crop through breeding. The present study revealed twelve yield contributing traits and their correlation as well as their direct and indirect partitioning to the seed yield per plant such as number of raceme per plant, number of flower buds per raceme, number of seeds per pod, green pod length, 100 dry seed weight etc. These traits can be used for further breeding program to improve the country bean yield..

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