J. Plant Production, Mansoura University Vol.1 (9):1233 - 1239, 2010

CORRELATION AND PATH- COEFFICIENT STUDIES IN COMMON BEAN (*Phaseolus vulgaris* L.).

Ghobary,H. M.M. and S.A. M. Abd Allah
Veg. Res. Dep., Hort. Res. Inst.,Agric. Res. Center, Giza, Egypt.

ABSTRACT

The objective of this study was to estimate the correlation coefficients (genotypic and phenotypic) and carry out path analysis between grain yield and its primary components. The experiments, in randomized complete blocks with three replicates, were carried out at El-Baramoon Horticulture Research Farm, Dakahlia Governorate Egypt in the 2009 and 2010 growing seasons. Twelve common bean genotypes were assessed including advanced lines and commercial varieties. The correlation studies revealed that in general, estimates of genotypic correlation coefficient were higher than corresponding phenotypic correlation coefficient. Seed yield per plant showed positive and significant correlation with number of pods per plant, number of branches per plant and biomass yield per plant at genotypic and phenotypic levels. Negative and significant association was observed between number of pods per plant, pod length and 100 seed weight. The results suggested that these traits could be considered as major grain yield contributing characters in common bean. Number of pods per plant, 100 seed weight and number of seeds per pod exhibited maximum positive direct effect on grain yield plant, respectively. It indicated that these are main contributors towards yield. Based on results expressing characters association and path coefficients for yield and its contributing characters, breeders should give attention to the characters like number of pods per plant, number of seeds per pod, 100 seed weight and days to 50 percent flowering and making selection of high yielding genotypes in common bean.

Keywords: *Phaseolus vulgaris* L. – Genetic breeding correlations – path analysis yield.

INTRODUCTION

Common bean (*phaseolus vulgaris* L.) is an important food worldwide and significant source of nutrients because of its contents of fiber, proteins and vitamins. It is traditionary a basic food crop in many developing countries and serves as a major plant protein source for rural and urban poor.

Yield improvement is a major breeding objective of most crop improvement programs (Hallaur, 1981; Wilson1981). In common beans, yield is improved by direct selection and by indirect selection for plant ideotype traits affecting yield. To achieve significant progress in breeding program, it is essential to know the relationship between seed yield and its components. According to Ramalho *et al.*, (1993) more than one trait should be considered in a common bean breeding program using pure lines or even progenies. Other traits in addition to grain yield, such as disease resistance, number of pods per plant, yield per plant and weight of 100 seeds should be observed and measured to complement the objectives established for the program. In this case, the estimated correlation, measured from the association among the characteristics, enable the breeder to understand the changes that occur in a determined traits in function of the selection practiced on another, correlated trait.

Thus knowledge of the correlation is improvement for simultaneous trait selection or when a trait of interest presents low heritability that hinders measurement or identification. When selecting another trait with high heritability easily identified and highly correlated with the desired trait, the breeder can obtain quicker progress than with direct selection.

Estimates of correlation coefficients in the common bean between grain yield and its primary components and structural and physiological traits have been frequency obtained (Santos *et al*., 1986; Pereira Filho *et al*., 1987; Coimbra *et al*., 1998; Coelho *et al*., 2002).

The quantification and interpretation of the magnitude of a correlation can result in errors when indirect selection strategy is used based on the correlated response because high correlation between two traits may be the result of the effect of a third or of a group of other traits on them (Cruz and Regazzi, 1997). For these authors, correlation studies among traits do not permit definitive conclusion on the relation of cause and effect path analysis coefficient analysis, a method proposed by Wright, (1921) and elaborated by Dewey and Lu Kh, (1959), permits the partitioning of the correlation coefficient into direct and indirect effects of various traits on a basic variable whose estimates are obtained by multiple regression equation where the variables are previously standardized. According to Gravios and Helms, (1992) path analysis has been little applied in crop breeding.

Although correlation coefficient among traits is frequently present, they are not incorporated into path analysis to investigate the relative direct and indirect influence of each trait on yield.

The objective of the present study was to estimate the phenotypic and genotypic correlations and partition of the correlation to direct and indirect contribution of various traits to yield.

MATERIALS AND METHODS

This study was carried out in spring seasons during 2009 and 2010 at El - Baramoon Horticulture Research Farm Dakhlia Governorate Egypt (Latitude 30^0 31.5 N, Longitude 30^0 32.0 E, Altitude 12 meters). The soil analysis of research area was EC=0.85 dsm ,ph = 7.6 , N =75.1 (ppm) ,Available p = 16.4 (ppm) , Available K= 350 (ppm) , Clay 65.35 % , Silt 12.37 % , Sand 22% and Texture class – loam. Experimental material comprised 12 genotypes of common bean (*phaseolus vulgaris* L.) viz , Neberaska . Giza 6 ,Bronko , Bolista , EURO , ROMONO POLE , FAGIOLO , Improved Golden wax , White Dutch , Swiss Blane , K11 and Malikal obtained from vegetable research Department ,Horticulture Institute , Giza , Egypt and some seed companies. Pure seed of each genotype were planted 28 February 2009 and 22 February 2010 in a randomized complete block with three replications. Each plot consisted of two 5 m long rows with 50 cm apart, spaced 10 cm within the row. All recommended agronomic practices were followed to raise good crop. Ten plants were taken randomly from each plot and assessed for the traits plant height in cm, number of branches per plant , number of days to 50 % flowering ,biomass yield per plant , number of pods per plant , pod length (cm), number of seeds per pod , 100 seed weight (g) , seed yield per plant (g) and harvest index was calculated as HI = seed yield X 100 / biomass yield. Since the errors of means of two years were homozygous, pooled analysis of data two years was made following the standard statistical methods. The means of each plot were considered for the genetic statistic analysis. The following statistical model was adopted:

Yijk = U + G1 +Ej +GEij + B / Ejk + Eijk , where :

U: general mean

G: effect of I –eth genotype (I = 1, 2………..12)

Ej: effect of j –eth environment (j = 1,2,3)

GEij : effect of the interaction of the i.eth genotype with the j.eth environment.

B / Ejk : effect of k.eth block within the j.eth environment (k = 1,2,3)

EIJK: Error

The correlation were estimated from the expressions quoted by Falconer (1987) and Ramalho *et al*.,(1993):

$$r_{F(xy)} = \frac{COV_{F(XY)}}{\sqrt{\delta^2_{FX} \cdot \delta^2_{FY}}}$$

معادلات

Where:

rxy : correlation between traits X and Y.

COV: covariance between the two traits.

δ^2 X and δ^2 y : variance of the traits x and y respectively .

The path analysis was done as given by Wright, (1921) and elaborated by Dewey and Lu Kh,(1959) to calculate the direct and indirect contribution of various traits to yield.

RESULTS AND DISCUSSION

The correlation studies in general indicated higher magnitude of genotypic correlation coefficients than the phenotypic ones for most traits Table (1), there by establishing inherent association among different traits under study. Results indicated that plant height showed a negative and significant association with number of seed per pod at genotypic and phenotypic levels (rg – 0.685* and rp -0.633*)which gave an understanding that tallest plants strain would give less seeds per pod as compared to short plants strain. A positive and significant correlation at genotypic and phenotypic levels of number of branches per plant was observed with number of pods per plant (r_g 0.694* and r_p 0.679*), seed yield per plant (r_g 0.877** and r_p 0.855**) and harvest index (r_g 0.615* and r_p 0.589*). A positive and significant correlation at genotypic and phenotypic levels of seed yield per plant also noted with biomass yield per plant (r_g 0.605* and r_p 0.592*), number of pods per plant (rg 0.785** and rp 0.711**) and harvest index (r_g 0.582* and r_p 0.579*) indicating that profuse plants strain would accommodate more number of pods per plant , seed yield per plant , biomass yield per plant and harvest index. Days to 50 % percent flowering was negatively and significantly correlated with 100 - seed weight at genotypic (r_g – 0.608*) and phenotypic (r_p -0.592*) levels suggesting that delayed flowering would decreased 100 – seed weight significantly.

A negative and significant correlation of number of pods per plant was observed at genotypic and phenotypic levels with pod length (r_g – 0.595* and r_p -0.585*) and 100 – seed weight (r_g – 0.643* and r_p -0.639*) which indicated that decreased in number of pods per plant would lead to a significant increase in pod length and 100 – seed weight. In case of pod length, a positive and significant correlation with 100 – seed weight at both levels which clearly indicated that increase in pod length would ultimately result in 100- seed weight. Number of seed per pod had a negative and significant correlation with 100 – seed weight at both genotypic (r_g – 0.713) and phenotypic (r_p -0.689) levels.

Similar results were reported by other researcher and there was generally good agreement in the direction of the correlation, except for the pair of traits number of pods per plant and number of seeds per pod whose correlations was very weak at both genotypic and phenotypic levels also, 100seed weight trait showed a negative and weak association with seed yield per plant in this study. Such disagreement, according to Falconer and Mackay (1996) is that the genetic and environmental variations influenced those traits through different physiological mechanisms. For these authors, occurrence of positive or negative genetic correlation is due mainly to pleiotropy or genetic links among the genes responsible for these characteristics. The number of pods per plant trait was the primary yield component that presented the highest positive correlation with seed yield per plant. Somewhat similar results were obtained by Ramalho *et al*., (1993) , Santos *et al*.,(1986) , Pereira Filho *et al*., (1987) ,Atilla (2007) and Salehi *et al*.,(2008).

The direct and indirect effects of ten examined traits on seed yield were estimated by path coefficient as shown in Table 2. Number of pods per plant had the greatest direct effect on seed yield per plant (P.C=1.740). This trait was followed by 100 - seed weight (P.C=1.534) and number of seeds per pod (P.C= 0.341), respectively. Number of branches per plant (P.C= - 0.366) showed high negative direct effect on seed yield per plant.

1-2

It is shown that, the number of branches per plant had the highest moderate indirect positive effect on seed yield per plant via number of pods per plant (P.C=1.181), while 100 – seed weight had the highest moderate indirect negative effect on seed yield per plant via number of pods per plant (P.C= -1.112).Similar observation have been made by Goncalves *et al*., (2003).

Conclusion

It is concluded that the primary yield component that correlated best and had greatest effect on seed yield per plant was number of pods per plant and it should be considered in indirect selection to increase this trait. Although the seed weight was correlated negative and weak with seed yield per plant but it had high direct effect on seed yield per plant, this trait should not be disregarded in genetic breeding studies. Since yield per plant, in common bean, is determinate in the yield per area unit, this indicated that sowing density must be very carefully considered.

REFERENCES

Atilla,D.(2007). Variability, Heritability and correlation studies in bean (*phaseolus vulgaris* L.) Genotypes.World Journal of Agricultural Sciences 3(1) 12-16.

Coelho,A.D.;Cardoso,A.A.; Cruz, C. D. ; Andrade Aranjo, G. A. ; Ribeiro Furtado,M. and Amaral, C. L. F.(2002). Heriatbility and correlation of production of common bean and their primary components during spring - summer and winter – autumn cultivation.Ciencia Rural. 32 :211- 216.

Coimbra,J.L.M. ; Guildolin, A.F.; Carralho,F.L.Fde and Duarte I.A.(1998). The quantitative analysis of genotypic and phenotypic parameters in common bean (*phaseolus vulgaris* L.) Pes.Agropecuaria Gaúcha 4(2): 163 – 171.

Cruz,C.D. and Regazzi ,A.J.(1997). Bio metrical models applied in genetic improvement .UFV,Vicosa.

Dewey DR,Lukh(1959). A correlation and path coefficient analysis of components of crested wheatgrass seed production, Agron.J.51:515 – 518.

Falconer, D.S.and Mackay, T.F.C.(1996). Introduction to quantitative genetics.4.ed. Longman, England.

Falconer,D.S.(1987). Introduction to quantitative genetics Imprensa Unviersitaria da UFV,Vicosa.

Goncalves,M.C.;A.M.Correa,D.Destro,L.D.Souza,S.T.Alves and L.C.F.Souza (2003). Correlation and path analysis of common bean grain yield and its primary components, crop breeding and Applied Biotechnology, 3 (3) : 21 7- 222.

Gravios ,K.A.and Helms,R.S.(1992). Path analysis of rice yield components as affected by seedling rate. Agronomy Journal 24:1-4.

Hallaur,A.R.(1981). Selection and breeding methods, P.3-57.In:K.J.Fry (ed.) Plant breeding II.Iowa State Univ.Press.Ames.

Pereira Filho,I.A. ; Ramalho , M.A.P. and Ferreira , S.(1987). Evaluation of progeny of common bean and selection of genetic parameters in Alto Sâo Francisco em Minas Gerais ,Pesquisa Agropecuarie Brasileira.22(9/10): 987- 993.

Ramalho, M. A. P. ; Santos, J. B. dos and Zimmermann,M.J.deO.(1993). Quatitative Genetics in plants outogamus :application Cowpea.UFG,Goiânia.

Salehi,M.;M.Tajik and A.G.Ebadi(2008). The study of relationship between different traits in common bean (phaseolus vulgaris L.) with Multivariate statical methods American – Eursian J.Agric.& Environ.Sci.,3(6):806-809.

Santos,P.C.dos ; Cardoso,A.A. ; Vieria , C.and Silva , J.C.(1986). Heritability and correlation of production in two crosses of cowpea.Revista ceres.33 (189):404-412.

Wilson,D.(1981). Breeding for morphological and physiological traits P.233-291: K.J.Fry(ed.)Plant breeding II.Iowa State Univ.Press. Ames.

Wright,S.(1921). Correlation and causation.Jornal of Agriculture Research .20:557 – 585.

دراسات على الارتباط والتاثير المباشر والغير مباشر لبعض الصفات على المحصول فى الفاصوليا.

حامد محمد محمد غباري و سامح عبد المنعم محمد عبد اللة.
قسم بحوث الخضر – معهد بحوث البساتين – مركز البحوث الزراعية – مصر.

اجريت هذة الدراسة بغرض دراسة الارتباط بين الصفات المختلفة فى الفاصوليا وتحديد التاثير المباشر والغير مباشر لبعض الصفات على محصول البذرة. وتمت التجارب فى مزرعة بحوث البساتين بالبرامون – دقهلية فى موسم الزراعة ٢٠٠٩ ، ٢٠١٠ صيفى فى تصميم قطاعات كاملة العشوائية فى ثلاث مكررات واستخدم فيها ١٢ تركيب وراثى من الاصناف التجارية والسلالات النقية من الفاصوليا وكانت نتائج الدراسة كالاتى:

- معامل الارتباط الوراثى بين الصفات المدروسة عموما كان اعلى من الارتباط المظهرى.
- يوجد ارتباط معنوى موجب بين محصول البذرة للنبات وكلا من عدد القرون / النبات – المحصول الخضرى للنبات – عدد الافرع / النبات.
- يوجد ارتباط معنوى سالب بين عدد القرون / النبات وكل من طول القرن ووزن ال١٠٠ بذرة.
- اظهرت صفات عدد القرون / النبات – وزن ال١٠٠ بذرة – عدد البذور / القرن اعلى تاثير موجب مباشر على محصول البذرة / النبات مما يشير الى ان هذة الصفات من المكونات الرئيسية لمحصول البذرة.

قام بتحكيم البحث

أ.د / سمير طه محمود العفيفى	**كلية الزراعة – جامعة المنصورة**
أ.د / السيد حسن عسكر	**مركز البحوث الزراعية**

Table (1): Phenotypic (r_p) and genotypic (r_g) correlation coefficients among various pair of 10 traits in common bean.

Traits	Corr.	No. of branches /plant	Days to 50% flowering	Biomass /plant (g)	No. of pods /plant	Pod length/ (cm)	No .of seeds /pod	100-seed weight (g)	Seed yield /plant (g)	Harvest index %
Plant height	r_g	0.414	0.113	0.414	0.094*	0.040-	-0.685*	0.397	0.387	0.343
	r_p	0.405	0.121	0.406	0.097*	0.051-	-0.633*	0.384	0.391	0.331
No.of branches /plant	r_g		0.110-	0.458	0.694*	0.273-	-0.517	0.081	0.879**	0.615*
	r_p		0.109-	0.456	0.679*	-0.261	-0.479	0.077	0.855**	0.589*
Days to 50% flowering	r_g			0.200-	0.314	0.559-	0.223	-0.608*	-0.018	0.303
	r_p			0.197-	0.311	0.546-	0.208	-0.592**	-0.018	0.301
Biomass /plant(g)	r_g				0.216	0.436	-0.143	0.277	0.605*	-0.083
	r_p				0.213	0.411	-0.134	0.274	0.592*	-0.094
No. of pods /plant	r_g					-0.595*	0.171	-0.643*	0.785**	0.525
	r_p					-0.585*	0.159	-0.639*	0.771**	0.514
Pod length/ (cm)	r_g						0.060	0.629	-0.186	-0.643*
	r_p						0.054	0.611*	-0.187	-0.613*
No. of seeds /pod	r_g							-0.713*	-0.236	-0.466
	r_p							-0.689*	-0.207	-0.440
100-seed weight(g)	r_g								-0.062	-0.083
	r_p								-0.050	-0.070
Seed yield /plant(g)	r_g									0.583*
	r_p									0.579*

****: Significant at 1 % level   *: Significant at 5 % level.**

Table (2) : Path coefficient for seed yield of common bean genotypes.

Character		Direct effect	Indirect effect									Total
			1	2	3	4	5	6	7	8	9	
1	**Plant height**	-0.12		**-0.149**	**0.022**	**0.068**	**0.168**	**0.008**	**-0.216**	**0.589**	**0.020**	**0.391**
2	**No. of branches /plant**	-0.366	-0.048		-0.020	0.076	1.181	0.041	-0.164	0.118	0.036	0.855
3	**Days to 50% flowering**	-0.180	-0.014	0.400		-0.033	0.541	0.087	0.071	-0.909	0.019	-0.018
4	**Biomass /plant (g)**	0.167	-0.049	-0.167	-0.035		0.371	-0.065	-0.046	0.420	-0.006	0.592
5	**No. of pods /plant**	1.740	-0.012	-0.249	0.056	0.036		0.093	0.054	-0.980	0.032	0.771
6	**Pod length/(cm**	-0.158	0.006	0.096	-0.098	0.069	-1.019		0.018	0.938	-0.038	-0.187
7	**No. of seeds /pod**	0.341	0.076	0.176	0.038	-0.022	0.277	-0.008		-1.057	-0.027	-0.207
8	**100 – seed weight**	1.534	-0.046	-0.028	-0.107	0.046	-1.112	-0.097	-0.235		-0.004	-0.050
9	**Harvest index**	0.061	-0.040	-0.216	0.054	-0.016	0.895	0.097	-0.150	-0.108		0.579