

## The Study of Relationship Between Different Traits in Common Bean (*Phaseolus vulgaris* L.) With Multivariate Statistical Methods

<sup>1</sup>M. Salehi, <sup>2</sup>M. Tajik and <sup>3</sup>A.G. Ebadi

<sup>1</sup>Department of Plant Breeding, Young Researchers Club,  
Islamic Azad University, Miyaneh Branch, Miyaneh, Iran

<sup>2</sup>Department of Agronomy, Aboureyhan Campus, Tehran Univesity, Tehran, Iran

<sup>3</sup>Department of Biological Sciences, Islamic Azad University, Sari Branch, Sari 48164-194, Iran

**Abstract:** In this study the relationships among different traits of common bean (*Phaseolus vulgaris* L.) were evaluated. A field study was conducted as an Randomized Complete Block Design (RCBD) based design with 3 replications in the Jihad-e-Agriculture research farm ministry of Miyaneh during growing season (spring 2004). Triats such as plant height, number of pods per plant, seed yield, number of seeds per pod, pod height, biomass yield and Harvest index was recorded. Data revealed significant differences for all characters except, harvest index. There were positive and significant correlations between number of seeds per pod, number of pods per plant and pod length, with grain yield. The results of factor analysis showed that the first factor with number of pods per plant, seed yield and number of seeds per pods were the important traits in relation to seed yield in common bean. Cluster analysis, separated genotypes to three distinct groups with high, moderate and low yields.

**Key words:** Correlation • Yield Components • Multivariate analysis • Common bean • Seed yield

### INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is the most important source of protein and has a major role as a food legume. To achieve significant progress in breeding programs, it is essential to know the relationship between seed yield and its components [1].

The correlation between yield components has been extensively studied. Assady *et al.* [1] reported that days to flowering had the highest significant positive correlation with seed yield and 100-seed had the significant negative correlation with seed yield and factor analysis revealed that five factors were accounted for 77.4% of total variation. Mohamadi *et al.* [5], showed that first component in Principal Components Analysis (PCA) explains only 75% of total variation. Salehi *et al.* [9], found positive and significant correlation between harvest index, number of primary branches, number of pods per plant and biological yield with seed yield in lentil. They also concluded that the second factor with number of primary branches, number of pods per plant, seed yield, canopy width and number of seeds

per plant were the important traits in relation with seed yield.

In another study, Siddique *et al.* [11] noted inverse associations of seed yield with days to flowering, poding and maturity in the narbon bean. Noor *et al.* [6], stated that days to floweing, secondary branch number and 100 seed weight exhibited high heritability. White and Gonzalez [14] and singh *et al.* [10] reported that PCA of cell volumes defined a first component accounting for 51% of the total variation. They also, reported positive relationships between seed size and yield in certain environments.

According to Scully *et al.* [12], harvest index had the lowest correlations with seed yield and the concomitant phenotypic correlations were mostly equal to the genetic correlations for biomass and three growth rates, but lower for the phenological traits (days to maturity, flowering and pod filling). Changezi *et al.* [2] reported the highest positive correlations with seed yield for the number of pods per plant and 100-seed. Goncalves *et al.* [3] reported that 100-seed is correlated negatively with seed yield, although its path coefficient was positive, thus

suggesting that it should be considered in breeding studies to increase grain yield.

The purpose of this study was to estimate the correlations among some important traits and to extract factors comprising important traits for improving seed yield of common bean (*Phaseolus vulgaris* L.) in breeding programs.

### MATERIALS AND METHODS

Eight diverse genotypes (COS-16, Khomeyn, Talash, Sayyad, Naz, Gole, Daneshkadeh and Dehghan), of common bean (*Phaseolus vulgaris* L.) obtained from National Bean Research Station of Khomein city, Iran that were grown in Research Farm of Jihad-e-Agriculture ministry of Miyaneh city, Iran (latitude 37°75' N, longitude 47°18', height 1733 m) in 2007. The soil analysis of research area was: EC=0.75mmhos/cm), pH=8.45,  $Co_3H=1.2$  meq/L),  $Co_3^{2-}=1.01$  meq/L) and  $cl=0.5$ (meq/L).

The experiment was conducted during the spring season of the year 2007, using a randomized complete block design (RCBD) with three replications. Each line was sown in 4 rows, 4 m long with 35 cm wide Before sowing, 40 kg ha<sup>-1</sup> N and 60 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub> fertilizers were applied. the plants irrigate in three times: planting, flowering and pod filling stage.

Randomly selected plants were determined for plant height, number of pods per plant, seed yield,

number of seeds per pod, pod height and biomass yield. Harvest index was calculated as  $HI = \text{seed yield} \times 100 / \text{straw yield}$ .

Correlation coefficients were calculated with MSTATC program in order to determine the relationships between examined traits and seed yield. The factor analysis and cluster analysis were performed using SPSS software (version 7.5).

### RESULTS AND DISCUSSION

Table1, showed that there were significant differences among genotypes for all characters except harvest index. There were also significant differences amongst the replications except for number of seeds per pod and biomass yield . Other studies have also indicated the existence of variation for differences among genotypes for most of the studied characters [5, 9].

The correlation coefficients between seed yield and yield components showed positive ( $p < 0.05$ ) relationships between seed yield and number of pods per plant number of seeds per pod and pod height ( $r_{0.755}$ ,  $r_{0.775}$  and  $r_{0.758}$ ). It was revealed that seed number per pod and number of pods per plant shows positive correlation with harvest index (Table 2). Similar results reported by Assady *et al.* [1], Singh *et al.* [10] in common bean and Negem *et al.* [7], in broad bean. Also, positive correlations were found between seed number per pod and number of pods per plant ( $r_{0.733}$ ,  $p < 0.05$ ) that by proved

Table 1: Mean squares of seed yield and yield components of common bean

		MS						
SOV	df	Plant height	pods per plant	No. of seeds per pod	No. of Pod height	Biomass yield	Seed yield	Harvest index
Rep	2	36.811*	8.641**	0.152	0.686*	5709.114	741048.9**	110.615**
Genotypes	7	29.822*	4.588**	0.330*	2.381**	2798168.60*	422019.5**	8.509
Error a	14	7.105	0.204	0.130	0.299	778364.600	28129.100	9.101
CV%	-	14.020	15.020	19.600	14.500	19.900	15.000	15.200

Table 2: Correlation coefficients between seed yield and yield components of common bean

Traits	Plant height	No. of pods per plant	No. of seeds per pod	Pod height	Biomass yield	Seed yield	Harvest index
Plant height	1						
Number pods per plant	0.171	1					
Number seeds per pod	-0.062	0.753*	1				
Pod height	0.431	0.942**	0.732*	1			
Biomass yield	0.886**	0.547	0.511	0.730*	1		
Seed yield	0.188	0.775*	0.775*	0.758*	0.465	1	
Harvest index	-0.110	0.718*	0.733*	0.715*	0.218	0.522	1

\* and \*\*: Significant at the 5% and 1% levels of probability, respectively

Table 3: Factor analysis with varimax rotation of yield components and seed yield in common bean

Traits	Factors		
	1	2	3
Plant height (cm)	0.017	0.970	-0.090
Number pods per plant	0.630	0.280	0.600
Number seeds per pod	0.780	-0.090	0.530
Pod height (cm)	0.560	0.500	0.630
Biomass yield (g/ha)	0.200	0.950	0.210
Seed yield (g/ ha)	0.920	0.210	0.220
Harvest index (%)	0.300	0.040	0.900
Total	2.300	20.400	20.500
% of Variance	33.300	32.000	29.300
% Cumulative	33.200	65.200	94.500

Kumar *et al.* [4]. Harvest index was correlated significantly with plant height and pod height ( $r=0.886$   $p<0.01$  and  $r=0.730$   $p<0.05$ , respectively). Similar results were reported by other researchers. It seems that number of pods per plant and number of seeds per pod were useful characters to select for high yield in common bean breeding programs [3, 4, 10].

Factor analysis is a multivariate statistical method which can reduce a large number of correlated variables in small number of uncorrelated factors. Factor analysis distributed seven variables in to three factors (Table 3).

For the better explanation, only those factor coefficients that were greater than 0.60, which were significant without considering their sign. The first factor could explain 33.33% of total variation. The most important coefficients in this factor were related to number of pods per plant, number of seeds per pod and seed yield. Significant correlations were observed for all these traits (Table 2).

The second factor contained 32% of total variations, where plant height and biomass yield were the most important traits. Also, there was positive correlations between plant height and biomass yield (Table 2).

The third factor included 29.3% of the total variation. The most important traits in this factor were harvest index and pod length.

Tikka and Asawa [13] reported that secondary branches, pods per plant, days to flower and primary branches substantially affect these traits accounted for 65% of the variation. The Principal Components Analysis (PCA) showed 14 morpho-agronomical traits that contained 60% of the phenotypic variation [8]. Cluster analysis divided cases such as 8 genotypes to 3 main groups (Fig. 1) Which were significantly different from each other in main agronomic traits.

In each plant, number of seeds per pod and pod length has the high biomass yield and seed yield; thus named large yields group. Group-II included medium yields. Table 4, showed that Group-III with the highest

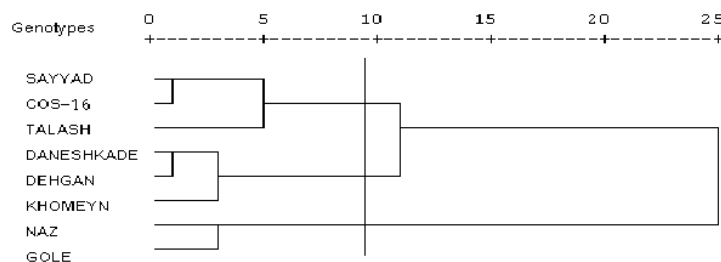


Fig. 1: Dendrogram produced by UPGMA cluster analysis of the 8 common bean genotypes

Table 4: Mean seed yield and yield components of common bean

Groups	Genotypes	Harvest index (%)	Seed yield (kg. ha <sup>-1</sup> )	Biomass yield (kg. ha <sup>-1</sup> )	Pod height (cm)	No. of seeds per pod	No. of pods per plant	Plant height (cm)
I	SAYYAD	41.00	3240.60	8900.60	11.60	4.00	10.26	65.20
	COS-16	36.40	3179.90	8760.50	10.60	3.00	9.56	63.60
	TALASH	36.30	2677.40	9488.30	10.30	2.80	8.10	70.50
II	DANESHKADE	36.40	2859.40	8068.06	9.60	3.90	7.69	64.10
	DEHGAN	37.73	2933.40	7795.50	9.10	3.00	6.96	64.30
	KHOMEYN	37.40	3498.03	7823.70	10.40	4.00	9.30	63.20
III	NAZ	39.83	3975.10	10298.10	12.60	4.20	10.63	69.70
	GOLE	36.80	3449.20	9967.60	10.70	3.00	9.10	70.00

average number of pods accessions with the lowest seed yield and number of pods per plant, pod height and moderate harvest index. Also, in group-I, with Sayyad, COS-16 and Talash genotypes had low yields.

### CONCLUSION

As results shown in this study, there were positive and significant correlations between number of seeds per pod, number of pods per plant and pod length, with grain yield. The results of factor analysis indicated that the first factor with number of pods per plant, seed yield and number of seeds per pods were the important traits in relation to seed yield in common bean. Cluster analysis, separated genotypes to three distinct groups with high, moderate and low yields. Totally, these traits had major contribution to seed yield and hence can increase the success of breeding studies of common bean in the Miyaneh region of Iran.

### REFERENCES

1. Assady, B., H.R. Dorri and S. Vaezi, 2005. Study of Genetic diversity of bean (*Phaseolus vulgaris* L.) genotypes by multivariate analysis methods. The first Iranian Pluse symposium, Research Center for Plant Sciences, Ferdowsi University of Mashhad, Mashhad, Iran, pp: 650.
2. Changezi, M., S. khaghani and S. khaghani, 2005. Traits Correlations and Yield Component Analysis of Local Beans in Arak. The first Iranian Pluse symposium, Research Center for Plant Sciences Ferdowsi University of Mashhad. Mashhad, Iran, pp: 321.
3. Goncalves, M.C., A.M. Correa, D. Destro, L.D. Souza, S.T. Alves and L.C.F. Souza, 2003. Correlations and path analysis of common bean grain yield and its primary components, *Crop Breeding and Applied Biotechnology*, 3(3): 217-222.
4. Kumar, J., H. Singh, T. Singh, D.S. Tonk and R. Lal, 2002. Correlation and path coefficient analysis of yield and its components in summer moong (*Vigna radiata* (L.) wilczek), *Crop Research*, 24: 374-377.
5. Mohamadi, A, M. Soloki, M.R. Ghannadha and B. Siyasar, 2005. Study of quantity traits effects on yield and yield components in 4 cultivar of common bean (*Phaseolus vulgaris* L.). The first Iranian Pluse symposium, Research Center for Plant Sciences, Ferdowsi University of Mashhad, Mashhad, Iran, pp: 652.
6. Noor, F., M. Ashaf and A. Ghafoor, 2003. Plant analysis and relationship among quantitative traits in chick pea (*Cicer arietinum* L.), *Pakistan Journal of Biological Sciences*, 6: 551-555.
7. Negem, S.A., M.A. Mohamed and H.A. Rabe, 1990. Yield analysis in broad bean, *Zagazig Journal of Agriculture Research, Zagazig Univ. Egypt*, 10: 125-139.
8. Rosales, S.R., G.J.A. Acosta, D.R.P. Duran, H. Guillen, H.P. Perez, E.G. Esquivel and M.J.S. Muruaga, 2003. Genetic diversity in common bean (*Phaseolus vulgaris* L.) bred germplasm in Mexico, *Agricultura Tecnica en Mexico*, 29(1): 11-24.
9. Salehi, M., A. Haghazari, F. Shekari and H. Baleseni, 2007. Evaluation of relationship between Different traits in Lentils (*Lens culinaris* Medik), *Journal of Sciences and Technology of Agriculture and Natural Resources*, 41(A): 205-215.
10. Singh, S.P., A. Molina and P. Gepts, 1995. Potential of wild common bean for seed yield improvement of cultivars in the tropics, *Canadian Journal of Plant Sciences*, 75(4): 807-813.
11. Siddique, K.H., P.S. Loss and D. Enneking, 1996. Narbean (*Vicia narbonensis* L.): apromising grain legume for low rainfall areas of south-western Australia, *Australian Journal of Experimental Agriculture*, 36: 53-62.
12. Scully, B.T., D.H Wallace and D.R. Viands, 1991. Heritability and correlation of biomass, growth rates, harvest index and phenology to the yield of common beans, *Journal of the American Society for Horticultural Science*, 116(1): 127-130.
13. Tikka, S.B.S. and B.M. Asawa, 1981. Factor analysis in lentil, *Lens*, 8: 19-20.
14. White, J.W. and A. Gonzalez, 1990. Characterization of the negative association between seed yield and seed size among genotypes of common bean, *Field Crops Research*, 23(3-4): 159-175.
15. Mensah, J.K. and R. Tope Olukoya, 2007. Performance of Mung Beans (*Vigna mungo* L.) (Hepper) Grown in Mid-west Nigeria, *American-Eurasian Journal of Agricultural and Environmental Sciences*, 2(6): 696-701.