THE RELATIONSHIP BETWEEN SOME MORPHOLOGICAL TRAITS AND YIELD ON ORGANIC CLIMBING BEANS

RELAȚIA DINTRE ANUMITE CARACTERISTICI MORFOLOGICE ŞI PRODUCȚIE LA FASOLEA URCĂTOARE ECOLOGICĂ

BURNICHI Floarea[1]*, STRUGARIU Carmen-Gabriela[1], DAVID Monica[1], TEODORESCU Eliza-Niculina[1]
*Corresponding author e-mail: burnichi@yahoo.com

Abstract. *The "components of yield" approach has been used widely to explain variations in the yield of grain legumes. The study has been conducted at Vegetable Research and Development Station (VRDS Buzau), under the normal testing conditions of 2018. The biological material was represented by 12 genotypes from the climbing beans* (*Phaseolus vulgaris* L.) *collectionof the Physiology, Agro-chemistry and Organic Crops Laboratory. A significant genetic variability has been found between climbing bean genotypes, for all indicators which have been analyzed. Some elements which define the pod architecture, the thickness and width have had a significant positive influence on yield indexes for climbing bean genotypes. Two lines of the climbing beans collection (L49M şi L6U) at VRDS Buzau have been identified with a very good performance in yield index on climatic conditions of 2018. These varieties could be used in the breeding program in agro-ecological system for obtaining new cultivars with a good performance in yield.*
Key words: collection, climbing bean, yield, morpho-agronomical traits

Rezumat. *Abordarea "componentelorrecoltei" a fostutilizată pe scară largă pentru a explica variațiile de producție la legumele pentru păstăi/boabe. Studiul a fostrealizat la Stațiunea de Cercetare-Dezvoltare pentru Legumicultură Buzău (SCDL Buzău), încondițiile de testare ale anului2018. Materialul biologic a fost reprezentat de 12 genotipuri din colecția de fasole (Phaseolus vulgaris L.) a Laboratorului de Fiziologie, Agrochimie şi Culturi Ecologice. O variabilitate genetică semnificativă a fost observată între genotipurile de fasole urcătoare, pentru toți indicatorii analizați. Unele elemente care definesc arhitectura păstăilor, grosimea şi lățimea acestora, au avut o influență pozitivă semnificativă asupra indicatorilor de producție, pentru genotipurile de fasole urcătoare. La SCDL Buzău au fost identificate două linii din colecția de fasole (L49M şi L6U), cu o foarte bună performanță în ceea ce priveşte indicele producție, în condițiile climatice din 2018. Aceste soiuri ar putea fi utilizate în programul de ameliorare în sistem agro-ecologic, pentru obținerea de noi soiuri, cu bune performanțe productive.*
Cuvinte cheie: colecție, fasole urcătoare, producție, caracteristici morfo-agronomice

[1]Vegetable Research and Development Station Buzau, Romania

INTRODUCTION

One of the most important objectives in the germplasm management of any crop is to measure and quantify genetic variability available in the species. In this way breeders can estimate the crop's potential and limitations (Von Schoohoven, 1991). Common bean is one of the most legume crop in the world. It has a special role for rich and poor countries (Onderand Babaoglu, 2001).

In plant breeding, seed / yield index of a cultivar is usually the most important attribute for crop production (Dawo *et al.,* 2007). Seed yield in common bean is expressed as the product of 3 traits: pods/plant, seeds/pod and seed weight (Dawo *et al.,* 2007). According to Ayazet al. 2004 and Dawo et al., 2007, the highest seed yieldis obtained when all these characters are maximized. Researches focused on common bean have shown that differences in plant architectural traits affect yield (Nelson *et al.,* 1997). Genotype × environment interaction was significant for fresh pod traits such as curvature, length/width and width/thickness ratios, and texture, and for dry seed traits such as length/width and width/thickness ratios, volume, hardness and water absorption. There were high correlations of pod texture with seed length/width and width-thickness ratios, seed coat percentage, seed water absorption, crude fat, total sugars, starch content and crude fiber (Escribano *et al*., 1997).

This study was conducted to characterize relationships between some morpho agronomical traitsand yield index of several genotypes in climbing bean.

MATERIAL AND METHOD

The biological material was represented by 12 climbing bean lines collected from Romania and other countries for the germplasm collection of the Physiology, Agro-chemistry and Organic Crops Laboratory. The biological material has been grown in opened field on the ecological polygon, according to the crop technology in the agro-ecological system which was recommended by the scientific papers. Biometrical and morphological determinations of the pods and beans have been performed according to the C.P.V.O. protocol, being prepared the standard papers for measurements. This study presents the variability of pod and bean traits of the selected genotypes. 10 plants were used for the measurements. Pod and bean determinations have been made using the calipers, electronic balance (Kern) and analytical balance (Partner WAS220/X). The data have been analyzed using ANOVA statistical analysis Excel. The paper presents the results obtained for the characterization of the collection in terms of the fruit biometrical indicators. The coefficients correlation has been established that it has allowed the comparison of the variation for the dataset and regression coefficients. The database has been established into electronic system, also a digital images database has been taken using a Nikon 5100 digital camera with DSLR.

RESULTS AND DISCUSSIONS

The data have been analyzed by statistical program Data Analysis from Microsoft Office – Excel. For the pods length (tab. 1), width (tab. 2), thickness (tab. 3), the beans weight (tab. 4), the pod weight (tab. 5) index, ANOVA test has shown the significant effect of climbing bean genotypes and that is why, therefore, these differences between genotypes were analyzed.

Table 1

ANOVA for pods length index;

ANOVA					
	DF	MS	F	P-value	F crit.
Genotypes	9	205.81	**133.1**	3.24E-09	3.02
Errors	10	1.54			
Total	19				

F values (bold) are significant at P≤0.05

Table 2

ANOVA for pods width index

ANOVA					
	DF	MS	F	P-value	F crit.
Genotypes	9	0.21	**61.29**	1.45E-07	3.020
Errors	10	0.004			
Total	19				

F values (bold) are significant at P≤0.05

Table 3

ANOVA for pods thickness index

ANOVA					
	DF	MS	F	P-value	F crit.
Genotypes	9	0,082042	**20,41**	2,69E-05	3,02
Errors	10	0,00402			
Total	19				

F values (bold) are significant at P≤0.05

Table 4

ANOVA for beans weight index

ANOVA					
	DF	MS	F	P-value	F crit.
Genotypes	9	1.23	**61.21**	1.46E-07	3.02
Errors	10	0.02			
Total	19				

F values (bold) are significant at P≤0.05

Table 5

ANOVA for pods weight index

ANOVA					
	DF	MS	F	P-value	F crit.
Genotypes	9	3.059007361	**15.01**	0.000108	3.02
Errors	10	0.20386595			
Total	19				

F values (bold) are significant at P≤0.05

Relationship between indicators analyzed in biometrical determinations for fructifications on climbing beans

Correlation analysis describes the mutual relationship between different pairs of characters without providing the nature of cause and effect relationship of each character. Hence, the path analysis was also performed to determine the direct and indirect contribution of each character to seed yield (Berhe *et al*., 1998). Factor analysis is a multivariate statistical method which can reduce a large number of correlated variables in small number of uncorrelated factors. Any component of yield may affect yield directly and/or it may act indirectly by influencing components which will be produced later in the developmental sequence (Doust *et al*., 1983) (tab. 6).

Table 6.

Relationship between indicators analyzed on climbing bean collection

	Pods length	Pods width	Pods thickness	Pods weight
Pods thickness	-0.55*	0.55*		
Pods weight	-0.01	0.63*	0.73**	
Beans weight	-0.07	0.55*	0.78**	0.98***

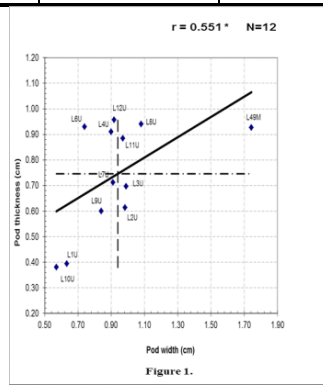

Fig. 1 Relationship between pod width and pod thickness indicators for fructifications on climbing beans;

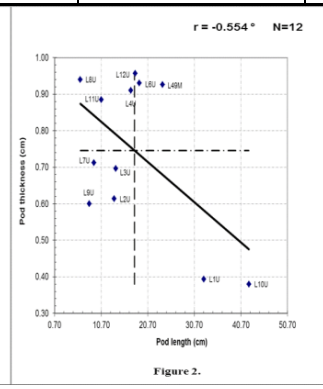

Fig. 2 Relationship between pod length and pod thickness indicators on climbing beans.

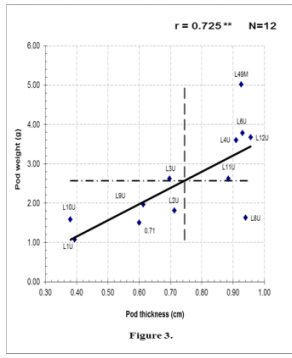

Fig. 3 Relationship between pod thickness and pod weight indicators on climbing bean plants

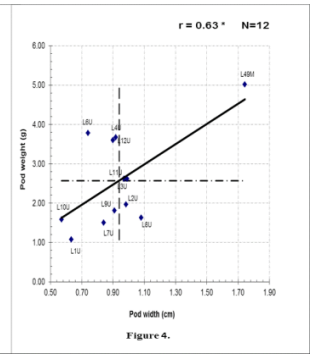

Fig. 4 Relationship between pod width and pod weightindicatorson climbing bean plants

Pods length and thickness indicators have had a negative significant correlation (r = -0.55*) (fig. 2). Climbing bean genotypes which have had high values of the pods length index, have had lower values of the pods thickness index and vice versa. The pod thickness indicator was significantly positively correlated with both yield indicators, respectively pods weight indicator (r = 0.725 **) (fig. 3) and beans weight indicator (r =0.782 **) (fig. 6). This correlation between indicators mentioned in regression analysis, has indicated that the fructification architecture of the climbing beans has had a positive influence for obtaining high yields in climbing bean genotypes.

Thus, the lines L49M and L6U are characterized by a great thickness and pod length (fig. 2), hovering above the regression line on the chart.L9U has had the lowest values for these indicators. The averages for these indicators have been found at L7U and L3U. Another very important indicator for yield index is pod width, which is correlated positively significantly (r = 0.55 *) (fig. 1) with another indicator related to fructifications architecture of the climbing beans, the pod thickness. Bean genotypes which had the best values for these indicators have been L49M and L6U. The genotypes which had the lowest values for these indicators have been L1U, L10U and L9U. These indicators having a significant positive correlation with other two indicators analyzed, respectively, the relationship between pod width and weight (r = 0.63 *) (fig. 4), the best values have been found for the same genotypes. The lines L1U, L9U and L7U bean have had the lowest values for these indicators, hovering below the regression line.

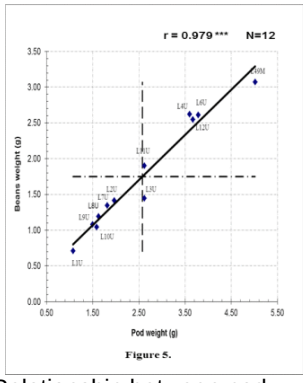

Fig. 5 Relationship between pod weight and bean weight indicators on climbing bean plants;

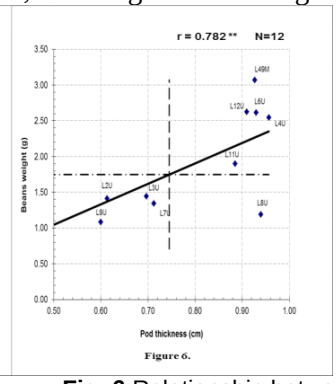

Fig. 6 Relationship between pod thickness and bean weight indicators on climbing bean plants.

Yield indicators, respectively pod weight and beans weight indexes, have been very significant positively correlated (r=0.979*) (fig. 5). Thus, for the breeding program in agro-ecological system, under normal testing conditions of 2018, romanianclimbing bean genotypes have had the good yield index, the highest yield has been found at two lines: L49M and L6U. L1U has been the genotype which had the lowest performance for both yield indicators.

CONCLUSIONS

1. Significant differences among genotypes have been found for all indicators analyzed.

2. Some indexes, as the pods width and thickness, have been correlated with a positive significance for yield indexes analyzed in agro-ecological system.

3. Some traits connected to the pod architecture, the thickness and width have had a significant positive influence on yield indexes for climbing bean genotypes.

4. Climbing bean genotypes collected for the germplasm collection at VRDS Buzau (Vegetable Research and Development Station) have been identified with a very good performance in yield index on climatic conditions of 2018, as climbing bean L49M and L6U and therefore, these varieties could be used in the breeding program in agro-ecological system for obtaining new cultivars with a good performance in yield.

5. For this study, the Romanian climbing bean lines have generally had the good values for yield index.

6. The climbing bean genotype L49M was registered for DUS testing at the State Institute for Variety Testing and Registration, Bucharest, Romania, in 2016.

REFERENCES

1. **Ayaz S., McKenzie B. A., Hill D. G., McNeil D. L., 2004** -*Variability in yield of four grain legume species in a subhumid temperate environment. I. Yields and harvest index,* J. Agric. Sci., 142, 9-20.
2. **Berhe A., Bejiga G., Mekonnen D. Mekonnen, 1998** -*Association of some characters with seed yield in local varieties of faba bean*, African Crop Science Journal, 6 (2), 197-204.
3. **Coyne D. P., 1968** -*Correlation heritability and selection of yield components in field beans Phaseolus vulgaris* L., Proc. Am. Soc. Hortic. Sci., 93, 338-396.
4. **Dawo M. I., Sanders F. E., Pilbeam J. D., 2007** -*Yield, yield components and plant architecture in the F3 generation of common bean (Phaseolus vulgaris* L.*) derived from a cross between the determinate cultivar „Prelude" and an indeterminate landrace*, Euphytica, 156, 77-87.
5. **Doust J. L., Doust L., Eaton G. W., 1983** -*Sequential yield component analysis and models of growth in bush bean (Phaseolus vulgaris* L.*),* American Journal of Botany, 70(7), 1063-1070.
6. **Escribano M., Santalla M., De Ron A., 1997** - *Genetic diversity in pod and seed quality traits of common bean population from northwestern Spain*, Euphytica 93, Issue 1, pp. 71-81.
7. **Nelson S.C., Robichoux R. M., 1997** - *Identifying plant architectural traits associated with yield under intercropping. Implications of genotype – cropping system interactions*, Plant breeding, 16, 163-170.
8. **Onder M., Babaoglu M., 2001** - *Interactions among gain variables in various dwarf dry bean (Phaseolus vulgaris* L.*) cultivars,* J. Agron. Crop Sci., 187, 19-23.
9. **Sarafi A., 1978** - *A yield component selection experiment involving American and Iranian cultivars of common bean*, Crop Sci., 18, 5-7.
10. **VonSchoohoven A., Voysest O., 1991** - *Common beans: research for crop improvement*, Centro Internacional de Agricultura Tropical.