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Application of Statistical Methods for Evaluation of Local *Phaseolus vulgaris* L. Experimental Data

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Abstract

Beans are a traditional crop grown almost anywhere in the country. The local forms are well adapted to specific agro-climatic conditions in the growing areas and are an interesting initial material for selection programs. The aim of the study is the implementation of statistical methods for evaluation of genetic diversity in the local *Phaseolus vulgaris* L. collection and to indicate correlation relationships between the studied parameters and economical characteristics. The included genotypes were collected from expeditions by bilateral cooperation project with China. The experiment was conducted in the vegetable field of IPGR, Sadovo. Plants are characterized by quantitative and qualitative indicators, according to the International descriptor of IBPGRI (1982). The results indicate genetic diversity in the studied collection and correlation relationships between the studied parameters and yield per plant.

Key words: Phaseolus vulgaris L., evaluation, correlations, cluster analysis

Introduction

The preservation of the plant biodiversity is the main priority in the research work in the IPGR – Sadovo, related to the implementation of the National Programme for Plant Genetic Resources. Germplazm collections from the main crops, which fully represent the genetic diversity in the context of the contemporary criteria for the future significance of the initial material in the selection programmes, have been created (Maggioni, 2004; Krasteva et al., 2007).

Beans are a traditional crop grown almost anywhere in the country. The local forms are well adapted to specific agro-climatic conditions in the growing areas (Angioi et al., 2010). In this context the collection of *Phaseolus vulgaris* L. is enriched annually through collection, evaluation and preservation of local plant genetic resources by expeditions around the country.

Tab. 1. Passport data of *Phaseolus vulgaris* L. accessions collected in project
Pasoški podaci Phaseolus vulgaris L. *prinova kolekcionisanih u projektu*

№	Cat. №	Year	Taxonomy	Project	Country	Place	Farmer	Accession	m	N	E
1	B1E0467	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
2	B1E0468	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
3	B1E0469	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
4	B1E0470	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
5	B1E0471	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
6	B1E0472	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
7	B1E0473	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
8	B1E0474	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
9	B1E0475	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
10	B1E0476	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
11	B1E0477	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
12	B1E0479	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
13	B1E0481	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
14	B1E0482	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
15	B1E0483	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
16	B1E0484	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
17	B1E0485	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
18	B1E0487	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
19	B1E0488	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973
20	B1E0489	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Zlatka Kafedjieva	Local	729	421058	235973

Tab. 1. Passport data of *Phaseolus vulgaris* L. accessions collected in project (continued)
Pasoški podaci Phaseolus vulgaris L. *prinova kolekcionisanih u projektu (nastavak)*

№	Cat. №	Year	Taxonomy	Project	Country	Place	Farmer	Accession	m	N	E
21	B1E0490	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Antonia Beleva	Local	729	421058	235973
22	B1E0496	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Ztvetelina Dimitrova	Local	729	421058	235973
23	B1E0497	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Ztvetelina Dimitrova	Local	729	421058	235973
24	B1E0498	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Ztvetelina Dimitrova	Local	729	421058	235973
25	B1E0499	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Ztvetelina Dimitrova	Local	729	421058	235973
26	B1E0500	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Velingrad	Ztvetelina Dimitrova	Local	729	421058	235973
27	B1E0507	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Rakitovo	Jordanka Markova	Local	874	421056	235971
28	B1E0508	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Rakitovo	Jordanka Markova	Local	874	421056	235971
29	B1E0509	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Rakitovo	Jordanka Markova	Local	874	421056	235971
30	B1E0510	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Kostandovo	Miran Miliov	Local	463	421020	246057
31	B1E0511	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Kostandovo	Emil Ztvetkov Milev	Local	463	421020	246057
32	B1E0513	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Dorkovo	Boryana Zaharieva	Local	464	422044	247055
33	B1E0517	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Dorkovo	Dimitria Valchinova	Local	464	422044	247055
34	B1E0518	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Dorkovo	Nikolai Kovachev	Local	464	422044	247055
35	B1E0519	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Dorkovo	Georgi Tashkov	Local	464	422044	247055
36	B1E0520	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Dorkovo	Manol Luchkov	Local	464	422044	247055
37	B1E0522	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Dorkovo	Eli Mircheva	Local	464	422044	247055
38	B1E0526	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Dorkovo	Dimitar Mirev	Local	464	422044	247055
39	B1E0535	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Rozovo	Nadka Marvakova	Local	650	420171	243670
40	B1E0536	2011	*Phaseolus vulgaris* L.	BGR-CHN	BGR	Rozovo	Emil Shalev	Local	650	420171	243670

The aim of the study is implementation of statistical methods for evaluation of genetic diversity in the local *Phaseolus vulgaris* L. collection and to indicate correlation relationships between the studied parameters and economical characteristics.

Materials and methods

Plant material and study parameters

During the period 2011-2012 at the Institute of Plant Genetic Resources – Sadovo, 40 indeterminant *Phaseolus vulgaris* L. accessions (Table 1) with local origin from expeditions by the bilateral project between Bulgaria and China were studied. Important morphological parameters according to the International descriptor of IBPGRI (1982) were evaluated. The plants were sown on the experimental vegetable field. The plants were grown based on a common technology for middle - early field production.

During the different stages of the crop development, biometric measurements of plants, pods and seeds from all tested accessions were made.

Statistical data analysis

The obtained results were processed using statistical package SPSS 13.0. for Windows. Correlations between study traits and cluster analysis of the experimental data was made (Dimova & Svetleva, 1996; Svetleva et al., 2005).

Results and discussion

Correlations between studied elements are shown in Table 2. The observation indicates a moderate to high correlation between morphological characteristics. Impressive are the direct connection of seed yield from one plant to the parameters number of flowers, width of pods, weight of 10 pods, the length and width of seeds. The only proven negative relationship extraction is with the length of the beak.

The connections of the elements associated with yield are in complex correlations of each other also. For example, increasing the number of flowers is directly affected by the number of branches. The width of pods proven correlate positively with the number of branches and flowers and negative - with length. The thickness of the pods is influenced positively by the number of flowers and branches, and the width of the pods. The mass of 10 pods is positively proven correlated with the number of flowers, width and thickness of the pods. This indicator has proven negative correlation with the length of the pods.

The length of the seed in the analyzed accessions is very polymorphic characteristic and has a feature relation with all studied morphological parameters. It is positively related to the number of branches, number of flowers, width and length of

pods, beak length and mass of 10 pods. There is a proven negative correlation of this indicator with the length of the pods and the number of pods in a plant.

Similarly to the previous indicator, the relationship between the width of seeds and other morphological indicators have largely proven. There is a positive correlation with the number of flowers, width and length of pods, mass of 10 pods and the length of the seed. Negative relationships are indicators of the length of the pods and their number in one plant.

The analysis of the results of the correlation analysis shows the complexity of the formation of seed yield in the culture. This indicator is identified like very polymorphic and it allows selection of initial material that might be included in future breeding programs successful.

Clarifying the genetic diversity of the accessions was done using the method of cluster analysis. Dendrogram (Fig. 1) shows that the genotypes are divided into two cluster groups.

In the first cluster covered the majority of the accessions. Parameters which are affecting the highest degree in their grouping are plant height, length of the average leaf, thickness of the pods, the number of pods per plant and weight of 10 pods. The values of these parameters in this cluster in the included genotypes significantly exceeded the average for the entire collection.

The other six accessions are separated in the other group and are in a great distance from the rest by these indicators.

Genotype with catalog number B1E0484 originating from Velingrad region is distinguished from all other with the highest plant, the largest mass of 10 pods and highest seed yield per plant. This makes it an interesting source for crop genetic improvement.

Conclusion

The results indicate a genetic diversity in the *Phaseolus vulgaris* L. collection by studied morphological indices.

The most of parameters which are yield formed take part in grouping the accessions in two clusters.

Breeders who work with this crop must have in mind the elements which correlate directly with seed yield per plant.

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Tab. 2. Correlations between study parameters of local *Phaseolus vulgaris* L. accessions
Korelacije između parametara lokalnih prinova Phaseolus vulgaris L.

	Plant height	Number of branches	Number of flowers	Length of pods	Width of pods	Thickness of pods	Length of beak	Weight of 10 pods	Number of pods per plant	Number pods peduncles	Seed length	Seed width	Yield per plant
Plant height	1	0,006	0,123	0,151	-0,116	0,197	0,103	0,242	-0,039	0,112	0,109	0,108	0,263
Number of branches		1	0,464 **	-0,223	0,516 **	0,424 **	-0,033	0,228	-0,304	-0,298	0,343 *	0,312	0,175
Number of flowers			1	-0,565 **	0,851 **	0,929 **	-0,081	0,725 **	-0,626 **	-0,261	0,831 **	0,906 **	0,656 **
Length of pods				1	-0,560 **	-0,508 **	-0,179	-0,350 *	0,365 *	-0,028 *	-0,465 **	-0,567 **	-0,300
Width of pods					1	0,831 **	-0,076	0,637 **	-0,698 **	-0,367 *	0,736 **	0,858 **	0,534 **
Thickness of pods						1	-0,058	0,737 **	-0,607 **	-0,312	0,769	0,890 **	0,676
Length of beak							1	-0,075	-0,086	-0,018	0,065 **	-0,031	-0,105 **
Weight of 10 pods								1	-0,516 **	-0,179	0,582 **	0,627 **	0,978 **
Number of pods per plant									1	0,436 **	-0,496 **	-0,634 **	-0,335
Number pod peduncles										1	-0,291	-0,254	-0,096
Seed length											1	0,830 **	0,519 **
Seed width												1	0,545 **
Yield per plant													1

* Correlation is significant at the 0.05 level / *Korelacija je značajna na nivou od 0,05*
** Correlation is significant at the 0.01 level / *Korelacija je značajna na nivou od 0.01*

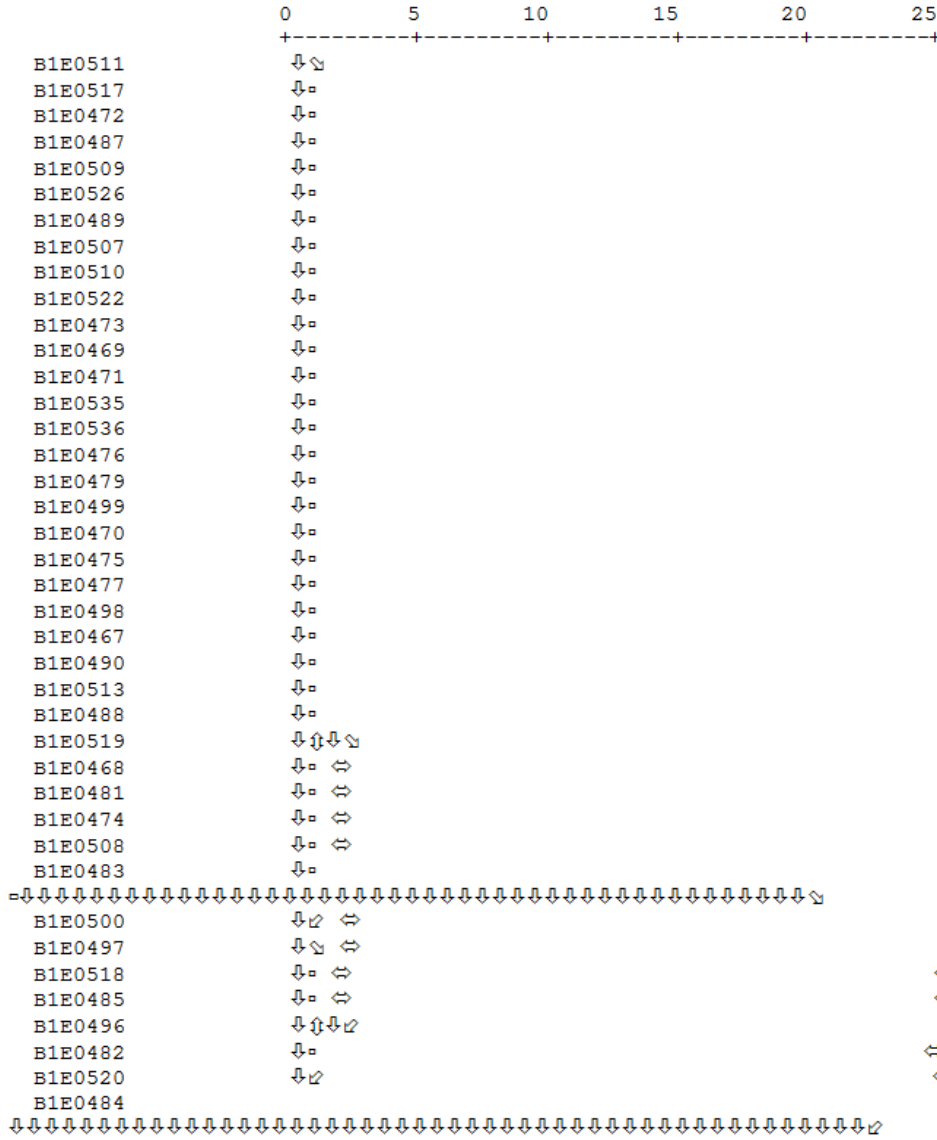

Fig. 1. Dendrogram of *Phaseolus vulgaris* L. genotypes, grouping based on differences between indices

Dendrogram genotipova Phaseolus vulgaris L.*, grupisanih na osnovu razlika između indeksa*

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Primjena statističkih metoda u evaluaciji ekperimentalnih podataka o lokalnim sortama pasulja (*Phaseolus vulgaris* L.)

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Sažetak

Pasulj je tradicionalna kultura koja se gaji gotovo bilo gdje u našoj zemlji. Lokalne sorte su dobro prilagođene specifičnim agro-klimatskih uslova u oblastima gdje se gaje i predstavljaju zanimljiv početni materijal za programe selekcije. Cilj studije je primjena statističkih metoda za ocjenu genetičke raznovrsnosti u lokalnoj kolekciji *Phaseolus vulgaris* L. kao i da ukaže na korelacijske odnose između ispitivanih parametara i ekonomskih karakteristika. Priloženi genotipovi su prikupljeni iz ekspedicije po projektu bilateralne saradnje sa Kinom. Eksperiment je izveden u biljnom oblasti IPGR, Sadovo. Karakterizacija biljaka se vršena kvantitativnim i kvalitativnim pokazateljima, prema IBPGRI (1982). Rezultati ukazuju na genetsku raznolikost u ispitivanoj kolekciji i korelacijske odnose između ispitivanih parametara i prinosa po biljci.

Ključne riječi: Phaseolus vulgaris L., evaluacija, korelacije, klaster analiza

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