Bulgarian Journal of Agricultural Science, 30 (No 3) 2024, 458–465

Diversity of common beans (*Phaseolus vulgar*is L.) accessions with Bulgarian and Chinese origin

Tsvetelina Stoilova[1*], Petar Chavdarov[1], Nikolaya Velcheva[1] and Lixia Wang[2]

[1] *Agricultural Academy, Institute of Plant Genetic Resources "K. Malkov", 4122 Sadovo, Bulgaria*
[2] *Chinese Academy of Agricultural Science, Institute of Crop Sciences, Zhongguancun South Street, Haidian District, 100081 Beijing, China*
[*]*Corresponding author:* tsvetelinas27@gmail.com

Abstract

Stoilova, T., Chavdarov, P., Velcheva, N. & Wang, L. (2024). Diversity of common beans (*Phaseolus vulgaris* L.) accessions with Bulgarian and Chinese origin. *Bulg. J. Agric. Sci., 30*(3), 458–465

There is a long tradition in cultivation of common bean (*Phaseolus vulgaris* L.) in the Balkans and China, mainly used for human consumption. A large number of landraces are still grown in different geographical locations of the countries, that have good adaptation to local conditions. This allows high yield stability with low input farming. The main purpose of this study was to analyze morphological variability of 17 Chinese and 20 Bulgarian accessions of common bean (*Phaseolus vulgaris* L.) grown under environmental conditions in Sadovo, located in the Central South Bulgaria. The differences among and within two subgroups were initially characterized using a set of 16 phenotypic descriptors. Three of the total characteristics, days to flowering, duration of flowering and days to maturity were analyzed separately. All accessions were evaluated for two bacterial diseases, caused by the pathogens, *Xanthomonas axonopodis* pv. *phaseoli* and *Pseudomonas syringae pv. phaseolicola*. A considerable morphological variation was found among different genotypes, particularly on earliness with CV(%) of 4.2 (BG) and CV(%) 2.9 (CH). Morphological traits, as plant biomass, weight of pods and seeds per one plant showed the highest variability among others, with CV > 41.2%. With reference to the results, accessions can be classified according to their yield, earliness and seed size.

Keywords: common bean; characterization; diseases resistance; diversity; germplasm

Introduction

The legume crops are of main importance for human populations as a source of cheap plant protein. Common (dry) bean (*Phaseolus vulgaris* L.) is one of the most important legumes in the world. The total harvested area registered in 2021 was 35920593 ha and the world yield production of common bean was 27715023.7 tones (FAOSTAT, 2021). This crop is considered as traditional food legume for Bulgarian populations and it is grown by both commercial and small scale farmers through all over the country (Stoilova et al., 2013). There is a big diversity of *Ph. vulgaris* and *Ph. coccineus* observed in both countries, Bulgaria and China (Long et al., 2014; Stoilova, 2011). Landraces are presented *in situ*/on farm in different geographical regions, which shows a wide morphological and genetic diversity (Stoilova, 2011). Common bean germplasm resources differ among populations belong to the different ethnic groups (Long et al., 2020). All plant material of *Phaseolus* germplasm, landraces, old varieties and populations are of big interest for future breeding and research work as well as for preserving in genebank/ *ex situ* for future purposes. The genetic diversity of 115 common bean germplasm collected from 27 counties of Chongqing, China was studied using PCA (Long et al., 2020).

Three main groups of accessions in their study were identified: the first principal component separated bean accessions with erect type, while the second and third principal components distinguished accessions from Mesoamerican and Andean gene pools. The distribution of different types of *Phaseolus* accessions depends from the farmers' preferences and agro ecological conditions in particular region (Servia et al., 2016). Farmers from different geographical regions selected accessions according to their consumer's preferences as seed size, color and shape with particular organoleptic tastes and better adaptation to local environments with specific micro climate of small geographical area (Piergiovanni et al., 2010). *In situ* on farm conservation and *ex situ* in genebank will ensure preservation of local plant germplasm in response to global climate changes (Gómez-Baggethun et al., 2013). Over the last four decades Bulgaria's climate has been changing, which is in accordance with global trends (Peev & Kouzmova, 2002).

Climate change includes higher temperatures, changes in precipitation and higher atmospheric CO_2 concentration (Rosenzweig et al., 2014). Extreme precipitation and flood changes often cause different extreme events, as drier climate (Tabari, 2020). Among different climate changes increased temperatures have the most negative impact on crop yield and quality of many crops, including grain legumes (Wheeler & von Braun, 2013; Zhao et al., 2017). In common bean high temperatures affect negatively flowering, fruit setting and maturity cycle, such as stress factor leading to abortion of flowers and pods, and cause premature ripening of plants (Minoz-Perea et al., 2006).

The monthly mean air temperature for the period of 1991-2020 in Bulgaria during vegetation cycle of common bean from April to August was from 10.5°C to 19.8°C (https://climateknowledgeportal.worldbank.org/country/bulgaria). The highest mean monthly air temperatures were 19.8–22.1°C during June and August. Precipitation is unevenly distributed in the country with annual value of 663.49 mm for region of Plovdiv in 2021. All these peculiarities in the climate of Bulgaria have an impact on crop productivity and variety distribution.

The Institute of Plant Genetic Resources (IPGR) in Sadovo, Bulgaria preserves a collection of about 2200 accessions of *Phaseolus* sp. Collected from different geographical origin of the country. During the last two decades, the research effort was made to collect local landraces and old varieties, to characterize, evaluate and preserve them at the IPGR National genebank.

The objectives of this study were 1) to characterize common bean germplasm with Bulgarian and Chinese origin, 2) to evaluate resistance to bacterial diseases; 3) to select promising accessions appropriate for future research and breeding work.

Material and Methods

The experiment was carried out at the experimental field of IPGR, Sadovo, Bulgaria. The Institute is situated in central southern part of the country, which lies between 24°57′00″ E longitude and 42°09′0″ N latitude, at an elevation of 153 m asl. Twenty (20) Bulgarian and seventeen (17) Chinese accessions were evaluated in this study (Table 1).

Table 1. List of *Ph. vulgaris* L. accessions included in this study

No	Accession number	Country of origin	No	Accession number	Country of origin
1	B2E0279	China	1	A8E0446	Bulgaria
2	B2E0280	China	2	C1E0014	Bulgaria
3	B2E0282	China	3	C1E0015	Bulgaria
4	B2E0283	China	4	C1E0016	Bulgaria
5	B2E0284	China	5	C1E0017	Bulgaria
6	B2E0285	China	6	C1E0018	Bulgaria
7	B2E0286	China	7	B9E0004	Bulgaria
8	B2E0287	China	8	B9E0005	Bulgaria
9	B2E0288	China	9	B9E0006	Bulgaria
10	B2E0289	China	10	B9E0008	Bulgaria
11	B2E0290	China	11	B9E0010	Bulgaria
12	B2E0291	China	12	B9E0012	Bulgaria
13	B2E0292	China	13	B9E0013	Bulgaria
14	B2E0293	China	14	B9E0024	Bulgaria
15	B2E0294	China	15	COE0329	Bulgaria
16	B2E0295	China	16	COE0330	Bulgaria
17	B2E0278	China	17	COE0331	Bulgaria
			18	COE0208	Bulgaria
			19	COE0209	Bulgaria
			20	COE0210	Bulgaria

Bulgarian accessions were collected from Rhodopi mountain region and part of the studied plant material was provided by the National genebank. Experimental field trial was carried out during two consecutive years, from 2021 to 2022. Figures 1 and 2 showed the mean T C and rainfall during vegetation cycle of *Phaseolus* in two years 2021 and 2022.

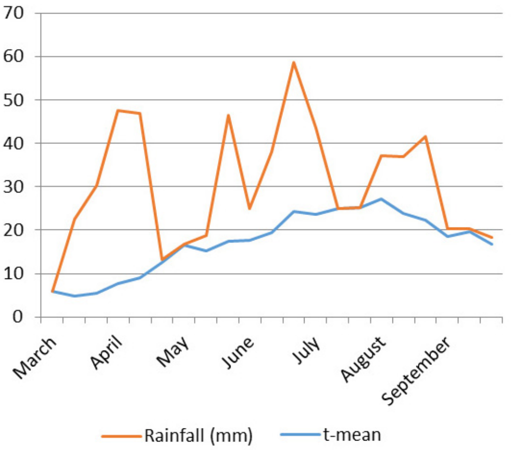

Fig. 1. Mean T°C and rainfall during 2021 (by decades)

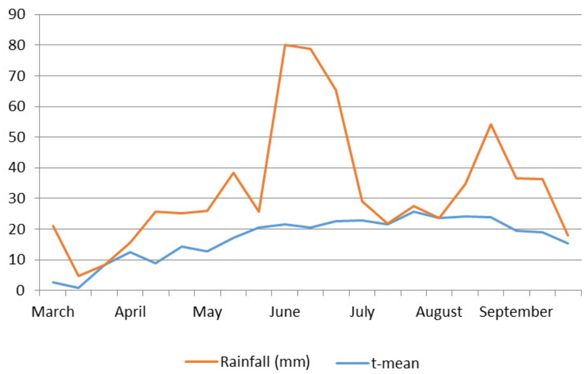

Fig. 2. Mean T°C and rainfall during 2022 (by decades)

Each accession was grown in two row plot with 2m length in two replications. Ten (10) plants per replication were chosen randomly for biometric measurements. Observations were made for 13 agro-biological and morphological characters, as follows: 1) days to flowering; 2) duration of flowering; 3) days to maturity; 4) plant height; 5) weight of plant; 6) weight of plant without pods; 7) number of pods/plant; 8) weight of pods/plant; 9) pod/length; 10) pod/width; 11) number of seeds/pod; 12) seed weight/plant; 13) weight of 100 seeds. Additional characteristics were taken on seed and pod morphology of each accession, including h of 1st pod, pod thickness, seed color and shape, etc. Some of these characters were included in PCA analysis. Characterization of each morphological trait was undertaken following the procedure described in *Phaseolus vulgaris* L. descriptor list (*Phaseolus vulgaris* descriptors, 1982). Evaluation of diseases resistance based on a scale with score from 1-9 was used (Genchev & Kiryakov, 2005).

Statistical analysis was performed using SPSS programme.

Results and Discussion

The results obtained show variation in phenological characters between Bulgarian and Chinese accessions (Figures 3 and 4). According to number of days to flowering stage in Bulgarian group of accessions was 34 with range from 28 to 42, while number of days to reach the same stage for Chinese accessions were bigger with 39.6 with bigger range from 28 to 48 (Tables 1 and 2). The differences between Bulgarian and Chinese accessions in phenological characters are shown in Figures 3 and 4. According to the vegetative cycle the accessions with Chinese origin showed low variation CV (%) – 2.9 compared with Bulgarian accessions with CV – 4.2%. Chinese accessions reached maturity after 67.6 days,

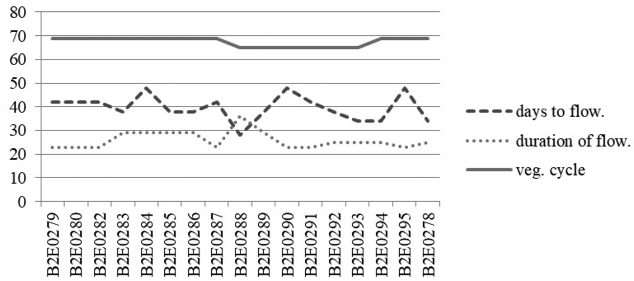

Fig. 3. Days to flowering, duration of flowering and vegetation cycle of Bulgarian accessions

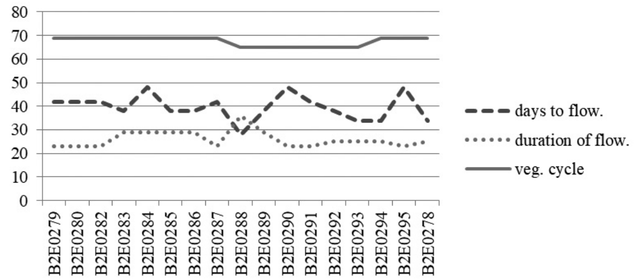

Fig. 4. Days to flowering, duration of flowering and vegetation cycle of Chinese accessions

Table 2. Descriptive statistics of phenological characters of 20 Bulgarian accessions

Value	Days to flowering	Duration of flowering	Vegetation cycle
Minimum	28.0	21.0	63.0
Maximum	42.0	40.0	69.0
Mean	34.0	30.6	66.4
Std. Error	1.3	1.7	0.6
CV, %	16.6	25.5	4.2

against to 66.4 days for BG group of accessions. Comparison into two groups of accessions showed higher variation among Bulgarian accessions, for number of days to 50% flowering with CV(%) 16.6 compared with 13.8% in Chinese group, and duration of flowering with CV(%) –25.5% (BG) and CV(%) – 14% for Chinese group.

The same trend was observed in duration of vegetation cycle with CV (%) – 4.2% (BG) and CV (%) – 2.9% (CH) for two groups, respectively (Tables 2 and 3). The results from table 2 showed numbers of days to 50% flowering and duration of this stage differed among the accessions. For accessions with cat. No C1E0017, C1E0018, COE0329 and COE0331 duration of flowering lasted in 20-22 days, while cat. No B9E0004, B9E0005, B9E0008, B9E0012, B9E0024 and COE0208 showed longer period of flowering of around 40 days. The last mentioned accessions needed 28–30 days to enter in this stage, 50% flowering. At the same time the accessions with Chinese origin are less diverse in terms of number of days to 50% flowering and duration of this stage. Accession No B2E0288 showed the least number of days necessary to reach flowering stage and longer period of du-

Table 3. Descriptive statistics of phenological characters of 17 Chinese accessions

Value	Days to flowering	Duration of flowering	Vegetation cycle
Minimum	28.0	23.0	65.0
Maximum	48.0	36.0	69.0
Mean	39.6	26.0	67.6
Std. Error	1.3	0.9	0.5
CV, %	13.8	14.0	2.9

Table 4. Morphological traits of Bulgarian landraces

Cat. №	Species	Hight of plant, cm	Weight of plant, g	Weight of plant without pods, g	Nr of pods/ plant	Weight of pods/ pl, g	Pod/ length	Pod/ width	Nr of seeds/ pod	Weight of seeds/ pl, g	Weight of 100 seeds, g
A8E0446	*Ph. vulgaris* L.	32	36.1	18.9	9.8	16.7	13.8	0.8	4.8	11.0	28.3
C1E0014	*Ph. vulgaris* L.	40.2	71.9	64.2	6.6	7.5	9.9	0.8	3.4	4.9	28.6
C1E0015	*Ph. vulgaris* L.	40.6	17.9	7.4	6.2	10.3	10.1	1.0	3.2	7.6	39.0
C1E0016	*Ph. vulgaris* L.	77.30	74.1	70.4	2.0	3.6	10.1	1.3	3.7	2.6	34.0
C1E0017	*Ph. vulgaris* L.	30.6	23.9	12.5	9.2	13.0	8.9	1.1	3.4	9.1	32.5
C1E0018	*Ph. vulgaris* L.	62.30	20.1	10.1	7.3	9.8	8.0	1.1	4.7	6.9	26.8
B9E0004	*Ph. vulgaris* L.	47	42.1	11.5	25.0	29.3	9.9	1.0	3.0	20.4	42.1
B9E0005	*Ph. vulgaris*	88	40.0	33.1	2.2	6.8	10.1	1.7	2.4	4.4	91.2
B9E0006	*Ph. vulgaris*	109.4	55.9	48.6	4.8	7.0	8.8	1.4	4.6	4.4	26.4
B9E0008	*Ph. vulgaris*	67.8	24.3	10.1	5.6	13.7	12.4	1.7	2.8	9.0	92.5
B9E0010	*Ph. vulgaris*	65.4	36.2	20.0	7.6	16.1	10.5	0.9	3.6	11.1	44.6
B9E0012	*Ph. vulgaris*	37.6	14.7	4.6	7.2	9.7	9.4	1.0	3.2	6.8	32.0
B9E0013	*Ph. vulgaris*	37.4	18.4	7.5	7.2	11.1	11.2	1.0	2.8	7.6	38.9
B9E0024	*Ph. vulgaris*	40	15.9	7.3	6.4	8.5	8.6	1.0	2.8	5.9	33.9
COE0329	*Ph. vulgaris* L.	100	68.32	49.5	9.6	18.4	7.9	1.1	4.6	12.5	33.1
COE0330	*Ph. vulgaris* L.	40.8	36.92	21.2	10.6	15.4	11.1	1.1	3.2	10.5	36.7
COE0331	*Ph. vulgaris* L.	48.2	55.62	41.2	11.2	13.8	11.7	0.8	4.4	8.6	25.8
COE0208	*Ph. vulgaris* L.	41.8	52.2	30.2	19.4	21.7	10.7	0.6	5.4	14.2	14.6
COE0209	*Ph. vulgaris* L.	34.2	34.1	19.2	9.6	14.5	11.5	1.1	5.4	10.6	26.6
COE0210	*Ph. vulgaris* L.	33.2	28.9	12.7	13.2	15.2	8.9	0.9	5.2	10.8	22.2
	Minimum	30.6	14.7	4.6	2.0	3.6	7.9	0.6	2.4	2.6	14.6
	Maximum	109.4	74.1	70.4	25.0	29.3	13.8	1.7	5.4	20.4	92.5
	Mean	53.7	38.4	25.0	9.0	13.1	10.2	1.1	3.8	8.9	37.5
	Std. Error	5.3	4.2	4.4	1.2	1.3	0.3	0.1	0.2	0.9	4.4
	Std. Deviation	23.7	19.0	19.9	5.4	5.9	1.5	0.3	1.0	4.0	19.9
	CV, %	44.1	49.5	79.4	59.4	44.7	14.7	26.1	25.1	45.1	53.0

Table 5. Morphological traits of Chinese accessions

Cat. №	Species	Hight of plant, cm	Weight of plan, g	Weight of plant without pods, g	Nr of pods/pl	Weight of pods/pl, g	Pod/length, cm	Pod/width, cm	Nr Of seeds/pod	Weight of seeds/pl, g	Weight of 100 seeds, g
B2E0279	*Ph. vulgaris* L.	60.7	19.2	14.8	3.67	4.8	5.9	1.0	2	3.1	33.9
B2E0280	*Ph. vulgaris* L.	94.4	38.5	33.1	4.4	5.5	7.8	1.1	2	3.6	29.8
B2E0282	*Ph. vulgaris* L.	77.4	32.2	26.2	5.4	5.6	6.8	1.8	2.2	3.0	26.3
B2E0283	*Ph. vulgaris* L.	69	34.2	26.4	9	7.6	6.2	0.7	2.33	4.9	26.3
B2E0284	*Ph. vulgaris* L.	77	10.2	6.9	3.6	3.1	6.6	1.2	2	1.5	22.6
B2E0285	*Ph. vulgaris* L.	62.8	27.3	19.9	4.8	7.2	9.5	1.4	3.2	4.8	28.9
B2E0286	*Ph. vulgaris* L.	86.8	39.5	24.9	9.8	14.6	8.5	0.9	5.6	10.2	18.8
B2E0287	*Ph. vulgaris* L.	79.4	56.7	49.1	5.2	7.4	8.6	1.0	4.6	5.0	30.1
B2E0288	*Ph. vulgaris* L.	43	16.5	9.4	4.2	6.1	9.8	1.5	3.8	3.7	29.2
B2E0289	*Ph. vulgaris* L.	77.8	34.5	28.0	5.4	6.4	6.9	1.5	2	2.8	21.8
B2E0290	*Ph. vulgaris* L.	80	43.8	41.2	3	2.9	6.2	0.9	2	1.6	28.0
B2E0291	*Ph. vulgaris* L.	88.6	20.5	15.7	3.6	4.7	6.3	1.2	2.6	3.0	22.0
B2E0292	*Ph. vulgaris* L.	41.4	22.7	12.8	6.2	9.7	10.2	1.4	3.8	6.1	28.0
B2E0293	*Ph. vulgaris* L.	77.2	29.1	21.3	5.2	7.4	8.6	1.2	4.6	4.9	25.5
B2E0294	*Ph. vulgaris* L.	101.3	76.3	70.4	2	5.5	8.7	1.5	2	3.6	74.6
B2E0295	*Ph. vulgaris* L.	76.2	59.1	51.4	5.2	7.7	8.3	1.3	2.8	4.4	25.4
B2E0278	*Ph. vulgaris* L.	103.6	20.8	13.5	5	7.2	7.0	1.4	3.2	4.5	27.9
	Minimum	41.4	10.2	6.9	2.0	2.9	5.9	0.7	2.0	1.5	18.8
	Maximum	103.6	76.3	70.4	9.8	14.6	10.2	1.8	5.6	10.2	74.6
	Mean	76.3	34.2	27.4	5.0	6.7	7.8	1.2	3.0	4.2	29.4
	Std. Error	4.2	4.2	4.1	0.5	0.6	0.3	0.1	0.3	0.5	3.0
	Std. Deviation	17.3	17.2	17.1	1.9	2.7	1.4	0.3	1.1	2.0	12.2
	CV, %	22.7	50.3	62.4	38.6	40.1	17.7	22.7	38.0	47.6	41.6

ration of flowering compared with other Chinese accessions (36 days). The differences in phenological stages, flowering stage, duration of flowering and vegetation cycle among Bulgarian and Chinese accessions served as a base to continue characterize them in terms of their origin and looked for diverse expression of phenotypic traits.

Minimum, maximum values and coefficient of variation of quantitative characters are presented in Tables 4 and 5. The most variable characters were weight of plant, weight of plant without pods, number of pods/plant, weight of seeds/plant and weight of pods/plant.

Plant height, weight of the whole plant, weight of plant without pods were measured when the plants attained maximum size. The range of plant height among Bulgarian accessions was from 30.6 to 109.4 with mean value of 53.7 cm. It needs to be noted 13 Bulgarian accessions possessed determinate growth habit and 7 accessions were with indeterminate growth habit. Bigger group of Chinese accessions (15) were with indeterminate growth habit and only two of the total were with determinate growth habit. The range of plant height in Chinese group was between 41.4–103.6 with mean value of 76.3 cm. Variation of plant height among accessions in each group, were expressed by coefficient of variation (%) showed higher variation in Bulgarian group compared with Chinese ones with 44.1 and 22.7% (CV), respectively. Accessions with Chinese origin have taller plants than Bulgarian landraces, 35% of accessions were with plant height from 40 to 50 cm. Two Bulgarian landraces from Petkovo village (B9E0005, B9E0006) were tallest among all accessions in the group, with 109.4 and 88.0 cm, while the tallest in Chinese group were accessions with cat. No B2E0278 (103.6cm) and B2E0294 (101.3cm).

Plant height and height of the 1st pod are important traits for quality of grain whereas pods located in upper part of plant will avoid contact with soil surface, as a source of pathogens. The number of pods and seeds per plant appeared to be the most important yield components (Dianatmanesh et al., 2017). Five Bulgarian accessions produced between 10 and 20 pods/plant and only one accession formed the largest number of 25 pods/plant, while the mean value for the BG group was 9.4 pods/plant and range was from 2 to 25 pods with higher variation with CV (%) – 59.4. Comparing the same morphological characters with Chinese accessions where range between minimum and maximum values was smaller in 2 to 9.4 pods/plant with mean value of 5 pods/plant and variation in the group of 38.6% (CV). Weight of pods showed almost similar variation in two groups of accessions with CV (%) – 44.7 for Bulgarian landraces and 40.1% in Chinese accessions. Pod length and pod width showed the same trend with bigger variation in Bulgarian plant material with differences between the two groups. The mean value of pod length in Bulgarian landraces was 10.2 cm and pod width 1.1 cm, while the mean value of pod length in Chinese group was 7.8 cm with pod width 1.2 cm. Variation of pod length was 14.7 and 17.7% (CV) for two groups. Weight of seeds/plant and 100 seed weight showed similar results with little difference in variation of weight of seeds per plant and bigger variation of Bulgarian group in 100 seed weight.

Cluster analysis

Clustering *Phaseolus vulgaris* accessions based on morphological traits showed three major groups. Cluster one contains 13 accessions and cluster 2 contains 12 accessions, while cluster 3 contains nine accessions and only two accessions No25 (B9E0005) and 27 (B9E0008) were grouped together with other accessions with third cluster (Figure 5). The last two accessions originated from the same place, Petkovo village. Genetically narrow accessions were shown by the coefficient of similarities, as follows: accession No 29 (B9E0012) with No 31 (B9E0024) and accession No 20 (C1E0015) with No 30 (COE0330). All mentioned accessions originated from Bulgaria, from the same region, while accessions from Chinese group with narrow genetic base were No 3 (B2E0282) with No 10 (B2E0289).

The dendrogram showed clusters of accessions formed mainly on their origin. At the same time accessions with maximum genetic distance were no 29 (B9E0012) with No 15 (B2E0294), No9 (B2E0288) with No 15 (B2E0294) and No 37 (COE0210) with No 15 (B2E0294).

Principal Component Analysis

To understand better the overall diversity of common bean accessions with Bulgarian and Chinese origin, the data collected were analyzed by Principal Component Analysis. The results showed that three components PC1, PC2 and PC3 explained 66% of the total variance of accessions with relevant traits (Table 5).

The characteristics responsible for separation along the second component were days to flowering (var1), vegetative cycle (var3), and height of plant (var4). The valuable characteristics situated along the third component were number of pods/plant (var9), weight of pods/plant (var10), and weight of seeds/plant (var18) (Fig.6) (Table 6).

The most productive accessions were B9E0008, B9E0004, B9E0005 and B2E0294 situated on the third component. The two accessions C1E0016 and COE0208 located on the opposite site were characterized with low yield values (Fig.7). These six accessions could be considered as the most appropriate source of variation and to be used for breeding and research work.

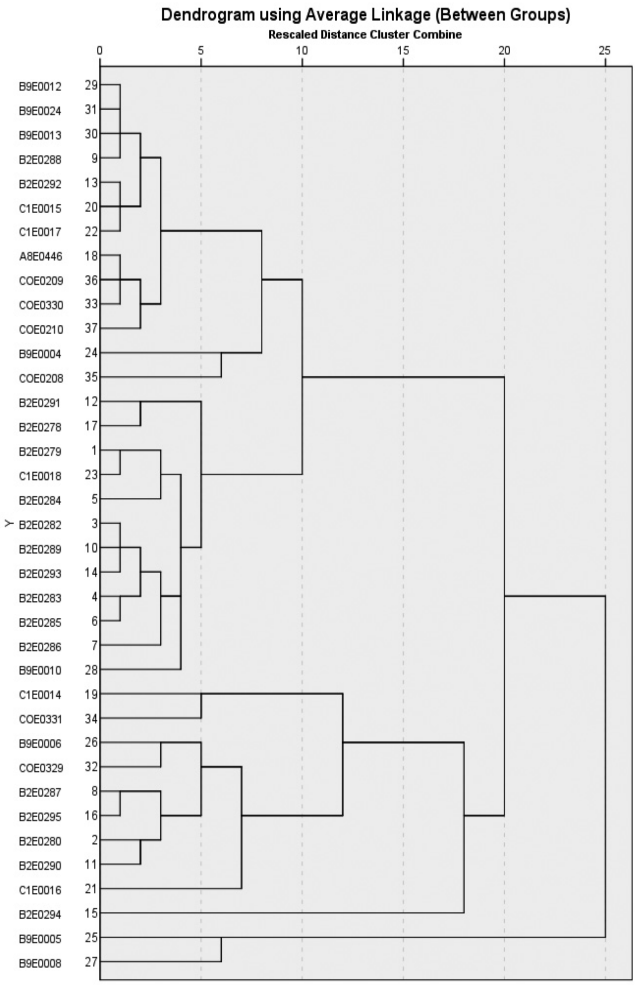

Fig. 5. Dendrogram illustrating similarities among *Ph. vulgaris* accessions with Bulgarian and Chinese origin

Table 5. Total variance

Component	Total variance explained		
	Total	% of Variance	Cumulative %
1	5.5	29.0	29.0
2	4.2	22.1	51.0
3	2.8	15.0	66.0

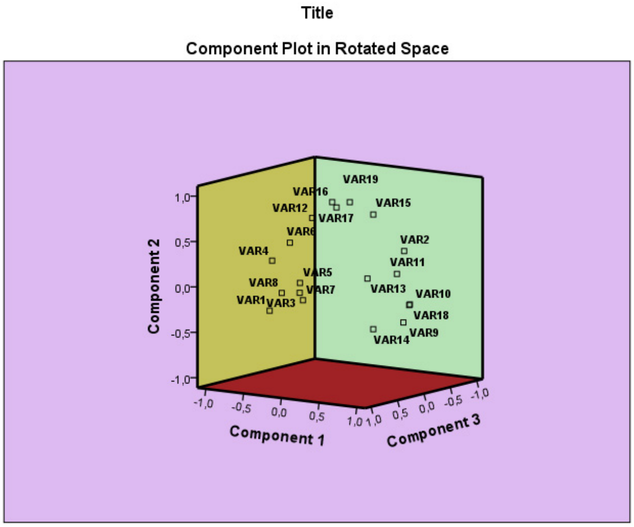

Fig. 6. Projection of 19 morphological characters

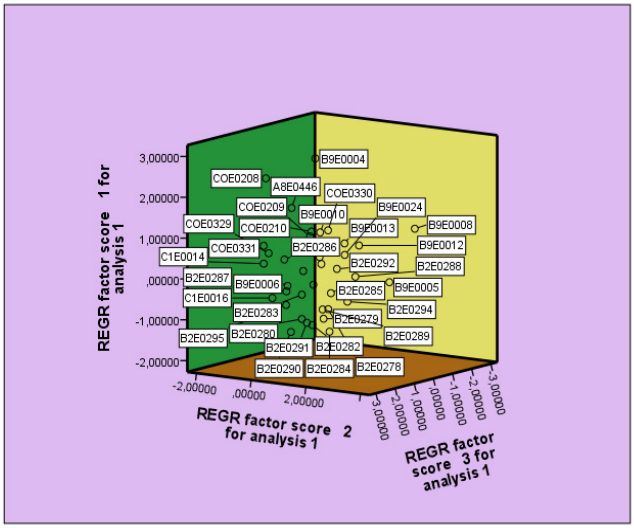

Fig. 7. Principal Component analysis of 37 accessions

Table 6. Characters with valuable components

No in row	Traits	No in row	Traits
var1	days to flow	var10	Weight of pods/pl, g
var2	duration of flow	var11	pod/length
var3	veg. cycle	var12	pod/width
var4	h height	var13	pod/thickness
var5	Nr of brunches	var14	nr of seeds/pod
var6	h 1st bean, cm	var15	seed/length
var7	Weight of plant, g	var16	seed/width
var8	Weight of pl./ without pod, g	var17	seed/thickness
var9	Nr of pods/plant	var18	weight of seeds/pl, g
		var19	weight of 100 seeds, g

The study on the resistance of the samples to the two bacterial diseases was carried out under field conditions and a natural infectious background. During the experimental period evaluation on diseases resistance, common bacterial blight *Xanthomonas phaseoli* pv. *phaseoli* (Smith), (Constantin et al., 2016), *Xanthomonas citri* pv. *fuscans* (Schaad et al., 2006), (Constantin et al., 2016) and hallo blight (*Pseudomonas syringae* pv. *phaseolicola*) were performed. Observations were done twice, during flowering and pod formation, using the scale from 1 to 9 (Bioversity, 1987; Kiryakov & Genchev, 1992). Most of studied accessions didn't show symptoms of the two bacterial diseases, like B9E0004, COE0329, COE0208, B2E0279, B2E0283, B2E0292. Some of accessions showed medium resistance with 3–5 score (B2E0293; B9E0010, COE0330), while one accession (COE0331) showed sensitive reaction with evaluation of 7 scores. It is important to mention that during the vegetation cycle, from May to July there were unfavorable meteorological conditions with less quantity of rainfall than normal and it didn't allow the development of pathogens 'symptoms. For the accessions with 5 and 3 scores testing will continue simultaneously under field and laboratory conditions for more precise results.

Conclusions

- Quantitative traits have been used to study morphological diversity and important agronomic traits of *Ph. vulgaris* accessions with Bulgarian and Chinese origin. Accessions with cat. No B9E0005 (BG), B9E0008 (BG), B2E0286 (CH) were selected with highest yield production. Bulgarian local accessions showed bigger diversity concerning morphological traits, compared with Chinese accessions. Plant height, weight of plant without pods, number of pods/ plant and weight of pods/ plant, pod width and weight of 100 seeds showed higher variation in BG group, while morphological characters as weight of plant, pod length, number and weight of seed/plant showed higher variation in CH group of accessions.
- Accessions with cat. No B9E0004, COE0329, COE0208 (BG) and B2E0279, B2E0283 (CH) showed resistance to common bacterial blight and hallo blight, evaluated under field conditions.
- The results from cluster analysis and Principal Component analysis will help to select accessions with

maximum genetic distance to assemble a broad–based panel of genetic resources of *Phaseolus* accessions.

Acknowledgements

The research leading to these results has received funding from the National Science Fund, Bulgaria, Grant КП-06-China /7/ 20.11.2020 and partially supported by the Grant КП-06-H56/13 / 21.11.2021.

References

Bioversity International/ International Board of Plant Genetic Resources (IBPGR) (1982). Descriptors for *Phaseolus vulgaris*. IBPGR, International Plant Genetic Resources Institute.

Climate Change Knowledge Portal (2021). For development practitioners and policy makers. Country Bulgaria. Country summary. The World Bank Group. https://climateknowledgeportal.worldbank.org/country/bulgaria.

Constantin, E.C., Cleenwerck, I., Maes, M., Baeyen, S., Van Malderghem, C., De Vos, P. & Cottyn, B. (2016). Genetic characterization of strains named as *Xanthomonas axonopodis* pv. *dieffenbachiae* leads to a taxonomic revision of the *X. axonopodis* species complex. *Plant Pathol., 65*, 792-806. [No PubMed record available.]

Dianatmanesh, M., Kazemeini, A. S., Bahrani, J. M., Shakeri, E., Alinia, M., Amjad, F. S., Mansoora, N., Poczai, P., Lalarukh, I., Abbas, H. H. M., Abdelhafez, A. A. & Hamed, H. M. (2022). Yield and yield components of common bean as influenced by wheat residue and nitrogen rates under water deficit conditions. *Environmental Technology and Innovations, 28,* 102549.

FAO. Faostat.org (2021). (https://www.fao.org/faostat/en/#data/QCL).

Genchev, D. & Kiryakov, I. (2005). Color scales for identification characters of common beans-characters and their evaluation. Dobrudja Agricultural Institute- General Toshevo, 2005, CD-Version, 25.

Gómez-Baggethun, E., Corbera, E. & Reyes-García, V. (2013). Traditional ecological knowledge and global environmental change: Research findings and policy implications. *Ecology & Society, 18*(4), 72.

Long, J., Zhang, J., Zhang, X. W. J., Chen, H., Wang, P., Wang, Q. & Du, C. (2020). Genetic diversity of common bean (*Phaseolus vulgaris* L.) Germplasm resources in Chongqing, evidenced by morphological characterization. *Front. Genet., 11*, 697.

Minoz-Perea, C., Teran, H., Allen, G., Wright, J., Westermann, T. D. & Singh, P. S. (2006). Selection for drought resistance in dry bean landraces and cultivars. *Crop Sci., 46,* 2111-2120.

Peev, B. & Kouzmova, K. (2002). Climate changes in the Agricultural regions of Bulgaria. Journal of Environmental Protection and Ecology, vol. 3 (1), p.120-125.

Piergiovanni, A. R. & Lioi, L. (2010). Italian common bean landraces: History, genetic diversity and seed quality. *Diversity, 2*(6), 837–862.

Rosenzweig, C., Elliott, J., Deryng, D. & Jones, W. J. (2014). Assessing agricultural risks in climate change in 21st century in a global gridded crop model inter comparison. *PNAS, 111*(9), 3268-3273.

Schaad, N. W., Postnikova, E., Lacy, G., Sechler, A., Agarkova, I., Stromberg, P. E., Stromberg, V. K. & Vidaver, A. K. (2006). Emended classification of xanthomonad pathogens on citrus. *Syst. Appl. Microbiol., 29,* 90-695. [No abstract available.] (Note: Erratum to Schaad et al. 2005.)

Servia, C. L. J., Garcia, H. E., Perez, M. N., Bolanos, A. N. E., Delgado, H. S., Rodruguez, C. C. J., Langarica, G. R. H. & Guzman, V. M. A. (2016). Diversity of Common bean (*Phaseolus vulgaris* L.) landraces and the nutritional value of their grains. Grain Legumes, Chapter 1, IntechOpen, 2-35. DOI: 10.5772/63439.

Stoilova, T. (2011). Morphological and agrobiological characterization of bean landraces *Phaseolus coccineus* L. with different origin. *Journal of Mountain Agriculture on the Balkans, 14*(6), 1213-1224.

Stoilova, T., Pereira, G. & Tavares De Sousa, M. M. (2013). Morphological characterization of a small common bean (*Phaseolus vulgaris* L.) collection under different environment. *Journal of Central European Agriculture*, *14*(3), 854-864.

Stoilova, T., Berova, M., Kouzmova, K. & Stamatov, St. (2014). Study on diversity on *Phaseolus spp*. landraces with reference to global climate change. *African Journal of Agricultural Research, Academic Journals, 9*(39), 2925-2935.

Tabari, H. (2020). Climate change impact on flood and extreme precipitation increases with water availability. *Sci. Rep., 10,* 13768.

Wheeler, T. & von Braun, J. (2013). Climate change impacts on global food security. *Science, 341*, 508–513.

Zhao, Ch., Piao, S., Wang, X., Huang, Y., Ciais, P., Elliott, J., Hoang, M., Janssens, I., Li, T., Lian, X., Liu, Y., Muller, K., Peng, S., Wang, T., Zeng, Z. & Penuelas, J. (2017). Plausible rice yield losses under future climate warming. *Nature Plants*, *3*, 16202.

Received: **January, 10, 2023**; *Approved*: **June, 14, 2023;** *Published:* **June, 2024**