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RESEARCH ON PHENOTYPIC AND GENOTYPIC EXPRESIVITY OF BEAN VARIETIES OBTAINED AT VEGETABLE RESEARCH DEVELOPMENT STATION BUZĂU

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Abstract

The pedo-climatic conditions of Romania are favorable for bean cultivation, one of the reasons that, in past, field beans used to occupy large areas in Romania. Although it is a plant that can offer high economic profit to the growers and is a good precursor for other vegetable plants due to nitrogen accumulation, the field bean it's no longer sought and used at its maximum potential as a crop plant. Since 1996, Vegetable Research Development Station (V.R.D.S.) Buzău has been revive the researches in beans, realizing until now a valuable collection of germplasm, grouped by types of growth and directions of use. For this research, three stable genotypes of field bean group were studied. The genotypes showed distinct variability in plant height, the highest value being 61.83 cm (A3) and the smallest value being 38.8 cm (A1). Slightly differences were also registered by the number of pods per plant. The studies have been completed with the registration of the genotype A2 for patenting and approval under the name of "Doina" and the other two genotypes will be proposed for approval.

Key words*: biodiversity, Phaseolus vulgaris, breeding, phenotype, patenting.*

INTRODUCTION

Common dried bean (*Phaseolus vulgaris* L.) is an annual herbaceous plant belonging to the family *Leguminosae* (*Fabaceae*) (Gentry, Howard Scott, 1969).

Hutchinson (1973) and Jones and Luchsinger (1987) mentioned that *Fabaceae* consist of about 440 genera and 12000 species.

Phaseolus vulgaris is one of the most important vegetables from the nutritional and alimentary point of view, being cultivated for dry seeds or unripe fruits (pods) that have a high content of proteins, iron, magnesium, folic acid and complex carbohydrates (Pachico, D., 1993).

Due to the high protein content it successfully replaces meat in vegetarian diets, but most importantly it keeps hunger under control in poor countries (Peters, A., 1993; Schwartz, H. F. and Pastor-Corrales, M.A., 1995). It also contains phytoestrogen which reduces the risk of breast cancer and helps in the treatment of postmenopausal osteoporosis (Shirke S.S. et al., 2009).

Beans first appeared in Europe in the early 16th century, when it was brought from Central America by the Spanish and Portuguese. It was used by Toltecs and Aztecs from ancient times (Wortmann, C.S., 2006). In Romania, beans were introduced in the eighteenth century. In Asia and Africa, dried leaves, stalks and ground pods are used as animal feed (Sperling L. et al., 1996).

Beans are like the other species in the legume family an excellent precursor for the other legume species, having the ability to fix atmospheric nitrogen, thus improving the soil structure. It is recommended to avoid returning to the same soil for a period of 3-4 years, thus reducing the risk of disease and pests. One of the most harmful diseases is *Xanthomonas phaseoli*, a bacterium that is stored and transmitted through the seed. (Lagunovschi-Luchian V and C. Vînătoru, 2016).

In 2018 the area cultivated with dry beans in Romania was 12 231 ha, with a production of 17 298 tons, and worldwide the largest cultivated area is occupied by the United States of America, more precisely 815 850 ha, with a production of 1 700 510 tons (FAOSTAT).

Until now, at the Vegetable Research and Development Station (VRDS) Buzău, five

varieties have been approved and can be found in the Official Catalogue of Romanian Crop Plants (Anisia, Clarisa, Ioana, Maura and Menuet).

MATERIALS AND METHODS

The Laboratory of Genetics, Breeding and Biodiversity from VRDS Buzau has a valuable germplasm collection of *Phaseolus* sp. having over 100 genotypes. A number of 77 genotypes are in an advanced state of breeding. The genotypes will be used as importance source material for breeders to develop new varieties.
The germplasm collection was divided into 3 groups according to the direction of use:
- cultivars with indefinite growth that can be grown in protected areas and field, in a fence system;
- cultivars with determined growth for pods suitable for field crop;
- field cultivars with determined and semi-determined growth for dry grains suitable for field crop;

In the present study were chosen 3 stable genotypes for dry grains: A1- C.A. Rosetti; A2- Doina; A3- Călărași, genotypes that come from localities located in Bărăganului Plain and Buzău Plain.
Phenological, biometric and laboratory measurements were carried out during the vegetation period.

Field work procedure

The research experiences were carried out in the research field of VRDS Buzău, on an alluvial soil.
The applied culture technology was specific to the field bean crop.
Sowing is done in rows, in the first decade of May, more precisely on the 7th, when the soil measure a temperature of over 10ºC for several days in a row. The distance between rows was 45 cm, and between plants/row was 15 cm, using 30-40 kg seeds per hectare.
The pest management was done accordingly to field bean crop and only when economic threshold of harm was exceed.
The negative mass selection was made and all the plants that were not typical were eliminated.

The care works applied were: two mechanical hoeing to keep the soil clean of weeds and loosen, drip irrigation and fertilizers for a good development of the plants.
Harvesting occurred when about 75% of the pods have reached maturity and the seeds are hard.

Observations and recording of data

Vegetative and reproductive growth. The variability of the qualitative and quantitative characters and the correlation between them was made, which is very important for the process and the conservative selection.
The qualitative characters analyzed were: terminal leaflet (shape), terminal leaflet (length of tip), leaf (intensity of green color), leaf rugosity, color of flower, pod (ground color), pod (degree of curvature), pod (shape of curvature), pod (shape of distal part).
The quantitative characters targeted in the study were divided into two groups:
Plant observations: plant height, bush diameter, diameter at stem base, number of main shoots, number of leaves/plant, total leaf length, total leaf width, petiole length, leaf length, leaf width.
Observations of the pods: number of pods per plant, weight of pods per plant at maturity of consumption, weight of pods per plant at physiological maturity, total weight of pods per plant, average weight of pods at maturity of consumption, average weight of pods at maturity physiological, the length of the pod, the width of the pod, the number of berries/ pods, the length of the spur.
For statistical analysis, ANOVA was used, followed by the Duncan test.

RESULTS AND DISCUSSIONS

Throughout the vegetation period, all the three cultivars studied were the subject to phenological and biometric measurements. Thus, the descriptive analysis of the quantitative characteristics are found in Tables 1 and 2, and that of the qualitative characteristics in Table 3.

Mean values and standard deviation regarding

Tabel 1. Quantitative plant characteristics

Plant observations	A1± sd	A2±sd	A3±sd
Plant height (cm)	60.5± 0.7b	38.8±2.8a	61.8±1.6b
Plant diameter (cm)	40.75±1.06a	43.2±0.7a	51.1±1.9b
Stem base diameter (cm)	0.87±0a	0.79±0.1a	0.75±0.1a
The number of main shoots (pcs)	2-3±0.7a	2-3±0.5a	3±0.1a
The number of leaves/plant (pcs)	22±1.4a	22±0.5a	21±0.1a
The length of total leaf (cm)	10.75±1.7a	11.46±0.2a	11.23±2.2a
The width of total leaf (cm)	16±2.1a	15.63±1.9a	13.23±3.1a
The length of petiole (cm)	13.6±0.8a	8.66±1.2ab	10.23± 2.1b
The number of blades/leaf (pcs)	3±0a	3±0a	3±0a
The length of the leaflets (cm)	7.85±1.9a	8.76±0.7a	8.1±1.7a
The width of the leaflets (cm)	5.15±0.9a	5.5±0.8a	5.7±1.6a

SD-standard deviation, different letters means significant differences

Regarding the quantitative characteristics of the three cultivars, significant differences were registered at the height and diameter of the plants and the length of the petiole.

The genotype that registered the highest height was A1 (Figure 1), with 60.5 cm, and the smallest height was at A2 with 39.1 cm.

The diameter of the plant ranged from 40.75 cm at A1 to 51.1 cm at A3.

The length of the petiole had the smallest record on A1 with 8.66 cm and the highest was record by A1with 13.6 cm.

The other quantitative characteristics studied were: stem base diameter, the number of main shoots, the number of leaves/plant, the length of the total leaf, the width of the total leaf, the length of the leaflets and the width of the leaflets have similar values.

Crop detail

Figure 1. A1 C.A. Rosetti

Figure2. A2 Doina

Figure 3. A3 Călărași

Tabel 2. Quantitative pod characteristics

Pod observations	A1±sd	A2±sd	A3±sd
Total number of pods/plant (pcs)	40±5.6b	21±0.5a	34±3.7b
Number of pods/plant at harvest maturity (pcs)	8±0.7a	13±4.5a	12±3.6a
Number of pods/plant at physiologic maturity (pcs)	32±4.9b	8±5a	22±1.5b
Total weight of pods/plant (g)	170±0c	83.33±11.5a	133.33±5.7b
Weight of pods/plant at harvest maturity (g)	20±0a	46.66±20,8a	46.67±15.2a
Weight of pods/plant at physiologic maturity (g)	150±0c	36.67±20,8a	86.66±20.8b
Means weight of a pod at harvest maturity (g)	2.67±0.2a	3.51±0,3b	3.84±0.1b
Means weight of a pod at physiologic maturity (g)	4.85±0.4a	5.06±1,4a	3.91±0.9a
Length of pod at harvest maturity (cm)	11.5±1.2a	11.02±0,5a	11.21±0.7a
Width of pod at harvest maturity (cm)	1.2±0.1a	119±0,1a	1.10±0.08a
Length of pod at physiologic maturity (cm)	14.55±0.4b	12.11±0,1a	12.59±0.9a
Width of the pod at physiological maturity (cm)	1.26±0,04a	1.19±0,04a	1.17±0.03a
Number of bean/pod (pcs)	8±0b	6±0.5a	7±0.5a
Length of distal part (cm)	1.07±0,2a	1.02±0.02a	1.06±0.1a

SD-standard deviation, different letters means significant differences

The highest number of pods per plant was registered by A1 with a number of 40 pods and A2 had 21 pods. A1 has a concentrate ripening, from a number of 40 pods/plant, 32 pods have reach physiological maturity. Contrariwise, A2 reaches maturity in a slowly manner, from 21 pods/plant, 8 pods have reach physiological maturity at the measurement time.

Accession A1 had recorded the highest total weight with a value of 170 g and from it 150 g were held by the pods that are at physiological maturity, resulting in an average weight of the pod of 4.85 g. At the same time, the lowest total weight was held by the genotype A2 (83.33 g), and the weight of the pods of physiological maturity was 36.67 g, resulting in an average weight of the pod of 5.06 g.

As for the rest of the quantitative characters of the pods, they have very close values, mentioning that for all the remaining characters the highest value was recorded by genotype A1. UPOV descriptors were used to determine the qualitative characters (Table 3).

The leaves of the 3 cultivars analyzed are similar in shape and size. Small differences were observed in the color of the leaves, varying from light green in the case of A3 (Figure 3), to medium-dark green in the case of A2 (Figure 2).

The degree of curvature of the pods varies from weak on accession A2 to strong on accession A1. The shape of the curvature differs on genotype A2, being convex (Figure 5), the other genotypes have a concave shape (Figures 4 and 6).

Figure 4. A1 C.A. Rosetti

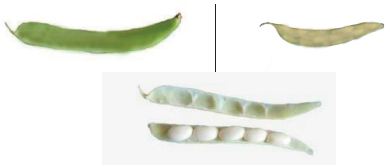

Figure 5. A2 Doina

Figure 6. A3 Călărași

Tabel 3. Qualitative characteristics

Characteristics	A1	A2	A3
Terminal leaflet (shape)	Triangular	Triangular	Triangular
Terminal leaflet (length of tip)	Short	Medium	Medium
Leaf(intensity of green color)	Medium	Medium-dark	Light
Leaf rugosity	Weak	Weak	Weak
Color of flower	White	White	White
Pod (ground color)	Light yellow	Light yellow	Light yellow
Pod (degree of curvature)	Strong	Weak	Medium
Pod (shape of curvature)	Concave	Convex	Concave
Pod (shape of distal part)	Acute to truncate	Acute to truncate	Acute to truncate
Seed color	White	White	White

Figure 7. Different stages development on Doina cultivar

Seed development is the final stage in the life of annual legumes, the seed weight is primarily composed of proteins and carbohydrates, which are derived from amino acids and sugars that are translocated from source tissues (Weber et al., 1997). The weight of thousand grains (TKW) varied from A2 with a weight of 378 g to 488 g at A1.

The length of seed had the highest value at A3 and the smallest one was recorded by A2 (Table 4).

Tabel 4. Seed characteristics

Seed observations	Unit	A1	A2	A3
TKW	g	488.2	378	421
The medium weight of a seed	g	0.49	0.39	0.43
Length of seed	mm	14.97	13.88	15.35
Width of seed	mm	8.43	8.53	8.52

CONCLUSIONS

The studied accessions showed differences amongst themselves and this can be useful for the future breeding program. The genotypes showed distinct variability in plant height, the number of pods per plant, the weight of the pods and Thousand Kernel Weight.

The studies have been completed with the registration of the genotype A2 for patenting under the name of "Doina" and the other two genotypes will be proposed for approval.

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