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EVALUATION OF THE MAIN QUANTITATIVE AND QUALITATIVE CHARACTERS FOR THE 'MAURA 2000' CLIMBING BEAN CULTIVAR

Bianca-Elena TĂNASE[1], Adrian ASĂNICĂ[2], Costel VÎNĂTORU[1], Elena BARCANU[1], Ovidia-Loredana AGAPIE[1], Ion GHERASE[1], Geanina NEGOȘANU[1]

[1]Vegetable Research Development Station Buzău, 23 Mesteacanului Street, Romania
[2]University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Horticulture, 59 Marasti Blvd, District 1, Bucharest, Romania

Corresponding author email: biancae.tanase@yahoo.com

Abstract

The 'Maura 2000' climbing bean cultivar was obtained at VRDS Buzau and patented in 2015. The cultivar was introduced into the culture and submitted to the conservative selection program in order to restrict the variability of the main characters, correlated with increasing production quality and productivity. 'Maura 2000' shows indefinite growth, a vigorous stem, with a linear appearance that has 4-6 main branches and a height between 2-2.6 m. In greenhouses, the height increases significantly. The stem and foliage are medium green, the flowers are white - yellow grouped 8-10 in raceme, linear, arranged in pairs. The pods are yellow, slightly pearly, have a length between 18-22 cm, width 1.8-2 cm and a thickness of 0.5-0.7 cm. They are straight, slightly arched towards the top. The pods forms threads late, after the optimal harvest period has passed. The seeds are medium-sized, single-colored, white, kidney-shaped. MMB = 355,654. The aim of the study was to present the phenotypic expressiveness of the main characters manifested by the cultivar in the fields of conservative selection.

Key words*: conservative selection, patented, Phaseolus vulgaris, VRDS Buzău.*

INTRODUCTION

Beans (*Phaseolus vulgaris*) are the member of the *Leguminosae*, family *Phaseoleae*, subfamily *Papilionoideae* and is the most important food legume for more than 300 milion people (Bressani, 1993; Graham and Ranalli, 1997). Common bean (*Phaseolus vulgaris* L.) have been recognized to be domesticated and originated in America on the basis of chronological, archeological, botanical and linguistic evidences (Gepts and Dpbouk, 1991; Papa and Gepts, 2003; Papa et al., 2005) and now consumed in every part of this globe especially by the people of low income group in the developing countries (Shimelis and Rakshit, 2005). Most often, beans are mainly used as dry seeds but there is possibility of their use as green pods as well as green shelled seeds (Lin et al., 2008). The important classes of dry beans include haricot beans (Shimelis and Rakshit, 2005), red kidney beans (Choung et al., 2003), black beans (Aparicio-Fernandez et al., 2006), Mexican beans (Hosfield et al., 2004), pinto beans, tirga beans (Amir et al., 2006), great northeren beans, navy beans and pink beans (Kelly et al., 2003; Luthria and Pastor-Corrales, 2006).

Nutritionally, beans are recognized as good source of proteins, which is 2-3 times that of cereal grains, (Siddiq et al., 2010). High dry matter content also contains high amounts of starch, dietary fibres, minerals and vitamins (Kutos et al., 2003; Costa et al., 2006). In addition to these, beans also contain rich variety of phytochemicals, antioxidant activity and an extensive array of flavonoids such as anthocyanins, flavonoids, proanthocyanidins, flavonols, phenolic acids and isoflavones (Beninger and Hosfield, 2003; Choung et al, 2003; Aparicio-Fernadez et al., 2005b; Lin et al., 2008; Granito et al., 2008). In beans, there are two varieties according to the type of stem growth: *nanus* convariety - having a determined growth, the stem is straight, branched and forms a dense bush, of small heights 40-60 cm (dwarf or oyster beans); conv. *vulgaris* - indeterminate growth, voluble stem, having lengths of 2-6 m (climbing beans). An essential feature of bean cultivation is the existence of a wide range of varieties that

allows staggered production, but also the rhythmic supply over a long period of time.
In Romania, the area cultivated in 2019 with green beans is 5380 ha with a production of 26,690 tons.
Worldwide the largest cultivated area with green beans in 2019 is occupied by China, more precisely 743143 ha, with a production of 21761383 tons, followed by India 256271 ha with a production of 725998 tons (FAOSTAT).
VRDS Buzău has a number of approved bean of 6 approved bean varieties, of which: one variety is French Bean (*Phaseolus vulgaris* L.) - 'Doina'; two varieties are Climbing French Bean (*Phaseolus vulgaris* L. var *vulgaris* L.) - 'Maura' and 'Teodora'; four varieties Dwarf French Bean (*Phaseolus vulgaris* L. var. *nanus* L.) Aschers - 'Anisia', 'Clarisa', 'Ioana' and 'Menuet'.

MATERIALS AND METHODS

The Laboratory of Genetics, Breeding and Biodiversity from VRDS (Vegetable Research Development Station) Buzau has a valuable germplasm collection of *Phaseolus* sp. having 418 genotypes. Of these, 285 are stable and 133 are segregating. These were structured on use groups and stages of improvement as follows:
STGD-Stable genotypes with determined growth for pods
SEGD-Segregated genotypes with determined growth for pods
STGI-Stable genotypes with indefinite growth
SEGI-Segregated genotypes with indefinite growth
STGDSD-Stable genotypes with determined and semi-determined growth for dry grains
SEGDSD-Segregates genotypes with determined and semi-determined growth for dry grains (Figure 1).

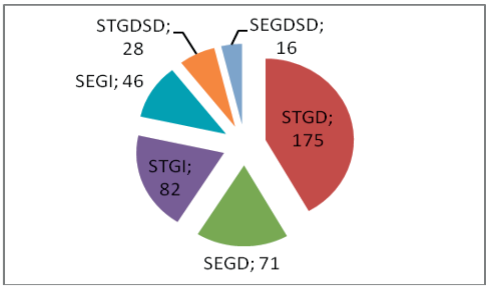

Figure 1. Germplasm collection from VRDS Buzău

The aim of this paper is to evaluate the main phenotypic and quantitative characteristics of the 'Maura 2000' climbing bean variety, in the fields of conservative selection.
Statistics indices used for each character were: the average ($\bar{x}$), standard deviation (SD), coefficient of variation (CV %), limits of variability ($\bar{x} \pm SD$).
From the two varieties of climbing beans that SCDL approved, 'Maura 2000' was chosen for the present study.
Phenological, biometric and laboratory measurements were carried out during the vegetation period.
The experiment was conducted in the research site of VRDS Buzau in a sandy-loam soil.

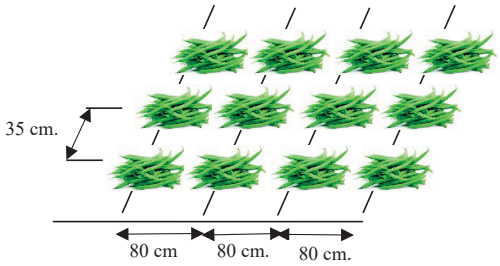

Figure 2. Planting scheme

The crop technology applied was the one specific for bean. The seed were sown at the beginning of May, the scheme used was 80 x 35cm (Figure 2).
The plants were grown in fenced system. Throughout the vegetation period a sets of 22 qualitative and 11 quantitative descriptors showing continuous variation were selected from the available literature on the crop, UPOV Guidelines.
Similar studies were made by us in our previous studies (Tănase et al., 2020; Gherase et al., 2020).
The quantitative characters analyzed were:, terminal leaflet (length of tip), flower (size of bracts), pod length, pod width, pod thickness, pod (length of beak), seed weight, seed (width in cross section), seed length, number of pods per plant, weight of pods per plant at maturity of consumption.
The qualitative descriptors targeted in the study were made on pod characteristics and plan (Tables 1 and 2).

Table 1. Qualitative traits plant

Descriptors	Polymorphism
Plant: anthocyanin coloration of hypocotyl(PACH)	1.absent 9.present
Plant: intensity of anthocyanin coloration of hypocotyls (PIACH)	3.weak 5.medium 7.strong
Plant: growth type (PGT)	1.dwarf 2.climbing
Plant: architecture(PA)	1.pyramidal 2.rectangular
Plant: start of climbing (80% of plants) PSC	3.early 5.medium 7.late
Plant: speed of climbing (PSpC)	3.slow 5.medium 7.fast
Leaf: intensity of green color (LIGC)	1.very light 3.light 5.medium 7.dark 9.very dark
Leaf: rugosity (LR)	1.absent or very weak 3.weak 5.medium 7.strong 9.very strong
Terminal leaflet: shape (TLS)	1.triangular 2. triangular to circular 3.circular 4.circular to rhombic 5.rhombic
Flower: color of standard (FCS)	1.white 2. pinkish white 3.pink 4. violet
Flower: color of wing (FCW)	1.white 2. pinkish white 3.pink 4. violet

Table 2. Qualitative traits pods

Descriptors	Polymorphism
Pod: shape in cross section (through seed) PSCS	1.eliptic 2.ovate 3.cordate 4.circular 5.eight-shape
Pod: ground color (PGC)	1.yellow 2.green 3.violet
Pod: intensity of ground color (PIGC)	3.light 5.medium 7.dark
Pod: presence of secondary color (PPSC)	1.absent 2.present
Pod: stringiness of ventral suture(PSVS)	1.absent 9.present
Pod: degree of curvature (PDC)	1. absent or very slight 3.weak 5.medium 7.strong 9.very strong
Pod: shape of curvature (PShC)	1.concave 2. s-shaped 3. convex
Pod: shape of distal part (excluding beak) PSDP	1.acute 2. acute to truncate 3.truncate
Pod: curvature of beak (PCB)	1. absent or very weak 3. weak 5.medium 7.strong 9. very strong
Pod: texture of surface (PTS)	1. smooth or slightly rough 2. moderately rough 3. very rough
Pod: constrictions (at dry stage) (PC)	1. absent or very weak 2. moderate 3. strong

RESULTS AND DISCUSSIONS

Throughout the vegetation period, the genotype studied was the subject to phenological and biometric measurements. Thus, the descriptive analysis of the qualitative and quantitative characteristics was made.

'Maura' is an early variety of beans with indeterminate growth (dryers), with a wide, long, yellow pod that does not show threads during maturation, intended for cultivation greenhouse and field in a fence system. The plant architecture is pyramidal, the start of climbing is medium and the speed of climbing is fast. The leaf are green, with medium rugosity. The terminal leaflet has a rhombic shape with a length varying between 10.6 cm and 13.6 cm. The color of wing (flower) and standard (flower) is white (Figure 3). The length of bracts has slight variations from 0.6-0.7 cm.

Figure 3. Flower of 'Maura 2000' garden bean variety

The pods are light yellow, shape in cross section is ovate. They present a texture of the surface smooth or slightly rough and a moderate constriction at dry stage. The stringiness of ventral suture of pods is present and the degree of curvature is weak (Figure 4 and Figure 6).

Shape of curvature is convex and the shape of distal part is acute. The beak has a length varied between 6.67 cm and 12.18 cm and a strong curvature.

The number of pods per plant varies between 80 and 100, with an average production of over

2.5 kg/plant in protected areas and over 1.5 kg in the field.

Figure 4. Crop detail 'Maura 2000' garden bean variety

Figure 5. Grains of 'Maura 2000'

Figure 6. Pods of 'Maura 2000'

Regarding the quantitative characteristics of the grain, it was found that it has an average length of 1.37 and a width of 0.76 cm. The weight of the grain varies from 0.37 g to 0.40 g.
The color of the grain is white, it is unicolor. The shape of the grain in longitudinal section is reniform, and in cross section is round. These have a medium degree of curvature (Figure 5).
Throughout years of study growth of the plant and the yield began to be relatively constant, being influenced only by environmental conditions. These data can be found in the Tables 3, 4 and 5.

Table 3. Variability in pod length

Year	SS	X+SD	X	SD	CV%
2016	SF	17.7-22.5	20.1	2.4	11.9
2017	PF	17.4-23.6	20.5	3.1	15.1
2018	PBF	18.5-21.7	20.1	1.6	7.8
2019	BF	18.2-21.8	20.0	1.8	9.0
2020	CF	18.0-22.0	20.0	2.0	10.0
Average	X	17.9-22.3	20.1	2.1	10.7

Over the years in which the 'Maura' bean cultivar was analyzed (2016-2020) the length of the pods varied from 17.4 cm to 23.6 cm, the highest value being recorded in 2017 in progeny field when the average was 20.5 cm .

Table 4. Variability in pod width

Year	SS	X+SD	X	SD	CV%
2016	SF	1.8-2.4	2,1	0.3	14.2
2017	PF	1.7-2.3	2.0	0.3	15
2018	PBF	2.0-2.2	2.1	0.1	4.7
2019	BF	1.9-2.1	2.0	0.1	5
2020	CF	1.8-2.2	2.0	0.2	10
Average	X	1.8-2.2	2.0	0.2	9.7

SF - selection field; PF - progeny field; PBF - prebase field; PB - base field; CF - commercial field

Regarding the variability of the width of the pods, no significant differences were identified. The recorded values ranged from 1.7 cm in the progeny field to 2.4 cm in the selection field. The average of these values was 2 cm.

Table 5. Variability in pod thickness

Year	SS	X+SD	X	SD	CV%
2016	SF	0.4-0.6	0.5	0.1	20.0
2017	PF	0.4-0.8	0.6	0.2	33.3
2018	PBF	0.5-0.7	0.6	0.1	16.6
2019	BF	0.6-0.8	0.7	0.1	14.2
2020	CF	0.5-0.7	0.6	0.1	16.6
Average	X	0.4-0.7	0.6	0.1	20.1

There were no major differences in the thickness of the pods, which attests to the fact that the 'Maura 2000' is a cultivar that has stability in the progeny field. The recorded values ranged from 0.4 cm to 0.8 cm. The coefficient of variation registered in the fields of conservative selection did not vary much between the length, width and thickness of the grain, which denotes a homogeneous population, but also that during the period of conservative selection a special attention was ensured on the quality characteristics of the cultivar.

CONCLUSIONS

Data presented showed that 'Maura 2000' variety is stable and distinct within the normal variability. The variety can be grown successfully in field and in greenhouse areas.
The Laboratory of Genetics, Breeding and Biodiversity from VRDS Buzau has a large variety of genotypes in *Phaseolus vulgaris* and the research will continue with assessment and enriching of the germplasm collection.

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