Scientific Papers. Series B, Horticulture. Vol. LXIV, No. 2, 2020
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

STUDY OF THE VEGETATIVE BEHAVIOUR AND PRODUCTIVITY OF SOME GENOTYPES OF FABA BEAN (*VICIA FABA* L.)

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Abstract

The aim of the study was a comparative analysis of several genotypes of faba bean (Vicia faba L.). The sowing of the seeds was carried out in November. The percentage of overwintering plants was determined. The vegetative behavior of the plants in dynamic as plant height, numbers and length of branches and numbers of leaves were investigated. The generative features of the plants and the yield of the green pods were registered. The results indicate that the plants of the studied genotypes were successfully survived during winter and in the spring, they developed a plant-like shrub with 3 or 4 branches. Differences in generative characteristics of plants were founded. The B1E238 genotype began flowering earlier and have the largest numbers of flowers. This genotype is distinguished also the highest yield of green fruits. The investigated genotypes of faba bean do not have significant differences by morphological features of the fruits and seeds.

Key words*: faba beans, genotypes, productivity, vegetative behaviour.*

INTRODUCTION

A faba bean (*Vicia faba*) is an annual plant of Fabaceae. The genetic variability of the species is quite large, and most researchers refer tofour botanical varieties: *V. faba paucijuga*, *V. faba mayor*, *V. faba equina* and *V. faba minor*. Differences between subspecies are mainly based on differences in seeds weight, shape and size (Metayer N., 2004; L´opez-Bellido et al., 2005). In Bulgaria the varieties of large-seeded of faba bean are mainly distributed. From the small-seeded and the middle-seeded mainly local forms occur (Kartalov et al., 1999). Faba bean is the third most important leguminous vegetable crop after beans and peas. In addition to human food, faba bean is also used as food for certain ruminants (Singh and Bhat, 2012a). Many researchers (Singh et al., 2009; Singh et al., 2010; Singh et al., 2013a) have indicated that the cultivation of faba bean affects soil fertility. Although the cultivation of faba bean in Bulgaria is limited, this doesn't define the importance of culture as unimportant. According to many authors, the importance of the faba bean will become ever greater. The reasons for this are social and environmentally sound (Hoffmann et al., 2007; Singh et al., 2010; 2013b). In the period 2010-2012, S. Angelova et al., visit different areas of the country for the purpose of collecting old varieties, populations and forms of faba bean (*Vicia faba*), which are grown and maintained by the local people. More than 70 specimens have been collected that differ significantly in plant habitat, duration of the growing season, size and color of seeds and crude protein content. According to the authors, the loss of this culture as a tradition in many places in the country is due to the aging of the population and depopulation of villages, as well the diminishing interest of the crop due to the wide variety of leguminous crops on the market.

MATERIALS AND METHODS

For a two years of research 4 type of genotype of faba bean were investigated. The experiment was carried out on experimental field of Agricultural University Plovdiv. Three of the investigation genotypes are local forms - B1E217, B1E235 and B1E238 (Figure 1), provided by the Institute of Plant Genetic Resources - Sadovo. The seeds are part of collection of old varieties, populations and forms of faba bean. Super Simonia variety was studied also (Figure 2). The sowing of seeds was carrying out in November. The experiment was carried out in 3 replications. The field germination of seeds and the percentage of

overwintering plants were determined. The biometric measurements of the plants were performed during the beginning of flowering and mass fruiting. The vegetative behaviour of the plants as plant height, numbers and length of branches and numbers of leaves were investigated. Some generative features of the plants and the yield of green pod were registered. Green fruits were harvested at technological maturity before seed growth in them, when they reached ¾ of the normal size for the variety and their consistency is juicy and fragile, without a parchment layer (Cholakov, 2009). Some morphological features of green pods and seeds were investigated.

Figure 1. Genotype - B1E238

Figure 2. Super Simonia variety

RESULTS AND DISCUSSIONS

Seed germination is one of the most important determinants of seed quality. The investigated genotypes have a high percentage of field germination (Table 1) - between 90% in genotype B1E235 and 98% in Super Simonia variety.

An essential indicator for the winter sowing of vegetables is the percentage of wintering plants (%). This indicator, as well as germination, is essential in determining the sowing rate. In two variants, the percentage of overwintering plants coincides with field germination, while in Super Simonia variety and B1E217 genotype it decreases by 3% to 5.5%. Nevertheless, the percentage of overwintering plants is highest in Super Simonia. In conclusion, it can be noted that the plants of the test variants successfully overwinter despite the decrease in temperatures during the winter months.

During the flowering period (Table 2), the plants do not have a significantly differences by the morphological characteristics. The height of the central stem is from 22 cm (B1E238) to 29 cm (Super Simonia). As for the number of branches per plant, two of the variants are characterized by a lower degree of branching- the Super Simonia variety and the local form B1E235 (var. 3). The number of reported branches in these variants is three, while in the other two variants it is four. The most intense branching growth is in Super Simonia variety (var. 1), where the length of all branches exceeds in value the other variants. The leaves number on the central stem is from 7.4 to 9.2. In all variants, the number of leaves on the branches is highest in the first forms, and then decreases.

During the period of mass fruiting phase (Table 3), the maximum stem length was reported at genotype 3 (62.2 cm). For the period between the two reports, the growth of the stem in this variant was most intense, 30 cm. The stem is lowest at variant 2, respectively 42 cm, which is stands with the slowest rate of growth of the stem, 17 cm for the period. Although for variants 1 and 4 the difference in the values of this indicator is 8 cm, we can say that the growth rate of the stem between the two reporting periods is similar by 26 cm for variant 4 and by 26.8 cm for variant one.

The number of branches does not change, three or four per plant. The average length of the branches depending on the genotype is between 37 cm and 55.3 cm. In variants with a higher central stem, the number of branches is smaller, an average of three plants. Variants with a lower central stem have a larger number of branches, but shorter than the others.

Table1. Field germination (%) and percentage of overwintering plants

Variant №	Field germination, %			Overwintering plants, %		
	2016	2017	average for the period	2016	2017	average for the period
1.Super Simonia	98	98	98	96	94	95.0
2. B1E217	93	91	92	88	85	86.5
3. B1E235	90	90	90	90	90	90.0
4. B1E238	92	90	91	92	90	91.0

Table 2. Biometric indicators of the plants in the beginning of flowering, average for the period 2016-2017

Variant	Branch number per plant	Length of:					Numbers of leaves on:				
		central stem	1st branch	2nd branch	3th branch	4th branch	central stem	1st branch	2nd branch	3th branch	4th branch
1.Super Simonia	3	29.1	25.4	25.0	21.1	-	9.2	8	7	5	-
2. B1E217	4	24.2	21.0	19.2	17.4	17.2	7.4	7	7	5	4
3. B1E235	3	27.5	21.7	17.4	13.1	-	9.2	8	5	3	-
4. B1E238	4	22.0	21.0	16.	12.2	10.2	8.4	7	6	5	5

Table 3. Biometric indicators of the plants during mass fruiting period, average for the period 2016-2017

Variant №	Length of central stem	Number of branches	Branch lengths on:					Numbers of leaves on:	
			1st branch	2nd branch	3th branch	4th branch	average length of branch	central stem	branch
1. Super Simonia	56.1	3	51.1	50.5	49.3	-	48	20	16
2.B1E217	42.9	4	40.5	37.5	36.4	35.0	37	18	14
3.B1E235	62.2	3	59.0	56.1	48.1	-	55.3	21	16
4.B1E238	48.7	4	46.3	43.4	37.4	35.2	41	17	13

The generative organs of the faba bean are embedded in the leaf petiole. Therefore, the number of leaves per plant is essential. Although the number of leaves is from 17 to 21 and relative to the length of the stem, differences between the studied genotypes appear in the length of the internodes. This, as well as differences in the degree of branching, show differences in the habitus of the plants. The average number of leaves on the branches

at the time of reporting is between 13 and 16. The lowest is in the variants with a lower stem and larger number of branches.

The location of the generative organs is important to determining maturity. Tested genotypes had differed on first flowers on the central stem (Table 4). The earliest betting on the first flowers was reported in genotype B1E238 - in second leaf. In plants of the other genotypes, this occurs after the 3rd - 5th leaf.

This trend for the early generation of the first flowers in genotype B1E238 is observed in all branches.

For the other genotypes, emergence of the first flowers on branches begins after 2 - 4 leaves.

Betting more flowers, as well as providing optimal conditions for the pollination and fertilization processes, are an important prerequisite for greater plant productivity. Depending on the genotype, the number of flowers per plant is between 38 and 46. The smallest is for genotype B1E235 and the largest is for B1E238.

The total standard yield of green pods (Table 5) is from 1036.4 kg/da - B1E217 (variant 2) to 1212 kg/da at B1E238 (variant 4).

Table 4. Some generative plant manifestations average for 2016-2017

Variant №	Betting first flower and number of flowers on:					Average number of flowers per 1 plant
	central stem	1st branch	2nd Branch	3rd branch	4th branch	
1. Super Simonia	$2^{(4)}$	$3^{(4)}$	$4^{(4)}$	$3^{(4)}$	-	45
2. B1E217	$3^{(3)}$	$2^{(4)}$	$2^{(2)}$	$3^{(2)}$	$2^{(3)}$	42
3. B1E235	$3^{(5)}$	$2^{(4)}$	$2^{(3)}$	$2^{(3)}$	-	38
4. B1E238	$3^{(2)}$	$2^{(2)}$	$3^{(1)}$	$4^{(1)}$	$3^{(2)}$	46

*The index in parentheses () shows in which leaves the first flowers are laid

Table 5. Yield (kg/da) and morphological characteristics of the green pods average for the period 2016-2017

Variant №	Yield, kg/da	Pod weight, g	Pod length, cm	Pod width, cm	Pod thickness, cm
1.Super Simonia	1153.5	7.8	7.63	1.20	0.94
2. B1E217	1036.4	6.3	6.81	1.08	0.81
3. B1E235	1064.0	6.6	6.84	1.10	0.84
4. B1E238	1212.0	7.6	7.83	1.13	0.87

The higher yield is due to the greater number of fruits per plant and the higher average weight of the pods. Good results were obtained for the Super Simonia variety. The reported yield exceeds variant 2 and variant 3, by an average of 103.3 kg/da.

Although the plants of variants 2 and variant 3 have some differences in habitus, the difference between the reported total yield is small - 26.7 kg. There are no differences between these genotypes of faba bean on the morphological features of the fruits.

Average for the period, green pods weigh is from 6.3 to 7.8 g, the length of the pods is 6.81-7.83 cm, the width of 1.08-1.20 cm, and the thickness of 0.81 to 0.94 cm. The higher values are for the Super Simonia variety, which is inferior to the B1E238 genotype only at the pod length indicator.

The values of the indicators are very similar in both variants.

With the passage of the pods into botanical maturity, their length slightly increases (Table 6). Depending on the variant, the length of the pod is from 7.6 (at variant 2) to 11.3 cm (at variant 4). The number of seeds per pod depending on the variant is from 3 to 4. The largest seeds are in the variant B1E238 (var. 4), where the weight per 100 seeds is 133.82 g., and the smallest is in B1E217 (var. 2), 90.56 g.

Table 6.Some morphological characteristics of maturity pod and seeds, average for the period 2016-2017

Variant №	Pod length,cm	Number of seed per pod	Mass of 100 seeds, g
1.Super Simonia	10.7	4	122.6
2. B1E217	7.6	3	90.56
3. B1E235	8.9	3	105.32
4. B1E238	11.3	4	133.82

CONCLUSIONS

The investigated genotypes successfully overwinter, which make them suitable for early production with winter sowing in region of Plovdiv. The Super Simonia variety is characterized by the highest percentage of overwintering plants.

The genotypes have a shrubby habitus with 3 or 4 branches and length of stem at the phase of mass fruiting from 42 cm to 62.2 cm. Plants with a lower central stem have a greater number of branches, and shorter internodes.

The genotypic differences are observed in the betting of the first generative organs. The earliest betting is on genotype B1E238, which is characterized by the better generative development due to the betting of the largest number of flowers. The reported yield in this genotype is by 5.1 to 13.9% higher than others.

The investigated genotypes don't have differed in the morphological characteristics of the pods and seed number, but seed masses are difference.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Agriculture University - Plovdiv, Department of Horticulture.

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