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SCREENING OF *BROAD BEAN* SAMPLES WITH ANTHOCYANIN IN SEED COAT IN THE SOUTH OF THE CENTRAL BLACK EARTH REGION (RUSSIA)

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Abstract:
The study of varieties of Vicia faba L. (Bel-1, Bobchinsky, Karmazin, Pink Flamingus, Russian Black, Royal Harvest) containing anthocyanin in the seed coats showed that the highest productivity of seeds in the conditions of the South of the Central Black Earth Region (Belgorod, Russia) marked for varieties Bel-1 (65 g on plant), the Pink Flamingus (64 g), the Royal Harvest (64 g). All studied varieties were characterized by a high protein content in the seeds (25-31%). The main contribution to the seed productivity of these varieties of broad beans was made by lateral shoots (r = +0.91). Varieties of beans Bobchinsky and Royal Harvest can be recommended as reducing the proportion of opportunistic, allergenic and toxigenic micromycetes in the soil. Plants of Karmazin and Bel-1 were characterized by minimal (0-9%) loss of productivity from common mycoses – alternariosis and fusariosis.

Key words: *broad beans, seeds productivity, anthocyanin, seed coat, high protein seeds, indirect signs of productivity.*

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INTRODUCTION:

The man began to use *Vicia faba* L. var. *Major* Harz back in antiquity, as evidenced even by the name – "faba" (food) [1-5]. And now it is a valuable food crop with a great bioresource potential, suitable for full and deep processing of raw materials taking into account chemical composition and biological value [5-6]. Seeds of beans are characterized by high protein content (27-35%) (by amino acid composition close to the animal), Vitamins A, B_1, B_2, C, PP, organic acids, mineral salts of potassium, phosphorus, calcium and magnesium. Bean seeds do not contain cholesterol, they have little fat and many complex carbohydrates. Seed coats of *V. faba* contains phenolic compounds, including flavonols, quercetin, myricetin, as well as catechins, that is, antioxidants, which are associated with chocolate, red wine and tea [7-12]. In addition, there are varieties and forms of broad beans, in the seed coats which contain anthocyanins, which possess strong antioxidant, antispasmodic, anti-inflammatory, antiallergic, bactericidal, antiviral properties, and also contribute to strengthening and increasing the elasticity of blood vessels, reducing the fragility of capillaries. However, anthocyanins enter the human body only with food [13-16]. Therefore, the study of anthocyanin-containing varieties of broad beans is of particular interest, which was the main purpose of our research.

Conditions, materials and methods of research

On the basis of the Botanical Garden (Belgorod) research was carried out. In small-scale experiments there are 30 varieties and hybrids of broad beans were studied, but discussing only forms with anthocyanin in seed coat in our article (Bobchinsky, Karmazin, Pink Flamingus, Russian Blacks, Royal Harvest, Bel-1). The soil is ordinary chernozem, containing up to 30-45% of physical clay, structurally small-lumpy, with an active acidity of 7.6.

The study of the biochemical composition of the seeds was carried out at the Department of General Chemistry of the National Research University "BelGU". Determination of protein in grain was carried out in accordance with GOST (10846-91) biuret method, using color reactions to proteins. To determine the structure of seed anthocyanin, the reversed-phase HPLC method was used on an Agilent 1200 chromatograph with a diode-array (DAD) and mass-spectrometric (MSD, electrospray ionization, positive ion mide) detectors [17]. Previous studies have shown that anthocyanin are found in the coats of seeds with a violet and dark violet color, and in reddish extracts from seeds with black and pink coat color, the color remained in the fraction of proanthocanidin, and no anthocyanin were detected [18].

Mycological experiments were conducted in the laboratory of the department of biotechnology and microbiology of the National University of BelSU according to the generally accepted methods [19-21]. The selection of soil fungi was carried out by the method of soil dilutions of Waxman with subsequent deep sowing into dense nutrient media. To study the micromorphology and identify the isolated fungi, the light microscope "Micromed-2" and the video-eyepiece DCM 310 SCOPE were used. Toxigenic, opportunistic and allergenic for human species of micromycetes was detected taking into account literary data. To assess the similarity between the complexes of soil micromycetes under the bean varieties, the similarity coefficient was used [22].

RESULTS AND DISCUSSION:

It has been established that the anthocyanic complexes of the seed coat of broad beans are represented by four derivatives of the three aglucones of the delphinidin series, dolphinidine, petunidine and malvidin with the main components (3-rutinosides) and derivatives, the usual 3-glycosides and 3-diglycosides.

Morphometric analysis of seeds showed that for seeds of Karmazin, Pink Flamingus and sample Bel-1, seeds are larger (1.4 × 2 cm) than for Bobchinsky, Russian Black and Royal Harvest (1.2 × 1.6 cm) varieties. Varieties Bobchinsky, Karmazin and Pink Flamingus were characterized by a rounded-shaped, rounded form of seeds, Russian black and Bel-1 were valkato-angular, and the Royal Harvest was flat-angular seeds. The carmine-pink color of the seeds was noted for the varieties Pink Flamingus and Karmazin, dark purple - Bel-1, Bobchinsky, Royal Harvest and Russian Black (to black).

Analysis of the elements of seed productivity of the studied varieties of broad beans (Table 1) showed that the largest were the pods of the varieties Pink Flamingus (12.6 ± 0.3 cm) and Karmazin (11.7 ± 0.3 cm), while the seed productivity of each plant was the highest in the Bel-1 (65.2 ± 1.8 g), the Pink Flamingus (63.6 ± 3.9 g) and the Royal Harvest (63.6 ± 3.9 g). The length of the fetus was determined by a mass of 1000 seeds (r = + 0.9). Varieties Royal Harvest and Bobchinsky were distinguished by the greatest number of pods on the lateral shoots (19.6 ± 2.5 and 16.5 ± 2.7 pieces, respectively), but their seeds contained less of the obtained percentage of protein (25%). The high protein content of the seeds was characterized by a sample of Bel-1 (31%).

Table 1 - Indicators of seed productivity of broad beans

Varieties	Length of Pod, cm	Weigth (g) of			Number of Pods on Lateral shoots	Protein contain, %
		Pod	Seeds on plant	1000 seeds		
Bel-1	10.3±0.3	10.8±1.1	65.2±1.8	1235±15	14.7±3.1	31
Bobchinsky	7.9±0.2	10.7±1.5	52.9±3.1	927±16	16.5±2.7	25
Karmazin	11.7±0.3	13.6±1.0	33.8±3.7	1219±28	5.4±0.7	27
Pink Flamingus	12.6±0.3	13.9±1.0	63.6±3.9	1437±15	23.0±1.8	28
Russian Blacks	9.1±0.8	8.1±1.6	33.5±4.1	928±22	2.4±0.7	29
Royal Harvest	7.8±0.3	8.3±0.6	63.6±3.9	1025±45	19.6±2.5	25

Analysis of the correlations of the elements of seed productivity with each other and with the morphometric characteristics of plants revealed that the mass of seeds from the plant positively correlated with the leaf area (r = +0.54), and the number of stomata on the upper epidermis of the leaves affected the length (r = +0.75) and weight of pod (r = +0.92), and also on the mass of 1000 seeds (r = +0.69). The weight of the pod strongly depended on its length (r = +0.85) and the mass of seeds in it (r = +0.8). The main contribution to the seed productivity of broad beans was made by side shoots (r = 0.91). The protein content in the seeds positively correlated with the leaf area (r = 0.53) and the length of the pods (r = +0.47).

It is of interest to study soil mycocomplexes under varieties of broad beans, as well as the presence of microscopic fungi harmful to humans (Table 2).

Table 2 - Representation of micromycetes harmful to humans and plants in soil mycocomplex of broad beans

Varieties	Number of species of micromyce tes	Coefficient of similarity	Abundance of species, %			Недобор продуктивности от, %	
			toxic	aller-genic	opportu-nistic	alterna-riosis	fusa-riosis
Bel-1	-	-	-	-	-	6	0
Bobchinsky	19	36	67	48	35	6	20
Karmazin	-	-	-	-	-	9	0
Pink Flamingus	12	27	89	68	58	0	42
Russian blacks	15	24	58	56	60	10	52
Royal Harvest	17	48	55	48	39	12	20
Fallow	25	100	76	71	49		

Note: "-" – no data

The data of Table 2 indicate that under all the anthocyanin-containing varieties of broad beans studied, the total number of species, as well as the allergenic species of microscopic fungi, is less, in comparison with the control soil (fallow). In addition, mycocomplexes under varieties Bobchinsky and Royal Harvest differed in less toxigenic and opportunistic species, and had the greatest specific similarity to steaming soil. Plants of Karmazin and Bel-1 were distinguished by minimal losses of productivity from common mycoses - alternariosis and fusariosis.

CONCLUSIONS:

1. The study of varieties of broad beans containing anthocyanin in the seed coat showed that the most productive in the soil-climatic conditions of the Belgorod region (Russia) were the plants of the Pink Flamingus, the Royal Harvest and the local selection sample Bel-1;
2. All studied varieties were characterized by high protein content in seeds (25-31%);
3. Indirect sign of high seed productivity of anthocyanin-containing varieties of broad beans is the leaf area (r = +0.54). The main contribution to the seed productivity of these varieties of broad beans was made by lateral shoots (r = +0.91);
4. Varieties of broad beans Bobchinsky and Royal Harvest can be recommended as reducing the proportion of opportunistic, allergenic and toxic micromycetes in the soil.

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