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RESEARCH ARTICLE

Effectiveness of influence of pre-sowing seeds treatment with combinations metabolically active compounds on biochemical composition of soybean grain

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Abstract

Soybean is the most valuable crop of all leguminous crops. Soy excels in terms of the content of vital substances in the grain. It is characterized by a high content of protein, oil and high nutritional qualities. Treatment of seeds with vitamin E in combination with ubiquinone-10 before sowing provided an increase in crude protein content in soybean seeds by an average of 31.44%. During pre-sowing treatment with a combination of vitamin E+ ubiquinone-10, an increase in the content of carotenoids was observed by an average of 45.65% compared to the control and by 43.48% according to the Vympel. The content of mono- and disaccharides increased with pre-sowing treatment with vitamin E and ubiquinone-10. The combination of vitamin E and ubiquinone-10, in comparison with other research options, proved to be the most effective when studying the biochemical composition of soybean seeds.

Keywords: Soy, Biochemical composition, Crude protein, mono- and disaccharides, carotenoids, Vitamin E, Ubiquinone-10, 4-hydroxibenzoic Acid (PHBA), Methionine, Magnesium sulfate ($MgSO_4$), Vympel

Introduction

Soy is one of the oldest agricultural crops used for food, fodder, technical and medical purposes. Soybean seeds contain 35% to 52% of complete protein in terms of amino acid composition, 17% to 27% of high-quality vegetable oil in terms of fatty acid composition, 18% to 25% of various carbohydrates, basic vitamins, 5% of mineral salts, as well as specific biologically active components (phosphatides, isoflavones, saponins, phytates, oligosaccharides), which are used for medicinal purposes. The green mass of soybeans is used for the production of silage, hay, haylage, grass flour, pellets, soybean straw is processed into fodder flour, pellets and ensiled in a mixture with green fodder (Babych, 1993; Fursova, 2004).

The quality of the leguminous products and soybeans in particular depends on the combined combination of weather and climate, soil factors and cultivation technology. Modern technological methods of growing legumes involve the utilization of plant growth regulators. Combinations of metabolically active compounds, in particular particular 4-hydroxibenzoic acid, $MgSO_4$, methionine, ubiquinone, and vitamin E can be promising growth regulators of leguminous crops. They are highly effective in small concentrations and are not toxic to human and animal health. Therefore, the aim of this paper is to study the influence of metabolically active compounds on the biochemical composition of soybeans of the Annushka variety.

Materials and Methods

The research was conducted in the educational and scientific laboratory for biochemical and medical and valeological research of Nizhyn State University named after Mykola Gogol during 2019-2021. The experimental part of the work was performed using Annushka soybeans and combinations of metabolically active substances: vitamin E, ubiquinone 10, 4-hydroxibenzoic Acid (PHBA), methionine and MgSO4. The Annushka variety was bred by the Breeding and Seed Research Company (NSNF) Soevy Vik (Korotich, 2006).

The research included the study of the effect of metabolically active compounds on the biochemical parameters of soybeans of the Annushka variety. To achieve this, three combinations of metabolically active substances were formed: vitamin E (10 M-8 M) +4-hydroxibenzoic Acid (PHBA) (0.001%) + methionine (0.001%); vitamin E (10 M-8 M) +PHBA (0.001%)+methionine (0.001%) +MgSO4, and vitamin E (10 M-8 M) + ubiquinone-10 (0.001%).

To compare the effectiveness of the above-mentioned combinations, the synthetic growth regulator Vympel (20 g/1 liter of water) was used. Substances treatment time of soybean seeds lasted 2 hours. After treatment, soybean seeds were sown in wide rows (width between rows –45 cm). The depth of seed wrapping was 4 cm–5 cm. The total area of the sowing plot was 108 m2. The research was guided by the "Fundamentals of scientific research in agronomy" (Yeshchenko, 2005). Determination of proteins in plant material was carried out according to the Lowry method (Lowry et al, 1951), determination of the content of carotenoids and free sugars: mono- and disaccharides was carried out by the spectrophotometric method (Goryacha, 2015; Kolisnyk, 2013). Statistical and mathematical processing of the results was performed using Excel 16.0 for Windows. Statistical evaluation was performed according to the student's t-test at a significance level of p 0.05.

Results and Discussion

Based on the research, it was found that pre-sowing treatment of soybean seeds with combinations of metabolically active substances affects the protein content of seeds (Tab 1). As a result of the conducted studies, a positive effect of combinations of vitamin E+ubiquinone-10 and vitamin E+methionine +PHBA + $MgSO_4$ on the content of crude protein in soybeans was established. Thus, treatment of seeds with vitamin E in combination with ubiquinone-10 before sowing provided an increase in the content of crude protein by an average of 31.44%, while pre-sowing treatment of seeds with a combination of vitamin E + methionine + PHBA+$MgSO_4$– by 4.77%, according to control indicators. It should also be noted that when using the complex vitamin E +ubiquinone-10, the content of crude protein was higher compared to the options where the growth regulator Vympel was used (Tab. 1).

The content of mono- and disaccharides in case of pre-sowing treatment of seeds with combinations of metabolically active compounds increases compared to the controls (Tab 1). The use of vitamin E in combination with ubiquinone-10 proved to be the most effective and increased the total mono- and disaccharide content, monosaccharide content and disaccharide content in Annushka soybean seeds by 122.89%, 136.41% and 124.58%, respectively, compared to the controls. The combination of vitamin E + methionine + PHBA + $MgSO_4$ also contributed to an increase in the indicators of mono- and disaccharides, and pre-sowing treatment with the above combination contributed to an increase in the studied indicators by 43.34%, 21.74% and 33.37% compared to the controls (Tab 1). In addition, the combinations of vitamin E + ubiquinonone-10 and vitamin E + methionine + PHBA + $MgSO_4$ showed higher results compared to the synthetic growth regulator Vimpel.

An increase in the content of carotenoids was observed after pre-sowing treatment with combinations of vitamin E + ubiquinone-10 and vitamin E + methionine + PHBA. The use of vitamin E in combination with ubiquinone-10 turned

out to be the most effective and on average the content of carotenoids increased by 45.65% compared to the control and by 43.48% compared to Vympel (tab 1). The combination of vitamin E + methionine + PHBA contributed to an increase in carotenoids by 6.52% and 4.35%, respectively, compared to controls and Vympel indicators. The increase in carotenoids in soybean seeds improves its nutritional properties

Table 1. The influence combinations metabolically active compounds on biochemical indicators soybean seeds, 2019-2021.

		Control	Vympel	Vitamin E + ubiquinone-10	Vitamin E + methionine + PHBA + $MgSO_4$	Vitamin E + methionine + PHBA
Content of mono- and disaccharides	Crude protein (mg/g)	18,00 ± 0,46	23,14 ± 0,63*	23,66 ± 0,96*	18,86 ± 0,43	17,56 ± 0,44
	Content of mono- and disaccharides (mg/g)	105,60 ± 8,49	128,23 ± 12,28*	235,38 ± 21, 31*	151,37 ± 13,99*	105,50 ± 10,19
	Content of monosaccharides (mg/g)	11,37 ± 4,07	19,61 ± 6,09*	26,88 ± 7,84*	20,51 ± 5,84*	32,57 ± 5,92*
	Content of disaccharides (mg/g)	90,59 ± 5,47	105,68 ± 5,94*	203,45 ± 11,35*	120,82 ± 6,96*	67,27 ± 6,59
	Carotenoid content (mg/g)	0,46 ± 0,09	0,47 ± 0,09	0,67 ± 0,21*	0,44 ± 0,05	0,49 ± 0,1

***Note. The difference is significant compared to the control (p<0.05).**

Conclusions

It was established that treatment of seeds with vitamin E in combination with ubiquinone-10 before sowing ensured an increase in crude protein content, an increase in total sugar content, monosaccharide content and disaccharide content in soybean seeds. Combinations of metabolically active substances vitamin E + ubiquinone-10, vitamin E + methionine + PHBA and vitamin E + PHBA + methionine + $MgSO_4$ enabled the increase of the content of carotenoids in soybean seeds, which significantly improves the biochemical composition of the seeds. The combination of vitamin E and ubiquinone-10, in comparison with other options of research, turned out to be the most effective when studying the biochemical composition of soybean seeds. The high efficiency of the above-mentioned substances can be explained by the efficiency of the components of the investigated combinations and their dosage during pre-sowing seed treatment.

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