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FORMATION OF TABLE BEET YIELD DEPENDING ON THE INFLUENCE OF BIOPREPARATIONS IN THE CONDITIONS OF THE RIGHT-BANK FOREST STEPPE OF UKRAINE

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Abstract
The results of research on the formation of table beet yield depending on the influence of biological products in the right-bank forest-steppe of Ukraine are presented. The duration of interphase periods was influenced by varietal characteristics and the action of biological drugs. The duration of the interphase period of mass germination – the end of the growing season under the action of the biological product Organic Balance + Azotophyte + Liposam in both variants was 67 days, which is three days less than in the control variant. Under the action of the biological product Humifrend + Azotophyte + Liposam, the duration of the period of mass germination – the end of the growing season was 69 days, compared with the control version - one day less. The average yield was higher in the hybrid Pablo F1 and was 72.6 t / ha, compared to the control, this figure is higher by 8.5 t / ha, in the variety Red Ball the average yield is 65.3 t / ha, which is higher than the control variant at 4.9 t / ha.
Keywords: table beet, variety, hybrid, biologicals, yield.

Introduction. Beetroot (*Beta vulgaris L.*) is a valuable vegetable crop. Beet roots contain up to 15 % dry matter, many mineral salts, organic acids and vitamins. It has beets and medicinal properties, including the ability to prevent the development of malignant tumors. In order to provide the population with the necessary quantity and range of vegetables, including table beets, it is necessary to increase their yield and biochemical quality. It depends on many factors, the main of which are the variety of beets and the timing of their sowing. In the world of varietal technologies of beet cultivation are widespread [18, 19].

Beetroot is a valuable vegetable crop, thanks to the content of food and dietary components. In Ukraine, among the roots of table beets is one of the leading places. Its growing area is 40-45 thousand hectares. Gross harvest of root crops in previous years amounted to 897-924 thousand tons, yield – 21-22 t / ha. The largest areas are concentrated in Polissya of Ukraine – 9.9%. The use of leading technologies provides root yields up to 70 t / ha. The range of varieties of table beets has recently expanded, which indicates the importance of this vegetable crop in the country [17, 20, 21].

Fruits of table beets contain protein up to 2 %, sugars 14.5 %, salts of potassium, calcium, magnesium, phosphorus. Unlike carrots, beets do not contain carotene, but more ascorbic acid. Roots and leaves of young plants are eaten. At early consumption (beet beet) young leaves and petioles are used [1, 2, 6, 14]. The healing properties of table beets are due to the large number of physiologically active useful compounds. Their concentration is quite high, so this plant has therapeutic and prophylactic value [16].

Currently, new requirements are set for table beet products that will satisfy the consumer, namely: high marketability and high quality products. The modern consumer prefers small roots - 6-8 cm in diameter, weighing 250-350 g. And in the first place is not always the yield [3, 5, 15].

The most common alternative method of agriculture in the world is biological (organic) farming. It creates potential opportunities to meet the growing consumer demand for environmentally friendly and safe for human health food [4].

The development of biologization of plant protection in Ukraine is an important scientific and industrial problem, the successful solution of which largely depends on the level of competitiveness of agricultural products in world, European and domestic markets and environmental protection.

Prospects for the development of the agricultural sector of Ukraine's economy and the growth of its export potential directly depend on the quality of agricultural products, their compliance with European and international standards. The efficiency of agricultural production in modern conditions largely depends on the successful use of crop protection against pests, diseases and weeds, which ensures the preservation of the crop from natural losses and increases their overall yield. One of the determining factors in ensuring high standards of agricultural products is to reduce the use of chemicals and the widespread introduction of environmentally friendly technologies in the agricultural production process. The biological method as a complex method of a wide range of action has the prospect of becoming the basis for the greening of agricultural production.

The use of biological products to ensure optimal conditions for growth and development of crops is a mandatory element of greening agricultural production. However, the refusal to use chemical plant protection products, the widespread introduction of the biological method are faced with misunderstandings by agricultural producers due to insufficient elucidation of the impact of biological products on plant biometrics [7, 8, 12].

The biological method of growing plants, as a result of which we get a clean environment, environmentally friendly high-quality products, reproduce the natural fertility of soils in agricultural production should

be one of the main ways to improve agricultural production [7, 12].

It is known that biological products affect the growth and development of many vegetable plants, increasing seed germination, resistance to a wide range of diseases, provide and improve nutritional processes and increase yields and marketability [8].

Methods. The study of the influence of biological drugs on the formation of the beet harvest was carried out in 2018-2019 in the experimental field of Vinnytsia NAU. The soil of the experimental field of VNAU – gray forest, medium loam, has the following indicators: humus content – average and is 2.4%, the supply of P_2O_5 – 21.2 mg / 100 g of soil, and low K_2O – 9.2 mg / 100 g of soil. Soil acidity is close to neutral. The area of the accounting plot is 20 m^2, the experiment is repeated four times. The experiment consisted of 6 options. The study was performed with the Chervona kylia variety and the Pablo F_1 hybrid. Variants of the experiment were biological drugs: Organic Balance + Azotophyte + Liposam, Humifrend + Azotophyte + Liposam. The control was an option without processing [13].

The technology of growing table beets is typical for the Forest-Steppe zone of the Right Bank and complies with DSTU 6014: 2008 "Table carrots and table beets. Growing technology "[9]. Field, statistical and laboratory research methods were used in conducting experimental research.

According to the method, phenological observations, biometric measurements and records are provided [13]. The area of the leaves was calculated according to the method of VI Kamchatny and GA Sinkovets [11]. Harvesting was carried out during the period of technical ripeness of root crops in accordance with the requirements of the current standard – "Fresh table beets. Technical conditions - DSTU 7033: 2009 "[10].

Results and discussion. According to the results of the research it was established that the onset of phenological phases of table beet depended on the variety, hybrid, as well as on biological preparations. Previously, the onset of phenological phases of growth and development of table beets was observed in plants of the Pablo F_1 hybrid. According to the calendar terms, single seedlings appeared earlier in the Pablo F_1 hybrid – 26.04, and in the Chervona kylia variety single seedlings appeared on 28.04 (*Table 1*). In general, such a pattern was observed in the following phases of growth and development of table beet plants.

Mass sprouts of table beet plants previously appeared in the hybrid Pablo F_1 – 11.05 in all studied variants, which is two days earlier than in the variety Chervona kylia – 13.05. The same pattern was observed with the appearance of the first and third pairs of true leaves of table beets. The appearance of the first pair of true leaves was first observed in the hybrid Pablo F_1 – 14.05, and a little later in the variety Chervona kylia – 16.05. The appearance of the third and fifth pairs of true leaves was previously observed in the Pablo F_1 hybrid on 22.05, and the appearance of the third pair of leaves was observed on 24.05 in the Red Ball variety. The appearance of the fifth pair of true leaves after the introduction of biological products in the hybrid Pablo F_1 was observed on 01.06, which is one day earlier than in the control variant, in the variety Chervona kylia – 02.06, which is two days earlier than in the control variant.

Table 1.

To date the phenological phases of table beets depending on the variety and biological product, 2018-2019.

Variety, hybrid	Biological drug	Plant seedlings		The appearance of pairs of true leaves		
		single	mass	1th	3th	5th
Chervona kylia	without processing (control)	28.04	13.05	16.05	24.05	04.06
	Organic Balance + Azotophyte + Liposam	28.04	13.05	16.05	24.05	02.06
	Humifrend + Azotophyte + Liposam	28.04	13.05	16.05	24.05	02.06
Pablo F_1	without processing (control)	26.04	11.05	14.05	22.05	02.06
	Organic Balance + Azotophyte + Liposam	26.04	11.05	14.05	22.05	01.06
	Humifrend + Azotophyte + Liposam	26.04	11.05	14.05	22.05	01.06

The passage of the subsequent phases of development of table beets also depended on the variety and biological products used in the subsequent phases of growth and development of table beets (*Table 2*).

Table 2.

Date of phenological phases of table beets depending on the variety and biological preparation, 2018-2019

Variety, hybrid	Biological drug	Shedding phase	Phase of intensive root growth	Phase of technical maturity	Harvesting
Chervona kylia	without processing (control)	08.06	12.06	21.07	17.09
	Organic Balance + Azotophyte + Liposam	06.06	11.06	18.07	17.09
	Humifrend + Azotophyte + Liposam	07.06	11.06	20.07	17.09
Pablo F_1	without processing (control)	06.06	11.06	19.07	17.09
	Organic Balance + Azotophyte + Liposam	04.06	09.06	16.07	17.09
	Humifrend + Azotophyte + Liposam	05.06	10.06	18.07	17.09

In the experiment, the growth and development of table beet plants was different, as it depended on the varietal characteristics of the plants and the biological product used. Seedlings of table beet plants were typical, mass, which testified to the high energy of seed germination.

Depending on the varietal characteristics of table beets and imported biological preparations, the studied variety and hybrid had different duration of interphase periods. The duration of the interphase period "sowing – germination" was 11 days for the hybrid Pablo F_1 and 13 days for the variety Chervona kylia. During these periods, the stairs were leveled. The duration of interphase periods was influenced by varietal characteristics and the action of biological drugs (*Table 3*).

Table 3.

Duration of interphase periods of table beets depending on the variety and biological preparation, 2018-2019.

Variety, hybrid	Biological drug	Mass seedlings – the molting phase	Mass seedlings – the beginning of intensive root formation	Mass seedlings – the end of the growing season
Chervona kylia	without processing (control)	26	30	70
	Organic Balance + Azotophyte + Liposam	24	29	67
	Humifrend + Azotophyte + Liposam	25	29	69
Pablo F_1	without processing (control)	26	31	70
	Organic Balance + Azotophyte + Liposam	24	29	67
	Humifrend + Azotophyte + Liposam	25	30	69

As a result of growing table beets in the open ground, the molting phase and root formation showed the adaptation of plants to environmental conditions and determined the effectiveness of the studied biological products. Based on the obtained data, it was found that the period from mass germination to the molting phase was the shortest under the action of biologicals Organic Balance + Azotophyte + Liposam and was 24 days in the Chervona kylia variety and Pablo F_1 hybrid, which is 2 days less than control variants. Under the action of biological drugs Humifrend + Azotophyte + Liposam, the interphase period from mass germination to the molting phase was 25 days, which is one day less than in the control version.

Interphase period mass germination – the beginning of intensive root formation in both cases was 29 days under the action of biological drugs Organic Balance + Azotophyte + Liposam. Compared to the control variant, it is 2 days less in the Pablo F1 hybrid and one day less in the Chervona kylia variety. The duration of the interphase period from mass germination to the beginning of intensive root formation under the action of the biological product Humifrend + Azotophyte + Liposam was 29 days in the Chervona kylia variety and 30 days in the Pablo F_1 hybrid, which is one day less than the control variant.

The duration of the interphase period of mass germination – the end of the growing season under the ac-

tion of the biological product Organic Balance + Azotophyte + Liposam in both variants was 67 days, which is three days less than in the control variant. Under the action of the biological product Humifrend + Azotophyte + Liposam, the duration of the period of mass germination – the end of the growing season was 69 days, compared with the control version – one day less.

In general, the obtained yield can be assessed as high, which determines the adaptability of varieties to their cultivation in open ground. The obtained products fully met the requirements of the standard, were not damaged by pests and pathogens. Based on the obtained yield data, the positive effect of biological products on yield indicators and biometric parameters of table beet production was established (*Table 4*).

Table 4.

Yield of table beets depending on the variety and biological preparation, 2018-2019.

Variety, hybrid	Biological drug		Yield capacity, t/ha		± before control	Increase ± to control,%
			2018 y.	2019 y.		
Chervona kylia	Without processing (control)		62,3	58,6	60,5	–
	Organic Balance + Azotophyte + Liposam		69,6	65,4	67,5	7,1
	Humifrend + Azotophyte + Liposam		67,4	63,2	65,3	4,9
Pablo F_1	Without processing (control)		66,1	62,0	64,1	–
	Organic Balance + Azotophyte + Liposam		76,8	72,5	74,7	10,6
	Humifrend + Azotophyte + Liposam		74,7	70,4	72,6	8,5
HIP_{05}		A	0,9	0,8	–	
		B	1,0	0,9		
		AB	1,6	1,4		

As a result of research, the highest yield was characterized by the hybrid Pablo F_1, where the average yield of root crops is higher than the control by 10.6 t / ha and is 74.7 t / ha under the action of biological drugs Organic Balance + Azotophyte + Liposam. The Chervona kylia variety also showed the highest yield due to the action of biological products Organic Balance + Azotophyte + Liposam, it was 67.5 t / ha, which is 7.1 t / ha higher than the control variant.

The efficiency of using Humifrend + Azotophyte + Liposam had a slightly lower effect on the formation of yields of the studied variants, but the indicators were higher compared to the control variant. Thus, under their action, the average yield was higher in the hybrid Pablo F_1 and amounted to 72.6 t / ha, compared with the control, this figure is higher by 8.5 t / ha, in the variety Chervona kylia, the average yield is 65.3 t / ha , which is higher than the control option by 4.9 t / ha.

The significance of this difference is confirmed by the results of analysis of variance. It was found that factor A (variety, hybrid) affected the yield by 36%, factor B (biological preparation) – by 57%.

Biometric measurements of root crops were also carried out during the harvest of table beets (*Table 5*).

Table 5.

Biometric indicators of table beet production depending on the variety and biological preparation, 2018-2019.

Variety, hybrid	Biological drug	Number of fruit, p/plant	Weight of fruit, g	Fruit diameter, cm
Chervona kylia	without processing (control)	270	8,0	7,8
	Organic Balance + Azotophyte + Liposam	315	8,5	8,3
	Humifrend + Azotophyte + Liposam	298	8,2	8,0
Pablo F_1	without processing (control)	295	8,2	8,0
	Organic Balance + Azotophyte + Liposam	326	8,7	8,5
	Humifrend + Azotophyte + Liposam	318	8,4	8,2

Among the studied variants, the largest biometric data of root crops were found in the hybrid Pablo F_1.

Biological preparations Organic Balance + Azotophyte + Liposam had the best effect on the formation of biometric indicators: the average weight of roots was 326 g, which is 31 g more than the control version, the diameter and length of the studied roots were 8.7 and 8.5 cm, respectively, while control option, these figures are lower by 0.5 cm

In the Chervona kylia variety, organic preparations Organic Balance + Azotophyte + Liposam also had the most effective effect on the formation of biometric parameters of root crops. Under the action of these drugs, the average weight of the root was 315 g, which in comparison with the control is 45 g more than in the version without treatment with biological products. The diameter and length relative to the control variant were lower by 0.5 cm and were 8.5 and 8.3 cm.

The use of biological products Humifrend + Azotophyte + Liposam had a slightly smaller impact on the formation of yield and biometric indicators of the variety and hybrid.

In general, the studied biological preparations showed a very effective effect on the formation of the yield of the studied varieties Chervona kylia and hybrid Pablo F_1. However, according to the results of crop accounting, it was found that more effective for the treatment of table beets are biological drugs Organic Balance + Azotophyte + Liposam, which most effectively influenced the formation of yield of table beets.

Conclusions. Studies have shown that the combination of variety and biological products provides the conditions for the formation of the highest yield with excellent biometric parameters of the product. Due to the provision of table beet plants with nutrients, all the studied options were characterized by a significant increase in yield compared to the option without treatment. However, the highest yield of table beets was obtained with the use of Organic Balance + Azotophyte + Liposam, where the increase relative to control in the variety Chervona kylia was – 7.1 t / ha, in the hybrid Pablo F1 – 10.6 t / ha. A positive effect was also noted with the use of Humifrend + Azotophyte + Liposam, where the weight of the fruit was in the variety Chervona kylia – 298 g, in the hybrid Pablo F_1 – 318 g.

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DYNAMICS OF HEIGHT AND DENSITY INDICATORS FORMATION OF PLANTS IN THE STUDIED SOYBEAN VARIETIES DEPENDING ON PRE-SOWING TREATMENT OF SEEDS

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Abstract

The results of the research on the study of pre-sowing treatment of soybean seeds with biostimulant and bioinoculant in the experimental field of Vinnytsia National Agrarian University are presented. Peculiarities of phenological development of the studied soybean varieties are established. Peculiarities of formation of one of the most important components of soybean crop formation formation - plant density at the time of germination and their survival, the number of plants per unit area before harvesting are analyzed.

According to the results of research conducted at the experimental sites, the effect of seed treatment with biostimulant and bioinoculant on field germination, density and survival of plants of the studied soybean varieties was revealed. It is established that on average for 2019-2020, depending on the action of intensification factors, the field germination of soybeans also changed, which influenced the formation of the plant density indicator for the period of full germination. As a result of the conducted researches, the influence of seed treatment with microelements and strain of nitrogen-fixing bacteria on the dynamics of plant height formation of soybean varieties was also revealed.

Keywords: variety, biostimulator, bioinoculant, plant preservation factor, plant height.

The problem formulation. Field germination of seeds - the main indicator of seedling quality - is a percentage of the number of sown similar seeds [1]. According to scientists [8], obtaining friendly and full seedlings of optimal density is the key to obtaining a high yield. According to research [10], reducing the field germination of seeds by 1% reduces the yield of spring cereals by 1-2%, winter wheat by 1-1.5%; field germination of seeds is usually: in cereals - 60-65, legumes - 70-75, sugar beets - 45-60, perennial grasses - 30-40, flax and hemp - 70-75%, which leads to significant yield losses. The height of the plant, its lodging and the height of attachment of the lower beans are one of the main features of soybeans, which determine its suitability for full mechanized cultivation from sowing to harvesting. The height of plants varies depending on the variety, year of cultivation, soil and climatic conditions and agronomic techniques used [13].

Due to the height of the plants, the number of productive nodes may increase (varieties with incomplete type of growth are indeterminate), but this feature is undesirable due to shading of the lower tiers, while reducing the inflow of solar insolation to the plant. In the future there is a struggle for assimilators between the vegetative mass of the plant and the generative, where the first indicator falls. This feature is inherent in the old varieties and varieties that are grown under irrigation in conditions of sufficient heat supply [11, 14].

Analysis of recent research and publications. A significant volume of publications is devoted to the problems of selection, cultivation and processing of soybeans and the use of growth regulating and stimulating drugs [1-5, 7, 9]. Seed treatment with plant

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