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ОБГРУНТУВАННЯ ТЕХНОЛОГІЧНИХ ПРИЙОМІВ ВИРОЩУВАННЯ БУРЯКА СТОЛОВОГО В УМОВАХ УКРАЇНИ

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SUBSTANTIATION OF TECHNOLOGICAL METHODS OF TABLE BEET GROWING IN THE CONDITIONS OF UKRAINE

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Анотація

У статті представлено результати вивчення впливу біологічних препаратів на біометричні показники рослин та формування врожаю. Встановлено залежність біометричних параметрів рослин від застосування біологічних препаратів. У середньому за роки досліджень найбільшу урожайність було відмічено за використання Органік баланс+Азотофіт+Липосам, де приріст відносно контролю у сорту Червона куля склав – 7,1 т/га, у гібриду Пабло F_1 – 10,6 т/га. Дещо менший, але позитивний ефект відмічено, також, за використання Гуміфренд + Азтофіт + Липосам, де маса плоду склала у сорту Червона куля – 298 г, у гібриду Пабло F_1 – 318 г.

Abstract

The article presents the results of studying the effect of biological drugs on plant table beets biometrics and crop formation. The dependence of biometric parameters of plants on the use of biological drugs is established. On average, over the years of research, the highest yield was observed 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 F_1 – 10.6 t / ha. Slightly smaller, but a positive effect was also observed with the use of Humifrend + Aztofit + Liposam, where the weight of the fruit was in the variety Chervona kylia – 298 g, in the hybrid Pablo F_1 – 318 g.

Ключові слова: біологічний препарат, сорт, гібрид, біометричні показники, урожайність.

Keywords: table beets, biological preparation, variety, hybrid, biometric indicators, yield.

Formulation of the problem. Table beets (*Beta vulgaris*) is one of the leading valuable food vegetable plants in the open ground, which occupies about 10 % in the structure of sown areas. In Ukraine, table beets occupy 44.1 thousand hectares. The yield of root crops averages 20.3 t / ha, gross harvest 894.1 thousand [10].

Table beets, in comparison with all other table beets, are the most caloric. This plant is used in food completely: young leaves and petioles – in salads and first courses, root vegetables – in first and second courses and for making beet juice, which is very useful, especially in iron deficiency and metabolic disorders. Table beets is also one of the vegetables that are most rich in iodine [18].

Analysis of recent research and publications. In terms of calories, table beets exceed all other juicy vegetables. Its roots contain carbohydrates, vitamins (C, B, PP), organic acids, salts of Ca, Mg, Fe, pectin. According to the content of phosphorus and potassium, it occupies one of the first places among vegetable crops. Therefore, table beet is one of the root vegetable crops, which is consumed almost completely: first young leaves, petioles and roots, and at the end of the growing season – only roots [17].

To obtain a high quality crop and excellent taste properties, varieties should be selected according to climatic conditions and soil structure, as well as cultivation technology, in which plants would be provided with all the important factors for their growth and development. Ukraine uses a fairly large set of varieties of both domestic and foreign selection. However, also, important attention should be paid to the technology of growing plants.

To provide the population with table beet products in accordance with food standards, it is necessary to find ways to increase yields and product quality. It is possible to get a high and stable yield under the conditions of correct selection of elements of technology which would be optimum for plants. Such elements include the use of biologicals. Today, the use of biological products is becoming increasingly common in order to obtain environmentally friendly vegetable products. Among the factors of man-caused load on the biosphere, a special place is given to the chemicalization of agriculture, which violates self-regulation in wildlife, weakens the protective forces of plants, animals and humans.

Unreasonable doses of mineral fertilizers, numerous treatments with chemical plant protection products, violations of application technology and intensive tillage are the cause of many negative environmental consequences. The organic system of agriculture provides for the maintenance and increase of soil fertility mainly due to organic fertilizers and complete abandonment of synthetic mineral fertilizers and pesticides.

Organic production covers not only crop production and animal husbandry, but also the processing industry [1, 2]. Among the many factors that significantly affect the yield of vegetables, the variety and timing of sowing seeds are important. Advances in science and the practice of advanced farms show that the variety factor with the appropriate farming techniques provides an increase in vegetable yields up to 30% [1, 3], which increases the profitability of production [1, 3, 4].

At the end of the second millennium, scientists and the world community began to pay much attention to the problem of greening agriculture as a fundamental component of healthy food production. Therefore, on the one hand, the return to traditional management methods without the use of chemical plant protection products and mineral fertilizers, and on the other - the use of fertilizers and waste of organic origin, as well as natural plant protection products are becoming increasingly important [16, 17].

The aim of the study. Substantiation of technological methods of growing table beets in Ukraine. Identify the impact of biological products on the biometric parameters of plants and products of table beets, as well as its yield.

Research methodology. Substantiation of technological methods of growing table beets was carried out in 2018-2019 in Ukraine. The soil of the experimental field – 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, + Azotophyte + Liposam. The control was an option without processing [12]. 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 "[6]. Field, statistical and laboratory research methods were used in conducting experimental research. According to the method, phenological observations, biometric measurements and records are provided [12]. The area of the leaves was calculated according to the method of VI Kamchatny and GA Sinkovets [7]. Harvesting was carried out during the period of technical maturity of roots in accordance with the requirements of the current standard – "Fresh table beets. Technical conditions – DSTU 7033: 2009 ”[5].

Results and discussion. The experiment performed biometric measurements of table beet plants, such as plant height, number of leaves per plant, leaf vein length to determine leaf area, depending on the phases of development of the Chervona kylia variety and Pablo F_1 hybrid, as well as the action of biological products. Measurements were performed in the molting phase, the phase of intensive root growth and the phase of technical maturity (*Table 1.*). Based on the obtained data, the research established the dependence of the formation of biometrics on the varietal characteristics of the plant and the applied biological product.

The analysis of the number of leaves revealed a positive effect of the biological product Organic Balance + Azotophyte + Liposam on the studied indicator during the cultivation of the Chervona kylia variety and the Pablo F_1 hybrid. In this embodiment, the number of leaves exceeded the number of leaves of the control variant by 2.3 and 1.3 leaves, respectively. In another version of the experiment, biologicals did not significantly affect the process of increasing the leaf mass of plants.

Calculation of leaf area on the studied variants established a positive effect of Organic Balance + Azotophyte + Liposam. Under the action of these biological products, the leaf area in the Chervona kylia variety was 0.94 dm^2 / plant, which is 0.9 dm^2 / plant more than the control variant. In the Pablo F_1 hybrid under the action of these biological products, the difference between the control variant was 0.13 dm^2 / plant.

1. Biometric indicators of table beet plants in the molting phase depending on the variety and biological preparation. The average for 2018-2019

Variety, hybrid	Biological drug	Height of plants, cm	Number of leaves, pieces /plant	Area of leaves, dm2 / plant
Chervona kylia	without processing (control)	28,6	6,3	0,86
	Organic Balance + Azotophyte + Liposam	29,6	8,6	0,95
	Humifrend + Azotophyte + Liposam	29,2	7,7	0,92
Pablo F_1	without processing (control)	29,6	7,8	0,94
	Organic Balance + Azotophyte + Liposam	30,5	9,1	1,07
	Humifrend + Azotophyte + Liposam	30,3	8,5	1,09

Biometric indicators of table beet plants in the phase of intensive root growth are shown in table. 2.

2. Biometric indicators of table beet plants in the phase of intensive root growth depending on the variety and biological preparation.

The average for 2018-2019

Variety, hybrid	Biological drug	Height of plants, cm	Number of leaves, pieces /plant	Area of leaves, thousands m^2/ha
Chervona kylia	without processing (control)	33,6	13,3	2,9
	Organic Balance + Azotophyte + Liposam	35,7	15,8	3,2
	Humifrend + Azotophyte + Liposam	34,4	14,9	3,1
Pablo F_1	without processing (control)	35,6	15,8	3,8
	Organic Balance + Azotophyte + Liposam	37,7	18,5	3,9
	Humifrend + Azotophyte + Liposam	35,6	16,9	3,8

The highest plant height in the phase of intensive root growth among the studied variants under the action of biological drugs Organic Balance + Azotophyte + Liposam had plants of the hybrid Pablo F_1 – 36.6 cm, where the difference with control was 2.1 cm, in the variety Chervona kylia plant height was 34, 6 cm with a difference with control also in 2.1 cm. At the same time under the action of + Azotophyte + Liposam plant height in the hybrid Pablo F_1 did not exceed the control variant and was 34.5 cm, and in the variety Chervona kylia plant height was 33.3 cm, which is 0.8 cm more than the control.

Analysis of the number of leaves in the phase of intensive root growth revealed a positive effect of Organic Balance + Azotophyte + Liposam on the studied indicator during the experiment. In this variant, the number of leaves exceeded the number of leaves in the variety Chervona kylia to the control variant by 2.5 pcs / plant, the difference between the hybrid Pablo F_1 and the control variant was 2.7 pcs / plant. In another version of the experiment, biologicals had almost no effect on the process of leaf growth on the plant: the difference with the control was 1.6 and 1.2 pcs / plant, respectively. Biometric indicators of table beet plants in the phase of technical maturity are given in *table 3*.

3. Biometric indicators of table beet plants in the phase of technical maturity depending on the variety and biological preparation.

The average for 2018-2019

Variety, hybrid	Biological drug	Height of plants, cm	Number of leaves, pieces /plant	Area of leaves, thousands m^2/ha
Chervona kylia	without processing (control)	34,8	11,8	2,6
	Organic Balance + Azotophyte + Liposam	35,5	12,4	3,0
	Humifrend + Azotophyte + Liposam	35,2	12,0	2,9
Pablo F_1	without processing (control)	37,2	13,7	3,5
	Organic Balance + Azotophyte + Liposam	38,3	14,2	3,7
	Humifrend + Azotophyte + Liposam	37,7	13,9	3,6

It is seen that the effect of biologicals was positive in the formation of biometric parameters of table beet plants in the phase of technical maturity. As can be seen from the table, the height of table beet plants, in the phase of technical maturity under the action of biological products in all variants increased. Under the action of the biological product Organic Balance + Azotophyte + Liposam, table beet plants were the highest in the Pablo F_1 hybrid and had a height of 38.3 cm, which was 1.1 cm higher than in the control variant. In the Chervona kylia variety, the plant height was the highest under the action of Organic Balance + Azotophyte + Liposam and was 35.5 cm, which is 0.7 cm more than in the control variant. table beet plants. Biopreparations also had a positive effect on leaf growth on table beet plants. The effect of Organic Balance + Azotophyte + Liposam had a significant effect. In the variety Chervona kylia under the action of these drugs, the number

of leaves, compared with the control was greater by 0.6 pcs / plant and was 12.4 pcs / plant. In the hybrid under the action of Organic Balance + Azotophyte + Liposam, the number of leaves was at the level of 14.2 pcs / plant, which is 0.5 pcs / plant more than in the control variant. The effect of + Azotophyte + Liposam was lower in the formation of the number of leaves on table beet plants. The difference with the control variants in the variety Chervona kylia and in the hybrid Pablo F_1 was at the level of 0.2 pcs /plant.

The effects of biological drugs in the phase of technical maturity of table beet plants were not observed with increasing leaf area. In the phase of technical maturity, the area of leaves in all studied variants began to decrease. In the variant using Organic Balance + Azotophyte + Liposam in the Chervona kylia variety, the leaf area was 3.0 thousand m^2 / ha, which is 0.4 thousand m^2 / ha more than in the control variant and 0.1 thousand less. m^2 / ha compared to the area of leaves in the phase of intensive root growth. In the hybrid Pablo F_1 under the action of Organic Balance + Azotophyte + Liposam leaf area was 3.7 thousand m^2 / ha, which is more than the control variant by 0.2 thousand m^2 / ha and less than in the phase of intensive root growth by 0, 1 thousand m^2 / ha. In the variant using + Azotophyte + Liposam, the leaf area on table beet plants also decreased in both studied variants.

Therefore, the action of biological drugs in the cultivation of table beet plants had a significant impact on crops. Under the action of biological drugs in both studied variants, we observed an effect on the passage of interphase periods, the duration of which was slightly shorter compared to the variants without installments. Also, biological preparations showed a significant effect in the formation of biometric parameters of table beet plants in all studied variants. Compared with the untreated options, the biometric parameters of the plants were slightly higher with the use of biological products. Only in the phase of technical maturity, the effect of biologicals was not observed in the formation of the leaf area of table beet plants – compared to previous phases, the leaf area on table beet plants began to decrease.

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.

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*).

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.

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		

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

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

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 varietal characteristics and biological products affect crop formation and biometric parameters of products. The use of biological drugs provided an increase in yield relative to the control option. However, the highest yields of table beets were 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 F_1 – 10.6 t / ha. Slightly smaller, but a positive effect was also observed 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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INFLUENCE OF MINERAL FERTILIZERS AND METHODS OF USING THE COMPLEX OF MICROELEMENTS ON THE HEIGHT OF SOYBEAN PLANTS

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Abstract

It is established that depending on weather conditions in the years of research and growing conditions, both the height of plants of different soybean varieties and the dynamics of the average daily linear growth of the stem of soybean plant varieties change. The results of the study and analysis of the regularity of the average daily linear growth depending on different growing conditions are presented. It was found that soybean plants of Gorlytsia and Vinnychanka varieties in the process of ontogenesis had slightly different stem height, which is due to genetics, and the intensity of the average daily linear growth. On the basis of the performed researches it is noted that in the conditions of the Forest-Steppe of the Right Bank both height of plants of grades of soybeans, and its dynamics during the vegetation period as a whole, to a large extent depended on hydrothermal conditions in years of researches.

Based on the calculations, it was found that there is a significant correlation between the applied doses of fertilizers and the height of soybean plants. The dependence of the height of soybean plants on the doses of mineral fertilizers is given by linear regression equations. It was found that the intensity of the average daily linear growth of plants of soybean varieties, along with hydrothermal conditions, was significantly influenced by organized factors, in particular the background of mineral nutrition and methods of treatment with a complex of trace elements. It is established that a comprehensive approach to the soybean fertilization system provides the best conditions for growth, development and preservation of the largest number of plants in crops, under these growing conditions, the largest average daily linear growth was observed.

Keywords: height, fertilizer system, linear growth, phenological phases, soybean varieties.

The problem formulation. Soybeans are the main high-protein crop in the world, they are one of the most common legumes and oilseeds, play a crucial role in agriculture, engineering and processing industry and medicine. This is a valuable legume, which is especially important in the formation of the domestic market of high-protein feeds, balanced in nutrients and amino acids. Soybean seeds contain an average of 36 - 45% protein, 19 - 22% - fat, 23 - 28% carbohydrates, a significant content of vitamins, enzymes, minerals and other substances [6, 7].

Throughout the growing season, plants undergo two interconnected, but at the same time, different processes: growth and development. The study of the growth and development of soybean plants in ontogenesis makes it possible to reveal the most important dependences of the formation process of this crop high productivity. One of the main features that characterize the rate of growth and development of plants is the height of the central stem [1-5].

The height of plants is influenced by soil and climatic conditions and technological methods of cultivation, as a result of which it changes in time and space, which, in turn, determines the yield of the crop. Active growth of soybean plants begins in 2 - 3 weeks after full germination, so the growth of plants in height during the growing season is an important morphobiological indicator that characterizes the reaction of plants to changes in environmental conditions [8-10].

Soybean plants are negatively affected by biotic and climatic environmental factors during growth and development. Excessive moisture and prolonged droughts in critical periods of the growing season can lead to their loss, both from the negative impact of these factors and from the development of diseases that are the result of their impact [12-17].

When growing soybeans in the North-Eastern Forest-Steppe of Ukraine, it is advisable to give preference to varieties with high plasticity and stability, which is an important factor in realizing the genetic potential of the variety and obtaining a guaranteed high soybean yield [11].

Thus, based on an in-depth analysis of literature

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