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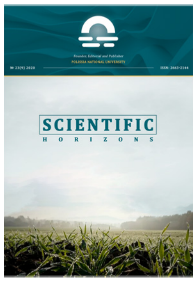

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Organic cultivation of carrot in the right-bank Forest-Steppe of Ukraine

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Abstract. The carrot (*Daucus carota var. sativus* L.) is one of the most widely grown vegetable crops in the world. It is characterised by prominent taste qualities and a rich chemical composition, which makes it valuable for fresh and processed consumption. Considering the population's need for high-quality, environmentally friendly products, it is vital to investigate the organic cultivation of the carrot. The purpose of this study was to investigate the organic cultivation of carrots in the right-bank Forest-Steppe of Ukraine. The following research methods were used: field, measuring and weighing, mathematical, and statistical. The paper presents findings for 2020-2022, where the

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growth, development, and formation of the crop under organic cultivation technology were investigated. The phenological phases and their duration, biometric parameters of carrot plants, and their yield were studied. The organic technology of growing carrots helped to reduce the interphase periods. The end of the vegetation period of carrots was observed earlier under organic cultivation technology by 2 and 3 days compared to the control variant. The height of the carrot plants was the highest in the Bolivar F_1 hybrid under organic cultivation technology – 37 cm, which is 7 cm more than the control variant. The highest leafiness was observed in the studied variety and hybrid under organic cultivation technology. In the Olympus variety, the increase relative to the control was 3 pcs./plant, in the Bolivar F_1 hybrid – 2 pcs./plant. The regularity of increasing the parameters of carrot roots under organic cultivation technology was noted. The increase in the diameter and length of the root crop under organic cultivation technology was 1.0-2.0 cm and 3 cm, respectively. The largest weight of root crops was under organic cultivation technology, where the increase relative to the control variant was 5 g for the Olympus variety and 7 g for the Bolivar F_1 hybrid. When using organic technology, which involves biological products, the total yield of root crops increased by 3.1 t/ha compared to the control variant

Keywords: organic technology; variety; hybrid; biometric parameters; interphase periods; yield

INTRODUCTION

Organic production has a much lower impact on nature and contributes to its preservation. Modern agricultural production methods require intensification of production to achieve maximum results, which has an adverse environmental impact and, subsequently, affects people who consume low-quality products. I. Bender (2021) notes that organic production is one of the fastest growing sectors of agriculture, as demand for organic products is increasing. Organic agriculture is based on the use of new crop varieties, the introduction of precise and more efficient technologies, crop rotations, and biological products to improve soil fertility. Thus, organic technologies involve the use of renewable resources, preservation of soil, water, environment, and growing plants without artificial and synthetic fertilisers and chemical plant protection products.

According to V. Radojević *et al*. (2021), M. Rajković *et al*. (2021), organic production of carrots can be profitable, but it is essential to consider the risks of this production. Organic farming is a production system that is classified as alternative agriculture. Furthermore, scientists believe that organic production is a system of managing ecological and biological processes to obtain a sufficiently high yield and the possibility of obtaining high-quality products. B. Nasiyev *et al*. (2022) believe that organic technology of growing agricultural plants involves the use of biological products. The use of biological products and organic biofertilisers of the latest generation as a biological technology on barley and safflower crops. According to the experimental data, under the biologically based technology in the conditions of the area under study, barley yield increased by 27.02% compared to conventional technologies, and protein yield increased by 0.02 t/ha.

According to S. Pyda *et al*. (2022), microbial preparations contribute to the increase in the number and weight of nodules on bean roots. It was found that plants grown from inoculated seeds had a higher survival rate during the growing season compared to the control variant by 9.2% when using Rhizobophyte and 13.4% when using Rhizohumine. There was an increase in bean yields by 4.4 c/ha (or 15.0%) (Rhizobophyte) and 6.2 c/ha (or 21.2%) (Rhizobophyte). V. Silva *et al*. (2019) noted that pesticide use underlies agricultural intensification, which has been observed over the past few decades. As a result, soil contamination by pesticide residues has become a growing concern due to the high persistence of some pesticides in the soil and toxicity to non-target species. The reason for this is that pesticides used in plant cultivation can accumulate in the crops and in the soil.

According to J. Trávníček *et al*. (2022), market research suggests that the number of organic products is increasing every year, but their cost is also higher. To produce high-quality, environmentally friendly vegetable products, research is underway to develop and implement organic technologies in open and closed ground and to improve the quality of the products themselves. I. Pariasa and A. Hardana (2023) point out that carrots are one of the main vegetables grown in the world due to respective alternative technologies and are in high demand due to their nutritional and chemical composition. The use of considerable amounts of organic fertilisers leads to intensive growth of the vegetative mass of plants. Organic fertiliser can be beneficial to the yield and quality of carrots if applied appropriately.

P. Atta Poku Snr *et al*. (2020) state that the formation of carrot yields is significantly influenced by soil type and its porosity. When growing carrots, the mechanical composition of the soil is essential, as carrots form branched root crops on heavy, compacted clay soils. Properly prepared soil increases yields and product quality. Studies have shown that fresh manure should be applied under the predecessor, as its direct application leads to a deterioration in the quality of root crops. A. Bjarnadottir (2023) notes that organic farming uses natural methods of growing crops, including vegetables. There is insufficient research in the world comparing conventional and organic carrot cultivation. According to the results of such technologies, no carotenoids were found, while carrot products obtained by conventional technology contained pesticide residues. The long-term health consequences of consuming low-quality pesticides are unknown, and a range of scientists have expressed their concern.

The variety, sowing scheme, and timing are essential in the technology of growing carrots. Studies found that in the conditions of the Forest-Steppe of Ukraine, it is recommended to sow carrots at an earlier date, which causes long interphase periods in the plants under study. The specified seed sowing time ensures the use of sufficient moisture, friendly germination, higher yields, with excellent product quality, and greater marketability of root crops. The yield of carrots sown in the third decade of March was 41.4-47.1 t/ha. The marketability index for this sowing period was 86.4-88% (Palamarchuk, 2022).

Organic cultivation technology involves the use of the best varieties and hybrids that are adapted to the relevant soil and climatic conditions. Thus, the Brilliant F_1 carrot hybrid provided the largest root crop weight. The yield of the Shantane CL variety was the highest and provided an increase in yield compared to the control variant by 1.6 t/ha. In hybrids, this indicator was highest in the Brilliant F_1 hybrid, which outperformed the control by 6.1 t/ha. The use of mulching materials is also positive, as their application increases the yield of vegetable crops relative to non-mulching options (Vdovenko *et al.*, 2018; Semenov *et al.*, 2019).

Considering the above analysis of literature sources, the purpose of this study was to investigate the benefits of organic carrot cultivation in the right-bank Forest-Steppe of Ukraine.

MATERIALS AND METHODS

Research on organic technology of carrot culture was conducted in the right-bank Forest-Steppe of Ukraine in 2020-2022. The right-bank Forest-Steppe zone is suitable for growing cold-resistant vegetable crops, including carrots. Weather conditions during the years of research were characterised by lower precipitation and higher temperatures compared to the average long-term data for the growing season but were generally favourable for growing carrots. The highest temperature and precipitation were in 2022, at 16.8°C and 345 mm, respectively. The lowest average temperature and precipitation for the growing season was recorded in 2020, at 14.5°C and 294 mm.

According to the guidelines, an experimental design was developed, which included 4 variants. The study involved observing the phases of plant growth and development, measuring biometric parameters, and calculating the yield (Rozhkov *et al.*, 2016). The predecessor of carrots was cucumbers. The technologies for growing carrots were studied with the Olympus variety and the Bolivar F_1 hybrid. The variants in the experiment were placed using the randomised block method. To record the data, all measurements and calculations were carried out according to the methodology of the experimental case on 10 accounting plants of each variant of the experiment. The experiment included the use of both organic and recommended cultivation technologies with a three-fold replication. The research used the Olympus variety and the Bolivar F_1 hybrid. The control variant was the recommended cultivation technology, which is basic for the Forest-Steppe zone.

The organic technology of carrot cultivation included the use of preparations from the Ukrainian manufacturer BTU-Centre, depending on the phenological development of plants, and was characterised by the following indicators:

Fertigation: Groundfix 5.0 l/ha in combination with Mycohelp preparation 2.0 l/ha;

Phase of 6^{th}-9^{th} true leaves: Phytohelp 1.0 l/ha in combination with preparations Azotophyt 0.3 l/ha and HelpRost 2.0 l/ha; Organic Balance 0.5 l/ha; Actoverm Formula 8.0 l/ha; Lepidocide 7.0 l/ha; Humifriend 0.6 l/ha; Liposam 0.3 l/ha.

Root formation phase: Mycohelp 3.0 l/ha in combination with preparations HelpRost Boron 2.0 l/ha; Azotophyt 0.3 l/ha; Organic Balance 0.5 l/ha; Humifriend 0.6 l/ha; Liposam 0.3 l/ha.

According to the methodological recommendations, the phases of plant growth and development and the duration of the periods between the phases were noted during the study. Specifically, single and mass shoots of plants, the formation of true leaves, the beginning of root growth, and technical maturity were noted. Root mass in dynamics and biometric parameters of plants were measured (Rozhkov *et al.*, 2016).

At the onset of technical ripeness, the carrot yield was calculated based on the current standard (DSTU 7035:2009, 2010). For each variant, the average weight of root crops was determined separately, based on which the average indicator was subsequently calculated separately for the variants. The diameter of the carrot fruit was measured with a caliper and its length with a measuring ruler. The marketability of carrots was defined according to the current standard as the ratio of marketable roots in total weight to non-standard products expressed in %. The coefficient of phenotypic stability of Levis (SFn) was calculated using the formulas, which was determined according to the following formula: S.F. = Xmax/Xmin, where Xmax is the highest yield; Xmin is the lowest yield. The resulting value, if it is close to 1, indicates more stable traits of the variety's productivity (Rozhkov *et al.*, 2016).

The indicators obtained as a result of the research were processed statistically using the method of analysis of variance. Experimental plant studies (both cultivated and wild), including the collection of plant material, were conducted following institutional, national, or international guidelines. The authors adhered to the standards of the Convention on Biological Diversity (1992) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (1979).

RESULTS AND DISCUSSION

During the research on carrot plants in the open field, the interphase periods of the plant were determined. Studies showed that varietal characteristics and cultivation technology affect the duration of the interphase periods of carrot plants. The emergence of mass shoots of carrot plants in all variants was noted on the 8th day after sowing carrots. The emergence of the 1st pair of true leaves was noted earlier than in the recommended cultivation technology – on Day 14, which was 1 day earlier than in the organic technology. Phenological observations of the phases of growth and development of carrot plants revealed that the second pair of true leaves appeared earlier in the Bolivar F_1 hybrid under organic cultivation technology, namely on Day 27, while in the control this phase was noted 1 day later, and in the Olympus variety – 2 days later (Table 1).

Table 1. *Duration of the interphase periods of carrots depending on the variety and cultivation technology. Average value for 2020-2022*

Variety	Cultivation technologies	Days from sowing seeds					
		emergence of mass shoots	emergence of the 1st pair of leaves	emergence of the 2nd pair of leaves	shedding of the root crop	root crop formation	end of the growing season
Olympus	Recommended (control)	8	14	29	46	64	162
	Organic	8	15	29	43	61	164
Bolivar F_1	Recommended (control)	8	14	28	41	49	141
	Organic	8	15	27	39	47	144

***Source**: compiled by the authors*

An essential phase in root crops is the shedding of the root crop, which was observed in different periods in the experimental variants. In the early period, this phase was observed in the Bolivar F_1 hybrid – 39 days after the emergence of mass shoots, which is 2 days earlier compared to the recommended technology (control), and 4 and 7 days earlier than in the Olympus variety under organic and recommended technology. Root formation is essential in assessing the growth and development phases of carrot plants. In the experiment, the formation of the product organ was not observed simultaneously due to the technological nature of cultivation. A certain positive effect was found under organic cultivation technology: much earlier root crop formation was observed in the Bolivar F_1 hybrid – on Days 47 and 49, which is 15 and 14 days earlier than in the Olympus variety. Notably, the organic technology of growing carrots helped to accelerate the formation of root crops due to the work of soil microorganisms and the prompt provision of nutrients as a result of foliar feeding and the passage of photosynthesis. Thus, under this technology, the phase of root crop formation was observed by 2 days in the Bolivar F_1 hybrid and by 3 days in the Olympus variety earlier compared to the control variants.

The end of the growing season of carrots was noted at Days 141-164 days mass shoots. Earlier this interphase period was observed in the Bolivar F_1 hybrid at Days 141 and 144, depending on the cultivation technology used, which is 11 and 10 days earlier compared to the Olympus variety. Notably, this interphase period was influenced by the cultivation technology. Thus, under organic cultivation technology, this phase was observed in the variety and hybrid under study 2 and 3 days earlier than in the control variant. Thus, the variety under study and cultivation technology had an impact on the duration of the interphase periods of carrots. Studies showed that the duration of the phases of growth and development of carrot plants varied depending on the varietal characteristics of the plant and the activity of microorganisms that formed the basis of organic technology (Table 2).

Table 2. *Duration of growth and development phases of carrot plants depending on varieties and cultivation technology, days, average for 2020-2022*

Cultivar	Cultivation technology	Emergence of sprouts	Emergence of the 1st pair of leaves	Root crop formation	The phase of technical ripeness
Olympus	Recommended (control)	3	3	85	17
	Organic	3	3	83	15
Bolivar F_1	Recommended (control)	3	3	73	16
	Organic	3	2	70	14

***Source**: compiled by the authors*

As a result of the conducted study, it was found that the emergence of carrot plants lasted 3 days. The emergence of the first pair of leaves was less long compared to other variants of the Bolivar F_1 hybrid and was 2 days under organic cultivation technology. The longest was the phase of root crop formation and was 70-85 days in the variants under study. The rapid formation of the root crop occurred in the Bolivar F_1 hybrid relative to the Olympus variety. This phase was shorter by 12 and 13 days. Under the organic technology of growing the variety Olympus and the Bolivar F_1 hybrid, it was shorter by 2 and 3 days compared to the control variant. The technical ripeness phase lasted 14-17 days. The longest period was observed in the Olympus variety under the recommended technology and amounted to 17 days. In addition, the shortest period was in the Bolivar F_1 hybrid and was only 14 days.

The cultivation technology used in the open field also had a considerable impact on the biometric parameters of carrots. The unconditional factor was usually the plant's nutritional regime, prompt control of pests, proper soil condition, and favourable climatic conditions. Notably, it was essential to control the beneficial microflora of the soil and to prevent the growth of pathogenic microorganisms, especially the genera *Fusarium*, *Rhizoctonia*, and *Alternaria*. Thus, the height of carrot plants was the highest in the Bolivar F_1 hybrid under organic cultivation – 37 cm, which was 7 cm higher than the control. The same pattern was also observed in the variety Olympus, where the growth relative to the control was 7 cm when using organic technology (Table 3).

Table 3. *Biometric parameters of carrot plants depending on varieties and cultivation technology. Average for 2020-2022*

Cultivar	Cultivation technology	Height, cm	Number of leaves in the rosette, pcs.	Root diameter, cm	Root length, cm	Root crop weight, g	Length to diameter ratio of the root crop
Olympus	Recommended (control)	29	13	3.5	10	107	2.9
	Organic	36	16	4.5	13	112	2.9
Bolivar F_1	Recommended (control)	30	14	3.5	11	102	3.1
	Organic	37	16	5.5	14	109	2.5

Source: *compiled by the authors*

The highest leafiness was observed in the variety and hybrid under study under organic cultivation technology. Thus, in the variety Olympus, the growth of leaf mass relative to the control was 3 pcs./plant, in the hybrid Bolivar F_1 – 2 pcs./plant. The regularity of increasing the parameters of root crops in carrots was noted under organic cultivation technology. Comparing the biometric parameters of root crops obtained in the experiment, they were higher in the Bolivar F_1 hybrid. The increase in the diameter of the root crop under organic cultivation technology was 1.0-2.0 cm, respectively. The increase in the length of the root crop was at the level of 3 cm relative to the control variant.

The key research data that affects the yield of root crops is their weight. As a result of the unfavourable microclimate in autumn, especially with uneven precipitation during the root crop formation period, its weight was considerably lower than the technical characteristics of the variety. However, the use of organic cultivation technology resulted in obtaining this indicator at the level of 112 g for the variety Olympus and 109 g for the hybrid Bolivar F_1, and the increase was 5 g for the variety Olympus and 7 g for the hybrid Bolivar F_1, compared to the control variant. The use of organic cultivation technology and proper soil maintenance resulted in a decrease in the ratio of root length to diameter only in the Bolivar F_1 hybrid. In this variant, the studied value of the condition was 2.5 units, which was 0.6 units less than the control. As a result of growing the Olympus variety, the ratio of the length of the root crop to its diameter did not decrease under this growing system but was similar to the control and amounted to 2.9 units.

The analysis of the data obtained on the biometrics of carrot plants showed the advantage of organic cultivation technology. The use of organic cultivation technology increased the height of the carrot plant, which indicates a positive effect of bacteria on the processes of photosynthesis, accumulation of dry matter and root mass. In the open field, in the absence of an irrigation system, Bolivar F_1 plants can form only 14 leaves, while the Bolivar F_1 hybrid can form up to 16 leaves per plant when using organic cultivation technology. The prompt supply of nutrients in organic cultivation helps to increase the diameter and length of root crops.

The yield of carrot roots varied over the years of cultivation and depended on climatic conditions. Thus, 2021 was a more favourable year for carrot cultivation, with an even supply of moisture and nutrients to the plants. However, the analysis of the obtained yield indicator revealed its dependence on the varietal characteristics of carrots and the technology of growing in open ground conditions. The average yield of carrots over the years of cultivation can be assessed as quite high, as it ranged within 44.6-48.6 t/ha (Table 4).

Table 4. *Yields of carrot plants depending on the variety and cultivation technology, t/ha*

Cultivar	Cultivation technology	Years of experiment			Mean	± to control		Marketability, %	Levis stability coefficient (K_{sf})
		2020	2021	2022		t/ha	%		
Olympus	Recommended (control)	43	48	49	46.6	–	–	82	1.1
	Organic	50	51	45	48.6	+1.8	+3	89	1.1
Bolivar F_1	Recommended (control)	43	46	45	44.6	–	–	84	1.1
	Organic	45	49	49	47.6	+3.1	+7	91	1.0
Least significant difference$_{05}$ (A)		0.9	1.3	1.5					
(B)		1.5	1.7	1.9					
(AB)		2.0	2.0	2.2					

Source: *compiled by the authors*

This value is quite high for the varieties under study, and the value of root crop yields of 47.6-48.6 t/ha indicates that organic technology fully meets the biological requirements of the plant, and the elements of the technology are adapted to the conditions of Ukraine. The resulting root crops were typical, met the requirements of the standard, were harvested in technical ripeness and were quite suitable for further use. On average, the highest yield of root crops was characterised by the late-ripening carrot variety Olympus, which had a total root yield of 47.6 t/ha. The resulting root crops corresponded to the general characteristics of the variety and were not damaged by pests and diseases. The Bolivar F_1 hybrid was characterised by lower, but also quite high yields, with an average yield of 46.1 t/ha, which was only 3% lower than that of the Olympus variety. Root crops were characterised by typical varietal colour and shape, and fully met the requirements of the standard.

The positive impact of organic cultivation technology on the recommended technology was determined only for the Bolivar F_1 hybrid. Upon using biological products and with a prompt provision of plants with essential nutrients, the total yield of root crops increased and averaged 47.6 t/ha, which substantially exceeded the yield of the control variant by 3.1 t/ha. As a result of the analysis of the values, it was found that the yield of the Bolivar F_1 hybrid can increase by 7% from the use of organic cultivation technology. During the cultivation of the Olympus carrot variety, there was no significant increase in yield from the use of organic cultivation technology. In this variant, the increase in yield was caused exclusively by varietal characteristics and prompt plant care.

The Levis stability coefficient is considered to be an indicator that determines the compliance of the cultivation technology. The closer its value is to 1, the more suitable the cultivation technology is considered to be. In the experiment, the Levis coefficient was at the level of 1.0-1.1, and therefore it should be assumed that the cultivation technologies in Ukraine are optimal for carrots. However, it was found that when growing the Bolivar F_1 hybrid and using organic cultivation technology, the coefficient was 1.0 and was lower than the control variant. The calculations showed that growing the Olympus variety is profitable, as the Levis coefficient, regardless of technology, was 1.1.

The social role of organic farming is twofold: it provides the market with organic products and, through biological protection, contributes to the preservation of the environment. The production of organic vegetable products on an industrial scale is far superior to conventional cultivation. From an environmental standpoint, organic plant cultivation preserves the natural state of the environment; contributes to the preservation of biodiversity in agricultural landscapes; preserves or restores soil fertility; prevents pollution of various water bodies; and, most importantly, supplies the population with high-quality vegetable products. Unfortunately, most Ukrainian enterprises are not profitable, and the products they produce do not meet international standards, which means that they cannot enter the world market, leading to loss-making farms. Considering the global trends in production, most producers prefer to produce organic products, which contributes to the preservation of the environment (Wierzbowska *et al.*, 2017; Milić & Simin, 2023).

According to I. Bender *et al.* (2020), organic carrot cultivation technology has a range of advantages over conventional technology. The yield of plants and their quality increase, namely lower nitrate content and higher vitamin C content. Thereby, the yield of marketable products increases. A 14.5% higher marketable yield and a 10.0% lower yield of non-standard organic products was obtained compared to the average conventional treatment. Furthermore, organic carrots had 14.1% less nitrates and 10.0% more vitamin C than conventionally grown carrots.

Analysing the study by S. Kalenska *et al.* (2023), it should be noted that the organic technology of carrot cultivation was slightly inferior to the integrated cultivation system in terms of chemical composition of products. Despite this, the marketability index was at the same level for both technologies. A. Wickham and J. Davis (2023) note that the use of cyanobacterial fertilisers in the cultivation of organic carrots resulted in an increase in the length of root crops and their yield. According to the results of the experiment by M. Kumar *et al*. (2022), it was found that the use of organic fertilizers FYM and vermicompost in combination with biofertilizers PSB with the treatment (T8) FYM (10 t/ha) + VC (2.5 t/ha) + PSB (2.5 kg/ha) gives the highest level of growth, yield, and quality characteristics, including plant height, number of leaves per plant, leaf area per plant, root length, root diameter, yield.

As a result of the application of organic cultivation technology, carrot yields can increase up to 51 t/ha for the Olympus variety, which is somewhat contrary to the data from I. Palamarchuk (2022) for total yields. However, such a value can be achieved with the proper use of bacterial preparations, which are manufactured by the Ukrainian enterprise "BTU-Tsentr". The Bolivar F1 carrot hybrid can also produce high root crop yields, provided that the recommendations for the use of the Forest-Steppe cultivation technology of the right-bank Ukraine are followed.

The studies conducted did not reveal an increase in harmful elements in root crops, and therefore the opinion of T. Kundilovska *et al*. (2019) fully meets the needs of consumers in obtaining environmentally friendly products and ensures the protection and development of rural areas in the future. In earlier studies, I. Palamarchuk (2022) obtained a carrot yield of 41.4-47.1 t/ha and a marketability of 86.4-88%. As a result of the application of organic technology and control of the main parameters of nutrition and protection against harmful objects through the integrated use of bacterial preparations from "BTU-Tsentr", the yield of carrot roots can increase up to 51 t/ha, which was proved by the research conducted in this paper.

Thus, according to the findings of the conducted study and the data of other scientists, the effectiveness of the use of organic technology for growing carrots was established. The positive impact of organic cultivation technology on the main phases of carrot growth and development, biometric parameters of plants and the formation of overall productivity was revealed.

CONCLUSIONS

The findings showed the impact of organic cultivation technology on the growth, development, and yield of carrots. According to the study, it was found that the variety under study and organic cultivation technology had an impact on the duration of the interphase periods of carrots. Thus, under this technology, the phase of root crop formation was observed 2 days earlier in the Bolivar F_1 hybrid and 3 days earlier in the Olympus variety compared to the control variant. The end of the vegetation period of carrots was observed earlier under organic cultivation technology by 2 and 3 days earlier than in the control, respectively.

The biometric parameters of carrots were influenced by the growing technology. The height of the carrot plants was the highest in the Bolivar F_1 hybrid under organic cultivation technology – 37 cm, which is 7 cm higher than the control. The highest leafiness was observed in the varieties and hybrids under study under organic cultivation technology. The regularity of increasing the parameters of carrot roots under organic cultivation technology was noted. The increase in the diameter of the root crop under organic cultivation technology was 1.0-2.0 cm, respectively. The increase in root length was 3 cm relative to the control variants. The weight gain of the root crop relative to the control variant was 5 g in the Olympus variety and 7 g in the Bolivar F_1 hybrid.

The positive impact of organic cultivation technology on the recommended technology was determined only for the Bolivar F_1 hybrid. Upon the use of biological products and prompt provision of plants with essential nutrients, the total yield of root crops increases and can average 47.6 t/ha, which is significantly higher than the yield of the control variant by 3.1 t/ha. Considering the value of carrots as a vegetable plant, it is worth exploring other elements of technology in combination with organic cultivation, which will allow for improved cultivation technology, environmentally friendly quality products and increased yields. In the future, it is planned to investigate the impact of biological products on the yield and quality of green vegetable crops in open and closed ground.

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CONFLICT OF INTEREST

The authors of this study declare no conflict of interest.

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Органічне вирощування моркви столової в правобережному Лісостепу України

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Анотація. Морква столова (*Daucus carota var. sativus* L.) відноситься до найбільш вирощуваних овочевих культур у світі. Вона характеризується високими смаковими якостями та багатим хімічним складом, а тому є цінною для споживання у свіжому та переробленому вигляді. Враховуючи потребу населення у якісній екологічно чистій продукції важливим є вивчення органічного вирощування моркви столової. Метою дослідження було вивчення органічного вирощування моркви столової в правобережному Лісостепу України. Використовувалися такі методи дослідження: польовий, вимірювально-ваговий, математичний та статистичні. Представлено результати досліджень за 2020-2022 рр., де досліджено ріст, розвиток та формування врожаю за органічної технології вирощування. Вивчено фенологічні фази та їх тривалість, біометричні параметри рослин моркви столової та їх врожайність. Органічна технологія вирощування моркви столової сприяла скороченню міжфазних періодів. Кінець вегетації моркви столової відмічали раніше за органічної технології вирощування на 2 та 3 порівняно з контрольним варіантом. Висота рослин моркви столової найбільшою була у гібриду Болівар F_1 за органічної технології вирощування – 37 см, а це більше контрольного варіанту на 7 см. Найбільшу облиствленість відмічали у досліджуваних сорту та гібриду за органічної технології вирощування. У сорту Олімпус приріст відносно контролю становив – 3 шт./рослину, у гібриду Болівар F_1 – 2 шт/рослину. Відмічено закономірність збільшення параметрів коренеплодів моркви за органічної технології вирощування. Приріст діаметру та довжини коренеплоду за органічної технології вирощування склав 1,0-2,0 см та 3 см відповідно. Найбільша маса коренеплодів була за органічної технології вирощування де приріст відносно контрольного варіант склав по сорту Олімпус – 5 г, а по гібриду Болівар F_1 – 7 г. За використання органічної технології, яка передбачає використання біологічних препаратів загальна урожайність коренеплодів підвищується на 3,1 т/га порівняно з контрольним варіантом

Ключові слова: органічна технологія; сорт; гібрид; біометричні параметри; міжфазні періоди; врожайність