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PRODUCTIVITY FORMATION OF SUNFLOWER HYBRIDS WITH THE USE OF PLANT GROWTH REGULATORS

Sunflower is the main oil crop in Ukraine, which provides almost 90 % of oil production, the volume of which increases annually, mainly due to the expansion of cultivated areas. Crop yield during 2013–2017 was 1.9–2.2 t/ha for varieties suitable for distribution in Ukraine included in the State Register of Plants suitable for distribution in Ukraine with a productivity of 3.5–5.0 t/ha. Therefore, it is actually to search for reserves to further increase the yield of crops under the conditions of global climate change, improve the quality of products and reduce the negative impact on soil fertility and the surrounding natural environment. The solution to this problem is possible by improving the elements of sunflower cultivation technology, including the use of plant growth regulators.

The research was carried out during 2013–2017 in the experimental field of PF "Bohdan and K" of Sniatynskyi district, Ivano-Frankivsk region. The placement of options in the experiment is systematic with four repetitions. The predecessor of the sunflower is winter wheat. Agrotechnical measures of cultivation in experimental variants are generally accepted for the conditions of the western part of the Forest-Steppe of Ukraine.

During the years of research, it was established that plant growth regulators Vermymah and Vermyiodis influenced the intensity of growth processes of sunflower plants, in particular, an increase in the leaf surface by 27–29 % and the

net productivity of photosynthesis by 1.2–1.9 g/m^2 per day, or by 16–25 % compared to the control.

A similar effect of the researched growth regulators on the formation of indicators of the structure of reproductive organs (basket diameter, number and weight of 1000 seeds) was established. Based on the mathematical and statistical analysis of the influencing factors and the proposed models, the structural indicators were directly correlated with the yield and provided 8–15 % higher yield increases than the control.

The highest seed yield of hybrids NK Brio and NK Rokki was obtained in the variants of two-time foliar application of the plant growth regulator Vermymah at the rate of 6 l/ha, respectively 3.64 and 3.51 t/ha, and Vermyiodis at the rate of 4 l/ha, respectively 3.66 and 3.52 t/ha.

The researched preparations provided a significant improvement in the quality of sunflower hybrids, in particular, the oil content increased by 1.2–2.4 %, oil yield – by 0.22–0.58 t/ha and acid number indicator decreased by 0.04–0.1 %.

In all options with the use of Vermymah and Vermyiodis growth regulators by one-time and two-time application of NK Brio and NK Rokki hybrids to growing sunflower plants compared to the control, conditional net income increased by UAH 2193–4014/ha, the level of profitability – by 12.7–22.7 %, and the cost price of sunflower seeds decreased by UAH 303–518/ton.

Keywords: sunflower hybrids, leaf surface area, productivity, plant growth regulators, photosynthesis, seed quality.

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Формування продуктивності гібридів соняшнику за застосування регуляторів росту рослин

Соняшник – основна олійна культура в Україні, яка забезпечує майже 90 % виробництва олії, обсяги якої щорічно збільшуються в основному за рахунок розширення посівних площ. Урожайність культури впродовж 2013–2017 рр. становила 1,9–2,2 т/га за внесених до Державного реєстру рослин сортів, придатних для поширення в Україні, з продуктивністю 3,5–5,0 т/га. Тому актуальним є пошук резервів подальшого збільшення врожайності культури за умов глобальних змін клімату, поліпшення якості продукції та зменшення негативного впливу на родючість ґрунтів і навколишнє природне середовище. Розв'язання цієї проблеми можливе за вдосконалення елементів технології вирощування соняшнику, зокрема й застосування регуляторів росту рослин.

Експериментальну роботу виконано впродовж 2013–2017 рр. на дослідному полі ПФ «Богдан і К» Снятинського району Івано-Франківської

області. Розміщення варіантів у досліді систематичне за чотириразового повторення. Попередник соняшнику – пшениця озима. Агротехнічні заходи вирощування культури у варіантах досліду – загальноприйняті для умов західної частини Лісостепу України.

За роки дослідження встановлено, що регулятори росту рослин вермимаг і вермийодіс впливали на інтенсивність ростових процесів рослин соняшнику, зокрема спостерігали збільшення листкової поверхні на 27–29 % та чистої продуктивності фотосинтезу на 1,2–1,9 г/м^2 за добу, або на 16–25 % порівняно з контролем.

Встановлено аналогічний вплив досліджуваних регуляторів росту на формування показників структури репродуктивних органів (діаметр кошика, кількість та маса 1000 насінин). На основі математично-статистичного аналізу за факторами впливу і запропонованими моделями структурні показники були в прямій кореляційній залежності з урожайністю і забезпечили вищі на 8–15 % прирости врожайності до контролю.

Найвищу врожайність насіння гібридів НК Бріо і НК Роккі отримано у варіантах дворазового позакореневого внесення регулятора росту рослин вермимаг у нормі по 6 л/га (відповідно 3,64 і 3,51 т/га) та вермийодіс у нормі по 4 л/га (відповідно 3,66 і 3,52 т/га).

Досліджувані препарати забезпечили істотне поліпшення якості зерна гібридів соняшнику, зокрема вміст олії зростав на 1,2–2,4 %, вихід олії – на 0,22–0,58 т/га та на 0,04–0,1 % зменшувався показник кислотного числа.

У всіх варіантах застосування регуляторів росту вермимаг і вермийодіс для одно- і дворазового внесення по вегетуючих рослинах соняшнику гібридів НК Бріо і НК Роккі порівняно до контролю умовно чистий дохід збільшувався на 2193–4014 грн/га, рівень рентабельності – на 12,7–22,7 %, а собівартість насіння соняшнику зменшувалася на 303–518 грн/т.

Ключові слова: гібриди соняшнику, площа листкової поверхні, продуктивність, регулятори росту рослин, фотосинтез, якість насіння.

Introduction. The development and implementation of new or improved technologies of sunflowers cultivation in agricultural production are one of the main conditions for increasing production efficiency and increasing the gross harvest of this crop. Currently, the level of use of the biological potential of sunflowers is only 50 %. Among the reasons for this is non-compliance with the basic requirements of crop rotation and crop cultivation technology [6, 14, 30].

In the scientific publications of many authors (S. M. Kalenska, I. I. Klymenko, V. V. Moisienko, V. O. Skydan, S. P. Tanchyk, Yu. I. Tkalich, etc.) the main aspects of increasing sunflower productivity are quite widely disclosed. They represent a wide range of positive effects of plant growth regulators, and it has been proven that new preparations of domestic production correspond to the best world samples in terms of

technical indicators and cost level and their effectiveness [7, 9, 10, 12, 15, 17, 18, 20].

The use of plant growth regulators and microfertilizers in hybrid sunflower seed production is economically justified has been established so long as the cost of the obtained increase in seeds of parental lines and hybrids of sunflower exceeds the cost of preparations and the cost of protecting plants from diseases [2, 16, 22]. It is important to take this component into account during their application at the same time as treating seeds or spraying plants with herbicides, as an integral element of modern technologies for growing high-quality sunflower seeds [11, 13, 24].

Growth regulators increase the resistance of plants to adverse factors of natural or anthropogenic origin (critical temperature drops, moisture deficiency, toxic effects of pesticides, damage by diseases and damage by pests). Their use makes it possible to fully realize the potential of plants embedded in the genome by nature and selection, to regulate the ripening period, to improve the quality and increase the productivity of agricultural crops [1, 28, 30].

Plant growth regulators influence the processes of adaptation to adverse conditions due to their ability to intensify the activity of the cellular apparatus and change the structure of plants, which is manifested in the strengthening of frost resistance and the weakening of the phytotoxicity of plant protection agents, etc. [3, 21, 26].

The mechanism of these phenomena was made possible by research at the cellular and molecular levels. In particular, it was established that the increase in frost resistance is caused by an increase in the proportion of bound water under the influence of plant growth regulators and an increase in the content of proteins and carbohydrates, which support the structural and functional organization of the plant, reduce the temperature of the transition of the cytoplasm from a liquid to a solid state [5, 25, 29].

An analytical review of the results of experimental studies on the effectiveness of plant growth regulators indicates their importance in the technology of sunflower cultivation. However, in the conditions of the western part of the Forest-Steppe, the effectiveness of the use of plant growth regulators Vermymah and Vermyiodis in sunflower cultivation technology has not yet been studied sufficiently [4, 8, 23].

Materials and methods. Experimental research was carried out during 2013–2017 in the experimental field of PF "Bohdan and K" of Snyatynskyi district, Ivano-Frankivsk region. According to the "Agreement on scientific cooperation" with HEI "Podilskyi State University" and the association "Bioconversion", is a basic enterprise for carrying out scientific

research, testing and introducing plant growth regulators, destructors, new organic fertilizers produced by the association's enterprises into production.

The total experimental area – 70 m^2, the accounting area – 50 m^2. The placement of options in the experiment is systematic with four repetitions. The predecessor of the sunflower is winter wheat. Agrotechnical measures of crop cultivation in the experimental variants are generally accepted for the conditions of the western part of the Forest-Steppe of Ukraine, except for the factors that were studied.

Scheme of the experiment: *factor A* – frequency of spraying (single, double); *factor B* – preparations Vermymah (5 l/ha), Vermymah (6 l/ha), Vermyiodis (3 l/ha), Vermyiodis (4 l/ha); *factor C* – sunflower hybrids NK Brio, NK Rokki.

Biopreparations Vermymah and Vermyiodis contain macro- and microelements, including magnesium (4 %) and iodine (2 %), vitamins, phytohormones and useful microorganisms, which ensured optimal physiological processes of the development of the agrocenosis of the culture [8].

The research was carried out in accordance with the principle of a single logical deduction, the rules of expediency, accuracy and reliability of the results of the experiment with the necessary documentation. State standards and technical conditions were used during crop yield accounting and in the process of determining grain quality indicators.

During the years of the research, the meteorological conditions were typical and fully reflected the agro-ecological and climatic resources of the Western Forest-Steppe of Ukraine, which makes it possible to use experimental data in production conditions.

The soil of the experimental plots – sod-podzolic, medium-loamy, superficially glazed and characterized by the following agrochemical parameters: humus content according to Tyurin – 3.05–3.39 %; the content of easily hydrolyzable nitrogen according to Kornfield – 67–76 mg/kg; mobile phosphorus and exchangeable potassium according to Chyrikov – 118–124 and 108–113 mg/kg, respectively; pH_{salt} by the potentiometric method) – 4.54–5.20.

The main cultivation of the soil after harvesting the predecessor, winter wheat, included husking of stubble and ploughing, pre-sowing – early spring harrowing and pre-sowing cultivation with the application of mineral fertilizers $N_{40}P_{60}$.

The sunflower was sown after constant warming of the soil at a depth of 10 cm to 10–12 °C. The method of sowing is of wide-row type (70 cm), and the depth of seed wrapping is 5–6 cm. The seed sowing rate is 70,000 germinated seeds/ha.

Spraying sunflower plants with Vermymah and Vermyiodis plant growth regulators during the growing season was carried out twice: the first – VVSN 14–19, the second – VVSN 28–35.

Mathematical analysis of yield indicators was performed using dispersion and correlation-regression methods on a computer using modern packages of application programs Exel, Statistica 6.0 [19].

Results and discussion. Formation of productivity of agricultural crops in agrocenosis is a set of processes of nutrition, growth and development of plants, transformation of matter and energy. It was established that the use of plant growth regulators Vermymah and Vermyiodis for foliar fertilization contributed to the activation of linear growth of crop plants.

One-time spraying of sunflower hybrid plants with Vermymah growth regulator (6 l/ha) in the flowering phase ensured a linear increase of 10–12 cm in crop plants, two-time spraying of 6 l/ha – 12–13 cm compared to the control.

The productivity of the agrocenosis of sunflower hybrids, different in origin, is formed by the effective use of sunlight energy, the level of providing them with carbon dioxide, nutrients and hydrothermal conditions of plant life.

Technological measures of crop cultivation, in particular, the use of plant growth regulators in technologies, must be considered as methods of optimizing the conditions for the formation of the productivity of the leaf apparatus, and the process of accumulation of the mass of dry matter, which is determined, first of all, by the size of the area of the leaf surface of the crop, which is formed by plants per unit area and its photosynthetic potential.

It was investigated that the growth regulators Vermymah and Vermyiodis significantly influenced the size of the sunflower assimilation surface of hybrids NK Brio and NK Rokki. The dynamics of changes in the leaf surface area in the phases of the growing season are shown in Figure 1.

It was established that in the case of one-time spraying of plants with a Vermymah growth regulator (6 l/ha) in the flowering phase (VVSN 61–69), the area of the assimilation surface of the hybrid NK Brio sunflower was 11.6 thousand m^2/ha (+27 %) greater compared to control. With the application of Vermyiodis (4 l/ha), the area of the assimilation surface increased by 11.8 thousand m^2/ha (+29 %). In the variants of growing the NK Rokki hybrid with the application of the mentioned preparations, the area of the assimilation surface was larger by 11.4 thousand m^2/ha (+29 %) and 11.7 thousand m^2/ha (+27 %), respectively.

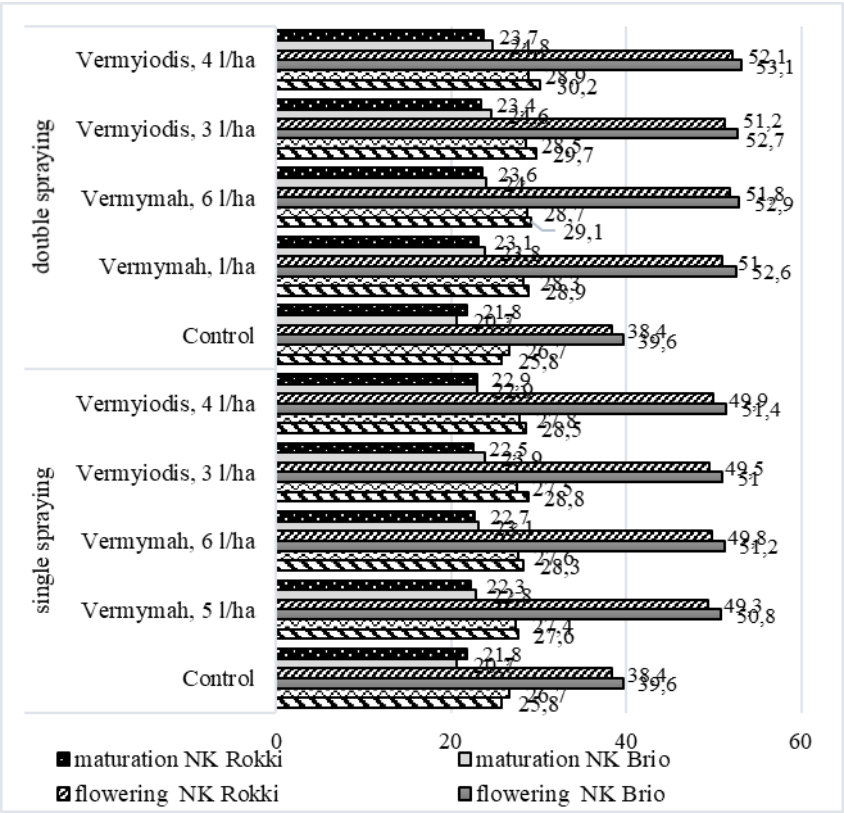


Fig. 1. Dynamics of the formation of the leaf surface area of sunflower plants hybrids NK Brio and NK Rokki depending on the application of growth regulators (average for 2013–2017), thousand m^2/ha

During two sprayings of sunflower plants of the NK Brio hybrid in the flowering phase (VVSN 61–69) with Vermymah growth regulator (6 l/ha each), the leaf surface area was 51.8 thousand m^2/ha or increased by 34%, and in the application variant of the Vermyiodis preparation (4 l/ha), respectively – 52.1 thousand m^2/ha, which is 35 % more compared to the control.

Researches has established the effect of spraying plants during the growing season with Vermymah and Vermyiodis growth regulators on increasing the photosynthetic potential and net productivity of sunflower agrocenosis of NK Brio and NK Rokki hybrids (Table 1).

1. Photosynthetic productivity of sunflower hybrids depending on the use of plant growth regulators (average for 2013–2017)

Factor A (multiplicity of treatments)	Norm of growth regulator (factor B)	Photosynthetic potential of sowing (seedling period-wax ripeness, VVSN 10–83), million m^2d/ha	Net photosynthesis productivity (flowering phase, VVSN 61–69), g/m^2 per day
	Hybrid NK Brio (factor C - C_1)		
	Control	2,178	6,5
Single (A_1)	Vermymah, 5 l/ha (B_1)	2,594	7,7
	Vermymah, 6 l/ha (B_2)	2,603	7,8
	Vermyiodis, 3 l/ha (B_3)	2,587	7,7
	Vermyiodis,4 l/ha (B_4)	2,612	7,8
Two-time (A_2)	Vermymah, 5 l/ha (B_1)	2,785	7,9
	Vermymah, 6 l/ha (B_2)	2,834	8,1
	Vermyiodis, 3 l/ha(B_3)	2,796	8,0
	Vermyiodis,4 l/ha (B_4)	2,840	8,3
	Hybrid NK Rokki (factor C - C_2)		
	Control	2,087	6,3
Single (A_1)	Vermymah, 5 l/ha (B_1)	2,527	7,6
	Vermymah, 6 l/ha (B_2)	2,575	7,8
	Vermyiodis, 3 l/ha(B_3)	2,516	7,7
	Vermyiodis,4 l/ha (B_4)	2,584	7,9
Two-time (A_2)	Vermymah, 5 l/ha (B_1)	2,683	8,1
	Vermymah, 6 l/ha (B_2)	2,742	8,0
	Vermyiodis, 3 l/ha(B_3)	2,690	7,9
	Vermyiodis,4 l/ha (B_4)	2,785	8,2
$LSD_{0,5}$ factor A		0,35	1,79
$LSD_{0,5}$ factor B		0,25	2,15
$LSD_{0,5}$ factor C		0,14	0,45
$LSD_{0,5}$ interaction AB		0,02	0,22
$LSD_{0,5}$ interaction AC		0,05	0,35
$LSD_{0,5}$ interaction BC		0,02	0,50
$LSD_{0,5}$ interaction ABC		0,01	0,07

Note: factor A is the frequency of spraying (single, double); factor B – preparations Vermymah, 5 l/ha, Vermymah, 6 l/ha, Vermyiodis, 3 l/ha, Vermyiodis, 4 l/ha; factor C – sunflower hybrids NK Brio, NK Rokki.

According to the results of the dispersion analysis, the nature of the influence of the factor characteristics during one- and two-time spraying of sunflower hybrid plants with Vermymah and Vermyiodis growth regulators on the level of photosynthetic potential of the agrocenosis was established

(Figs. 2, 3).

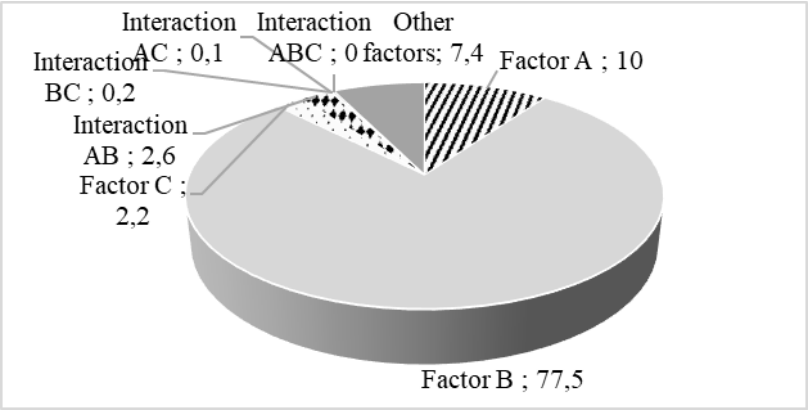


Fig. 2. The influence of plant growth regulators on the photosynthetic potential of the agrocenosis of sunflower hybrids during the period "seedlings – wax maturity" (average for 2013–2017), %

Over the years of research, it was established that factor B (plant growth regulators) has the largest specific weight among influencing factors – 77.5 %, factor A (spray frequency) – 10 %, and factor C (sunflower hybrid) – 2.2 %, the interaction of AB factors – 2.6 %, the rest – do not have a significant impact on the result.

Similar results of the significant influence of factor B (plant growth regulators) on the net productivity of photosynthesis of sunflower agrocenosis were obtained in the flowering phase (VVSN 61-69) (Fig. 3).

Factor B (plant growth regulators) had the greatest impact on the resulting trait - 85.2%, factor A (spraying frequency) – 3.6% less, the rest of the research factors had no significant impact.

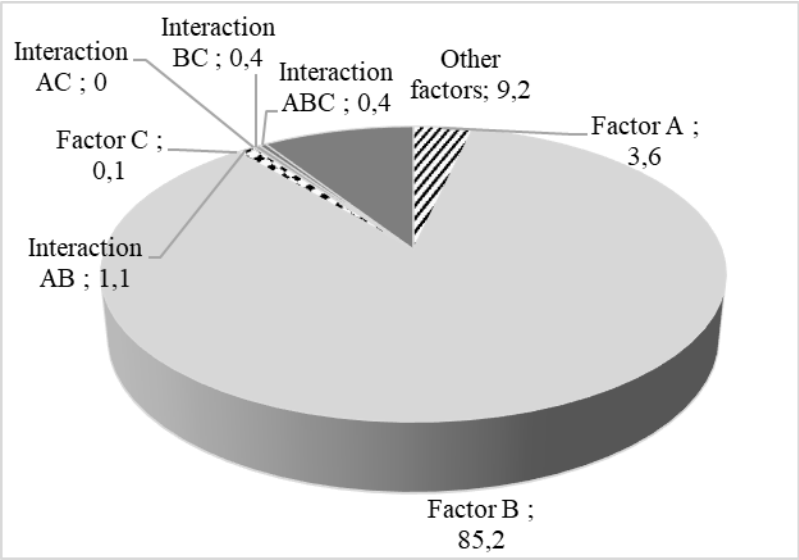
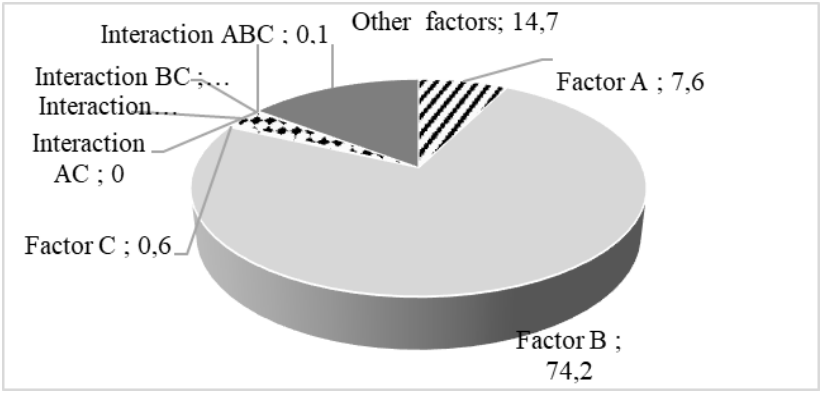
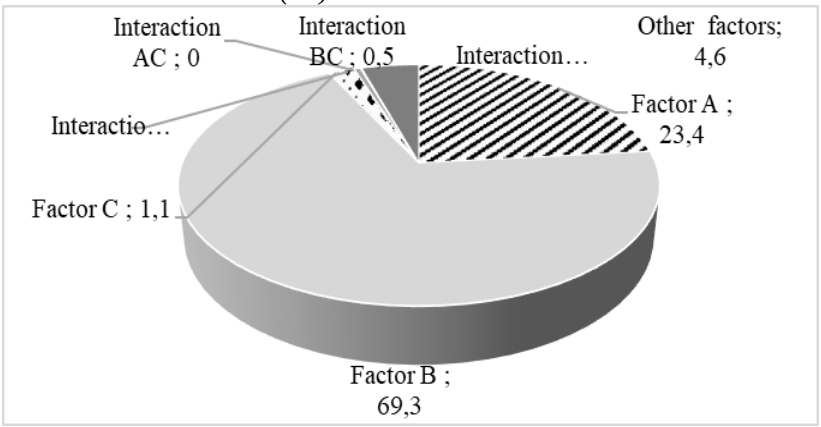


Fig. 3. The influence of plant growth regulators on the net productivity of photosynthesis of the agrocenosis of sunflower hybrids in the flowering phase (average for 2013–2017), %

The elements of the crop structure are an integral part of forming the productivity of agricultural crops. Over the years of research, the influence of plant growth regulators of the new generation – Vermymah and Vermyiodis on the formation of individual productivity of sunflower hybrids has been established. According to the results of the dispersion analysis of the research results, the influence of factors on the formation of elements of the structure of the sunflower crop (diameter of the basket and weight of 1000 seeds) was determined. (Fig. 4).



basket diameter (cm)



weight of 1000 seeds (g)

Fig. 4. The influence of plant growth regulators on the diameter of the basket and the weight of 1000 seeds of sunflower hybrids (average for 2013–2017), %

It was established that the share of influence of the plant growth regulator (factor B) was 74.2 %, spraying (factor A) – 7.6 %, and sunflower hybrid (factor C) – only 0.6 %, the interaction of factors A and B – 2.7 %.

According to the effect of plant growth regulators Vermymah and Vermyiodis on the mass of 1000 seeds, it was established that the share of influence (factor B) was the largest - 69.3 %, the frequency of spraying (factor A) – 23.4 %, and sunflower hybrid – only 1.1 %.

According to the results of the study, it was established that in the options for one-time spraying of sunflower plants of the NK Brio hybrid with Vermymah and Vermyiodis growth regulators, the seed yield was higher by 8.09-11.41%, in the case of two-time spraying – by 12.35–14.86 %, respectively, compared to control (Table 2).

The highest seed yield of the NK Brio hybrid was obtained under the most favorable climatic conditions for culture in 2017 – 3.96 t/ha, or 0.53 t/ha more compared to the control, and the lowest – in the less favorable – 2014 and 2015 – on average 3.31 and 3.40 t/ha, respectively. In the variant with two-time application of Vermyiodis (4 l/ha each), the yield on average over the years of the study was the highest and amounted to 3.66 t/ha, which is 14.86 % more compared to the control.

The use of correlation-regression analysis made it possible to calculate the model of the influence of experimental factors on the grain yield of the NK Brio hybrid according to the formula $U = 1.146x + 0.0081$, while the coefficient of determination $R^2 = 0.9449$, which indicates the high reliability of the result.

The results of the study of the effect of spraying with plant growth regulators on the formation of the crop of the NK Rokki hybrid showed that the highest crop yield was obtained in the variant of two-time spraying with the preparation Vermyiodis (4 l/ha each) (Table 3).

The effect of a two-time application of the plant growth regulator Vermyiodis (4 l/ha) for spraying plants of the NK Rokki hybrid on its yield is shown in the form of a linear function $U = 1.1834x – 0.1091$. The coefficient of determination $R^2 = 0.9638$ indicates a high level of influence of the experimental factor on the resulting characteristic. In both cases, a very close correlation was established between the effective and factor characteristics, as evidenced by correlation coefficients close to 1.

2. The yield of sunflower seeds of the NK Brio hybrid depending on the use of plant growth regulators (average for 2013-2017), t/ha

Factor A (multiplicity of treatments)	Norm of growth regulator (factor B)	Year					Average	± to control	
		2013	2014	2015	2016	2017		t/ha	%
	Control	3,21	2,91	2,97	3,43	3,43	3,19	-	-
Single (A_1)	Vermymah, 5 l/ha (B_1)	3,45	3,15	3,24	3,68	3,72	3,45	0,26	8,09
	Vermymah, 6 l/ha (B_2)	3,52	3,17	3,26	3,70	3,78	3,49	0,30	9,34
	Vermyiodis, 3 l/ha (B_3)	3,56	3,16	3,25	3,69	3,74	3,48	0,29	9,09
	Vermyiodis,4 l/ha (B_4)	3,63	3,24	3,33	3,77	3,80	3,55	0,36	11,41
Two-time (A_2)	Vermymah, 5 l/ha (B_1)	3,67	3,23	3,38	3,79	3,85	3,58	0,39	12,35
	Vermymah, 6 l/ha (B_2)	3,78	3,27	3,42	3,84	3,90	3,64	0,45	14,17
	Vermyiodis, 3 l/ha (B_3)	3,70	3,28	3,40	3,81	3,89	3,62	0,43	13,35
	Vermyiodis,4 l/ha (B_4)	3,79	3,31	3,40	3,86	3,96	3,66	0,47	14,86
$LSD_{0,5}$ factor A		-	-	-	-	-	0,06	-	-
$LSD_{0,5}$ factor B		-	-	-	-	-	0,04	-	-
$LSD_{0,5}$ interaction AB		-	-	-	-	-	0,008	-	-

Note: factor A is the frequency of spraying (single, double); factor B – preparations Vermymah, 5 l/ha, Vermymah, 6 l/ha, Vermyiodis, 3 l/ha, Vermyiodis, 4 l/ha.

3. Sunflower yield of NK Rokki hybrid with the use of growth regulators (2013-2017), t/ha

Factor A (multiplicity of treatments	Norm of growth regulator (factor B)	Year					Average	± to control	+ %
		2013	2014	2015	2016	2017			
	Control	3,07	2,84	2,88	3,21	3,35	3,07	-	-
Single (A_1)	Vermymah, 5 l/ha (B_1)	3,29	3,10	3,14	3,49	3,62	3,33	0,26	8,40
	Vermymah, 6 l/ha (B_2)	3,41	3,13	3,16	3,54	3,65	3,38	0,31	10,03
	Vermyiodis,3 l/ha (B_3)	3,45	3,12	3,15	3,50	3,63	3,37	0,30	9,77
	Vermyiodis,4 l/ha (B_4)	3,53	3,14	3,17	3,56	3,66	3,41	0,34	11,14
Two-time (A_2)	Vermymah, 5 l/ha (B_1)	3,58	3,18	3,28	3,65	3,71	3,48	0,41	13,36
	Vermymah, 6 l/ha (B_2)	3,60	3,20	3,30	3,67	3,80	3,51	0,44	14,46
	Vermyiodis,3 l/ha (B_3)	3,59	3,17	3,26	3,66	3,73	3,48	0,41	13,42
	Vermyiodis,4 l/ha (B_4)	3,60	3,20	3,31	3,69	3,82	3,52	0,45	14,79
	$LSD_{0,5}$ factor A	-	-	-	-	-	0,008	-	-
	$LSD_{0,5}$ factor B	-	-	-	-	-	0,006	-	-
	$LSD_{0,5}$ interaction AB	-	-	-	-	-	0,001	-	-

Note: factor A is the frequency of spraying (single, double); factor B – is preparation Vermymah, 5 l/ha, Vermymah, 6 l/ha, Vermyiodis, 3 l/ha, Vermyiodis, 4 l/ha.

According to the results of the study, it was established that the plant growth regulators we studied had a positive effect on the quality indicators of sunflower seeds (Fig. 5).

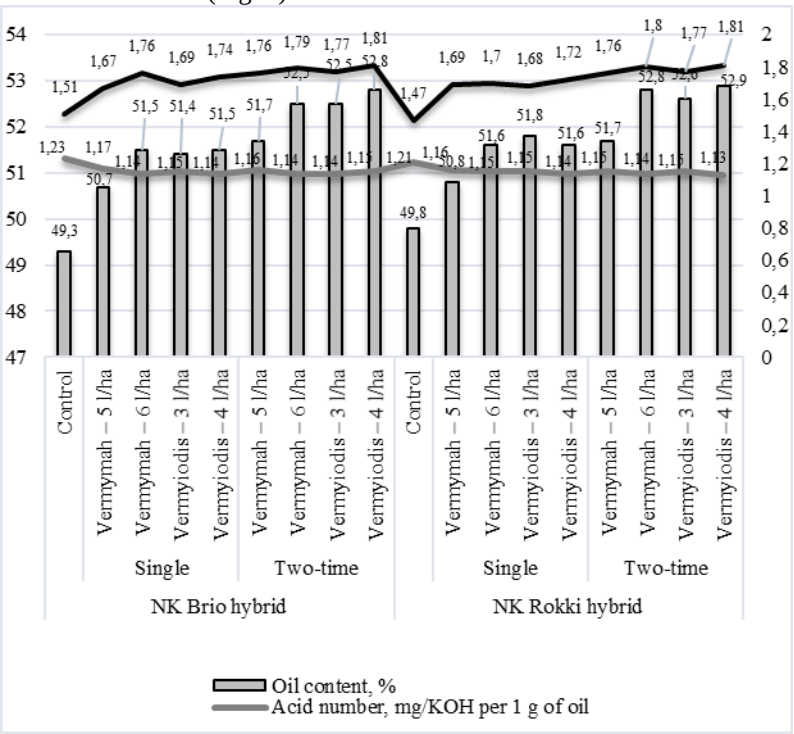


Fig. 5. The effect of spraying plants with growth regulators on quality indicators of sunflower seeds (average for 2013–2017)

It was found that the application of different rates of plant growth regulators Vermymah and Vermyiodis during a single spraying of sunflower plants had an effect on increasing the oil content in sunflower seeds of the NK Brio hybrid by 1.6 and 1.7 %, respectively, compared to the control, the yield of oil – up to 0.25 and 0.23 t/ha; in the NK Rokki hybrid – 2.1 and 2.3 %, 0.23 and 0.25 t/ha, respectively.

In the case of two-time spraying of sunflower crops with plant growth regulators Vermymah and Vermyiodis, the oil content in the seeds of the NK Brio hybrid increased to 1.9 and 2.0 %, respectively, the oil yield was up to 0.28 and 0.30 t/ha, and in the hybrid NK Rokki – respectively 3.2 and 3.3% and 0.33 and 0.34 t/ha.

The decrease in acid number was established in all variants of the experiment within the range of 0.04-0.1 mg/KOH per 1 g of oil.

In all variants of the experiment, the use of plant growth regulators for one-time and two-time spraying of sunflower hybrids NK Brio and NK Rokki conditionally net income increased by UAH 2193–4014/ha, the level of profitability – by 12.7–22.7 % compared to the control. At the same time, the cost price of sunflower seeds decreased on average by 303–518 UAH/t compared to the control.

Conclusions

Growth regulators Vermymah and Vermyiodis contributed to the activation of sunflower growth processes of NK Brio and NK Rokki hybrids, which ensured a 27–29 % increase in the formation of the leaf area apparatus and the value of the net productivity of photosynthesis by 7.7–8.3 g/m^2 per day, or 20–25 % more compared to the control.

The highest seed yield of hybrids NK Brio and NK Rokki was obtained in variants of two-time application of the plant growth regulator Vermymah (6 l/ha each) respectively – 3.64 and 3.51 t/ha and Vermyiodis (4 l/ha each) – respectively 3.66 and 3.52 t/ha.

The use of growth regulators ensured a significant improvement in the quality of sunflower hybrids, in particular, the oil content increased by an average of 1.2–2.4 %, oil yield – by an average of 0.22–0.58 t/ha, and by 0.04–0.1 % decreased acid number value.

In all variants of the experiment, conditional net income increased by 2193–4014 UAH/ha, the level of profitability – by 12.7–22.7 %, and the cost of sunflower seeds decreased by 303–518 UAH/ton compared to the control.

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