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INFLUENCE OF FOLIAGE FEEDING IN PRODUCTIVITY FORMATION OF SUNFLOWER HYBRIDS

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The results of our research made it possible to recommend for production certain agrotechnical methods of sunflower cultivation technology, which, in the conditions of insufficient moisture in the Vinnytsia region, allow obtaining sunflower yields close to the level of the genetic potential of hybrids based on resource conservation and optimization of energy consumption.

Additional feeding of growth regulators affected the accumulation of above-ground biomass in sunflowers. The greatest increase in above-ground biomass in comparison with the control group was observed in the year with unfavorable weather conditions. The maximum values of above-ground biomass in sunflower plants were reached at the end of the flowering phase when applying two-time spraying of sunflowers in the phase of 3-4 pairs of leaves and budding and were from 1205 to 1350 grams per one plant, compared to 980 grams per plant in the control version of the experiment. When growing sunflower hybrids LG 50505 and LG 50585, the maximum area of the leaf surface of 4631-4687 cm^2 was formed by crops against the background of the use of the Architect restregulator. Growing sunflowers using Kalm's restregulator in the 2023 season led to a decrease in the leaf surface area of plants of both studied hybrids.

The yield of sunflower seeds in the control variant was 2,55 tons per hectare, but due to the use of additional fertilizers, the yield increased to 2,61-2,46 tons per hectare, which corresponds to an increase in the range from 8,3 to 39,3%. The maximum level of productivity was achieved under the condition of using Architect at a dose of 1,2 l/ha in the phase of 3-4 pairs of leaves and during budding. The calculation of the economic efficiency of the conducted experimental studies and hybrids showed that the hybrids have a sufficiently high profitability, but the greater increase in net profit was provided by the LG 50505 hybrid.

***Key words:** sunflower, hybrid, growth processes, yield and quality of seeds, re-regulator Architect, Kalma, economic efficiency, oil quality.*

Table 6. Lit. 10.

Statement of research problems. In any field experiment, recording the harvest and determining its quality must necessarily be supplemented by other records and observations. Some records and observations make it possible to give a complete description of economic characteristics, the harvest, which are important in assessing the suitability of hybrids for simultaneous harvesting.

The main requirements for conducting correct statistical records and observations are first of all the program of records and observations, which in turn should follow from the scheme of experience, is an organic component of it, and not a random set of definitions. In addition, the accounts included in the program of the field experiment and observations were a system of connected determinations, so that in general they ensured the greatest effectiveness of the experiment with the least expenditure of labor and resources.

In agriculture, a very important indicator is the coefficient of total water consumption, which characterizes how much water is used to form one ton of products, and the lower it is, the better. In the conditions of Vinnytsia, a moisture

deficit during the entire growing season of crops is characteristic, therefore, optimizing water consumption is one of the most important factors that determines yield. In the conditions of the arid zone, moisture is at the first minimum and acts as a limiting factor in the formation of productivity and the most common stress factor that limits the growth processes of plants.

Therefore, an important condition for increasing the efficiency of sunflower cultivation is the introduction of intensive technologies and the implementation of agrotechnical methods taking into account agrometeorological factors. That is, in the conditions of the Southern Steppe, the productivity of agricultural crops depends on environmental factors, the potential productivity of the variety or hybrid, and agrotechnical means.

Analysis of recent research and publications. Sunflower is a crop that is very demanding on climatic conditions and requires a significant amount of moisture and solar energy in a certain ratio in different growing seasons. From the beginning of development to the formation of baskets, sunflower consumes 20-25% of moisture from the total need, absorbing it mainly from the upper layers of the soil. It absorbs the most moisture (60%) in the interphase period of the formation of baskets - flowering, with a lack of moisture in this period, the baskets and seeds may be underdeveloped [1, 4, 5]. In the period from flowering to ripening of seeds, sunflower consumes 30-40% of moisture. It is the accumulation of moisture that is the key to obtaining high yields, therefore, technological methods should be directed to the accumulation and preservation of moisture in the soil, since water supply is the main limiting factor that has the maximum impact on the productivity of agricultural crops [2, 6, 8]. The dynamics of yield is considered as a change in the culture of agriculture, against the background of which there are fluctuations, mainly related to the peculiarities of the weather conditions of individual years.

Moisture supply is a key factor for the vital activity of plants. As noted by K.A. Timiryazev: «Productivity of agricultural crops is directly proportional to their moisture availability. With a sufficient amount of soil moisture, favorable conditions for the life of plants are formed».

Moisture determines the living conditions of microorganisms, the biogenicity of the soil, the intensity of decomposition of organic compounds and the accumulation of mobile nutrients in the soil. It is a limiting factor in determining the yield level of field crops.

Water makes up 75-90% of the plant organism. All life processes, such as swelling, germination, growth, supply and movement of nutrients, photosynthesis, root nutrition, formation of organic compounds, crop formation are related to the supply and movement of water. In hot weather, water prevents the death of plants, cools and increases their resistance to high temperatures, supports cell turgor, places assimilation products in individual organs. Lack of moisture leads to a lack of harvest, causes suppression, and sometimes even death of plants.

Some special features of sunflower – a deep root system, a stiff pubescent stem and

leaves – are characteristic of drought-resistant plants. However, it is not entirely true to claim that sunflower is a drought-resistant crop. It can really withstand fairly long atmospheric and soil drought at a young age (before the formation of baskets), and in dry years it gives larger yields, compared to other spring crops. At the same time, the formation of one part of dry matter consumes a significant amount of moisture, more than grain crops, including corn; due to which it can simultaneously be attributed to the group of moisture-loving cultures [7, 9].

Total water consumption depends on weather conditions, mineral nutrition regime, sowing density, level of agricultural technology and moisture availability of the field. Thus, the total water consumption of the same crop in different areas is different. The level of water consumption, depending on the variety, weather conditions, etc., can fluctuate quite strongly [3, 5, 7, 10].

Presentation of the main research material. All phenological observations are carried out systematically on all hybrids of the experiment in two non-adjacent repetitions, allocated for accounting before seedlings. The onset of the phase in 10-15% of the plants on the entire plot is taken as the date of the beginning of the phase, and the full phase is marked when it occurs in at least 75% of the plants. If it is difficult to determine the visual onset of the phase in three different places of two plots, randomly count 15-20 plants each and determine the number of plants that have entered the phase. The results are summarized and the percentage of plants that have entered the phase is calculated.

Phenological observations in the experiment are presented in the form of a table. Analyzing Table 1, it should be noted that the seedlings obtained are friendly, so the passage of phenological phases and maturation of both studied hybrids was friendly.

Table 1

Phenological observations in the experiment on testing sunflower hybrids, (average for 2022-2023)

Hybrid	Sowing	Full seedlings	Completeness of seedlings, %	Complete budding	Complete flowering	Physiological maturity	Technical maturity	Vegetation period
LH 50505	20.04	03.05	93	30.05	01.07	29.07	21.08	110
LH 50585	20.04	03.05	95	02.06	02.07	28.07	21.08	109

source: formed on the basis of own research

Productivity indicators of sunflower plants are decisive in the formation of productivity and depend on the biological characteristics of the hybrid, on varietal agricultural techniques and growing conditions that develop during the growing season.

Scientific research in this direction confirms that the parameters of individual productivity indicators can be influenced by technological measures. At the same time, it should be noted that seed yield and quality will depend on the establishment and formation of productive organs of sunflower hybrids, such as the size of the basket, the weight of 1000 seeds, the level of huskiness [2, 7]. These features are

individual for hybrids and for the greatest manifestation of potential productivity, it is necessary to study them in specific soil and climatic conditions depending on technological measures.

The use of re-regulators significantly influenced the development of plants, including the formation and development of the leaf surface area of agrocenoses. In the phase of 8-9 plant leaves of both researched hybrids, restregulators were applied according to the scheme of the experiment. At the end of flowering, the advantage in the leaf surface area of one plant according to these indicators, depending on the hybrid, reached 52-75 cm^2 (Table 2).

Table 2

Dynamics of the leaf surface area of plants of sunflower hybrids studied, cm^2

(average for 2022-2023)

Hybrid	Background	Leaf surface area of one plant, cm^2			
		8-9 leaves	11-13 leaves	Buttonization	Flowering
LH 50505	Control	972	1462	2849	4552
	Architect	983	1534	2963	4631
	Kalma	992	1492	2896	4579
LH 50585	Control	953	1433	2821	4532
	Architect	977	1506	3016	4687
	Kalma	983	1468	2940	4612

source: formed on the basis of own research

Thus, when growing sunflower hybrids LH 50505 and LH 50585, the maximum plant leaf surface area of 4631-4687 cm^2 was formed by crops against the background of the Architect restregulator. Growing sunflowers using Kalm's restregulator in the 2023 season led to a decrease in the leaf surface area of plants of both studied hybrids.

When growing agricultural crops, it is important to know what elements the crop consists of. This is necessary in order to intelligently influence the productive process.

The main elements of crop formation and its main structural units in sunflower are the diameter of the basket, the weight of seeds from one basket, the nature of the seeds, the weight of 1000 seeds. By affecting any of the indicated indicators of plant productivity and investigating the causes and consequences of the impact on productivity from the application of various elements of growing technology, system approaches to plant productivity management are developed.

The indicator of plant productivity, as a factor that can be influenced during the entire growing season of a crop, and the issue of assessing the causes and consequences of changes in individual plant productivity under various technological techniques, defining and developing systematic technological techniques for managing plant productivity is an important task today.

The analysis of sunflower productivity during the years of research on various options for seed treatment with biological preparations made it possible to reveal the difference in the reaction of the sunflower hybrid to the applied element of the growing

technology, especially in years that differed significantly from the statistical average in terms of the amount of precipitation and the sum of positive temperatures.

Table 3

The influence of the hybrid and the use of growth regulators on the formation of stem and basket diameters by sunflower plants (average for 2022-2023)

Hybrid	Growth regulator	Indicator	
		Diameter stems, cm	Diameter basket, cm
LH50505	Control	2,6	14,7
	Architect	2,7	16,2
	Kalma	2,7	15,1
LH 50585	Control	2,6	13,7
	Architect	2,8	15,7
	Kalma	2,7	14,9

source: formed on the basis of own research

The above-ground mass of plants plays a significant role in the formation of the crop, because key exchange processes take place here, photosynthetic activity takes place, and nutrient accumulation takes place. The formation of a significant vegetative mass at the initial stages of growth is a prerequisite for obtaining high yields. The analysis of Table 3 shows that the stem diameter of the investigated sunflower hybrids was within the experimental error, while the basket diameter varied significantly depending on the hybrid. The largest diameter of the basket among the studied hybrids was formed by LH 50505 – 16,2 cm, which is 0,5 cm more than LH 50585. When determining the structure of the harvest, it should be noted the greatest importance of such indicators as the diameter of the basket, since there is a correlation between the size of the basket and the size of the seeds.

According to the results of our research, it was established that the diameter of the basket, the weight of seeds from the basket and the weight of 1000 seeds varied depending on the studied factors. The weight of 1000 seeds is one of the main indicators of seed quality. The weight of seeds formed by hybrids in the experiment varied from 51,9 to 52.9 g (Table 4).

Table 4

Elements of the sunflower yield structure depending on the use of regulators, (average for 2022-2023)

Hybrid	Growth regulator	Basket diameter, cm	Weight of seeds from the basket, g	Weight of 1000 seeds, g
LH 50505	Control	14,7	54,2	50,8
	Architect	16,2	56,1	52,4
	Kalma	15,1	55,3	51,9
LH 50585	Control	13,7	54,0	50,9
	Architect	15,7	55,3	52,9
	Kalma	14,9	54,9	52,6

source: formed on the basis of own research

In the conditions of the experimental field of VNAU in the village of Agronomic research, the weight of seeds from one basket changed as follows: it was the smallest against the background of the use of the Kalm re-regulator in the hybrid LG 50585 – 54,9 g, the use of the re-regulator Architect ensured an increase in the weight of seeds from one basket in the hybrid LH 50585 by 0,4 g, and in hybrid LH 50505 by 0,8 g.

According to research results, the use of mineral fertilizers increased the mass of 1000 grains of both studied hybrids by 0,3 and 0,5 g, respectively.

Varietal agricultural technology has a significant effect on the realization by plants of their genetic potential. Environmental conditions affect productivity by changing competitive relationships between plants through the use of individual elements of varietal agricultural technology in the technological process of sunflower cultivation. An increase or decrease in yield indicators of the investigated sunflower hybrids was not always accompanied by identical changes in the use of restregulators (Table 5).

Table 5

Yield of sunflower hybrids studied, t/ha (average for 2022-2023)

Hybrid	Growth regulator	Yield, t/ha
LH 50505	Control	2,19
	Architect	2,61
	Kalma	2,49
LH 0585	Control	2,10
	Architect	2,51
	Kalma	2,46

source: formed on the basis of own research

The analysis of Table 5 allows us to draw the following conclusions, that the hybrid LH 50505 turned out to be the most productive of the studied hybrids, which produced a yield of 24,9-2,61 t/ha, which is 0,03-0,1 t/ha more than that of the hybrid LH 50585.

According to the research results, the best re-regulator turned out to be the Architect, with the application of which the maximum yield was obtained for both investigated hybrids. Thus, during the cultivation of sunflower, the elements of varietal agrotechnics, such as the selection of the most adapted and productive hybrids and the re-regulator, should be aimed at achieving the realization of the maximum productivity indicators. The quality and composition of oil largely depend on geographical regions, soil and climatic conditions, variety and agricultural techniques of growing oil crops. The properties and quality of the oil are determined by such indicators as saponification number, iodine and acid numbers.

Qualitative indicators of the grown crop are represented by the following elements: fat content and crude protein content in seeds (Table 6).

It is possible to determine the quality of the oil by organoleptic and instrumental methods (acid and iodine numbers, saponification number). The quality of the oil is characterized by its smell, color and transparency. Edible oil should be completely transparent, have a light yellow color and a characteristic smell. One of the signs of

oil quality is the amount of residue (non-greasy impurities). The number of saponification is the number of milligrams of caustic KOH alkali, necessary for neutralization of free and glycerol-bound fatty acids obtained during saponification of 1 g of fat.

Table 6

Sunflower seed oil quality indicators (average for 2022-2023)

Hybrid	Control	Architect	Kalma
	Number of saponification ml KOH per 1 g of oil	Iodine number, g of iodine per 100 g of oil	Acid value ml of KOH per 1 g of oil
LH 50505	183	124	1,2
LH 50585	186	130	1,7

source: formed on the basis of own research

Acid value is the number of milligrams of caustic KOH stool required to neutralize free fatty acids contained in 1 g of fat. This is an important indicator of the properties and condition of fat, as it can easily increase when storing both fat and fat-rich foods. Iodine number – the number of grams of iodine that binds to 100 g of fat. It makes it possible to assess the quality of the oil, its suitability for use. Since the addition of iodine occurs at the site of double bonds in the molecules of unsaturated fatty acids, the iodine number gives an idea of the content of these acids in fat. The higher the iodine number, the easier the fat oxidizes, so it is more suitable for the production of varnishes, paints, oil and less suitable for eating. The drying ability of the oil is determined by the ability of unsaturated fatty acids to oxidize quickly. According to this feature, oils are divided into: quick-drying, semi-drying and non-drying. Quick-drying oils – linseed, hemp, whose iodine number is 130-295. They include glycerol, linoleic (50-60%) and linoleic (17-45%) acids. Semi-drying and slightly drying – sunflower, soybean, corn with an iodine number from 85 to 130. Glycerides of linoleic (40-57%) and oleic (28-50%) acids prevail in their composition. Non-drying oils – peanut, castor oil with an iodine value of up to 85. They are dominated by oleic acid (up to 83%). Conclusions and prospects for further research. Therefore, certain agrotechnical methods of sunflower cultivation technology, which were carried out in the conditions of insufficient moisture in the Vinnytsia region, allow to obtain a sunflower yield close to the level of the genetic potential of hybrids based on resource conservation and optimization of energy consumption. Additional feeding of growth regulators affected the accumulation of above-ground biomass in sunflowers. The greatest increase in above-ground biomass in comparison with the control group was observed in the year with unfavorable weather conditions. The maximum values of above-ground biomass in sunflower plants were reached at the end of the flowering phase when applying two-time spraying of sunflowers in the phase of 3-4 pairs of leaves and budding and were from 1205 to 1350 grams per one plant, compared to 980 grams per plant in the control version of the experiment. The yield of sunflower seeds in the control variant was 2,55 tons per hectare, but due to the use of additional fertilizers, the yield increased to 2,61-2,46 tons per hectare, which corresponds to an increase in the range from

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АНОТАЦІЯ
ВПЛИВ ПОЗАКОРЕНЕВОГО ПІДЖИВЛЕННЯ НА ФОРМУВАННЯ ПРОДУКТИВНОСТІ ГІБРИДІВ СОНЯШНИКА

Результати проведених нами досліджень дали змогу рекомендувати виробництву окремі агротехнічні прийоми технології вирощування соняшника, які в умовах недостатнього зволоження Вінницької області дозволяють отримувати врожайність соняшника, близької до рівня генетичного потенціалугібридів на основі ресурсозбереження, оптимізації енерговитрат. Проведення додаткового живлення регуляторів росту впливало на накопичення надземної біомаси у соняшниках. Найбільші збільшення надземної біомаси, порівнюючи з контрольною групою, спостерігалися в рік з несприятливими погодними умовами. Максимальні значення надземної біомаси в рослин соняшника досягалися наприкінці фази цвітіння під час застосування дворазового обприскування соняшників у фази 3-4 пар листків і бутонізації, і становили від 1205 до 1350 г на одну рослину, порівнюючи з 980 г на рослину в контрольному варіанті досліду.

Під час вирощування гібридів соняшнику ЛГ 50505 і ЛГ 50585 максимальну площу листкової поверхні рослини 4631–4687 см^2 формували посіви на фоні застосування рістрегулятора Архітект. Вирощування соняшника із застосуванням рістрегулятора Кальма в сезоні 2023 р. призводило до зниження площі листкової поверхні рослин обох досліджуваних гібридів. Урожайність насіння соняшника у контрольному варіанті становила 2,55 тонни на гектар, але внаслідок застосування додаткових добрив урожайність зросла до 2,61–2,46 тонн на гектар, що відповідає збільшенню в межах від 8,3 до 39,3 %. Максимальний рівень урожайності було досягнуто за умови використання Архітект у дозі 1,2 л/га у фазу 3-4 пар листків і під час бутонізації. Розрахунок економічної ефективності проведених експериментальних досліджень і гібридів показав, що гібриди мають достатньо високу рентабельність, але більший приріст чистого прибутку забезпечив гібрид ЛГ 50505.

Ключові слова: *соняшник, гібрид, ростові процеси, урожайність і якість насіння, регулятор Архітектор, Кальма, економічна ефективність, якість олії.*

Табл. 6. Літ. 10.

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