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INFLUENCE OF TECHNOLOGICAL APPROACHES OF GROWING ON SUNFLOWER SEED PRODUCTIVITY

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The article covers an experimental field study of scientific issues - increasing the yield of sunflower seeds by optimizing the basic elements of cultivation technology. The research was carried out in the period 2020-2021 in the research field of VNAU on the basis of NDG "Agronomichnenske", which is located in the village of Agronomichne Vinnytsia region. Two hybrids of early-ripening sunflower maturity Integral and Slavson were studied in the studies of row spacing and sowing density. To achieve this goal used field, laboratory, statistical and computational methods. The quality of the harvest and its structure, the efficiency of the use of environmental resources were determined by the laboratory method. The reliability of the obtained research results was assessed by a statistical method. The economic efficiency of the studied elements of the technology was determined by the calculation-comparative method. It was found that when sowing sunflowers with a row spacing of 45 cm, the growing season of the hybrid Integral is 108 days, and the hybrid Slavson - 95 days. With a row spacing of 70 cm, the vegetation of plants of both hybrids is reduced by 2-6 days. It was observed that with the thickening of crops from 50 to 90 thousand / ha, the plant height of the hybrid Slavson increases from 179.1 to 190.4 cm, and the hybrid Integral from 184.1 to 196.9 cm. Larger weight of 1000 seeds was provided by the early-ripening hybrid Integral with a row spacing of 70 cm and a sowing density of 50 thousand plants / ha - 72.6 g, and the lowest value of this indicator was at a density of 90 thousand plants / ha - 56.1 g. Sunflower yield depends on structural elements such as number of inflorescences per unit area, number of seeds per inflorescence, average weight or weight of 1000 seeds, and seed quality is mainly determined by fat and protein content. We state that the optimal sowing density of hybrids Integral Slavson and for sowing with a row spacing of 45 and 70 cm was - 70 thousand / ha. Higher seed yield for sowing 70 cm was provided by the hybrid Integral - 2.72 t / ha.

***Key words:** hybrids, sunflower, seeds, sowing rates, row spacing, yield, economic efficiency.*
Table 4. Lit. 15.

Formulation of the problem. Among the factors that ensure a high yield of sunflower are the spatial and quantitative placement of plants in the area, as well as technological measures aimed at realizing the genetic potential of sunflower in the forest-steppe of Ukraine. This is of great value because the width of the row spacing and sowing density are studied in the complex, which aims to reduce energy consumption and increase the profitability of cultivated products [1, 4].

During the growing season, plants have different lengths of interphase periods of growth and development. In the conditions of the shortened day they accelerate the development, and after flowering, on the contrary, develop as plants of a long light day [1-2, 5, 7, 15].

Analysis of recent research and publications. Sunflower is a long day crop. According to some scientists [1, 3-4], the duration of the growing season is influenced by the intensity and spectral composition of sunlight. The reason for accelerating or slowing down the development of agricultural plants is the accumulation of different amounts of organic compounds in the apical growth points [6-7].

The rate of plant development depends mainly on the ambient temperature, and humidification conditions affect only in certain interphase periods (sowing-germination and flowering-ripening) [2, 4-6, 14].

Research methods. The research was conducted in accordance with the economic contract "Development of adaptive technology for growing industrial crops, taking into account soil productivity and natural resources and material and technical potential of the customer" (state registration number UkrIntei 0121U111052) during 2020-2021 in the research field of VNAU on the basis of NDG "Agronomichne", which is located in the village of Agronomichne, Vinnytsia region. The soil of the experimental site is gray forest of medium loamy mechanical composition. According to the final agrochemical survey, the humus content in the arable layer is low - 3%. The content of easily hydrolyzed nitrogen (according to Cornfield) is low - 7.0-8.0, mobile phosphorus (according to Chirikov) is high - 16.0-19.4; exchangeable potassium (according to Chirikov) increased - 9.5 mg / 100 g of soil. Hydrolytic acidity is high and is 4.31 mg-eq./100 g of soil. By metabolic acidity pHNsol. 5.0-5.4 (soil - moderately acidic). The soil of the research site and its agrochemical parameters are typical for this zone and are suitable for growing industrial crops, in particular sunflower [8-9].

Presentation of the main research material. As the interphase periods over the years took place under different weather conditions, this affected the growth and development of plants. In addition to climatic factors, the passing of the phases of plant development is also influenced by agronomic cultivation techniques, including row spacing and planting density. Thickening of crops from 55 to 90 thousand / ha accelerated the ripening of sunflower for 2-5 days (Table 1). With the thickening of sunflower crops to 80 thousand / ha, there was no noticeable difference in the timing of phenophases. The increase in density was accompanied by the acceleration of the ripening phase only in conditions of severe drought [3, 12], which contributes to the prolongation of the growing season with the thickening of crops in wet years. Our observations have shown that the duration of the vegetation phases and interphase periods was also significantly influenced by the ecological and biological characteristics of sunflower hybrids. Thus, if the precocious hybrid Slavson interphase period sowing-germination lasted only 10 days, the period of germination-formation of discs 29-31 days, quite short - 15-17 days, it was during the formation of flowering discs and the longest - 36-37 days in the flowering period – full maturity. The duration of the growing season of both hybrids mainly depended on the interphase period of flowering-full maturity. There is also a difference in the length of the growing season depending on the width of the rows. In the early-maturing hybrid Integral, compared with the precocious hybrid Slavson, the duration of these interphase periods increased to 12, 34, 18, 45 days, respectively (Table 1). In the precocious hybrid Slavson on crops with a row spacing of 45 cm, it was shorter by one, in the middle-early hybrid Integral - by two days. The duration of the period of formation of discs - flowering in hybrids of different maturity groups changed little. At all rates of sowing flowering occurred simultaneously.

Table 1

Duration of interphase periods of different-ripening sunflower hybrids, days (average 2020-2021)

Hybrid	Row spacing, cm	Sowing density thousand / ha	Sowing - the emergence of shoots	Shoots - the formation of discs	Formation of discs - flowering	Flowering - full maturity	Duration of the growing season
Slavson	45	50	10	31	17	37	95
		70	9	31	16	37	93
		90	10	30	17	36	93
	70	50	10	29	15	36	90
		70	10	30	14	35	90
		90	9	29	16	37	91
Integral	45	50	12	34	17	45	108
		70	11	35	17	44	107
		90	12	34	16	46	108
	70	50	12	32	18	43	105
		70	12	34	17	43	106
		90	11	33	18	42	104

Source: obtained on the basis of own research results

The interphase period of flowering-full maturity was shorter in both hybrids with different widths between rows, because the wet May and June were replaced by arid, high temperatures. The total duration of the growing season in the early-maturing hybrid Slavson was 90-95 days, in the early-maturing hybrid Integral - 105-108 days. This completely coincides with their varietal ecological and biological features.

One of the important morphological signs of sunflower growth is the height or length of the stem, the diameter of the disc, the size of the leaf surface. They characterize the interaction between genotype and growing conditions and to some extent, reflect the state of plant development. Sunflower - a plant in the stem of which creates special air, water and light regimes. This determines the nature of intraspecific competition for factors of life in the agrocenosis and affects crop yields. Therefore, the density of crops is an important element of the technology of growing different crops. With the optimal determination of the number of plants per unit area, you can achieve maximum yield while maintaining high quality.

Our data show that the height of plants and the diameter of the disc vary depending on the density of crops (Table 2).

Recently, much attention is paid to the creation of low-growing forms of sunflower with a short growing season. They combine a number of useful characteristics of intensive plants, namely: high coefficient of economic efficiency (CGE - the percentage of seed yield in the total biomass yield) and high rate of accumulation of organic matter. On the other hand, with lower altitudes, such plants lose out to weeds and require new elements of cultivation technology.

Table 2

Plant height and diameter of sunflower discs in the flowering phase, depending on sowing density and row spacing (average 2020-2021)

Hybrid	Row spacing, cm	Sowing density thousand / ha	Stem height, cm	The diameter of the disk, cm
Slavson	45	50	179,1	18,7
		70	184,1	19,8
		90	189,1	19,1
	70	50	180,1	19,5
		70	184,8	21,3
		90	190,4	20,6
Integral	45	50	184,1	18,1
		70	189,5	18,7
		90	195,3	18,3
	70	50	186,7	18,2
		70	192,3	19,3
		90	196,9	18,6

Source: obtained on the basis of own research results

In the control variant - 70 thousand / ha, the height of plants of the hybrid Slavson with a row spacing of 70 cm was on average - 184.8 cm, and with a row spacing of 45 cm -184.1 cm, in the hybrid Integral this figure was - 192.3 and 186.7 cm. It can be noted that in the year of research the difference in plant height at a density of 70 and 90 thousand / ha was not significant. Lower plant height was observed at a density of 50 thousand / ha - in the precocious hybrid Slavson with a row spacing of 45 cm - 179.1 cm, and with a row spacing of 70 cm - 180.1 cm, early-maturing hybrid Integral, respectively - 181.1 and 188.1 cm , larger - at 90 thousand plants / ha - in the hybrid Slavson with a row spacing of 70 cm - 190.4 cm, with a row spacing of 45 cm - 189.1 cm.

In the hybrid Integral with a row spacing of 45 cm, the height of plants was 195.3 cm, with a row spacing of 70 cm - 196.9 cm, which is 6.5 cm more than in the hybrid Slavson. The increase in plant height during the thickening of sunflower crops in conditions of insufficient moisture [5, 7, 11] is due to the action of other (except moisture) limiting factors, such as light and nutrients. In experiments, the density of crops affected the height of plants in accordance with the conditions of moisture: in wet years, it increased as it thickened, in dry - decreased. This indicates that sparse sunflower crops use the precipitation of the second half of the growing season better than denser ones. The limiting factor in terms of plant height was the amount of precipitation in the first half of the sunflower vegetation, and the diameter of the disc in the second. The diameter of the disc varied, depending on the seeding density of both hybrids in the range of 18.1-21.3 cm. Larger discs were observed in the hybrid Slavson, formed at a density of 70 thousand plants / ha and a row spacing of 70 cm - 21.3 cm. and smaller - with a row spacing of 45 cm and a density of 50 thousand plants / ha - 18.7 cm. In the variants with a sowing density of 90 thousand / ha of the plant, small discs were formed - 18.3 and 20.6 cm.

The formation of the sunflower crop is a process determined, on the one hand, by the characteristics of plants, and on the other - by a number of external factors, including those that are regulated to varying degrees by humans.

Among the biological features the most important are the ability of hybrids to create a coenosis with a certain height and weight of plants capable of forming a leaf area that would not limit the intensity of photosynthesis, be resistant to adverse growing conditions due to different lengths of vegetation and individual interphase mineral nutrition and use them to form crops of a certain quality.

Among the technological measures in the cultivation of sunflower, one of the most important is the width between rows and the density of crops.

Based on long-term experiments [2-3, 13], it was concluded that the weight of 1000 seeds varies little over the years, and plant productivity depends mainly on the number of seeds in the disc. The mass of 1000 sunflower seeds is a genetically determined indicator, but it can vary depending on soil and climatic conditions and agronomic techniques, in particular the sowing density [2, 14].

The study of the effect of sowing density and row spacing of different sunflower hybrids on the weight of 1000 seeds and the weight of seeds from one plant (disc) showed that the weight of 1000 seeds decreased as the crop thickened.

Moreover, the indicators of the mass of 1000 seeds and the mass of seeds in the disc were higher in crops of both hybrids with rows of 70 cm (Table 3).

Table 3

Influence of sowing density and row spacing on mass of sunflower seeds, g

Hybrid	Row spacing cm	Sowing density thousand / ha	Average 2020-2021	
			Weight 1000 seeds, g	Seed weight from one disk, g
Slavson	45	50	71,3	115,5
		70	58,6	89,8
		90	56,1	81,8
	70	50	71,7	116,4
		70	59,9	91,8
		90	57,6	83,6
Integral	45	50	71,1	108,7
		70	59,5	85,1
		90	57,5	78,4
	70	50	72,6	110,9
		70	60,4	86,4
		90	56,6	75,8

Source: obtained on the basis of own research results

The studied hybrids were quite plastic (Table 4).

Integral hybrid formed a higher yield when the distribution of precipitation was uniform and before the seeds of this hybrid fell 41 mm, during flowering-full maturity of precipitation or was not at all, or their number was much lower than many years.

Table 4

Seed yield of different sunflower hybrids depending from sowing density and row spacing, t/ha

Hybrid	Row spacing, cm	Sowing density thousand / ha	Average 2020-2021
			Yield
Slavson	45	50	2,41
		70	2,64
		90	2,23
	70	50	2,44
		70	2,66
		90	2,26
HIP_{05}			*0,18*
Integral	45	50	2,48
		70	2,69
		90	2,30
	70	50	2,54
		70	2,72
		90	2,39
HIP_{05}			*0,22*

Source: obtained on the basis of own research results

The yield of seeds of early-maturing hybrid Slavson significantly depended on the conditions that developed during the growing season.

Conclusions and prospects for further research. Theoretical substantiation and solution of problems of new sunflower hybrids cultivation in the conditions of Vinnytsia region is given, which consists in determination of regularities of productivity of plants formation at change of row spacing and density of crops. The dependence of economic efficiency of sunflower cultivation on morphological features of new hybrids, row spacing and crop density is proved and the expediency of using the presented sunflower biotypes for this region is substantiated, which is manifested in the following:

- it was found that when sowing sunflowers with a row spacing of 45 cm, the growing season of the hybrid Integral is 108 days, and the hybrid Slavson - 95 days. With a row spacing of 70 cm, the vegetation of plants of both hybrids is reduced by 2-6 days.

- it was observed that with the thickening of crops from 50 to 90 thousand / ha the height of plants of hybrid Slavson increases from 179.1 to 190.4 cm, and hybrid Integral - from 184.1 to 196.9 cm.

- we state that the optimal sowing density of Integral and Slavson hybrids for sowing with a row spacing of 45 and 70 cm was - 70 thousand / ha. Higher seed yield for sowing 70 cm was provided by the hybrid Integral - 2.72 t / ha.

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АНОТАЦІЯ
ВПЛИВ ТЕХНОЛОГІЧНИХ ПРИЙОМІВ ВИРОЩУВАННЯ НА НАСІННЄВУ ПРОДУКТИВНІСТЬ СОНЯШНИКУ

У статті висвітлено експериментально-польового дослідження наукової проблематики – підвищення врожайності насіння соняшнику, шляхом оптимізації основних елементів технології вирощування. Дослідження здійснювали у період 2020-2021 років в умовах дослідного поля ВНАУ на базі НДГ «Агрономічне», яке знаходиться у селі Агрономічне Вінницького району. В дослідженнях із вивчення густоти міжрядь та густоти посіву досліджувались два гібрида соняшнику ранньостиглої групи стиглості Інтеграл та Славсон.

Для досягнення поставленої мети користувались польовим, лабораторним, статистичним і розрахунково-порівняльним методами. Лабораторним методом визначали якість урожаю та його структури, ефективності використання ресурсів навколишнього середовища. Статистичним методом оцінювали достовірність одержаних результатів досліджень. Розрахунково-порівняльним методом визначали економічну ефективність досліджуваних елементів технології. Установлено, що за сівби соняшника з міжряддям 45 см тривалість періоду вегетації гібрида Інтеграл становить 108 днів, а гібрида Славсон - 95 днів. За міжряддя 70 см вегетація рослин обох гібридів скорочується на 2-6 днів. Виявлено, що за загущення посіву з 50 до 90 тис./га висота рослин гібрида Славсон збільшується від 179,1 до 190,4 см, а гібрида Інтеграл від 184,1 до 196,9 см.Більшу масу 1000 насінин, забезпечив ранньостиглий гібридІнтеграл з шириною міжрядь 70 см і густотою посіву 50 тис. рослин/га - 72,6 г, а найменше значення цього показника було при густоті 90 тис. рослин/га - 56,1 г.

Урожайність соняшника залежить від таких структурних елементів як кількість суцвіть на одиниці площі, кількість сім'янок у суцвітті, середня маса або маса 1000 сім'янок, а якість насіння головним чином визначається вмістом жиру та білка.

Виявлено, що оптимальною густотою посіву гібридів Інтеграл Славсон та за сівби з шириною міжрядь 45 та 70 см становила - 70 тис./га. Вищу урожайність насіння за сівби 70 см забезпечив гібрид Інтеграл - 2,72 т/га.

***Ключові слова**: гібриди, соняшник, насіння, норми висіву, ширина міжрядь, урожайність, економічна ефективність.*

Табл. 4. Літ. 15.

АННОТАЦИЯ

ВЛИЯНИЕ ТЕХНОЛОГИЧЕСКИХ ПРИЕМОВ ВЫРАЩИВАНИЯ НА СЕМЕНУЮ ПРОИЗВОДИТЕЛЬНОСТЬ ПОДСОЛНЕЧНИКА

В статье отражены экспериментально-полевые исследования научной проблематики - повышение урожайности семян подсолнечника, путем оптимизации основных элементов технологии выращивания. Исследования проводились в период 2020-2021 годов в условиях опытного поля ВНАУ на базе НДГ «Агрономическое», которое находится в селе Агрономическое Винницкого района. В исследованиях по изучению густоты междурядий и густоты посева исследовались два гибрида подсолнечника раннеспелой группы спелости Интеграл и Славсон. Для достижения поставленных целей пользовались полевым, лабораторным, статистическим и расчетно-сравнительным методами. Лабораторным способом определяли качество урожая и его структуры, эффективность использования ресурсов окружающей среды. Статистическим методом оценивали достоверность результатов исследований. Расчетно-сравнительным методом определяли экономическую эффективность изучаемых элементов технологии.

Установлено, что при севе подсолнечника с междурядьем 45 см продолжительность периода вегетации гибрида Интеграл составляет 108 дней, а гибрида Славсон - 95 дней. За междурядья 70 см вегетация растений обоих гибридов сокращается на 2-6 дней.

Обнаружено, что при загущении посева с 50 до 90 тыс./га высота растений гибрида Славсона увеличивается от 179,1 до 190,4 см, а гибрида Интеграл от 184,1 до 196,9 см.

Большую массу 1000 семян, обеспечивших раннеспелый гибрид Интеграл с шириной междурядий 70 см и густотой посева 50 тыс. растений/га - 72,6 г, а наименьшее значение этого показателя было при плотности 90 тыс. растений/га - 56,1 г.

Урожайность подсолнечника зависит от таких структурных элементов, как количество соцветий на единицы площади, количество семянок в соцветии, средняя масса или масса 1000 семянок, а качество семян главным образом определяется содержанием жира и белка.

Выявлено, что оптимальной густотой посева гибридов Интеграл Славсон и сев с шириной междурядий 45 и 70 см составила - 70 тыс./га. Высшую урожайность семян при посеве 70 см обеспечил гибрид Интеграл - 2,72 т/га.

Ключевые слова: *гибриды, подсолнечник, семена, нормы высева, ширина междурядий, урожайность, экономическая эффективность.*

Табл. 4. Лит. 15

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