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AGRONOMIC AND ECONOMIC ASPECTS OPTIMIZATION TECHNOLOGY OF CULTIVATION OF SUNFLOWER HYBRIDS IN SOUTHERN UKRAINE

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The article shows the results of studies on the productivity, economic and energy efficiency of cultivation of sunflower depending on the hybrid composition, stand density of plants and fertilizing compound fertilizers. The aim of this work was to establish performance, economic and energy efficiency technologies sunflower cultivation in the South of Ukraine. According to the research found that when growing sunflower on dark chestnut soils without irrigation in Southern Ukraine the highest yield at 2,3-2,5 t/ha seed of hybrid forms Megasan. When growing studied culture density stand of plants should be adjusted depending on the genetic potential of hybrids. Thus, for hybrids Megasan and Jason optimum stand density is 50 thousand/ha for hybrid Darius – 40 thousand/ha. Processing of sunflower crops provides complex fertilizers increase yield at 10.7-20.9% and improves the quality of seeds, with the greatest efficiency is characterized by complex fertilizer Master. Growing sunflower seeds were cost-effective in all versions of the experiment, indicators of production costs were characterized by stability, and net income and profitability had significant fluctuations. The use of any and all complex fertilizers caused significant (in 20.2-35.1%) increase in net profit in growing hybrid seeds Megasan, Jason and Darius. Energy efficiency ratio reached its highest level in the variant with hybrid Megasan in the formation of standing plant density 40-60 thousand/ha of fertilizer feeding.
Keywords: sunflower hybrids, stand density of plants, compound fertilizers, economic efficiency, energy rating.

Formulation of the problem. Comparison of global economic indicators of global agriculture suggests that the main oil crops in most countries is soy. But in Ukraine the main oilseeds was and is sunflower because of specific regional characteristics [1]. The value of this crop in the state food security as an important export component overemphasized. Growing sunflower lets two major products that have exceptional significance for the development of food base Ukraine – is, first, valuable vegetable oil, which by its nutritional value is not inferior animal fats and, secondly, press cake (oil cake) – a very valuable component to balance feed on protein and amino acids, which is used in large scale animal husbandry, poultry, fish, etc. [2]. At present and for the future urgent problem is to improve economic and energy efficiency sunflower and the growing demand for quality seeds by choosing a hybrid structure, optimization of stand density of plants and the application of science-based system of fertilization, including by applying for foliar feeding of complex fertilizers with trace elements.

Analysis of recent research and publications. Proved that the efficiency of agricultural production belongs to the complex of interrelated economic categories, based on the action of objective economic laws. It reflected one of the most important aspects of social production – efficiency, reflecting the shape and purpose of agricultural production process. Moreover, when describing the end result should distinguish the concept of effect and efficiency of the studied technologies of agricultural items crops, including sunflower. Economic and energy efficiency and sunflower processing depends on a complex set of natural, economic, technological, scientific, technical and other factors. To optimize cultivation technology, improving the economic and energy efficiency should take into account the following main features: high requirements for growing conditions; sensitivity to herbicides; epiphytotic possibility of pathogens that can lead to significant loss of yield and quality of seeds [3].

The purpose of the article. The task of the research was to establish economic and energy efficiency of growing technology elements seed sunflower hybrids in the conditions of South Steppe of Ukraine.

Presentation of the main material. Field experiments with hybrids of sunflower conducted during 2014-2016 in the experimental farm «Copani» Institute of irrigated agriculture NAAS of Ukraine according to universally accepted methods of business research [4]. Economic efficiency study of culture established by analysis of the following metrics: productivity, production costs per unit area, the cost of 1 kg seeds earnings per 1 ha of crops and the profitability [5]. For the calculation of economic efficiency on growing technology elements studied sunflower hybrids Megasan, Jason and Darius had taken stock prices for seed [6] and the market price for agrarian resources that have been established for the period of October 2016.

The role of fertilizing the performance of sunflower hybrids was positive in all the years of research, even the deterioration of environmental conditions, ie reducing rainfall, increase in temperature and decrease in relative humidity. However, it was shown varying degrees and amounted on average compared with control plots (without treatments): in 2014 – 11.5-23.1%; in 2015 – 9.2-16.8; 2016 – 12.1-21.9%, respectively.

In average years of research noted the advantage of growing hybrid Megasan which formed a high yield seeds 2.41 t/ha with a maximum rise to 2.62-2.74 t/ha in the standing plant density of 50 thousand/ha of crops and processing agents Wuxal and Master (table 1).

Density stand of plants caused significant fluctuations in plant productivity. Thus, on average, the smallest seed yield in all the studied hybrids within 1.62-1.90 t/ha was recorded at the minimum and maximum density stand of plants – 30 and 60 thou-

sand/ha. On average, a factor in growing hybrids Megasan and Jason optimum density was 50 thousand/ha, in which the yield was respectively 2.47 and 2.14 t/ha. In the version with hybrid Darius optimal density was 40 thousand/ha, which is obtained by sunflower yield – 1.89 t/ha.

The use of complex fertilizers Concentrategrowth, Wuxal and Master of feeding positively affected the performance of hybrids, which were studied in the experiment. The largest increase in use has provided the Master with an average yield of 2.11 t/ha with a corresponding decrease in other variants fertilized in 5.7-11.4%.

According to the research, it was found that the investigated factors significantly affected the value of gross output. This figure exceeded 20 thousand UAH/ha for growing all investigated hybrids of density stand of plants within 40-60 thousand/ha and processing complex fertilizers Concentrategrowth, Wuxal and Master. The lowest value of this index in the range of 14.0 to 17.4 thousand UAH/ha were under minimum stand density of plants (30 thousand/ha) and without the use of complex fertilizers. Fertilizing crops Sunflower complex fertilizer Master boosted the value of gross output per unit area, on average, to 20.6 thousand/ha. In an embodiment of the processing plant Wuxal this indicator decreased by 5.7%, and in areas with Concentrategrowth – by 11.4%. Overall crop processing complex fertilizers provided compared with control plots growth in gross tax on 10.7-20.9%.

According to the analysis process maps cultivation of sunflower hybrids Megasan, Jason and Darius on test plots demonstrated that production costs slightly varied relative changes of density stand of plants and the application of complex fertilizers Concentrategrowth, Wuxal and Master as feeding.

The highest production costs of more than 9.6 thousand UAH/ha recorded in variants with hybrid Megasan on stand density 50-60 thousand/ha and making complex fertilizers Wuxal and Master,

Table 1

Yield seeds sunflower hybrids based on stand density of plants and fertilizers, t/ha (average for 2014-2016)

Hybrid (factor A)	The density of plant standing, thous./ha (factor B)	Fertilizers (factor C)					Average factor A	Average factor B
		control (without treatments)	Concentrate-growth	Wuxal	Master	average		
Megasan	30	1.68	1.81	1.96	2.14	1.90	2.19	1.77
	40	1.96	2.26	2.38	2.57	2.29		2.07
	50	2.05	2.49	2.62	2.74	2.47		2.16
	60	1.78	2.09	2.25	2.31	2.11		1.82
Jason	30	1.56	1.76	1.73	1.93	1.74	1.90	
	40	1.82	1.93	2.00	2.29	2.01		
	50	1.90	2.09	2.19	2.37	2.14		
	60	1.57	1.73	1.83	1.76	1.72		
Darius	30	1.44	1.63	1.68	1.81	1.64	1.75	
	40	1.67	1.82	1.99	2.09	1.89		
	50	1.69	1.79	1.95	2.00	1.86		
	60	1.45	1.57	1.70	1.76	1.62		
Average factor C		1.67	1.87	1.99	2.11	1.96		

Lowest significant difference (t/ha):
Assessment of Materiality partial factors for the differences: A – 0.049; B – 0.068; C – 0.055
Assessment of Materiality middle (main) effects: A – 0.027; B – 0.021; C – 0.039

Table 2

Net profit from growing sunflower depending on the hybrid composition, stand density of plants and fertilization, UAH/ha (average for 2014-2016)

Hybrid (factor A)	The density of plant standing, thous./ha (factor B)	Fertilizers (factor C)					Average factor A	Average factor B
		control (without treatments)	Concen-trategrowth	Wuxal	Master	average		
Mega-san	30	7378	8520	9640	11455	9273	11975	8030
	40	9995	12794	13622	15535	12962		10847
	50	10795	14959	15884	17114	14639		11652
	60	8158	11055	12273	12918	11125		8335
Jason	30	6233	8057	7423	9433	7738	9180	
	40	8659	9606	9946	12834	10261		
	50	9363	11090	11723	13538	11453		
	60	6154	7588	8221	7598	7366		
Darius	30	5088	6815	6960	8288	6788	7749	
	40	7228	8564	9880	10915	9122		
	50	7359	8208	9426	9973	8766		
	60	5010	6054	6979	7624	6417		
Average factor C		7188	9012	9840	11070	9765		

and the hybrid Jason – at the same thickening and applying for feed preparation Wuxal.

Calculations revealed that the lowest cost of 1 c of sunflower seeds at UAH 350.4 was in variant with hybrid Megasan, stand density 50 thousand plants/ha of crops and processing complex fertilizer Master. The largest (at 629.5 UAH/c) in the figure formed hybrid version with Darius on stand density 60 thousand plants/ha and without the use of complex fertilizers fertilizing.

For hybrid composition greatest level of cost of sunflower hybrids had Darius and Jason, where the figure rose to 532.2 and 491.9 UAH/c, respectively. When growing hybrid Megasan the figure decreased by 19.5 and 12.9% – to 428.2 UAH/c, indicating that the best use of financial resources it is in the cultivation of the hybrid.

The maximum net profit of 17.1 thousand UAH was obtained in the variant with hybrid Megasan by planting density 50 thousand/ha and conducting complex fertilizer fertilizing Master (table 2).

Among the studied hybrids Megasan also had advantages in terms of developing the largest conditional net income. Thus, in this hybrid version of the figure was, on average, by a factor A, 11 975 UAH/ha, and in versions with hybrids Jason and Darius it fell to 7749-9180 UAH/ha or at 23.3-35.3%.

The use of any and all complex fertilizers caused significant (in 20.2-35.1%) increase in net profit in growing hybrid seeds Megasan, Jason and Darius. In control variant observed minimum values of the studied parameters – at 7.2 thousand UAH/ha. The largest net profit was in the version with the introduction of the drug Mehasan, where he rose to 11.1 thousand UAH/ha.

The level of profitability than 160% was observed in variants with hybrid Megasan on stand density 40-50 thousand/ha and for making complex fertilizers Concentrategrowth, Wuxal and Master. And the greatest profitability (178.3%) formed when grown on test plots for hybrid Megasan density 50 thousand/na and included in the feed complex fertilizer Master.

Gross revenues from energy crop seed was due to variations in seed yield under the influence of factors studied – a hybrid structure (factor A), stand density of plants (factor B) and fertilization (factor C).

Among the largest sunflower hybrids energy output per unit area provided growing hybrid Megasan where the study figure was 53.0 GJ/ha. In hybrids Jason and Darius was decreased energy intake from seed to harvest 45.9 and 42.3 GJ/ha, or 13.2 and 20.1%.

According to calculations proved that gross energy consumption in the production of sunflower seeds slightly changed under the influence of investigated factors associated little difference between individual technological operations and resources for individual variants cultivation technology.

To form a hybrid crop Megasan spent 18.4 GJ/ha, while grown hybrids Jason and Darius – to 18.1-18.2 GJ/ha.

Unlike indices spending energy on growing technology, increase energy fluctuated significantly for the studied factors and variations, due to differences in performance of gross income energy and, conversely, stable energy costs.

Maximum energy surplus at 34.6 GJ/ha was in variant with hybrid Megasan and other hybrids, this figure decreased to 24.2-27.7 GJ/ha or at 19.8-30.1%.

Energy efficiency ratio is a reflection of the ratio of energy intake from harvest sunflower seeds and energy costs on cultivation technology and resources. This indicator is most fully to draw conclusions about the energy efficiency of the studied factors, especially from the viewpoint of saving technological costs [7]. In our study, the maximum level of energy efficiency ratio (more than 3.0) was in variant with hybrid Megasan with stand density 40-60 thousand plants/ha and conduct of complex fertilizers fertilizing Concentrategrowth, Wuxal and Master (table 3).

In areas with a hybrid Megasan the average factor A was 2.88, which exceeded the rates in 12.5-19.1% energy efficiency in hybrids Jason and Darius.

For gradations density of plant standing on forming investigated the energy performance of hybrids Megasan and Jason had the advantage of standing plant density of 50 thousand/ha, while

Table 3

Energy efficiency in technology of cultivation of sunflower hybrids in the South of Ukraine depending on factors studied (average for 2014-2016)

Hybrid (factor A)	The density of plant standing, thous./ha (factor B)	Fertilizers (factor C)					Average factor A	Average factor B
		control (without treatments)	Concen-trategrowth	Wuxal	Master	average		
Mega-san	30	2.26	2.41	2.60	2.82	2.53	2.88	2.36
	40	2.60	2.97	3.12	3.35	3.01		2.74
	50	2.71	3.25	3.41	3.55	3.23		2.85
	60	2.36	2.76	2.96	3.03	2.78		2.42
Jason	30	2.11	2.35	2.31	2.56	2.32	2.52	
	40	2.43	2.56	2.65	3.01	2.66		
	50	2.52	2.76	2.88	3.10	2.82		
	60	2.10	2.31	2.43	2.35	2.29		
Darius	30	1.95	2.18	2.24	2.41	2.20	2.33	
	40	2.24	2.42	2.63	2.76	2.51		
	50	2.26	2.38	2.58	2.65	2.47		
	60	1.94	2.10	2.27	2.35	2.17		
Average factor C		2.23	2.48	2.63	2.78	2.60		

the hybrid Darius – 40 thousand/ha. On average, this factor observed maximum growth factor energy efficiency by up to 2,85 stand density of plants 50 thousand/ha and other density, this figure decreased to 2.36-2.74 or on 3.8-17.0%.

Analysis of energy intensity of 1 t of sunflower seeds revealed trends to decrease this indicator for 0.068-0.072 GJ growing hybrid Megasan of standing plant density 40-50 thousand/ha and making complex fertilizers Wuxal and Master. With a minimum (30 thousand/ha) and maximum (60 thousand/ha) of standing plant density without making complex fertilizers in hybrid version of the study Darius index gained the highest level – 0.124 GJ/t.

Conclusions and suggestions. According to the research found that when growing sunflower on dark chestnut soils without irrigation in Southern Ukraine the highest yield at 2.3-2.5 t/ha seed of hybrid forms Megasan. When growing studied culture density stand of plants should be adjusted depending on the genetic potential of hybrids. Thus, for hybrids Megasan and Jason optimum stand density is 50 thousand/ha for hybrid Darius – 40 thousand/ha. Processing of sunflower crops provides complex fertilizers increase yield at 10.7-20.9% and improves the quality of seeds, with the greatest efficiency is characterized by complex fertilizer Master. Growing sunflower seeds were cost-effective in all versions of the experiment, indicators of production costs were characterized by stability, and net income and profitability had significant fluctuations. The use of any and all complex fertilizers caused significant (in 20.2-35.1%) increase in net profit in growing hybrid seeds Megasan, Jason and Darius. Energy efficiency ratio reached its highest level in the variant with hybrid Megasan in the formation of standing plant density 40-60 thousand/ha of fertilizer feeding.

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АГРОЕКОНОМІЧНІ АСПЕКТИ ОПТИМІЗАЦІЇ ТЕХНОЛОГІЇ ВИРОЩУВАННЯ ГІБРИДІВ СОНЯШНИКУ В УМОВАХ ПІВДНЯ УКРАЇНИ

Анотація
В статті відображено результати досліджень з вивчення продуктивності, економічної та енергетичної ефективності вирощування насіння соняшнику залежно від гібридного складу, густоти стояння рослин та проведення підживлень комплексними добривами. Метою цієї роботи є встановлення продуктивності, економічної та енергетичної ефективності технології вирощування насіння соняшнику в умовах півдня України. За результатами досліджень встановлено, що при вирощуванні соняшника на темно-каштановому ґрунті в неполивних умовах півдня України найбільшу врожайність на рівні 2,3-2,5 т/га насіння формує гібрид Мегасан. При вирощуванні досліджуваної культури густоту стояння рослин слід коригувати залежно від генетичного потенціалу гібридів. Так, для гібридів Мегасан та Ясон оптимальною густотою стояння є 50 тис. /га, а для гібриду Дарій – 40 тис. /га. Обробка посівів соняшнику комплексними добривами забезпечує приріст урожайності на 10,7-20,9% та покращує якість насіння, причому найбільшою ефективністю характеризується комплексне добриво Майстер. Вирощування насіння соняшнику було економічно вигідним в усіх варіантах досліду, показники виробничих витрат характеризувались стабільністю, а чистого прибутку та рівня рентабельності – мали істотні коливання. Застосування всіх без виключення комплексних добрив обумовило істотне (на 20,2-35,1%) зростання чистого прибутку при вирощуванні насіння гібридів Мегасан, Ясон і Дарій. Коефіцієнт енергетичної ефективності максимального рівня досягнув у варіанті з гібридом Мегасан при формуванні густоти стояння рослин 40-60 тис. /га з підживленнями добривами.
Ключові слова: соняшник, гібриди, густота стояння рослин, комплексні добрива, економічна ефективність, енергетична оцінка.

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АГРОЭКОНОМИЧЕСКИЕ АСПЕКТЫ ОПТИМИЗАЦИИ ТЕХНОЛОГИИ ВЫРАЩИВАНИЯ ГИБРИДОВ ПОДСОЛНЕЧНИКА В УСЛОВИЯХ ЮГА УКРАИНЫ

Аннотация
В статье отражены результаты исследований по изучению продуктивности, экономической и энергетической эффективности выращивания семян подсолнечника в зависимости от гибридного состава, густоты стояния растений и проведения подкормок комплексными удобрениями. Целью этой работы является установление продуктивности, экономической и энергетической эффективности технологии выращивания семян подсолнечника в условиях юга Украины. По результатам исследований установлено, что при выращивании подсолнечника на темно-каштановой почве в неполивных условиях юга Украины наибольшую урожайность на уровне 2,3-2,5 т/га семян формирует гибрид Мегасан. При выращивании исследуемой культуры густоту стояния растений следует корректировать в зависимости от генетического потенциала гибридов. Так, для гибридов Мегасан и Ясон оптимальной густотой стояния является 50 тыс. /га, а для гибрида Дарий – 40 тыс. /га. Обработка посевов подсолнечника комплексными удобрениями обеспечивает прирост урожайности на 10,7-20,9% и улучшает качество семян, причем наибольшей эффективностью характеризуется комплексное удобрение Мастер. Выращивание семян подсолнечника было экономически выгодным на всех вариантах опыта, показатели производственных затрат характеризовались стабильностью, а чистой прибыли и уровня рентабельности – имели существенные колебания. Применение всех без исключения комплексных удобрений обусловило существенное (на 20,2-35,1%) рост чистой прибыли при выращивании семян гибридов Мегасан, Ясон и Дарий. Коэффициент энергетической эффективности максимального уровня достиг на варианте с гибридом Мегасан при формировании густоты стояния растений 40-60 тыс. /га с подкормкой удобрениями.
Ключевые слова: подсолнечник, гибриды, густота стояния растений, комплексные удобрения, экономическая эффективность, энергетическая оценка.