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EFFICIENCY OF GROWING BASIC SEEDS OF SOFT WINTER WHEAT UNDER VARIOUS AGROTECHNOLOGICAL MEASURES

Increasing the level of crops and gross yields of agricultural crops, the main share of which is cereals, in particular winter wheat, which fully uses the natural resource potential of the country's regions, is the main priority for agricultural science. The expansion of the production of grain crops seeds as an effective and environmentally friendly mean of intensifying agricultural production encourages the development of market relations in Ukraine. This is a strategically promising direction for the development of both the agro-industrial complex and the economy as a whole, orienting them to leading positions in the global hierarchy of high-tech countries. Seeds are an important innovative and investment highly competitive product intended for sale in the domestic and world markets. It harmonizes the relationship between producers and consumers through scientific research on seed needs, ensuring that the range and production volumes meet existing needs, constantly improving the variety of structure and technologies, activating entrepreneurship, using marketing, and the latest achievements of economic opinion.

The article presents the results of studies on the effect of varieties, mineral fertilizers and microfertilizers on the efficiency of growing basic seeds of soft winter wheat, conducted at the Institute of Agriculture of the Carpathian Region of the National Academy of Agrarian Sciences of Ukraine in 2019–2021 on the influence of the variety, mineral fertilizers and microfertilizers on the efficiency of growing basic seeds of soft winter wheat. It was established that on the low-fertility soils of the Western Forest-Steppe zone the highest profitability (137.1–144.6 %) of elite seed production was obtained from the introduction of highly productive varieties included in the State Register of plant varieties suitable for distribution in Ukraine of the forest-steppe ecological type: MIP Vyshyvanka (originator – Myronov Institute of wheat, named after V. M. Remeslo of the National Academy of Sciences), Kvitka poliv (Bilotserkivska DSDS of the Institute of Bioenergy Crops and Sugar Beet of the National Academy of Sciences of Ukraine), Spivanka Poliska (National Scientific Center "Institute of Agriculture of the National Academy of Sciences of

Ukraine") and the optimal system of plant nutrition, including the rate of mineral fertilizers $N_{220}P_{90}K_{160}S_{28}$ application and plant nutrition with microfertilizers: oracul multicomplex and yaraVita Gramitrel (1.5 l/ha each) in phases BBCH 13 (three leaves), BBCH 32–37 (the second node – the last flag leaf).

The highest level of profitability in the production of seeds of winter wheat was provided by: varieties of the forest-steppe ecotype – MIP Vyshyvanka (originator – Myronov Institute of wheat, named after V. M. Remeslo of the National Academy of Sciences), Kvitka poliv (Bilotserkivska DSDS of the Institute of Bioenergy Crops and Sugar Beet of the NAAS of Ukraine), Spivanka Poliska (National Scientific Center "Institute of Agriculture of the NAAS of Ukraine") – respectively 144.6 %, 137.6 and 137.1 %, the rate of application of mineral fertilizers $N_{220}P_{90}K_{160}S_{28}$ and the application in the phase BBCH 29–31 (end of tillering – first node) of microfertilizers – 175.1 % (oracul multicomplex) and 176.0 % – yaraVita Gramitrel.

Keywords: wheat, variety, seeds, mineral fertilizers, microfertilizers, yield, profitability.

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Ефективність вирощування базового насіння пшениці м'якої озимої за різних агротехнологічних заходів

Підвищення рівня врожаю та валових зборів сільськогосподарських культур, основну частку яких становлять зернові, зокрема пшениця озима, яка у повному обсязі використовує природноресурсний потенціал районів країни, є головним завданням для аграрної науки. Розширення площ посівів зернових культур як ефективного та екологічно безпечного засобу інтенсифікації сільськогосподарського виробництва зумовлює розвиток ринкових відносин в Україні. Це є стратегічно перспективним напрямом розвитку як агропромислового комплексу, так і економіки в цілому, орієнтуючи їх на провідні позиції в світовій ієрархії високотехнологічних країн. Насіння виступає важливим інноваційно-інвестиційним висококонкурентним продуктом, призначеним для продажу на внутрішньому та світовому ринках, гармонізує взаємозв'язок між виробниками і споживачами через наукові дослідження, забезпечення відповідності асортименту та обсягів виробництва наявним запитам, постійне вдосконалення сортової структури і технологій, активізацію підприємництва, використання маркетингу та новітніх здобутків економічної думки.

Представлено результати досліджень, проведених в Інституті сільського господарства Карпатського регіону НААН у 2019–2021 рр., з впливу сорту, мінеральних добрив та мікродобрив на ефективність вирощування базового насіння пшениці м'якої озимої. Встановлено, що на низькородючих ґрунтах зони Західного Лісостепу найвищу рентабельність (137,1–144,6 %) вирощування насіння еліти отримано від впровадження в сільськогосподарське виробництво високопродуктивних сортів, внесених до

Державного реєстру сортів рослин, придатних для поширення в Україні, лісостепового екологічного типу: МІП Вишиванка (оригінатор – Миронівський інститут пшениці імені В. М. Ремесла НААН), Квітка полів (Білоцерківська ДСДС Інституту біоенергетичних культур і цукрових буряків НААН), Співанка Поліська (Національний науковий центр «Інститут землеробства НААН») та оптимальної системи живлення рослин, яка включає норму внесення мінеральних добрив $N_{220}P_{90}K_{160}S_{28}$ і позакореневе підживлення рослин мікродобривами: оракул мультикомплекс і яраВіта Грамітрел (по 1,5 л/га) у фази ВВСН 13 (три листки), ВВСН 32–37 (другий вузол – останній прапорцевий листок).

Найвищий рівень рентабельності виробництва насіння пшениці озимої забезпечили: сорти лісостепового екотипу – МІП Вишиванка (оригінатор – Миронівський інститут пшениці імені В. М. Ремесла НААН), Квітка полів (Білоцерківська ДСДС Інституту біоенергетичних культур і цукрових буряків НААН), Співанка Поліська (Національний науковий центр «Інститут землеробства НААН») – відповідно 144,6 %, 137,6 і 137,1 %, норма внесення мінеральних добрив $N_{220}P_{90}K_{160}S_{28}$ – 161,7 % та позакореневе внесення в фазі ВВСН 29–31 (кінець кущіння – перший вузол) мікродобрив – 175,1 % (оракул мультикомплекс) та 176,0 % – яраВіта Грамітрел.

Ключові слова: пшениця, сорт, насіння, мінеральні добрива, мікродобрива, врожайність, рентабельність.

Introduction. In the context of the national economy development, effective seed production is a strategic issue. The industry that realizes the genetic potential of the formed varietal plant resources of the state is the guarantee of the further growth of agricultural production. It is her task to produce competitive seed products that would meet the consumer's purchasing power on the domestic and foreign markets and would be profitable for the producer [1, 11, 12].

The efforts of a number of countries are focused on providing domestic needs for seeds, planting material and increasing exports, in particular: Germany with a share of 44.4 % of world sales, the USA – 24.8 %, China – 12.0 %, France – 8.3 %, the Netherlands – 4.3 % [31, 32].

The largest producer of seeds in Ukraine is the National Academy of Agrarian Sciences. 550 varieties and 87 hybrids are cultivated in 46 scientific institutions and 135 research farms. Annually, more than 5,000 tons of additional basic seeds of primary links, 60,000 tons of basic seeds, 1,100 tons of parental forms of hybrids of corn, sunflower, sugar beet, sorghum, 70–80 tons of vegetable seeds and more than 100 tons of melon crops, 20,000 tons of basic potato seeds, 1.5 million pieces of seedlings of fruit crops, 1.5 million pieces of grape seedlings, as well as seeds and seedlings of other crops [15].

Up to 2.5–3.0 million tons of high-quality seeds of various types of grain crops are produced annually, of which 1.5–1.8 million tons are winter grains and 1.0–1.2 million tons of spring grains, of which 60 % of domestic selection [4].

The high level of improvement in the creation of high-yielding varieties of agricultural crops by domestic breeding institutions and the production of a sufficient number of seeds are convincing factors of the overestimation of the real productivity of foreign varieties and their seed material. The importance of the variety also increases under the condition of effective use of those that have passed the state test, entered in the "State Register of Plant Varieties Suitable for Distribution in Ukraine" and recommended by scientific institutions for distribution in the appropriate soil and climate zone [14, 17, 19, 22].

Variety replacement and variety renewal play an increasingly important role. The production of seeds at the expense of a new variety is economically profitable, under the conditions of a scientifically based cultivation technology that takes into account natural factors and elements of varietal agrotechnics. The greatest value comes from those varieties that respond positively to intensive technology, are able to pay back the spent energy costs and meet the social demand of the producer [16, 24, 30].

The significance of a single factor or agricultural technology of cultivation in the final share of the crop is quite difficult to single out and evaluate, however, a number of scientists estimate the influence of the variety and seeds at 25–35 %, while 10 % is allocated to the natural fertility of the soil, 15 % to weather factors, 10 % to soil cultivation, and fertilizers – 25, plant protection – 15 % [3, 18, 20, 26].

In the conditions of the market economy development, there is an increased demand of agricultural producers for the seeds of grain crops, which, being a product of scientific and technical progress, increases the efficiency of grain production, strengthens the competitiveness of business entities and is one of the determining factors in increasing the supply of commercial grain [5–8, 10].

The cost of seeds depends on the productivity of the variety and the technology of crop cultivation, which determine the economic evaluation and justify the wide implementation of the proposed agricultural measures at the final stage of scientific research [2, 9, 13, 21, 33].

The purpose of our research was to establish the economic efficiency of growing basic seeds of winter soft wheat varieties depending on the variety and the system of main and additional nutrition of plants in the Western Forest-Steppe zone.

Materials and methods. The research was conducted in the crop rotation of the Department of Seed Production and Seed Science of the Institute of Agriculture of the Carpathian Region of the National Academy of Sciences during 2019–2021.

The total area of the sown plot – 65 m^2, the accounting area – 50 m^2. Placement of options is systematic, repetition is three times.

Agricultural technology for growing soft winter wheat is generally accepted for culture in this zone. The predecessor is winter rapeseed. Seed sowing rates are 5.5 million seeds/ha. Sowing dates 25.09–15.10. Seeds' protection: poisoner – Vitavax 200 FF, 34 % v. s. k. (3.0 l/t); plants' protection: herbicides – Roundup, 48 % v.r. (4.0 l/ha) (2–3 weeks before plowing); Granstar, 75 % v.r. (0.025 g/ha); fungicide – Falcon Dow, k.e. (0.6 l/ha). The total area of the sown plot – 60 m^2, the accounting area – 50 m^2. Repetition – three times.

The objects of research were soft winter wheat varieties included in the "State Register of Plant Varieties Suitable for Distribution in Ukraine", in particular: Trudivnytsia Myronivska (control), MIP Vyshyvanka (Myroniv Institute of Wheat named after V. M. Remesla of the National Academy of Sciences); Gratsiia Bilotserkivska, Kvitka Poliv (Bilotserkivska DSDS of the Institute of Bioenergy Crops and Sugar Beet of the National Academy of Sciences); Vodohray, Spivanka Poliska (National Research Center "Institute of Agriculture of the National Academy of Sciences of Ukraine"), mineral fertilizer standards ($N_{90}P_{50}K_{90}S_{19}$, $N_{168}P_{70}K_{120}S_{21}$, $N_{220}P_{90}K_{160}S_{28}$), microfertilizers (oracul multicomplex, yaraVita Gramitrel).

Experiments were carried out according to the methodology of V. O. Ushkarenko, R. A. Vozhegova (2020) [27], phenological observations were determined by G. K. Fursov, D. I. Fursov, V. V. Sergeyeva (2004) [28]; phytopathological evaluation – according to V. P. Omeliuta, I. V. Hryhorovych, V. S. Chaban, and others. (1986) [23]; net productivity of photosynthesis – by N. V. Peterson, T. O. Chernomyrdina, E. K. Kuryliak (1993) [25]; economic efficiency – according to V. I. Shorban (2017) [29].

Results and discussion. The dependence of soft winter wheat yield on the soil and climatic conditions of cultivation in the Western Forest-Steppe is greater than in other zones. The low natural fertility of soils, their increased acidity, the washing regime, do not always give the opportunity to obtain the expected results. Breeding work with wheat is not carried out in the studied area, therefore grain producers purchase seed material of new varieties from the originator institutions of the Central Forest-Steppe,

Steppe. Under such conditions, varieties with high adaptability to local (zonal) conditions, resistance to abiotic stresses and the ability to ensure high and stable grain yield over the years are valuable.

In our experiments, the average yield of seeds by varieties varied from 4.12 to 4.34 t/ha with a difference between them of 0.02–0.14 t/ha (Table 1). The highest yield of seeds was formed by varieties in 2019 – 4.12–4.30 t/ha. The range of variation (R) by varieties was 0.02–0.60 t/ha, by years – 0.18–0.44 t/ha.

The phenotypic difference in seed yield was insignificant (0.24–0.31). The most stable to the influence of abiotic and biotic factors of the environment were the following cultivars: Grazia bilotserkivska ($\sigma = 0.10$), Spivanka Poliska ($\sigma = 0.15$), Kvitka poliv ($\sigma = 0.16$). Slight variability of seed yield, under the influence of environmental conditions, was recorded in the Grazia bilotserkivska variety (V = 0.20%), a much wider range of variation was observed in the Trudivnytsia myronivska variety (V = 6.2%). The range of variability of the variety Trudivnytsia myroniska was the highest (R = 0.60 t/ha), and Grazia bilotserkivska was the lowest (R = 0.02 t/ha). Based on the difference between the maximum and minimum seed yield, we determined the resistance of varieties to stressful growing conditions. A lower indicator was obtained in 2019 – R = 0.18 t/ha, which indicates higher stability of varieties and a wider range of adaptability.

Significant differences of winter wheat varieties in response to the soil and climatic conditions of the Western Forest-Steppe zone caused their different seed productivity, which affected the indicators of the economic efficiency of basic seed production. Depending on the productivity of the variety, at the price of the basic seed – 12.0 thousand UAH/t, the cost of sold seeds was 49.4–52.4 thousand UAH (Table 2). The cultivation costs amounted to 21.3 thousand UAH/ha, conditional net profit varied from 28.1 thousand UAH/t (Grazia bilotserkivska variety) to 30.8 thousand UAH/t (MIP Vyshyvanka). The cost price of 1 ton of seeds was in the range of 4.91–5.17 thousand UAH/t. The profitability of seed production of all varieties was high, but the highest (144.6 %) was provided by the MIP Vyshyvanka variety, and the lowest (131.9 %) by Grazia bilotserkivska.

1. Phenotypic stability and adaptive potential of soft winter wheat varieties by seed yield (2019–2021), t/ha

Variety, indicator	Yield for years, t/ha				σ	V, %	R	Nom	Sc	b_i
	2019	2020 (opt.)	2021 (min)	$\bar{x}$						
Trudivnytsia Myronivska (control)	4.16	4.49	3.89	4.18	7.2	6.2	0.60	96.9	3.6	0.69
MIP Vyshyvanka	4.30	4.57	4.15	4.34	4.8	4.8	0.41	220.8	4.0	0.81
Grazia Bilotserkivska	4.12	4.13	4.11	4.12	0.2	0.2	0.02	284.0	4.1	0.62
Kvitka poliv	4.20	4.45	4.01	4.22	5.3	5.3	0.45	175.2	3.8	0.70
Vodohrai	4.13	4.40	3.98	4.17	5.9	5.9	0.49	143.0	3.7	0.55
Spivanka Poliska	4.18	4.43	4.02	4.21	5.0	5.0	0.42	199.4	3.8	0.43
$LSD_{0,05}$	0.10	0.08	0.06				0.34	300.7		
X	4.18	4.41	4.01	4.20	0.29	4.7				
Mim	4.12	4.13	3.89	4.12	0.10	0.2				
Max	4.30	4.57	4.15	4.34	0.48	6.2				
R	0.18	0.44	0.27	0.22	0.38	6.0				

2. Economic assessment of the cultivation of soft winter wheat seeds depending on the variety (2019–2021)

Variety	Seed yield, t/ha	Cost of sold seeds, thousand UAH/ha	Amount of cultivation costs, thousand UAH/ha	Conditionally net profit, thousand UAH/ha	Cost of 1 ton of products, thousand UAH	Profitability	
						%	± to control
Trudivnytsia myronivska (control)	4,18	50.2	21.3	28.9	5.10	135.7	-
MIP Vyshyvanka	4.34	52.1	21.3	30.8	4.91	144.6	8.9
Grazia bilotserkivska	4.12	49.4	21.3	28.1	5.17	131.9	-3.8
Kvitka poliv	4.22	50.6	21.3	29.3	5.05	137.6	1.9
Vodohray	4.17	50.0	21.3	28.7	5.11	134.7	-1.0
Spivanka Poliska	4.21	50.5	21.3	29.2	5.06	137.1	1.4

Note. Background of mineral fertilizers $N_{168}P_{70}K_{120}S_{21.}$ Cost of 1 ton of winter wheat seeds in 2021 – UAH 12,000.

The use of mineral fertilizers in agriculture must meet the requirements of modern agriculture, providing the needs of agricultural crops in nutrients for crop formation and extended reproduction of soil fertility. Today, grain producers prefer new complex fertilizers, but they do not always get the expected results due to their high prices.

Over the years of research, the average seed yield of soft winter wheat varieties varied from 1.58 – in the control to 4.95 t/ha – in the option of applying mineral fertilizers in the norm $N_{220}P_{90}K_{160}S_{28}$ (Fig. 1).

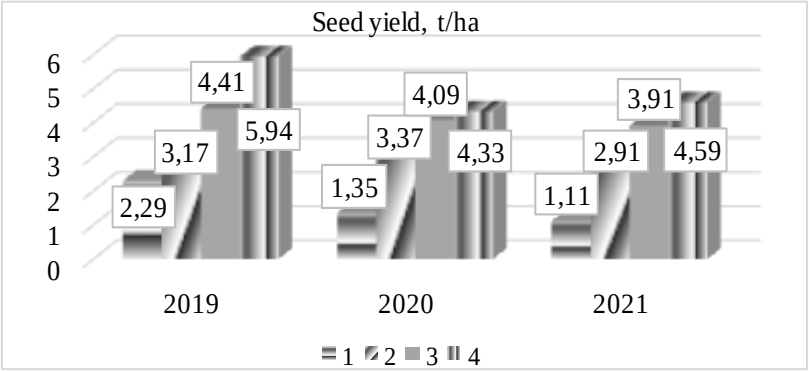

Fig. 1. Indicator of soft winter seeds' yield of wheat varieties depending on the rates of mineral fertilizer application (2019–2021)

Note. 1 – control (without fertilizers); 2 – $N_{90}P_{50}K_{90}S_{19}$; 3 – $N_{168}P_{70}K_{120}S_{21}$; 4 – $N_{220}P_{90}K_{160}S_{28}$.

3. Economic assessment of winter soft wheat seeds cultivation depending on the rates of mineral fertilizer application (2019–2021)

Rate of mineral fertilizers, d.r./ha	Seed yield, t/ha	Cost of realized seeds, thousand UAH	Cultivation costs, thousand UAH/ha	Conditionally net profit, thousand UAH/ha	Cost of 1 ton of products, thousand UAH	Profitability	
						%	± to control
Control (without fertilizers)	1.58	19.0	10.2	8.8	6.5	86.3	-
$N_{90}P_{50}K_{90}S_{19}$	3.14	37.7	19.8	17.9	6.3	90.4	4.1
$N_{168}P_{70}K_{120}S_{21}$	4.12	49.4	21.3	28.1	5.2	131.9	45.6
$N_{220}P_{90}K_{160}S_{28}$	4.95	59.4	22.7	36.7	4.6	161.7	75.8

Note. The cost of 1 ton of winter wheat seeds in 2021 prices is UAH 12,000.

Table data indicate the high economic efficiency of using mineral fertilizers in the production of winter wheat seeds. Depending on the obtained yield, the cost of the basic seed sold increased from 19.000 UAH/t

in the control (without fertilizers) to 59.400 UAH/t with the application of mineral fertilizers – $N_{220}P_{90}K_{160}S_{28}$. Under such options, the amount of expenses increased from 10.2 to 22.7 thousand UAH/ha, and the cost price decreased from 6.5 to 4.6 thousand UAH/t. The introduction of mineral fertilizers ensured a higher conditional net profit by 17.9–36.7 thousand UAH/ha and, accordingly, by 4.1–75.8 % profitability of basic seed production.

The system of fertilizing winter wheat is built on the principles of optimizing plant nutrition with the main macro- and microelements, due to which it is possible to regulate the needs of plants during the growing season.

The research data obtained confirmed that the increase in seed yield of varieties varied significantly depending on foliar feeding of plants with microfertilizers (Figs. 2, 3).

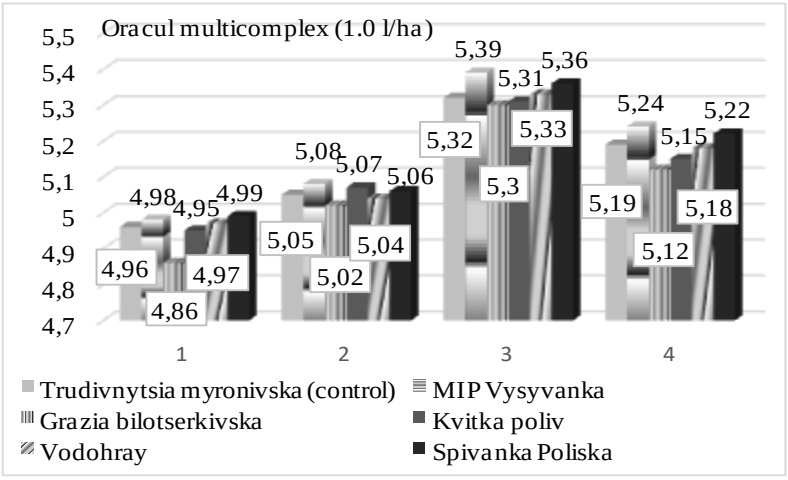

Fig. 2. Seed yield of soft winter wheat varieties depending on the period of foliar feeding of plants with microfertilizer oracul multicomplex (1.0 l/ha) (2019–2021), t/ha

Note. The level of mineral nutrition is $N_{220}P_{90}K_{160}S_{28}$. 1 – control (without microfertilizers); 2 – BBCH 13 (three leaves); 3 – BBCH 29–31 (end of tillering – first node); 4 – BBCH 32–37 (the second knot – the last flag leaf).

With the application of microfertilizers in the phase of BBCH 13 (three leaves), the increases were 0.10–0.14 t/ha, and the highest were for

foliar fertilization in the phase of BBCH 29–31 (end of tillering – first node) – 0.39–0.40 t/ha.

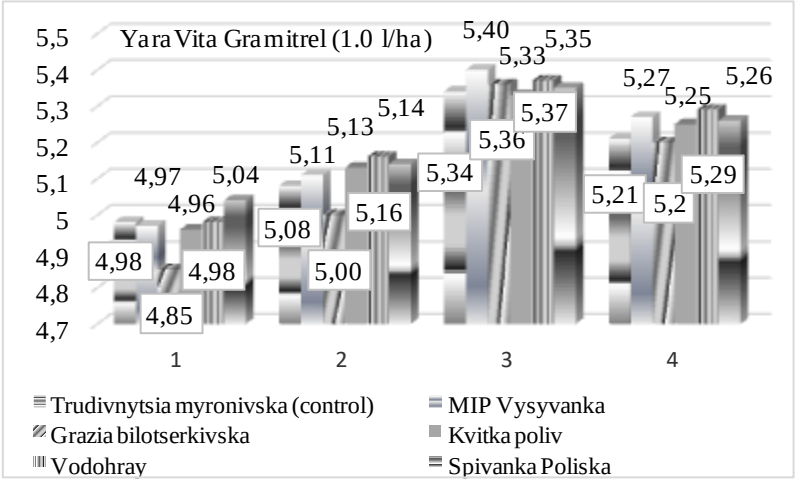

Fig. 3. Yield of seeds of soft winter wheat varieties depending on the period of foliar feeding of plants with microfertilizer yaraVita Gramitrel (1.0 l/ha) (2019–2021), t/ha

Note. The level of mineral nutrition is $N_{220}P_{90}K_{160}S_{28}$. 1 – control (without microfertilizers); 2 – BBCH 13 (three leaves); 3 – BBCH 29–31 (end of probing – first node); 4 – BBCH 32–37 (the second knot – the last flag leaf).

Economic calculations showed that according to the obtained highest seed yield (5.34 t/ha) for the application of oracul seed microfertilizer at the rate of 1.5 l/ha in phase 1 of the internode (BBCH 25–31), the cost of sold elite seeds was 64.1 thousand UAH by the incurred costs of cultivation 23.3 thousand UAH (Table 4).

Conditionally net profit compared to the control (without microfertilizers) was higher by 4.7 thousand UAH/ha, and the cost of 1 ton was lower by 0.29 thousand UAH. The introduction of micro-fertilizer oracul multicomplex in different development phases of soft winter wheat ensured a higher profitability of seed production by 3.2–18.2 % compared to the control.

4. Economic evaluation of the cultivation of winter soft wheat seeds depending on the use of microfertilizer oracul multicomplex by development phases (2019–2021)

Development phase	Seed yield, t/ha	Cost of sold seeds, thousand UAH	Cultivation costs, thousand UAH/ha	Conditionally net profit, thousand UAH/ha	Cost of 1 ton of products, thousand UAH	Profitability	
						%	± to control
Control (without microfertilizers)	4.95	59.4	23.0	36.1	4.65	156.9	-
BBCH 13 (three leaves)	5.05	60.6	23.3	37.3	4.61	160.1	3.2
BBCH 29–31 (end of tillering – first node)	5.34	64.1	23.3	40.8	4.36	175.1	18.2
BBCH 32–37 (second node – last flag leaf)	5.18	62.2	23.3	38.9	4.50	167.0	10.1

Note. In 2021 prices, the cost of micro-fertilizer oracul multicomplex is 190.00 UAH/l.

Foliar application of microfertilizer yaraVita Gramitrel (1.5 l/ha) in the phase of BBCH 13 (three leaves) ensured a higher cost of sold seeds by 1.7 thousand UAH/ha compared to the control (without microfertilizers), in the phase of BBCH 25–31 (end of tillering – first node) – by 4.8 thousand UAH/ha, and in BBCH 32–37 (second node – last flag leaf) by 2.8 thousand UAH/ha (Table 5). When applied BBCH 29–31 (end of tillering – first node), the cost price of a ton of elite compared to the control (without microfertilizer) was lower – by 0.29 thousand UAH, and the level of profitability was the highest – 176.0 %.

5. Economic evaluation of the cultivation of winter soft wheat seeds depending on the use of microfertilizer yaraVita Gramitrel in different development phases (2019–2021)

Development phase	Seed yield, t/ha	Value of sold seeds thousand UAH	Cultivation costs, thousand UAH/ha	Conditional net income thousand UAH/ha	Cost of 1 ton of products, thousand UAH	Profitability	
						%	± to control
Control (without microfertilizers)	4.96	59.5	23.0	36.5	4.64	158.7	-
BBCH 13 (three leaves)	5.10	61.2	23.3	37.9	4.57	162.7	4.0
BBCH 29–31 (end of tillering – first node)	5.36	64.3	23.3	41.0	4.35	176.0	17.3
BBCH 32–37 (second node – last flag leaf)	5.25	63.0	23.3	39.7	4.44	170.4	11.7

Note. In 2021 prices, the cost of yaraVita Gramitrel microfertilizer is UAH 218.00/l.

The average rate of profitability for both microfertilizers in the control (without the application of microfertilizers) was the lowest – 158.7 % and increased by 6.6–17.8 % when they were applied in different phases (Table 6). The efficiency of the microfertilizer yaraVita Gramitrel in comparison to oracul multicomplex was slightly higher by 0.9–3.4 %.

Comparative efficiency of microfertilizers in terms of profitability of basic seed production of soft winter wheat (2019–2021) in comparison, the oracle multicomplex was slightly higher by 0.9–3.4 %.

6. Comparative efficiency of microfertilizers in terms of profitability of basic seed production of soft winter wheat (2019–2021)

Culture development phase	Microfertilizer				Average		Differences by micro-fertilizers
	oracul multicomplex (control)		yaraVita Gramitrel		%	± to control	
1	2		3		4	5	6
Control (without microfertilizers)	156.9	-	158.7	-	157.8	-	1.8

1	2		3		4	5	6
BBCH 13 (three leaves)	160.1	3.2	162.7	4.0	164.4	6.6	2.6
BBCH 29–31 (end of tillering – first node)	175.1	18.2	176.0	17.3	175.6	17.8	0.9
BBCH 32–37 (second node – last flag leaf)	167.0	10.1	170.4	11.7	168.7	10.9	3.4
LSD_{05}	8.5		6.0				

Conclusions

1. The level of efficiency of economic activity of seed enterprises is largely determined by the profitability of seed production of grain crops. Calculations of the economic efficiency of growing basic seeds of soft winter wheat varieties using various elements of technology allow us to state that the variety and quality seeds are the main factors in increasing the profitability of any farm. In the Western Forest-Steppe zone of Ukraine, the profitability of seed production for the cultivation of highly productive ecologically plastic varieties of the forest-steppe ecotype – MIP Vyshyvanka, Kvitka poliv, Spivanka poliska was: 144.6 %, 137.6 and 137.1 %.

2. Due to the application of mineral fertilizers, the conditional net profit per hectare increased by 27.9 thousand UAH, and the cost of the elite decreased by 1.9 thousand UAH/t. The highest profitability was provided by the norm $N_{220}P_{90}K_{160}S_{28}$ – 161.7 %, which is higher than the control (without fertilizers) by 75.8 %.

3. Foliar application of microfertilizers (oracul multicomplex and yaraVita Gramitrel at 1.5 l/ha each) in the phase of BBCH 29–31 (end of tillering – first node) was the most cost-effective in both forms, providing a 12.2 % higher level of profitability compared with the introduction phase in BBCH 13 (three leaves) and by 6.9 % in BBCH 32–37 (second node – last flag leaf).

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