СЕКЦІЯ 4
ЕКОНОМІКА ТА УПРАВЛІННЯ ПІДПРИЄМСТВАМИ

UDC 338.31:631.816.12:633.16
DOI: https://doi.org/10.32840/2522-4263/2020-4-4

Gyrka Anatoliy
Doctor of Agricultural Sciences, Professor,
Deputy Director for Research
SE The Institute of Grain Crops of National Academy of Agrarian Sciences of Ukraine

Kompaniets Viktoriya
Candidate of Economic Sciences, Senior Research Fellow,
Head of the Laboratory of Economics
SE The Institute of Grain Crops of National Academy of Agrarian Sciences of Ukraine

Kulik Alla
Chief Specialist of the Laboratory of Economics
SE The Institute of Grain Crops of National Academy of Agrarian Sciences of Ukraine

Гирка А.Д.
доктор сільськогосподарських наук, професор,
заступник директора з наукової роботи
Державної установи «Інститут зернових культур Національної академії аграрних наук України»

Компанієць В.О.
кандидат економічних наук, старший науковий співробітник,
завідувач лабораторії економіки
Державної установи «Інститут зернових культур Національної академії аграрних наук України»

Кулик А.О.
головний фахівець лабораторії економіки
Державної установи «Інститут зернових культур Національної академії аграрних наук України»

ECONOMIC EFFICIENCY OF APPLICATION OF FOLIAR FERTILIZATIONS IN THE TECHNOLOGY OF GROWING SPRING BARLEY IN THE CONDITIONS OF THE NORTHERN STEPPE OF UKRAINE

ЕКОНОМІЧНА ЕФЕКТИВНІСТЬ ЗАСТОСУВАННЯ ПОЗАКОРЕНЕВИХ ПІДЖИВЛЕНЬ В ТЕХНОЛОГІЇ ВИРОЩУВАННЯ ЯРОГО ЯЧМЕНЮ В УМОВАХ ПІВНІЧНОГО СТЕПУ УКРАЇНИ

ANNOTATION

The results of economic evaluation of the effectiveness of foliar fertilizations of plants in the technology of growing spring barley in the Northern Steppe of Ukraine are presented in the article. The experimental part of agrotechnological researches has been carried out on the basis of the Erastivka Experimental Station of SE The Institute of Grain Crops of National Academy of Agrarian Sciences of Ukraine. The variants for foliar fertilizations of spring barley with nitrogen fertilizers (ammonium nitrate) and humic preparation Humisol Plus, depending on the background of nutrition, periods of crop processing in different phases of plants development and dosage of fertilization have been studied. According to the results of the economic assessment, the most effective variants of foliar fertilizations in terms of yield, production cost of grain, the amount of net income per 1 hectare and the level of profitability, which can be recommended for implementation into production, are revealed.

Keywords: spring barley, technology, fertilizers, foliar fertilizations of plants, yield, cost, profitability.

АНОТАЦІЯ

В сучасних умовах зернове виробництво не втрачає свого стратегічного значення для економіки країни. Ефективне його функціонування створює міцний фундамент для забезпечення продовольчих потреб населення, розвитку кормової бази тваринництва та забезпечення сировиною переробної промисловості. Однією з провідних зернофуражних культур в Україні є ярий ячмінь. Аналіз динаміки показників його врожайності свідчить, що в посушливих умовах Степу України, яка є зоною ризикованого землеробства, генетичний потенціал сортів ярого ячменю реалізується недостатньо, що передусім пов'язано з порушеннями технологічного регламенту вирощування даної культури та низьким рівнем використання технологічних заходів підвищення адаптивної спроможності рослин до несприятливих природних факторів. Одним з визначальних факторів формування зернової продуктивності та високих економічних показників у вирощуванні ярого ячменю є забезпечення оптимального режиму живлення. В умовах змін клімату,

впровадження прогресивних селекційних досягнень та інших елементів адаптивних технологій, зокрема, методів органічного землеробства, важливим питанням є розробка раціональних систем удобрення, які передбачають поєднання основного фону живлення з позакореневими підживленнями рослин як твердими мінеральними добривами (аміачною селітрою), так і рідкими гуміновими препаратами (Гумісол Плюс). В статті наведені результати економічної оцінки експериментальних досліджень з вивчення ефективності застосування позакореневих підживлень в технології ярого ячменю, проведених на базі Ерастівської дослідної станції ДУ Інституту зернових культур НААН України. Проаналізовані отримані показники врожайності ярого ячменю, виробничих витрат в розрахунку на 1 га посіву і на 1 т продукції, чистого доходу в розрахунку на 1 га та рівня рентабельності для різних варіантів позакореневих підживлень, диференційованих за нормами і строками застосування (залежно від фази розвитку рослин) для удобреного та неудобреного фонів живлення. Визначені найбільш ефективні з точки зору врожайності та економічної ефективності варіанти застосування позакореневих підживлень рослин ярого ячменю аміачною селітрою і препаратом Гумісол Плюс, які можуть бути рекомендовані для впровадження у виробництво.

Ключові слова: ячмінь ярий, технологія, добрива, позакореневі підживлення рослин, урожайність, собівартість, рентабельність.

АННОТАЦИЯ

В статье представлены результаты экономической оценки эффективности применения внекорневых подкормок растений в технологии выращивания ярового ячменя в условиях северной Степи Украины. Экспериментальная часть агротехнологических исследований проводилась на базе Эрастовской опытной станции ГУ Института зерновых культур Национальной академии аграрных наук Украины. Были изучены варианты проведения внекорневых подкормок ярового ячменя азотными удобрениями (аммиачной селитрой) и гуминовым препаратом Гумисол Плюс в зависимости от фона питания, сроков обработки посевов в разные фазы развития растений и норм внесения удобрений. По результатам экономической оценки выявлены наиболее эффективные с точки зрения урожайности, производственной себестоимости зерна, суммы чистого дохода с 1 гектара и уровня рентабельности варианты внекорневых подкормок, которые могут быть рекомендованы для внедрения в производство.

Ключевые слова: яровой ячмень, технология, удобрения, внекорневые подкормки растений, урожайность, себестоимость, рентабельность.

Problem statement. The study of the state of development of the grain sector has shown that the gross harvest of grain crops in both Ukraine and the very Steppe zone is formed by growing three main crops such as winter wheat, spring barley and maize, among which the priority importance belongs to wheat. Until 2010, the second place in terms of sizes of production constantly belonged to spring barley, and only starting from 2011–2012 orientation to market demand has caused a reduction in its sowings in favour of a sharp expansion of maize acreage. For the period 2011–2019 the harvested areas of spring barley in the Steppe zone of Ukraine decreased from 1.7 million hectares in 2.35 times and over the past three years they have stabilized at the level of 0.7–0.9 million hectares. The analysis of the dynamics of spring barley productivity indicates that its yield potential is not sufficiently realized in the conditions of the Steppe zone of Ukraine, which is characterized by a large number of limiting natural and climatic factors. Thus, during 2001–2019, the minimum yield of this crop was 0.89 t/ha in 2007, and the maximum productivity was 2.72 t/ha in 2008. Fluctuations in the productivity of spring barley are on the one hand the consequences of adverse weather and climate conditions and on the other hand the results of violations of technological regulation for its cultivation.

In technology of growing spring barley, an important place belongs to ensuring optimal plant nutrition. In the conditions of climate change and the introduction of adaptive farming systems, the optimization of dosage and methods for applying mineral fertilizers, as well as the use of alternative preparations of organic origin in order to increase productivity of spring barley and improve quality of grain, becomes an urgent issue.

Analysis of recent research and publications. Scientific and methodological issues of grain production efficiency, problems of theory and practice of intensification of the sector are embodied in the works of A. Babych-Poberezhna, O. Bodnar, V. Boiko, P. Haidutskyi, O. Zakharchuk, L. Kurilo, A. Lysetskyi, M. Lobas, Z. Nikolaieva, P. Sabluk, V. Saiko, V. Sytnik, O. Shpychak and others. A significant contribution to the study of effectiveness of scientifically based technologies and progressive agrotechnical measures for growing spring barley in the Steppe zone of Ukraine has been made by such researchers as O. Bochevar [1; 2], O. Gaidenko [3; 4], O. Dudka [5], O. Ilienko [1; 2], V. Ishchenko [3; 4], V. Kamins'ka [5], G. Kozelets [3; 4], E. Lebid, F. Liorinets, A. Musatov, B. Mushik [5], I. Pabat, Yu. Sydorenko [1; 2], A. Cherenkov, M. Shevchenko, etc.

In the context of climate changes, improving the quality of varietal resources of spring barley and requirement to develop alternative adaptive technologies for its cultivation, including the use of organic farming methods, there is a need for further research on the rational use of fertilizers for foliar fertilization of plants with mineral fertilizers (ammonium nitrate) and liquid humic preparations in order to increase the efficiency of production of spring barley grain in arid conditions of the Steppe zone of Ukraine.

Formulation of purposes of the article. The purpose of this article is to ground the directions for increasing efficiency of spring barley grain production based on optimizing the dosage and terms of foliar fertilization of plants.

Statement of the main research material. The economic assessment of effectiveness of foliar fertilizations in technology of growing spring barley has been based on the use of experimental data obtained from the researches which have been conducted during 2017–2019 on the basis of the Erastivka Experimental Station of SE The Institute of Grain Crops of NAAS of Ukraine, which geographically belongs to the zone of the Northern Steppe of Ukraine. The field

experiment was placed in a six-field crop rotation after winter wheat with the use of traditional tillage technology. In the experiments, the Stalker variety, which is zoned for the Steppe zone, has been sown. According to the scheme of the experiment, the fertilization of the crop with ammonium nitrate, as well as spraying of plants with humic preparation Humisol Plus was provided. Grounding norms of expenses for the production of barley grain has been carried out on the basis of composed technological maps of cultivation, prices for material and technical resources and spring barley grain, which were the actual in the second quarter of 2020. Calculations have been performed for the natural climate conditions of the Northern Steppe zone of Ukraine with the use of existing methodical recommendations [6–8].

The data of Table 1 indicate that the use of nitrogen fertilizing in doses and terms, which have been provided by the scheme of experiment, has led to an increase in the productivity of spring barley and rising the profitableness of its cultivation on the both studied backgrounds.

It should be noted that the cultivation of spring barley without the use of fertilizers (Tables 1–2) allows only to balance on the verge of break-even with the profitability level of 2.7 %, and in another experiment with the Humisol Plus fertilizer it even allows to get losses (-0.3 %). If additional expenses related to the sale of grain, which may reach 5–10 % of the production cost of product, are incurred, the amount of losses may increase to 317–614 UAH per hectare.

Comparison of control variants of the both experiments has revealed the effectiveness of the basal fertilization at a dose of $N_{30}P_{30}K_{30}$, which provided an increase in the yield of barley by 86.7–87.2 %, a reduction in the cost of production by 23.4–23.7 % and an increase in the level of profitability from -0.3–2.7 % to 30.1–34.7 % (Tables 1–2). In general, it can be argued that in the both experiments, applying Nitroammophoska at a dose of $N_{30}P_{30}K_{30}$ for preseeding cultivation

Table 1

Economic efficiency of foliar fertilization of plants with ammonium nitrate in the technology of growing spring barley

Variants of experiment	Yield, tons per 1 ha	Production expenses, UAH per 1 ha	Cost of 1 ton of grain, UAH	Net income from 1 ha, UAH	Level of profitability, %
Without background fertilizing					
Control variant (without fertilization)	1.41	6195	4394	170	2.7
Fertilization in the shoot phase:					
N_{15}	1.67	6731	4031	807	12.0
N_{30}	1.85	7161	3871	1190	16.6
N_{45}	2.06	7618	3698	1681	22.1
Fertilization in the tillering phase:					
N_{15}	1.65	6713	4068	735	11.0
N_{30}	1.83	7142	3903	1118	15.7
N_{45}	2.01	7572	3767	1502	19.8
Fertilization in the phase of forming stem:					
N_{15}	1.57	6638	4228	449	6.8
N_{30}	1.75	7067	4039	832	11.8
N_{45}	1.95	7516	3854	1287	17.1
$N_{30}P_{30}K_{30}$					
Control variant (without fertilization)	2.64	8849	3352	3068	34.7
Fertilization in the shoot phase:					
N_{15}	3.02	9497	3145	4135	43.5
N_{30}	3.13	9861	3151	4267	43.3
N_{45}	3.40	10375	3051	4973	47.9
Fertilization in the tillering phase:					
N_{15}	3.00	9479	3160	4063	42.9
N_{30}	3.09	9824	3179	4124	42.0
N_{45}	3.38	10356	3064	4901	47.3
Fertilization in the phase of forming stem:					
N_{15}	2.84	9329	3285	3490	37.4
N_{30}	3.03	9768	3224	3909	40.0
N_{45}	3.26	10244	3142	4471	43.6

Table 2

Economic efficiency of foliar fertilization of plants with the Humisol Plus preparation in the technology of growing spring barley

Variants of experiment	Yield, tons per 1 ha	Production expenses, UAH per 1 ha,	Cost of 1 ton of grain, UAH	Net income from 1 ha, UAH	Level of profitability, %
Without background fertilizing					
Control variant (without fertilization)	1.35	6114	4529	-21	-0.3
Fertilization in the shoot phase:					
0.5 l/ha	1.56	6422	4117	620	9.6
1.0 l/ha	1.76	6677	3793	1268	19.0
1.5 l/ha	1.76	6744	3832	1201	17.8
Fertilization in the tillering phase:					
0.5 l/ha	1.56	6422	4117	620	9.6
1.0 l/ha	1.66	6583	3966	910	13.8
1.5 l/ha	1.75	6735	3848	1165	17.3
Fertilization in the phase of forming stem:					
0.5 l/ha	1.45	6320	4358	226	3.6
1.0 l/ha	1.65	6574	3984	874	13.3
1.5 l/ha	1.63	6623	4063	735	11.1
$N_{30}P_{30}K_{30}$					
Control variant (without fertilization)	2.52	8743	3469	2632	30.1
Fertilization in the shoot phase:					
0.5 l/ha	2.59	8920	3444	2771	31.1
1.0 l/ha	2.65	9044	3413	2918	32.3
1.5 l/ha	2.70	9158	3392	3030	33.1
Fertilization in the tillering phase:					
0.5 l/ha	2.52	8855	3514	2521	28.5
1.0 l/ha	2.67	9062	3394	2990	33.0
1.5 l/ha	2.68	9139	3410	2958	32.4
Fertilization in the phase of forming stem:					
0.5 l/ha	2.52	8855	3514	2521	28.5
1.0 l/ha	2.60	8997	3460	2739	30.4
1.5 l/ha	2.62	9083	3467	2744	30.2

has been effective and compensated by the value of growth of the yield of spring barley, regardless of the types, doses and terms of foliar fertilization.

The study of the differentiation of nitrogen fertilizations by the terms of their application (Table 1) has showed that the highest efficiency on both studied backgrounds of nutrition has been provided by carrying out of foliar fertili-zations in the shoot phase, where in comparison with the control variant, the yield increases of 0.26–0.65 t/ha (or 18.4–46.1 %) have been obtained against a background without application of fertilizers and 0.38–0.76 t/ha (or 14.4–28.9 %) when there have been applied $N_{30}P_{30}K_{30}$. When fertilizing has been carried out in the shoot phase, the level of profitability was 12.0–22.1 % for variants on an unfertilized background and 43.5–47.9 % on a fertilized one.

Applying the fertilization with ammonium nitrate in the tillering phase has been provided smaller increases in yield and ensured the formation of a level of profitability of 11.0–19.8 % against an unfertilized background and 42.9–47.3 % when applying $N_{30}P_{30}K_{30}$. The lowest efficiency indicators have been formed in the variants where the foliar fertilization was carried out in the phase of forming stem.

According to the research results, the best indicators of productivity and paying on expenses have been formed in the variants where the fertilization has been carried out at the highest dose (N_{45}).

According to the indicators of spring barley productivity, income per hectare of sowing and profitability, the recommended variants may be those where the foliar fertilization with ammonium nitrate at a dose of N_{45} was carried out in the shoot phase and in the tillering phase. Against the background without fertilizers, this measure has provided an increase in productivity to 2.06 and 2.01 t/ha (by 46.1 and 42.6 %), a reduction in the cost of production of 1 ton of grain

by 15.8 and 14.3 %, and obtaining an additional 1511 and 1332 UAH/ha of net income at the level of profitability of 22.1 and 19.8 %, respectively. On a fertilized background ($N_{30}R_{30}K_{30}$) the foliar fertilization at a dose of 45 kg of nitrogen in the shoot phase and in the tillering phase has provided a lower growth rate of yield compared to the control variant (by 28.8 and 28.0 %), but for yields of 3.40 and 3.38 t/ha, the application of this measure has allowed to obtain, respectively, 4.97 and 4.90 thousand UAH of net income per hectare and 0.47–0.48 UAH per 1 UAH of production expenses.

In modern conditions, the importance of implementing adaptive systems of agriculture and crop production, as well as organic farming methods aimed at reducing the chemical load on a hectare of land in parallel with the use of effective biological methods to increase soil fertility is increasing.

Gumisol is a unique fertilizer that is produced from vermicompost, i.e. the product of processing cattle manure by *Eisenia fetida* worms. Vermicompost itself is a valuable organic fertilizer, and preparations based on it retain all the useful properties of raw materials. They include humic substances, macro- and microelements, natural growth stimulants (phytohormones), amino acids and vitamins, and agronomically useful microflora [9].

In experimental researches, effectiveness of the Humisol Plus preparation in foliar fertilizations of spring barley plants has been studied. According to research results, it has been revealed that the best response to the use of organic fertilizer Humisol Plus spring barley plants has been in conditions of their cultivation on a background without fertilizers. A pronounced positive reaction to foliar fertilization has been observed even at the minimum expenditure rates of the Humisol Plus (0.5 l/ha). Yield increases relative to the control variant have ranged from 0.10 t/ha (7.4 %) when spraying crops in the phase of forming stem with the rate of 0.5 l/ha to 0.41 t/ha (30.4 %) according to the norms of expenses of the preparation of 1.0 and 1.5 l/ha when fertilizing barley plants was performed in the shoot phase. Profitability indicators against an unfertilized background have been formed at a low level and ranged from 3.6 to 19.0 %.

Analysis of agrotechnical timing of fertilizing barley crops has showed a slight advantage of variants where the works have been carried out in the shoot phase. Close to them in terms of efficiency there have been the variants where the spraying of plants has been carried out in the tillering phase. The smallest increases in yield, the lowest indicators of profitableness and cost payback have been formed when fertilizing crops has been performed in the phase of forming stem. This situation is typical for both the unfertilized background of nutrition and for variants where Nitroammophoska has been applied at a dose of $N3_0P_{30}K_{30}$.

Against a background without fertilizers, the recommended variant can be considered, where spring barley crops has been sprayed with the organic fertilizer Humisol Plus at the rate of 1.0 l/ha in the shoot phase where additional 1289 UAH/ha of net income were obtained at the level of profitability of 19.0 % by reducing the cost of production of 1 ton of grain by 16.3 % and increasing the yield by 30.4 %. Similar in terms of efficiency, there are also variants of fertilization of barley crops with this preparation at the rate of 1.5 l/ha in the shoot phase as well as 1.5 l/ha in the tillering phase where 1165–1268 UAH of net income have been obtained per 1 ha of sowing and 0.17–0.18 UAH per 1 UAH of production expenses.

According to the research results, opportunities for increasing the profitableness and implementing expanded reproduction of production appear only on a fertilized background where the level of profitability increases from 3.6–19.0 % to 28.5–33.1 %. However, it should be noted that the yield increases from the use of humic preparation Humisol Plus in a case of applying fertilizers in absolute and relative terms were significantly less than on a background without fertilizers, and ranged from 0 to 0.18 t/ha (or 0–7.1 %). The use of minimum expenditure rates of the studied preparation has not provided sufficient productivity increases for spring barley and in the variants of fertilization in the tillering and forming stem phases even led to a loss of net income and a decrease in the level of profitability from 30.1 to 28.5 % in comparison with the control variant due to raising the unit product cost by 1.3 %.

The best variant that can be recommended for implementation into production is the spraying of spring barley crops with the Humisol Plus preparation at the rate of 1.5 l/ha, where at the cost of 3392 UAH/t, a net income of 3.03 thousand UAH/ha and 0.33 UAH per 1 UAH of production expenses has been received. Among the variants that are similar in terms of yield and efficiency, it can distinguish the variants with introduction of the Humisol Plus preparation at the rate of 1.0 l/ha in the shoot phase, as well as 1.0 and 1.5 l/ha in the tillering phase. Here, with a yield of 2.65–2.68 t/ha, it is possible to get 2.92–2.99 thousand UAH/ha of net income at the level of profitability of 32.3–33.0 %.

Conclusions. According to the results of experimental researches, it is revealed that the best conditions for realizing the yield potential of spring barley and achieving a high level of cost payback are created in terms of providing a favourable background of nutrition. The main conclusions and recommendations for production are the next:

1. Growing spring barley without the use of fertilizers in the best case allows only balancing on the verge of break-even with a level of

profitability of -0.3–2.7 %, which with additional expenses related to the sale of grain can lead to losses in the amount of 317–614 UAH/ha.

2. The reaction of spring barley plants to fertilizing with ammonium nitrate and the Humisol Plus preparation is the best against an unfertilized background, but the highest indicators of productivity and economic efficiency are formed against the background of applying $N_{30}P_{30}K_{30}$ for preseeding cultivation.

3. When processing crops with nitrogen fertilizers, the recommended variants may be where the foliar fertilization with ammonium nitrate at a dose of N45 has been carried out in the shoot phase and in the tillering phase. Against the background without fertilizers, this measure has been provided an increase in productivity by 46.1 and 42.6 %, a reduction in the cost of production of 1 ton of grain by 15.8 and 14.3 %, and an additional 1511 and 1332 UAH/ha of net income at the level of profitability of 22.1 and 19.8 %, respectively. On a fertilized background the foliar fertilization at a dose of 45 kg of nitrogen in the shoot phase and in the tillering phase with a yield of 3.40 and 3.38 t/ha has allowed to obtain respectively 4.97 and 4.90 thousand UAH of net income per hectare of sowing at the level of profitability of 47.9 and 47.3 %.

4. The use of the Humisol Plus is promising from the point of view of reducing chemical load on a hectare of land in the context of implementing adaptive farming systems, increasing the yield of spring barley, net income per a hectare of land and payback of production expenses. At the same time, the real opportunities for extended reproduction of production appear only on a fertilized background, where the level of profitability increases from 3.6–19.0 % to 28.5–33.1 %.

5. As the best recommended variant it can be considered the spraying of spring barley crops with Humisol Plus preparation at the rate of 1.5 l/ha, where with a yield of 2.70 t/ha, a net income of 3.03 thousand UAH per 1 ha has been obtained at a level of profitability of 33.1 %. Among the variants that are similar in terms of yield and efficiency, it can distinguish variants with applying the Humisol Plus preparation at the rate of 1.0 l/ha in the shoot phase, as well as 1.0 and 1.5 l/ha in the tillering phase.

Innovative technical and technological development of grain production, progressive achievements in selection and development of new preparations to increase soil fertility in the system of organic farming will determine the continuation of experimental agrotechnological and economic researches to ground the ways to improve the efficiency of spring barley grain production.

REFERENCES:

1. Gyrka A.D., Tkalich I.D., Sydorenko Yu.Ya., Bochevar O.V., Ilienko O.V. (2017) [Comparative productivity of spring and alternative barleys depending on agricultural measures of growing]. *Zernovi kultury,* vol. 1, no. 2, pp. 262–269.
2. Gyrka A.D., Tkalich I.D., Sydorenko Yu.Ya., Bochevar O.V., Ilienko O.V. (2017) *Reaktsiia yaroho yachmeniu na mulchuvannia, dobryva ta shyrynu mizhriad.* [Reaction of spring barley to mulching, fertilizers and row spacing]. *Ahronom,* no. 2 (56), pp. 92–96.
3. Kozelets G.M., Ischenko V.A., Gaidenko O.M. *Ekonomichna otsinka prybutkovosti yachmeniu* [Economic assessment of barley profitability]. Available at: http://agro-business.com.ua/agro/ahronomiia-sohodni/item/15375-ekonomichna-otsinka-prybutkovosti-iachmeniu.html (accessed 15 August 2020).
4. Gaidenko O.M., Ishchenko V.A., Kozelets G.M. *Efektyvne vyroshchuvannia yachmeniu yaroho: naukove doslidzhennia* [Effective cultivation of spring barley: scientific research]. Available at: http://agro-business.com.ua/agro/ahronomiia-sohodni/item/636-efektyvne-vyroshchuvannia-iachmeniu-iaroho-naukove-doslidzhennia.html (accessed 15 August 2020).
5. Kamins'ka V.V., Dudka O.F., Mushik B.V. (2016) Produktyvnist yachmeniu yaroho za riznykh tekhnolohii vyroshchuvannia [Productivity of spring barley by various technologies of cultivation]. *Zbirnyk naukovykh prats NNTs «Instytut zemlerobstva NAAN»,* vol. 3–4, pp. 114–122.
6. Sabluk P.T., Mazorenko D.I., Mazniev H.Ye. (2008) *Tekhnolohii vyroshchuvannia zernovykh i tekhnichnykh kultur v umovakh Lisostepu Ukrainy* [Technologies for growing cereals and industrial crops in the Forest-Steppe conditions of Ukraine]. Kyiv: NNTs IAE. (in Ukrainian)
7. Cherenkov, A.V., Ribka, V.S., Kompaniets V.O., et al. (2017) *Normatyvno-metodychnyi dovidnyk po obgruntuvanniu vyrobnychykh zatrat v zernovomu hospodarstvi Stepu Ukrainy* [Normative-methodical reference book on substantiation of production costs in the grain economy of the Steppe of Ukraine]. Dnipro: DU Instytut zernovykh kultur NAAN Ukrainy. (in Ukrainian)
8. Sabluk, P.T., Mel'nyk, Yu.F., Zubets', M.V, Mesel'-Veseliak, V.Ya. et al. (2008) *Normatyvna sobivartist' ta tsiny na sil's'kohospodars'ku produktsiiu* [Normative cost and prices for agricultural products]. *Tsinoutvorennia ta normatyvni vytraty v sil's'komu hospodarstvi (teoriia, metodolohiia, praktyka)* [Pricing and normative expenses in agriculture (theory, methodology, practice)], vol. 2. Kyiv: NNTs IAE, pp. 8–38.
9. Piat' prychyn kupyty dobryva humisol prosto zaraz [Five reasons to buy Humisol fertilizers right now]. Available at: https://propozitsiya.com/ua/pyat-prychyn-kupyty-dobryva-gumisol-prosto-zaraz (accessed 15 August 2020).

БІБЛІОГРАФІЧНИЙ СПИСОК:

1. Гирка А.Д., Ткаліч І.Д., Сидоренко Ю.Я., Бочевар О.В., Ільєнко О.В. Порівняльна продуктивність ячменю ярого та озимого дворучки залежно від агротехнічних заходів вирощування. *Зернові культури*. 2017. Т. 1, № 2. С. 262–269.
2. Гирка А.Д., Ткаліч І.Д., Сидоренко Ю.Я., Бочевар О.В., Ільєнко О.В. Реакція ярого ячменю на мульчування, добрива та ширину міжрядь. Агроном. 2017. № 2 (56). С. 92–96.
3. Козелець Г.М., Іщенко В.А., Гайденко О.М. Економічна оцінка прибутковості ячменю. URL: http://agro-business.com.ua/agro/ahronomiia-sohodni/item/15375-ekonomichna-otsinka prybutkovosti-iachmeniu.html (дата звернення: 15.08.2020).
4. Гайденко О.М., Іщенко В.А., Козелець Г.М. Ефективне вирощування ячменю ярого: наукове дослідження.

URL: http://agro-business.com.ua/agro/ ahronomiia-sohodni/item/636-efektyvne-vyroshchuvannia-iachmeniu-iaroho-naukove-doslidzhennia.html (дата звернення: 15.08.2020).
5. Камінська В.В., Дудка О.Ф., Мушик Б.В. Продуктивність ячменю ярого за різних технологій вирощування. *Збірник наукових праць ННЦ «Інститут землеробства НААН».* 2016. Вип. 3-4. С. 114–122.
6. Технології вирощування зернових і технічних культур в умовах Лісостепу України / За ред. П.Т. Саблука, Д.І. Мазоренка, Г.Є. Мазнєва. Київ : ННЦ ІАЕ, 2008. 720 с.
7. Нормативно-методичний довідник по обґрунтуванню виробничих затрат в зерновому господарстві Степу України / А.В. Черенков та ін. ; за ред. А.В. Черенкова, В.С. Рибки. Дніпро : ДУ Інститут зернових культур НААН, 2017. 244 с.
8. Нормативна собівартість та ціни на сільськогосподарську продукцію. Ціноутворення та нормативні витрати в сільському господарстві (теорія, методологія, практика) / За ред. П.Т. Саблука, Ю.Ф. Мельника, М.В. Зубця, В.Я. Месель-Веселяка. Київ : ННЦ ІАЕ, 2008. Т. 2. С. 8–38.
9. П'ять причин купити добрива гумісол просто зараз. URL: https://propozitsiya.com/ua/pyat-prychyn-kupyty-dobryva-gumisol-prosto-zaraz (дата звернення: 15.08.2020).