UDC 633.16.631.816.3 https://doi.org/10.31867/2523-4544/0288

MORPHOLOGICAL FEATURES AND YIELD OF SPRING BARLEY DEPENDING ON THE FERTILIZATION SYSTEM

V. D. Palamarchuk
Vinnytsia National Agrarian University, 3 Soniachna St., Vinnytsia, 21008, Ukraine

Topicality. *The fertilizer system affects the characteristics of the formation of the optical and morphological system of plants and the possibility of formation and accumulation of organic matter and plant adaptability to stress factors of growing conditions.* ***Purpose.*** *To determine the effect of nitrogen feeding on the formation of morphological characteristics and productivity elements in the spring barley varieties.* ***Methods****. Field, laboratory, laboratory-field. The research was carried out during 2021–2022 on the basis of Organic-D LLC in Sutysky village, Tyvrivsky district, Vinnytsia region, Ukraine.* ***Results.*** *Feeding with nitrogen fertilisers at the rate of N_{60} increased the plant height by 13.6 cm in Lofant variety, Hetman variety – by 14.1 cm, Vakula variety – by 9.5 cm and Helios variety – by 10.1 cm; and the spike length at the rate of N_{35} – in the Lofant variety by 0.7 cm, Hetman – 0.4 cm, Vakula – 0.7 cm and Helios – 0.7 cm, and at the rate of N_{45} – by 1.2 cm, 0.4 cm, 1.0 and 0.9 cm, compared to the control. On average for two years of research, the highest number of productive shoots was obtained under introduction of N_{60} kg a. i./ha in the Lofant variety – 407.3 pcs./m^2, Hetman – 493 pcs./m^2, Vakula – 437.2 pcs./m^2 and Helios – 431.8 pcs./m^2. The highest yield was obtained in the variant with the application of N_{60} on grey forest soils for Lofant variety – 3.85 t/ha, Hetman – 4.78 t/ha, Vakula – 4.62 t/ha and Helios – 4.84 t/ha, which is explained by primarily due to the rapid regrowth of shoots and roots, the formation of optimal plant density, as well as the highest productivity of varieties.* ***Conclusions.*** *The best indicators of plant height, spike length, number of productive shoots and yield in the studied mid-ripening varieties of spring barley, such as the Lofant variety (70.5 cm, 9.4 cm, 407.3 pcs./m^2, 3.85 t/ha), Hetman (72.9 cm, 8.8 cm, 493.0 pcs. /m^2, 4.78 t/ha), Vakula (69.7 cm, 9.2 cm, 437.2 pcs./m^2, 4.62 t/ha) and Helios (67.3 cm, 9.3 cm, 431.8 pcs./m^2, 4.84 t/ha) were formed by feeding with nitrogen fertilisers at a rate of N_{60} in the tillering stage of plants.*

Key words: *barley, feeding, plant height, nitrogen, grain, tillering, spike length, productivity*

Introduction. The effectiveness of spring barley cultivation is determined by innovative approaches to cultivation technologies, in particular, such an important element as the fertiliser system. The fertiliser system affects the formation of the optical and morphological system of plants, as well as the possibility of formation and accumulation of organic matter, and plant adaptability to stress factors of growing conditions. It is worth emphasising the importance of the fertiliser system, especially the use of nitrogen fertilisers, depending on the intended purpose of the crop, in particular, spring barley is used for feed, food or brewing purposes.

Barley has been and remains one of the main grain crops in Ukraine and the world, exhibiting a certain positive dynamics in terms of cultivation areas. Due to its short growing season, low resource consumption, and a wide range of varieties, spring barley is currently attracting more interest from commodity producers [1, 2].

It is worth noting that one of the sources of increasing spring barley grain production is optimisation of plant nutrition through the application of fertilisers. According to the scientific literature, fertilisers combined with soil fertility preservation are one of the most effective ways to realise the genetic potential of a spring barley variety [3, 4]. Fertilisers contribute to 40–50 % of the increase in yield. The effectiveness of a particular fertiliser system depends on soil and climatic conditions, biological characteristics of the variety and organisational and economic capabilities of the agricultural enterprise [5]. Spring barley removes a significant amount of soil nutrients; therefore, it requires an affordable amount of fertilisers that can be provided by a scientifically based fertiliser system [4, 5].

The stage of plant development, as well as the rate and frequency of feeding, are important for the efficiency of nitrogen fertilisation, which significantly depend not only on the biological characteristics of the variety but

Author information:
Vitalii D. Palamarchuk, *Doctor of Agricultural Sciences, Associate Professor of the Department of Plant Science, Breeding and Bioenergy Crops*, e-mail: vd-palamarchuk@ukr.net, https://orcid.org/0000-0002-4906-3761

also on agrometeorological conditions, sowing conditions and soil availability of mobile forms of nutrients [6, 7]. Optimal plant density created by the fertiliser system, in particular with nitrogen fertilisers, also affects the formation of the photosynthetic apparatus of plants, which ultimately ensures the formation of the future grain yield [8].

The stem of the plant regulates the formation of the above-ground part of the spring barley. The stem is responsible for the development and growth of the vegetative mass. Future leaves are formed on the stem, which ensure the photosynthetic activity of plants and future yield [9]. It should be noted that plant height is a crucial morphological and biological indicator that characterises the response of plants to growing conditions. In addition to plant height, the productivity level of barley is significantly influenced by the spike length, the number of productive shoots, the number and weight of kernels per spike, and other yield attributes [10].

In common with other grain crops, spring barley stem grows from the lower part of the internode, where the young tissue is protected by the leaf sheath. The stem height is determined by the genetic characteristics of the variety, but can be significantly affected by growing conditions, in particular, nitrogen nutrition. The plant height of spring barley varieties can vary widely from 47 to 140 cm, with a moisture deficit decreasing to 35–87 cm. [5, 9].

The formation of optimal parameters of spring barley photosynthetic potential is influenced not only by fertilisers, but also by genetic characteristics of a particular variety [2, 4, 11]. V. V. Tynko and M. I. Polishchuk [9] note that the height of spring barley plants during the growing season can increase unevenly, in particular, during the period from tillering to stem elongation, plants have the same height, but after the heading and flowering stages, plants are characterised by intensive growth. Growth processes stop in the stage of milky-wax ripeness, when almost all the photosynthates are consumed for grain formation and filling.

Therefore, studies of the effectiveness of nitrogen fertilisation in spring barley cultivation technologies are relevant and necessary, since nitrogen fertilisers can change the habitus and characteristics of the individual productivity of the plant itself.

This study is aimed at determining the influence of nitrogen fertilisation on the formation of morphological characteristics of plants and productivity elements in spring barley varieties of domestic selection.

Materials and Methods. In 2021–2022, the research was conducted on the fields of Organic-D LLC in a two-factor experiment, where factor A was domestic mid-ripening spring barley varieties Lofant, Hetman, Vakula and Helios, and factor B was feeding plants with ammonium nitrate at rates of N_{35}, N_{45} and N_{60} kg/ha in the tillering stage.

The experimental plot has grey forest medium loamy soil with a mechanical texture that contains 9.6 mg/100 g of easily hydrolysable nitrogen (according to Cornfield), 8.5 mg/100 g of mobile phosphorus (P_2O_5) and 11.4 mg/100 g of exchangeable potassium (K_2O) (according to Chirikov).

The predecessor was winter wheat. The primary tillage included disking and ploughing to a depth of 20–22 cm, and pre-sowing tillage included cultivation and harrowing.

Spring barley was sown with a SZ-3.6 seeder, using a conventional row method with a row spacing of 15 cm and a seeding rate of 4.0 million seeds/ha. The depth of sowing was 4–5 cm. Seeds treated with Vitavax 200 FF were used for sowing.

The fertiliser system involved the application of nitrogen fertilisers (ammonium nitrate) in the tillering stage of barley plants in accordance with the experimental design at rates of N_{35}, N_{45} and N_{60}. The control variant involved no fertiliser application.

Plots of different varieties were laid out by randominisation. The plot size in the experiments was 50 m^2, the registration plot was 25 m^2, and the experiment was repeated four times. Sampling for biometric measurements was 25 plants in each replication. After sowing, the crops were rolled with ZKKSh-6 sprocket packer.

For weed control, herbicides of the 2,4-D amine salt class were used.

The linear dimensions of plants, in particular, the spike length, productive and unproductive tillering was determined in the stage of wax ripeness according to generally accepted methods [11–13].

Harvesting and registration of the crop

was carried out by selecting trial sheaves from two adjacent rows. The grain yield was brought to standard moisture content and 100 % purity [13].

Results. Four spring barley varieties belonging to the same maturity group were used in our research (Table 1).

Table 1. Characteristics of spring barley varieties

Variety	Subspecies	Maturity group	Originator	Year of registration
Lofant	two-rowed	mid-ripening	Vinnytsia State Agricultural Experimental Station of Institute of Feed Research and Agriculture Podillia of NAAS	2006
Hetman	two-rowed	mid-ripening	Plant Breeding and Genetics Institute – National Center for Seeds and Cultivar Investigation	2001
Vakula	six-rowed	mid-ripening	Plant Breeding and Genetics Institute – National Center for Seeds and Cultivar Investigation	2003
Helios	six-rowed	mid-ripening	CJSC Selena	2006

Table 1 shows the domestic mid-ripening spring barley varieties Lofant, Hetman, Vakula and Helios. Lofant and Hetman are two-rowed barley subspecies that can be used as brewing varieties, while Vakula and Helios are six-rowed barley subspecies that are more suitable for grain and feed purposes.

It is worth noting that climate change causes stressful conditions in moisture supply, accompanied by soil and air droughts, which negatively affect the nitrogen nitrification processes in the soil, therefore, modern cultivation technologies for normalising plant growth processes involve the application of nitrogen fertilisers [5, 14].

Nitrogen fertilisation of spring barley crops increases the intensity of development of the aboveground part of plants and affects the complex of economic valuable traits. We have found that the application of nitrogen fertilizers affects, in particular, the linear dimensions of the plant and spike in the studied spring barley varieties (Table 2).

According to Table 2, spring barley varieties differed insignificantly in linear size of plant. Thus, the average plant height of Lofant variety was 64.0 cm, Hetman variety – 64.3 cm, Vakula variety – 64.9 cm and Helios variety –

Table 2. Spike length and plant height of spring barley varieties depending on nitrogen feeding (for 2021–2022)

Variety	Fertiliser system	Plant height, cm			Spike length, cm		
		2021	2022	average for 2021–2022	2021	2022	average for 2021–2022
Lofant	control *	63.3	50.5	56.9	8.5	6.9	7.7
	N_{35}	71.6	53.6	62.6	9.4	7.3	8.4
	N_{45}	74.7	57.0	65.9	10.0	7.8	8.9
	N_{60}	83.3	57.6	70.5	10.3	8.5	9.4
Hetman	control *	65.7	51.9	58.8	8.4	7.4	7.9
	N_{35}	70.1	52.7	61.4	8.6	7.9	8.3
	N_{45}	75.2	53.1	64.2	8.6	8.0	8.3
	N_{60}	86.4	59.3	72.9	8.9	8.6	8.8
Vakula	control *	75.0	45.3	60.2	7.7	6.4	7.1
	N_{35}	75.8	50.6	63.2	8.8	6.8	7.8
	N_{45}	78.2	54.8	66.5	9.0	7.2	8.1
	N_{60}	83.0	56.4	69.7	10.6	7.7	9.2
Helios	control *	66.1	48.3	57.2	8.6	7.3	8.0
	N_{35}	71.3	52.0	61.7	9.1	8.3	8.7
	N_{45}	77.0	56.6	66.8	9.4	8.5	9.0
	N_{60}	73.7	60.8	67.3	9.7	8.9	9.3

* *control – no nitrogen fertilisers*

63.3 cm.

On average, over two years of research, in variants with nitrogen feeding, an increase in the plant height of spring barley was observed, in particular, under feeding with N_{35}, the plant height of Lofant variety increased by 5.7 cm, Hetman variety – by 2.6 cm, Vakula variety – by 3.0 cm, Helios variety – by 4.5 cm, and with feeding with N_{45} the plant height increased by 9.0 cm, 5.4, 6.3 and 9.6 cm, with feeding with N_{60} – 13.6 cm, 14.1, 9.5 and 10.1 cm, respectively. In contrast, in the control (no fertilisers), the plant height of barley varieties, on average over two years of research, was as follows: Lofant variety – 56.9 cm, Hetman variety – 58.8 cm, Vakula variety – 60.2 cm, and Helios variety – 57.2 cm. In other words, feeding of nitrogen fertilisers ensured an increase in plant height through improving the intensity of growth processes.

The best weather conditions for the growth and development of barley were in 2021, the plant height for this year varied from 63.3 to 86.4 cm, while in 2022 this indicator was 45.3–60.8 cm.

According to A. D. Gyrka, I. D. Tkalich, Y. Y. Sidorenko, et al. [15] fertilisers, in addition to other elements of technology and climatic conditions, affect the biometric parameters of spring barley.

The spike length of spring barley, on average for two years of research, was for Lofant variety – 8.6 cm, Hetman variety – 8.3 cm, Vakula variety – 8.1 cm and Helios variety – 8.7 cm. In the variant without nitrogen fertilisation, the spike length was the smallest and amounted to 7.7 cm, 7.9, 7.1 and 8.0 cm, respectively.

Fertilisation with nitrogen fertiliser N_{35} in the tillering stage of plants provided an increase in the spike length of Lofant variety by 0.7 cm, Hetman variety by 0.4 cm, Vakula variety by 0.7 cm and Helios variety by 0.7 cm, at N_{45} – by 1.2 cm, 0.4, 1.0 and 0.9 cm respectively compared to the control (no nitrogen fertilisation). The highest values of spike length were obtained in the variants with the introduction of nitrogen fertilisers in the rate of N_{60} – for Lofant variety – 9.4 cm, Hetman variety – 8.8 cm, Vakula variety – 9.2 cm and Helios variety – 9.3 cm.

The research results confirm that the spike length of spring barley can increase by 5.5–25.5 % as a result of fertilisation and other technological elements [15].

Thus, the application of nitrogen fertilisers in the tillering stage of spring barley plants of mid-ripening varieties has a positive effect on the formation of the aboveground part of plants and the spike length in the studied varieties.

According to the results of the research, it was found that nitrogen fertilisation also improves the productivity of spring barley crops by increasing the number of productive shoots (Table 3).

The analysis of the data shows that the

Table 3. Effect of fertiliser system on tillering productivity of spring barley varieties

Variety	Fertiliser system	Number of unproductive shoots, pcs/m^2			Number of productive shoots, pcs/m^2		
		2021	2022	average	2021	2022	average
Lofant	control*	33.0	38.7	35.9	383.2	334.5	358.9
	N_{35}	39.6	45.7	42.7	422.0	354.6	388.3
	N_{45}	39.6	49.8	44.7	448.7	361.3	405.0
	N_{60}	46.2	53.6	49.9	468.6	345.9	407.3
Hetman	control*	39.6	45.6	42.6	393.0	368.5	380.8
	N_{35}	48.9	51.9	50.4	481.8	375.2	428.5
	N_{45}	52.8	57.6	55.2	541.2	381.4	461.3
	N_{60}	57.5	59.9	58.7	590.6	395.3	493.0
Vakula	control*	36.4	41.5	39.0	345.2	294.3	319.8
	N_{35}	43.0	46.7	44.9	401.6	301.0	351.3
	N_{45}	59.4	60.1	59.8	447.8	314.4	381.1
	N_{60}	66.0	68.8	67.4	546.5	327.8	437.2
Helios	control*	35.0	40.4	37.7	382.7	297.9	340.3
	N_{35}	39.0	43.7	41.4	459.0	304.6	381.8
	N_{45}	44.6	48.2	46.4	481.8	335.0	408.4
	N_{60}	47.5	51.5	49.5	488.4	375.2	431.8

* *control – no nitrogen fertilisers*

number of unproductive shoots of barley plants depended on the climatic conditions of the year. Thus, 2022 was an extreme year in terms of precipitation and temperature compared to 2021, which resulted in the number of unproductive shoots for the Lofant variety – 47.0 pcs/m^2, Hetman variety – 53.8 pcs/m^2, Vakula variety – 54.3 pcs/m^2 and Helios variety – 46.0 pcs/m^2. In 2021, the number of unproductive shoots for these varieties was 39.6 pcs/m^2, 49.7, 51.2 and 45.1 pcs/m^2, respectively.

Nitrogen feeding also had an impact on the number of unproductive shoots, on average for two years of research, this indicator in the variant with the application of nitrogen fertiliser at a dose of N_{60} was 49.9 pcs/m^2 for Lofant variety, Hetman variety – 58.7, Vakula variety – 67.4 and Helios variety – 49.5 pcs/m^2, while in the control (no fertilisers) it was 35.9 pcs/m^2, 42.6, 39.0 and 37.7 pcs/m^2, respectively.

Feeding with N_{35} nitrogen fertiliser increased the number of unproductive shoots by 6.8, 7.8, 5.9 and 3.7 pcs/m^2, and with N_{45} – 8.8, 12.6, 20.8 and 8.7 pcs/m^2, respectively.

On average for two years of research, the increased number of productive shoots was due to foliar feeding with nitrogen fertilizers, and the highest indicators were obtained in the variant with the introduction of N_{60}, thus, for the Lofant variety – 407.3 pcs/m^2, Hetman variety – 493, Vakula variety – 437.2 and Helios variety – 431.8 pcs/m^2. On the control (variant without feeding), the number of productive shoots was 358.9 pcs/m^2, 380.8, 319.8 and 340.3 pcs/m^2, respectively.

For feeding with N_{35}, on average for two years, the following number of productive shoots by varieties was obtained – 388.3 pcs/m^2, 428.5, 351.3 and 381.8 pcs/m^2, for feeding with N_{45} – 405.0 pcs/m^2, 461.3, 381.1 and 408.4 pcs/m^2, respectively.

The formation of a larger number of productive shoots on fertilised variants had a positive effect on the increase in spring barley grain yield. It was experimentally proved that feeding with nitrogen fertilizers in the cultivation of different varieties of spring barley in the Central Forest-Steppe of the Right-Bank Ukraine plays an important role not only in optimising plant growth processes, but also positively affects the formation of crop yields (Table 4).

Based on the analysis of data for two years (Table 4), it was concluded that feeding spring barley in the tillering stage with nitrogen fertilisers stimulates plant growth processes and provides an increase in grain yield compared to the control variant (without fertilisation), where the lowest yield in Lofant variety was 2.64 t/ha, Hetman variety – 2.69 t/ha, Vakula variety – 2.22 t/ha and Helios variety – 2.69 t/ha. The

Table 4. Effect of nitrogen feeding on the yield of spring barley varieties

Variety (factor A)	Fertiliser system (N kg/ha) (factor B)	Yield, t/ha		
		2021	2022	average
Lofant	control*	3.22	2.05	2.64
	N_{35}	3.84	2.51	3.18
	N_{45}	4.26	2.73	3.50
	N_{60}	4.84	2.85	3.85
Hetman	control*	3.25	2.12	2.69
	N_{35}	4.35	2.54	3.44
	N_{45}	5.12	3.19	4.15
	N_{60}	6.02	3.53	4.78
Vakula	control*	2.88	1.56	2.22
	N_{35}	3.75	1.71	2.73
	N_{45}	4.55	2.14	3.35
	N_{60}	6.60	2.63	4.62
Helios	control*	3.41	1.97	2.69
	N_{35}	4.37	2.57	3.47
	N_{45}	5.29	3.09	4.19
	N_{60}	5.83	3.85	4.84
LSD_{05}, t/ha	A	0.23	0.17	–
	B	0.15	0.11	
	AB	0.28	0.21	

* *control – no nitrogen fertilisers*

highest grain yield of spring barley varieties was obtained in the variant with feeding with N_{60} on grey forest soils, namely: Lofant variety – 3.85 t/ha, Hetman variety – 4.78, Vakula variety – 4.62 and Helios variety – 4.84 t/ha, which is explained primarily by creating conditions for rapid regrowth of shoots and roots and formation of optimal plant density and highest plant productivity.

Feeding with N_{35} increased the grain yield of the studied varieties by 0.54 t/ha, 0.75, 0.51 and 0.78 t/ha, respectively, and feeding with N_{45} increased the grain yield by 0.86 t/ha, 1.46, 1.13 and 1.50 t/ha compared to the control (no fertilisers).

Conclusions. The mid-ripening varieties of spring barley achieved the best indicators of plant height, spike length, number of productive shoots and grain yield under feeding at a rate of N_{60} in the tillering stage of plants, in particular for Lofant variety (70.5 cm, 9.4 cm, 407.3 pcs/m^2, 3.85 t/ha), Hetman variety (72.9 cm, 8.8 cm, 493.0 pcs/m^2, 4.78 t/ha), Vakula variety (69.7 cm, 9.2 cm, 437.2 pcs/m^2, 4.62 t/ha) and Helios variety (67.3 cm, 9.3 cm, 431.8 pcs/m^2, 4.84 t/ha), respectively.

Therefore, we conclude that feeding spring barley crops with ammonium nitrate improves a set of valuable economic traits and grain yield of mid-ripening varieties, in particular, Lofant, Hetman, Vakula and Helios varieties.

References

1. Vernera, I. Ye. (2022) *Statystychnyi shchorichnyk Ukrainy. Derzhavna sluzhba statystyky Ukrainy* [Statistical yearbook of Ukraine. State Statistics Service of Ukraine]. [in Ukrainian].
2. Palamarchuk, V. D., Doronin, V. A., Kolisnyk, O. M., Alieksieiev, O. O. (2022). *Osnovy nasinnieznavstva (teoriia, metodolohiia, praktyka): monohrafiia* [Basics of seed science (theory, methodology, practice): monograph]. Vinnytsia: TOV Druk. [in Ukrainian].
3. Yatsuk, I. P. Matusevych, H. D. (2014). Agroecological condition of soils of Kyiv region. *Zbalansovane pryrodokorystuvannia* [Balanced nature management], *1*. 79–85. [in Ukrainian].
4. Shkatula, Yu. M., Barskyi, D. O. (2022). Formation of leaf surface area by winter barley plants depending on fertilization. *Silske hospodarstvo ta lisivnytstvo* [Agriculture and forestry], *1 (24)*. 227–240. [in Ukrainian].
5. Mazur, V. A., Palamarchuk, V. D., Polishchuk, I. S., Palamarchuk, O. D. (2017). *Novitni ahrotekhnolohii u roslynnytstvi* [The latest agricultural technologies in crop production]. Vinnytsia. [in Ukrainian].
6. Kolisnyk, O. M. (2020). The influence of technological methods of cultivation on the growth and development of spring barley in the conditions of the Pravoberezhny Forest Steppe. *Silske hospodarstvo ta lisivnytstvo* [Agriculture and Forestry], *16*. 89–107. [in Ukrainian].
7. Shkatula, Yu. M., Barskyi, D. O. (2021). Yield of winter barley depending on the fertilization system. *Silske hospodarstvo ta lisivnytstvo* [Agriculture and forestry], *21*. 82–94. [in Ukrainian].
8. Reznichenko, N. D. (2017). Formation of leaf surface area by plants of winter barley (*Hordeum vulgare* L.) under different technological methods of cultivation. *Zroshuvane zemlerobstvo:* mizhvidomchyi tematychnyi naukovyi zbirnyk [Irrigated agriculture: interdepartmental thematic scientific collection], *68*. 123–126. [in Ukrainian].
9. Tynko, V. V., Polishchuk, M. I. (2022). The influence of mineral and microfertilizers on the height of spring barley plants in the conditions of the Right Bank Forest Steppe of Ukraine. *Silske hospodarstvo ta lisivnytstvo* [Agriculture and Forestry], *2 (25)*. 227–235 [in Ukrainian].
10. Rozhkov, A. O. (2014). The yield of spring barley of the Dokuchaevskiy variety depending on the application of different sowing rates and foliar fertilization. *Visnyk Silske hospodarstvo. Roslynnytstvo* [Visnyk Agriculture. Plant growing], *4*. 30–34. [in Ukrainian].
11. Ushkarenko, O. V. et al. (2016). *Naukovi doslidzhennia v ahronomii: navchalnyi posibnyk* [Scientific research in agronomy: a study guide]. Kherson: Hrin D. [in Ukrainian].
12. Moiseichenko, V. F., Yeshchenko, V. O. (1994). *Osnovy naukovykh doslidzhen v ahronomii* [Basics of scientific research in agronomy]. Kyiv: Vyshcha shkola. [in Ukrainian].
13. Volkodav, V. V. (Ed.). *(2001)*. *Metodyka Derzhavnoho sortovyprobuvannia silskohospodarskykh kultur (zernovi, krupiani ta zernobobovi kultury)* [Methodology of the State variety testing of agricultural crops (cereal, grain and leguminous crops)]. Kyiv: N. p. [in Ukrainian].
14. Palamarchuk, V. D., Kalenska, S. M., Yermakova, L. M., Polishchuk, I. S., Polishchuk, M. I.. (2015). *Systemy suchasnykh intensyvnykh tekhnolohii u roslynnytstvi* [Systems of modern intensive technologies in crop production]. Vinnytsia: FOP Rohalska I. O. [in Ukrainian].
15. Hyrka, A. D., Tkalich, I. D., Sydorenko, Yu. Ya., Bochevar, O. V., Ilienko, O. V. (2017). Response of spring barley to mulching, fertilizers and row spacing. *Ahronom* [Agronomist], *2*. 92–96. [in Ukrainian].

УДК 633.16.631.816.3
Паламарчук В. Д. Морфологічні особливості та урожайність ячменю ярого залежно від системи удобрення. *Зернові культури. 2023. 7 (2). 278–284.*
Вінницький національний аграрний університет, м. Вінниця, вул. Сонячна, 3, Україна, 21008

Актуальність. Система удобрення впливає на характеристику формування морфологічної системи рослин та можливості утворення, та накопичення органічної речовини і адаптивності рослин щодо стресових чинників умов вирощування. **Метою досліджень** було встановлення впливу азотного підживлення рослин на формування морфологічних особливостей та елементів продуктивності у сортів ячменю ярого. **Методи.** Польовий, лабораторний, лабораторно-польовий. Дослідження проводились протягом 2021–2022 рр. на базі ТОВ «Органік-Д» с. Сутиски Вінницької області, Україна. **Результати.** Підживлення азотними добривами дозою N_{60} забезпечує збільшення висоти рослин у сорту Лофант на 13,6 см, Гетьман – на 14,1 см, Вакула – на 9,5 та Геліос – на 10,1 см, довжини колоса: N_{35} – у сорту Лофант на 0,7 см, Гетьман – на 0,4 см, Вакула – на 0,7 см та Геліос – на 0,7 см; N_{45} – на 1,2 см, 0,4 см, 1,0 та 0,9 см, відповідно, порівняно з контролем. Найвищі значення кількості продуктивних пагонів отримано, в середньому за два роки досліджень, у варіанті з внесенням N_{60} у сортів Лофант – 407,3 шт./м^2, Гетьман – 493 шт./м^2, Вакула – 437,2 шт./м^2 та Геліос – 431,8 шт./м^2. Найбільша урожайність зерна сортів ячменю озимого одержана із підживленням на сірих лісових ґрунтах N_{60}: Лофант – 3,85 т/га, Гетьман – 4,78 т/га, Вакула – 4,62 т/га та Геліос – 4,84 т/га, це пояснюється, перш за все, створенням умов для швидкого відростання пагонів, коренів і формуванням оптимальної густоти стеблостою та найбільшої продуктивності рослин. **Висновки.** Найкращі показники висоти рослин, довжини колоса, кількості продуктивних пагонів та урожайності зерна у середньостиглих сортів ячменю ярого Лофант (70,5 см, 9,4 см, 407,3 шт./м^2, 3,85 т/га), Гетьман (72,9 см, 8,8 см, 493,0 шт./м^2, 4,78 т/га), Вакула (69,7 см, 9,2 см, 437,2 шт./м^2, 4,62 т/га) та Геліос (67,3 см, 9,3 см, 431,8 шт./м^2, 4,84 т/га) відповідно формувалися за проведення підживлення азотними добривами у фазу кущіння рослин дозою N_{60} д.р./га.

Ключові слова: *ячмінь, підживлення, висота рослин, азот, зерно, кущистість, довжина колоса, продуктивність*