UDC 633.11:631.53.027.2:632.95 https://doi.org/10.31867/2523-4544/0346

PRODUCTIVITY AND SOWING QUALITY OF BREAD WINTER WHEAT SEEDS DEPENDING ON NITROGEN FEEDING

O. A. Zaima, O. B. Kalitsinska
The V. M Remeslo Myronivka Institute of Wheat NAAS, Tsentralne village, Obukhiv district, Kyiv region, 08853, Ukraine

Topicality. *The problem of rational feeding of winter wheat crops and the study of its impact on yield, grain quality and sowing quality is relevant and of great practical interest.* ***Purpose.*** *To investigate the impact of early spring feeding of bread wheat crops with different rates of nitrogen fertilisers on the yield level, grain quality indicators and seed sowing qualities.* ***Materials and Methods.*** *The impact of nitrogen feeding with ammonium nitrate and UAN-32 at different application rates of N_{25}, N_{50}, and N_{75} was studied on bread wheat varieties MIP Valensiia, MIP Vidznaka, MIP Aelita and MIP Fortuna. Nitrogen feeding of crops was carried out at the beginning of the spring growth resumption.* ***Results.*** *The application of nitrogen fertilisers contributed to the formation of higher indicators of yield attributes. In the control variants, plant height was 86–105 cm, spike length – 8.3–8.8 cm, number of grains per spike – 42–49 pcs, grain weight per spike – 2.13–2.39 g, and in the variants with nitrogen feeding – 87–109 cm, 8.5–9.7 cm, 45–62 pcs and 2.18–2.84 g, respectively. In the variants with fertilisation, the yield level increased to 5.79–6.85 t/ha compared to the average yield of the varieties at 5.45–6.28 t/ha. Higher increases in yields were observed when ammonium nitrate was applied at rates of N_{50} and N_{75}. A positive effect of nitrogen feeding on the grain quality and sowing qualities of bread winter wheat seeds was noted. The yield of standard seeds was 66.7–80.7 % in the controls, and 68.9–85.3 % in the variants with fertilisers. Indicators of germination energy and laboratory germination of seeds in the variants with nitrogen feeding showed a tendency to increase. Thus, the laboratory germination rate of seeds from variants without fertilisers was 94–96 %, while seeds from variants with nitrogen feeding had a germination rate of 95–99 %.* ***Conclusions.*** *Early spring feeding of bread winter wheat with nitrogen fertilizers contributes to the formation of plants with larger productivity elements and increases the level of grain yield by 0.15–0.60 t/ha. The application of ammonium nitrate at rates of N_{50} and N_{75} contributed to higher increases in yield. The positive effect of nitrogen feeding on grain quality and sowing qualities of seeds of bread winter wheat varieties was also noted.*

Key words: *varieties, feeding, yield level, grain quality, yield of standard seeds, germination energy, laboratory germination*

Introduction. Bread winter wheat (*Triticum aestivum* L.) is the most widely cultivated crop in the world alongside maize, rice and soybeans [1, 2]. Global wheat consumption in the 2020–2021 marketing year exceeded 759 million tonnes [3]. Wheat is one of the most important crops and a major source of carbohydrates and proteins [4]. Wheat grain products are widely consumed and play an important role in human nutrition and animal feed [5, 6].

The yield of winter wheat depends on genetic and environmental factors: availability of nitrogen and water, temperature, as well as management methods. Agriculture requires resistant varieties to various levels of abiotic and biotic stress and with good and stable grain yields over many years. Given the observed trend of decreasing wheat variety productivity due to negative changes in environmental factors, which is particularly noticeable in Europe [7], modern winter wheat varieties must have a high average yield combined with a low degree of variability when grown in different environments [8].

The growth and development of agricultural crops, as well as their yield, are the result of an effective agricultural management system within an agroecological environment [9]. In order to increase the productivity of winter wheat varieties, it is important to use regionally adapted cultivation technologies [10, 11].

The cultivation of new varieties requires the application of optimal rates of fertilisers and plant protection products, which allows the full potential yield of the variety to be realised [12].

Winter wheat production depends on syn-

Author information:

Oleksii A. Zaima, *Candidate of Agricultural Sciences, Leading Researcher of Department of Seed Production and Agricultural Technologies,* e-mail: oleksii.zaima@ukr.net, https://orcid.org/0000-0001-5714-6308,

Olesia B. Kalitsinska, *Postgraduate Student, Researcher at the Laboratory of Patent and Market Research, Economics and Intellectual Property,* e-mail:ekonomistmip@ukr.net, https://orcid.org/0009-0000-1661-3838

thetic nitrogen fertilisers, as the use of animal manure is very limited and many soils have low humus levels [13]. Therefore, there are environmental and economic problems associated with wheat cultivation, especially given the high cost of nitrogen fertilisers and relatively low grain prices.

Winter wheat is particularly demanding on fertilisers because its root system covers a small area of soil and has a low capacity to absorb nutrients [14]. The penetration depth of the root system affects not only water availability from deep soil layers, but also nitrogen absorption from the soil profile [15]. A shallow dense root system makes it easier to use rainfall during the growing season [16] and also helps absorb P, K, Ca, and Mg in acidic soils [14].

Nitrogen is a key factor in plant growth and development, with a positive effect on rooting, tillering, leaf system development, photosynthesis, productivity, and quality [17, 18]. Studies of different soil tillage methods and nitrogen feeding for winter wheat have shown that, in addition to weather conditions, soil tillage had a strong influence on the parameters studied, while nitrogen fertilisers had a much smaller influence, and finally, the interaction between soil tillage and nitrogen fertilisers had an even smaller influence [19].

One of the most important and economically advantageous means of increasing gross grain yields is high-yield commercial seeds. To avoid the negative impact on winter wheat seed crops, varieties resistant to extreme environmental conditions should be used, and rational technological practices should be applied in a timely manner to ensure high and stable yields of seed material [20]. Grain uniformity is economically important because a high percentage of small grains is lost during the cleaning process [21]. In addition, a high percentage of small grains indicates poor flour yield [22, 23]. Sowing non-uniform grain mass of winter wheat for a new harvest causes uneven germination and uneven seedlings, which often results in lower yields [24]. For this reason, high uniformity of individual ripened grain mass of winter wheat in seed-breeding plots is an important objective of seed production [25].

The problem of rational fertilisation of winter wheat crops and studying its impact on yield, grain quality and sowing qualities of seeds is relevant and of great practical interest, which prompted us to conduct this research.

The study was aimed at investigating and establishing the effect of early spring feeding with different rates of nitrogen fertilisers on the level of yield and indicators of grain quality and seed sowing quality of bread winter wheat.

Materials and Methods. Field trials were conducted in accordance with the state variety testing methodology [26]. Agrotechnology is generally accepted for winter wheat cultivation in the conditions of the Right-Bank Forest-Steppe of Ukraine. The soil was low-humus, slightly leached, medium loam chernozem. The thickness of the humus horizon was 38–40 cm. The humus content in the 0–20 cm soil layer was 3.7–4.0 %, content of easily hydrolysable nitrogen – 12–13 %, mobile phosphorus – 21–25 % and exchangeable potassium – 10–16 mg/100 g of soil. Hydrolytic acidity was 1.7–2.2 mg-eq/100 g of soil, pH was 5.4–6.0. Sowing was carried out in early October using an SN-10 Ts seeder, with a seeding rate of 5 million seeds per 1 ha. The plot area was 10 m^2, and the experiment was repeated four times.

The effect of different rates of nitrogen fertilisation was studied on soft winter wheat varieties. The plants were treated at the beginning of spring vegetation resumption. The experimental variants were compared with a pure control, where no fertilisers were applied to the plants. The experimental design included the study of the following factors: A – varieties (MIP Valensiia, MIP Vidznaka, MIP Aelita and MIP Fortuna); B – nitrogen fertilisers: ammonium nitrate with application rates of 25, 50, 75 kg a.i./ha (N_{25}, N_{50}, N_{75}) and UAN-32 – 25, 50, 75 kg a.i./ha.

The harvest was collected from the experimental plots using the Sampo-130 direct combine harvester and converted to standard (14%) moisture content. The sowing qualities of the seeds were studied from the grains harvested from the experimental variants [27, 28, 29]. The yield of commercial seeds was considered to be the sum of all grain fractions remaining on sieves with holes from 3.2 to 2.0 mm, expressed as a percentage of the total grain sample weight.

Mathematical processing of experimental data was performed using special software packages (Excel, Statistica 6.0).

In the 2022/23 growing season, the average air temperature in the period from August

2022 to July 2023 was 9.7 °C, which is 0.7 °C higher than the long-term average (Table 1). The temperature regime in autumn contributed to the normal development of winter wheat. In spring and summer, the average monthly temperatures in April, May and July were 0.2–0.6 °C lower than the long-term average, while in other months they were 0.3–2.8 °C higher.

Table 1. Hydrothermal conditions of research (2022/23, 2023/24)

Month	Air temperature, °C					Precipitation, mm				
	long-term average	2022/2023		2023/2024		long-term average	2022/2023		2023/2024	
		actual data	±*	actual data	±*		actual data	±*	actual data	±*
August	20.6	21.6	1.0	22.8	2.2	51.5	84.4	32.9	4.8	-46.7
September	14.8	12.9	-1.9	18.4	3.6	55.3	117.5	62.2	7.8	-47.5
October	8.8	8.2	-0.6	12.0	3.2	38.4	30.2	-8.2	50.5	12.1
November	2.6	3.8	1.2	4.5	1.9	41.7	80.9	39.2	78.8	37.1
December	-1.6	0.2	1.8	0.9	2.5	42.2	43.0	0.8	60.4	18.2
January	-3.4	-0.1	3.3	-1.9	1.5	36.8	10.6	-26.2	23.1	-13.7
February	-2.2	-0.5	1.7	3.3	5.5	31.7	27.5	-4.2	43.7	12.0
March	2.4	5.2	2.8	4.4	2.0	34.9	46.0	11.1	86.2	51.3
April	9.9	9.3	-0.6	13.1	3.2	47.2	84.9	37.7	71.8	24.6
May	15.7	15.5	-0.2	15.9	0.2	50.2	21.0	-29.2	5.8	-44.4
June	19.4	19.7	0.3	21.4	2.0	82.4	39.4	-43.0	102.5	20.1
July	21.2	20.9	-0.3	24.5	3.3	75.6	183.5	107.9	7.3	-68.3
Over year	9.0	9.7	0.7	11.6	2.6	587.9	768.9	181.0	542.7	-45.2

Notes. ***** *± – deviation from long-term average.*

Precipitation from August 2022 to July 2023 fell to 768.9 mm (181 mm more than the long-term average). Precipitation in August and September (84.4 and 117.5 mm) contributed to the uniform seedling of winter wheat. Sufficient moistening was observed during the spring-summer growing season of winter wheat. According to the moisture supply indicator, the year had optimal moisture (HTC = 1.52). During the spring-summer growing season of winter wheat, excessive moisture was observed (HTC = 2.8).

In the 2023/24 growing season, the average air temperature in the period from August 2023 to July 2024 was 11.6 °C, which is 2.6 °C higher than the long-term average. The autumn period before sowing winter wheat for the 2024 harvest was characterised by soil and air drought. During the spring-summer growing season of winter wheat, average monthly temperatures were 0.2–3.3 °C higher than the long-term average.

From August 2023 to July 2024, precipitation amounted to 542.7 mm (45 mm less than the long-term average). Insufficient precipitation in August and September delayed the emergence of winter wheat seedlings for early sowing dates. However, excessive rainfall in October and November contributed to the accumulation of productive moisture and the growth and development of plants. Precipitation during certain periods of winter wheat growth was mostly below the long-term average, except during the periods -from seedling emergence to growth cessation, from the resumption of growth to stem elongation, and from milk ripeness to threshing, the precipitation was higher. In terms of moisture supply, 2023/24 was a year of severe drought (HTC = 0.48). During the spring-summer growing season of winter wheat, HTC was 0.1–0.37, with optimal moisture conditions only in June (HTC = 1.59). Thus, the hydrothermal conditions of the years under study differed both in terms of temperature regime and precipitation, which contributed to objective results regarding the formation of the productivity of bread winter wheat plants depending on individual elements of cultivation technology.

Results and Discussion. The research showed that the application of nitrogen fertilisers at the beginning of the growth resumption of bread winter wheat contributed to the formation of plants with higher indicators of yield attributes. In the control variants, the plant height was 86–105 cm, the main spike length was 8.3–8.8 cm, the number of grains per spike was 42–49, and the grain weight per spike was 2.13–2.39 g, while in the variants with feeding, these values were 87–109 cm; 8.5–9.7 cm; 45–62 grains and 2.18–2.84 g, respectively (Table 2).

Table 2. The effect of plant feeding with fertilisers on yield attributes of bread winter wheat (average for 2023–2024)

Variety	Variant	Plant height, cm	Spike length, cm	Number of grains per spike, pcs.	Grain weight per spike, g
MIP Fortuna	Control	105	8,8	49	2.39
	ammonium nitrate N_{25}	105	9.2	57	2.57
	ammonium nitrate N_{50}	109	9.2	62	2.84
	ammonium nitrate N_{75}	110	9.4	60	2.77
	UAN-32 N_{25}	105	9.3	58	2.62
	UAN-32 N_{50}	107	9.4	60	2.72
	UAN-32 N_{75}	108	9.7	60	2.68
MIP Valensiia	Control	86	8.3	42	2.13
	ammonium nitrate N_{25}	88	8.5	45	2.27
	ammonium nitrate N_{50}	88	8.7	47	2.31
	ammonium nitrate N_{75}	89	8.9	50	2.33
	UAN-32 N_{25}	87	9.0	44	2.18
	UAN-32 N_{50}	88	8.9	51	2.41
	UAN-32 N_{75}	87	9.0	47	2.38
MIP Aelita	Control	103	*8.4*	*44*	*2.17*
	ammonium nitrate N_{25}	106	8.6	45	2.23
	ammonium nitrate N_{50}	107	8.8	51	2.44
	ammonium nitrate N_{75}	108	8.9	53	2.45
	UAN-32 N_{25}	103	8.7	45	2.22
	UAN-32 N_{50}	105	8.9	49	2.28
	UAN-32 N_{75}	104	9.0	48	2.26
MIP Vidznaka	Control	97	8.7	43	2.15
	ammonium nitrate N_{25}	99	8.8	45	2.23
	ammonium nitrate N_{50}	100	9.0	48	2.29
	ammonium nitrate N_{75}	102	9.1	47	2.30
	UAN-32 N_{25}	97	8.9	44	2.25
	UAN-32 N_{50}	100	9.2	46	2.32
	UAN-32 N_{75}	101	9.1	47	2.31
LSD_{05}		2	0.2	2	0.13

MIP Fortuna variety had a higher grain weight (2.84 g) and number of grains (62 pcs) per spike in the variant with ammonium nitrate feeding at a rate of 50 kg a.i./ha, MIP Valensiia had 2.41 g and 51 grains in the variant with UAN-32 (N_{50}), and MIP Aelita had 2.45 g and 53 grains in the variant with ammonium nitrate (N_{75}), the MIP Vidznaka variety – 2.30–2.31 g and 47 grains in the variants with the maximum application rates of the studied fertilisers.

Feeding bread winter wheat plants with nitrogen fertilisers during the spring tillering stage contributed to an increase in grain yield. With a yield of 5.45–6.28 t/ha, the yield in the variants with fertiliser application was 5.79–6.85 t/ha (Table 3). The most high-yielding variety was MIP Vidznaka, but the greatest increases in yield due to the fertilisation were recorded for the MIP For-

Table 3. The effect of plant feeding with fertilisers on grain yields of bread winter wheat (average for 2023–2024)

Variant	Variety							
	MIP Valensiia		MIP Vidznaka		MIP Aelita		MIP Fortuna	
	yield, t/ha	increase in yield, t/ha	yield, t/ha	increase in yield, t/ha	yield, t/ha	increase in yield, t/ha	yield, t/ha	increase in yield, t/ha
Control	5.75	–	6.28	–	5.45	–	5.99	–
ammonium nitrate N_{25}	6.07	0.32	6.46	0.18	5.79	0.34	6.31	0.32
ammonium nitrate N_{50}	6.31	0.56	6.85	0.57	5.93	0.48	6.59	0.60
ammonium nitrate N_{75}	6.32	0.58	6.84	0.56	6.01	0.56	6.63	0.64
UAN-32 N_{25}	6.07	0.32	6.45	0.18	5.80	0.35	6.14	0.15
UAN-32 N_{50}	6.21	0.46	6.67	0.39	5.92	0.47	6.25	0.26
UAN-32 N_{75}	6.21	0.46	6.70	0.42	6.01	0.56	6.27	0.28

tuna variety. Higher increases in yield were observed when ammonium nitrate was applied, especially at rates of 50 and 75 kg a.i./ha.

The introduction of ammonium nitrate contributed to an increase in the yield of MIP Valensiia variety by 0.32–0.58 t/ha, MIP Vidznaka variety – 0.18–0.57 t/ha, MIP Aelita variety – 0.34–0.56 t/ha, and the MIP Fortuna variety by 0.32–0.64 t/ha compared to the control. The application of UAN-32 increased the yield of the varieties by 0.32–0.46; 0.18–0.42; 0.35–0.56 and 0.15–0.28 t/ha, respectively. The highest yield in the experiment (6.84–6.85 t/ha) was observed in the variants with the application of ammonium nitrate at rates of N_{50} and N_{75} on the MIP Vidznaka variety. Feeding plants with fertilisers at the beginning of the growth resumption contributed to an increase in the yield of commercial seeds compared to the variants without fertiliser application. The seed yield in MIP Valensiia was 80.7 % in the control, and 80.8–82.6 % – in the variants with fertilisers, in MIP Vidznaka variety – 68.6 and 68.9–70.9 %, in MIP Aelita variety – 79.2 and 78.4–85.3 %, in MIP Fortuna variety – 66.7 and 69.7–76.8 %, respectively (Table 4). The germination energy and laboratory germination rates of bread winter wheat seeds tended to increase in the variants with nitrogen fertilisation compared to the control variants.

Thus, seeds from variants without fertili-

Table 4. The effect of plant feeding with fertilisers on the sowing quality of harvested bread winter wheat seeds (average for 2023–2024)

Variant	Seed yield, %	1000 grain weight, g	Germination energy, %	Laboratory germination, %
1	*2*	*3*	*4*	*5*
MIP Valensiia				
Control	80.7	49.2	93	94
ammonium nitrate N_{25}	81.0	49.4	94	95
ammonium nitrate N_{50}	82.6	49.2	96	97
ammonium nitrate N_{75}	82.5	49.6	96	97
UAN-32 N_{25}	80.8	49.3	95	96
UAN-32 N_{50}	80.9	50.3	97	98
UAN-32 N_{75}	81.8	49.1	96	98
MIP Vidznaka				
Control	68.6	46.2	94	95
ammonium nitrate N_{25}	68.9	49.4	96	97
ammonium nitrate N_{50}	69.3	49.1	95	96
ammonium nitrate N_{75}	69.4	49.1	95	97

Table 4 continuation

1	*2*	*3*	*4*	*5*
UAN-32 N_{25}	69.4	49.1	96	97
UAN-32 N_{50}	70.0	48.4	96	97
UAN-32 N_{75}	70.9	48.8	97	98
MIP Aelita				
Control	79.2	47.2	94	95
ammonium nitrate N_{25}	81.4	44.8	96	98
ammonium nitrate N_{50}	85.3	45.4	95	96
ammonium nitrate N_{75}	78.4	45.5	96	97
UAN-32 N_{25}	79.9	45.2	95	96
UAN-32 N_{50}	81.2	46.3	96	97
UAN-32 N_{75}	83.0	46.0	97	98
MIP Fortuna				
Control	66.7	43.9	95	96
ammonium nitrate N_{25}	74.2	45.4	97	99
ammonium nitrate N_{50}	69.7	45.3	96	98
ammonium nitrate N_{75}	72.8	44.2	98	99
UAN-32 N_{25}	72.1	44.0	96	97
UAN-32 N_{50}	72.1	44.7	97	97
UAN-32 N_{75}	76.8	45.1	96	98
LSD_{05}	2.1	1.7	3.0	3.0

sers had a laboratory germination rate of 94–96 %, while seeds from variants with nitrogen feeding had a germination rate of 95–99 %. For the MIP Valensiia, MIP Vidznaka, and MIP Aelita varieties, higher laboratory seed germination (98 %) was observed in the variant with UAN-32 (N_{75}) fertilisation, only the MIP Fortuna variety had higher germination (99 %) when fertilised with ammonium nitrate at the application rate of N_{75}. The sowing quality indicators of the seeds of the studied varieties, depending on the hydrothermal conditions of the growing year, hardly differed.

Conclusions. The application of nitrogen fertilisers at the beginning of the spring vegetation resumption of bread winter wheat contributes to the formation of plants with higher productivity values and increases grain yield by 0.15–0.60 t/ha. Higher yield increases were obtained when ammonium nitrate was applied at rates of 50 and 75 kg a.i./ha. A positive effect of plant feeding on the sowing seed quality of bread winter wheat varieties was also noted. Thus, the seed yield was 66.7–80.7 % in the control, and 68.9–85.3 % – in the fertilised variants. The germination energy and laboratory germination rates of seeds in the variants with nitrogen feeding tended to increase compared to the control variants.

References

1. FAOSTAT. (2019). Crops and livestock products. https://www.fao.org/faostat/en/#data/QCL
2. Abhinandan, K., Skori, L., Stanic, M., Hickerson, N. M. N., Jamshed, M., Samuel, M.A. (2018). Abiotic stress signaling in wheat – An inclusive overview of hormonal interactions during abiotic stress responses in wheat. *Frontiers in Plant Science, 11 (9).* 1–25. https://doi.org/10.3389/fpls.2018.00734
3. Shahbandeh, M. (2021). Global wheat consumption 2017–2021. https://www.statista.com/statistics/ 1094056/ total-global-rice-consumption/
4. Mickky, B., Aldesuquy, H., Elnajar, M. (2020). Effect of drought on yield of ten wheat cultivars linked with their flag leaf waterstatus, fatty acid profile and shoot vigor at heading. *Physiol. Mol. Biol. Plants, 26 (6).* 1111–1117. https://doi.org/10.1007/s12298-020-00807-0
5. Hossain, M.M., Hossain, A., Alam, M.A., El Sabagh, A., Ibn Murad, K. F., Haque, M. M., Muriruzzaman, M., Islam, M. Z., Das, S., Barutcular, C., Kizilgeci, F. (2018). Evaluation of fifty spring wheat genotypes grown under heat stress condition in multiple environments of Bangladesh. *Fresenius Env. Bull.*, *27*. 5993–6004. https://doi.org/10.1155/2008/896451
6. Kizilgeci, F., Albayrak, O., Yildirim, M., Akinci, C. (2019). Stability evaluation of bread wheat genotypes under varying environments by AMMI model. *Fresenius Env. Bull., 28 (9).* 6865–6872. URL: https://www.prt-parlar.de/download_feb_2019/
7. Schauberger, B., Ben-Ari, T., Makowski, D., Kato, T., Kato, H., Ciais, P. (2018). Yield trends, variability and stagnation analysis of major crops in France over more than a century. *Sci. Rep.*, *8*. 16865. https://doi.org/10.1038/s41598-018-35351-1
8. Ioana Claudia Dunăreanu, Dorina Bonea (2022). Grain

yield and hectolitre weight of some wheat cultivars in organic and conventional production systems. *Romanian agricultural research, 39*. 229–237. https://doi.org/10.59665/rar3922
9. Alexandru I. Cociu, George Daniel Cizmaș. (2020). The effect of crop rotation, tillage, residue management and n fertilization rate on winter wheat growth and development, evaluated with an optical sensor. *Romanian agricultural research, 37*. DII 2067-5720 RAR 2020-25
10. Zubets, M. V. (2004). Scientific bases of agro-industrial production in the forest-steppe zone of Ukraine. Ed. M. V. Zubets. Kyiv: Lohos. [in Ukrainian]
11. Bilonozhko, V. Ya., Balashchuk, M. I., Poltoretskyi, S. P., Yatsenko, A. O. (2017). Impact of agro-measures on productivity of spring wheat. *Biuleten Umanskoho natsionalnoho universytetu sadivnytstva* [Bulletin of Uman National University of Horticulture], *2*. 33–36. [in Ukrainian]
12. Sviderko, M. S., Bolekhivskyi, V. P., Tymkiv, M. Yu., Kubyshyn, S. Ya. (2004). Efficiency of spring wheat cultivation technologies in the Western Forest-Steppe. *Kolektsiia naukovykh prats Instytutu zemlerobstva UAAN* [Collection of scientific works of the Institute of Agriculture of UAAS (special issue)]. Kyiv. 119–122. [in Ukrainian]
13. Biel, W., Stankowski, S., Sobolewska, M., Sadkiewicz, J., Jaroszewska, A., Puzynski, S. (2016). Effect of selected agronomic factors on the baking quality of winter spelt strains and cultivars (*Triticum aestivum* ssp. spelta L.) in comparison with common wheat (*Triticum aestivum* ssp. vulgare). *Romanian Agricultural Research*. 33, 251–258. DII 2067-5720 RAR 2016-45
14. Lynch, J. P. (2019). Root phenotypes for improved nutrient capture: an underexploited opportunity for global agriculture. *New Phytologist*. https://doi.org/10.1111/nph.15738
15. Singh, V., van Oosterom, E. J., Jordan, D. R., Hunt, C. H., Hammer, G. L. (2011). Genetic variability and control of nodal root angle in sorghum. *Crop Sci., 51 (5).* 2011–2020. https://doi.org/10.2135/cropsci2011.01.0038
16. Liao, M., Palta, J.A., Fillery, I.R.P. (2006). Root characteristics of vigorous wheat improve early nitrogen uptake. *Australian Journal of Agricultural Research, 57 (10).* 1097–1107. https://doi.org/10.1071/AR05439
17. Matei, Gh. (2014). Fitotehnie. Cereale şi leguminoase. Vol. 1. Edit. Sitech, Craiova.
18. Iancu, P., Păniţă, O., Soare, M. (2019). Response of some new wheat genotypes to nitrogen fertilization and prospects of yield breeding based on yield elements. *Romanian Agricultural Research, 36 (1).* 1–9. https://doi.org/10.59665/rar3606
19. Stošić, M., Brozović, B., Tadić, V., Stipešević, B., Jug, D. (2017). The effect of soil tillage and nitrogen fertilization treatments on winter wheat grain yield. *Romanian Agricultural Research, 34.* 105–111. DII 2067-5720 RAR 2017-160
20. Kavunets, V. P., Siroshtan, A. A., Malasai, V. M., Vorona, N. P. (2007). Impact of cultivation of spring wheat crops on yield and sowing quality of seeds. *Seed production, 5*. 9–11. [in Ukrainian]
21. Beral, A., Rincent, R., Le Gouis, J., Girousse, C., Allard, V. (2020). Wheat individual grain-size variance originates from crop development and from specific genetic determinism. *PLoSONE, 15 (3).* e0230689. https://doi.org/10.1371/journal. pone.0230689
22. Sharma, D. L., Anderson, W. K. (2004). Small grain screenings in wheat: interactions of cultivars with season. Site and management practices. *Aust. J. Agric. Res*. 55, 797. https://doi.org/10.1071/AR03265
23. Nuttall, J. G., O'Leary, G. J., Panozzo, J. F., Walker, C. K., Barlow, K. M., Fitzgerald, G. J. (2017). Models of grain quality in wheat A review. *Field Crops Research, 202*. 136-145. https://doi.org/10.1016/j.fcr.2015.12.011
24. Finch-Savage, W. E., Bassel, G. W. (2016). Seed vigour and crop establishment: extending performance beyond adaptation. *EXBOTJ, 67*. 567–591. https://doi.org/10.1093/jxb/erv490
25. Bradshaw, A. D. (2006). Unravelling phenotypic plasticity – why should we bother? *New Phytologist, 170*. 644–648. https://doi.org/10.1111/j.1469-8137.2006.01761.x
26. Methods of state variety testing of agricultural crops. The general part. Ed. by V. V. Vovkodav. Kyiv, 2000. 100 p. [in Ukrainian]
27. Crop seeds. Methods for determining the quality of DSTU 4138-2002: State Standart. (2003). Kyiv: State Consumer Standard Ukraine. [in Ukrainian]
28. Makrushyn M. M. Seed production. Simferopol: VD «Arial». 2011. [in Ukrainian]
29. Makrushyn M. M. Seed science of field crops. Kyiv: Urozhai. 1994. [in Ukrainian]

УДК 633.11:631.53.027.2:632.95

Заїма О. А., Каліцінська О. Б. Продуктивність та посівні якості насіння пшениці м'якої озимої залежно від підживлення азотними добривами. *Зернові культури. 2024. 8 (2). 297–304.*

Миронівський інститут пшениці імені В.М. Ремесла НААН, с. Центральне, Обухівський р-н., Київська обл., 08853, Україна

Актуальність. Проблема раціонального підживлення посівів пшениці озимої та вивчення його впливу на урожайність, якість зерна і посівні якості насіння є актуальною та становить великий практичний інтерес. **Мета.** Дослідити вплив ранньовесняного підживлення посівів пшениці м'якої озимої різними нормами азотних добрив на рівень врожайності та посівні якості насіння. **Матеріали і методи.** На сортах пшениці м'якої озимої МІП Валенсія, МІП Відзнака, МІП Аеліта і МІП Фортуна досліджували вплив підживлення азотними добривами – селітрою аміачною та КАС-32 за різних норм внесення N_{25}, N_{50}, N_{75}. Підживлення рослин проводили на початку відновлення весняної вегетації. **Результати.** Застосування азотних добрив сприяло формуванню вищих показників елементів структури врожаю. У контрольних варіантах висота рослин становила 86–105 см, довжина колоса – 8,3–8,8 см, кількість зерен – 42–49 шт., маса зерна з колоса – 2,13–2,39 г, а у варіантах із підживленням – 87–109 см;

8,5–9,7 см; 45–62 шт. і 2,18–2,84 г відповідно. При урожайності сортів на рівні 5,45–6,28 т/га, у варіантах із внесенням добрив рівень врожайності підвищувався до 5,79–6,85 т/га. Вищі прирости урожайності відмічено за внесення селітри аміачної в нормах N_{50} та N_{75}. Відмічено позитивний вплив підживлення рослин на посівні якості насіння пшениці м'якої озимої. У контролях вихід кондиційного насіння становив 66,7–80,7 %, а у варіантах із добривами – 68,9–85,3 %. Показники енергії проростання та лабораторної схожості насіння у варіантах із азотними добривами мали тенденцію до підвищення. Так, за показників лабораторної схожості насіння з варіантів без добрив на рівні 94–96 %, насіння з варіантів із підживленням мало схожість 95–99 %. **Висновки.** Ранньовесняне підживлення пшениці м'якої озимої азотними добривами сприяє формуванню рослин з більшими елементами продуктивності та підвищує рівень врожайності зерна на 0,15–0,60 т/га. Вищі прирости урожайності отримано за внесення селітри аміачної в нормах N_{50} та N_{75}. Також відмічено позитивний вплив підживлення рослин на посівні якості насіння пшениці м'якої озимої.

Ключові слова: *сорти, підживлення, рівень врожайності, якість зерна, вихід кондиційного насіння, енергія проростання, лабораторна схожість*