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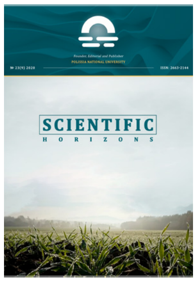

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Formation of Seed Productivity and Sowing Qualities of Soft Winter Wheat Seeds Depending on the Levels of Mineral Nutrition of Plants in the Western Forest Steppe of Ukraine

Ihor Voloshchuk, Olexandra Voloshchuk*, Valentyna Hlyva, Maria Zapisotska

Institute of Agriculture of Carpathian Region National Academy of Agrarian Science
81115, 5 Hrushevskyi Str., v. Obroshyne, Ukraine

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Abstract. Today, considerable attention is paid to the intensification of grain production, which depends on the accelerated introduction of highly productive varietal resources with the preservation of the properties of the variety in the process of further reproduction, the production of high-quality and competitive products for the sub-markets of pre-basic, basic, and certified seeds. Improved technologies for growing soft winter wheat should be based on the effective use of the soil and climatic conditions of the studied region, the biological, the genetic potential of varieties, technological innovations in agrotechnical methods of growing crops and the optimal use of material and technical resources. They should be effective for both the producer and the consumer of seed products. The purpose of the research was to determine the features of the formation of seed productivity and sowing qualities of soft winter wheat seeds, depending on the levels of mineral nutrition of plants in the Western Forest Steppe of Ukraine. The methodological basis consisted of general scientific and special research methods. Studies have established that with the low natural fertility of grey forest surface-gley soils of the Western Forest Steppe and considering climate change towards warming with a decrease in precipitation, the introduction of new more productive varieties of intensive type, complex forms of mineral fertilisers, microfertilisers, growth regulators into agricultural production, the questions of the nutrition system of soft winter wheat plants are insufficiently substantiated in this region. The research results presented in the article from 2019 to 2021 demonstrate the issues of the influence of the norm of application of mineral fertilisers with stage-by-stage feeding with nitrogen in different phases of organogenesis on the formation of indicators of seed productivity of varieties of the forest steppe ecological type of soft winter wheat. It was found that the rate of yield of conditioned seeds was the lowest in the control without fertilisers and grew by 16-20% for the application of mineral fertilisers. The seed yield varied from 1.58 t/ha in the control to 4.59 t/ha at the rate of $N_{220}P_{90}K_{160}S_{28}$, and the multiplication factor, respectively, from 6.3 to 19.8 units. According to this option, the total yield of the large and medium fractions was from 94.9 to 95.2%. A balanced complex of macroelements positively influenced the formation of indicators of sowing qualities of seeds, increasing the weight of 1000 seeds by 5.3-7.5 g, germination energy – from 4.8 to 8.4%, laboratory germination – from 13.6 to 14.4%

Keywords: variety, yield, multiplication factor, the yield of conditioned seeds, fractional composition

*Corresponding author

INTRODUCTION

In the context of the functioning of new forms of market-type management in the agricultural sector, the scientifically based use of mineral fertilisers remains an effective factor in the guaranteed and efficient production of agricultural products [1-3]. Majority of scientists and specialists believe that the best conditions for seed formation occur when mother plants are fully supplied with nutrients [4-6]. Intensive technologies for growing soft winter wheat are based on the widespread use of mineral fertilisers and pesticides; therefore, their uncontrolled use is economically unjustified and environmentally hazardous [7-9]. According to scientific recommendations, the rate of application of nitrogen fertilisers for growing winter wheat in intensive technologies is 120 kg/ha a.b. [10-12]. However, an excess of nitrogen worsens the quality of seeds, since in the phases of milk and wax ripeness nitrate forms, toxic to the embryo, and accumulate in it. And also the supply of potassium, calcium, and magnesium to mother plants is delayed, which leads to the biological inferiority of seeds [13-15].

Phosphorus is an indispensable element for the complete development of plants. It promotes the assimilation of nutrients by the plant, thereby improving the sowing qualities and yielding properties of seeds, it actively participates in phosphorylation reactions; it is a part of organic compounds and largely determines the level of energy processes in the plant. Therefore, its presence in the seeds in sufficient quantities ensures the life of a young plant at a high energy level and determines the intensity of further biochemical transformations, plant development, and the final yield. In soil, phosphorus is mainly in a bound state, so the concentration of mobile forms in it is low [16-18]. The diffusion at soil temperatures above 14°C is the main method of its delivery to the root hairs; in lower plants, they suffer from its deficiency even at a high content in the soil [19].

Potassium serves as a regulatory and transport “agent” in a plant, promotes quality optimisation, increases plant resistance to diseases and pests, regulates water regime, improves root development, and prevents lodging of plants. Insufficient potassium supply to the soil leads to a delay in wheat growth, a sharp reaction of plants to soil temperature and moisture is observed, and the quality of seeds deteriorates [20; 21]. Sulfur is a key component of most proteins as it is found in the amino acids methionine and cysteine. In wheat, this microelement affects the increase in the content of proteins in seeds, grain for protein synthesis. A culture cannot assimilate nitrogen without a sufficient amount of sulfur, therefore the N:S ratio should not exceed 4-8:1 [22; 23].

In recent years, there has been a tendency in Ukraine to introduce higher norms of mineral fertilisers for wheat, but they remain significantly less than the standards adopted in the developed countries of the world. According to the FAO World Organisation, the increase in grain crop yields from the use of 1 kg of nitrogen in Germany is 20.3 kg, France – 21.2 kg, Great Britain – 24.3 kg, and in Ukraine it does not exceed 11-12 kg [24].

World experience in the use of mineral fertilisers convincingly confirms their 40-50% share in the formation of winter wheat yields, considering soil fertility, predecessors, and varietal characteristics [25-27]. According to the variety testing data in the Forest Steppe zone of Ukraine, on the production fields of Western Polissya, the Right-Bank and Left-Bank Forest Steppe, the average parameters of nutrient absorption by winter wheat of modern varieties are (kg/t): for grain N – 21.6; P_2O_5 – 6.5; K_2O – 4.6, for straw – 4.9; 1.1 and 17.5; trace elements (mg/kg): for grain – Zn – 19, Co – 0.51, Fe – 37, Mn – 30, Cu – 2.1, for straw – Zn – 1.8, Co – 0.52, Fe – 27, Mn – 12, Cu – 0.6 [28]. Studies conducted in the Eastern States of Australia confirm that when nitrogen fertilisers are applied up to 100 kg/ha active ingredient the yield of winter wheat increases significantly, but this effect strongly depends on environmental conditions (precipitation, temperature, and water-holding capacity of the soil) [29].

This problem is very important within the Western Forest Steppe zone, which is characterised by low natural fertility, leaching regime, high acidity, etc., which determines the physiological needs of varieties to obtain biologically valuable seeds.

The purpose of the study was to determine the features of the formation of seed productivity and sowing qualities of soft winter wheat seeds depending on the levels of mineral nutrition of plants in the Western Forest Steppe.

MATERIALS AND METHODS

Field experiments in the crop rotation were carried out in the laboratory of the Institute of Agriculture of the Carpathian Region of the National Academy of Agrarian Sciences, from 2018 to 2021. The total area of the experimental site was 60 m^2, the accounting area was 50 m^2. Placement of variants was systematic, repetition – threefold. The soil of the research plots was grey forest, superficially gleyed, light loamy, which was characterised by such indicators, as humus content (according to the Tyurins) – 1.7%, the number of absorbed bases – 13.7 mg-eq per 100 g of soil, puddle-hydrolysed nitrogen (according to Cornfield) – 89.6 mg/kg, mobile phosphorus and exchangeable potassium (according to the Kirsanovs) – 69.5 and 68.0 mg/kg, respectively. As for gradation, such a soil has a very low nitrogen, medium phosphorus, and low potassium supply. The reaction of the soil solution (pH sol – 5.4) is weakly acidic.

Agricultural technology for growing varieties of winter wheat is common for the crop in this area. The predecessor is winter rapeseed. Sowing time is from

09.25 to 01.10. Seeding rate – 5.5 million viable seeds/ha, application of mineral fertilisers (basic) – $N_{30}P_{70}K_{120}S_{21}$. Seed treatment – dressing agent Vitavax 200FF, 34% (water suspension concentrate, 3.0 l/t). Plant protection against weeds and diseases – herbicides: Roundup, 48% (4.0 l/ha); Granstar, 75% (water-soluble granules, 0.025 g/ha); Fungicide: Falcon (emulsion concentrate, 0.6 l/ha) [30].

The experimental scheme included 1 – control (without fertilisers), 2 – $N_{168}P_{66}K_{120}S_{21}$, 3 – $N_{224}P_{88}K_{160}S_{28}$, 4 – $N_{280}P_{110}K_{200}S_{35}$. Mineral fertilisers were applied in various forms, in particular: in all variants – phosphoric potash fertiliser – nitroammophoska $NPK_{8\text{-}19\text{-}29}$ (3S).

1 variant of experiment – $N_{90}P_{50}K_{90}S_{19}$ – nitroammophoska $NPK_{8\text{-}19\text{-}29}$ (3S) – 265 kg/ha for cultivation; BBCH 20-22 (permafrost soil) ammonium sulfate – 50 kg/ha; BBCH 30-32 (phase of plant emergence into the tube) ammonium nitrate – 90 kg/ha; BBCH 37-49 (heading phase) ammonium nitrate – 80 kg/ha.

2 variant of experiment – $N_{90}P_{50}K_{90}S_{19}$ – nitroammophoska $NPK_{8\text{-}19\text{-}29}$ (3S) – 370 kg/ha for cultivation; BBCH 20-22 (permafrost soil) ammonium sulfate – 50 kg/ha + ammonium nitrate – 150 kg/ha; BBCH 30-32 (phase of plant emergence into the tube) ammonium nitrate – 130 kg/ha; BBCH 37-49 (heading phase) ammonium nitrate – 93 kg/ha.

3 variant of experiment – $N_{90}P_{50}K_{90}S_{19}$ nitroammophosk $NPK_{8\text{-}19\text{-}29}$ (3S) – 450 kg/ha for cultivation; BBCH 20-22 (permafrost soil) ammonium sulfate – 60 kg/ha + ammonium nitrate – 190 kg/ha; BBCH 30-32 (phase of plant emergence into the tube) ammonium nitrate – 160 kg/ha; BBCH 37-49 (heading phase) ammonium nitrate – 150 kg/ha.

The studies were carried out according to generally accepted methods, such as phenological observations of the growth and development of plants, evaluation of crops in autumn and during the restoration of spring vegetation, the structure of plants in the phase of full grain ripeness – H.K. Fursova, D.I. Fursov, V.V. Serhyeyev, 2004 [31]; phytopathological assessment – according to V.P. Omelyuta, I.V. Hryhorovych, V.S. Chaban et al., 1986 [32]; leaf surface area and net productivity of photosynthesis were determined by N.V. Peterson, T.O. Chernomyrdina, Ye.K. Kurilyak, 1993 [33]. The yield was taken into consideration when determining the moisture at the time of harvesting and recalculating to a standard 14% moisture. The output of conditioned seeds was determined after bringing them to sowing conditions on the grain cleaning machine Petkus "Giant", multiplication factor – concerning the cleaned seeds to the sown ones. Processing and summarising the results of the study was carried out using Microsoft Excel programs. The obtained data were processed by the method of dispersion and correlation analysis by B.A. Dospekhov, 1985 [34].

RESULTS AND DISCUSSION

Seed technologies should be based on varietal agricultural technology, considering the reaction of the variety to certain growing conditions, including the nutritional system, under which the genetic potential laid down by selection can be used to the maximum. Yield is a complex feature that is formed from many structural elements, the value of each of which is determined by the impact on the effective value.

According to the grain yield formed by the varieties in 2019, the yield of conditioned seeds was the lowest in the control and amounted up to 65%. With an increase in the rates of application of mineral fertilisers, this indicator grew by 6-11%. Plants on the control (without fertilisers) created a shrivelled grain, therefore, the yield of conditioned seeds in 2020 was also low – 52%. The introduction of mineral fertilisers at different rates contributed to a better supply of plants with nutrients, which positively influenced the formation of full seeds. Under such conditions, the yield of conditioned seeds grew up to control simultaneously with an increase in the rate of fertilisation, according to the $N_{90}P_{50}K_{90}S_{19}$ option by 18%, $N_{168}P_{70}K_{120}S_{21}$ – by 21%. High rates of application of nitrogen fertilisers at rates of $N_{220}P_{90}K_{160}S_{28}$ somewhat reduced this indicator. In comparison with the control, its increase was significant, and with the norm $N_{168}P_{70}K_{120}S_{21}$ it was less by 3%. In 2021, the yield of conditioned seeds varied from 48% in the control (without fertilisers) to 76% with the application rate of mineral fertilisers $N_{220}P_{90}K_{160}S_{28}$. There are no differences between the norms $N_{168}P_{70}K_{120}S_{21}$ and $N_{220}P_{90}K_{160}S_{28}$ for this indicator. Over the years of research, the rate of yield of conditioned seeds was the lowest in the control (without fertilisers) (Table 1). With the introduction of mineral fertilisers, this indicator increased by 16-20%.

***Table 1**. Indicators of seed productivity of winter wheat varieties depending on the norms of mineral fertilisers application (from 2019 to 2021)*

Mineral fertilisers rate, active substance/ha	The yield of conditioned seeds		Seed yield		Seed multiplication factor	
	%	± to control	t/ha	± to control	units	± to control
Control (without fertilisers)	55	–	1.58	–	6.3	–
$N_{90}P_{50}K_{90}S_{19}$	71	16	3.14	1.56	12.6	6.3
$N_{168}P_{70}K_{120}S_{21}$	75	20	4.12	2.54	16.6	10.3
$N_{220}P_{90}K_{160}S_{28}$	73	18	4.95	3.37	19.8	13.5
$SSD_{0.05}$	2.1		0.47		2.8	

In 2019, under the influence of different rates of application of mineral fertilisers under control (without fertilisers), the average seed yield varied from 2.12 t/ha for the Gratsia Bilotserkivska variety to 2.37 t/ha for Trudivnytsa Myronivska and Vodograi Bilotserkivskiy. Depending on the yield of conditioned seeds in 2020, the yield under control was, respectively, 1.35 t/ha, and when the rate of mineral fertilisers $N_{90}P_{50}K_{90}S_{19}$ was applied, it increased to 3.37 t/ha. Under the weather conditions of 2021, the seed productivity of varieties varied from 1.11 t/ha in the control (without fertilisers) to 4.59 t/ha at the rate of application of mineral fertilisers $N_{220}P_{90}K_{160}S_{28}$. The average indicators over the years of research on the yield of seeds of soft winter wheat varieties varied from 1.58 t/ha for control to 4.95 t/ha for the option of applying mineral fertilisers at the rate of $N_{220}P_{90}K_{160}S_{28}$.

Depending on the yield of conditioned seeds in 2020, the yield under control was, respectively, 1.35 t/ha. When applying the rate of mineral fertilisers $N_{90}P_{50}K_{90}S_{19}$, it increased to 3.37 t/ha, or 2.02 t/ha. The highest was the application rate of $N_{220}P_{90}K_{160}S_{28}$ – 4.33 t/ha, or 2.98 t/ha in the control.

Under the weather conditions of 2021, the seed productivity of varieties ranged from 1.11 t/ha in the control (without fertilisers) to 4.59 t/ha at the rate of application of mineral fertilisers $N_{220}P_{90}K_{160}S_{28}$. An increase in the application rate of mineral fertilisers in $N_{168}P_{70}K_{120}S_{21}$ contributed to a significant increase to the lower rate by 1.0 t/ha and by 1.68 t/ha – to the $N_{220}P_{90}K_{160}S_{28}$ rate. The average indicators over the years of research on the yield of seeds of soft winter wheat varieties varied from 1.58 t/ha on the control to 4.59 t/ha according to the option of applying mineral fertilisers at the rate of $N_{220}P_{90}K_{160}S_{28}$.

The regulating factor for expanding the area under crops is to build up a sufficient number of pre-basic seeds of new varieties in the first years of their introduction after being included in the Register of plant varieties suitable for distribution in Ukraine. This is facilitated by obtaining a high rate of reproduction. In our experiments in 2019, compared with the control (without fertilisers), the seed multiplication factor increased from 9.2 to 23.8 units and was significantly higher than $SSD_{0.05}$ = 4 units. Depending on the obtained seed yield, the multiplication factor in 2020 increased with the rate of application of mineral fertilisers by 8.5-11.9 units in comparison with the control. With $SSD_{0.05}$ = 3.0, all the studied variants of the mineral nutrition of plants provided a significant increase in this indicator. In 2021, the seed multiplication factor grew from 4.4 units in the control to 18.4 units of the rate of application of mineral fertilisers $N_{220}P_{90}K_{160}S_{28}$. Over the years of research, the indicator of the seed multiplication factor in the control (without fertilisers) was -6.3 units and grew to 19.8 units of the application rate of mineral fertilisers $N_{220}P_{90}K_{160}S_{28}$.

Under the influence of weather and agro-technological factors, seeds with different weights were formed within the ear and on the plant as a whole, which determined its fractional composition when brought to sowing conditions and its assessment. Presented in Table 2 data allow us to assert that in the control (without fertilisers) the yield of the fine fraction of seeds was the highest – 28.0-29.9%, and the highest – 30.5-31.7%. When mineral fertilisers were applied at the rate of $N_{90}P_{50}K_{90}S_{19}$, the output of coarse (from 2.2 mm to 2.8 mm) and medium (from 2.2 mm to 2.5 mm) fractions increased: up to 41.6-42.0% and 44.6-45,0%, and small (from 2.0 mm to 2.2 mm) decreased to 12.4-13.8%. The same pattern was observed at the highest rate of mineral fertilisers $N_{168}P_{70}K_{120}S_{21}$, these indicators were, respectively: 52.2-53.4% (large), 36.7-37.8 (medium) and 9.9-10.0% (small). The highest total yield of coarse and medium fractions of 94.9-95.2% was provided by the rate of mineral fertilisers $N_{220}P_{90}K_{160}S_{28}$ with a phased application of nitrogen at the stages of organogenesis.

***Table 2**. Fractional warehouse of the population of winter wheat varieties fallow as normal application of mineral goodness (2019-2021), %*

Mineral fertilisers rate, active substance/ha	The output of seed fractions by years, mm									The average		
	2019			2020			2021					
	Large (2.2-2.8)	Medium (2.2-2.5)	Small (2.0-2.2)	Large (2.2-2.8)	Medium (2.2-2.5)	Small (2.0-2.2)	Large (2.2-2.8)	Medium (2.2-2.5)	Small (2.0-2.2)	Large (2.2-2.8)	Medium (2.2-2.5)	Small (2.0-2.2)
Control (without fertilisers)	30.5	39.6	29.9	31.7	40.3	28.0	31.0	40.0	29.0	–	–	–
$N_{90}P_{50}K_{90}S_{19}$	41.6	44.6	13.8	42.3	45.3	12.4	42.0	45.0	13.0	11.0	5.0	-16.0
$N_{168}P_{70}K_{120}S_{21}$	52.2	37.8	10.0	53.4	36.7	9.9	52.8	37.2	10.0	21.8	-2.8	-19.0
$N_{220}P_{90}K_{160}S_{28}$	60.7	34.2	5.1	61.2	34.0	4.8	61.0	34.0	5.0	30.0	-6.0	-24.0

The problem of increasing the sowing quality of seeds remains extremely important due to the influence of negative factors during its formation and maturation. One of the important indicators of the sowing properties of seeds is the mass of 1000 seeds. The parameters of this indicator were genetically incorporated when creating a variety, however, the formation of biologically valuable seeds is provided primarily by the plant nutrition system. This issue acquires particular importance in cases where the cultivation technology does not correspond to the genetic capabilities of the variety to ensure a sufficient degree of reliability and protection of the genotype from the unfavourable influence of biotic and abiotic environmental factors.

In the conducted experiments, a balanced complex of macronutrients had a positive effect on the formation of the mass of 1000 seeds. The average given indicator over the years of research varied from 38.2 in the control to 45.7 g at the rates of application of mineral fertilisers $N_{220}P_{90}K_{160}S_{28}$ (Table 3).

The effect of fertilisers on the growth of this indicator was significant in all years of research. In 2019, in comparison with the control, this indicator grew by 4.2-5.6 g. In 2020, under the control (without fertilisers), the varieties formed a mass of 1000 seeds at the level of 36.3 (Gratsia belotserkivska) – 37.3 g (Kvitka poliv). It was higher by 5.8-8.4 g in the variants of applying mineral fertilisers. Compared to the control, the lowest rate of application of mineral fertilisers – $N_{90}P_{50}K_{90}S_{19}$ contributed to its growth by 5.8 g, and the highest $N_{220}P_{90}K_{160}S_{28}$ – by 8.4 g, with the smallest significant difference of 0.8 g between all rates of mineral fertilisers. Under the influence of weather conditions and levels of mineral nutrition of plants in 2021, the average weight of 1000 seeds by varieties was 35.9 g and higher by 6.1-8.7 g at the studied rates of mineral fertilisation.

Seeds with a higher mass of 1000 seeds provided a high percentage of germination energy (from 73.1% to 76.7%) and laboratory germination (from 92.8% to 93.6%). With a high rate of mineral fertilisers $N_{220}P_{90}K_{160}S_{28}$ compared to the rate of $N_{168}P_{70}K_{120}S_{21}$, the difference in seed germination energy and laboratory germination was within the error limits of 2.1 and 0.5% ($SSD_{0,05}$ = 2.5 and 1.1).

***Table 3**. Sowing qualities of seeds of winter wheat varieties depending on the application rates of mineral fertilisers (average for varieties and years 2019-2021)*

Mineral fertilisers rate, active substance/ha	Weight 1000 seeds		Seed germination energy		Laboratory germination of seeds	
	g	± to control	%	± to control	%	± to control
Control (without fertilisers)	38.2	–	68.3	–	79.2	–
$N_{90}P_{50}K_{90}S_{19}$	43.5	5.3	73.1	4.8	92.8	13.6
$N_{168}P_{70}K_{120}S_{21}$	44.7	6.5	76.7	8.4	93.6	14.4
$N_{220}P_{90}K_{160}S_{28}$	45.7	7.5	74.6	6.3	93.1	13.9
$SSD_{0.05}$	0.6		2.5		1.1	

CONCLUSIONS

In the zone of the Western Forest Steppe of Ukraine, on low in natural fertility grey forest surface gleyed soils, obtaining a high yield and quality of seeds depends on the provision of soft winter wheat plants with an optimal level of mineral nutrition.

1. At the rate of application of complex mineral fertilisers at the rate of $N_{90}P_{50}K_{90}S_{19}$ (nitroammophoska $NPK_{8-19-29}$ 3S) – 450 kg/ha for cultivation and feeding in BBCH 20-22 (frozen ground) with ammonium sulfate – 60 kg/ha + ammonium nitrate – 190 kg/ha + BBCH 30-32 (phase of plant emergence into the tube) ammonium nitrate – 160 kg/ha + BBCH 37-49 (heading phase) ammonium nitrate – 150 kg/ha, varieties provided a higher (before control without fertilisers) 18% yield of conditioned seeds, 3.37 t/ha yield and 13.5 units of multiplication factor.

2. With an increase in the rates of application of mineral fertilisers, the yield of large (from 2.2 to 2.8 mm) and medium (from 2.2 to 2.5 mm) seed fractions increased. At the rate of $N_{220}P_{90}K_{160}S_{28}$ with staged nitrogen addition by stages of organogenesis, the total yield of these fractions was from 94.9% to 95.2%.

3. Mineral fertilisers at different application rates contributed to an increase in the mass of 1000 seeds by 5.3-7.5 g, which increased the seed germination energy by 4.8-8.4% and laboratory germination by 13.6-14.4 g.

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Формування насіннєвої продуктивності та посівних якостей насіння пшениці м'якої озимої залежно від рівнів мінерального живлення рослин у Західному Лісостепу України

Ігор Степанович Волощук, Олександра Петрівна Волощук, Валентина Вікторівна Глива, Марія Степанівна Запісоцька

Інститут сільського господарства Карпатського регіону НААН
81115, вул. Грушевського, 5, с. Оброшине, Україна

Анотація. Сьогодні значна увага приділяється інтенсифікації виробництва зернових культур, яка залежить від прискореного впровадження високопродуктивних сортових ресурсів із збереженням властивостей сорту в процесі подальшого його розмноження, виробництва високоякісної та конкурентоспроможної продукції для субринків добазового, базового та сертифікованого насіння. Удосконалені технології вирощування пшениці м'якої озимої повинні базуватися на ефективному використанні ґрунтово-кліматичних умов досліджуваного регіону, біологічному й генетичному потенціалі сортів, технологічних інноваціях в агротехнічних прийомах вирощування культури та оптимальному застосуванні матеріально-технічних ресурсів, бути ефективними як для виробника, так і споживача насіннєвої продукції. Мета наших досліджень полягала у визначенні особливостей формування насіннєвої продуктивності та посівних якостей насіння пшениці м'якої озимої залежно від рівнів мінерального живлення рослин в Західного Лісостепу України. Методологічну основу становили загальнонаукові та спеціальні методи досліджень. Дослідженнями встановлено, що за низької природньої родючості сірих лісових поверхнево-оглеєних грунтів Західного Лісостепу та з урахуванням змін клімату в сторону потепління і зменшення кількості опадів, впровадженням у сільськогосподарське виробництво нових більш продуктивних сортів інтенсивного типу, складних форм мінеральних добрив, мікродобрив, регуляторів росту, недостатньо обґрунтованими в даному регіоні є питання системи живлення рослин пшениці м'якої озимої. Подані в статті результати досліджень за 2019–2021 рр. висвітлюють питання впливу норм внесення мінеральних добрив з поетапним підживленням азотом у різні фази органогенезу на формування показників насіннєвої продуктивності сортів лісостепового екологічного типу пшениці м'якої озимої. Встановлено, що показник виходу кондиційного насіння найнижчим був на контролі без добрив) і зростав на 16–20 % за внесення мінеральних добрив. Урожайність насіння варіювала від 1,58 т/га на контролі до 4,59 т/га за норми $N_{220}P_{90}K_{160}S_{28}$, а коефіцієнт розмноження, відповідно від 6,3 до 19,8 одиниць. За даного варіанту сумарний вихід крупної і середньої фракції становив 94,9–95,2 %. Збалансований комплекс макроелементів позитивно впливав на формування показників посівних якостей насіння підвищуючи масу 1000 насінин на 5,3–7,5 г, енергію проростання – на 4,8–8,4 %, лабораторну схожість – на 13,6–14,4 %

Ключові слова: сорт, урожайність, коефіцієнт розмноження, вихід кондиційного насіння, фракційний склад