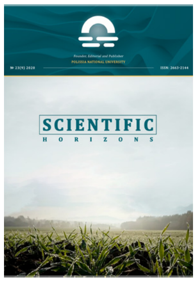
SCIENTIFIC HORIZONS

Journal homepage: https://sciencehorizon.com.ua

Scientific Horizons, 24(6), 34-40



UDC 551.583:631.53.01:633.111

DOI: 10.48077/scihor.24(6).2021.34-40

Weather Factors and Their Influence on the Adaptive Properties of Winter Wheat Varieties in the Western Forest-Steppe of Ukraine

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Article's History:
Received: 15.09.2021
Revised: 16.10.2021
Accepted: 13.11.2021

Suggested Citation:
Zapisotska, M., Voloshchuk, O., Voloshchuk, I., & Hlyva, V. (2021). Weather factors and their influence on the adaptive properties of winter wheat varieties in the Western Forest-Steppe of Ukraine. *Scientific Horizons*, 24(6), 34-40.

Abstract. The yield potential of winter wheat (*Triticum aestivum* L.) is formed in changing weather conditions and depends on the proposed agro-technological measures, to which the response of a particular variety is different. The purpose of this study was to determine the influence of weather factors on the field germination of soft winter wheat seeds, the growth and development of plants in the autumn and wintering in the zone of the Western Forest-Steppe of Ukraine, by sowing high-quality basic seed, careful soil preparation and the presence of optimum environmental factors. A sufficient level of productive soil moisture, which protects young shoots from possible deficiency after germination and is a long-term source of moisture at the next stages of organogenesis, has a great influence on obtaining friendly and timely shoots. Often overwintering conditions, when plants suffer from low negative temperatures at the beginning and at the end of the winter period, ground ice crust, resumption of vegetation in winter are the causes of freezing, loss, and ultimately a decrease in yield and seed quality. It has been confirmed that an increase in the temperature regime in 244-247°C in the autumn-winter period and the optimal amount of precipitation contribute to sufficient (31.6-34.6 mm) productive soil moisture (0-20 cm), which positively influences the process of germination of soft winter wheat, provides a high percentage of field germination of seeds of varieties (93.8-94.5%), lengthens the autumn development of plants by 3-12 days, which causes 3.5-5.7% higher accumulation of sugar content in the tillering nodes and a high percentage of overwintering (up to 95.5-96.4%). Varieties of the forest-steppe ecological type of soft winter wheat have insignificant phenotypic variability of adaptive traits, therefore, in the production of grain and seed products, it is recommended to give preference to the plant varieties listed in the Register, suitable for distribution in Ukraine for the Forest-Steppe zone, Polissya. The recommendations set out in this scientific work will help agricultural producers of the studied soil and climatic zone to carry out an effective, more ecologically plastic, highly productive variety replacement

Keywords: air temperature, precipitation, soft winter wheat, field germination of seeds, autumn development of plants, overwintering

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INTRODUCTION

The yield potential combines the importance of the biological properties of plants in the formation of the possible maximum yield due to the variability of weather conditions and their adjustment by organizational and technological measures. The introduction into agricultural production of ecologically plastic varieties with different rhythms of development contributes to an increase in the yield of grain crops and stabilization of the production of grain and seeds [1-6].

According to some authors, V.P. Dmitrenko was the first to work on the concept, meaning, and content of the climatic potential of yield (potential, actual) as a prognostic and calculated indicator when calculating the yield of winter wheat. The growing season of soft winter wheat covers almost the entire calendar year, which makes it possible to determine the influence of weather factors on the growth and development of plants, the state of dormancy, and ultimately on the productivity of plants [7; 8].

Agrometeorological resources, which are determined by such environmental factors as heat, moisture and air, and nutrient minerals in production conditions for the formation of sustainable yields of winter wheat are used no more than 60%, therefore, considering the climate change in Ukraine, it is necessary to introduce varieties adapted to the ecological regions which are significantly influenced by unfavorable biotic and abiotic factors [9; 10].

One of the most important indicators of biological control in the technology of growing any crop is the field germination of seeds [11]. The period from sowing to germination is critical, since the seedling doesn't have nutritional organs. Therefore, it is very sensitive to all kinds of factors, and metabolic processes are provided by those resources that are accumulated by the seeds due to the productivity of the mother plant. The lower the field germination of seeds, the less evenly the placement of the plant on the area is, as a result of which the differentiation of individual development, overwintering and the state of crops as a whole will increase [12].

Research results show that under production conditions, due to sowing high-quality base seeds, careful soil preparation and the presence of optimum environmental factors, high field germination rates are provided, but reaching the level of 95-98% is a difficult task [13; 14].

A sufficient level of productive soil moisture, which protects young shoots from possible deficiency after germination and is a long-term source of moisture at the next stages of organogenesis, has a great influence on obtaining friendly and timely shoots [15].

Often wintering conditions are the causes of freezing, loss, and ultimately a decrease in yield and seed quality [16; 17]. It is because plants suffer from low temperatures, ground ice crust, resumption of vegetation at the beginning and at the end of the winter period.

Scientists around the world are unanimous that the variety plays a large positive role in increasing the adaptive properties of crops, but the percentage of its influence is different, therefore, the need for adaptation of winter wheat varieties to stress factors associated with global climate change is of strategic importance. Breeding must respond to this challenge of nature by creating frost and winter-hardy varieties with a high potential for productivity and product quality [18; 19].

The purpose of this study was to identify the influence of weather factors on the field germination of soft winter wheat seeds, the growth, and development of plants in the autumn period and wintering in the zone of the Western Forest-Steppe of Ukraine.

MATERIALS AND METHODS

The object of research was the varieties of soft winter wheat from various originator institutions, included in the Register of plants varieties suitable for distribution in Ukraine – Trudivnytsa myronivska, MIP Vyshyvanka, Gratsia belotserkivska, Kvitka poliv, Vodograi belotserkivskiy, Spivanka poleska. 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, during 2018-2021. The total area of the experimental site was 60 m^2, the accounting area was 50 m^2. Placement of variants – systematic, repetition – threefold.

The soil of the research plots was gray forest, superficially gleyed, light loamy, which was characterized by the following indicators: humus content (according to the Tyurins) – 1.7%, the amount of absorbed bases – 13.7 mg-eq per 100 g of soil, puddle-hydrolyzed 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 supply, medium phosphorus supply, 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 – 09.25-01.10. Seeding rate – 5.5 million viable seeds/ha, application of mineral fertilizers (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).

According to the Lviv hydrogeological reclamation station, the sum of the temperature regime and the amount of precipitation in the autumn and winter periods and the duration of the autumn vegetation and dormancy of plants were determined. Using the method of counting sites, the dates were established, based on calculations: the beginning of seedlings (at least 15% of seedlings appeared), mass seedlings (at least 50%), full seedlings – 75% or more, the end of the phase – the appearance of the last seedlings and the field germination as the ratio of the number of seedlings to the total number of sown germinating seeds [20; 21].

Using the method [22], phenological observations of the growth and development of plants in the autumn were carried out. Linear measurements such as the height of plants and the length of the root system, and quantitative measurements such as the presence of shoots and leaves on the plant were taken into account. The total content of mono- and disugars was determined with the method of photometry using picric acid [23]. With a weighed portion of the samples pounded in a mortar and dried in a drying oven (105°C each), the sugars were extracted with water in a water bath (10 min. 100°C). The concentration of total sugars after acid hydrolysis (3.3% HCl) was determined colorimetrically at 490 nm using a calibration curve constructed using a scale of standard solutions of glucose or hydrolyzed sucrose. The dry matter content in the plant material was calculated by the gravimetric method.

The wintering of plants of varieties was carried out based on the data from autumn and spring records of the state of crops in each repetition concerning to plants that restored spring vegetation to field germination of seeds [24]. The range of variability (R) of cultivar traits and weather conditions was determined by the difference between the maximum and minimum values. The statistical reliability of the experimental data, variance, and correlation between the sugar content in the tillering nodes of soft winter wheat varieties and the duration of the autumn growing season and overwintering were established [25] using programs Microsoft Excel and "Statistica 6.0".

RESULTS AND DISCUSSION

Over the years of our research, the weather conditions were contrasting, which made it possible to give an objective assessment of their effect on the field germination of seeds of soft winter wheat (Table 1).

***Table 1**. Field germination of soft winter wheat seeds depending on the productive soil moisture (average for varieties, 2018-2020), %*

Year	Indicators of the sowing-germination period						Field germination of seeds	
	Air temperature		Precipitation amount		Productive soil moisture*			
	%	±	mm	±	mm	±	%	±
Average long-term indicator	11.2	–	19.0	–	34.6	–	94.5	–
2018	10.7	-0.5	21.6	2.6	31.6	-3.0	92.4	-2.1
2019	12.3	1.1	32.8	13.8	33.8	0.8	93.8	0.7
2020	14.4	2.2	72.1	53.1	38.4	3.8	97.2	2.7

***Note**: *Productive soil moisture up to 20 mm – sufficient, 20-40 mm – satisfactory*

In 2018, during the sowing period, germination was characterized by 0.5°C lower air temperature and 2.6 mm higher precipitation compared to the long-term average. Under such conditions and according to the predecessor of winter rapeseed, the productive soil moisture was 31.6 mm. The highest temperature regimes by 1.1 and 2.2°C and a large amount of precipitation by 13.8 and 53.8 mm were recorded in 2019 and 2020. That provided the productive soil moisture at the level of 33.8 and 38.4 mm. With sufficient moisture supply, the field germination rate was higher than the previous year by 0.7-2.7%, that is, the weather conditions contributed to the intensive germination of seeds and the receipt of friendly seedlings.

In close connection with controlled and uncontrolled environmental factors, the structure of plants and the entire crop as a whole was formed in the autumn. The termination of the autumn vegetation of plants in 2018 occurred at the beginning of the third decade of November, which corresponds to the average long-term periods, therefore the sum of active temperatures was 567°C (Table 2). The growing season of winter wheat plants between 2019 and 2020 was longer (before the beginning of December) and warmer, which is due to the sums – 664 and 614°C. Over the years of research, in comparison with the long-term average sum of temperatures of 320°C, the increase was 247-344°C, which confirms a significantly warmer temperature regime and a longer autumn period of growth and development of plants of varieties – 56-65 days. During this period, the plants accumulated the optimal sugar content in the tillering nodes (28.5-30.7%).

***Table 2**. Influence of the autumn temperature regime and the age of soft winter wheat plants on the carbohydrate content in the tillering nodes (2018-2020), %*

Year	The sum of temperatures, °C for the autumn period				Average long-term data, °C	Duration of autumn vegetation of plants, days	Sugar content in tillering nodes,%
	September	October	November	Sum			
2018	107	335	125	567	320	56	28.5
2019	123	326	195	664		65	32.3
2020	144	344	126	614		64	30.7
The average	112	248	72	432		62	30.5

An increase in the content of water-soluble carbohydrates in cells is one of the adaptive responses of plants to the effects of cold. The importance of sugars as the main protective substances in the development of frost resistance of winter wheat is undoubted, since they play an important role in ensuring the structural and functional stability of cells in conditions of loss of water. Characterizing the accumulation of sugars in the tillering nodes of plants, we did not establish significant differences between the varieties, they were within the error (SSD_{05}=0.9, 0.7, 0.6%) (Table 3). However, the range of variation over the years revealed a significant 2.4% (variety Trudivnytsa myronivska) – 4.3% (Gratsia belotserkivska).

***Table 3**. Correlation (r) between the sugar content in the tillering nodes of soft winter wheat varieties and the duration of the autumn growing season (2018-2020)*

Variety	Sugar content in tillering nodes by year, %				R (range of variability)
	2018	2019	2020	The average	
Trudivnytsa myronivska	28.6	32.3	31.0	30.6	2.4
MIP Vyshyvanka	29.0	32.4	30.5	30.6	3.4
Gratsia belotserkivska	28.3	32.6	30.7	30.5	4.3
Kvitka poliv	28.7	32.2	30.4	30.4	3.5
Vodograi belotserkivskiy	28.2	32.3	30.5	30.3	4.1
Spivanka poleska	28.1	32.0	31.1	30.4	3.9
The average	28.5	32.3	30.7	30.5	3.8
SSD_{05}	0.9	0.7	0.6	–	–
Duration of the autumn growing season, days	56	65	64	62	–
Correlation (r)*	0.32	0.27	0.37	0.15	–

***Note**: *From 0 to 0.33 – weak, 0.33 to 0.66 – medium, 0.66 to 1.00 – strong, 1.00 – complete, both for direct (+) and inverse (–) correlation (r)*

At the time of the termination of the autumn growing season, the length of the root system of plants varied from 9.2 cm (cultivar Trudivnytsa myronivska) to 9.7 cm (cultivar Spivanka poleska), and the number of nodal roots was in the range of 3.0-3.4 pcs./plant (Table 4). The difference in plant height (0.1-0.6 cm), the number of shoots and leaves on the plant was unreliable.

***Table 4**. The development of soft winter wheat plants at the time of the termination of the autumn growing season, depending on varietal characteristics (2018-2020)*

Variety	Root system length		Plant height		Quantity per plant					
					Nodal roots		of leaf		Shoots	
	cm	± to control	cm	± to control	pc	± to control	pc	± to control	pc	± to control
Trudivnytsa myronivska	9.2	–	16.1	–	3.0	–	2.5	–	6.5	–
MIP Vyshyvanka	9.6	0.4	16.7	0.6	3.3	0.3	2.8	0.3	6.8	0.3
Gratsia belotserkivska	9.0	-0.2	16.0	-0.1	3.1	0.1	2.5	0.0	6.3	0.2
Kvitka poliv	9.3	0.1	16.4	0.3	3.2	0.2	2.6	0.1	6.4	-0.1
Vodograi belotserkivskiy	9.4	0.2	16.7	0.6	3.3	0.3	2.5	0.0	6.5	0.0
Spivanka poleska	9.7	0.5	16.5	0.4	3.4	0.4	2.8	0.3	6.7	0.2
The average	9.4	–	16.4	–	3.2	–	2.6	–	6.5	–
SSD_{05}	0.8		1.0		0.5		0.4		0.3	

Winter periods have been distinguished by a significant diversity in the last few years (Table 5). According to the average long-term sum of temperatures minus 308°C, in 2018-2019 this indicator was minus 84.4°C, in 2019-2020 – minus 36.4°C, and 2019-2020 – plus 135.0°C. The amount of precipitation in the winter period prevailed on an average long-term indicator by 17 mm (2018-2019), 11.7 mm (2019-2020) and 147.1 mm (2020-2021). The length of a day with temperatures below 0°C varied from 30 – in December to 61 – in January, the average being 46 days.

***Table 5**. Hydrothermal factors of the winter dormancy period of soft winter wheat plants (2018-2021)*

Month	Hydrothermal factor								
	Sum of temperatures, °C				Number of precipitation, mm				Duration of the winter period with temperatures below 0°C, days
	2018-2019	2019-2020	2020-2021	Mean annual data	2018-2019	2019-2020	2020-2021	Mean annual data	
December	54.0	12.0	81.0	-54.0	49.9	69.3	49.9	48.0	30
January	-12.4	-102.4	-21.7	-143.0	28.4	61.0	28.4	40.0	61
February	-126.0	54.0	75.0	-111.0	69.7	12.4	69.7	43.0	47
The sum of temperatures for the winter period	-84.4	-36.4	135.0	-308.0	148.0	142.7	147.1	131.0	46

***Table 6**. Overwintering of winter wheat plants, soft depending on the biological characteristics of the variety (2018-2021)*

Variety	Overwintering plants by years, %				R_1 (range of variability by varieties)
	2018-2019	2019-2020	2020-2021	Average	
Trudivnytsa myronivska	97.3	94.2	96.4	96.0	3.1
MIP Vyshyvanka	97.9	94.5	96.5	96.3	3.1
Gratsia belotserkivska	97.1	94.0	95.9	95.7	3.1
Kvitka poliv	98.0	94.3	96.6	96.3	3.7
Vodograi belotserkivskiy	97.0	94.0	95.6	95.5	3.0
Spivanka poleska	97.7	94.8	96.8	96.4	2.9
The average	97.5	94.3	96.3	96.0	3.2
SSD_{05}	0.5	0.6	0.9		
R_2 (range of variability over the years)	0.9	0.8	1.2	0.9	–
The sum of temperatures for the winter period	-84.4	-36.4	135.0	-308.0	–
Correlation (r)*	0.14	-0.72	0.40	–	–

***Note**: *From 0 to 0.33 – weak, 0.33 to 0.66 – medium, 0.66 to 1.00 – strong, 1.00 – complete, both for direct (+) and inverse (–) correlation (r)*

The cultivation of varieties of the forest-steppe ecological type of soft winter wheat confirmed their high adaptability to various changes in external factors in winter, provided by both modification and genotypic variability, which cannot be considered separately (Table 6). The range of variability of plant overwintering by cultivars (R_1) was unreliable and varied from 2.9% cultivar Spivanka poleska to 3.7% cultivar Kvitka poliv (SSD_{05}=0.5-0.9%) and reliable over the years (R_2) – 0.9-1.2% (SSD_{05}=0.9-1.2%). A strong inverse correlation was observed between the sum of temperatures (°C) in winter and overwintering of plants (%) in 2019-2020 (r= -0.72), the average straight line – in 2020-2021 (r=0.40) and a weak straight line – in 2018-2019 (r=0.14).

CONCLUSIONS

It has been established that when growing soft winter wheat in the Western Forest-steppe zone of Ukraine, the most limiting factors in the technological process are weather factors and variety. The adaptive ability has been confirmed, which has a deeply specific character and is closely related to the weather conditions of the place where the variety was created. Varieties of forest-steppe ecological type provide insignificant phenotypic variability of adaptive traits, so the production is not recommended to give preference to varieties that are not in the Register of plant varieties suitable for distribution in Ukraine.

Changes in weather factors, in particular, an increase in the temperature regime by 244-247°C in the autumn-winter period and the optimal amount of precipitation, contribute to sufficient (31.6-34.6 mm) productive soil moisture (0-20 cm), providing a high percentage of field germination of seeds of varieties (93.8-94.5%). In 2018-2021 the duration of the autumn vegetation of plants was 3-12 days longer, which caused 3.5-5.7% higher accumulation of sugars in the tillering nodes, increasing the overwintering of plants to 95.5-96.4%.

REFERENCES

[1] Sadras, V.O., Lawson, C., & Montoro, A. (2012). Photosynthetic traits in Australian wheat varieties released between 1958 and 2007. *Field Crops Research,* 134, 19-29. doi: 10.1016/j.fcr.2012.04.012.

[2] Rudnik-Ivashchenko, A.I. (2012). Features of growing winter crops in conditions of climate change. *Variety Study and Protection of Plant Varieties*, 2, 8-10.

[3] Tereshchenko, Yu.F., Ulich, L.I., Sokolyuk, L.P., & Krivykh, M.S. (2012). Variety study of morpho-biological characteristics, selection of complementary varieties and refinement of varietal technologies for growing winter wheat. *Collection of Scientific Papers of the Uman National University of Horticulture,* 80(1), 144-149.

[4] Kirilenko, V.V., Dergachev, A.L., Gumenyuk, A.V., & Dubovik, N.S. (2016). Productivity of promising genotypes of soft winter wheat depending on growing conditions. *Agriculture and Breeding in Belarus*, 52, 95-101.

[5] Lyubich, V.V. (2017). Productivity of wheat varieties and lines depending on abiotic and biotic factors. *Bulletin of the Black Sea Region*, 3(95), 146-160.

[6] Priadkina, G.O., Stasik, O.O., Poliovyi, A.M., Yarmolska, O.E., & Kuzmova, K.Z. (2020). Radiation use efficiency of winter wheat canopy during pre-anthesis growth. *Plant Physiology and Genetics*, 52(3), 208-223. doi: 10.15407/frg2020.03.208.

[7] Kryvoshein, O.O., Odnoletok, L.P., & Dzyuba, L.P. (2016). Impact evaluation of weather conditions and farming practices in crop yield of winter wheat through its climatic potential. *Agrometeorology. Scientific works of Ukrainian Research Hydrometeorological Institute,* 269, 151-158.

[8] Polevoy, A.N., Bozhko, L.Yu., & Krysak, A.A. (2019). Agroclimatic assessment of the impact of the autumn-winter period on the productivity of winter wheat. In A.A. Holma, T.A. Chaika, I.A. Yasnolob (Eds.), *Natural resource and energy potentials: Directions of conservation, restoration and rational use* (pp. 50-57). Poltava: Astraya Publishing House.

[9] Chen, X.-X., Zhang, W., Liang, X.-Y., Liu, Y.-M., Xu, S.-J., Zhao, Q-Y., Du, Y-F., Zhang, L., Chen, X-P., & Zou, C-Q. (2019). Physiological and developmental traits associated with the grain yield of winter wheat as affected by phosphorus fertilizer management. *Scientific Reports,* 9(1), article number 16580. doi: 10.1038/s41598-019-53000-z.

[10] Krivenko, A.I., Pochkolina, S.V., & Kudryashov, N.S. (2020). Winter wheat productivity depending on forecrops in short crop rotations in the Southern Steppe of Ukraine. *Tavriyskiy Scientific Bulletin*, 116(2), 3-9.

[11] Varavkin, V.A. (2011). Dependence of the growth response of winter wheat seedlings on the effect of temperature stress and treatment with etamon. *Bulletin of Agrarian Science,* 11, 30-32.

[12] Morgun, V.V., Priadkina, G.A., Stasik, O.O., & Zborivska, O.V. (2020). Canopy assimilation surface and yield of winter wheat varieties under atypical weather conditions. *Factors in Experimental Evolution of Organisms*, 27, 259-264. doi: 10.7124/FEEO.v27.1335.

[13] Pradhan, S., Sehgal, V.K., Bandyopadhyay, K.K., Panigrahi, P., Parihar, C.M., & Jat, S.L. (2018). Radiation interception, extinction coefficient and use efficiency of wheat crop at various irrigation and nitrogen levels in a semi-arid location. *Indian Journal of Plant Physiology,* 23(3), 416-425. doi: 10.1007/s40502-018-0400-x.

[14] Morales, F., Ancin, M., Fakhet, D., Gonzalez-Torralba, J., Gamez, A.L., Seminario, A., Soba, D., Mariem, S.B., Garriga, M., & Aranjuelo, I. (2020). Photosynthetic metabolism under stressful growth conditions as a bases for crop breeding and yield improvement. *Plants,* 9, article number 88. doi: 10.3390/plants9010088.

[15] Polevoy, A.N., Blyshchyk, D.V., & Feoktistov, P.A. (2015). Modeling the formation of winter hardiness in winter wheat plants. *Problems of Ecological Monitoring and Ecosystem Modelling*, 1, 28-48.

[16] Awal, M.A., Amin, M.R., Rhaman, M.S., Shelley, I.J., & Rahman, M.Sh. (2017). Canopy characters and light-use efficiency of some modern wheat varieties in Bangladesh. *Journal of Agriculture and Ecology Research International*, 11(1), 1-16. doi: 10.9734/JAERI/2017/31744.

[17] Priadkina, G.O., Stasik, O.O., Kapitanska, O.S., Yarmolska, O.E., & Tsukrenko, N.V. (2019). Efficiency of use of photosynthetically active radiation in winter wheat crops. *Bulletin of Kharkiv National Agrarian Univerrsity. Series Biology*, 1(46), 23-34. doi: 10.35550/vbio2019.01.023.

[18] Lollato, R.P., & Edwards, J.T. (2015). Maximum attainable wheat yield and resource-use efficiency in the southern great plains. *Crop Science*, 55(6), 2863-2876. doi: 10.2135/cropsci2015.04.0215.

[19] Tao, Z.Q., Wang, D.M., Ma, S.K., Yang, Y.S., Zhao, G.C., & Chang, X.H. (2018). Light interception and radiation use efficiency response to tridimensional uniform sowing in winter wheat. *Journal of Integrative Agriculture*, 17(3), 566-578. doi: 10.1016/S2095-3119(17)61715-5.
[20] Izhik, N.K. (1976). *Field germination.* Kyiv: Urozhay.
[21] Maysuryan, M.A. (1970). *Workshop on plant growing*. Moscow: Kolos.
[22] Fursova, H.K., Fursov, D.I., & Serhyeyev, V.V. (2004). *Crop production: Laboratory and practical employment.* Kharkiv: TO Exclusive.
[23] Bertrand, M. (1906). Le dosage des sucres réducteurs. In *Mémoires presentes a la societe chimique* (pp. 1285-1299). Paris: Masson.
[24] Yeshchenko, V.A., Kopytko, P.G., Kostogryz, P.V., & Opryshko, V.P. (2014). *Fundamentals of scientific research in agronomy*. Vinnytsia: PE "Edelweiss and K".
[25] Dospekhov, B.A. (1985). *Methodology of field experience (with the basics of statistical processing of research results)*. Moscow: Agropromizdat.

Погодні фактори та їхній вплив на адаптивні властивості сортів пшениці озимої в умовах Західного Лісостепу України

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Анотація. Потенціал урожайності пшениці м'якої озимої (*Triticum aestivum* L.) формується в мінливих погодних умовах і залежить від запропонованих агротехнологічних заходів на які реакція конкретного сорту різна. Метою цього дослідження було визначити вплив погодних факторів на польову схожість насіння пшениці озимої м'якої, ріст і розвиток рослин в осінній період та перезимівлю в зоні Західного Лісостепу України, за рахунок висіву якісного базового насіння, ретельної підготовки ґрунту та наявності оптимуму екологічних факторів. На отримання дружних і своєчасних сходів має великий вплив достатній рівень продуктивної вологості ґрунту, який захищає молоді пагінці від ймовірного дефіциту після з'явлення сходів і є тривалим джерелом зволоження на наступних етапах органогенезу. Часто умови зимівлі, коли рослини страждають від дії низьких негативних температур на початку і в кінці зимового періоду, притертої крижаної кірки, відновлення вегетації в зимовий період є причинами вимерзання, випадання, а в кінцевому результаті зниження урожайності й якості насіння. Підтверджено, що підвищення температурного режиму на 244–247 °С в осінньо-зимовий період та оптимальна кількість опадів, сприяють достатній (31,6–34,6 мм) продуктивній вологості шару ґрунту (0–20 см), що позитивно впливає на процес проростання пшениці озимої м'якої, забезпечуючи високий відсоток польової схожості насіння сортів (93,8–94,5 %), подовжує осінній розвиток рослин на 3–12 діб, що обумовлює більше на 3,5–5,7 % накопичення цукрів у вузлах кущіння та високий відсоток перезимівлі (до 95,5–96,4 %). Сорти лісостепового екологічного типу пшениці м'якої озимої мають незначну фенотипову мінливість адаптивних ознак, тому при виробництві зернової і насіннєвої продукції рекомендується віддавати перевагу внесеним до Реєстру сортам рослин, придатним для поширення в Україні для зони Лісостепу, Полісся. Викладені в цій науковій роботі рекомендації допоможуть сільськогосподарським товаровиробникам досліджуваної ґрунтово-кліматичної зони здійснювати ефективну, більш екологічно пластичну, високопродуктивну сортозміну

Ключові слова: температура повітря, кількість опадів, пшениця озима м'яка, польова схожість насіння, осінній розвиток рослин, перезимівля