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GRAIN YIELD OF PROMISING AND NEW WINTER WHEAT VARIETIES DEPENDING ON DIFFERENT SOWING DATES IN THE SOUTHERN UKRAINE

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Topicality. *In the contemporary period, due to gradual climate changes, the study of growth and development peculiarities of various varieties of winter wheat depending on sowing dates is of both scientific and practical interest. Unfortunately, in the conditions of the Southern Steppe of Ukraine, these issues are insufficiently studied, characterized by the presence of debatable points, and conclusions of individual experts show significant discrepancies. Numerous scientific research and practical experience confirm that the problem of yield and grain quality is critically acute in the Southern region of our country and requires more detailed examination.* ***Purpose****. To test and adapt innovative grain production technologies for new winter wheat varieties to the region's conditions, ensuring the genetic potential level of their yield and grain quality.* ***Materials and Methods.*** *The primary method used was field research, complemented by analytical investigations, measurements, calculations, and observations according to commonly accepted methodologies and guidelines in Agriculture and Crop Science. The study involved 10 varieties of winter wheat. Sowing was conducted in three dates: September 25, October 5, and October 15.* ***Results.*** *The study presents the results of investigating the influence of sowing dates on the yield and grain quality of various varieties of winter wheat in the Southern Steppe of Ukraine. It was established that all studied winter wheat varieties produced the highest yields at sowing on 5 October. In this case, the average yield over two years (2021–2022) was 10.9 % higher compared to the September 25 sowing date and 11.1 % higher compared to the October 15 sowing date. In 2023, compared to sowing date of 25 September, the grain yield of winter wheat was 10.2 % higher for sowing of 5 October and 8.3 % higher for sowing of 15 October, which is mathematically proven. The highest average yield over two years (2021–2022) was achieved for the following varieties when sowing on October 5: Dovira Odeska (4.03 t/ha), Storytsia (3.90 t/ha), Palitra (3.80 t/ha), Zhytnytsia Odeska (3.68 t/ha). The lowest yield was obtained in the Veteran variety (3.24 t/ha). In 2023, the highest yield for the October 5 sowing date was achieved by the following varieties: Katrusia Odeska (5.16 t/ha), Pokrovska (4.48 t/ha), Hospodarka Odeska (4.28 t/ha), Udacha Odeska (4.08 t/ha).* ***Conclusions.*** *Sowing of winter wheat is advisable to be carried out within optimal dates, specifically in early October (5.10). This approach will lead to the best results in terms of yield, income, and profitability.*

Key words: *sowing dates, winter wheat, promising varieties, yield*

Introduction. In recent years, due to climate change, the average temperature in Ukraine has increased by 1.2–1.5 ℃. According to the Ukrainian Hydrometeorological Centre, changes in temperature are most pronounced in winter, especially in January and February, when the average temperature increased by 2.3–2.5 ℃. Changes in key climate parameters significantly affect the sowing dates of crops, especially winter crops, the conditions and duration of their autumn growing season, their overwintering and the beginning of the spring growth resumption.

Modern cultivation technology for winter grain crops requires the development and implementation of new innovative solutions that would mitigate the negative environmental impact on plant growth and development and productivity. Therefore, the study of the response of promising and new varieties of winter wheat to various abiotic conditions in this context is of scientific and practical interest. Dif-

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ferent environmental conditions (air temperature, precipitation, daylight hours, and productive moisture reserves in the topsoil) are observed at different sowing dates for winter grain crops. Therefore, as the main basis for the development of normative data for the technical specifications to produce high quality seeds of promising and new varieties of winter wheat, we used the norms of their response to different environmental conditions [1–4].

Vernalisation and photoperiodic sensitivity are critical factors affecting the growth of winter wheat after seedling emergence. Modern varieties, which were developed through traditional breeding without the participation of spring forms of southern origin, have the ability to vernalise not only at low winter temperatures but also at moderately high temperatures (+16...+18 ℃) with a short day. [5–9]. According to M. Lytvynenko and S. Lyfenko, intensive and universal new varieties of winter wheat have a curtailed vernalisation period and low photoperiodic sensitivity, unlike previous varieties, which, on the contrary, have a long vernalisation period and high photoperiodic sensitivity. New winter wheat varieties are highly responsive to early sowing dates because they grow very quickly in autumn and have a short ontogeny period. For this reason, the optimal sowing date for these varieties is 5–8 days later than for previous varieties [10–12].

In spring, at the beginning of vegetation recovery, the second period of winter wheat development begins, which ends in summer with the formation of the crop and the death of plants. The beginning of growth resumption is considered when the air temperature passes +5℃ and continues to rise. During this period, the above-ground organs and nodal roots of plants grow intensively, which can be seen with the naked eye [13, 14].

Sowing dates for winter wheat vary within September – mid-October. However, climate warming, droughts in autumn and spring and summer, prolongation of the autumn growth of winter crops, warm winters with frequent thaws and precipitation, which contribute to the resumption of plant growth several times during the winter, all these factors encourage further research into sowing dates and their impact on grain yield and quality and the response of varieties with intensive early growth [15, 16].

Materials and Methods. The research was carried out during 2021-2023 in the fields of the Odesa State Agricultural Research Station of the Institute of Climate-Smart Agriculture of NAAS. The main research method was field, which was accompanied by analytical studies, measurements, calculations and observations in accordance with generally accepted methods and guidelines in agriculture and crop production [17].

In the experiment, ten varieties of winter wheat (Table 1) of different years of registration were studied. Sowing was carried out in three dates: 25 September, 5 and 15 October. The experiment was repeated three times.

Results and Discussion. Our research shows that sowing dates have a significant effect on winter wheat yields. Only three varieties of winter wheat were studied for three years (Table 2).

The analysis of the research results shows that on average, the highest yield (3.69 t/ha) was obtained when sowing was carried out on 5 October. During sowing on 25 September and 15 October, the yield was almost the same, the difference was insignificant.

On average, over the three years of research, the highest yield was formed by the Dovira Odeska variety (3.99 t/ha) at sowing on 5 October.

At sowing on 25 September, the grain yield of winter wheat was lower by 13.2 %, and at sowing on 15 October by 5.7 %.

On average over two years of research, the yields of ten winter wheat varieties show that optimal weather conditions for plant growth and development and grain formation were achieved at sowing on 5 October (Table 3).

During the two years of research, on average, ten varieties showed the highest yield (3.60 t/ha) at sowing on 5 October. The result was 10.9 % higher compared to the first date (25 September) and 11.1 % higher compared to the third date (15 October).

The early and late sowing dates (25 September and 15 October) should be considered acceptable. The difference between the yields obtained from sowing on 25 September (3.31 t/ha) and 15 October (3.24 t/ha) is insignificant.

The highest yields were recorded for the varieties sown on 5 October, including Dovira

Table 1. Experimental design (2021–2023)

Variety	Year of registration	Sowing date		
		25 September	05 October	15 October
		Plot No.		
Fortetsia	2019	1	4	7
Pokrovska	2020	2	5	8
Dovira Odeska	2020	3	6	9
Experimental design (2021–2022)				
		Plot No.		
Zhytnytsia Odeska	2016	1	11	21
Lira Odeska	2013	2	12	22
Fortetsia	2019	3	13	23
Palitra	2019	4	14	24
Liha Odeska	2017	5	15	25
Nasnaha	2015	6	16	26
Veteran	2014	7	17	27
Pokrovska	2020	8	18	28
Storytsia	2015	9	19	29
Dovira Odeska	2020	10	20	30
Experimental design (2023)				
		Plot No.		
Katrusia Odeska	2016	1	11	21
Mudrist Odeska	2015	2	12	22
Fortetsia	2019	3	13	23
Udacha Odeska	2021	4	14	24
Hospodarka Odeska	2022	5	15	25
Oranta Odeska	2017	6	16	26
Peremoh Odeska	2018	7	17	27
Pokrovska	2014	8	18	28
Vyhoda Odeska	2021	9	19	29

Table 2. Grain yield of winter wheat varieties depending on on sowing dates, t/ha (average for 2021–2023)

Variety (A)	Sowing date (B)			Average
	25 September	05 October	15 October	
Fortetsia	2.92	3.21	3.25	3.13
Pokrovska	3.15	3.87	2.93	3.32
Dovira Odeska	3.72	3.99	3.71	3.81
Average	3.26	3.69	3.30	3.42
%, to sowing date (25 September)	100	113.2	101.2	
LSD_{05}, t/ha	A–0.09; B–0.09; AB–0.18			

Odeska (4.03 t/ha), Storytsia (3.90 t/ha), Palitra (3.80 t/ha), and Zhytnytsia Odeska (3.68 t/ha). Veteran variety produced the lowest yield (3.24 t/ha).

Our studies show that winter wheat varieties of different years of registration and with different vernalisation conditions and photosensitivity respond differently to the same abiotic conditions within each sowing date. For example, the Zhytnytsia Odeska variety, sown on 15 October, had a grain yield of 3.46 t/ha, and the Pokrovska variety – 2.68 t/ha, i.e. the difference was 0.78 t/ha.

The cultivation of different winter wheat varieties in 2022–2023 allowed us to determine that yields vary depending on the sowing dates (Table 4). This year, other winter wheat varieties were studied in comparison with the 2020–2021 and 2021–2022 growing seasons.

The data obtained indicate that the highest yield of 3.90 tonnes per hectare was

Table 3. Grain yield of winter wheat varieties depending on on sowing dates, t/ha (average for 2021–2022)

Variety (A)	Sowing date (B)			Average
	25 September	05 October	15 October	
Zhytnytsia Odeska	3.66	3.68	3.46	3.60
Lira Odeska	2.82	3.33	3.15	3.10
Fortetsia	2.83	3.28	3.24	3.12
Palitra	3.65	3.80	3.57	3.67
Liha Odeska	3.10	3.65	2.97	3.24
Nasnaha	3.31	3.50	3.21	3.34
Veteran	3.08	3.24	2.84	3.05
Pokrovska	3.04	3.57	2.68	3.10
Storytsia	3.79	3.90	3.47	3.72
Dovira Odeska	3.84	4.03	3.78	3.88
Average	3.31	3.60	3.24	3.38
%, to sowing date (25 September)	100	110.9	97.0	
LSD_{05}, t/ha	A–0.08; B–0.08; AB–0.16			

Table 4. Grain yield of winter wheat varieties depending on on sowing dates, t/ha (2023)

Variety (A)	Sowing date (B)			Average
	25 September	05 October	15 October	
Katrusia Odeska	4.73	5.16	4.58	4.82
Mudrist Odeska	3.29	3.28	3.26	3.28
Fortetsia	3.10	3.09	3.26	3.15
Udacha Odeska	3.67	4.08	3.88	3.88
Hospodarka Odeska	3.89	4.28	3.90	4.02
Oranta Odeska	3.62	3.81	3.72	3.72
Peremoha Odeska	3.39	3.69	3.67	3.58
Pokrovska	3.37	4.48	3.43	3.76
Vyhoda Odeska	2.84	3.16	2.76	2.92
Dovira Odeska	3.50	3.92	3.58	3.67
Average	3.54	3.90	3.60	3.68
%, to sowing date (25 September)	100	110.2	101.7	
LSD_{05}, t/ha	A–0.09; B–0.09; AB–0.18			

obtained when sowing on 5 October. The deviation between the yields from 5 October and 15 October was 0.30 t/ha for ten varieties. Compared to sowing on 25 September, the increase in yield was 0.36 t/ha. The difference in yields between the sowing dates of 25 September and 15 October was insignificant.

Winter wheat grain yield was 10.2 % higher compared to the sowing on 25 September and 8.3 % higher compared to the sowing on 15 October. The following varieties produced the highest yields when sown on 5 October: Katrusia Odeska (5.16 t/ha), Pokrovska (4.48 t/ha), Hospodarka Odeska (4.28 t/ha), and Udacha Odeska (4.08 t/ha). The lowest yield was recorded for Fortetsia (3.09 t/ha).

An analysis of economic indicators of winter wheat cultivation was conducted to determine the economic efficiency of the developed elements of winter wheat cultivation technology depending on the sowing dates. The production rates, prices for mechanised and manual work were taken in accordance with the standards recommended for the production of crop production. We calculated the following key indicators to assess economic efficiency: prime cost, net operating profit and profitability.

On average for two years (2021–2022), the calculation of the economic efficiency of growing ten varieties of winter wheat (Table 5) shows that sowing on 5 October resulted in the highest yield of 3.60 t/ha, the highest conditio-

Table 5. Economic efficiency of cultivation for ten varieties of winter wheat at different sowing dates (average for 2021–2022)

Indicator of efficiency	Sowing date		
	25 September	05 October	15 October
Grain yield, t/ha	3.31	3.60	3.24
Cost of production per 1 ha, UAH	25950.40	28224.00	25401.60
Production costs per 1 ha, UAH	14054.00	14054.00	14054.00
Prime cost per 1 tonne of grain, UAH	4245.92	3903.89	4334.65
Conditional net profit: per 1 ha, UAH per 1 tonne, UAH	 11896.40 3594.07	 14170.00 3936.11	 11347.60 3502.35
Profitability level, %	84.6	100.8	80.7

nal profit per 1 ha was 14170.00 UAH; per 1 tonne of product – 3936.81 UAH, and the highest profitability was 100.8% with the lowest prime cost of production – 3903.89 UAH.

Conclusions. In the Southern Ukraine, sowing of winter wheat should be carried out at the optimum time, namely in early October. This will ensure the best results in terms of yield, profit and profitability.

The highest yields of winter wheat over the last two years (2021–2022) were produced by the following varieties sown on 5 October: Dovira Odeska (4.03 t/ha), Storytsia (3.90 t/ha), Palitra (3.80 t/ha), Zhytnytsia Odeska (3.68 t/ha). The Veteran variety had the lowest yield (3.24 t/ha).

In 2023, the highest yields of winter wheat were obtained by the following varieties sown on 5 October: Katrusia Odeska (5.16 t/ha), Pokrovska (4.48 t/ha), Hospodarka Odeska (4.28 t/ha), Udacha Odeska (4.08 t/ha). The lowest yields was recorded in the Fortetsia variety (3.09 t/ha).

References

1. Druziak, V. H. (2002). *Stroky sivby yak element adaptyvnoi selektsii ozymoi pshenytsi* [Sowing dates as an element of adaptive selection of winter wheat]. *Adaptyvna selektsiya roslyn. Teoriya i praktyka: tezy mizhnar. konf.* Proceedings of the *Adaptive selection of plants. Theory and practice:* intern. conf. (pp. 39–40). November 11–14, 2002, Institute of plant breeding named after V. Ya. Yuriev, Kharkiv. Ukraine. [in Ukrainian].
2. Druziak, V. H. (2002). Influence of sowing dates of new varieties of winter soft wheat on grain yield. *Ahrarnyi visnyk Prychornomoria:* zb. nauk. prats - **[**Agrarian Bulletin of the Black Sea Littoral], *18*. 15–16. [in Ukrainian].
3. Lyfenko, S. F., Lytvynenko, M. O. (2000). Achievements in the breeding of soft winter wheat. *Visnyk ahrarnoyi nauky* [Bulletin of Agrarian Science], *12*. 15–16. [in Ukrainian].
4. Stelmakh, A. F., Lytvynenko, M. A., Fait, V. I. (2004). Springing requirement and photosensitivity of modern genotypes of winter soft wheat. *Zb. nauk. prats SHINATs NAIS* [Collection of scientific works of the Institute of Selection and Genetics - National Center for Seed Science and Varietal Studies], *5 (45)*. 118–127. [in Ukrainian].
5. Feoktistov, P. O., Pomond, S. A. (2004). The main requirements for the adaptability of the variety in conditions of global climate change. *Ahrarna nauka:* naukovo-tekhnichnyi biuleten Myronivskoho instytutu pshenytsi im. V. M. Remesla [Agricultural science], *3*. 40–46. [in Ukrainian].
6. Bulavka, N. V. (1980) Inheritance of the length of the vernalization stage of some winter varieties of soft winter wheat of Myroniv selection. *Biuleten VNDI roslynnytstva* [Bulletin of All-Union Institute of Crop Production], *98*. 62–63. [in Ukrainian].
7. Bulavka, V. N. (1981). Vyvchennia riznomanitnykh myronivskykh sortiv ozymoi pchenytsi po dovzhyni stadia yarovyzatsii [Study of various Myronovka winter wheat varieties according to the length of the vernalization stage]. *Pryiomy i metody pidvyshchennia urozhai-nosti poliovykh kultur*, 78–79. [in Ukrainian].
8. Bulavka, N. V., Holyk, L. M. (2007). The springing need of modern varieties of soft winter whea (*Tritisum aestivum*). *Sortovyvchennia ta okhorona prav na sorty roslyn* [Variety study and protection of rights to plant varieties], *6*. 54–59. [in Ukrainian].
9. Bulavka, N. V. (2010). Springing need, photoperiodic sensitivity and the relationship of these traits with frost resistance in Myronov varieties of winter soft wheat. *Ahrarna nauka* [Agricultural science], *10*. 59–65. [in Ukrainian].
10. Lytvynenko, M. A., Lyfenko, S. P. (2004). Influence of sowing dates and sublethal winter temperatures on survival and yield of winter wheat. *Visnyk ahrarnoi nauky* [Bulletin of Agrarian Science], *5*. 27–31. [in Ukrainian].
11. Lyfenko, S. P., Lytvynenko, M. S., Morhun, V. V. (2001). Wheat breeding in Ukraine. *Henetyka i selektsiia v Ukraini na mezhi tysiacholit* [Genetics and breeding in Ukraine on the verge of millennia]. (V. V. Morhun Ed.). Kyiv: Lohos. [in Ukrainian].
12. Lyfenko, S. P., Yerinyak, N. I., Narhan, T. P. (2002).

Selection of varieties of winter soft wheat of intensive type. *Zb. nauk. prats*. *Odesa: SHI-NATs NAIS* [Collection of scientific works of the Institute of Selection and Genetics - National Center for Seed Science and Varietal Studies], *3 (43)*. 22–42. [in Ukrainian].
13. Netis, I. T. (1998). *Naukove obhruntuvannia ta rozrobka enerhozberihaiuchykh tekhnolohii vyroshchuvannia ozymoi miakoi i tverhoi pshenytsi na zroshuvanykh zemliakh pivdnia Ukrainy* [Scientific substantiation and development of energy-saving technologies for growing winter soft and hard wheat on irrigated lands of southern Ukraine]. (Doct. Agric. Sci. Diss.). Kherson. Ukraina. [in Ukrainian].
14. Druziak, V. H. (2002). Influence of sowing dates of new varieties of winter soft wheat on grain yield. *Ahrarnyi visnyk Prychornomoria* [Agrarian Bulletin of the Black Sea Littoral], *18*. 123–127. [in Ukrainian].
15. Netis, I. T. (2009). Critical moisture for winter wheat. *Zerno* [Grain], *1*. 41–46. [in Ukrainian].
16. Shevchenko, A. I., Zhyvotkov, L. O., Barsuk, H. Yu., Hubenko, N. P., Hubenko, I. A. (2003). Basic recommendations for sowing winter barley and caring for its crops. *Ahronom* [Agronomist], *8*. 80–82. [in Ukrainian].
17. Kryvenko, A. I., Pochkolina, S. V. (2019). Realization of the genetic potential level of yield of various varieties of winter wheat and barley depending on the terms of sowing in the conditions of the Black Sea Steppe of Ukraine. *Ahrarnyi visnyk Prychornomoria* [Agrarian Bulletin of the Black Sea Littoral], *92*. 44–52. [in Ukrainian].

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Почколіна С. В., Когут І. М., Сергєєв Л. А., Мельник О. Т. Урожайність зерна перспективних і нових сортів пшениці озимої залежно від різних строків сівби в умовах півдня України.
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Актуальність. У зв'язку зі змінами клімату вивчення особливостей росту та розвитку різних сортів пшениці озимої залежно від строків сівби представляють науковий і практичний інтерес. На жаль, в умовах півдня України ці питання вивчені недостатньо, відрізняються наявністю дискутивних моментів, а висновки окремих фахівців з них мають велику розбіжність. Чисельні наукові досліди та практика підтверджують, що в південному регіоні нашої країни проблема урожайності зерна та його якості стоїть дуже гостро і потребує більш детального вивчення. **Мета.** Випробувати та адаптувати до умов регіону інноваційні технології виробництва зерна пшениці озимої нових сортів для забезпечення генетично-потенційного рівня їх урожайності і якості зерна. **Матеріали і методи.** Основний метод – польовий, який доповнювався аналітичними дослідженнями, вимірами, підрахунками і спостереженнями відповідно до загальноприйнятих методик та методичних рекомендацій у землеробстві і рослинництві. У досліді вивчалися десять сортів пшениці озимої. Сівба проводилася у три строки: 25 вересня, 5 і 15 жовтня. **Результати.** Встановлено, що вищі урожаї одержано за сівби 5 жовтня у всіх сортів пшениці озимої, які вивчалися. За цього строку урожайність, в середньому за два роки (2021–2022 рр.), була вище на 10,9 % порівняно зі строком сівби 25 вересня, на 11,1 % – у порівнянні зі строком сівби 15 жовтня. У 2023 р. порівняно з сівбою 25 вересня урожайність зерна пшениці озимої була вища на 10,2 % при сівбі 5 жовтня і вища на 8,3 % за сівби 15 жовтня. Найвищий врожай, у середньому за 2 роки, сформували за сівби 5 жовтня такі сорти: Довіра одеська (4,03 т/га), Сториця (3,90 т/га), Палітра (3,80 т/га), Житниця одеська (3,68 т/га). Мінімальний врожай отримали у сорту Ветеран (3,24 т/га). У 2023 р. за сівби 5 жовтня найбільший урожай отримали такі сорти: Катруся одеська (5,16 т/га), Покровська (4,48 т/га), Господарка одеська (4,28 т/га), Удача одеська (4,08 т/га). **Висновки.** Сівбу пшениці озимої доцільно проводити в оптимальні строки, а саме на початку жовтня (5.10). При цьому будуть отримані найкращі результати за урожаєм, прибутком та рівнем рентабельності.

Ключові слова: *строки сівби, пшениця озима, перспективні сорти, урожайність*