




**original article** | UDC 633.111:631.526.32 | doi: 10.31210/visnyk2022.01.01**INFLUENCE OF VARIOUS WINTER WHEAT VARIETY PROPERTIES ON PRODUCTIVITY VARIABILITY**S. M. Shakalii<sup>1\*</sup>A. V. Bahan<sup>1</sup>S. O. Yurchenko<sup>1</sup>L. M. Golovash<sup>2</sup>ORCID  [0000-0002-4568-1386](https://orcid.org/0000-0002-4568-1386)ORCID  [0000-0001-8851-5081](https://orcid.org/0000-0001-8851-5081)ORCID  [0000-0002-5812-3877](https://orcid.org/0000-0002-5812-3877)ORCID  [0000-0002-5486-8302](https://orcid.org/0000-0002-5486-8302)<sup>1</sup> Poltava State Agrarian University, 1/3, Skovorody Str., Poltava, 36003, Ukraine<sup>2</sup> Ustymivka Research Station of Plant Breeding IR NAAS of Ukraine, Academician M. I. Vavilov, 15, st., Ustimovka substation, Globinsky district, Poltava region, 39074, Ukraine

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Every year, a large number of winter wheat varieties are entered into the State Register of Plant Varieties Suitable for Distribution in Ukraine. And the figures are constantly growing. Before choosing them, determine the parameters of the requirements for them and objectively assess the level of technological support of the economy, composition and fertility of soils, the level of their cultivation, predecessors and timing of harvest, natural and climatic zone and weather conditions of the year; take into account the spread of typical pests and pathogens in the region, because the genetic potential of the variety can be realized only if the technology meets its biological properties. The aim of the research was to evaluate the varieties of soft winter wheat according to the indicators that form the yield. To do this, the effect of the variety on the sowing properties of winter wheat grain was established; substantiated the role of the variety in the formation of wheat yields; established the main indicators of crop structure that shape plant productivity. The lowest yields were Sagaidak (5.4 t/ha), Favoritka and Smuglyanka (5.5 t/ha). It exceeded the Orzhysia variety by 0.5 t/ha and the Bohdan variety by 0.3 t/ha. Compared to 2019, 2020 had a slightly higher yield. In the variety Sagaidak and Vilshana it increased by 0.4 t/ha. At 0.3–0.4 t/ha – in the varieties Favoritka and Smuglyanka. Bohdan variety exceeded the yield in 2019 by 0.3 t/ha. The highest yield remained in the variety Orzhysia and amounted to 6.4 t/ha. The grain yield of winter wheat varieties in 2021 was from 5.7 to 6.3 t/ha. This year the high yields are Smuglyanka – 6.0 t/ha, Bohdan – 6.1 t/ha, Orzhysia – 6.3 t/ha. Favorite varieties – 5.8 t/ha and Sagaidak – 5.7 t/ha have lower yields. The conducted research showed us how the variability of the elements of the structure of the harvest of winter wheat varieties is explained by the uneven moisture supply for all years of research. A necessary task is to constantly determine the variability of winter wheat productivity depending on varietal characteristics.

**Key words:** winter wheat, variety, productivity, sowing properties, yield structure, yield.

**ВПЛИВ СОРТОВИХ ВЛАСТИВОСТЕЙ ПШЕНИЦІ М'ЯКОЇ ОЗИМОЇ НА МІНЛИВІСТЬ ПРОДУКТИВНОСТІ**

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*Щороку до «Державного реєстру сортів рослин, придатних для поширення в Україні» вноситься велика кількість сортів пшениці озимої. І показники постійно зростають. Перш ніж їх вибирати, визначаються із параметрами вимог до них та об'єктивно оцінити рівень технологічного забезпечення господарства, склад і родючість ґрунтів, рівень їх окультурення, попередники та строки збирання, природно-кліматичну зону й погодні умови конкретного року; враховують поширення типових шкідників і збудників хвороб у регіоні, адже генетичний потенціал сорту може бути реалізований лише за умови, коли технологія відповідає його біологічним властивостям. Метою досліджень було оцінити сорти пшениці м'якої озимої за показниками, які формують врожайність. Для цього встановили вплив сорту на посівні властивості зерна пшениці озимої; обґрунтували роль сорту у формуванні врожайних показників пшениці; встановили основні показники структури врожаю, які формують продуктивність рослин. Найменшою урожайністю виділився сорт Сагайдак (5,4 т/га), Фаворитка та Смуглянка (5,5 т/га). На 0,5 т/га перевищив сорт Оржиця та на 0,3 т/га сорт Богдана. В порівнянні з 2019 роком 2020 рік мав децю вищу врожайність. У сорту Сагайдак та Вільшана вона підвищилася на 0,4 т/га. На 0,3–0,4 т/га – у сортів Фаворитка та Смуглянка. Сорт Богдана перевищив врожайність 2019 року на 0,3 т/га. Найвищою врожайність залишилася у сорту Оржиця і склала 6,4 т/га. Урожайність зерна сортів пшениці озимої 2021 року була від 5,7 до 6,3 т/га. В цей рік високою врожайністю вирізняються сорти Смуглянка – 6,0 т/га, Богдана – 6,1 т/га, Оржиця – 6,3 т/га. Нижчою врожайністю вирізняються сорти Фаворитка – 5,8 т/га та Сагайдак – 5,7 т/га. Проведені дослідження нам показали, як мінливість елементів структури врожаю сортів пшениці озимої пояснюється нерівномірною вологозабезпеченістю за всі роки досліджень. Необхідним завданням є постійне визначення мінливості продуктивності пшениці озимої залежно від сортових особливостей.*

**Ключові слова:** пшениця озима, сорт, продуктивність, посівні властивості, структура врожаю, урожайність.

**Introduction**

One of the main conditions for obtaining grain with higher yields is the introduction of new but most high-yielding varieties in production, which have increased winter hardiness, drought resistance, resistance to many diseases and pests, with high baking properties and good yield potential [1–3]. The variety can show its high productivity and good quality only when the technology of its cultivation to the greatest extent corresponds to their biological characteristics [4].

Comparative study, as well as new more high-yielding varieties of winter wheat and already studied remains relevant [5]. Varieties in specific soil-climatic zones allow the most objective assessment of their relationship, to identify the most effective methods that will ensure higher and stable grain yields of good quality [6–8].

In modern conditions, there is a shortage of wheat grain in the world, and humanity is once again facing an acute problem of food crisis. The annual production of wheat grain averages about 840 million tons [9]. Meeting this need is a difficult task given that the world's sown area is declining and wheat yields in more developed countries have already reached a maximum, for example, in European countries is more than 8 t/ha [10].

Variety is one of the cheapest and most affordable ways to increase yields. Without it, it is impossible to realize the achievements of scientific and technological progress in agriculture [6]. Increasing yield potential has always been and remains fundamentally important in breeding programs. But modern varieties should be not only high-yielding, producing high quality products, but also resistant to adverse environmental factors, highly adapted, highly homeostatic [11–15].

Producing the necessary volumes of high-quality food and feed grain is a strategic task of the agro-industrial complex at the present stage of food security and will be crucial for the world community in the future, as the annual population growth confirms the fact that many do not eat enough. and starves [16].

## СІЛЬСЬКЕ ГОСПОДАРСТВО. РОСЛИННИЦТВО

The aim of the research was to evaluate the varieties of soft winter wheat in terms of sowing quality and yield elements.

### Materials and methods of research

Field research was conducted during 2019–2021 in the production conditions of FG "Mir - 2" Myrhorod district of Poltava region and in the laboratory conditions of the Laboratory of Grain Quality of Poltava State Agrarian University. Placement of experiments, selection of soil samples for fertility analysis was performed according to generally accepted methods [17].

For research we used data from six varieties of soft winter wheat: Sagaidak, Vilshana, Orzhitsa, Favoritka, Smuglyanka, Bogdan.

During the vegetation periods of 2019–2021, we determined the sowing qualities of seeds in accordance with current standards for seeds of agricultural crops. Seeds that meet the requirements of GOST 52325-2005 [1] were used for sowing. All plants within the site were combined into bundle samples, which were then used for laboratory analysis of crop structure.

Accounting for standing density and determination of field germination was determined during the period of full germination on stationary sites (0.25 m<sup>2</sup>) in three repetitions for each repetition of the experiment. Determination of crop structure was performed according to the method of State variety testing for each variant of the experiment. For analysis, we counted the number of stems, and also productive, the length of the ear, and the number of grains on the ear, determined the mass of grain from the ear, and 1000 grains [18]. After harvesting wheat, the harvest was recorded by weighing the grain harvest from each plot. Then determine its humidity. Biological yield was determined by the method of beam selection, but each repetition in the experiment.

### Research results and their discussion

It is well known that the number of plants preserved before harvest, and therefore the harvest is largely determined by the density of seedlings, which is directly related to germination energy and field germination [1, 19].

The field germination index characterizes the sowing and yielding qualities of seeds, as well as the viability of germinating seeds. The value of this indicator depends on many factors: soil characteristics, reserves of productive moisture, soil and air temperature, sowing technology and others. The degree of influence of individual factors is determined not only by their severity, but also by the stage of plant organogenesis [18, 20].

Over the years of testing, the field germination of winter soft wheat varieties by varieties varied on average from 88 to 95 % (Table 1).

#### *1. Influence of varietal characteristics on sowing qualities of winter wheat*

Varieties	2019	2020	2021	average
Seed germination energy, %				
Sagaidak	74	75	73	74
Vilshana	80	78	77	78
Orzhitsia	83	90	84	85
Favorite	80	78	75	77
Smuglyanka	77	80	80	79
Bogdana	82	80	82	81
Seed germination, %				
Sagaidak	87	88	88	88
Vilshana	90	91	92	91
Orzhitsia	95	94	97	95
Favorite	92	90	92	91
Smuglyanka	89	92	94	91
Bogdana	91	95	96	93

According to average data, the Sagaidak variety had an energy level of 74 %. Accordingly, the similarity was 88 %. It exceeded energy by 14 %. Varieties Favoritka and Vilshan according to average data had an

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energy of 77–78 %, and 91 % field germination. In the variety Orzhytsya, the seed germination energy index was the highest 85 %, and the germination rate was 95 %, which was 5–7 % higher than other varieties in terms of field germination.

In wheat, the main elements of the structure of the crop are: the density of all productive stems, and graininess, but also the productivity of the ear, as well as grain size [1].

The length of the ear in 2019 by varieties ranged from 8.5 cm (the smallest in the variety Sagaidak) to 9.6 cm (the largest variety Smuglyanka and Bogdan). The longest ears are characterized by 2021 and 2020. The length of the ear was influenced by soil and climatic conditions of the area of the experimental sites. Variety Orzhytsya from 9.0 to 11.3 cm, variety Bohdan – 9.6 to 11.0 cm. According to average data, the length of the ear was greater in the varieties Orzhytsya – 10.5 cm and Bohdan – 11.0 cm (Table 2).

### *2. Influence of variety on the structure of winter wheat yield*

Varieties	Ear length, cm				Number of grains in the ear, pcs			
	2019	2020	2021	average	2019	2020	2021	average
Sagaidak	8,5	9,4	10,2	9,4	30	31	34	32
Vilshana	8,9	10,3	10,1	9,8	32	34	36	34
Orzhytsya	9,0	11,3	11,1	10,5	33	35	38	35
Favorite	9,3	10,2	10,0	9,9	31	34	36	34
Smuglyanka	9,6	9,9	10,4	9,9	30	37	35	34
Bogdana	9,6	10,6	11,0	10,4	34	36	37	35

According to the number of grains in the ear can be distinguished: with the largest number of varieties Orzhitsa – 35–38 pieces, Bogdan variety – 34–37 pieces. Sagaidak varieties had the smallest number of grains in the ear – 30–34 pieces, Smuglyanka – 30–37 pieces.

Ear weight is a very important indicator of crop structure. The largest mass of ears was obtained in the variety Orzhytsya from 2.0 g in 2019 and 2.41 g in 2021. Smuglyanka and Bohdan varieties had a rather large ear weight during the years of research and ranged from 1.78 g to 2.30 g and 2.10 to 2.31 g, respectively (Table 3). According to the average data, the varieties Orzhytsya, Smuglyanka, Bohdan can be distinguished by the weight of the ear, and to a lesser extent – the varieties Favoritka and Vilshana.

### *3. Structural analysis of winter wheat varieties over the years of research*

Varieties	2019	2020	2021	average
Colossus mass, g				
Sagaidak	1,75	1,89	2,01	1,88
Vilshana	1,84	2,10	1,98	1,97
Orzhytsya	2,00	2,23	2,41	2,21
Favorite	1,94	2,20	2,11	2,08
Smuglyanka	1,78	2,30	2,28	2,12
Bogdana	2,10	2,24	2,31	2,22
Mass of grain from the ear, g				
Sagaidak	1,43	1,50	1,60	1,51
Vilshana	1,51	1,62	1,64	1,59
Orzhytsya	1,74	1,98	2,23	1,98
Favorite	1,60	1,81	1,72	1,71
Smuglyanka	1,50	1,96	1,94	1,80
Bogdana	1,76	1,94	2,15	1,95
Mass 1000 grains, g				
Sagaidak	37,0	40,0	39,9	38,9
Vilshana	37,8	41,9	41,0	40,5
Orzhytsya	41,0	43,7	43,1	42,6
Favorite	38,4	39,9	40,0	39,4
Smuglyanka	37,6	40,8	41,1	39,8
Bogdana	37,9	41,0	42,0	40,3

## СІЛЬСЬКЕ ГОСПОДАРСТВО. РОСЛИННИЦТВО

According to the indicator of grain weight from the ear, the varieties Orzhytsia had quite high data – 1.74–2.23 g, Bohdan – 1.76–2.15 g, Smuhlyanka – 1.50–1.94 g. Varieties Sagaidak, Vilshana and Favoritka 0.12–0.31 g less than others. According to the average data for the years, the Sagaidak and Vilshana varieties had a grain weight of 1.51 and 1.59 g, respectively. Varieties Favoritka and Smuglyanka – 1.71 and 1.80 g, respectively.

The mass of 1000 grains characterizes its size [21]. In our experiments, the mass was not less than 37.0 g, which in turn characterizes the seeds as large and full. In 2019, the weight of 1000 grains by varieties ranged from 37.0 g (Sagaidak variety) to 41.0 g (Orzhytsia variety). Vilshan and Smuglyanka varieties were 0.6–0.8 g higher than Sagaidak. About 2.0 g less weight was in the variety Favoritka than in Orzhytsia.

According to years of research, the high mass of 1000 grains was in 2020 and 2021. The largest varieties were Orzhytsia (43.7–43.1 g) and Vilshan (41.9–41.0 g), Smuhlyanka (40.8–41.1 g), respectively. Varieties of Bohdan and Favoritka in terms of weight of 1000 grains were almost within the same limits. The main indicator of the advantage of a variety, the effectiveness of agricultural techniques is the yield, which depends not only on biological characteristics but also on growing conditions [1].

Comparative analysis of all varieties for winter wheat showed us that the impact on their productivity was huge not only features of the genetics of varieties, but also formed weather conditions, sowing dates and sowing rates [14].

2019 yield was 5.4–5.9 t/ha. The lowest yields were Sagaidak (5.4 t/ha), Favoritka and Smuglyanka (5.5 t/ha) (Table 4). It exceeded the Orzhytsia variety by 0.5 t/ha and the Bohdan variety by 0.3 t/ha. Compared to 2019, 2020 had a slightly higher yield. In the variety Sagaidak and Vilshana it increased by 0.4 t/ha. At 0.3–0.4 t/ha – in the varieties Favoritka and Smuglyanka. Bohdan variety exceeded the yield in 2019 by 0.3 t/ha. The highest yield remained in the variety Orzhytsia and amounted to 6.4 t/ha (Table 4).

#### 4. Yield of winter wheat varieties for years of research, t/ha

Varieties	2019	2020	2021	Average
Sagaidak	5,4	5,8	5,7	5,6
Vilshana	5,6	6,0	5,9	5,8
Orzhytsia	5,9	6,4	6,3	6,2
Favorite	5,5	5,7	5,8	5,7
Smuglyanka	5,5	5,9	6,0	5,8
Bogdana	5,7	6,0	6,1	5,9
HIP <sub>005</sub>	0,3	0,2	0,3	

The grain yield of winter wheat varieties in 2021 was from 5.7 to 6.3 t/ha. This year the high yields are Smuglyanka – 6.0 t/ha, Bohdan – 6.1 t/ha, Orzhytsia – 6.3 t/ha. Favorite varieties – 5.8 t/ha and Sagaidak – 5.7 t/ha have lower yields. According to the yield of 2021, we can say that the farm growing these varieties received a fairly high profit.

#### Conclusions

Studies conducted during 2019–2021 with varieties of winter wheat in the Poltava region showed that the variety significantly affects the sowing properties of winter wheat grain, seed germination was up to 97 % in the field. According to average data (2019–2021), the level of grain yield by 35 % depended on weather conditions, 25 % on the variety and 20 % on other factors. Analyzing the average data for the years of research, we distinguish the varieties with the highest yield: variety Orzhytsia – 6.2 t/ha, Bohdan – 5.9 t/ha. Varieties Vilshan and Smuglyanka according to the average data were 5.8 t/ha, and slightly lower yields were in the varieties Favoritka (5.7 t/ha) and Sagaidak (5.6 t/ha). According to the yield indicator, we can single out Orzhytsia and Bohdan as the most productive.

*The prospect of further research* is to study the quality indicators (quantity and quality of gluten and protein content in grain) in the varieties of Poltava selection.

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