

## QUALITY OF GRAIN OF DIFFERENT SORTS OF WINTER WHEAT DEPENDING ON AGRO-TECHNOLOGY METHODS OF CULTIVATION IN THE CONDITIONS OF THE NORTHERN STEPPE

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*Результати наведених експериментальних досліджень свідчать, що при вирощуванні різних сортів пшениці озимої після ріпаку ярого в умовах північного Степу України, якісне зерно (третього класу) можливо одержати за сівби 25 вересня та 5 жовтня. Серед сортів, вирощених на дослідних ділянках, найбільшим вмістом білка (11,2–13,0 %) та клейковини (17,5–22,7 %) в зерні відзначався сорт Селянка, найменші показники були у сорту Подолянка – 10,6–12,5 та 17,1–21,9 % відповідно. Встановлено вплив норм висіву насіння на показники якості зерна. Високий вміст білка та клейковини в зерні був за норми висіву 4 млн схожих насінин/га, зі збільшенням посівної норми значення цих показників зменшувалися.*

*У середньому за роки досліджень найвищу врожайність формував сорт Селянка (4,89 т/га) за сівби 25 вересня (норма висіву 5 млн схожих насінин/га). Найвища врожайність сорту Золотокола-са (4,20 та 4,19 т/га) була за сівби 25 вересня (5 млн) та 5 жовтня (6 млн схожих насінин/га). Серед сортів найнижчою врожайністю відзначався сорт Подолянка – 2,99–3,75 т/га.*

**Ключові слова:** пшениця озима, сорт, строк сівби, норма висіву насіння, якість зерна, урожайність.

The northern Steppe of Ukraine long since was considered as one of the most favorable regions for receiving high-quality grain of wheat winter – the main grain culture of our state. Features of climatic conditions of a zone of the Steppe which is characterized by a low amount of precipitation within a year, frequent droughts, demand from agricultural producers of conscientious observance of recommendations about cultivation of wheat winter. They are providing consecutive performance of agrotechnical actions. Unfortunately, recently, in connection with changes in structure of the cultivated areas caused by reformation of market economy, violation by producers of the recommendation of scientific institutions on cultivation of this culture even more often is observed. It consists in carrying out sowing after not studied predecessors, in particular, a spring rape. At the same time, gradual climate changes towards warming which note recently in the territory of Ukraine, and also more intensive development of modern grades of wheat, which biological features aren't investigated yet, demand from agrarian science of improvement existing and development of new agromethods of cultivation of this culture.

Already long time scientists conduct researches on studying of influence of processing methods of cultivation on quality of grain. Under the certificate of many scientists, protein content and glutens increases in grain at cultivation of winter wheat in the conditions of increased temperatures and moderate deficiency of moisture [4, 11].

Researchers in the works note a great influence on protein content and glutens in grain of predecessors and level of mineral food of plants [7].

Scientists note high efficiency from use of tank mixes of nitric fertilizers and insecticides when processing plants which provides, at cultivation after not steam predecessors, in the conditions of the Steppe of grain 2–3 classes of quality [3].

In scientific works of domestic scientists it is noted about dependence of indicators of quality of grain on a sort, level of moisture security, protection of plants and doses of fertilizers [1, 5, 6, 12].

At the same time, in scientific literature there are no publications with results of researches on studying of seeding dates and seeding rates of modern sorts of winter wheat, at its cultivation after a spring rape in the conditions of the northern Steppe of Ukraine. Studying of the matters will allow determining parameters of formation of quality of grain by various sorts of winter wheat at

cultivation after a spring rape.

The aim of the research was to develop more advanced technological methods of cultivation of high-quality winter wheat at sowing after a spring rape in different sowing, different seeding rate. The research problem consisted in definition of factors of influence on increase of indicators of quality of grain of various sorts of wheat winter in the conditions of insufficient moistening of the northern Steppe of Ukraine.

Field experiments were conducted at the experimental field of Dnepropetrovsk State Agrarian University (now Dnepropetrovsk State Agrarian-Economic University) in 2007–2010 years, according to conventional techniques [8, 9]. The soil cover of research sites is presented by chernozems ordinary low-humus and full-height. The content of nitrogen (according to Tyurin and Kokonova) in a layer of 0–20 cm makes 8,0–8,5 mg/100 g of the soil, mobile phosphorus (according to Chirikov) – 9,0–10,0, exchange potassium (according to Maslova) – 14,0–15,0 mg/100 g of the soil. Reaction of soil solution – close to neutral, pH – 6,8–7,0. In experiences grew up sorts of wheat winter Zolotokolosa, Selyanka, Podolyanka. The predecessor – a spring rape. Seeding rates – 4, 5 and 6 million units germinating seeds/ha. Sowed CH-16 seeder in four times: 5, 15, on 25 September and on 5 October. The technology of cultivation of winter wheat, except the questions raised on studying was the standard for the northern Steppe Ukraine. Frequency in experiences – triple, placement of sites consecutive, systematic, a cultivated area of one site – 80 m<sup>2</sup>, registration – 60 m<sup>2</sup>. The accounting of a crop carried out a method of the continuous thresh of all area of a registration allotment the combine Sampo-500 (direct combining) to full ripeness of grain. Statistical data processing of productivity of winter wheat carried out on the personal computer a method of the dispersive analysis according to B. A. Dospekhov [2].

Bioclimatic resources of the northern Steppe are rather favorable for receiving grain of quality winter wheat. During carrying out researches, hydrothermal indicators significantly differed from averages long-term therefore conditions for vegetation winter were non-uniform. So, for example, annual quantity of an atmospheric precipitation in 2007/08 vegetative year I exceeded average long-term norm (514 mm) on 10 mm (1,9 %), in 2009/10 year – on 183,7 mm (26,3 %). In 2008/09 year the amount of precipitation was on 7,9 mm or is 1,5% lower in comparison with average long-term values of this indicator. At the same time, the temperature mode of air in 2007/08 year exceeded long-term norm on 0,2 °C with, in 2008/09 and 2009/10 years – on 0,7 and 3,6 °C with respectively.

First of all, it is necessary to carry the content in it of protein, a gluten and its properties, and also such baking indicators of quality to the main indicators of quality of grain of winter wheat, as the volume of bread and its porosity.

In references, according to long-term supervision on high-quality fields it is specified that the amount of protein in grain of winter wheat, can fluctuate ranging from 8,4 to 17,6 % [13]. Our researches conducted for the purpose of definition of indicators of quality of grain of various sorts of winter wheat allowed to reveal certain dependences on action of agrotechnical receptions which studied, and weather conditions which developed during carrying out researches (tab. 1).

The obtained experimental data testify that the amount of protein in grain of wheat depended on many factors, in particular, from a sort. Among sorts which were studied by us in experiences, the highest grain protein content Selyank's sort differed. Depending on seeding rate, when sowing on 5 September, protein content fluctuated within 11,2–12,1 %, on 15 September – 11,4–12,3 %, on 25 September – 12,0–12,8 %, on 5 October – 12,2–13,0 %. The amount of protein in grain was noted by the smallest at sort Podolyanka – 10,6–11,3 %, 11,2–11,6 %, 11,8–12,3 % and 11,9–12,5 %, respectively, at crops in these terms.

The greatest number of protein of a grade of winter wheat formed in the conditions of 2009 year when loss of the smallest amount of precipitation for the vegetative period winter and formation of a smaller grain yield by the sizes was noted. Bigger accumulation of protein in wheat grain this year, is explained by more droughty conditions, in comparison with other years of researches during its maturing. So, the amount of precipitation in June made only 16 mm (25,8 % mean annual monthly norm). Under more favorable conditions of moistening which noted in 2008

and 2010 years protein content at sorts of winter wheat it was considerable the smaller.

**1. Protein content in grain of different sorts of wheat winter (%) depending on seeding dates and seeding rates (2008 –2010 years)**

Seeding date	Seeding rate, mln/ha	Years			Average
		2008	2009	2010	
Sort Zolotokolosa					
5 September	4	11,1	11,8	11,3	11,4
	5	11,0	11,3	11,0	11,1
	6	10,8	11,0	10,9	10,9
15 September	4	11,5	12,1	11,6	11,7
	5	11,3	11,6	11,3	11,4
	6	10,9	11,8	11,2	11,3
25 September	4	12,1	13,1	12,3	12,5
	5	11,6	12,8	11,7	12,0
	6	11,5	12,6	11,6	11,9
5 October	4	12,2	13,2	12,4	12,6
	5	11,8	12,9	11,9	12,2
	6	11,6	12,8	11,8	12,1
Sort Selyanka					
5 September	4	11,7	12,5	12,0	12,1
	5	11,2	12,4	11,3	11,6
	6	10,8	11,9	10,9	11,2
15 September	4	12,0	12,8	12,2	12,3
	5	11,4	12,7	11,5	11,9
	6	11,0	12,1	11,1	11,4
25 September	4	12,6	13,2	12,7	12,8
	5	11,9	13,0	12,1	12,3
	6	11,5	12,5	12,0	12,0
5 October	4	12,7	13,5	12,9	13,0
	5	12,0	13,1	12,3	12,5
	6	11,6	12,7	12,3	12,2
Sort Podolyanka					
5 September	4	11,1	11,6	11,3	11,3
	5	11,0	11,2	11,0	11,1
	6	10,5	10,8	10,6	10,6
15 September	4	11,4	12,0	11,5	11,6
	5	11,2	11,5	11,2	11,3
	6	10,8	11,7	11,1	11,2
25 September	4	12,0	12,8	12,1	12,3
	5	11,5	12,5	11,6	11,9
	6	11,3	12,5	11,6	11,8
5 October	4	12,1	13,0	12,3	12,5
	5	11,7	12,7	11,8	12,1
	6	11,5	12,6	11,7	11,9

It is established that on amount of protein in grain seeding date of winter wheat had essential influence. Almost on all sites of experience of a plant when sowing on 25 September and on 5 October formed better grain on protein content. On the average for 2008–2010 years at sort Zolotokolosa when sowing on 25 September, depending on seeding rate, grain protein content made 11,9–12,5 %, at sort Selyanka – 12,0–12,8 %, at sort Podolyanka – 11,8–12,3 %. When sowing on 5 October at the specified sorts – 12,1–12,6 %, 12,2–13,0 % and 11,9–12,5 % respectively.

**2. The maintenance of gluten in grain of different sorts of wheat winter depending on seeding dates and seeding rates, % (2008–2010 years)**

Seeding date	Seeding rate, mln/ha	Years			Average
		2008	2009	2010	
Sort Zolotokolosa					
5 September	4	17,0	18,0	17,8	17,6
	5	16,9	17,9	17,4	17,4
	6	16,8	17,7	17,3	17,3
15 September	4	17,4	18,1	17,9	17,8
	5	17,2	18,2	17,9	17,8
	6	17,0	18,0	17,7	17,6
25 September	4	18,5	20,3	19,2	19,3
	5	18,3	19,8	18,3	18,8
	6	18,2	18,8	18,8	18,6
5 October	4	21,7	23,4	22,2	22,4
	5	21,5	23,2	21,8	22,2
	6	20,6	22,6	21,1	21,4
Sort Selyanka					
5 September	4	17,4	18,2	17,9	17,8
	5	17,3	18,0	17,7	17,7
	6	17,1	17,8	17,6	17,5
15 September	4	17,5	18,3	18,0	17,9
	5	17,4	18,2	17,9	17,8
	6	17,3	18,1	17,8	17,7
25 September	4	18,6	20,5	19,5	19,5
	5	18,4	20,0	18,9	19,1
	6	18,3	18,9	18,8	18,7
5 October	4	22,3	23,5	22,4	22,7
	5	21,9	23,3	22,1	22,4
	6	21,2	23,2	21,4	21,9
Sort Podolyanka					
5 September	4	16,9	17,9	17,6	17,5
	5	16,7	17,8	17,3	17,3
	6	16,6	17,6	17,1	17,1
15 September	4	17,3	18,2	17,7	17,7
	5	17,0	18,0	17,6	17,5
	6	16,9	17,9	17,5	17,4
25 September	4	18,4	18,7	18,9	18,7
	5	18,2	19,4	18,3	18,6
	6	18,1	18,3	18,1	18,2
5 October	4	21,2	22,8	21,8	21,9
	5	20,8	22,6	21,3	21,6
	6	20,5	22,5	20,8	21,3

Seeding rates, defining density of standing of plants in crops, also influenced accumulation of protein in grain. It is established that grades formed bigger grain protein content on experience options where sowing of winter wheat carried out seeding rate of 4 million units germinating seeds/ha. The increase in norm promoted reduction of protein content in grain of plants. So, increase of norm of seeding with 4 to 6 million units germinating seeds/ha at a sort Selyanka led to reduction of protein content in grain at crops on 5 September – for 7,4 %, on 15 September – for 7,3 %. On experience sites where wheat sowed on 25 September and on 5 October this difference made 6,3 and 6,2 % respectively. The similar tendency was observed at Zolotokolosa and Podolyanka grades.

It is known that the flour received from grain of wheat winter, has to possess ability to create dough which has to have necessary physical properties with high elasticity, tensile proper-

ties and considerable ability to absorb water [10]. The maintenance of a gluten in grain of different sorts of winter wheat also was defined by conditions of cultivation and depended on high-quality features of plants, seeding dates and seeding rates. More gluten contained in grain of winter wheat of a sort Selyanka. Depending on seeding rate, its quantity made at crops on September 5 – 17,5–17,8 %, on 15 September – 17,7–17,9 %, on 25 September – 18,7–19,5 %, on 5 October – 21,9–22,7 %. Sort Podolyanka in grain had a small maintenance of a gluten and, depending on seeding dates and seeding rates, made 17,1–21,9 % (watch table 2).

Plants of all sorts, which we studied in experiences, formed more gluten in grain when sowing on 25 September and on 5 October. The smallest values of this indicator experience options where sowing of wheat carried out on 5 September differed. Quality of gluten in grain, which received from skilled sites, depending on a grade, seeding dates and seeding rates, had high rates, according to the operating quality standards. By researches it is established that crops of early seeding date (on 5 September) had more indistinct gluten (more than 75 units), and later (on 25 September and on 5 October), on the contrary, more elastic (50–75 units).

The best quality of a gluten in grain was formed in the conditions of 2009 year in comparison with grain which received in 2008 and 2010 years where quality of a gluten was much worse that it is possible to explain with more damp conditions during grain maturing, high level of productivity, and also essential damage of crops by a bug (*Eurygaster integriceps*). Indicators of measuring instrument of deformation of a gluten made from 67 to 95 units. When determining an index of deformation of gluten it wasn't noticed an essential difference in the size of the received indicators on experience sites where wheat winter sowed with various seeding rate. However, on options where wheat sowed with seeding rate 6 million units germinating seeds/ha, that is on more in dense crops, the index of deformation of a gluten was 2–5 units higher.

The main indicators in determination of suitability of grain for the food purposes is its baking properties, in particular, the volume of bread (tab. 3).

In our experiences baking indicators of quality of grain of winter wheat were influenced significantly, first of all, by the content in protein and gluten grain, elasticity of gluten, and also its chemical composition. All specified indicators, it agrees to the data obtained by us, depended on agrotechnical factors, studied also weather conditions in the years of carrying out researches.

The most qualitative on baking indicators grain was formed by wheat plants in 2009 year. The volume of the bread received from a flour of wheat of winter of a sort Selyanka, was the highest. So, on the average for 2008–2010 years it fluctuated from 495 cm<sup>3</sup> at crops on 5 September seeding rate of 4 million units germinating seeds/ha to 612 cm<sup>3</sup> at crops on 5 October the same norm. The greatest volume of bread it is noted at baking from a flour of the grain, the experience got on sites where sowing of the winter carried out in the middle of the first decade of October. Considerable influence on baking indicators of quality had as well seeding rate.

On the average for years of carrying out the researches, the greatest volume of bread provided the grain received from crops which sowed with norm 4 million units germinating seeds/ha. The increase in seeding rate led to decrease in volume of bread. Level of productivity of various grades of winter wheat in our experiences depended on seeding dates and seeding rates. On the average for years of carrying out the researches, the highest productivity (4,89 t per ha) created plants of a sort Selyanka which sowing carried out in the middle of the third decade of September (on 25 September) with seeding rate of 5 million units germinating seeds/ha. Grain efficiency of a sort Zolotokolosa was lower than at sort Selyanka, it's maximum indicators (4,20 t per ha) are noted when sowing on 5 October by seeding rate of 6 million units germinating seeds/ha and on 25 September norm of 5 million units germinating seeds/ha (4,19 t per ha). The lowest, among grades, productivity was formed by Podolyank's grade which fluctuated during carrying out researches, within 2,99–3,75 t per ha. High fruitful rates of this sort (3,75 t per ha) are noted at crops on 5 October by norm of 6 million units germinating seeds/ha.

**3. The volume of the bread baked of grain of different sorts of wheat of winter depending on seeding dates and seeding rates (cm<sup>3</sup>), 2008–2010 years**

Seeding date	Seeding rate, mln/ha	Years			Average
		2008	2009	2010	
Sort Zolotokolosa					
5 September	4	530	572	547	550
	5	469	553	491	504
	6	442	548	472	487
15 September	4	536	580	554	557
	5	472	560	499	510
	6	450	554	479	494
25 September	4	580	603	584	589
	5	519	575	509	534
	6	504	559	513	525
5 October	4	600	615	605	607
	5	543	584	552	560
	6	514	580	524	539
Sort Selyanka					
5 September	4	539	580	554	558
	5	476	560	500	512
	6	449	556	479	495
15 September	4	550	585	560	565
	5	480	565	505	517
	6	455	560	485	500
25 September	4	585	610	590	595
	5	525	580	515	540
	6	510	565	520	532
5 October	4	605	620	610	612
	5	550	590	560	567
	6	520	585	530	545
Sort Podolyanka					
5 September	4	527	568	542	546
	5	465	549	486	500
	6	437	544	467	483
15 September	4	520	565	550	545
	5	480	540	510	510
	6	450	535	475	487
25 September	4	565	580	575	573
	5	510	560	515	528
	6	500	545	510	518
5 October	4	585	600	605	597
	5	530	580	540	550
	6	510	570	535	538

Thus, at cultivation after a spring rape the most qualitative grain was formed by crops of winter wheat which sowed on 25 September and on 5 October. Grain on these options of experience corresponded mainly to the third class of quality. Sowing provided on 5 and 15 September, generally the fifth and fourth classes of quality. The greatest protein content and glutens in grain, and also the bread volume, all sorts formed at crops on 25 September and on 5 October. On these indicators the best quality of grain among studied differed sort Selyanka. Productivity of this grade, on the average for years of carrying out researches, was also high (4,89 t per ha) at crops on 25 September norm of 5 million units germinating seeds/ha.

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