

GROWTH, DEVELOPMENT AND PRODUCTIVITY OF WINTER WHEAT DEPENDING ON THE SOIL TILLAGE AND SOWING SYSTEMS

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The results of the field experiment on production testing and implementation of the systems and introduction the soil tillage and sowing systems of winter wheat are presented. On the results of experimental researches were stated, that the applying the direct seeding of winter wheat using the seeding machine ATD-6.35 contributed to an increase in the indicators of the density of productive stems for 7,4–20,9 %, a decrease in the grain weight out of 1 ear for 0,11–0,27 g and the weight of 1000 grains for 2,8–4,7 g compared with the use of surface tillage and seeding with seeding machine ATD-6.35 and SZ-3.6.

The highest grain yield of winter wheat was formed in the variant that mentioned a surface soil tillage and seeding with ATD-6.35 and was 5,62 t/ha, which was 0,12 and 0,16 t/ha more than the variant using the seeding machine ATD-6.35 without tillage and seeding machine SZ-3.6 on surface tillage. Analysis of winter wheat grain in the phase of full ripeness showed, that the protein and gluten contents of in samples of variants 1 and 2, where the ATD-6.35 was used were higher compared to option 3 and amounted respectively to 12,7–13,3 and 24,0–25,3 % which corresponds to the requirements of grain class 2.

Key words: winter wheat, plant, soil tillage, seeding, growth, development, grain, crop yield, quality.

Ukraine's grain market has all chances to take the leading position. However, the increase in gross grain harvest hampers insufficient and unstable for years crop yields level of grain crops, due to the complex meteorological, agro-technological and agrobiological factors. Productivity of winter wheat is largely determined by its biological characteristics. Among other winter crops has higher drought tolerance and can more productively use moisture to create a unit of organic matter [1, 2].

Winter wheat has high requirements to soil structure and to predecessor. Growing it according to biological requirements always increases productivity. When implementing scientifically based soil tillage made the rotation factor as element of biological agriculture. It stabilizes productivity level even without fertilization [3].

Soil tillage and sowing systems of winter

wheat have a positive effect on water and nutrient regimes of the soil, and in combination with fertilizers and other means of growing technology yields increased by 35–50 % at stable indicators of soil fertility. In the current socio-economic farming conditions, aggravated by climate change, the development and implementation a varietal agro-technology of most adapted grain crops in specific soil and climatic conditions and the development of resource-saving technology elements based on the fullest possible use of plants biological potential has a practical interest and is an actual problem for modern plant growing [4].

Material and methods. Production testing the feasibility of using soil tillage and sowing systems of winter wheat were carried out in SE EF "Dnipro" IGC NAAS in Soloniansky district, Dnipropetrovs'k region (field № 7, division № 2) during 2008–2010 in crop rotation link:

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peawinter wheat – sunflower. In field experiment were studied the effectiveness of these technological schemes of winter wheat growing variety Kuial'nyk: 1 – no-tillage, seeding with seeding machine ATD-6.35; 2 – surface tillage, seeding with seeding machine ATD-6.35; 3 – surface tillage, seeding with SZ-3.6. In variant 1 after harvesting predecessor and regrowth of weeds (on August) used a herbicide mixture (vulkan – 4 l/ha + esteron – 1 l/ha). Technology of surface tillage (var. 2 and 3) included soil disking with BDT-7 at a depth of 8–10 cm, sub-surface loosening with combined aggregate KR-4,5 at a depth of 10–12 cm, pre-sowing cultivation with KPS-4 at a depth of 6–8 cm. Other agro-technical elements – were generally accepted for Steppe zone [5, 6].

Seeding rate of winter wheat was 5 million pcs. of germinated seeds/ha. Sowing time – October, 1. At the end of tillering phase of plants in spring the sowings were locally dressed by ammonium nitrate (N₃₀).

Results and discussion. Weather conditions during 2008–2009 were favorable for winter wheat growing. Abundant rains in the second half of September have created good prerequisites for obtaining even sprouts and plant establishment. In October and November observed elevated air temperature conditions. Ceasing of autumn vegetation (CAV) of winter wheat was marked only on December, 8. Wintering of crops was successful. Early spring was cool, April was dry, but due to rain fall in May, the winter wheat is well developed and has formed a relatively high grain yield.

At the time of sowing winter wheat (01.10), the productive moisture reserves in the top soil (0–10 cm) were sufficient for the emergence of seedlings. The average daily temperature of the first decade of October was 13,8 °C, the second 11,0 °C and the third +8,0°C, that exceeded the average long-term data for this indicator by 3,0, 2,2 and 2,2 °C respectively. This contributed to the early and even sprouts.

The phase of full emergence of plants in plots where the winter wheat seeding was planted without tillage, seeding with seeding machine ATD-6.35 (variant 1) was marked on the 7th day (October, 8), and in plots where the seeding was carried out on surface tillage with ATD-6.35 (variant 2) and SZ-3.6 (variant 3) –

for 2 days later, that is, on the 9th day (October, 10).

The tillering phase of winter wheat plants in variant 1 was marked on October, 27, and in variants 2 and 3 – on October, 28. Autumn vegetation of winter wheat occurred under the moderate conditions of moisture and heat supply. From October, 1 till October, 31, was fell 34,7 mm of productive precipitations, which was for 3,7 mm more than the average annual rate for this month. A rapid decline in average daily air temperatures on November, 7 in 2008 led to a temporary ceasing of autumn vegetation (CAV). However, in 4 days (on November, 11) the increase in average daily air temperatures contributed to the restoration of physiological and growth processes in plants. Fluctuations in average daily temperatures at the limit +5 °C lasted until December, 9 in 2008, when the final ceasing of autumn vegetation (CAV) was fixed.

The results of laboratory tests indicated, that the winter wheat plants at that time were in a good physiological state. It have accumulated enough sugar content in the leaves (24,62–24,70 %) and in the tillering nodes as well (31,97–32,98 %). Analysis of the data of biometric indices showed a slight lag in growth and development of plants in variant 3, where the seeding was carried out on surface tillage with sowing machine SZ-3.6 in comparison with variants 1 and 2 (seeding with seeding machine ATD-6.35). At the same time, the use of ATD-6.35 contributed to the formation of a tillering node in winter wheat plants in 2009 for 0,12–0,30 cm deeper than in the variant of using the conventional seeding machine SZ-3.6 on a surface tillage (Table 1).

Retrieval of spring vegetation (RSV) of winter wheat plants was marked on March, 30 in the period which was close to the long-time average annual date. Weather conditions of the winter period contributed to the good overwintering of wheat winter. The general physiological state of plants and shoots at the time of the restoration of spring vegetation was evaluated as good. This is confirmed by the results of the growth of winter plants in soil monoliths. The analysis of the plant samples showed that during the winter period the number of damaged and dead plants in variant 1 was 2,1 %, and in vari-

ants 2 and 3, respectively, 1,9 and 1,4 %. The short-term decrease in the air temperature in the third 10 day period of February (to -10...-12 °C)

did not lead to negative consequences and did not significantly affect the viability of winter wheat plants.

1. Biometric indices of winter wheat and the carbohydrate content in plants tissues at CAV, depending on the soil tillage and sowing systems

Variant of tillage and seeding	Plant height, cm	Amount of / per plant			Depth of tillering nodes, cm	Leaf area of 1 plant, cm ²	Weight of 100 completely dry plants, g	Carbohydrate content, %	
		stems	leaves	roots				in leaves	in tillering nodes
No-tillage (seeding ATD-6.35)	21,0	3,6	11,2	8,8	2,26	6,13	47,0	24,70	31,97
Surface tillage (seeding ATD-6.35)	22,0	4,0	10,8	8,0	2,44	5,60	46,0	24,65	32,98
Surface tillage (seeding SZ-3,6)	19,9	3,6	11,2	7,4	2,14	5,16	41,0	24,62	31,97

It should be noted that during the autumn and early spring period of vegetation was marked some lag in the growth and development of winter wheat plants in variants 2 and 3 compared to variant 1. This is due to the later emergence of plants in the variant with a surface tillage and seeding with sowing machine ATD-6.35 and SZ-3.6 and, obviously, due to the cultivation of soil, which, in contrast to direct sowing (no-tillage), complicated the direct contact of the seed with the soil surface of the seedbed.

The phase of stem elongation in all variants of the experiment was noted on May, 10. Since then, the difference in the initial individual development of plants in the studied variants was gradually offset. In this period, was observed the gradual equalization the plant height in different variants of different soil tillage and sowing systems.

The heading phase in all variants of the

experiment was marked on June, 3, and the complete grain ripeness was fixed on July, 7. The analysis of the structural productivity elements of winter wheat plants, which was determined by selecting the test shears in the pre-harvest period, showed that in the variant with the use of a sowing machine ATD-6.35 on no-tillage there was a tendency to increase the number of productive stems per unit area, the coefficient of productive tillering and elongation of the ear (Table 2).

Instead, at the use of surface tillage and seeding with ATD-6.35 and SZ-3.6, there was observed a decrease of the above-mentioned indices and, at the same time, a significant increase in the grain weight out of 1 ear and the weight of 1000 grains. The combination and correlation of these indicators and determines the level of the formed crop yield.

The highest grain yield of winter wheat was

2. Main elements of the ear structure and grain yield of winter wheat, depending on the soil tillage and sowing systems

Variant of tillage and seeding	Plant height, cm	Amount of productive stems, pcs./m ²	Coefficient of productive tillering	Ear length, cm	Amount of grains, pcs./ear	Weight of grains, g		Grain yield, t/ha
						out of 1 ear	1000 pcs.	
No-tillage (seeding ATD-6.35)	93,3	518,9	1,7	7,2	29,2	1,06	37,1	5,50
Surface tillage (seeding ATD-6.35)	92,4	480,3	1,6	7,1	29,3	1,17	39,9	5,62
Surface tillage (seeding SZ-3,6)	95,5	410,5	1,4	7,1	31,8	1,33	41,8	5,46

formed in the variant that mentioned a surface soil tillage and seeding with ATD-6.35 and was 5,62 t/ha, which is 0,12 and 0,16 t/ha more than the variant using the seeding machine ATD-6.35 without tillage and seeding machine SZ-3.6 on surface tillage.

It is well-known that plants are a kind of indicator and sensitively react to both the deficit and the surplus of any factor of life. In its turn, their chemical composition is fully characterized by nutritional conditions [7–11].

Thus, according to the results of a leafy diagnosis, which was carried out in the heading phase, the content of nitrogen (3,75–3,85 %) and

phosphorus (0,79–0,82%) corresponded to high levels, but of potassium (0,35–0,36%) – was on the of medium-elevated level. The optimal ratio between nitrogen and phosphorus indicates a balanced nutrition of winter wheat and the creation of prerequisites for the formation of high-quality grain.

Application of growing technology based on no-tillage system and direct seeding with ATD-6.35 resulted in an increase in grain protein content up to 13,3% and gluten – to 25,3 %, which corresponds to the requirements of class 2 (Table 3).

As a result on the variant 1 (no-tillage and

3. Quality of winter wheat grain, depending on the soil tillage and sowing systems

Variant of tillage and seeding	Grain-unit, g/l	Grain content, %		Gluten deformation index	Grain class
		protein	gluten		
No-tillage (seeding ATD-6.35)	785	13,29	25,3	62	2
Surface tillage (seeding ATD-6.35)	800	12,74	24,0	68	2
Surface tillage (seeding SZ-3,6)	810	11,71	22,9	56	3

seeding with ATD-6.35, these indicators were at grain class 3 (respectively 11,7 and 22,9 %). Improvement of the parameters of grain quality at direct seeding of winter wheat in 2009 is due to the formation of small grains in this variant. Thus, at the lower grainunit mass, the proportion of proteins relative to carbohydrates (starch) is proportional grows.

Conclusions

Thus, based on the results of researches on the efficiency of winter wheat growing systems, the following conclusions can be led. Applying the direct seeding of winter wheat using the seeding machine ATD-6.35 contributed to an increase in the indicators of the density of productive stems for 7,4 and 20,9 %, a decrease in the grain weight out of 1 ear for 0,11–0,27 g

and the weight of 1000 grains for 2,8–4,7 g compared with the use of surface tillage and seeding with seeding machine ATD-6.35 and SZ-3.6. The highest grain yield of winter wheat was formed in the variant that mentioned a surface soil tillage and seeding with ATD-6.35 and was 5,62 t/ha, which was for 0,12 and 0,16 t/ha more than the variant using the seeding machine ATD-6.35 without tillage and seeding machine SZ-3.6 on surface tillage. Analysis of winter wheat grain in the phase of full ripeness showed, that the protein and gluten contents in samples of variants 1 and 2, where the ATD-6.35 used was higher compared to variant 3 and amounted respectively to 12,7–13,3 and 24,0–25,3 % which corresponds to the requirements of grain class 2.

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Гирька А. Д., Гасанова И. И., Гирька Т. В., Бокун А. И. Рост, развитие и формирование продуктивности пшеницы озимой под влиянием различных систем обработки почвы и посева.

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Обобщены результаты полевого опыта по производственной проверке и внедрению разных систем обработки почвы и посева пшеницы озимой. Определены особенности роста, развития, формирования урожайности и качества зерна под влиянием исследуемых факторов.

Экспериментальными исследованиями установлено, что при использовании для прямого посева пшеницы озимой сеялки АТД-6.35 плотность продуктивного стеблестоя увеличивается на 7,4–20,9 %, а масса зерна с колосса и масса 1000 зерен уменьшаются соответственно на 0,11–0,27 и 2,8–4,7 г в сравнении с высевом семян сеялками АТД-6.35 и СЗ-3,6 на фоне мелкой обработки почвы.

Наиболее высокая урожайность зерна пшеницы озимой формировалась в варианте с мелкой обработкой почвы и высевом семян сеялкой АТД-6.35 – 5,62 т/га, что на 0,12 и 0,16 т/га

превышает показатели в вариантах с использованием сеялок АТД-6.35 по нулевой обработке почвы и СЗ-3,6 по мелкой.

Анализ образцов зерна озимой пшеницы (фаза полной спелости) показал, что в вариантах 1 и 2, где высеив семян осуществлялся посевным комплексом АТД-6.35, содержание белка и клейковины было выше по сравнению с вариантом 3 и составляло соответственно 12,7–13,3 и 24,0–25,3 %, что соответствует требованиям к показателям качества зерна второго класса.

Ключевые слова: пшеница озимая, растение, обработка почвы, посев, рост, развитие, зерно, урожайность, качество зерна.

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Гирка А. Д., Гасанова І. І., Гирка Т. В., Бокун О. І. Ріст, розвиток і формування продуктивності пшениці озимої під впливом різних систем обробітку ґрунту і сівби.

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Наведені результати польового дослідження по виробничій перевірці і впровадженню різних систем обробітку ґрунту і сівби пшениці озимої. З'ясовані особливості росту, розвитку, формування урожайності і якості зерна під впливом досліджуваних факторів.

На підставі експериментального дослідження встановлено, що при використанні для прямої сівби пшениці озимої сіялки АТД-6.35, збільшується щільність продуктивного стеблостою на 7,4–20,9 % і зменшуються маса зерна з колосу на 0,11–0,27 г і маса 1000 зерен на 2,8–4,7 г порівняно з висівом насіння цієї культури сіялками АТД-6.35 та СЗ-3,6 на фоні мілкового обробітку ґрунту.

Найбільш висока урожайність зерна пшениці озимої формувалась у варіанті з мілким обробітком ґрунту і висівом насіння сіялкою АТД-6.35 – 5,62 т/га, що на 0,12 та 0,16 т/га перевищує показники у варіанті з використанням сеялок АТД-6.35 по нульовому обробітку ґрунту і СЗ-3,6 по мілкому.

Аналіз зразків зерна пшениці озимої (фаза повної стиглості) показав, що у варіантах 1 і 2, де насіння висівали посівним комплексом АТД-6.35, вміст білка і клейковини був більший порівняно з варіантом 3 і становив відповідно 12,7–13,3 і 24,0–25,3 %, що відповідає вимогам до показників якості зерна другого класу.

Ключові слова: пшениця озима, рослини, обробіток ґрунту, сівба, ріст, розвиток, зерно, урожайність, якість зерна.