

EFFICIENCY OF GROWING WINTER WHEAT DEPENDING ON THE SOIL TILLAGE AND SOWING SYSTEMS

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The results of the analysis of the efficiency of winter wheat growing depending on the soil tillage and sowing systems in changing hydrothermal conditions of Steppe zone are presented.

Weather conditions during the investigations were different, but in general favorable, which made it possible to fully assess its influence of soil tillage and sowing systems on growth, development, grain productivity and economic and bioenergy efficiency of winter wheat growing. It is established, that the highest grain yield of winter wheat was formed in the variant of 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 showed, that the protein and gluten contents in samples of variants 1 and 2, where the ATD-6.35 used were higher compared to variant 3, where the SZ-3.6 used and amounted respectively to 12,7–13,3 and 24,0–25,3 %.

At direct seeding observed the increasing the prime cost of 1 ton of grain, reducing the profitability and the energy efficiency ratio, as compared to the surface tillage and seeding with sowing machine ATD-6.35, respectively, by 124 UAH, 38,8 % and 1,17, and at seeding with SZ-3,6 – for 164 UAH, 53,5 % and 1,18.

Key words: winter wheat, soil tillage, seeding methods, crop yield, grain quality, economic and bioenergy efficiency.

Winter wheat along with high crop yield ability and grain quality, also characterized by increased resistance to stressful environmental conditions, makes it possible to significantly reduce the production costs of labor and resources at its growing and increase the sustainability of grain production. Growing highly well-adapted varieties is one of the cheapest ways to meet the challenges of saving as well as provides an opportunity to increase crop yield and improve its quality with little additional cost. Important in such event is high environmental requirements to soil structure and to predeces-

sors [1–3].

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. 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

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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 [4–7].

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: pea – winter 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, subsurface 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 [8, 9].

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.

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 indi-

cator by 3,0 °C, 2,2 ° and 2,2 °C respectively. This contributed to the early and even sprouts. 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. 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.

In general, the spring months were cool. Thus, April was dry, but due to rain fall in May, the winter wheat was well developed. In general, the development and spreading of diseases and pests in winter wheat crops was not rampancy, revealed differences in terms of their harmfulness for different tilling and sowing technologies were non-substantial and could not be considered as a determining factor in terms of the possible impact on the formation of winter wheat productivity.

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 at 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. The combination and correlation of these indicators and determines the level of the formed crop

yield. Thus, 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 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 (Fig. 1).

Scientifically substantiated application of

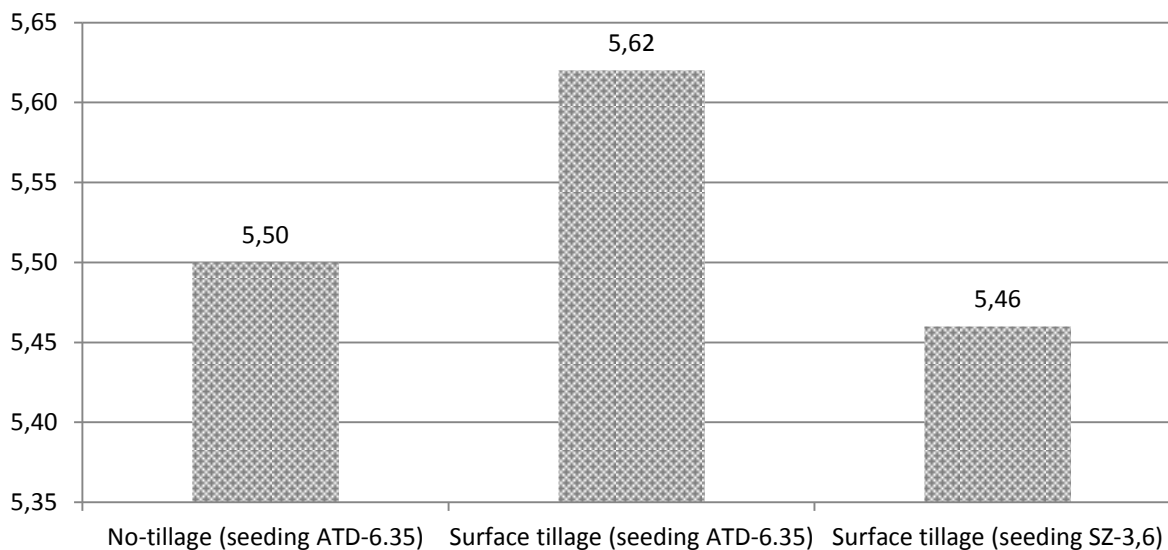


Fig. 1. Grain yield of winter wheat (t/ha), depending on the soil tillage and sowing systems.

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. As a result on the variant 1 (no-tillage and 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 grain-unit mass, the proportion of proteins relative to carbohydrates (starch) is proportional grows. Thus, by the results of research was not installed the significant changes between the variants of experiment on the influence of tilling technologies on effective soil fertility and chemical composition of plants. Some trends that determined were of a general character.

Transferring the obtained indexes of yield structural elements of winter wheat into the program of mathematical processing we got a graphical model in which the corresponding parameters are displayed in each of the three lines – variants of tilling and sowing methods, wherein: the thin continuous line shows the no-tillage, seeding with sowing machine ATD-6.35; heavy continuous line – surface tillage, seeding with sowing machine ATD-6.35 and hatched line –

surface tillage, seeding with SZ-3,6. The value of each of 8 variables laid off by one of the radiuses in order to better compare cases with multi-dimensional view (Fig. 2).

Analysing the graphical model, it should be noted that at no-tillage and sowing with ATD-6.35 observed the highest manifestation of the 3 elements of the structure (amount of productive tillers per unit area, coefficient of productive tillering and the length of the head), and at the surface tillage and sowing with SZ-3,6 – of 4 other (plant height, amount and weight of grains per head, 1000 grains weight). Only at the surface tilling and sowing method (with ATD 6.35), we noted the almost equal expression of the 5 structure elements, which, even at a significant reduction in plant height and reducing the number of grains per head, have provided formation the largest grain yield in experiment – 5,62 t/ha.

By the in-depth analysis of the economic efficiency of using the different methods of soil tillage and sowing systems shows that despite the fuel economy and the reduction of labor costs due to the direct sowing of winter wheat in unprocessed soil by the ATD-6.35 complex, in comparison with the generally accepted growing technology, a significant increases in production costs and total energy costs were noted. At the

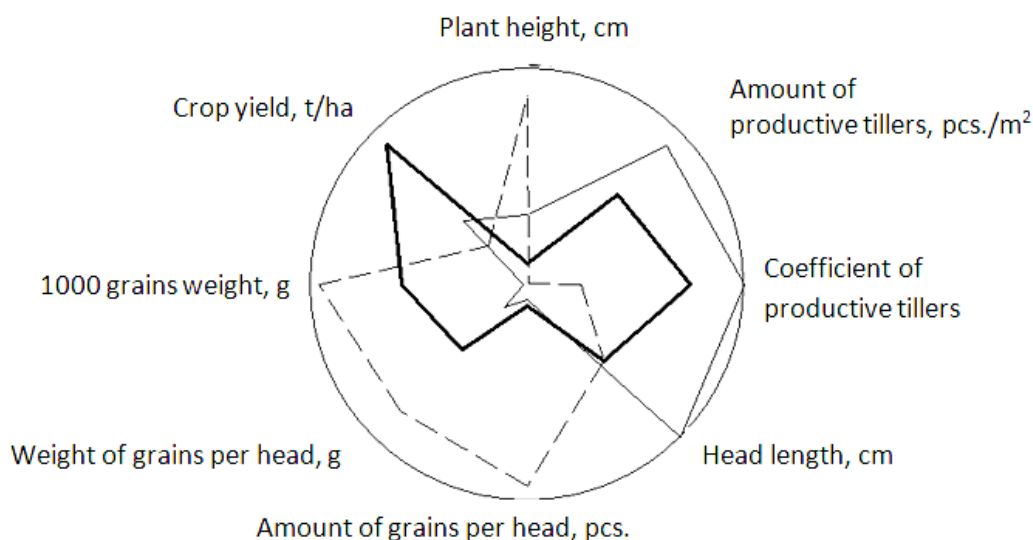


Fig. 2. Graphical display of structure elements and grain yield of winter wheat depending on the tillage and seeding systems.

same time, at no-tillage, the total production costs for the purchasing and application of herbicides and the using of energy-intensive (expensive in purchasing and servicing) of the complex of sowing machines that do not cover the expenses by the corresponding increasing in crop yield, which leads to a significant rising in products prices. Therefore, even in spite of sim-

plification of the production cycle, at the direct seeding increases the prime cost of 1 ton of grain, reduces the profitability and the energy efficiency ratio, as compared to the surface tillage and seeding with sowing machine ATD-6.35, respectively, by 124 UAH, 38,8 % and 1,17, and at seeding with SZ-3,6 – for 164 UAH, 53,5 % and 1,18 (Table).

Economic and bioenergy efficiency of winter wheat growing after peas at different methods of soil tillage and sowing systems

Indicators	Method of soil tillage and sowing systems		
	No-tillage, seeding with ATD-6.35	Surface tillage, seeding with	
		ATD-6.35	SZ-3.6
Crop yield, t/ha	5,50	5,62	5,46
Production costs per 1 hectare, UAH	6082	5518	5143
Prime cost of 1 ton of grain, UAH	1106	982	942
Profitability, %	207,5	246,3	261,0
Costs of total energy per 1 hectare, MJ	10948	9802	9521
Energy intensity 1 ton of grain, MJ	1991	1744	1744
Energy efficiency ratio	8,26	9,43	9,44

Thus, direct seeding of winter wheat with sowing machine ATD-6.35 contributed to an increasing in the indicators of density of productive stems by 7,4 and 20,9 %, and decreasing in the weight of grain out of an ear by 0,11–0,27 g, and the weight of 1000 grains – by 2,8–4,7 g in comparison with the use of surface tillage and seeding with sowing machines ATD-6.35 and SZ-3.6.

The highest crop yield of winter wheat

grain was formed in the variant that provided a surface tillage and seeding with sowing machines ATD-6.35 and was 5,62 t/ha, which is 0,12 and 0,16 t/ha more than the variant using the sowing machine ATD-6.35 at no-tillage and SZ-3.6 at surface tillage.

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 %.

At the direct seeding increases the prime cost of 1 ton of grain, reduces the profitability and the energy efficiency ratio, as compared to the surface tillage and seeding with sowing machine ATD-6.35, respectively, by 124 UAH, 38,8 % and 1,17, and at seeding with SZ-3,6 – for 164 UAH, 53,5 % and 1,18.

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Гирька А. Д., Винюков А. А., Гирька Т. В., Бокун А. И., Кулик А. А. Эффективность выращивания пшеницы озимой в зависимости от системы обработки почвы и посева. Зерновые культуры. 2019. Т. 3. № 1. С. 61–67.

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Представлены результаты опыта по производственной проверке и внедрению систем обработки почвы и посева пшеницы озимой. Освещена экономическая и биоэнергетическая эффективность выращивания озими под влиянием исследуемых факторов.

На основании экспериментальных исследований установлено, что прямой посев пшеницы озимой сеялкой АТД-6.35 обуславливал увеличение плотности продуктивного стеблестоя на 7,4 и 20,9 % и уменьшение массы зерна с колоса на 0,11–0,27 г, а массы 1000 зерен на 2,8–4,7 г по сравнению с мелкой обработкой почвы и посевом сеялками АТД-6.35 и СЗ-3,6.

Самую высокую урожайность пшеница озимая сформировала в варианте с мелкой обработкой почвы и посевом сеялкой АТД-6.35 – 5,62 т/га, что на 0,12 и 0,16 т/га превышает варианты с использованием сеялки АТД-6.35 по нулевой обработке почвы и сеялки СЗ-3,6 – по мелкой.

Анализ зерна пшеницы озимой в фазе полной спелости показал, что содержание белка и клейковины в образцах зерна из вариантов 1 и 2, где посев осуществлялся посевным комплексом АТД-6.35, было выше по сравнению с вариантом 3 – соответственно 12,7–13,3 и 24,0–25,3 %.

При прямом севе пшеницы озимой возрастала себестоимость 1 т зерна, снижался уровень рентабельности и уменьшался коэффициент энергетической эффективности по сравнению с мелкой обработкой почвы и посевом АТД-6.35 соответственно на 124 грн., 38,8 % и 1,17, а при посеве СЗ-3,6 – на 164 грн., 53,5 % и 1,18.

Ключевые слова: пшеница озимая, обработка почвы, способ посева, урожайность, качество зерна, экономическая и биоэнергетическая эффективность.

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Гирка А. Д., Винюков О. О., Гирка Т. В., Бокун О. І., Кулик А. О. Ефективність вирощування пшениці озимої залежно від системи обробітку ґрунту та сівби. Зернові культури. 2019. Т. 3. № 1. С. 61–67.

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Висвітлено результати дослідів з виробничої перевірки та впровадження систем обробітку ґрунту й сівби пшениці озимої. З'ясовано економічну й біоенергетичну ефективність вирощування озимини під впливом досліджуваних факторів.

В результаті експериментальних досліджень встановлено, що пряма сівба пшениці озимої сівалкою АТД-6.35 зумовлювало збільшення щільності продуктивного стеблостою на 7,4 і 20,9 % та зменшення маси зерна з колосу на 0,11–0,27 г, а маси 1000 зерен на 2,8–4,7 г порівняно з мілким обробітком ґрунту і сівбою сівалками АТД-6.35 і СЗ-3,6.

Найбільша врожайність зерна пшениці озимої була у варіанті з мілким обробітком ґрунту і сівбою сівалкою АТД-6.35 – 5,62 т/га, що на 0,12 та 0,16 т/га перевищувало показники варіантів з використанням сівалки АТД-6.35 по нульовому обробітку і сівалки СЗ-3,6 – по мілкому.

Аналіз зерна пшениці озимої в фазі повної стиглості показав, що вміст білка та клейковини в зразках зерна з варіантів 1 і 2, де сіяли посівним комплексом АТД-6.35, був вищим порівняно з варіантом 3 і становив відповідно 12,7–13,3 і 24,0–25,3 %.

За прямої сівби пшениці озимої підвищувалась собівартість 1 т зерна, знижувалась рентабельність і зменшувався коефіцієнт енергетичної ефективності порівняно з мілким обробітком ґрунту і сівбою АТД-6.35 відповідно на 124 грн, 38,8 % та 1,17, а за сівби СЗ-3,6 – на 164 грн, 53,5 % та 1,18.

Ключові слова: пшениця озима, обробіток ґрунту, спосіб сівби, урожайність, якість зерна, економічна та біоенергетична ефективність.