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RESOURCE-SAVING TECHNOLOGIES OF GRAIN GROWING – AT THE VALUE OF GLOBAL FOOD SECURITY

РЕСУРСОЗБЕРІГАЮЧІ ТЕХНОЛОГІЇ ВИРОЩУВАННЯ ЗЕРНОВИХ – НА ВАРТІ СВІТОВОЇ ПРОДОВОЛЬЧОЇ БЕЗПЕКИ

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Improving crop cultivation technologies plays an important role in increasing yields and improving the quality of crop production. Achieving high and sustainable yields in the face of rising energy prices can be achieved through the introduction of resource-saving technologies, which include a high level of agricultural technology, optimal fertilizer rates and doses, an integrated system of plant protection against diseases, weeds and pests, and the introduction of modern high-intensity varieties and hybrids. Hence, all the efforts of commodity producers to use inputs economically while maintaining the quality of their products, careful attention to soil fertility, and research in this area are timely and relevant.

The current weather and climatic, environmental and economic conditions of agricultural production require measures that ensure the most realistic level of crop productivity, high quality of grain and seeds while reducing the cost of growing them. One of the effective measures for solving the problems of resource saving while preserving soil fertility during crop cultivation is the introduction of MZURI PRO-TILL cultivation technology, which combines elements of traditional for the southern Steppe zone and no-till tillage technology.

The study of this technology for growing winter wheat was conducted by setting up a field experiment during September 2022 – July 2023 at the experimental field of Mykolaiv National Agrarian University.

The standard technology of winter wheat cultivation involved cultivation grain with a row spacing of 15 cm into the soil prepared after harvesting the predecessor with a disk tillage tool to a depth of 18–20 cm, pre-cultivation cultivation to the depth of seed placement and post-cultivation rolling with ring-spur rollers.

As for the innovative MZURI PRO-TILL technology, cultivation was carried out without preliminary tillage and grinding of the previous crop residues. The minimum narrow strip tillage is carried out simultaneously with the cultivation of the main crop with a seeding rate of 3 million germinating seeds/ha, as in the classical cultivation technology. The area of the field that is subjected to mechanical processing under the resource-saving technology does not exceed 33%.

Further treatment of the crops did not differ between the two studied technologies. All records and observations of the crops were carried out in accordance with the methods of state cultivar testing, yield accounting and evaluation of the crop structure were carried out by direct combining and recalculation of grain moisture by 14%, taking into account the presence of impurities.

The main limiting factor in the realization of the genetic potential of winter wheat agrocenosis in the Ukrainian Steppe is the deficit of soil and air moisture. The analysis of weather conditions during the growing season of winter wheat can be classified as good and slightly arid, with the exception of October 2022, January and June 2023, when the amount of precipitation was significantly lower than the long-term average. As for the temperature regime, it was significantly higher than the long-term average during the entire growing season, with temperature fluctuations within short time periods typical of recent years. Such frequent and significant temperature fluctuations caused stressful conditions in winter wheat crops, which negatively affected the productivity and realization of the genetic potential of agrocenosis in the future.

Changes in climatic conditions in southern Ukraine in recent years have further exacerbated the problem of increasing frequency of droughts, especially during crucial periods of the crop's growing season. The harmful effects of drought can be somewhat changed and reduced by the water retention mechanisms of plant leaves. Drought tolerance of crop plants, in most cases, is due to their ability to preserve water. During the experiment, the moisture loss by the leaves of winter wheat plants over a period of 6 and 10 hours was analyzed. The daily water loss in plants grown using both technologies was almost at the same level, but the water loss after 6 hours was 8.9% less, and after 10 hours – 8.2% less in plants grown using the

MZURI technology compared to the standard one. This indicates that the innovative technology showed greater resistance to stress factors caused by drought and high temperature compared to the standard methods.

It is difficult to overestimate the importance of a strong and extensive root system in the development of each field crop and its productivity. Winter wheat is no exception. After analyzing the impact of both technologies of winter wheat cultivation on the formation of the root system, it can be concluded that plants sown with Mzuri technology formed a more powerful and branched root system both in the upper layer (0–10 cm) of the soil and in the deeper horizon (30–50 cm) compared to the classical technology (Table 1).

Table 1

Weight of absolutely dry roots of Peremoha Odeska winter wheat depending on cultivation technologies, g/0.1 m2 (for 2023)

Soil layer, cm	**Cultivation technology**	
	Mzuri Pro Till	**Standard**
0–10	25,8	20,6
10–30	10,1	8,5
30–50	3,4	2,2

The actual productivity of a particular winter wheat cultivar is realized under the influence of the combined effect on each of the productivity elements, which can be compensated for by the formation of one of them in a more favorable environment during the growing season. The key element affecting the yield of winter wheat is the formation of a productive stem. In the research, a general pattern was observed in that the number of productive stems per winter wheat plant increased when using the technology of strip sowing compared to the standard one.

The different cultivation technologies had different effects on the formation of a productive winter wheat stem. Under the minimum tillage technology, the plants had a tillering coefficient of 2.6 compared to plants grown under the classical technology, where the tillering coefficient was 1.8, respectively.

The productivity of winter wheat is determined by the characteristics of its components and subcomponents, which are significantly modified under the influence of abiotic and biotic environmental factors. Elements of winter wheat productivity are to some extent compensated by other components that are formed in more favorable conditions during the growing season (Table 2). According to the experiment, the yield of 7.10 t/ha was recorded in case of sowing winter wheat using the Mzuri minimum tillage technology. The grain yield of 6.30 t/ha was formed in the variant of sowing according to the classical technology.

Table 2

Manifestation of productivity elements in winter wheat depending on different cultivation technologies in 2023

Mzuri Pro Till technology			Standard technology		
number of grains per ear, pcs.	1000 grains weight	yield, t/ha	number of grains per ear, pcs.	1000 grains weight	yield, t/ha
56.0	44.8	7.10	49.2	38.3	6.30

In the arid conditions of the south, the efficient use of moisture by agrocenoses plays a crucial role in the productivity of both the main crop and the subsequent crops in the rotation. Accordingly, the residual amount (accumulation) of moisture after harvesting winter wheat is becoming increasingly important. The results of the research show that different technologies had different effects on plant moisture use and its accumulation in the soil in the future. For such an analysis, the moisture content of different soil layers (from 0 to 50 cm) was measured after the end of the winter wheat growing season the day before harvesting (Table 3).

Table 3

Water saving capacity of different technologies

Soil moisture content, %		
Soil layer, cm	**MZURI-PRO TILL technology**	**Standard technology**
10	11.6	11,4
15	13,7	13,5
20	14,0	13,9
25	19,9	19,0
30	20,6	19,4
35	22,4	20,1
40	24,8	21,0
45	31,1	22,4
50	32,7	23,5

According to the results of the research, different sowing technologies had no significant difference in the accumulation of moisture in the active soil layer of 0–20 cm. However, in the lower layers (25–50 cm), the soil moisture content was different. Thus, under minimum tillage technology, soil moisture at a depth of 40 to 50 cm was almost 10% higher. The preliminary results of the field experiment lead to the conclusion that different technologies have different water-saving capacities. Thus, Mzuri technology allows to accumulate moisture in the lower soil layers, which will be used in the future by subsequent crops in the crop rotation.

Conclusions. Field research conducted in the arid conditions of southern Ukraine proves the advantage of the latest technology of winter wheat cultivation MZURI PRO-Till compared to the classical one. The introduction of this resource-saving technology allows to form larger and fuller grain with a weight of 1000 seeds, to obtain higher ear productivity and to increase the yield of the agrocenosis in general by 12% compared to the standard cultivation technology. Winter wheat plants grown using the innovative technology were more resistant to stress factors caused by drought and high temperatures.