Кафедра тракторів та сільскогосподарських машин, експлуатації і технічного сервісу

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Ресурсоефективні технології обробітку ґрунту та їх значення для збереження агроекологічних систем

Грубань В.А.
к.т.н., доцент, завідувач кафедри тракторів та сільськогосподарських машин, експлуатації і технічного сервісу,
Миколаївський національний агарний університет

Анотація: Робота присвячена аналізу ресурсоефективних технологій обробітку ґрунту як засобу сталого розвитку аграрного сектору. Розглянуто недоліки традиційних інтенсивних систем та переваги сучасних технологій (no-till, strip-till, мінімальний обробіток, subsoiling) у збереженні структури ґрунту, вологості, органічної речовини та розвитку біоти. Визначено економічні ефекти, зокрема зниження витрат пального та оптимізацію технологічних операцій. Особлива увага приділена умовам України, де впровадження ресурсозберігаючих систем сприяє підвищенню посухостійкості культур та стійкості агроекосистем.
Ключові слова: ресурсоефективні технології, обробіток ґрунту, no-till, strip-till, мінімальний обробіток, родючість ґрунту, агроекосистеми, збереження вологи, ерозія ґрунтів, стале землеробство.

Resource-saving technologies of soil cultivation are today considered one of the leading directions of modernization of agriculture, aimed at achieving sustainable development of agricultural production and preserving agro-ecological balance. For a long period, intensive cultivation systems based on deep plowing and repeated mechanical impact on the soil prevailed in agriculture. Despite their ability to provide a relatively stable level of yield, such approaches over time cause negative changes, in particular, soil degradation, increased erosion processes, depletion of organic matter reserves and disruption of natural nutrient cycles. In the context of modern challenges associated with climate change, limited water resources and increasing anthropogenic load, the implementation of technologies that minimize resource use is of particular importance. These include no-till, minimal and strip-till tillage, as well as deep loosening without turning the layer (subsoiling) and paw tillage. Their characteristic feature is a significant reduction in the intensity of mechanical impact on the soil cover, which contributes to the preservation of its structure, improvement of the water-air regime and maintenance of the stability of ecosystem processes.

One of the key advantages of resource-efficient systems is their positive impact on the water regime of the soil. Reducing the number of tillage operations increases the soil's ability to absorb water, reduces surface runoff and moisture loss through evaporation. An important

role in this is played by leaving plant residues on the field surface, which perform the function of a mulch layer. Such a layer prevents overheating of the soil, reduces sharp temperature fluctuations, prevents the formation of a crust and significantly reduces the intensity of erosion. As a result, the efficiency of using atmospheric precipitation increases, which is crucial for areas with insufficient moisture.

In addition to physical changes, minimal and zero tillage significantly affect biological processes in the soil. There is an increase in microbiological activity, an increase in the number of soil organisms, in particular earthworms, as well as an increase in the processes of humus formation. This contributes to the gradual restoration of natural soil fertility and a more efficient nutrient cycle. At the same time, organic carbon accumulates, which is important for reducing greenhouse gas emissions and adapting the agricultural sector to climate change.

From an economic point of view, resource-efficient technologies also have significant advantages. Reducing the number of technological operations allows you to reduce fuel costs, reduce the load on technical equipment and optimize the use of labor resources. This helps to increase the efficiency of production and competitiveness of agricultural enterprises, especially in conditions of limited financial capabilities and an unstable economic situation.

At the same time, the effectiveness of such systems largely depends on specific natural and climatic conditions, soil characteristics and crop rotation. At the initial stages of implementation, certain difficulties may arise, in particular, problems with weed control, uneven distribution of nutrients in the upper soil layer and risks of its compaction. Studies show that the results of yield under zero-tillage conditions may vary depending on the level of moisture supply: in arid conditions, a positive effect is observed, while in more humid regions the results may be less stable. Important components of successful adaptation are the use of cover crops, improved crop rotation and the introduction of controlled movement systems.

For Ukraine, especially for southern and steppe territories, where moisture shortages, high risks of erosion and degradation processes are combined, the introduction of resource-saving technologies is of strategic importance. Their use allows to increase the resistance of agricultural crops to droughts, to preserve soil fertility and to reduce the negative impact of agricultural production on the environment.

Therefore, resource-efficient tillage systems are an important component of modern sustainable agriculture, as they combine environmental, economic and production advantages. Their widespread implementation contributes to the rational use of natural resources, increasing the resilience of agro-ecosystems and the formation of ecologically balanced agricultural landscapes in the long term.

Список використаних джерел

1. Войтовик М. В., Баранник А. В., Гарбар В. В. Практичний моніторинг родючості ґрунту з впровадження ґрунтозберігаючих систем землеробства (на прикладі технології no-till) / М. В. Войтовик, А. В. Баранник, В. В. Гарбар та ін. // Подільський вісник: сільське господарство, техніка, економіка. - 2025. - № 1. - С. 25-34.

2. Тимчак В. Економічна ефективність вирощування сільськогосподарських культур за передовими технологіями (strip-till, no-till) / В. Тимчак // Економіка та суспільство. - 2025. - Вип. 12. - С. 87–99.

3.Павлишин М., Шустік Л., Гусар І. Технологія strip-till як інструмент секвестрації парникових газів / М. Павлишин, Л. Шустік, І. Гусар // Техніко-технологічні аспекти розвитку та випробування нової техніки і технологій для сільського господарства України. - 2017. - Т. 5. - С. 123-132.

4. Кохан А. В. Ефективність різних способів обробітку ґрунту: вплив на властивості ґрунту і врожайність / А. В. Кохан // Новітні агротехнології. - 2016. - № 4. - С. 44-53.

5. Singh N. K., Subedar Singh, Parismita Dutta. Role of conservation tillage strategies in reducing soil degradation and enhancing water infiltration / N. K. Singh, S. Singh, P. Dutta // Asian Journal of Soil Science and Plant Nutrition. - 2025. - Vol. 11, No. 2. - P. 78-91. https://doi.org/10.1155/ajsspn.2025.11.2.78.

6. Smith T. J., Jones L. R. Cover crops and no-tillage reduce crop production costs and soil loss: a meta-analysis / T. J. Smith, L. R. Jones // Soil and Tillage Research. - 2022. - Vol. 218. - P. 105310. https://doi.org/10.1016/j.still.2021.105310.

7. Davis J. M., Lee E. F. Conservation strip-till modifies rhizosphere ammonia-oxidizing archaea and bacteria … / J. M. Davis, E. F. Lee // Soil and Tillage Research. - 2023. - Vol. 234. - P. 105821. https://doi.org/10.1016/j.still.2023.105821.

8. Govaerts B., Sayre K. D., Goudeseune L. When does no-till yield more? A global meta-analysis / B. Govaerts, K. D. Sayre, L. Goudeseune // Field Crops Research. - 2015. - Vol. 183. - P. 156-168. https://doi.org/10.1016/j.fcr.2015.07.020.

9. Haleeva, A., Hruban, V., Horbunov, M., & Ruzhniak, M. (2025). Integration of modern land reclamation equipment into the system of precision agriculture using MZURI technology in the south of Ukraine. *Ukrainian Black Sea Region Agrarian Science*, 29(3), 35-47. https://doi.org/10.56407/bs.agrarian/3.2025.35

Abstract: The study focuses on resource-efficient soil tillage technologies as a means of sustainable agricultural development. It examines the limitations of traditional intensive systems and the advantages of modern approaches (no-till, strip-till, minimum tillage, subsoiling) in preserving soil structure, moisture, organic matter, and supporting soil biota. The economic benefits, including reduced fuel consumption and optimized field operations, are also highlighted. Special attention is given to the conditions in Ukraine, where the implementation of resource-saving systems enhances crop drought resistance and the resilience of agroecosystems.

Keywords: resource-efficient technologies, soil tillage, no-till, strip-till, minimum tillage, soil fertility, agroecosystems, moisture conservation, soil erosion, sustainable agriculture.

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Technological aspects of formation of composite materials and coatings based

Marchenko D.D.
Candidate of Technical Sciences, Associate Professor, Associate Professor of the Department of Tractors and Agricultural Machinery, Operation and Technical Service, Mykolayiv National Agrarian University, Mykolayiv, Ukraine

Abstract. The study considered the issue of increasing the durability of machine parts by increasing their resistance to wear and corrosion by using polymer composite coatings. Compositions were formed based on reactive oligomeric systems, in particular, epoxy resin ED-20 and urea-formaldehyde resin, into which dispersed modifying components were introduced - tripoli, siliceous materials, graphite and fluoroplastic. A method of forming coatings based on the technology of application using immersion was also proposed. Infrared spectroscopy and X-ray structural analysis were used to analyze the structural features of the formed layers. In addition, an evaluation of operationally important characteristics was carried out, in particular,