

## INNOVATIONS IN THE AGRICULTURAL SECTOR: DRONES, AUTOMATIC SYSTEMS AND SMART TECHNOLOGIES

*У статті розглянуто сучасні інноваційні технології, що впроваджуються в аграрному секторі, зокрема використання безпілотних літальних апаратів, автоматичних систем керування сільськогосподарською технікою та smart-технологій. Проаналізований їхній вплив на підвищення ефективності аграрного виробництва, оптимізацію використання ресурсів і розвиток точного землеробства. Обґрунтовано значення цифровізації та автоматизації для сталого розвитку сільського господарства*

**Ключові слова:** аграрний сектор, дрони, автоматизація, smart-технології, точне землеробство, агроінженерія.

*The article looks at current innovative technologies that are being promoted in the agricultural sector, including the development of unmanned aircraft, automatic water treatment systems, agricultural technology and smart technologies. Analyzes of their inputs to improve the efficiency of agricultural production, optimize the use of natural resources and develop precision agriculture. The importance of digitalization and automation for the ongoing development of agricultural rule has been outlined*

**Keywords:** agricultural sector, drones, automation, smart technologies, more precisely agriculture, agricultural engineering.

The modern agriculture sector is going through deep structural changes caused by the development of digital technologies, automation of production processes and the introduction of innovation technical solutions. The growth of agricultural production under conditions of limited natural resources, climate change and increased environmental requirements makes it necessary to move from traditional farming methods to precision and digital agricultural systems. In this context, drones, automatic machine control system and smart technologies become especially important, as they create a new model of agricultural production.

One of the most dynamic directions in modern agriculture is the use of unmanned aerial vehicles. Drones are mainly used for agro-scouting, which means regular monitoring of crop conditions from the air. According to agro-scouting guidelines, the use of UAVs makes it possible to quickly obtain spatial information about plant condition, field structure and uneven crop development. Aerial monitoring significantly reduces the need for labor-intensive field inspections and increases the accuracy of agronomic decisions. An important element of drone application is the use of vegetation indices, especially NDVI. This index is based on the analysis of light reflected by plants in different spectral ranges and allows the assessment of photosynthetic activity.

Using NDVI, it is possible to identify areas with poor growth, lack of moisture or nutrients before visible signs appear. Compared to satellite data, drones provide higher spatial resolution and greater flexibility, which is especially important for small and medium-sized farms. In addition to monitoring, drones are increasingly used to perform certain technological operations. In particular, they are applied for local spraying and precise fertilizer application. This approach follows the principles of precision agriculture and helps reduce chemical use while decreasing negative environmental impact.

Modern studies also emphasize the growing role of artificial intelligence and machine learning in the analysis of data obtained from drones, which allows automation of image interpretation and crop condition forecasting. Another important area of innovation in agriculture is the automation of agricultural machinery. Modern machines are equipped with satellite navigation systems, automatic steering and electronic control of operating parameters.

According to educational materials on production automation, automatic control systems help maintain stable operating modes and reduce the influence of the human factor. Automatic driving of agricultural machines ensures accurate movement along a given path, which is especially important during sowing, fertilization and harvesting. Automatic direction control systems reduce overlaps and gaps, which improves resource efficiency and the quality of agricultural operations. Automation increases machine reliability and reduces downtime caused by technical failures.

Smart technologies play an important role in modern agricultural production. They combine the Internet of Things, wireless sensor networks and digital data processing platforms. The Internet of Things in precision agriculture involves the use of sensors to measure soil moisture, temperature, acidity and other parameters of the agro-ecosystem. According to G. V. Antonova, LoRa and LoRaWAN technologies provide energy-efficient data transmission over long distances, which makes them especially suitable for agriculture. Data collected by IoT sensors form the basis for Big Data technologies and analytical systems.

Processing large amounts of information makes it possible to predict crop yields, optimize the timing of agricultural operations and make well-grounded management decisions. Educational materials on precision agriculture emphasize that the combination of GPS technologies, geographic information systems and digital analytics creates an integrated system for agricultural production management. Thus, innovations in the agricultural sector — drones, automatic systems and smart technologies — form a new technological structure of agriculture. Their implementation increases productivity, reduces costs and ensures environmental sustainability. Studying these technologies within courses on mechanization, automation, electronics and information technologies is an important part of professional training for future agro-engineers.

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### COMPARISON OF WHEAT VARIETIES BY THEIR YIELD

*Основна мета дослідження полягала у визначенні впливу сорту пшениці на врожайність за однакових умов вирощування. Дослідження підтвердило важливу роль сорту в досягненні високих врожайів пшениці. Подальші дослідження в цьому напрямку дозволять розширити знання про біологічні особливості пшениці та розробити більш ефективні технології її вирощування.*

**Ключові слова:** озима пшениця, сорти пшениці, врожайність культур, сільськогосподарська продуктивність, порівняльний аналіз, польовий дослід.

*The primary objective of the study was to determine the impact of wheat variety on yield under identical growing conditions. The research confirmed the crucial role of the variety in achieving high yields. Further studies in this area will expand knowledge of its biological characteristics and help develop more effective cultivation technologies.*

**Keywords:** winter wheat, wheat varieties, crop yield, agricultural productivity, comparative analysis, field experiment.