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INFLUENCE OF MINERAL FERTILIZERS ON THE FERTILITY OF CHERNOZEMS OF THE SOUTHERN STEPPE OF UKRAINE

У публікації проаналізовано вплив мінеральних добрив на показники родючості чорноземів Південного Степу України. Розглянуто агрохімічні характеристики чорноземів, їх сучасний стан та роль систем удобрення у підтриманні балансу поживних речовин. Досліджено ефективність застосування азотних, фосфорних і калійних добрив та визначено їх вплив на врожайність сільськогосподарських культур і екологічний стан ґрунту.

Ключові слова: *чорноземи, мінеральні добрива, родючість ґрунту, Південний Степ України, азот, фосфор, калій, агрохімічні показники.*

The publication analyzes the influence of mineral fertilizers on the fertility indicators of chernozems in the Southern Steppe of Ukraine. The agrochemical characteristics of chernozems, their current condition, and the role of fertilization systems in maintaining nutrient balance are considered. The effectiveness of nitrogen, phosphorus, and potassium fertilizers and their impact on crop productivity and environmental soil condition are studied.

Keywords: *chernozems, mineral fertilizers, soil fertility, Southern Steppe of Ukraine, nitrogen, phosphorus, potassium, agrochemical indicators.*

In modern agricultural production, maintaining soil fertility is one of the key tasks of sustainable land use. Agricultural intensification, climate change, and insufficient nutrient return to soil significantly affect the productivity of agroecosystems. In these conditions, rational fertilization becomes one of the main factors ensuring stable crop yields and sustainable soil management [1].

Chernozems of the Southern Steppe of Ukraine occupy significant areas and are considered among the most fertile soils in the world. These soils are characterized by high humus content, good soil structure, high biological activity, and a significant supply of essential nutrients. According to scientific data, the humus content in southern chernozems ranges from 3 to 5%, which ensures favorable physical and chemical properties of the soil [1].

However, long-term agricultural use without systematic fertilization leads to the gradual depletion of nutrient reserves. Intensive crop production removes large quantities of nitrogen, phosphorus, potassium, and other elements from soil. Without compensating for these losses through fertilization, soil fertility gradually decreases, which negatively affects crop productivity and soil quality indicators [2].

The climatic conditions of the Southern Steppe are characterized by limited moisture supply, high summer temperatures, and frequent droughts. Under such conditions, the mineralization of organic matter in soil becomes more intensive. This process accelerates the decomposition of humus and contributes to the loss of nutrients from soil. Therefore, maintaining the nutrient balance through fertilization is especially important for agricultural production in this region [3].

Mineral fertilizers are one of the most effective tools for regulating plant nutrition and maintaining soil fertility. Nitrogen fertilizers play a key role in plant development because nitrogen is a major component of amino acids, proteins, enzymes, and chlorophyll. Nitrogen fertilization stimulates vegetative growth, increases leaf surface area, and contributes to higher yields of agricultural crops. However, excessive application of nitrogen fertilizers may lead to negative environmental consequences, including nitrate accumulation in plants and groundwater contamination.

Phosphorus fertilizers play an important role in energy metabolism and root system development. Phosphorus is essential for the formation of nucleic acids and ATP, which are responsible for energy transfer in plant cells. Adequate phosphorus nutrition improves plant resistance to drought and promotes better crop establishment under unfavorable environmental conditions [4].

Potassium fertilizers regulate plant water balance and improve resistance to environmental

stress factors such as drought and temperature fluctuations. Potassium also contributes to the improvement of crop quality, including grain filling, sugar accumulation, and resistance to diseases and pests. Therefore, balanced application of nitrogen, phosphorus, and potassium fertilizers is essential for achieving optimal plant nutrition and sustainable crop production.

Numerous studies indicate that the application of balanced NPK fertilizers significantly increases crop productivity. Under conditions of the Steppe zone, the use of scientifically justified fertilizer rates can increase yields by 20–40% compared to unfertilized control variants. In addition, balanced fertilization contributes to maintaining an optimal nutrient regime in soil and preventing soil degradation processes associated with nutrient depletion [2].

At the same time, environmental aspects of fertilizer application should also be taken into account. Improper use of fertilizers, especially excessive nitrogen application, may cause nitrate leaching into groundwater, soil acidification, and disturbance of ecological balance in agroecosystems. Therefore, the rates and methods of fertilizer application should be based on agrochemical soil analysis, crop requirements, and climatic conditions of the region.

In conclusion, mineral fertilizers play a crucial role in maintaining and improving the fertility of chernozems in the Southern Steppe of Ukraine. Their effective use requires scientifically based fertilizer rates, systematic soil monitoring, and integration with organic fertilization systems. The development of optimized fertilization systems under conditions of climate change and limited moisture availability is an important direction for further scientific research in agronomy and agrochemistry.

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PROSPECTS FOR MICROBIAL DEGRADATION OF SYNTHETIC POLYMERS

У статті досліджується критична проблема накопичення пластикових полімерів у біосфері та розглядаються біотехнологічні стратегії їх переробки. Проведено аналіз еволюційної адаптації мікроорганізмів до синтетичних субстратів, механізмів роботи ферментативних систем та роль генної інженерії у створенні високоефективних штамів-деструкторів.

Ключові слова: *біодеградація, антропогенне навантаження, ензими, Ideonella sakaiensis, ПЕТ-гідролази, мікробна конверсія, полімери, ПЛА.*

This article examines the critical issue of the accumulation of plastic polymers in the biosphere and explores biotechnological strategies for their degradation. It analyses the evolutionary adaptation