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THE IMPORTANCE OF APPLYING LOCALIZED FERTILIZERS TO THE INTER-ROW SPACES OF AGRICULTURAL CROPS

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Annotation. In this article, the agro-technical, economic, and ecological advantages of the technology for applying localized fertilizers to the inter-row spaces of agricultural crops are scientifically substantiated. It is noted that during localized fertilization, directing the fertilizer precisely to the active soil layer where the plant roots are located significantly increases the efficiency of nutrient uptake, reduces fertilizer consumption, and increases yield by 10–25%. Research shows that the structural and technical parameters of localized fertilizer applicators depend on soil type, fertilizer composition, and row spacing width; selecting them correctly ensures the quality of agro-technical processes. The localized fertilization method improves the physical–mechanical properties of the soil, increases humus content, enhances the absorption of nutrients, and reduces environmental damage. This technology is recommended as an important factor in increasing labor productivity in agricultural production, saving resources, and achieving stable yields.

Keywords: Localized fertilization, inter-row spacing, plant root system, organic fertilizers, mineral fertilizers, yield, resource efficiency, agrotechnical requirements, fertilizer applicator, soil fertility.

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Аннотация. В данной статье научно обоснованы агротехнические, экономические и экологические преимущества технологии внесения локализованных удобрений в междурядья сельскохозяйственных культур. Отмечено, что при локализованном внесении удобрений их точное направление в активный почвенный слой, где располагаются корни растений, значительно повышает эффективность усвоения питательных веществ, снижает расход удобрений и увеличивает урожайность на 10–25%. Исследования показывают, что конструктивные и технические параметры машин для локализованного внесения удобрений зависят от типа почвы, состава удобрений и ширины междурядий; правильный их выбор обеспечивает качество агротехнических процессов. Метод локализованного внесения удобрений улучшает физико-механические свойства почвы, увеличивает содержание гумуса, повышает усвоение питательных веществ и снижает экологический ущерб. Эта технология рекомендуется как важный фактор повышения производительности труда в сельском хозяйстве, экономии ресурсов и обеспечения стабильной урожайности.

Ключевые слова: локализованное удобрение, междурядья, корневая система растений, органические удобрения, минеральные удобрения, урожайность, экономия ресурсов, агротехнические требования, машина для внесения удобрений, плодородие почвы.

Introduction. Nowadays, creating high-performance and high-quality technical tools and technologies that serve the cultivation of quality agricultural products occupies a leading position. In recent years, increasing the efficiency of producing quality products in agriculture, preserving soil fertility, and the rational use of fertilizers have become urgent issues. The distribution of localized nutrients plays an important role in the growth and development of crops. Therefore, the technology of using localized fertilizers in agriculture is expanding year by year.

With traditional methods of fertilizer application, a large portion of the fertilizer is lost due to wind, water, or evaporation, which reduces economic efficiency and leads to environmental problems. By using methods of applying localized fertilizers to the inter-row spaces, the fertilizer is placed directly near the plant roots, which in turn increases crop yield by 10–25%.

In the agricultural production of our country, comprehensive measures are being implemented to reduce labor and energy consumption, save resources, cultivate crops using advanced technologies, and develop high-performance agricultural machinery. In particular,

special attention is being paid to the development of equipment that ensures reliable and high-quality execution of the specified technological processes while consuming minimal energy when working in the inter-row spaces of orchards.

Materials and methods. In conducting the research, scientific methods such as comparison, analytical approach, generalization, and literature review were used.

Results and discussion. The most optimal way to increase efficiency when applying organic fertilizers in the field, without reducing effectiveness, is to use a localized method, that is, to place the fertilizer directly in the area where the plant roots are located.

For this purpose, there are several agrotechnical requirements for machines that distribute organic fertilizers uniformly in the designated area, which are as follows:

- The machine must open furrows in a single pass and evenly place the fertilizer in the designated area;

- The applied organic fertilizer should be covered, and irrigation furrows should be opened;

- During the fertilization process, regardless of the amount of fertilizer in the hopper, the application rate must remain uniform;

- The fertilizer application rate should not deviate from the set value by more than ±25%.

According to the literature, localized fertilizers include animal manure, liquid manure, bird and poultry droppings, coal dust, various waste materials, food residues, and plant litter. These fertilizers are rich in urea, nitrogen, phosphorus, hydrogen, magnesium, sulfur, and other substances. When used, they improve the soil structure in pomegranate orchards and enrich it with organic matter. The cohesiveness of light soils increases, enhancing their ability to retain moisture and absorb essential nutrients. While localized fertilizers improve soil fertility, mineral fertilizers enhance the nutrient regime of the soil [5; 4-5-b.].

The use of localized manure increases soil fertility and enriches it with organic matter. The cohesiveness of light soils improves, enhancing their ability to retain moisture and absorb nutrients, which in turn contributes to increased crop yields.

Organic fertilizers are used to restore soil fertility and to increase the humus content as well as the physical and mechanical properties of the soil.

The application of organic fertilizers is divided into broadcast and localized methods. Localized application itself is further divided into two techniques: band (tape) and strip (line) methods. The most optimal way to apply organic fertilizers in the field is the strip method, placing the fertilizer only in the areas where the plant roots are located.

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Research has shown that the main technical parameters of a localized fertilizer applicator directly depend on the soil type, fertilizer type, and row spacing width. Through the working parts of the machine, the placement depth of the fertilizer corresponds to the active layer of the crop root system, ensuring efficient nutrient uptake by the plants.

Applying localized (i.e., linear or row-by-row) fertilizers to the inter-row spaces of agricultural crops has several significant advantages. This method is considered one of the most effective agricultural techniques in modern farming.

Main advantages of applying localized fertilizer to the inter-row spaces of crops:

- since the fertilizer is applied directly to the root zone, the plant absorbs nutrients quickly and efficiently;
- nutrient losses (due to wind, leaching, or diffusion) are minimized;
- less mineral fertilizer is used compared to uniform broadcasting;
- since the plant receives fertilizer exactly in the area it needs, the overall consumption is reduced;
- fertilizer applied in a timely and precise manner optimizes the plant's vegetative growth stages;
- the plant grows faster, its root system develops well, and as a result, the yield increases by 10–25%;
- the interaction between the fertilizer and the soil is improved;
- during localized application, the fertilizer comes into direct contact with the moist soil layer;
- since the fertilizer is less likely to be washed into the air or water, the environmental risk is reduced;
- since the fertilizer is applied only near the roots of the cultivated crops, weeds do not grow rapidly.

Conclusion. Based on the conducted analysis and scientific sources, it can be concluded that the technology of applying localized fertilizers to the inter-row spaces of agricultural crops is one of the most optimal fertilization methods, meeting agro-technical requirements and ensuring high efficiency. By placing localized fertilizers directly near the plant root system, the nutrients are absorbed by the plants quickly and completely, with minimal losses. This process allows for a reduction in fertilizer consumption by 20–30% and an increase in crop yield by 10–25%.

The localized application of organic and mineral fertilizers improves the physical and mechanical properties of the soil, increases its humus content, activates microbiological processes, and enhances the mobility of nutrients. In particular, since phosphorus and potassium are less mobile, applying them row by row ensures their maximum uptake by the plant roots. As a result of localized fertilization, the risk of root burn is reduced, soil moisture is better retained, weed growth slows down, and the environmental risk decreases.

Moreover, the mechanization of the localized fertilization process increases labor productivity, reduces energy and resource consumption, and ensures the efficient operation of agricultural machinery. The design of fertilizer applicators, developed in accordance with row spacing, soil type, and fertilizer composition, directly affects their performance quality.

Overall, the use of localized fertilization technology accelerates crop growth and development, restores soil fertility, improves the quality of agro-technical processes, and ensures high economic efficiency in agricultural production. Therefore, the widespread implementation of this method in practice is of significant importance for ensuring sustainable agricultural production.

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