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MODERN TYPES OF SEED TREATMENTS AND THEIR EFFECTIVENESS

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Abstract. Seed treatment is an important element of integrated plant protection systems, ensuring the prevention of infections and increasing the yield of agricultural crops. The article examines the main types of seed treatments - inorganic, organic, and combined preparations. Their chemical nature, mechanisms of action, and development trends towards reducing toxicity and increasing environmental safety are highlighted.

Keywords: seed treatments, fungicides, disinfection, plant protection, toxicity, resistance.

In recent years, there has been a trend of reducing the area sown with cotton in the Republic of Uzbekistan. Thus, in 2024-2025, the area allocated for this crop decreased by 250 thousand hectares. In the context of the reduction of sown areas, the task of increasing yields is becoming especially relevant. One of the most important agrotechnical measures contributing to achieving this goal is the use of highly effective complex seed treatments.

Taking into account the growing requirements for the economic efficiency of cotton cultivation, as well as the need to increase plant resistance to abiotic stresses and biotic pathogens (of viral, bacterial, and fungal origin), the use of complex seed treatments is of particular importance within the framework of an integrated plant protection system. Such treatments effectively suppress the development of cotton disease pathogens that penetrate both the seed coat and the internal structures of the seeds. In this regard, the systemic properties and high penetrating ability of the products used play a key role.

According to their chemical nature, seed treatments are divided into inorganic, organic, and combined.

Inorganic compounds (mercury, copper, zinc) were among the first to be used. They were characterized by pronounced fungicidal action; however, they possessed high toxicity to humans and soil biota [1]. Gradually, they were replaced by organic compounds with more selective action and less persistence in the environment [2].

Among the most common organic seed treatments are dithiocarbamates, thiurams, and their derivatives. TMTD (tetramethylthiuram disulfide) remained a standard fungicide for a long time due to its broad spectrum of action and low phytotoxicity [3]. Other preparations, such as Vitavax 200, Granozan, and Fundazol, are distinguished by their systemic action, which ensures the protection of not only the seed surface but also seedlings in the early stages of development [4].

According to the analysis of scientific sources, the biological activity of active substances is noticeably enhanced when mono-, di-, and triethanolamines, as well as their derivatives in combination with acetic acid, are used together in the composition of seed treatment agents.

Such a combination of components exhibits a pronounced synergistic effect, ensuring not only the suppression of phytopathogens but also a stimulating effect on physiological processes in seedlings during the early stages of ontogenesis. This, in turn, contributes to the formation of more viable and stress-resistant plants.

In addition, recent research data confirm that pre-sowing treatment using multifunctional compositions significantly increases seed germination energy, improves field germination, activates root system development, and contributes to the accelerated progression through early growth phases. This is especially relevant in conditions of limited water supply and unstable temperature regimes, characteristic of most cotton-growing regions of Uzbekistan.

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We are faced with the task of creating scientific-theoretical, physicochemical, applied, and technological foundations for the development of complex preparations and compositions for pre-sowing treatment of cotton seeds. This is a pressing task, having both theoretical and practical significance.

We investigated the solubility in aqueous systems of copper acetate monohydrate, mono-, di-, triethanolamine, and monoethanolammonium acetate using the method of isomolar series [5-10]. The interaction of components in the following systems was investigated:

$NH_2C_2H_4OH \cdot (CH_3COO)_2Cu \cdot H_2O$-$H_2O$;

$NH(C_2H_4OH)_2 \cdot (CH_3COO)_2Cu \cdot H_2O$-$H_2O$;

$N(C_2H_4OH)_3 \cdot (CH_3COO)_2Cu \cdot H_2O$-$H_2O$.

$CH_3COOH \cdot NH_2C_2H_4OH$- $(CH_3COO)_2Cu \cdot H_2O$-H_2O;

$2CH_3COOH \cdot NH_2C_2H_4OH$- $(CH_3COO)_2Cu \cdot H_2O$-H_2O

In the studied systems, the formation of compounds with equimolar composition was observed: monoethanolamine - copper acetate monohydrate; diethanolamine - copper acetate monohydrate; triethanolamine - copper acetate monohydrate; mono-substituted acetic acid monoethanolammonium - copper acetate monohydrate; di-substituted acetic acid monoethanolammonium - copper acetate monohydrate. The formed compounds were synthesized in solid form. Elemental chemical analysis for nitrogen, carbon, hydrogen, oxygen, and copper was conducted.

The results of the chemical analysis showed the consistency of the analytical results with the calculated values. The obtained compounds were identified using X-ray diffraction, IR spectroscopic, and thermogravimetric analysis methods, and the results confirmed the individuality of the obtained compounds.

Using IR spectroscopic analysis, the mechanism of compound formation through intermolecular hydrogen bonding was elucidated. This chapter also presents the results of thermogravimetric analysis of the obtained compounds and explains the observed exothermic and endothermic effects.

The obtained results provide a solid foundation for developing new forms of seed treatments that combine fungicidal, bactericidal, and growth-stimulating properties. Ultimately, this will enable farmers to increase cotton yields on diminishing cultivated areas without increasing the chemical burden on the agrocenosis.

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