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Control of Plant Diseases and Pests in Greenhouses under the Conditions of Bukhara Region

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Abstract. This article discusses the main diseases and pests affecting agricultural crops grown in greenhouses under the sharply continental climate of the Bukhara region, their patterns of spread, and measures to control them. It examines an integrated pest management (IPM) system combining agronomic, biological, and chemical methods to control pests such as greenhouse whiteflies, spider mites, and tomato leaf miners, as well as diseases such as Fusarium wilt, powdery mildew, and late blight. Practical recommendations are also provided for producing environmentally friendly crops by using Bukhara's hot summer climate for soil solarization and by applying entomophages.

Keywords: greenhouse, Bukhara climate, pests, whitefly, spider mite, soil solarization, entomophages, integrated pest management.

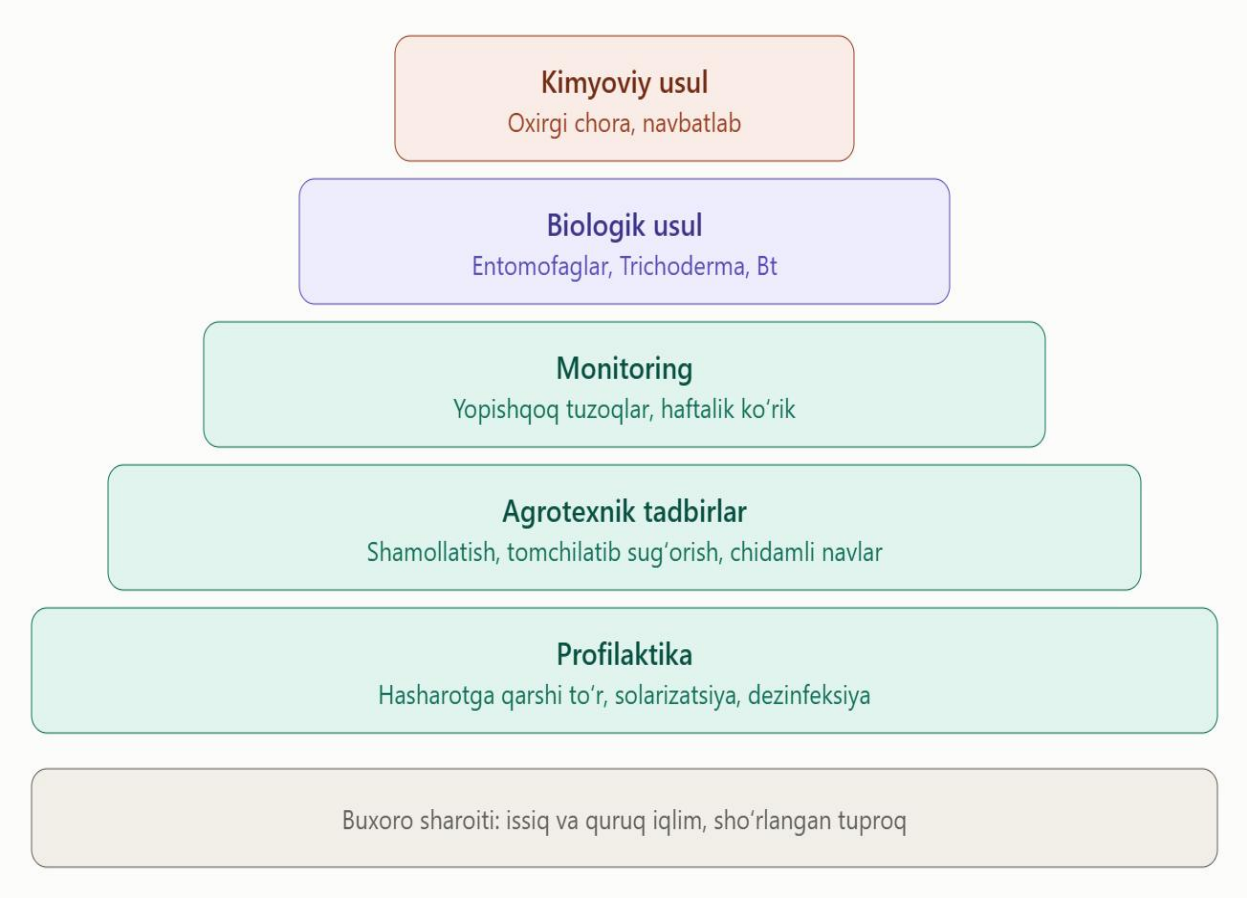
Introduction. The cultivation of vegetables and flowers under protected conditions (in greenhouses) has expanded considerably in recent years. This is important for supplying the population with fresh vegetables throughout the year, increasing yields, and strengthening export potential. The climate of Bukhara region is hot and dry, creating favorable opportunities for the development of greenhouse farming. At the same time, the enclosed greenhouse environment, high temperatures, fluctuations in humidity, and prolonged cultivation of crops in the same location create favorable conditions for harmful organisms.

Greenhouses are susceptible to the rapid spread of pests such as whiteflies, thrips, spider mites, aphids, tomato leaf miners, and root-knot nematodes, as well as diseases including powdery mildew, gray mold, late blight, Fusarium wilt, and viral diseases. Some of these can destroy a large proportion of a crop in a short time and reduce product quality. Saline soils in the region and high mineralization of irrigation water further reduce plant resistance.

Relying solely on chemical agents to control harmful organisms causes several problems: pests develop resistance to pesticides, beneficial organisms (entomophages) are killed, residues accumulate in produce, and risks arise for the environment and workers' health. Therefore, integrated pest management (IPM) is increasingly used as a modern approach. It combines prevention, agronomic measures, monitoring, biological control agents, and the justified use of chemical pesticides as a last resort.

Aim and objectives of the study. The aim of this study is to analyze effective, economically viable, and environmentally safe methods for protecting greenhouse crops from diseases and pests under the natural and climatic conditions of Bukhara region, and to develop practical recommendations.

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To achieve this aim, the following objectives were established:

1. 1. Identify the main pests and diseases found in the region's greenhouses and study their development patterns;

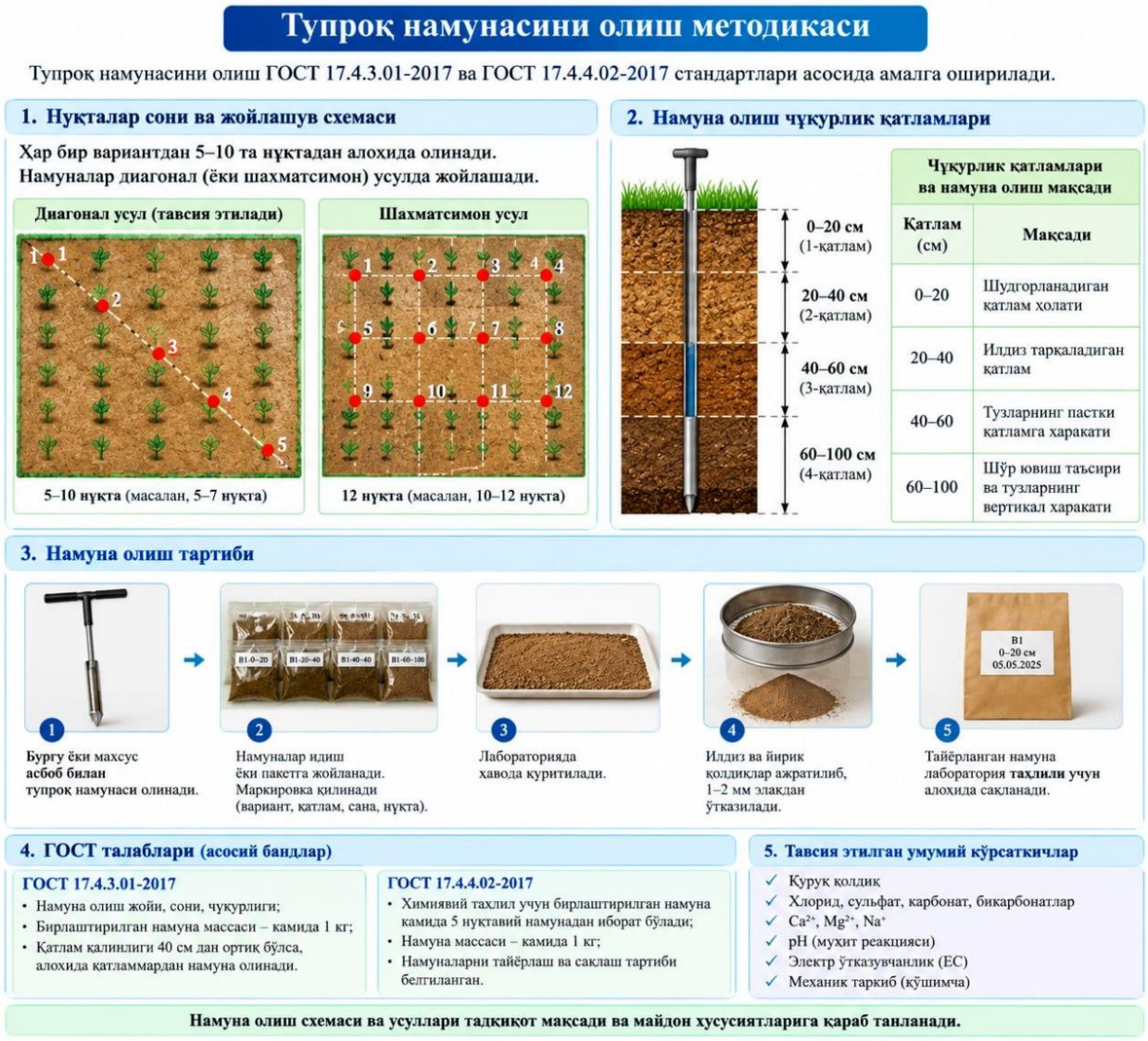
2. 2. Assess factors affecting the spread of harmful organisms, including temperature, humidity, and soil and water quality;

3. 3. Compare agronomic, biological, and chemical control methods and analyze their effectiveness;

4. 4. Propose a seasonal protection system for farmers and greenhouse operators.

The significance of this work is that its recommendations can be used in practice by greenhouse operators, farmers, and agricultural specialists, as well as by students and learners in the educational process.

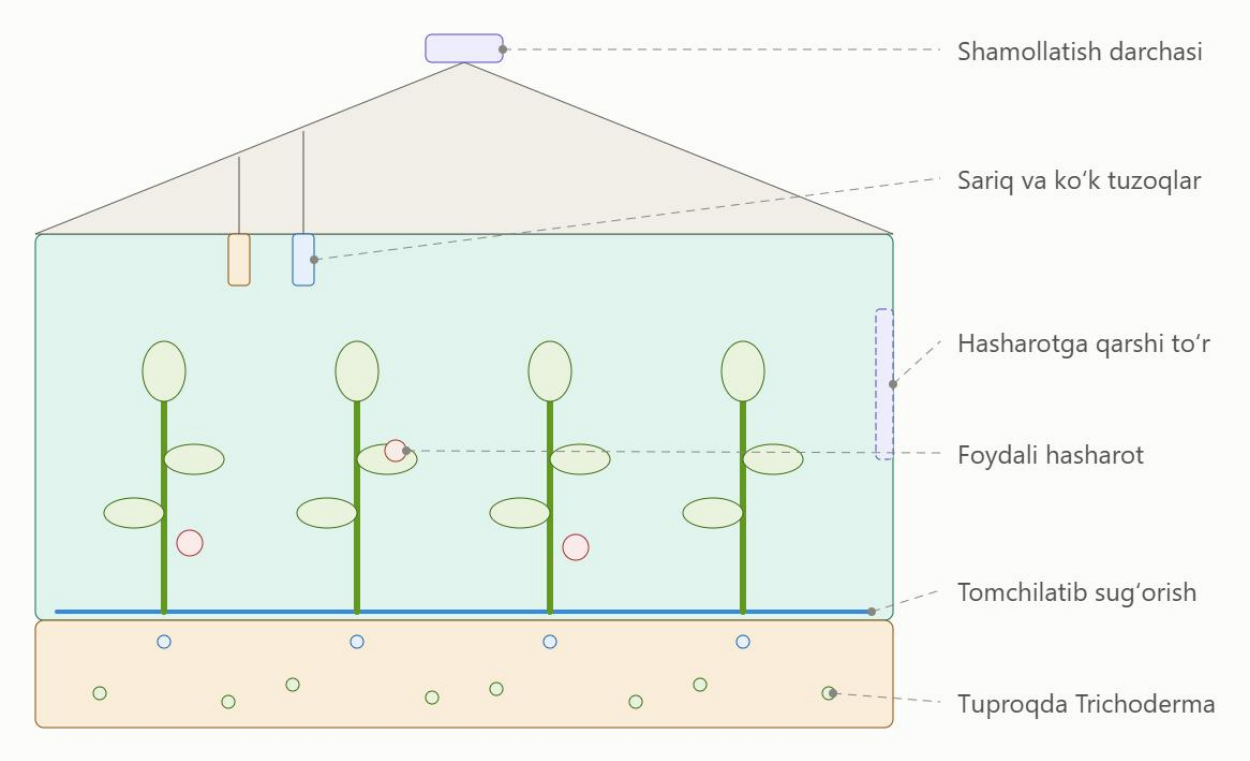
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Soil sampling methodology. To assess the condition of greenhouse soil, samples were collected in accordance with the requirements of GOST 17.4.3.01-2017 and GOST 17.4.4.02-2017. Since soil salinity directly affects the resistance of greenhouse crops to diseases and pests, the sampling procedure was followed carefully.

Sampling points. Samples were taken from 5–10 points in each experimental treatment. The points were arranged diagonally or in a chessboard pattern across the plot. In the diagonal method, 5–10 points (usually 5–7) are selected across the plot. In the chessboard method, up to 10–12 points are selected, providing more accurate coverage of plot variability.

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This illustration is a cross-section of a greenhouse and shows the protective measures described above in their practical locations:

Roof: The ventilation opening reduces humidity and lowers the risk of gray mold and powdery mildew.

Suspended from the ceiling: Yellow traps help detect whiteflies and aphids, while blue traps detect thrips.

Right wall: Insect-proof netting prevents pests from entering.

On the leaves: Beneficial insects (entomophages) naturally reduce pest populations.

Above the soil: Drip irrigation avoids wetting the leaves and reduces root rot.

In the soil: The green dots represent beneficial fungi such as Trichoderma, which help control Fusarium wilt and root rot.

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