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THE TECHNOLOGY OF CULTIVATING SWEET BELL PEPPERS UNDER THE SOIL AND CLIMATIC CONDITIONS OF BUKHARA

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Abstract
The article presents information on the study of methods for cultivating sweet bell pepper (*Capsicum annuum* L.) under greenhouse conditions in the Bukhara region, focusing on the impact of TERIA-S and Green microbiological preparations on plant growth, prevention of stress conditions, and increasing productivity.

Keywords: Sweet Bell Pepper (*Capsicum annuum* L.), TERIA-S and Green microbiological preparations

Introduction

At present, further development of agriculture is considered one of the most important and urgent tasks. In order to meet the demand for food products under the conditions of Uzbekistan, along with increasing the volume of food production, agricultural products are also being exported.

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In Presidential Decree No. PF-6159, *"The Concept for the Priority Development of the System of Knowledge and Innovation in Agriculture for 2021–2025"*, it is emphasized that the effective use of land and water resources, increasing the productivity of agricultural crops, creating new varieties, developing breeding, seed production and seedling production, introducing scientific achievements into production, and specializing the regions of the Republic in the cultivation of certain crops and food products are priority conceptual directions for the development of science and represent an urgent task.

Bukhara region is distinguished by its dry, hot, and continental climate. In particular, during the summer months, air temperatures rise above 40 °C, while in winter they may drop to –10 °C. Under such conditions, the use of greenhouses and other covered facilities is considered effective for the stable year-round cultivation of vegetables. Sweet bell pepper (*Capsicum annuum* L.), due to its high nutritional value, marketability, and constant demand, is regarded as one of the most suitable crops for greenhouse cultivation.

Materials and Methods

In the course of the research, geographical-comparative, chemical-analytical, field, laboratory, experimental, and sectional methods were applied.

Results and Analysis

Sweet bell pepper (*Capsicum annuum* L.) is one of the most widely cultivated vegetable crops in the world. It has high nutritional value and contains vitamin C, carotene, potassium, phosphorus, iron, and other essential microelements. In addition, it is widely used in salads, preserves, and various dishes. Sweet pepper varieties are distinguished by their high yield and marketability.

A study was conducted to evaluate the effectiveness of microbiological preparations using sweet bell pepper (*Capsicum annuum* L.) as a model. The **Green** microbiological preparations and **TERIA-S** were applied in Bukhara district of the Bukhara region to improve the yield and quality of late-planted peppers and to assess the possibilities of their application in the region. Two

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varieties of sweet bell pepper (*Capsicum annuum* L.) were used for testing at different stages of development.

For normal growth, sweet bell pepper (*Capsicum annuum* L.) requires optimal soil moisture, and irrigation is considered one of the key factors for successful cultivation under moisture-deficient conditions[1]. Continuous and sufficient soil moisture plays a crucial role, especially during the stages of vegetative growth, flowering, and fruit formation, when water demand is at its highest. Maintaining optimal moisture levels during these periods is particularly important, as insufficient moisture negatively affects yield and fruit quality. In the Bukhara region, where sweet pepper is cultivated, soil salinity combined with moisture deficiency is often observed. Therefore, irrigation is not only an important but also an essential element of agricultural practice to ensure stable yields. The development of irrigation systems such as drip irrigation allows for the efficient use of water resources and the maintenance of adequate soil moisture[2].

In protecting sweet pepper crops, forecasting the occurrence of pests and diseases plays a key role. This involves the regular monitoring of crops and the application of scientific methods for risk assessment. Forecasting makes it possible to take proactive measures against pest outbreaks and ensures optimal planning of plant protection strategies[3].

Sweet bell pepper (*Capsicum annuum* L.) is among the most popular vegetable crops, used in various forms, including sauces, preserves, and spices. Thus, the effective management of soil moisture, a scientific approach to plant protection, and the integration of innovative technical methods can significantly increase sweet pepper yields in the Bukhara region.

Expanding the production of agricultural products is one of the key reserves for development. Improving their quality requires protecting plants from pests, weeds, and diseases, applying new chemical, biological, and other plant

[1] Беленков А.И., Калмыкова Е.В., Петров Н.Ю., Калмыкова О.В. Возделывание перца сладкого в условиях орошения: от эксперимента к технологии. Картофель и овощи. 2021;1:25–28. https://doi.org/10.25630/ PAV.2021.95.96.002
[2] Белик В.Ф.; Советкина В.Е.; Дерюжкин В.П. Овощеводство. Учебное пособие. Москва: Колос. 2014. 383 с.
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protection agents, and introducing new varieties and cultivation technologies of agricultural crops. This requires not only adequate theoretical preparation but also knowledge of essential modern experimental methods[4].

The purpose of the research is to study the effectiveness of **TERIA-S** and **Green** microbiological preparations in improving the yield and quality of late-planted sweet pepper.

Experimental Period: January – September 2025

Experiments were carried out taking into account the climatic conditions of Bukhara region as well as the soil and plant characteristics.

Sweet pepper is a heat-loving crop, and its optimal growth temperature ranges between 20–28 °C. Low temperatures and sudden climate changes negatively affect its growth and flowering. For cultivation, fertile, well-aerated, and water-permeable loamy or sandy-loam soils are required. The optimal soil pH should be between 6.0–6.8.

Sweet pepper is usually grown through seedlings. Seeds were sown in early March in a greenhouse or seedbed. Before sowing, the seeds were disinfected in a potassium permanganate solution or treated with special stimulants. Seedlings were maintained for 55–65 days. In autumn, before planting, 30–40 tons/ha of decomposed manure, 1.5–2 kg of superphosphate, and 0.8–1 kg of potash fertilizers were applied per $100m^2$ of land. Transplanting into closed ground was carried out at the end of April – beginning of May, when the soil temperature exceeded 15 °C. The planting scheme was generally 60 × 30 cm or 70 × 25 cm. Approximately 4–5 thousand seedlings were transplanted per $100m^2$.

Greenhouse Conditions

- **Type:** Polycarbonate or film-covered structures, equipped with a heating system for winter.

[4] Власенко И.Г. Агротехнический метод в защите растений: достоинства и недостатки. В: Сб. материалов V международной научно-практической конференции «Агротехнический метод защиты растений от вредных организмов». Краснодар: Кубанский государственный аграрный университет, 2011. – 396 с.

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• **Temperature:** Maintained at 22–26 °C during the day and 18–20 °C at night. During flowering and fruit setting, the temperature was kept at 25–28 °C.
• **Relative Humidity:** Maintained at around 65–75%.

Cultivation Practices

1. **Irrigation** – Sweet pepper requires consistent moisture. During the fruiting period, irrigation was carried out every 7–10 days.
2. **Fertilization** – During the vegetative period, nitrogen fertilizers were applied 2–3 times, while phosphorus-potassium fertilizers were supplied during flowering and fruit formation.
3. **Weed Control** – Conducted through row loosening, mulching, and manual weeding.
4. **Pest and Disease Control** – Primarily against late blight, damping-off, thrips, and spider mites, using both biological and chemical methods.

Seed Sowing Period: Seeds were sown on January 25. For soil disinfection against bacteria and viruses, potassium permanganate solution was sprayed prior to sowing. The seeds were then germinated in a special chamber where the temperature was maintained at 28–30 °C until sprouting.

Seedling Growing Period: 55–60 days. Once the seedlings developed 6–8 true leaves, they were transplanted into the main greenhouse. In greenhouse conditions, pepper stems grow rapidly; therefore, side shoots were regularly removed until plants were shaped into 2–3 main stems. To improve fruit quality, lower leaves and weak branches were pruned.

At the 3–4 leaf stage, seedlings were transplanted into two experimental plots within the greenhouse. The experimental fields were prepared beforehand: drip irrigation tapes were laid at a depth of 20 cm, perennial weeds were removed, and a basal application of fertilizers at the rate of N180, P135, K60 was applied. During the growth period, peppers were irrigated more frequently due to the weak

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development of adventitious roots, which is a characteristic feature of the crop's water regime.

Sweet pepper, in terms of direct nutrient removal per unit of yield, is comparable to tomato. To obtain 100 quintals of harvest, approximately **32 kg of nitrogen, 13 kg of phosphorus, and 45 kg of potassium** were applied to the soil. Since peppers have a relatively small root system, they are more demanding of soil fertility. Sweet pepper responds well to nitrogen fertilizers; therefore, we applied a complete mineral fertilizer with a predominance of nitrogen. In selecting the varieties, market demand, product quality, and regional adaptability were taken into account[5].

For pest control, biological agents (such as *Trichogramma* and other entomophages) were mainly used against whiteflies, thrips, and spider mites; when necessary, chemical preparations were also applied. Against fungal diseases, "Fitosporin" fungicides were used.

Harvesting was carried out when the peppers reached the technical ripening stage (green or yellow color). The average fruit weight of the cultivated sweet bell pepper (*Capsicum annuum* L.) varieties was **80–95 g**. The fruits were smooth, with wall thickness of **5–7 mm**, aromatic, with excellent taste, and conical in shape. When fully ripe, fruits turned light green or light yellow. The plant height was **40–50 cm**, with large green leaves. Yields reached **100–120 quintals/ha**.

A distinctive feature of sweet pepper cultivation is the requirement for optimal soil moisture, especially during critical stages such as planting, flowering, and fruit formation, as the crop is highly moisture-loving. From the moment seedlings are transplanted, peppers require water to establish roots. During flowering and fruit formation, water requirements increase significantly because fruit development is active, and lack of moisture at this stage reduces both yield and fruit quality.

[5] Toxirov, Baxtiyor, and Mukhayo Tagaeva. "Studying the activity of microorganisms (laboratory conditions) in moderately and highly saline meadow alluvial soils based on cotton." e3s web of conferences. vol. 389. edp sciences, 2023
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In Bukhara region, where the climate is often characterized by moisture deficiency, irrigation systems play a crucial role in achieving planned yields. Irrigation ensures efficient water management and supplies plants with sufficient moisture during critical growth stages.

To improve the accuracy of the experiment, designated plots were divided into sections: one treated with **TERIA-S**, and another with **Green** microbiological preparations. The number of variants was determined, plot sizes and shapes were chosen, and replication was ensured. The field experiment was laid out according to two essential requirements:

1. The experimental area corresponds to the typical soil, climatic, and agro-technical conditions of the region.
2. The site has uniform soil cover to ensure sufficient experimental accuracy.

When using microbiological preparations, it is therefore necessary to carefully study the site, conduct soil tests, assess topography and microrelief, determine the degree of weed infestation, and account for possible random factors.

Efficient irrigation methods such as **drip irrigation** minimize water losses and ensure uniform soil moisture, which is particularly important under limited water supply conditions. Proper soil moisture management and irrigation thus significantly increase the possibility of obtaining high pepper yields in arid areas. Adapting standard drip irrigation technology to the soil-climatic conditions of the region, while considering the biological characteristics of pepper, is essential.

Like most fruiting crops, sweet pepper (*Capsicum annuum* L.) directs much of its energy to the development of the first fruits. Therefore, early fruits are harvested to redirect energy to new growth, flowers, and subsequent fruits. Due to the crop's slow growth rate, the balance between vegetative growth and generative development (flowering and fruiting) is easily disrupted. If this balance is not maintained, yields drop sharply. Another reason for yield reduction is that pepper begins forming flower buds six weeks before fruiting. If plants undergo stress during this period, and stress persists, yields are severely affected. One major stress factor is the retention of too many mature fruits on the plant. Once stress is eliminated, recovery takes about six weeks before new buds form.

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The first fruits required **70–80 days** for development. The overall interval from stress recovery to harvesting new fruits reached about **120 days**. A well-designed **pruning system** ensured continuous production of high-quality fruits and helped restore plant balance, as confirmed by experimental observations.

For higher yields, side shoots had to be removed before flowering. Additionally, when growth slowed or flowers were absent, lower fruits were removed to strengthen the plant. Conversely, if growth was too vigorous, one immature fruit was deliberately left on a weaker side shoot to slightly slow down excessive vegetative growth.

Conclusion

The use of the *Green* microbiological preparations *Tesla* and is recommended as an important agrotechnical measure in the technology of cultivating sweet bell pepper. Their application not only increases productivity but also makes it possible to obtain environmentally friendly, vitamin-rich, and marketable products. The partial substitution of chemical fertilizers with these preparations is considered economically and environmentally efficient.

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