

Soil Preparation and Management Techniques for Protected Cultivation

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Available online at

www.sunshineagriculture.vitalbiotech.org

Article History

Received: 27. 3.2026

Revised: 2. 4.2026

Accepted: 6. 4.2026

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INTRODUCTION

Protected cultivation involves growing crops in controlled environments such as greenhouses, polyhouses, and shade net structures. Unlike open-field conditions, the soil in protected cultivation systems is continuously used, which can lead to nutrient depletion, salinity buildup, and increased incidence of soil-borne pathogens. Therefore, proper soil preparation and management are essential to maintain soil health and ensure optimum crop growth and yield.

2. Soil Selection and Testing

Soil selection is a fundamental step in protected cultivation. The soil should be well-drained, fertile, and free from pests and diseases. Soil testing is carried out to determine physicochemical properties such as pH, electrical conductivity (EC), and nutrient status.

The optimal soil pH for most horticultural crops ranges between 6.0 and 7.5. Based on soil test results, corrective measures such as the application of lime or gypsum are adopted to maintain suitable soil conditions. Regular soil testing helps in precise nutrient management and prevents overuse of fertilizers.

3. Soil Sterilization and Disinfection

Continuous cultivation in protected structures increases the risk of soil-borne diseases and pests. Soil sterilization is therefore necessary to eliminate harmful microorganisms.

Methods of Soil Sterilization:

- **Solarization:**

A non-chemical method where moist soil is covered with transparent polyethylene sheets for 4–6 weeks. High temperatures generated under the sheet kill pathogens, nematodes, and weed seeds.

- **Chemical Sterilization:**

Involves the use of chemicals such as formalin, although it requires careful handling due to toxicity.

- **Steam Sterilization:**

A highly effective method used in advanced systems, where steam is applied to raise soil temperature and destroy pathogens.

4. Organic Matter Management

Organic matter plays a critical role in maintaining soil fertility and structure. The addition of organic inputs such as farmyard manure (FYM), compost, vermicompost, and green manure enhances soil properties.

Organic matter improves soil aggregation, increases water-holding capacity, and stimulates beneficial microbial activity. It also contributes to the slow release of nutrients, ensuring long-term soil fertility.

5. Bed Preparation and Layout

Proper bed preparation is essential for efficient crop management in protected cultivation systems. Raised beds of 15–30 cm height are commonly used to ensure proper drainage and aeration.

Beds are typically 1–1.2 meters wide with adequate spacing between them for movement and intercultural operations. Raised bed systems facilitate root development, prevent waterlogging, and support efficient irrigation practices such as drip irrigation.

6. Nutrient Management through Fertigation

Fertigation is the application of fertilizers through irrigation systems, commonly used in protected cultivation. This technique ensures precise nutrient delivery directly to the root zone.

Balanced nutrient management includes the supply of macronutrients (N, P, K), secondary nutrients (Ca, Mg, S), and micronutrients (Zn, Fe, Mn, etc.). Fertigation improves nutrient use efficiency and reduces losses due to leaching or volatilization.

7. Soil Moisture Management

Maintaining optimum soil moisture is critical for plant growth. Drip irrigation is widely used in protected cultivation as it provides uniform water distribution and minimizes wastage.

Mulching, using plastic or organic materials, helps conserve soil moisture, regulate soil temperature, and suppress weed growth. Over-irrigation should be avoided to prevent root diseases and nutrient leaching.

CONCLUSION

Soil preparation and management are key components of successful protected cultivation. Practices such as soil testing, sterilization, organic matter addition, proper bed preparation, fertigation, and moisture management contribute to improved soil health and crop productivity. Adoption of these techniques ensures sustainable and profitable farming under protected environments.

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