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Cultivation of Strawberry (*Fragaria × ananassa*) under Polyhouse Conditions in the North-Eastern Region of Bihar

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Strawberry (Fragaria × ananassa) is an important high-value fruit crop widely appreciated for its attractive color, pleasant aroma, and rich nutritional content and antioxidants. In India, strawberry cultivation is traditionally confined to temperate regions; however, the adoption of protected cultivation techniques has made it possible to grow strawberries successfully in non-traditional areas. Polyhouse cultivation provides a favorable microclimate by regulating temperature, humidity, and light, thereby enhancing plant growth, flowering, and fruit quality. The northeastern region of Bihar experiences a humid subtropical climate with winter temperatures ranging from 10–25°C, which is suitable for strawberry cultivation. However, open-field cultivation often faces challenges, such as irregular rainfall and temperature fluctuations. Therefore, the adoption of polyhouse cultivation can improve productivity, ensure better fruit quality, and provide higher economic returns to farmers in this region.

Keywords: Strawberry, Polyhouse cultivation, protected cultivation, Bihar, production.

Introduction

Cultivated strawberry (Fragaria × ananassa Duch.) is one of the most important soft fruits worldwide and was introduced to India in the early 1960s (Sharma & Sharma, 2004). Currently, it is well acclimatized to the temperate regions of the country. The crop originated through deliberate hybridization between two Native American species, Fragaria chiloensis and Fragaria virginiana. It belongs to the family Rosaceae and is an octaploid species with a chromosome number of 2n = 56. Its wide genetic diversity and high degree of heterozygosity have contributed significantly to the global expansion and adaptability of cultivated strawberries. Strawberries are soft fruits with pleasant and attractive aromas (Sharma and Yamdagni, 2000). It is highly nutritious and contains important vitamins A, B, and C, along with niacin. Strawberries are also a good source of minerals such as phosphorus, potassium, calcium, and iron (Karkara and Dwivedi, 2002). Because of its good taste and nutritional value, strawberries have good potential in the processing industry and are also suitable for growing in kitchen gardens. Strawberries contain vitamin C and many other important vitamins and minerals. They are a good source of manganese, which helps keep bones healthy and supports the body's metabolism. Strawberries also provide folate, which is important for cell growth and development, particularly during pregnancy (Newerli-Guz et al., 2023).

Polyhouse cultivation provides a controlled environment for plant growth and development. Temperature, humidity, and light can be managed according to the needs of the crop. It protects plants from bad weather, such as heavy rain, frost, and extreme temperatures. This helps achieve better plant growth, good fruit quality, and higher yield compared to open-field cultivation.

Soil and Climate

Strawberries grow best in cool and moderate climates. Some varieties can also grow in subtropical areas. In protected structures like polyhouses or low tunnels, strawberries need about 12 h of sunlight and 50–80% relative humidity for good growth and fruit production. Strawberry grows well in sandy loam soil that has good drainage and enough organic matter. Water should not remain in the soil for a long time. The ideal soil pH for better growth and yield is 5.7–6.5.




Varieties

Winter Dawn, Flaminia, Parthenope, Pusa Early Dwarf, Camarosa, Nabila, Chandler, Pajaro, Katrain Sweet, Florida 90, Selva, Bangalore are all these varieties suitable for North- Eastern region of Bihar.

Propagation

Strawberry plants are mainly propagated through runners. Normally, one plant produces approximately 7–10 runners, and with proper care, this number may increase up to 15 per plant. IBA (Indole-3-Butyric Acid) (1000 ppm) was applied to improve rooting and support

better establishment of young plantlets. For this purpose, the runner tips are dipped in the IBA solution for a few seconds before planting, or it may be applied near the base of the runner to encourage rapid root formation.

Micropropagation

Strawberry can also be propagated through micropropagation (tissue culture method). In this method, small shoot tips or meristem tissues are cultured in a nutrient medium under sterile laboratory conditions. This technique helps produce disease-free, healthy, and uniform planting materials in large numbers within a short period. Micropropagation is especially useful for the rapid multiplication of elite cultivars and maintenance of true-to-type plants.

Planting Time: The best time to plant strawberries is September to October.

Bed Preparation: Strawberry plants are grown on raised beds in a double hedge row system. The bed width is 1 m. The plant-to-plant spacing was 25-30 cm and row-to-row spacing was 45-50 cm to ensure proper plant growth and development.

Mulching

Mulching is important for strawberry cultivation. Black or silver plastic mulch is used to control weeds, maintain soil moisture, and maintain proper soil temperature for good plant growth. It also helps reduce nutrient loss from the soil. Straw mulch between rows keeps the fruits clean and prevents them from touching the soil, reducing fruit rot. It also helps save water and control weeds.

Irrigation

Irrigation is crucial for successful strawberry production. Strawberry plants have shallow roots and are usually grown in sandy loam soil; therefore, they require frequent irrigation with a small amount of water. More water is required during the vegetative growth stage, but irrigation should be reduced during fruit development because excess water can soften the fruits. Excess irrigation is harmful as it increases leaf and runner growth, reduces flowering and fruiting, and may also increase diseases such as Botrytis rot and root rot. Different irrigation methods are used in strawberry cultivation, such as drip, overhead, and micro-sprinklers. Among the different irrigation systems, the drip method is widely preferred for efficient water use. Micro-sprinklers are useful during early plant establishment, whereas drip irrigation is preferred during fruit development for proper water and nutrient supply. Micro-sprinklers should be avoided during flowering, as they may damage flowers and spoil fruits.

Fertilization

Strawberry plants require a large number of nutrients to develop. In subtropical regions, field preparation before planting involves applying 20–50 tonnes of well-decomposed cow dung, one-third of nitrogen (100 kg), and the entire dose of phosphorus (70 kg) and potash (150 kg) per hectare. After planting in equal amounts at intervals of ten–15 days, the remaining nitrogen is applied using the drip method (Chadha, 2019). Micronutrients such as Ca, Mg, and S are essential for better plant health and quality fruit production (Singh, 2020).

Harvesting

Strawberries are harvested when the fruit becomes half to three-fourths red. Picking is usually performed every 2–3 days. The fruits should be picked carefully, with a small part of the stem attached. The morning is the best time for harvesting to maintain good fruit quality.

Pest and Disease

Pests: Strawberry plants are attacked by common pests such as aphids, red spider mites, vine weevils, tarnished plant bugs, and sap beetles.

Control: Use clean planting material, maintain field sanitation, remove affected leaves and fruits, and spray suitable insecticides/acaricides when necessary. Neem oil and imidacloprid can be used against aphids, whereas dicofol and abamectin are effective against mites.

Diseases: Strawberry plants are affected by diseases such as anthracnose, powdery mildew, red core, crown rot, and gray mold. Root diseases, such as Verticillium wilt, Fusarium, Rhizoctonia, and Pythium root rot, also damage plants.

Control: Use disease-free runners, avoid over-irrigation, ensure proper drainage, remove infected plant parts, and follow crop rotations. Spraying **carbendazim or mancozeb** helps control fungal diseases. For grey mold and powdery mildew, improve air circulation and avoid overhead irrigation. (Singh *et al*., 2023)

Conclusion

The cultivation of strawberries (*Fragaria* × *ananassa*) in northeastern Bihar represents a significant shift toward high-value, protected horticulture. Traditionally a temperate crop, the use of polyhouse technology allows farmers to overcome the challenges of a humid subtropical climate, such as erratic rainfall and temperature fluctuations. By maintaining a controlled microclimate with optimal humidity (50-80%) and light, polyhouses ensure superior plant growth and fruit quality, which open-field cultivation cannot guarantee.

Success in this region relies on precise technical management, such as selecting adaptable varieties, such as Winter Dawn or Camarosa, utilizing raised beds with plastic mulch to prevent fruit rot, and employing drip irrigation for efficient fertigation. Providing a balanced nutrient solution (specifically N, P, K, Ca, Mg, and S) directly to the root zone maximizes productivity. Furthermore, proactive pest and disease management targeting common threats, such as aphids and powdery mildew, is essential for maintaining crop health.

Ultimately, polyhouse strawberry cultivation offers a highly profitable opportunity for farmers in Bihar. By adopting these modern protection techniques, farmers can produce nutrient-rich, high-quality fruits that meet market demands, ensuring significant economic returns and sustainable agricultural growth in the region.

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