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Dragon Fruit Cultivation in India: Production, Management and Economic Potential

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Dragon fruit (*Selenicereus* spp.), belonging to the family Cactaceae, is an emerging fruit crop valued for its adaptability, nutritional importance, and economic potential. Native to Mexico and Central America, it is now widely cultivated in tropical and subtropical regions, including India, where its area under cultivation is steadily increasing. The crop grows well in warm climates with well-drained soils and is mainly propagated through stem cuttings. Adoption of proper management practices such as suitable planting systems, training, nutrient application, and irrigation is essential for achieving higher productivity. Dragon fruit is rich in antioxidants, beneficial fatty acids, and has wide uses in fresh consumption as well as processing. Although it is relatively tolerant to pests and diseases, some fungal and bacterial problems may occur under adverse conditions. Owing to its high yield potential, market demand, and profitability, dragon fruit is gaining importance as a suitable crop for diversification and enhancing farmers' income.

Introduction

Dragon fruit, commonly known as pitahaya or strawberry pear, belongs to the family Cactaceae and is scientifically classified as *Selenicereus* spp. (formerly *Hylocereus*). It is characterized by a leathery, scaly outer skin and a fleshy interior (Mizrahi *et al.*, 1997). The fruit occurs in different types such as white-, red-, yellow-, and occasionally black-fleshed varieties, with white and yellow types being commonly cultivated in India. Native to Mexico and the Americas, dragon fruit is now widely grown in Southeast Asia, India, Thailand, China, the United States, and Australia. In India, its cultivation has expanded since its introduction in the late 1990s, particularly in states like Karnataka, Kerala, Tamil Nadu, Maharashtra, Gujarat, Odisha, West Bengal, Andhra Pradesh, and the Andaman & Nicobar Islands, although much of the market supply is still imported. The fruit is valued for its nutritional richness, antioxidant content, and health benefits, including its potential role in weight management and disease prevention.

Nutritional Value of Dragon Fruit

Dragon fruit is a nutrient-rich fruit providing about 264 kcal (1,100 kJ) of energy per 100 g of dry matter. It mainly contains carbohydrates (≈82%), along with small amounts of protein (≈4%), and is a good source of vitamin C and calcium, contributing significantly to daily nutritional requirements. The seeds are rich in beneficial fatty acids, particularly linoleic acid (≈50.1%) and a small amount of linolenic acid (≈1%). Other fatty acids present include oleic acid (≈23.8%), palmitic acid (≈17.6%), stearic acid (≈4.4%), palmitoleic acid (≈0.6%), and myristic acid (≈0.3%).

Uses of Dragon Fruit

- Rich in antioxidants, anti-inflammatory, and potential anti-cancer compounds.
- Helps lower cholesterol and supports weight management.

- Promotes skin health and overall well-being.
- May help prevent anemia during pregnancy.
- Flowers can be used to make herbal tea.
- Flower buds are edible and used in soups and salads.
- Processed into value-added products: juice, jam, ice cream, squash, and wine.
- Serves as a natural colorant and flavoring in beverages.
- Has strong economic potential to increase farmers' profits.

Soil and climatic requirement

Dragon fruit can be successfully cultivated in a wide range of soils from sandy loam to clay loam, with an ideal soil pH of 5.5–7.0, and good organic matter content; however, it can also tolerate relatively poor soils (Nobel *et al.*, 2002). The crop prefers warm climatic conditions, with an optimum temperature range of 20–30°C, and can withstand brief periods of frost but is not suitable for prolonged exposure to freezing temperatures. An annual rainfall of about 40–60 cm is considered adequate for its growth.

Propagation

Dragon fruit is commonly propagated through stem cuttings, as it is simple and effective. Healthy cuttings of about 20–25 cm length are selected from elite mother plants after the fruiting season, and are kept for 1–2 days to allow the latex to dry. Before planting, the cuttings are treated with fungicides to prevent diseases. They are then planted in polyethylene bags (12 × 30 cm) filled with a mixture of soil, farmyard manure, and sand in a 1:1:1 ratio, and kept under shade for rooting. Care should be taken to avoid excess moisture to prevent rotting. The cuttings develop good roots and become ready for field planting within 5–6 months (Tripathi *et al.*, 2014). Propagation through seeds is not preferred for commercial cultivation, as seedlings grow slowly, develop thin stems even after one year, and show high variability, resulting in plants that are not true to type (Tripathi *et al.*, 2014).

Planting

Dragon fruit should be planted in open areas with full sunlight, as shaded conditions are not suitable for its growth. In the commonly followed single-post system, planting is done at a spacing of 3 × 3 m, using support poles of about 1.5–2 m height to allow the plants to climb, branch, and hang. Usually, 2–4 plants are maintained per pole depending on climatic conditions. For proper growth, only 2–3 main stems are retained, while excess lateral shoots are removed regularly. A circular metal or concrete frame at the top of the pole helps in evenly spreading and supporting the hanging shoots. At planting, incorporation of dolomite and organic manures is beneficial, and the growing medium is enriched with farmyard manure, coir compost, vermicompost, and biofertilizers. Dragon fruit vines grow rapidly, with an average increase of about 8.2 cm per week, forming a dense canopy over the trellis within 8 months. Phenological studies conducted in Orissa, India classified the growth stages of dragon fruit using the extended BBCH scale, identifying seven principal stages—bud development (0), shoot development (1), vegetative organ development (4), reproductive development (5), flowering (6), fruit development (7), and fruit maturation (8)—along with 40 secondary stages. This standardized scale is useful for improving crop management practices such as nutrient application, pollination, propagation, harvesting, and pest control (Kishore, 2016).

Training system

Dragon fruit is a fast-growing climber that requires proper training and support for better growth and yield. During the initial stage, lateral buds and excess branches are pruned to guide the plant towards the support, and once it reaches the top, the tip of the main stem is removed to promote lateral branching, forming an umbrella-shaped canopy where flowering and fruiting occur; this is known as structural pruning. A healthy plant can produce 30–50 branches in the first year and over 100 branches within four years (Fig. 1). Among various trellis systems used in India, studies at IIHR, Bengaluru found the single pole system with a

circular ring (about 6 ft height and 5–6 inch thickness) to be most effective for growth and yield, as it supports plant weight and allows easy management. Although wooden poles are cheaper, concrete poles are preferred for commercial cultivation due to their higher durability.

Figure 1. Field view dragon fruit established with trellis system

Flowering

Flowering in dragon fruit begins with the formation of small spiral, button-like structures along the stem margins, which develop into flower buds within 10–15 days. The flowers are large (25–30 cm long), hermaphrodite, white inside and greenish-yellow with purple tinge outside, and are fragrant, blooming only at night for a single night (Fig. 2). Flowering generally occurs from May to August, with fruits ready for harvest 30–40 days after fruit set. Although fruit quality varies among varieties, the stage of harvest has a greater influence on quality than varietal differences. Both self-compatible and self-incompatible types exist, and considerable variation is observed in fruit size and shape. However, limited information is available on varietal performance and production aspects (Karunakaran and M. Arivalagan, 2019).

Fig. 2. Flowering bud of Dragon fruit

Nutrient Requirement

Farmyard manure is applied at the rate of 20–25 kg per acre to improve soil fertility. In addition, a water-soluble fertilizer (NPK 20:20:20) is recommended twice in a season—once in early spring and again after complete flowering. A concentration of about one tablespoon per gallon of water is considered effective for application.

Irrigation

Dragon fruit requires relatively less water as it belongs to the cactus family; however, irrigation is essential during critical stages such as planting, flowering, fruit development, and under hot dry conditions. Drip irrigation is recommended for efficient water management.

Harvesting

Dragon fruit plants start bearing within 12–15 months after planting. Fruit maturity is indicated by a change in skin color from green to red, and harvesting is usually done about 7 days after this color transition. The harvesting season extends from June to September, with picking carried out 3–4 times per month. Individual fruit weight ranges from 300–800 g, and a three-year-old planting under the single pole system can yield about 30–35 kg per pole. The prevailing farm gate price generally ranges from INR 80 to 120 per kg.

Varieties

- *Selenicereus undatus* (white-fleshed): Also known as pitahaya; has white pulp with pink skin, fruits are 6–12 cm long and 4–9 cm thick with small edible black seeds.
- *Selenicereus costaricensis* (red-fleshed): Commonly called red pitaya; characterized by red flesh with pink skin, native to Mexico but now widely cultivated.
- *Selenicereus megalanthus* (yellow-skinned): Has white flesh with yellow skin, originally from South America.

Fig. 3. Fruit ready to harvest

Sun Burn Injury

Sunburn is a common issue in dragon fruit during March–April when temperatures exceed 38°C and day–night variation is high. It can be managed through shade net cultivation, use of anti-transpirants, and growing filler crops for protection. Studies on off-season production are ongoing at IIHR.

Expected Pests and Diseases

- Dragon fruit is a hardy crop with few major pest and disease problems.
- Minor pests like ants, scale insects, and mealy bugs may occur and are easily controlled.
- Major diseases include anthracnose, brown spot, and stem rot, especially in wet and poorly drained conditions.
- Anthracnose (*Colletotrichum siamense*) causes reddish-brown lesions and is managed with mancozeb/chlorothalonil and carbendazim. (Abirami *et al.*, 2019).
- Wilt (*Fusarium spp.*) leads to drying and loss of turgidity.
- Rot diseases may be caused by *Alternaria, Bipolaris, Rhizopus,* and *Dothiorella*.
- Stem rot (*Xanthomonas campestris, Erwinia carotovora*) is linked to sunburn and calcium deficiency; controlled with copper oxychloride.
- Fruit flies (*Anastrepha spp.*) are reported elsewhere but not confirmed in India.

Fig. 4. Stem rot of dragon fruit caused due to *Xanthomonas campestris*

Fig. 5. Brown spot on the fruit caused due to *Dothiorella* spp.

Cost Economics of Dragon Fruit

- Commercial propagation is done through stem cuttings with support of cement poles (20–25 years lifespan).
- About 500 poles (4 plants each) are planted per acre, totaling ~2000 plants.
- Initial investment is around ₹18 lakh/acre; maintenance cost from second year is ~₹1 lakh/acre (Raveh *et al.*, 1998).
- Average yield is about 10 tons/acre (≈5 kg per plant).
- Market price ranges ₹160–200/kg, giving profits of ₹15–18 lakh/acre annually (Perween *et al.*, 2018).
- High demand and export potential make it a profitable crop.

Conclusion

Dragon fruit is a profitable and sustainable crop with wide adaptability and growing market demand. Adoption of improved cultivation practices can enhance yield and quality, making it a promising option for increasing farmers' income and promoting agricultural diversification in India.

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