

Unveiling the Exotic Beauty: The Rise of Dragon Fruit in Global Palates

Gautam Kunal¹, Kumari Madhumala² and Pavan Shukla²

¹Department of Entomology, ²Dept. of Horticulture, Veer Kunwar Singh College of Agriculture, Dumraon, Buxar, Bihar

SUMMARY

Dragon fruit, has gained popularity not only for its exotic appearance but also for its nutritional richness and potential health benefits. Dragon fruit is renowned for its vibrant, pink or red outer skin and white or red-fleshed interior speckled with tiny black seeds. Rich in essential nutrients, dragon fruit is a good source of vitamin C, fiber, antioxidants, and several minerals. The fruit's low calorie and high-water content make it a refreshing and hydrating snack. Studies suggest that the antioxidants in dragon fruit may contribute to reducing oxidative stress and inflammation, thereby supporting overall health. It (*Hylocereus* species) produces large, nocturnal flowers with numerous petals arranged in a radial pattern. These flowers exhibit both male and female reproductive organs, facilitating self-pollination. While dragon fruit is primarily self-pollinating, the presence of nocturnal pollinators, such as moths and bats, can enhance fruit set. The unique flowering characteristics, including nocturnal blooming, contribute to the plant's reproductive versatility. Dragon fruit plants benefit from various pollination services provided by nocturnal pollinators. While self-pollination is common, external agents like moths and bats play a crucial role in cross-pollination. These pollinators facilitate the transfer of pollen between flowers, promoting genetic diversity and potentially increasing fruit yield. Dragon fruit cultivation may be susceptible to various insect pests and diseases that can impact plant health and reduce fruit yield.

INTRODUCTION

Dragon fruit, a recently introduced superfruit in India, is recognized as a promising and lucrative fruit crop. The fruit boasts an attractive color, a soft, mouth-melting pulp with black edible seeds embedded in it, and exceptional nutritive properties. These qualities have drawn growers from various parts of India to cultivate this fruit, which originated in Mexico and Central and South America (Britton and Rose, 1963; Morton, 1987; Mizrahi et al., 1997). Being a long-day plant, dragon fruit features beautiful night-blooming flowers often referred to as the "Noble Woman" or "Queen of the Night." The fruit goes by various names such as Strawberry Pear, Pithaya, Night-blooming Cereus, Belle of the Night, Cinderella Plant, and Jesus in the Cradle. The term "pitaya" is derived from the scales on the fruit skin, translating to "the scaly fruit." Apart from its potential as a fruit crop, dragon fruit holds ornamental value due to the large, creamy white flowers (25 cm) that bloom at night. Considered a fruit crop for the future (Pushpakumara et al. 2006), dragon fruit comes in three types, each with leathery, slightly leafy skin: *Hylocereus undatus* (white flesh with pink skin), *Hylocereus polyrhizus* (red flesh with pink skin), and *Hylocereus costaricensis* (violet-red flesh with pink skin) and *Hylocereus (Selenicereus) megalanthus* (white flesh with yellow skin). One of the significant advantages of dragon fruit cultivation is its longevity; once planted, it can grow for about 20 years, with one hectare accommodating approximately 800 dragon fruit plants. Commercial cultivation of dragon fruit is observed in Israel, Vietnam, Taiwan, Nicaragua, Australia, and the United States (Merten, 2003). The fruit starts producing in the second year after planting and reaches full production within five years. The goal of this article is to compile literature on *Hylocereus*, covering aspects such as importance, botany, vegetative and reproductive biology, cultivation, manuring, pollination, harvesting, and pest & disease management. This comprehensive overview aims to familiarize everyone with the intricacies of dragon fruit cultivation.

Botanical Classification

Dragon fruit belongs to the genus *Hylocereus* within the family Cactaceae. The botanical classification of dragon fruit is as follows:

Kingdom: Plantae (Plants)	Order: Caryophyllales
Subkingdom: Tracheobionta (Vascular plants)	Family: Cactaceae (Cactus family)
Super division: Spermatophyta (Seed plants)	Subfamily: Cactoideae
Division: Magnoliophyta (Flowering plants)	Tribe: Hylocereeae

Class: Magnoliopsida (Dicotyledons)	Genus: Hylocereus
Subclass: Caryophyllidae	

There are several species and varieties within the genus *Hylocereus* that produce dragon fruit. The most common species cultivated for its fruit include:

1. ***Hylocereus undatus***: This species produces dragon fruit with white flesh and pink skin. It is one of the most widely cultivated varieties.
2. ***Hylocereus polyrhizus***: This species produces dragon fruit with red or magenta flesh and pink skin.
3. ***Hylocereus costaricensis***: This species produces dragon fruit with violet-red flesh and pink skin.
4. ***Hylocereus megalanthus*** (formerly *Selenicereus megalanthus*): This species produces dragon fruit with white flesh and yellow skin. It is less common than the other varieties.

The classification may vary slightly based on taxonomic revisions and advancements in botanical research. Dragon fruit plants are epiphytic or lithophytic cacti, and their unique appearance and characteristics make them distinct within the Cactaceae family.

Package and practices of Dragon Fruit

The cultivation of dragon fruit, also known as pitaya or pitahaya, involves a set of recommended agricultural practices known as a "package of practices." These practices aim to optimize the growth, development, and yield of dragon fruit. Here is a general package of practices for dragon fruit cultivation:

Selection of Variety: Common varieties include *Hylocereus undatus* (white-fleshed), *Hylocereus polyrhizus* (red-fleshed), and *Hylocereus costaricensis* (violet-red-fleshed).

Land Preparation: Select well-drained soil with good aeration. Incorporate organic matter, such as compost or well-rotted manure, into the soil. Ensure proper soil pH (6.0 to 7.5).

Planting: Opt for horizontal or vertical planting, depending on the support structure. Use well-developed, disease-free cuttings for planting. Maintain appropriate spacing between plants (e.g., 3 to 4 meters apart).

Support Structure: Install a support structure for the dragon fruit vines to climb. Vertical support, like trellises or pergolas, is commonly used.

Irrigation: Provide regular and consistent irrigation, especially during the flowering and fruiting stages. Avoid waterlogging, as dragon fruit plants are susceptible to root rot.

Fertilization: Apply a balanced fertilizer with an N-P-K ratio suited for fruiting plants. Supplement with organic fertilizers to enhance soil fertility.

Pruning: Prune the dragon fruit plants to control excessive growth and promote branching. Remove diseased or dead branches promptly.

Harvesting: Harvest dragon fruit when the skin color changes and the fruit becomes slightly soft to touch. Use pruning shears or a sharp knife to cut the fruit from the plant.

Post-Harvest Handling: Handle harvested fruit with care to avoid bruising or damage. Store dragon fruit in a cool, well-ventilated place.

Crop Rotation: Practice crop rotation to prevent the buildup of pests and diseases in the soil.

Training and Trellising: Train the vines to climb the support structure. Regularly check and adjust the trellising system for optimal support.

Floral Structure

The floral structure of dragon fruit (*Hylocereus* species) is a fascinating aspect that contributes to the plant's reproductive process. Here is an overview of the key components of the dragon fruit flower:

Flower Type:

Dragon fruit flowers are large, showy, and typically bloom at night. They are nocturnal flowers, meaning they open and release their fragrance during the night to attract nocturnal pollinators.

Pedice: The flower is attached to the plant by a stalk known as the pedicel.

Sepals: Dragon fruit flowers have several sepals, which are the outermost floral structures that protect the developing bud.

Petals: The petals of dragon fruit flowers are numerous and arranged in a radiating pattern. Petals are typically white or cream-colored, and their arrangement contributes to the characteristic star-like appearance of the flower.

Stamens: Dragon fruit flowers have numerous stamens, the male reproductive organs. The stamens consist of filaments and anthers. The anthers contain pollen, the male reproductive cells.

Pistil: The central part of the flower is the pistil, the female reproductive organ. The pistil consists of a stigma, style, and ovary.

Stigma: The stigma is the receptive surface at the top of the pistil that receives pollen during pollination.

Style: The style is the slender tube connecting the stigma to the ovary. It provides a pathway for pollen to reach the ovary.

Ovary: The ovary is the basal part of the pistil that contains ovules. It develops into the fruit after successful fertilization.

Nectar Receptacle: Dragon fruit flowers may have a nectar receptacle that produces nectar to attract pollinators.

Reproductive Strategy: Dragon fruit flowers are primarily self-pollinating. However, they can also benefit from cross-pollination facilitated by nocturnal pollinators like moths and bats.

Fruit Development: After successful pollination, the ovary develops into the dragon fruit. The flower petals fall off, and the ovary enlarges to form the characteristic fruit with its scaly skin.

Understanding the floral structure is essential for successful dragon fruit cultivation, especially in terms of promoting pollination and ensuring fruit set. The unique features of dragon fruit flowers, including their nocturnal blooming and self-pollinating capabilities, contribute to the plant's reproductive success.

Pollination of Dragon Fruits

Primarily Dragon fruit is a self-pollinating fruit, meaning that the flowers have both male and female reproductive organs, allowing them to fertilize themselves. However, while dragon fruit is capable of self-pollination, the presence of pollinators, such as bees and moths, can enhance fruit set and yield. Here's an overview of the pollination process in dragon fruit:

Self-Pollination: Dragon fruit flowers are capable of self-pollination, where pollen from the stamens can reach the stigma of the same flower. The flowers often open at night, and the self-pollination process can occur without the need for external agents.

Insect Pollination: While dragon fruit is primarily self-pollinating, the presence of pollinators can still be beneficial. Insects, especially bees, can transfer pollen between flowers, potentially leading to increased fruit set and improved yield. Moths are also known to be effective pollinators of dragon fruit, particularly in regions where they are prevalent.

Hand Pollination: In some cases, especially in commercial plantations, growers may engage in hand pollination to ensure maximum fruit set. Hand pollination involves transferring pollen from the stamens to the stigma using a brush or other gentle means.

Environmental Factors: Dragon fruit is sensitive to environmental conditions during flowering and fruiting. Factors such as temperature, humidity, and light can influence the success of pollination and subsequent fruit development.

Fruit Development: After successful pollination, the flower begins to develop into the characteristic dragon fruit. The fruit starts as a small bud and gradually enlarges, reaching maturity over several weeks.

While dragon fruit flowers are equipped for self-pollination, encouraging a diverse ecosystem with pollinators in the cultivation area can provide additional benefits. This diversity helps ensure consistent and efficient pollination, leading to improved fruit quality and yield. Additionally, maintaining a healthy and well-balanced ecosystem supports the overall sustainability of dragon fruit cultivation.

Nutritional Composition and Health Benefits of Dragon Fruit

Dragon fruit is a rich source of essential nutrients, making it a valuable component of a balanced diet. Its nutritional profile includes:

Nutritional Composition

Vitamins: Dragon fruit is notably high in vitamin C, a powerful antioxidant that supports immune function and skin health. It also contains B vitamins, including B1, B2, B3, and B9, which play crucial roles in energy metabolism and overall well-being.

Minerals: The fruit provides essential minerals such as iron, magnesium, and phosphorus, contributing to bone health, blood circulation, and various physiological processes.

Dietary Fiber: Dragon fruit is a good source of dietary fiber, aiding in digestion, promoting satiety, and supporting a healthy gut.

Antioxidants: The presence of antioxidants, including betalains and flavonoids, helps combat oxidative stress in the body, potentially reducing the risk of chronic diseases.

Health Benefits:

Heart Health: The fiber and antioxidants in dragon fruit may contribute to cardiovascular health by reducing cholesterol levels and supporting overall heart function.

Digestive Health: The dietary fiber content promotes regular bowel movements, prevents constipation, and supports a healthy digestive system.

Hydration: Dragon fruit has high water content, contributing to hydration and helping maintain optimal fluid balance in the body.

Weight Management: The low-calorie content and fiber in dragon fruit can aid in weight management by promoting a feeling of fullness.

Blood Sugar Regulation: The fiber and antioxidants may help regulate blood sugar levels, making dragon fruit a potentially beneficial fruit for individuals with diabetes.

Skin Health: The vitamin C content supports collagen synthesis, contributing to healthy skin, and the antioxidant properties may help combat skin aging.

Nutritional Security:

Dietary Diversity: Including dragon fruit in the diet adds diversity, ensuring access to a wide range of nutrients necessary for overall health.

Micronutrient Intake: The vitamins and minerals in dragon fruit contribute to meeting daily micronutrient requirements, supporting overall nutritional adequacy.

Sustainable Agriculture: Dragon fruit cultivation, with its adaptability to various climates, offers a sustainable option for enhancing nutritional security in regions where it can be grown.

Insect Pests and diseases of Dragon Fruit

Dragon fruit cultivation may be susceptible to various insect pests and diseases that can impact plant health and reduce fruit yield. Here are some common insect pests and diseases that affect dragon fruit:

Insect Pests:

Scale Insects (*Coccus* spp.): Scales are sap-feeding insects that can infest dragon fruit plants. They appear as small, immobile bumps on the stems and fruits. Scales can cause damage by draining sap and creating a favourable environment for sooty mold.

Mealybugs (*Pseudococcidae* family): Mealybugs are soft-bodied insects that feed on plant sap. They produce a cottony substance that covers the plant. Mealybug infestations can weaken the plant and reduce fruit quality.

Aphids (*Aphididae* family): Aphids are small, sap-sucking insects that can infest young shoots and flower buds. They reproduce quickly, leading to large populations that can cause stunted growth and distortion of new growth.

Ants: While not directly harmful to dragon fruit, ants can protect and farm sap-sucking pests like aphids and mealybugs, exacerbating pest problems.

Diseases:

Anthracnose (*Colletotrichum* spp.): Anthracnose is a fungal disease that can affect dragon fruit, causing dark, sunken lesions on stems and fruits. It thrives in humid conditions and can lead to fruit rot.

Bacterial Soft Rot (*Erwinia* spp.): Bacterial soft rot can affect dragon fruit, especially in damaged or wounded areas. It causes soft, watery decay of tissues and can lead to the collapse of affected plant parts.

Brown Spot (*Neoscytalidium* spp.): Brown spot is a fungal disease that manifests as small, reddish-brown lesions on stems and fruits. It can lead to premature fruit drop and reduced fruit quality.

Powdery Mildew (*Oidium* spp.): Powdery mildew is a fungal disease that appears as a white, powdery substance on the surface of leaves and stems. It can reduce photosynthesis and overall plant health.

Root Rot (*Phytophthora* spp.): Root rot is a soil-borne disease that affects the roots of dragon fruit plants. It can lead to wilting, yellowing, and eventual death of the plant.

Preventive and Control Measures:

Cultural Practices: Ensure proper spacing and ventilation between plants. Avoid overwatering and maintain well-draining soil conditions.

Biological Control: Introduce natural predators like beneficial insects to control pest populations.

Chemical Control: Use insecticidal soaps, neem oil, or other approved pesticides to manage insect pests. Fungicides may be applied to control fungal diseases.

Regular Monitoring: Inspect plants regularly for signs of pests and diseases. Promptly remove and destroy affected plant parts to prevent the spread of diseases.

Implementing integrated pest management (IPM) practices, including a combination of preventive measures, biological controls, and targeted chemical interventions, can help manage insect pests and diseases in dragon fruit cultivation.

REFERENCES

- Britton NL, Rose JN. 1963. *The Cactaceae: Description and Illustration of Plants of the Cactus Family*, Dover, New York. USA. 1(2):183-195.
- Merten S. A. 2003. Review of Hylocereus Production in the United States. *Profe. Assoc. Cactus Dev.* 5:98-105
- Mizrahi Y, Nerd A, Nobel PS. 1997. Cacti as a crop. *Hort. Rev.* 18:291-320. 20.
- Morton J. Cactaceae. 1987. Strawberry pear and related species. In: *Fruits of Warm Climates*, Ed., Miami, and Fl. 347-348.
- Pushpakumara DKNG, Gunasena HPM, Kariyawasam M. 2006. Flowering and fruiting phenology, pollination agents and Breeding system in *Hylocereus* spp. (dragon fruit). *Proc Peradeniya University Research Sessions.* Sri Lanka. 11:15.