

Dragon Fruit: An Emerging Superfruit for Sustainable Horticulture in India

Deen Dayal Sharama and Chita Meena

Introduction

Dragon fruit a recently introduced super fruit in India, is considered to be a promise, remunerative fruit crop. Fruit has very attractive colour and melodious mouth melting pulp with black colour edible seed embedded in the pulp along with marvelous nutritive property which attract the farmer from different part of India to grow this fruit which is originated in Mexico and Central and South America. It is a long day plant with beautiful night blooming flower that is known as Dragon fruit, pitahaya, Night blooming Cereus, Belle of the night, Cinderella plant and Jesus in the Cradle. Fruit is named as pithaya because of the bracts or scales on the fruit skin and hence their large flowers (25 cm) that bloom at night and they are creamy-white in colour. It is considered as a fruit crop for future (Gunasena and Pushpakumara, 2006). The fruit comes in three types, all with leathery, a little leafy skin: *Hylocereus undatus*- white flesh with pink skin, *Hylocereus polyrhizus*- red flesh with pink skin, *Hylocereus costaricensis*- with violet, red flesh and pink skin and *Hylocereus (Selenicereus) megalanthus* – white flesh with yellow skin.

The major advantage of this crop is that once planted, it will grow for about 20 years, and one Hectare could provide accommodation for about 800 dragon fruit plants. It is being grown commercially in Israel, Vietnam, Taiwan, Nicaragua, Australia and the United States (Merten, 2003). It produces fruit in the second year after planting and reaches full production within five years. *Hylocereus* comprises 16 species, which are widespread in Latin America, and they are not very well known among the farmers and researchers and have only recently been the subject of studies. Very few research works have been done on this fruit crop in India. Specific topics associated with the difficulties met by countries that have introduced the new species.

Nutritional security and importance of dragon fruit

Nearby nutraceutical values in g or mg per 100 g edible portion of white-flesh dragon fruit are as follows: moisture (85.3%), protein (1.1), fat (0.57), crude fiber (1.34), energy (Kcal) (67.7), ash (0.56), carbohydrates (11.2), glucose (5.7), fructose (3.2), orbitol (0.33); vitamin C (3.0), vitamin A (0.01), niacin (2.8), Ca (10.2), Fe (3.37), Mg (38.9), P (27.75), K (272.0), Na (8.9) and Zn (0.35) and for red-flesh fruit, moisture (82.5-83.0), protein (0.159-0.229), fat (0.21-0.61), crude fiber (0.7-0.9) and ascorbic acid (8-9) (Jaafar et al., 2009).

Deen Dayal Sharama

Agriculture Supervisor, Rajasthan Agriculture Department, Malpura

Chita Meena

Agriculture Supervisor, Rajasthan Agriculture Department, Malpura

As regards different uses of Dragon fruit, young stems of *H. undatus* are fit for human consumption as well as fresh flower buds that are eaten as vegetables, while dried ones are used for homemade medicine. In Taiwan, dry flowers are consumed as vegetables besides this it is also taken in the form of juice, jam, or preserves according to the taste needed, besides used as fresh table fruit. Dragon fruit helps in fighting next to cough and asthma and it helps for healing wounds and cuts quickly due to it contains high amount of vitamin C. Though, the high level of vitamin C found in Dragon fruit plays significant role to enhance immune system and also to stimulate the activity of other antioxidants in the body. In addition to being used as a food colouring agent, utilization of Dragon fruit mostly as fresh fruit as relieving thirst due to it contains high water level compared with other nutrient levels. Health benefits of Dragon fruit is also rich in flavonoids that act against cardio related problems, also dragon fruit aids to treat bleeding problems of vaginal discharge. Dragon fruits are rich in fibers; yet it aids in digestion of food. Dragon fruit is also packed with vitamin B group (B₁, B₂ and B₃) which has an important role in health benefits. Vitamin B₁ helps in rising energy production and with carbohydrate metabolism, Vitamin B₂ in Dragon fruit act as a multivitamin; on the other hand, it aids to improve and recover the loss of appetite. And Vitamin B₃ present in dragon fruit plays an important role in lowering bad cholesterol levels; it provides smooth and moisturizes skin appearance. As well as it prevents hypertension and improves eyesight. Dragon fruit is also helpful in reducing blood sugar levels in people suffering from type 2 diabetes, studies suggest that the glucose found in Dragon fruit helps in controlling the blood sugar level for diabetes patients. It has high levels of phosphorus and calcium. It helps to support bones and plays an important role in tissue formation and forms healthy teeth.

Botanical classification

Dragon fruit belongs to the botanical family Cactaceae and genus *Hylocereus*. This genus is primarily characterized by climbing vine cactus with aerial roots that bear a glabrous attractive berry with large scales. *Hylocereus spp.* are diploid ($2n = 22$). The dicotyledonous family Cactaceae (Caryophyllales) comprise between 120 and 200 genera consisting of between 1500 and 2000 species found especially in the semi-desert, hot tropical regions of Latin America (Spichiger et al., 2000). Cactaceae are mostly appreciated for their ornamental qualities, but they also include nearly 250 cultivated species of fruit-bearing and industrial crops. However, few species are of economic value. We focused more particularly on the *Hylocereus* species. There are many contradictions concerning the botanical classification of *Hylocereus* that are probably explained by the similar morphological characteristics and environmental conditions. The Britton and Rose classification (Britton and Rose.,

1963) was followed commonly. The five-species determined by Britton and Rose classification Britton and Rose (1963) can be more precisely described:

1. **H. purpusii (Weing.) Britton and Rose** -has very large (25 cm) flowers with margins; outer perianth segments are more or less reddish; middle perianth segments golden and inner perianth segments white. it presents scarlet, oblong fruit covered with large scales (length: 10–15 cm; weight: 150– 400 g); red flesh with many small black seeds; pleasant flesh texture, but not very pronounced.
2. **H. polyrhizus (Web.) Britton and Rose** - has very long (25–30 cm) flowers with margins; outer reddish perianth segments, especially at the tips; and rather short and yellowish stigma lobes. its scarlet fruit (length: 10– 12 cm; weight: 130–350 g) is oblong and covered with scales that vary in size; it has a red flesh with many small black seeds, pleasant flesh texture and good taste.
3. **H. costaricensis (Web.) Britton and Rose** – Represented by vigorous vines, perhaps the stoutest of this genus. Stems are waxy white and flowers are nearly the same as *H. polyrhizus*; its scarlet fruit (diameter: 10–15 cm; weight: 250–600 g) is ovoid and covered with scales that vary in size; it has a red purple flesh with many small black seeds, pleasant flesh texture and good taste.
4. **H. undatus (Haw.) Britton and Rose** - has long and green stems, more or less horny in the age margins. Flowers are very long (up to 29 cm), outer perianth segments are green (or yellow-green) and inner perianth segments pure white. its rosy-red fruit (length: 15–22 cm;weight: 300–800 g) is oblong and covered with large and long scales, red and green at the tips; it has a white flesh with many small black seeds, pleasant flesh texture and a good taste.
5. **H. trigonus (Haw.) Saff** - represented by slender, green with margins, not horny stems. The areoles are located on the top of the rib's undulation. Spines, at first greenish, soon turn dark brown. its red fruit (diameter: 7–9 cm; weight: 120–250 g) is ovoid or oblong, becoming nearly smooth; the white flesh has many small black seeds and pleasant flesh texture, but not a very pronounced flavor the top of the rib's undulation. Spines, at first greenish, soon turn dark brown. its red fruit (diameter: 7–9 cm; weight: 120–250 g) is ovoid or oblong, becoming nearly smooth; the white flesh has many small black seeds and pleasant flesh texture, but not a very pronounced flavour.

Basis, distribution and ecology

Most *Hylocereus* species originate from Mexico, Central, and South America. Today, they are widely distributed across tropical and subtropical regions. in india, *H. undatus* is the most commonly

grown species, followed by *H. costaricensis*, due to their hardy nature and ability to tolerate arid and semi-arid climates. *Hylocereus* species are semi-epiphytes, preferring partial shade, though *H. undatus*, *H. costaricensis*, and *H. purpusii* can also thrive in full sun. However, excessive heat and water scarcity can cause stem burns and flower bud drop.

Propagation and planting density

H. undatus and *H. costaricensis* be able to multiplied naturally and very easily by cutting off the stem as soon as it touches the ground. it takes generally 14 months to come to bearing; however duration may vary in different locality for different climatic conditions. Seeds can also be used as propagation material but it will take 3 years to come to bearing. The hardihood of the crop enable it to survive under field condition. Provided cuttings are at least 50 to 70 cm in length and are repeatedly watered in order to make sure satisfactory rooting. if all these conditions are provided around 90% of the cuttings ensure rooting. The distance among plants depend on the type of support used. With a vertical support a 2–3 m distance between planting lines is required which could accommodate 2000 and 3750 cuttings/ ha. With horizontal supports the density can be much higher because the cuttings are planted every 50-75 cm around the production table (6500 cuttings ha⁻¹) or along the inclined support (6500 cuttings). Planting at a distance of 2.5m each to row and between the plants with 4 cuttings/ support can accommodate 6400 plants/ ha and also gives good yields and quality of fruits.

Circumstances of Dragon fruit cultivation in india

Dragon fruit is a semi-epiphytic vine with aerial roots that allow it to climb natural or artificial supports like trees, cement or iron posts, and walls. Vertical supports are preferred, as growing on the ground damages the vines and complicates activities like pollination and harvesting. Growth is generally rapid but may slow during unfavorable conditions such as drought or cold.

Proper support and pruning are essential. initial major pruning is done in the first year to shape the plant and guide its growth. Maintenance pruning from the second year helps control bunch density and prevent damage from wind, as mature plants can weigh up to 70 kg. Damaged or entangled stems are removed regularly. Post-harvest pruning encourages new shoot development, leading to better flowering in the next season.

Mineral nutrition and irrigation requirement

For better yield performance of the crop appropriate nutrient requirement is needed. The pitahaya's root system is superficial and can rapidly assimilate even the least quantity of nutrients. Mineral and organic nutrition is particularly beneficial. Even, if pitahaya can survive with very low rainfall, many months of drought, when good quality fruits are required, a regular water supply is needed. Regular irrigation is essential, because it enables the plant to build enough reserves not only

to flower at the most favourable time but also to ensure the development of the fruits. Confined micro-irrigation is recommended. In addition to the efficiency of the water supplied by this system, micro-irrigation avoids uneven and excess watering that can result in the flowers and the young fruits falling off.

Pollination

Due to limited genetic diversity and lack of natural pollinators in some regions, manual cross-pollination is necessary to ensure good fruit set and quality in dragon fruit. The large floral parts of *Hylocereus* make manual pollination easy, which can be done from 4:30 PM to 11:00 AM the next day. Natural pollinators like Sphingid butterflies (genus *Maduca*) and bees may aid pollination early in the morning (Anon, 2017), but manual methods are more reliable. The process involves gently opening the flower to expose the stigma and applying pollen using a brush or directly with fingers. Pollen from another clone or species can be collected and stored at $-18\text{ }^{\circ}\text{C}$ to $-196\text{ }^{\circ}\text{C}$ for 3–9 months. However, pollen stored at $4\text{ }^{\circ}\text{C}$ produces smaller fruits.

Fruits from manual pollination are usually larger and of higher quality than those from natural or free pollination, making it a beneficial practice in commercial cultivation.

Harvesting

Dragon fruit skin colors late in the maturation stage, turning from green to red or rosy-pink around 25–27 days after anthesis, depending on the species. *H. costaricensis* takes about 30 days to mature. Peak coloration occurs 4–5 days later, after which fruits may split, causing economic loss.

Yields vary with planting density and range from 10 to 30 t/ha. Harvesting is tricky due to the absence of a peduncle, but gently twisting the fruit clockwise minimizes damage. While the fruits are fairly sturdy, careful handling during harvesting and storage is important, especially for *H. costaricensis*, which has fragile foliated scales.

Pests and diseases

A small number of pests have been recorded on *Hylocereus*. Ants belonging to the genera *Atta* and *Solenopsis* are very notorious pest and can cause major damage to the plants, flowers and fruits. *Cotinus mutabilis* perforates the stem and *Leptoglossus zonatus* sucks the sap, leaving stains and some deformation. Different species of aphids and scales have also been observed on fruits and flowers. Rats and birds can cause serious damage, mainly to flowers and fruits as well as ripe fruits. Bees can be tremendously efficient and, after only a few hours of activity, they will have harvested all the pollen. The pollen must be collected earlier than the bees arrive and manual pollination carried out the next morning as soon as the bees have left the plantation. Different fungal (*Gloeosporium agaves*,

Macssonina agaves, *Dothiorella* sp. and *Botryosphaeria dothidea*), viral (Cactus virus X), and bacterial (*Xanthomonas* sp. and *Erwinia* sp.) are disease.

Conclusion

Commercially, dragon fruit has several advantages—its attractive shape, vibrant color, and high nutraceutical value have gained the attention of farmers across India. The red-fleshed variety (*H. costaricensis*) is especially valued for its high betalain content, aligning with growing demand for antioxidant-rich and natural food colorants. The fruits store well at room temperature, and the pulp can be processed into various products.

The crop is hardy, adaptable to diverse climatic and soil conditions (with good drainage), and begins fruiting quickly. Currently, it faces few pest and disease issues, but further research is needed to explore and optimize its cultivation and utilization.

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