



RESEARCH ARTICLE

DRAGON FRUIT CULTIVATION: A MANAGEABLE AND PROFIT PROVIDING AGRI-ENTERPRISE IN INDIA

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ARTICLE INFO

Article History:

Received 20th October, 2024
Received in revised form
17th November, 2024
Accepted 24th December, 2024
Published online 24th January, 2025

Key Words:

Origin, Names, Uses, Nutritional Value, Health Benefits, Adverse Effects, Types, Varieties, Cultivation Procedures, Advantages, Disadvantages, Success Story, Economic Importance, Promising, Manageable, Profitable, Sustainable

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ABSTRACT

Dragon fruit, as the name suggests, resembles a dragon. It grows on climbing cactus known as *Hylocereus*, which can be found in tropical regions. The outer covering of dragon fruit is in shades of red and pink or yellow. Their leaves resemble a dragon and have spikes that shoot up like a flame around the fruit. *Hylocereus* originally grew in Southern Mexico, South & Central America. The inside of a dragon fruit is white, semi-solid fruit that can be eaten with a spoon and has nutty seeds sprinkled all over it. It is juicy with a slightly sweet taste, whereas the seeds have a nutty flavour. Farmers are enthusiastic in dragon fruit farming as a new and promising crop that offers both difficulties and potential. Dragon fruit, pitaya or strawberry pear (*Hylocereus* spp. and *Selenicereus* spp.) or Kamalam is emerging as a super crop worldwide, even in the marginal lands, owing to its health and medicinal benefits. It is basically a climbing cactus vine, tolerant to the abiotic stresses and resistant to pests and diseases. It has many advantages including low water and nutrient requirements, relatively less requirement of resources for establishing the orchard and maintenance; multiple harvest of fruit in a year; potential to sustain high yield up to 20 years; high benefit to cost ratio; and high nutraceuticals and functional properties (e.g. rich in antioxidants and fibres). All these qualities are attracting the growers worldwide to establish and expand dragon fruit farming, provide opportunity for global export and encourage for high quality produce to meet the market demand. Being a crassulacean acid metabolism (CAM) plant with xerophytes' characters, it has got ability to grow in a wide range of agro-climates including areas of high temperature and water scarcity regions. Furthermore, the fruit has a higher profit margin than other field crops. Weeds, bird invasions, high labor expenses, lack of technical knowledge of farmers on dragon fruit farming were recognized as major obstacles to fruit production. More government support, and fixing the issues described above could increase the fruit's future prospects in the country.

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Citation: Hiralal Jana and Debabrata Basu. 2025. "Dragon fruit cultivation: a manageable and profit providing agri-enterprise in India". *International Journal of Current Research*, 17, (01), 31115-31122.

INTRODUCTION

Dragon fruit is a tropical fruit that's low in calories and high in fiber and antioxidants. Some people say it tastes like a cross between a pear and a kiwi. You can slice and eat the fruit as-is, try it with yogurt, or add it to a smoothie or salad. Dragon fruit has become increasingly popular in recent years. Though people primarily enjoy it for its unique look and taste, evidence suggests it may provide health benefits as well. Dragon fruit is also known as the Honolulu queen, whose flowers only open at night. Today, it is grown all over the world. Dragon fruit is a tasty fruit. The plant's name comes from the Greek word "hyle," which means woody, and the Latin word "cereus," which means waxen. On the outside, the fruit looks like a hot pink or yellow bulb with spike-like green leaves shooting up like flames around it. Cut it open, and you'll find fleshy white, pink, red, or purple pulp dotted with black seeds that are good to eat.

It looks something like the inside of a kiwi fruit. Central Americans call dragon fruit pitaya. In some parts of Asia, it's a strawberry pear, while in India, it's called Kamalam, after the Sanskrit name for lotus. The common name in English – dragon fruit – derives from the leather-like skin and scaly spikes on the fruit exterior. Depending on the variety, pitaya fruits may have sweet- or sour-tasting flesh that can be red, white, or yellow in color. Dragon fruit is an incredible cactus that produces strange looking fruit resembling a magical dragon egg. Cut through the vibrant pinky red skin to reveal white or pink flesh speckled with tiny black seeds. The taste is hard to pin down with some saying it's a sweet mix of mild kiwi fruit, watermelon, strawberry and pear flavours. Well growing conditions and ripeness of the fruit can impact taste but nonetheless it's visually impressive and packed full of nutrients, like Vitamin C. Their stunning large flowers are easily over 20cm wide and appear in summer.

They are yellowy green on the outside and open to a scented white, lily like bloom. "Dragon fruit is the fruit of several cactus species of the genus *Hylocereus* and *Selenicereus*.

NAMES OF DRAGON FRUIT: It goes by many names, including pitaya, pitahaya, and strawberry pear. These fruits are commonly known in English as "dragon fruit", a name used since 1963. The fruit is often designated as "Vietnamese dragon fruit" as Vietnam is the lead exporter. The names *pitahaya* and *pitaya* derive from Mexico, and *pitaya roja* in Central America and northern South America, possibly relating to pitahaya for names of tall cacti species with flowering fruit. Common Names are Red Pitaya, Kamalam, Pitaya Roja. It is a climbing vine cactus species with most beautiful fruit in the family Cactaceae that has beautiful flowers and is nicknamed as 'Noble woman' or 'Queen of the Night'.

GEOGRAPHY OF DRAGON FRUIT: Pitaya or dragon fruit is native to the region of southern Mexico and along the Pacific coasts of Guatemala, Costa Rica, and El Salvador. The dragon fruit is cultivated in East Asia, South Asia, Southeast Asia, the United States, the Caribbean, Australia, and throughout tropical and subtropical regions of the world. Dragon Fruit (*Hylocereus* sp.) has its origin in Southern Mexico, Central America and South America. It was introduced during 1990 for its commercial cultivation in south Asian tropical countries. It is widely cultivated in South-East Asia, USA, Caribbean Islands, Australia throughout the tropical and sub-tropical world. It is a new introduction in India and the commercial cultivation is picking up. In India, the cultivation of the fruit is fast picking up and farmers of Karnataka, Kerala, Tamil Nadu, Maharashtra, Gujarat, Chhattisgarh, Odisha, West Bengal, Andhra Pradesh, Andaman & Nicobar Islands, Mizoram and Nagaland have taken up its cultivation. In 2020, the total area under cultivation of Dragon Fruit in India is more than 3,000 ha. which is not able to meet the domestic demand, hence majority of the dragon fruits available in Indian market is imported from Thailand, Malaysia, Vietnam and Sri Lanka.

ADVANTAGES OF DRAGON FRUIT FARMING

- High export demand
- Huge domestic demand, less supply
- Needs less water and maintenance
- Highly nutritious fruit, good for diabetic patients.
- Low pest and disease occurrence

USES OF DRAGON FRUIT:-The fruit's texture is sometimes likened to that of the kiwifruit because of its black, crunchy seeds. The seed oil contains the fatty acids linoleic acid and linolenic acid. Dragon fruit is used to flavor and color juices and alcoholic beverages, such as "Dragon's Blood Punch" and the "Dragotini". The flowers can be eaten or steeped as tea. The red and purple colors of some *Selenicereus* fruits are due to betacyanins, a family of pigments that includes betanin, the same substance that gives beets, Swiss chard, and amaranth their red color.

NUTRITIONAL VALUE

170 gms of dragon fruit cubes contain:

Nutrient	Amount per 170g	Nutrient	Amount per 170g
Calories	102	Vitamin A (IU)	100 IU
Carbohydrates	22g	Vitamin C	4mg
Protein	2g	Calcium	31mg
Fat	0g	Iron	0.1mg
Fiber	5g	Magnesium	68mg
Sugars	13g		

Antioxidants found in dragon fruit serve various purposes:

- **Betalains:** These red pigments found in dragon fruit flesh help protect against bad cholesterol (LDL) by preventing its oxidation and damage.
- **Hydroxycinnamates:** This group of antioxidants in dragon fruit is linked to anti-cancer benefits.
- **Flavonoids:** Dragon fruit contains flavonoids, which are also found in many other fruits and vegetables. These antioxidants are associated with better brain health and function, as well as a reduced risk of cardiovascular diseases.

HEALTH BENEFITS

Dragon fruit has many potential health benefits, though studies are mostly in early stages. The fruit may:

- Reduce insulin resistance and fatty liver
- Dragon fruit contains prebiotic fiber which improves metabolic health
- Help prevent oxidative damage
- Help with weight management
- Ease constipation
- Help lower blood sugar
- Improve gut health
- Strengthen your immune system
- Lower inflammation
- Boost iron levels and increase iron absorption
- Improve skin health.
- Reduces risk of diabetes
- Reduces risk of cancer
- Helps boost immunity
- Improves digestion
- Improves heart health
- Fights against ageing skin
- Good for hair
- Healthy bones
- Good for eyes
- Good during pregnancy
- Rich source of fats
- Guards against infections
- Elevation of haemoglobin levels

ADVERSE EFFECTS

- Overall, dragon fruit appears to be safe. However, people may develop an allergic reaction in some rare cases.
- It's a fairy tale that fruits are loaded with unhealthy sugar.
- People who are following a very low carbohydrate or ketogenic diet may also want to avoid fruit.
- You may have heard that people with diabetes should avoid fruit, but this is a myth.

- If you eat enough red dragon fruit, it might turn your pee pink or red.
- Digestive discomfort: - Dragon fruit is high in fiber, so if you're not used to a lot of fiber and you eat a lot of it, you could get some digestive upset.
- Mild laxative effect
- Medication interactions: Dragon fruit might interact with certain medications.
- Kidney stone risk: Some individuals with a history of kidney stones should consume dragon fruit in moderation.

Eating procedures:-Though it may look intimidating, dragon fruit is very easy to eat.

- Select a ripe fruit with bright red, evenly colored skin that gives slightly when squeezed.
- Use a sharp knife and cut straight through the fruit, slicing it in half.
- You can use a spoon to eat the fruit out of the skin or peel the skin off and slice the pulp into small pieces.

While dragon fruit's thick, leathery skin can be intimidating, eating this fruit is quite simple. The trick is finding one that is perfectly ripe. An unripe dragon fruit will be green. Look for one that is bright red. Some spots are normal, but too many bruise-like splotches can indicate that it's overripe. Like avocado and kiwi, a ripe dragon fruit should be soft but not mushy.



Red skin, white flesh



Red skin, red flesh



Red skin, purple flesh



Yellow skin, white flesh

Is dragon fruit peel edible?: Yes, it's edible and studies suggest it contains substances with potential antioxidant, prebiotic, and anti-inflammatory effects. Deep-fried dragon peel is a popular dish in Indonesia and dragon peel tea is made in China. However, the raw peel tastes bitter and can be covered in a lot of pesticides. No matter how you use your dragon fruit, be sure to wash the peel thoroughly.

Dragon fruit juice: You can find many recipes for dragon fruit juice, often combined with lemons and sugar for a bright twist on lemonade, or with other fruits, ranging from apples and pears to mangos and kiwis. It's also used in margaritas, mojitos, and other cocktails.

Dragon fruit syrup: You can also buy or make dragon fruit syrup to use in drinks, or as a topping for ice cream, yogurt, and other foods.

Dragon fruit powder: These products are another way to add the color and taste of dragon fruit to drinks, desserts, and other foods. The powder is also sold as a nutritional supplement.

REASONS TO ADD DRAGON FRUIT TO YOUR DIET:

Dragon fruit is a low calorie tropical fruit known for its vibrant red skin and sweet, seed-speckled pulp. It contains nutrients, prebiotic fibers, and other healthy substances. Its unique look and acclaimed superfood powers have made it popular among foodies and the health-conscious.

- High in nutrients
- May help fight chronic disease
- Loaded with fiber
- Promotes a healthy gut
- Strengthens your immune system
- May boost low iron levels
- Good source of magnesium

TASTE OF DRAGON FRUIT:-Dragon fruit is juicy with a slightly sweet taste that some describe as a cross between a kiwi, a pear, and a watermelon. The seeds have a nutty flavor. Dragon fruit comes in a variety of color combinations, but the most common types have red or pink skin, white flesh, and black seeds.

TYPES OF DRAGON FRUIT:-Dragon fruit comes in a variety of colors.

White dragon fruit:-The best known dragon fruit varieties typically have pink skin and white flesh. They are not as sweet as some other types. You might find them sold as Alice, Cosmic Charlie, or Guyute varieties. Vietnam is a top producer of dragon fruit with white pulp.

Red dragon fruit:-Bigger, sweeter fruits with red or pink pulp go by names including Red Jaina and Bloody Mary. Nicaragua and Ecuador are major producers of these types. This one has bright red flesh.

Yellow dragon fruit:-Dragon fruits with yellow skins have white pulp inside and are the sweetest of all varieties. But they are also the hardest to find. They often come from Ecuador or elsewhere in Central or South America.

Purple Dragon Fruit: - This one looks cool and tastes great. It's full of vitamins and fiber too.

Pink Dragon Fruit: - It's sweet and a bit tangy, and it's good for your skin and digestion because it's full of vitamin C and fiber.

The name dragon fruit is used to refer to several types of cacti that produce edible fruits. In Australia the mostly grown species are:

- *Selenicereus undatus* (*Pitaya blanca* or white-fleshed pitaya, also known as *Hylocereus undatus*) has pink-skinned fruit with white flesh. This is the most commonly seen "dragon fruit".
- *Selenicereus costaricensis* (*Pitaya roja* or red-fleshed pitaya, also known as *Hylocereus costaricensis*, and possibly incorrectly as *Hylocereus polyrhizus*) has red-skinned fruit with red flesh.
- *Selenicereus megalanthus* (*Pitaya amarilla* or yellow pitaya, also known as *Hylocereus megalanthus*) has yellow-skinned fruit with white flesh.

VARITIES

Pitaya Varieties: Dragon fruit, also known as pitaya, is cultivated in various varieties, including Red pitaya, White pitaya, Pitaya Roja, Pitaya Amarilla, Yellow pitahaya, Alice, American beauty, Bloody mary, Cosmic Charlie, Costarican sunset, Dark star, David bowie, Delight, each with unique characteristics in terms of appearance, taste, and cultivation requirements.

Red Pitaya: Red pitaya is characterized by its vibrant red skin and red flesh. This variety is favored for its rich, sweet flavor and high nutritional content, including antioxidants, vitamins, and minerals.

American beauty: The American beauty variety is notable for its large, attractive fruit with red skin and purple-red flesh. It is highly valued for its sweet, mildly tangy flavor and high antioxidant content.

Costarican sunset: Costarican Sunset is a variety that features bright red skin with vibrant red flesh. It is appreciated for its juicy texture and balanced sweetness. This variety has a strong growth habit and can produce abundant yields under optimal conditions.

White pitaya: White pitaya is distinguished by its white flesh and red or yellow skin. It has a mildly sweet flavor with a hint of tartness, making it a refreshing choice for consumers.

CULTIVATION PROCEDURE: After a thorough cleaning of the seeds from the pulp of the fruit, the seeds may be stored when dried. The ideal fruit is unblemished and overripe. Seeds grow well in a compost or potting soil mix – even as a potted indoor plant. Pitaya cacti usually germinate after between 11 and 14 days after shallow planting. As they are cacti, overwatering is a concern for home growers. As their growth continues, these climbing plants will find something to climb on, which can involve putting aerial roots down from the branches in addition to the basal roots. Once the plant reaches a mature 4.5 kilograms in weight, the plant may flower. Commercial plantings can be done at high density with between 1,100 and 1,350 per hectare. Plants can take up to 60 months/260 weeks to come into full commercial production, at which stage yields of 20 to 30 metric tons can be expected. Pitaya flowers bloom overnight and usually wilt by the evening.

They rely on nocturnal pollinators such as bats or moths for fertilization. Self-fertilization will not produce fruit in some species and while crossbreeding has resulted in several "self-fertile" varieties, cross-pollinating with a second, genetically distinct plant of the same species generally increases fruit set and quality. This limits the capability of home growers to produce the fruit. However, the plants can flower between three and six times per year depending on growing conditions. Like other cacti, if a healthy piece of the stem is broken off, it may take root in the soil and become its own plant. The plants can endure temperatures up to 40 °C and short periods of frost but will not survive long exposure to freezing temperatures. *Selenicereus* has adapted to live in dry tropical climates with a moderate amount of rain. In numerous regions, it has escaped cultivation to become a weed and is classified as an invasive weed in some countries. The crop is hardy and can survive in any type of climatic condition favourable for flowering and fruiting and soil condition provided with good drainage.



Plant Selection: A crucial step in dragon fruit farming image

- Always select cuttings/plants with well developed shoot and root.
- Always purchase the saplings from trusted source.
- Choose variety that performs well in your region.

Land preparation

- Plough the land and make sure its free of weeds.
- Set proper drainage for rainwater by setting slopes.
- Maintain adequate amount of organic matter by adding manure
- Spacing: Row to Row 11 feet, pole to pole 7 feet.
- Plant 7 feet tall cement pole with circular disc every 7 feet (500 poles per acre)
- Total number of plants per acre: Plant 4 saplings for each pole (2000 saplings per acre)

Environment

Soil: Optimum soil environment is basic requirement for achieving higher yields. Dragon fruit can be grown wide range of soil from sandy loam to clay loam. However, well drained sandy soil with good organic matter is best for its cultivation. It can be grown in considerable degree of soil acidity and alkalinity but optimum pH is about 5-7. It cannot be cultivated in waterlogged condition.

Temperature: Dragon fruit is a semi-epiphytic plant that prefers a dry tropical or subtropical climate. Temperature about 25 °C suitable for its growth and when fruits are growing on the plant, its needs a temperature of 30 °C-35 °C but plant can also tolerate maximum temperature of 40 °C and minimum of 7 °C.

Moisture: For obtaining better yield 1,145-2,540 mm/year of rainfall is required. If the area is under irrigation, the about 1 inch of water is required weekly to the plants such that plants does not get completely dry.

Light : Light is important factor influencing growth, flowering and stem development. Dragon fruit belongs to photophilic plant species. About 7-10 hours of bright sunlight is highly useful for active growth and ripening.

Propagation: Dragon fruit plants can easily multiply through stem cutting. Generally 20-25cm long stem cuttings are used for planting. The cutting should be prepared one-two days prior to planting and the latex oozing out of cut is allowed to dry. The cutting should be treated with fungicides to prevent diseases.

These cuttings are planted in 12 x 30 cm size polyethylene bags, filled with 1:1:1 ratio of soil, farmyard manure and sand. The bags are kept at a shady place for rooting. Excess moisture should be avoided for prevention of rotting of cutting. These cutting roots become ready for planting with 5-6 months. Dragon fruit grow easily from seed or cuttings. To grow from seed, squash some flesh onto paper towel and keep moist in a warm position but away from direct sunlight. Seeds will sprout 2-3 weeks later and can be potted up into punnets. Seedlings will take several years to reach fruiting size. To take a cutting, simply break off a segment 30-50cm long and leave in a dry shady spot for a week. This allows the cut end to seal and prevents rotting. Plant into a pot and keep in a bright shady spot while roots are forming before then moving into the sun. The finished blossom after flowering during the night. The most common propagation method in dragon fruit cultivation is by using cuttings, although it can also be propagated by seeds. For planting in the field, cuttings of about 20-30 cm in length should be used and treated with a 0.5% solution of Agallol or Aretan. The recommended pit size for planting is 60 cm × 60 cm × 60 cm, with a spacing of 2 meters between plants. This spacing allows for a plant density of 1,700 plants per acre of land.

Planting: Dragon fruit cultivation prefers full sunlight open area for planting. Generally in single post system planting is done at 3x3 m distance. Single post will have vertical height of pole 1.5 m to 2 m at which point they are allowed to branch and hang down. The Dragon fruit may be planted near the poles to enable them to climb easily. Number of plants per pole may be 2 to 4 plants depending on the climatic condition. Lateral shoots must be limited and 2-3 main stems are allowed to grow. It is important to arrange round metal/concrete frame to maintain balanced shrub. Cost effective structures using iron poles and tyres as base structure are also being used. In high rainfall areas, concrete poles are used as trellises. The concrete pillars are supported by a square structure in the top to train the vine for bearing purpose. The planting season is generally Summer monsoon (June–August). Fruiting occurs in July–October in a 6-8 flushes of market quality fruits.

Training and Pruning: The dragon fruit plants are fast growing vines and produce more thick dense of branches during the initial stage. The lateral buds and branches should be pruned to grow towards stands. Once vines reach up to the top of the stands the branches are then allowed to grow. The removal of tip of main stem is done to allow growth of new shoots to grow laterally and climb at the ring to form an umbrella like structure of vines where flowers will emanate and develop into fruits which would induce lateral branching. This pruning referred as structural pruning or making a structure on the trellis.

Nutrient management: Dragon fruit plant root system is superficial and can rapidly assimilate even the smallest quantity of nutrients. The recommended dose of fertiliser application varies with soil type and location of plantation. In general, 10–15 kg FYM or organic manure and 100 g SSP/plant is compulsory at the time of plantation of dragon fruit. About 300 g N, 200 g P and 200 g K is essential per plant each year for the initial two years. The mature plant should be given 540 g N, 720 g P and 300 g K in four equal split doses with interval of 3 months. The nutrients are supplied in four split doses to each pillar having four plants @ 10, 10 and 30% of total, before flowering, 20, 40 and 25% at fruit set, 30, 20

and 30% at harvest and finally 40, 30 and 15 % of total NPK after two months of harvest. A combination of organic manure with neem cake and 100g of complete fertilizer (19-19-19) is applied every three to four months.

Intercultural operation: Weed control is an important operation in dragon fruit cultivation and the use of weed mat efficiently reduced the weeds growth and also aids in soil moisture conservation. Therefore, regular weeding is a necessary measure.

Manual and mechanical weeding: Manual weeding is a traditional and effective method, especially suitable for small-scale farming or areas with dense weed growth. By manually pulling out weeds, the roots can be completely removed, reducing the chances of regrowth. For large-scale cultivation, mechanical weeding is a highly efficient option. Using weeding machines can significantly reduce labor intensity and time costs, improving weeding efficiency.

Chemical weeding: The use of chemical herbicides can effectively control weed growth, but it is crucial to carefully select the appropriate type and dosage of herbicide to avoid adverse effects on dragon fruit and the environment.

Biological weeding: Biological weeding is an environmentally friendly method of weed management, involving the introduction of natural weed predators or the use of biological agents to control weed growth.

Mulching: Mulching materials (such as black plastic film, straw, or weed mats) have multiple functions in dragon fruit cultivation. They can effectively prevent weed growth, retain moisture, regulate temperature, and improve soil structure.

Irrigation: Regular irrigation is important, because it enables the plant to build sufficient reserves not only to flower at the most favorable time but also to ensure the development of the fruits. Local drip irrigation found beneficial for better yield and growth. Irrigation by flooding is not recommended as it wastes water and increases work of weeding. Approximately 2-4 litres of water weekly twice per plant is sufficient during the summer/dry days. The shallow root system of dragon fruit is primarily distributed between 15 to 30 cm of soil. Therefore, irrigation must be ensured to provide sufficient water during dry seasons. Scientific irrigation methods significantly impact the growth and yield of dragon fruit, with drip irrigation being considered one of the most effective methods.

Pest and disease management: In general dragon fruit is tolerant to major pests and diseases.

Diseases: Few important diseases of fungal and bacterial pathogens origins viz., anthracnose, brown spots and stem rots affect dragon fruit crop. Heavy rainfall and overwatering or waterlogged conditions predispose the crop for these diseases. Anthracnose can be prevented by spraying with Chlorothalonil / mancozeb at 2g/L and curable by spraying with carbendazim at 1g/L. Rotting diseases are vulnerable to excess sun light and it can be controlled through copper oxychloride (at 0.2%). Fruit are occasionally infected with ants, scale insects, mealy bugs, slugs, snails, bores, caterpillars, termites, nematodes, fruit flies, bats, rats and birds. It can be easily managed by some control measures like agronomic and crop hygiene, chemical control using copper sulphate, fruit bagging, soil amendment

and sterilization. Stems and fruits are susceptible to several diseases caused by fungi, bacteria, a nematode, and a virus. Overwatering or excessive rainfall can cause the flowers to drop and fruit to rot.

Pest: Aphids: Prune to avoid a dense canopy, avoid intercropping with different hosts, and improve natural enemies by incorporating agroforestry and flower strips as natural habitats around the field. Spray Lambda, Cyhalothrin, Cypermethrin, Amidaclorpid, Acetamipride, etc. at a rate of 1 ml/l L of water. Mealybugs: Spray profenophos 50 EC @ 2 ml, acephate 75 SP @ 1 g/L, quinalphos 25 EC @ 2 ml, chlorpyrifos 25 EC @ 2 ml, or thiodicarb 75 WP @ 2 g/L.

Flowering and Fruiting: The off-white dragon fruit flower blooms at night. Pollinators are drawn to them by their scent. Early in the morning is the best time to pollinate the dragon fruit with honey bees (*Apis cerema*), little honey bees (*Apis floreae*), and rock bees (*Apis dorsata*). Around semi-arid regions, dragon fruit flowering begins in June.



The incredible looking dragon fruit!

Under standard cultivation procedures, there were five harvests total, but with good management techniques, two more flushes were collected each year. Large numbers of blossoms will be visible on every plant when the first flowering begins after a protracted dry period. A maximum of 80 blossoms should be kept on each pole at a time after blossom thinning. Pay close attention as well.

Harvesting: Most ideal harvesting period for dragon fruit is June–October in India. The plant start yielding after 12-15 months from the date of planting. Dragon fruits become ready for harvesting in 25-35 days after flowering. Usually outer bright green skin of immature fruit gradually turns into red at the end of ripening process. Proper time of harvesting was found after seven days of color transition. Only ripened fruit should be selected for harvesting so that harvesting can be done twice during week. Fruits are harvested manually using pruning knives without getting damaged. Then, harvested fruits should be immediately shifted into shades before packaging or being transferred to storage room. The shelf life of freshly harvested dragon fruit varies between 3–4 days at ambient conditions. Fruits shows decrease in weight and shrivelling after 7–8 days of harvest. The fruits are generally stored in perforated bags at 8°C for 25–30 days. Sometimes storage temperature of 15–20°C and relative humidity of 85–90% is preferred fresh market delivery. The shelf life can extended up to 45 days during storage at 7–10°C with relative humidity of 90-98%. The yellow varieties can be stored up to 28–30 days at 10°C temperature. Fruit is ripe approximately a month after flowering but this can vary with local conditions.

Fruit will not continue to ripen once picked so you need to look for other signs before picking. Check that the colour of the fruit is bright and even all over and the small “wings” on the fruit are starting to wither. Lightly press the fruit in your hand and if ripe it will give just a little. Pick by twisting the fruit off the plant or cut with secateurs. After 12 to 15 months from the date of planting, the plant begins to produce. The fruits are produced by the plants between June and September, and they may be harvested three or four times per month. The fruit weight varied from 300 to 800 grams, and the three-year-old planting produced an average yield of 30 to 35 kilograms from a single post. The annual yield of dragon fruit is typically 8-10 tonnes/ha.

Post-Harvest Management: Post-harvest management is a critical aspect of dragon fruit farming, ensuring that the fruit remains fresh and retains its quality from the time of harvest until it reaches the consumer. Proper handling and storage can significantly extend the shelf life of dragon fruits, minimizing losses and maximizing profitability for farmers. After harvesting, dragon fruits are sorted and graded based on size, color, and external appearance. Fruits are categorized into different grades, with premium grades fetching higher market prices. This step is essential to meet market standards and consumer preferences.

Dragon fruits are cleaned to remove dirt, debris, and pesticide residues. Pre-cooling is an essential step to rapidly remove field heat from the harvested fruits. It helps in slowing down the metabolic processes, thereby extending the shelf life of the fruit. Forced-air cooling or hydro-cooling methods are commonly used for pre-cooling dragon fruits. Packaging plays a vital role in protecting dragon fruits during transportation and storage. Proper storage conditions are crucial for maintaining the quality of dragon fruits. The ideal storage temperature for dragon fruits is between 6 °C-10 °C with a relative humidity of 85%-90%. Storage at lower temperatures can lead to chilling injury, while higher temperatures can accelerate ripening and spoilage. By implementing these post-harvest management practices, farmers can significantly improve the shelf life and marketability of dragon fruits, ensuring that consumers receive high-quality, fresh fruits.

Processing:-Dragon fruit pulp and juice with solution containing 1.5 per cent pectin, 55% sugar and 0.9 per cent citric acid solution improved the colour as well as other organoleptic characteristics of dragon fruit jam and jelly. In case of dragon fruit beverage 14 per cent pulp, 12 per cent sugar and 0.9% was found to be most suitable. The prepared product was found to be organoleptically acceptable. Prepared products can be stored for the period of more than three months at ambient storage condition without microbial spoilage or any considerable loss in quality.

SUCCESS STORY:-Despite being told that dragon fruits could only thrive in soil, Remabhai fearlessly took on the challenge of growing them on her terrace, adopting a soilless planting medium and defying conventional wisdom. “I do not have enough vacant land. Also, growing dragon fruits on the terrace required a lot of soil to be transported. I couldn’t carry soil to the terrace on my own. So, I decided to follow a soilless planting method,” she says. Remabhai grows 100 plants of rare exotic fruits, including red and yellow varieties of dragon fruits, in 50 large plastic barrels with compost as the growing medium.



Remabhai grows 100 plants of dragon fruits in 50 large plastic barrels

Revealing her technique for making the nutrient-rich combination, she says, “Take a plastic barrel and make a small hole at the bottom for drainage. Put a thick layer of green leaves, then a layer of sawdust, followed by a layer of rice peel, and a thick layer of compost (say 3 kg). Add 100 grams of bone meal as the last layer. Plant your saplings thereafter. I planted two saplings in each container.” “This combination provides all the required nutrients and enough aeration for root growth. It has been a convenient way for me to grow plants without soil,” she adds. Remabhai has also crafted her own organic fertilisers using a blend of dry leaves, vegetable waste, and natural ingredients like fish, prawn skin, and crab shells for accelerated growth and fruiting. Her innovative approach yielded vibrant and healthy dragon fruit plants. Sharing the secrets of her organic fertiliser, she says, “Take 1 kg of fish, prawns, crab shells, and an equal quantity of jaggery. Mix them with tender papaya peel. Keep it under shade and the fertiliser will be ready for use in about three months. It’s a very good source of calcium and phosphorus. These minerals are very useful for the growth of dragon fruit plant.”

Remabhai meticulously tends to her dragon fruit plants. Through a soilless planting method, she has found a sustainable and effective way to nurture them without the need for vast expanses of land or tedious soil transportation. She takes pride in stating that all her day’s harvest is readily sold out. From the harvest, she saves some produce to send it to her son Dr Krishna Advait, who revels in the joy of receiving fresh dragon fruits. “One of the ways my mother showers her affection on me is by sending dragon fruits via post. They are my favourite, especially when grown organically at home, they taste better. My biggest flex is that I can go to my backyard at home and pluck fresh fruits whenever I like!”

He admires her resilience and commitment to staying active and engaged in her post-retirement years. “I wished that my parents would stay active even after retirement as once you start a sedentary lifestyle, you are prone to lifestyle diseases. I am happy that she is trying out new experiments with dragon fruit cultivation. She nurtures each plant as her own child,” he adds. For Remabhai, the journey of exotic fruit farming has healed her loneliness by allowing her to remain engaged all day. She also runs a YouTube channel ‘JC’s World’ to share her expertise in dragon fruit cultivation. In the twilight of her life, Remabhai exudes a youthful exuberance and zest for life that transcend barriers

of age. “I am 58 but I feel I am only 20! Every day, 200 to 300 flowers bloom on my terrace; just looking at my garden makes my day. All my negative feelings and worries fade away,” she remarks. Kerala Teacher Turns To Soilless Dragon Fruit Farming Post Retirement, Earns Rs 1 Lakh/Month After retirement, Remabhai S (58) from Kollam, Kerala, found solace in cultivating dragon fruits on her terrace using innovative soilless methods. Now, she harvests 500 kg of dragon fruit every month, earning Rs 1 lakh. After dedicating 36 years of her life to educating young minds as a zoology teacher and later serving as a headmistress in a government school, Remabhai S finally embraced retirement in 2022. Little did she know that her retirement would mark the beginning of a deeply fulfilling journey into the world of dragon fruit farming.

Grieving the loss of her mother, who passed away around the same time, Remabhai found solace and purpose in cultivating exotic fruits as a hobby. “My mother lived with my sister, whose house is adjacent to mine. Whenever I would come home after school in the evening, she would be waiting for me. She would lovingly welcome and hug me,” she says. “My father died when I was 15. She looked after all of us 13 siblings. She was a very strong lady. After her death, I felt lonely as there was no one left to welcome me in the lonely house,” adds Remabhai, who lives in Kollam, Kerala. Remabhai found solace and purpose in cultivating exotic fruits as a hobby. With her husband engaged in work and her son residing far away in Delhi, the 58-year-old turned to her terrace as a sanctuary where she could channel her energy and emotions into nurturing plants. Driven by her son’s insights on the myriad health benefits of dragon fruit, including its ability to lower cholesterol and improve vision, Remabhai set out on a mission to cultivate this unique fruit. She now harvests about 500 kg of dragon fruit every month from her terrace. With a bountiful harvest selling out at a lucrative price of Rs 200 per kg, she manages to earn Rs 1 lakh per month, post-retirement.

ECONOMIC IMPORTANCE

- Dragon fruit provides fast return with economic production in the first year after planting and full production is attained in 3-4 years.
- The life expectancy of the crop is about 20 years.
- The average yield per pillar (3-4 plants) per year is about 15 kgs. Fruit weight varies from 300 to 500 grams.

- Average economic yield after 2 years of planting is 10 tonnes per acre. At present the market rate is Rs 100 per kg fruit, so the revenue generated by selling fruits per year is Rs 10,00,000. Benefit Cost Ratio (BCR) is: 2.58.

PROBLEMS OF DRAGON FRUIT CULTIVATION

Improper varietal selection

Lack of Flowers and Fruits:-The lack of flower buds can be fixed with simple maintenance. If you have a ton of vegetative growth on your plants, but don't see any flower buds, several factors could be in place. Poor fruit set (usually due to poor pollination). Forcing redirects energy to boost flower and fruit production. "Tipping" is one of the best solutions for a lack of flowers! Also known as "forcing," this method essentially forces the cactus to stop putting all its energy into leaf growth.

P and K Fertilizer:-Switch to a phosphorus and potassium fertilizer to enhance blooms.

Cold Weather or Extreme Heat:-Protect your plant from extreme temperatures for optimal growth. Cold damage on this tropical plant is a major bummer, but extreme heat can also dwindle fruit yields.

Wrong Pot Size or Material:-Start with a large pot to avoid frequent transplanting later on.

Pot Material:-Choose a sturdy terracotta pot with excellent drainage for optimal growth. The pot material is also very important. Plastic, fabric, or thin ceramic are not ideal. A thick, sturdy terracotta pot is best.

Cactus Rust:-Early detection of cactus rust prevents serious plant damage. The most common disease that afflicts dragon fruit is called cactus rust. This rust mainly spreads during the winter time. High humidity, dew, and mist can transfer the rust between plants.

Prevention and Treatment:-Hydrogen peroxide spray effectively controls early cactus rust outbreaks organically. When you barely start to notice orange rust dots, a hydrogen peroxide spray is the best means of preventing spread.

Overwatering:-For healthy growth, avoid overwatering—check soil moisture before watering deeply. It is a big mistake to overwater this cactus. This growing problem is incredibly common because many people mistakenly treat dragon fruit like other tropical plants. Although this tropical cactus requires more water than a desert cactus, it still dislikes excessively wet conditions.

Improper Pruning and Training:-Proper trellising and regular pruning ensure optimal growth and fruit production. Lack of pruning and improper trellising are major problems with any perennial vining plant. It is especially problematic with dragon fruit because the vining stems can quickly get out of hand. If you forget to tie the plant to the trellis, it can run off in its own direction. Fortunately, the vines are somewhat flexible, so you can re-train them and give them a haircut.

Weak Trellis Design:-A strong, durable trellis is essential for supporting these vines.

Lack of Sunlight:- Provide ample sunlight to ensure healthy dragon fruit growth.

CONCLUSION

Till now, we have seen that dragon fruit has innumerable health benefits. Easy ways to eat dragon fruit are to have it with salad, use it as a topping for greek yoghurt, squeeze it in juices, or put it in ice cream. Eating dragon fruit on a regular basis will help you ward off diseases and improve your health. It has many benefits, such as low water and nutrient requirements, relatively low resource requirements for setting up the orchard and maintaining it, the ability to sustain a high yield for up to 20 years, a high benefit to cost ratio, and a high level of nutraceuticals and functional properties (e.g. rich in antioxidants and fibres). Because of its antioxidant properties, dragon fruit is often referred to as a "super-fruit" by many people. Dragon fruit, rich in fiber, water-soluble compounds, vitamin C, and antioxidants, offers a range of health benefits, including weight management and improved digestion. It also aids in reducing cholesterol levels and boosting immune function. All of these characteristics are inviting growers worldwide to start and grow their dragon fruit farming operations. In conclusion, dragon fruit farming is one of the best prospects for agricultural diversification and overall economic growth. This review describes the prospects of dragon fruits cultivation and discusses its high tolerance to unfavorable factors and low demands on resources. There is no doubt that there are constraints of uncertainty in the market and high initial production cost but with these come the opportunities of enhancing the living standards of small farmers and food security. By combining all synthetic and analytical efforts, there is a big potential for the development of dragon fruit farming as a high-value agricultural enterprise through support from government authorities. The low maintenance (manageable) and high profitability of dragon fruits has attracted the farming community throughout India.

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