

Dragon Fruit: Wholesome and remunerative fruit crop for India

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ABSTRACT

Dragon fruit belongs to family Cactaceae, is a perennial semi epiphytic vine. It was initially used as ornamental plant and latter due to its health benefits and market value emerged as a new fruit crop. Owing to its rich nutrient contents and antioxidant properties, it is gaining popularity as a super fruit. The burgeoning population and the health concern people are showing interest over this fruit due to its immense medicinal properties and health benefits. It helps in the prevention of cardiovascular diseases, controlling blood sugar level thus, considered to be outstanding fruit for diabetic patient. It plays a vital role in fighting against cough, asthma, and wound healing, etc. Further, it requires very less water for growth and development due to its CAM pathway. Thus, it could be a lucrative fruit crop, particularly for degraded lands, abiotic stress and rainfed areas of the country.

Keywords: Antioxidants, CAM, Dragon fruit and Stem cutting.

Dragon fruit [*Hylocereus undatus* (Haworth) Britton & Rose] belongs to the family Cactaceae. It has received worldwide recognition, first as an ornamental and then as a fruit crop. The flower of dragon fruit is so beautiful, that it has nicknamed as “Noble Woman” or “Queen of the Night”. Several types of dragon fruits based on its colour of the peel and pulp are found throughout the world but mainly cultivated is red peel with white pulp (Fig. 1).



Fig 1. Dragon fruit plant and Lateral section of fruit

Health benefits

The rich nutrient contents and antioxidant properties made dragon fruit a super fruit. This fruit can be used for table and processing purpose. Colourful bracts, dark red and white flesh and edible tiny black seeds embedded in it, makes choicest fruit for salads. Value added products like juice, jam, jelly, candy, syrup, and wine can also be prepared from the pulp. Fruit peel is rich source of pectin. It also can be used as a food colouring agent and raw material for food colour industries (Gao-Xi and Wan, 2004). The values of different components, vitamins and minerals in red dragon fruit weighing 394 g fruit are given in table (To *et al.*, 2000).

Tab 1: Nutrients composition in dragon fruits

Particulars	Average value (g/100 g edible portion)	Particulars	Average value (mg/100 g edible portion)
Moisture	85.30	Vitamin C	3.0
Crude protein	1.10	Thiamin	0.028-0.043
Fat	0.57	Riboflavin	0.043-0.045
Glucose	5.70	Niacin	2.8
Fructose	3.20	Vitamin A	0.0111
Sucrose	Not detected	Calcium	10.2
Maltose	Not detected	Iron	3.37
Sorbitol	0.33	Magnesium	38.9
Carbohydrate	11.20	Phosphorous	27.5
Crude fibre	1.34	Potassium	272.0
Ash	0.56	Sodium	8.9
Energy	67.70 kcal	Zinc	0.35

Hylocereus spp. is having huge medicinal benefits. Besides fruits, their leaves and flowers have traditionally been used in Latin America as a hypoglycemic, diuretic, and cicatrizing agent. Consumption of red pitahaya plays an important role in the prevention of cardiovascular diseases. Presence of different antioxidants such as vitamin C, B₃, flavonoids assist in reducing blood cholesterol and hypertension, thus very good for prevention of cardiovascular diseases.

Other than this dragon fruit also helps in proper digestion owing to rich in fibers, richness of vitamin c and assistance in enhancing other antioxidants results in boosting immunity. This fruit has very low sugar and glucose is a prominent sugar in dragon fruit which helps in controlling blood sugar levels thus, considered to be very good fruit for diabetic patient. Regular intake of this fruit helps in fighting against cough, asthma, wound healing, etc. Since it is rich in phosphorus and calcium minerals, helps in bone and teeth growth. It also improves eyesight as well as known for anti-aging property. Other benefits like reduction of weight and improvement of memory are also associated with the dragon fruit.

Origin and geographical distribution

It is considered to be native to tropical and sub-tropical forest regions of Mexico, Central America, and Northern South America, where it is distributed widely and occurs naturally. From centre of origin it has been spread to several countries viz. Australia, China, Guatemala, Hawaii, Indonesia, Israel, Malaysia, Taiwan, Thailand, and Vietnam, etc. In India, this fruit crop has been recently introduced and grown in parts of Maharashtra, Karnataka and Gujarat mainly and other states also.

Soil requirement

Dragon fruit could be grown in a wide range of soils, but the soil should be well drained as water logging for long period hampers its growth and favours rotting of stems. The sandy loam soil, rich in organic matter is good for its commercial cultivation. The soil pH of 5.5-6.5 is optimum. It is very shallow rooted crop; mostly roots are confined up to 40 cm, therefore, depth of soil may not be problem for cultivation. It prefers slightly acidic soil and can tolerate some salts in soil.

Climate requirement

Being originated from tropical rain forest regions, cultivation of dragon fruit is commercially good in areas with sufficient rainfall. But over the time, this fruit crop has been acclimatized well in dry climates with low rainfall also. About 500-1500 mm rainfall with proper distribution is good for its growth. Excess water leads to the abscission of flowers and young fruits. 20-30°C temperature is optimum for the cultivation. Light intensity also plays an important role in cultivation as it is light loving crop. At higher temperatures, cladodes become yellowish and a succulent stem loses water to

wilt down. Therefore, optimum shades (20-50%) as per the conditions need to be provided in the initial years. It can be cultivated up to altitude of 1700 m above mean sea level.

Varieties

Presently, available types or varieties of dragon fruit in our country are primary introductions from other countries. No variety of dragon fruit is yet released in India. In India, mostly red skinned with white pulp (93%) (*Hylocereus undatus*) are cultivated by the growers and fruits having red peel with red flesh (6.5%) (*Hylocereus monacanthus*) and yellow peel with white flesh (≤ 0.5) (*Hylocereus megalanthus*) are grown on very small scale.

Planting

Rainy season with the onset of monsoon (June to August), is the best time for planting but it can be planted in other seasons too with the provision of irrigation. It is a semi epiphytic vine plant; therefore support system needs to be erected before planting. Around the pole, 3-4 plants should be planted (Fig. 2) in pits of (0.5 x 0.5 x 0.5 m) which are filled with top soil along with FYM and other fertilizers. After planting of cuttings, regular watering in basin prepared around plants is required to ensure satisfactory rooting.



Fig 2. Planting of dragon fruit

Planting can be done at 2.5 × 2m, 3 × 1.5m, 3 × 3m, and 4 × 3m etc.. Therefore, as per the situations planting can be done at above spacing. It is advised not to grow dragon fruit below optimum spacing which hinders harvesting and other intercultural operations.

Training requirement

It is a climbing cactus, therefore for successful cultivation requires support system. An economic life span of dragon fruit is nearly 20 years and during full bearing period, plants are laden with fruits, and thus the support system should be enough strong and durable. Therefore, RCC poles of 2 m height with square/rectangular plate at the top can be used to support the plants as shown in the figure 3.



Fig 3. Support system of dragon fruit

Dragon fruit can be trained using T-bar, rubber tyre, Israeli (Wall system) and Vietnamese trellis. In Israeli trellis system, shoots are hanged on wires at height of below 160 cm and thus it forms walls with fruit production on both sides, with ease of access to growers for pollination and harvesting. In Mexico, live trees have been used for trellising purpose (Ortiz-Hernandez and Carrillo-Salazar, 2012). In India, Single pole with cement and iron ring, continuous pyramid stands and "T" stands trellis systems were tested for dragon fruit at ICAR-IIHR, Bangalore (Karnataka), but Single pole with a cement ring was reported better.

Pruning requirement

Corrective/structural pruning is carried out during initial years after planting. Main stems and branch stems are kept to grow around the support and all lateral growth and parts of the plant facing the ground should be removed. The aim of maintenance pruning is to limit bunch growth and this should be carried out as early as the second year after planting. Pruning of all the damaged and entangled branches should be encouraged. The post-harvest pruning encourages the growth of new young shoots that will bear flowers the following year.

Water requirement

It is having high water use efficiency and low water requirement compare to C₃ and C₄ crops. It develops aerial roots from the sides of the stem to collect water from the surroundings and for anchorage. It requires only 10% of the water required by most of other fruit crops such as pear, citrus, peach, etc. 120 to 150 mm of irrigation/year is recommended to meet its water requirement. Dragon fruit is very shallow rooted crop, its water requirement and frequency of irrigation is higher than other cacti. Small quantity of irrigation at shorter interval is more effective to ensure proper growth and higher fruit yields. Flowering and fruit enlargement

stages are the critical stages. Micro-irrigation is recommended to avoid uneven and excess watering that can result in flowers and early fruit drop.

Manures and fertilizers

Dragon fruit is not exhaustive fruit crop but having a superficial root system; it can assimilate smallest quantity of nutrients. Judicious application of manures and fertilizers is necessary for higher fruits yield with better quality. There are different fertilizers doses are observed in different countries viz. In Taiwan, 100 g of commercial 13-13-13 fertilizer per plant along with 4 kg of organic manure at every 4 months interval; in Vietnam, 540:720:300 g of NPK and 20 kg manure per plant per year in four splits. In India, ICAR-NIASM, Pune (MS) has recommended dose for dragon fruit grown in rocky degraded lands in which for first two years, 500 g urea and 500 g P and 300 g K is applied to each pole per year in four splits at three months interval. After two years each pole/year should be fertilized with 800 g N, 900 g P and 550 g K, which should be well distributed in six splits (Nangare *et al.*, 2020).

Propagation

The dragon fruit can be propagated by sexual (by seed) as well as asexual (by cuttings) means. The seed propagated plants are not true to type and possess longer juvenile period. The best and fastest way of multiplying the dragon fruit is by cuttings (Fig. 3). The mature cuttings of 15 to 60 cm or whole segment of cladode with uniform colour should be selected for multiplication. Root and shoot growth in dragon fruit stem cuttings increases with size of cuttings (Kakade *et al.*, 2019). A slating and sharp cut should be made while separating the cuttings from the mother plant. Cuttings should be treated with fungicides to avoid fungal diseases.



Fig 4. Propagation of dragon fruit through stem cutting

Flowering and pollination

The cylindrical shaped flower buds emerge from stem margins develops into light green flowers. The flowers are large, hermaphrodite, nocturnal and showy in nature. The flowers start opening in evening (6.30-7.30pm) and completes opening of flower by around 10.00 pm and start closing by 2.00 am approximately. Thereafter, wilting of flowers begins. It flowers in waves and the period of flowering season is reported from May to November, sometimes up to December in several countries. The number of flushes varies from five to six. Fruit is ready to harvest within 30-50 days after flowering (pollination).

The pollination of flowers is critical event as it essential in production of dragon fruit. In many countries, this crop is introduced as a new crop thus; pollination is problematic event because of unavailability of pollinators. The flowers of dragon fruit being a nocturnal it is naturally pollinated by bats and hawk moths. Other pollinators includes, honey bee, little honey bee and rock bee. It possesses a weakened self-incompatibility thus, planting of compatible clones is important for effective pollination and fruit set.



Fig 5. Flower of Dragon fruit

Plant protection

Generally, dragon fruit is free from pest and diseases. Fruit fly, aphids, mealy bugs, and termites have been observed. Snails, rabbits, and rats are also found to feeding on plants and birds on fruits. In waterlogged or wet weather conditions, stem rot has been found to affect dragon fruit (Fig. 4). Water logging in the field and high temperature is found to be associated with the disease, so proper measures to be taken avoid water logging and optimum shade provision may be done where the problem of high temperature occurs. Other diseases includes, brown spot and anthracnose have also been reported. Proper management and care of orchard at regular interval will help in keeping the orchard insect

and pest free. Optimum spacing will also help in keeping orchards pest and disease free by air circulation and light penetration and also reduce the spread of disease and pest.



Fig 6. Stem rot in dragon fruit

Harvesting

Dragon fruit is a non-climacteric fruit; therefore it should be harvested when ripe for good quality. It develops dark red colour on ripening. TSS/acidity ratio should be 40. Fruits should be normal in shape with full colour developed without any skin splits, curled bracts, fungal or insect damages. Due care should be taken to avoid delayed harvesting. Fruits can be graded into following classes for export or domestic market based on fruit weight.

Tab 2: Fruit grade based on size

Grade	Fruit weight/Size
Extra large	> 500 g
Large	>380–500 g
Regular	>300–380 g
Medium	260–300 g
Small	<260 g

Yield

It is a fast return perennial fruit crop. In well managed orchards, the flowering may start from 2nd year onwards and potential yield can be realized in 3rd or 4th year. The ripened fruits can be harvested between 30-50 days after flowering. The dragon fruit's flowering episodes results in staggered harvesting. The harvesting of fruits starts from June and may go up to December-January in cases. The average yield can be 10 to 12tonnes/ha. But in well managed commercial orchards the yield of 16-27tonnes/ha can be possible from 3rd year onwards under favourable climatic and properly managed conditions.

Processing and value addition

Until now, no much work has been conducted on the processing of dragon fruit. However, it is commercially processed in a fine jelly. Value added products like juice, jam, jelly, candy, syrup, and wine can be prepared from pulp. The process of dragon fruit jelly has been given below.



Fig 7. Dragon fruit at harvesting stage

For the preparation of dragon fruit jelly, fruit juice is extracted from ripe, healthy and fresh fruits pulp. The seeds are removed from the pulp and then fruits are blended by a blending machine and juice can be preserved by freezing. During processing of dragon fruit jelly, 450 g of filtered dragon fruit juice, 550 g of sugar and 5 g of citric acid is used to prepare one kg jelly. Three different formulations of jelly can be prepared by using 5, 10 and 15 g of pectin (High Methoxy pectin: DE>50) addition. Pectin is mixed with equal amount of sugar and remaining sugar is mixed in juice. It is then heated until the TSS becomes nearer to 55° B. Then after this, pectin-sugar mixture is added and continued the heating until 58° B. Then citric acid and KMS is added when TSS of the jelly reaches 67° B. Then it is poured in a sterilized glass bottle and parafin the cap. The jelly can be stored up to 4 months of packaging at ambient temperature (27 to 24° C).

Conclusion

Dragon fruit owing to its rich nutrient contents and antioxidants properties, it is gaining popularity as a super fruit. The burgeoning population and the health

concern peoples are showing interest over this fruit due to its immense medicinal property and health benefits. Further, it requires very less water for growth and development and shows tolerance to many abiotic stresses. Thus, it could be a lucrative fruit crop for not only to arable lands having good resources but also to degraded lands, abiotic stress and rainfed areas of the country as a wholesome and remunerative fruit crop.

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