STATUS OF DRAGON FRUIT CULTIVATION AND MARKETING IN INDONESIA

Irwan Muas and Jumjunidang
Indonesian Tropical Fruit Research Institute (ITFRI)
Jl. Raya Solok-Aripan Km. 8. PO BOX 5 Solok, West Sumatera-Indonesia
E-mail: irwan_muas@yahoo.co.id

ABSTRACT

Dragon fruit (Hylocereus spp.) has been intensively cultivated in Indonesia since 15 years ago. This crop is found in almost all parts of Indonesia with the production centers located in the provinces of Riau, Kepulauan Riau, West Sumatra, East Kalimantan and Java Island. Red flesh dragon fruit (H. polyrhizus) is the most common cultivar. Statistics information for dragon fruit cultivation, production and marketing in Indonesia is very limited. Based on altitude and climate conditions, the regions below 800 meters above sea level is suitable for dragon fruit cultivation. Preliminary survey of ITFRI and farmers’ experiences reveal that dragon fruit productivity in Indonesia was about 24 to 30 t/ha/year. There are two flowering and fruiting patterns of dragon fruit in Indonesia. The first pattern of flowering and fruiting throughout the year occurred in the regions near the equator. The second pattern is flowering and fruiting for 6 to 7 months, from October to April, which occurred in Java Island. The main problem in cultivation is diseases. In the last few years, disease outbreaks destroyed many dragon fruit orchards in production centers, especially outside of Java Island. Major diseases are white/yellow spot (scab), yellow and black stem rots, stem and fruit scabs, anthracnose and stem canker (Neoscytalidium dimidiatum), which attacked simultaneously. Other diseases include stem rots caused by Fusarium sp., Schlerotium sp. and bacteria, and anthracnose by Colletotrichum gloeosporioides, and stem and fruit scabs by Pestalotiopsis sp. and Alternaria sp. The major problem in marketing is low price due to over supply of fruits due to similar harvest seasons at almost all production centers. In addition, the long distance between production centers and markets led to the high cost of transportation. Indonesian dragon fruit productions mainly supply to local markets, but a small portion of which is exported to Singapore. Indonesia also imported dragon fruit from Vietnam, China and Thailand. Research on dragon fruit in Indonesia is still limited. Research activities in ITFRI started in 2013. The activities focus on the identification and control of the diseases, and the application of chemical and organic fertilizers. Research on the extension of flowering period with the use of artificial lights is conducted in the Java region.

Keywords: dragon fruit, cultivation, marketing, Indonesia

INTRODUCTION

Dragon fruit (Hylocereus spp.) is a veining epiphytic cactus, native to the tropical forest regions of Mexico and Central and South America (Mizrahi et al. 1997). Hylocereus has been introduced for production to Bahamas, Bermuda, the United States (Florida and California), Australia, Thailand, India, China, Taiwan, Philippines, Malaysia, Vietnam, Indonesia, Cambodia, Israel and others (Nerd et al. 2002; Lim et al. 2012). Hylocereus undatus has become an important crop in Southeast Asia, ever since it was introduced via the Philippines, in the XVI century (Casas and Barbera 2002; Marten 2003).
Dragon fruit can be cultivated in wet and dry temperate zone with irrigation facilities. Dragon fruit adapt well in various environmental conditions, such as poor soil and various temperature. The tropical climate is very favorable for cultivation of dragon fruit. The optimum temperature ranges from 20 to 30°C, and annual rainfall of about 500-1500 mm.

Production areas of dragon fruits have continuously increased in Indonesia since 2000s. The popularity might be due to its unique appearance, exotic, fresh sweet taste, and many health benefits. Unfortunaley, there is no official data about dragon fruit production in Indonesia. But it has been cultivated commercially in West Sumatra, Riau, Central Java, East Java, East Kalimantan and Nusa Tenggara Barat. Between 2005 and 2011, the islands of Bintan and Batam, province of Kepulauan Riau have a number of dragon fruit orchards for Singaporean markets. But most of dragon fruit production is used to fill local market demand.

**CURRENT STATUS OF DRAGON FRUIT CULTIVATION AND MARKETING**

**Cultivated Area**

Dragon fruit was introduced to Indonesia around 1997 and developed in the islands of Sumatera, Java, and Kalimantan. Main cultivated areas are East Java, Central Java, West Java, Bali, Riau, Kepulauan Ria, West Sumatra, North Sumatra, East Kalimantan and South Sulawesi (Figure 1). Widely cultivated varieties are red-skin and red-flesh, and red-skin and white-flesh. Cultivation of yellow–skin and white-flesh is still limited. Specific locations of dragon fruit orchard are presented in Table 1.

![Figure 1. Locations of dragon fruit orchards in Indonesia.](image-url)
Table 1. Locations of dragon fruit orchard in Indonesia

<table>
<thead>
<tr>
<th>Province</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Sumatera</td>
<td>Deli Serdang</td>
</tr>
<tr>
<td>Riau</td>
<td>Pekanbaru, Siak</td>
</tr>
<tr>
<td>Kepulauan Riau</td>
<td>Batam, Bintan, Karimun, Tanjung Pinang</td>
</tr>
<tr>
<td>West Sumatera</td>
<td>Padang Pariaman, Solok, Pasaman</td>
</tr>
<tr>
<td>Lampung</td>
<td>Lampung Timur, Tulang Bawang, Lampung Selatan</td>
</tr>
<tr>
<td>West Java</td>
<td>Bogor, Bekasi, Sumedang, Indramayu.</td>
</tr>
<tr>
<td>Centre of Java/Yogyakarta</td>
<td>Boyolali, Karanganyar, Kendal, Semarang, Pati, Wonosobo, Purbaingga, Pemalang, Banjarnegara, Sragen, Sukoharjo, Sleman, Bantul, Kulonprogo.</td>
</tr>
<tr>
<td>East Java</td>
<td>Jember, Pasuruan, Malang, Lumajang, Banyuwangi.</td>
</tr>
<tr>
<td>East Kalimantan</td>
<td>Kutai Kartanegara</td>
</tr>
</tbody>
</table>

At first, many Indonesians assumed that dragon fruit can be grown and produced well in both coastal areas and fertile land. Related to those assumptions, the dragon fruit developed in coastal areas were located in Yogyakarta, West Sumatra and Riau. Since the last few years, dragon fruit has been cultivated in the areas from the low land to 800 m above sea level. In addition, a lot of farmers have cultivated the dragon fruit on marginal lands which is known as low fertility area. In the marginal land at the district of Kutai Kartanegara, East Kalimantan province, dragon fruits grow rapidly and show good productivity. At the end of 2014, the dragon fruit cultivation area in East Kalimantan reach about 1,500 ha (Source: Dragon Fruit Farmer Group, East Kalimantan). This information indicates that at marginal lands supported with good farming technology, dragon fruit can grow and produce well.

**Cultivation**

The propagation technique known as stem cuttings propagation is the most commonly used form of propagation by dragon fruit growers. This technique ensures the quick growth of plants and fruiting will occur quickly, at 10 to 12 months after planting. Cuttings can be obtained throughout the year. However, it is preferable to collect the cuttings after fruiting period of the mother plants. Plant materials for cuttings are chosen from the healthy and dark green branches, about 20-30 cm long. Dragon fruit plants need some type of trellis to support the plants when grown in orchards. Many trellises designs have been used, such as live tutors, solid wood and concrete pillars used in many production areas. The trellis used must be strong, well-built and durable to support dragon fruit plants, with about 2-2.5 m height.

In general, the planting system of dragon fruit in Indonesia is carried out by a spacing or distance between the trellises of about 2 to 3 m x 2.5 to 4 m. Each trellis consists of four seedlings or cuttings. To obtain better growth and productivity, good management of planting, fertilizing, watering, pruning, pest and disease control is needed. Well managed plant will bear fruits in one year.
Dragon fruits are night blooming and the hermaphroditic blooms remain open for one night only. Dragon fruit generally has a very short period of blooming and the maturation of male and female gametes do not happen together. This condition caused the low percentage of successful fruiting which is only 50% (Kriswiyanti et al. 2009). *Hylocereus polyrhizus* and *H. costaricensis* have been reported as self-incompatible, requiring cross-pollination to set fruit. *H. undatus* cannot produce fruits by automatic self-pollination and produce a reduced number of seeds by hand self-pollination (50-79.6% fruit set) compared to outcrossed fruits (100% fruit set). *Selenicereus megalanthus* is self-compatible, producing fruits both by automatic self-pollination (60-73% fruit set) and by hand self-pollination (100% fruit set) (Weiss et al. 1994). Apparently, differences between the pollination systems of the two species are due to morphological differences in the position of anthers and stigma that prevent automatic self-pollination (Weiss et al. 1994). The anthers and stigma were separated by at least 2 cm. Most of the dragon fruit plants grown in Indonesia possess self-incompatibilities. Several of the autogamous *Hylocereus* clones produce about 350 grams of fruit at the average, when the flower is not hand-pollinated.

The application of fertilizer rates vary widely in orchard areas. The use of inorganic fertilizers on crops highly influenced the growth and productivity of plants. Organic manures and composts have been used in Indonesia with much success. About 300 - 500 g N, 500-700 g P2O5, 300-500 g K2O, and 20 kg organic manure per pillar per year were used.

Based on the preliminary survey of ITFRI and from farmers’ experiences dragon fruit productivity in Indonesia was about 24 to 30 t/ha/year. The productivity varies among locations and cultivation technique. The Standard Operating Procedure (SOP) for dragon fruit cultivation has not been developed yet.

In Indonesia, there are some morphological variations in phenotypes of dragon fruit, both in group *H. polyrhizus* and *H. costaricensis* (Figure 2). The variations can be seen on stem and fruit which can be observed, i.e.; stem shape (triangle, quadrangle), stem color (whitish green, light green, dark green), flower color (pure white, white), calyx color (light green, reddish green), fruit color (vermilion, red, dark red), color of fruit flesh (white, red, dark red, blackish red), and fruit shape (round, oval), etc. (Rahmawati and Mahajoeno 2009).
Flowering and Fruiting Season

There are two flowering and fruiting patterns of dragon fruit in Indonesia (Table 2). The first pattern is flowering and fruiting throughout the year, which occurs in the regions near the equator such as Sumatra, Kalimantan and Sulawesi islands. The second pattern is flowering and fruiting for six to seven months from October to April, which occurred in part of Sumatra (Lampung province), Java Island, Madura, Bali, West Nusa Tenggara and East Nusa Tenggara. These areas are located near the Southern Hemisphere, more than 5° S. Previous observations reported that the different circumstances, occurred in the Northern Hemisphere, several dragon fruit bear flowers from May to October (Nerd and Mizrahi 1997). The flowering season in California is from May through November (Thomson 2002).

Tabel 2. The flowering/fruiting patterns of dragon fruit in Indonesia.

<table>
<thead>
<tr>
<th>Region</th>
<th>Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near of the equator</td>
<td>J</td>
</tr>
<tr>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Southern Hemisphere</td>
<td></td>
</tr>
<tr>
<td>(more than 5° S)</td>
<td>V</td>
</tr>
</tbody>
</table>

Under optimal conditions, floral buds appear at intervals of about two weeks, especially at the location near the equator. From emerging floral buds to opened flower, it takes about one month, and from opened flower to harvest time, it takes about a month. The average from the floral buds to harvest takes about two months (Figure 3) and the harvest can be done at intervals of about two weeks. The harvested fruit cannot be stored longer than 7 days, unless it is stored in a cold storage. Therefore it should be marketed soon after harvesting.
Improving Pitaya Production and Marketing

Marketing
Prior to year 2000, Indonesia imported 100% of its dragon fruit from overseas. After 2000, dragon fruit started to be cultivated commercially, and area and production increased rapidly. In a short time the fruit orchard spread to many regions. Many farmers show great interest to cultivate the dragon fruit because this commodity has several advantages: period from planting to fruiting is short (about 10 months), long period of productivity, high prices, and many good health benefits.

Dragon fruit has a great potential in Indonesia with 250 million people. About 10 years ago, most consumers of dragon fruit are limited to high-income groups. Now the fruit can be found even in traditional markets and roadside with the consumers consisting of practically all levels of society. Dragon fruit is considered as the fruit of the future which are commonly consumed directly as fresh fruit or processed into juice, jam, syrup, and other valuable products.

Marketing of dragon fruit is very simple. After harvesting, the dragon fruits are collected by merchants and sold to the fresh fruit stores, supermarkets or directly marketed to consumers. For farmers who are just starting the business, they usually market the fruits to vendors who in turn offer the fruit to shops, supermarkets, merchants in traditional markets. Some farmers join the dragon fruit growers association.

The demand for dragon fruit in Indonesia is all-year round but the highest demand is usually during the celebration of the Lunar New Year (January or February). During this time, the demand can increase of up to 25% compared to other times of the year. Currently Indonesia still imports the dragon fruit from Vietnam, China and Thailand. The proportion of dragon fruit import is estimated to be about 50% of the total requirement.

MAJOR PRODUCTION CONSTRAINTS AND MARKETING CHALLENGES

Pests and Diseases
The main constraint in dragon fruit cultivation is pest and diseases that have destroyed dragon fruit cultivation. Rarely, cactus scale (Pseudococcus sp.), ants and aphids will cover a bloom or fruit, but they are easily controlled and not usually a serious problem. In Bintan and Batam, the district of Kepulauan Riau provinces, this case have been reduced by 80 to 100% in 2011. Diseases problem also occurred at central production in West Sumatera province since 2012. In these locations, hundreds of hectares planted to dragon fruit were destroyed.

Figure 3. The development of dragon fruits flower from floral buds (left), opened flower (middle) and mature fruit (right).
Sumatera and Kepulauan Riau provinces. The diseases were white/yellow spot (scab) that attack stem and fruit (*Alternaria* sp. and *Pestalotiopsis* sp. as causal agents?), yellow stem rot (*Fusarium* sp., *Schlerotium* sp., *Phythophthora* sp., and bacteria), antrachnose (*Colletotrichum* sp.) and disease like stem canker in Malaysia and Vietnam that caused by *Neoscytalidium dimidiatum*. The symptomps of yellow stem rot, white/yellow spot, antrachnose, black/brown spot, and black rot disease were presented in Figures 4, 5, 6, 7 and 8.

![Figures 4, 5, 6, 7, and 8 showing symptoms of various diseases in dragon fruit plants.](image1)

Figure 4. Symptoms of yellow stem rot disease of dragon fruit plants.

![Figures A to G showing symptoms of white/yellow spot disease in dragon fruit.](image2)

Figure 5. Symptoms of white/yellow spot (Scab) of dragon fruit: A=early symptoms, B, C=further symptoms, D=died shoot due to disease, E, F, G= symptom on fruits
Figure 6. Symptoms of antrachnose.

Figure 7. Symptoms of black brown spot.

Figure 8. Symptoms of black rot.

Marketing Constraints
The harvesting period of dragon fruit is unique and different from other commodities. Under similar agroecological conditions, dragon fruit harvesting occur simultaneously. In this case, there are many production stocks in these areas. The harvested fruit must be marketed as soon as possible, since it cannot be stored longer. These fruit are non-climactic and the quality of which can last for at least two weeks when stored at 14°C (Nerd et al. 1999). Cold storage facilities are needed to extended storage period of the dragon fruit.

In some production centers, such as East Java and East Kalimantan, the prices of dragon fruit often drop when over supply occurs. Furthermore, high transportation costs from production centers to other regions in an archipelagic country is another constraint. In addition, there are inadequate refrigeration, storage and transport facilities. These problems become obstacles in marketing of dragon fruit in Indonesia. Compounding the marketing problem is the fact that currently, there is no existing farmer association of dragon fruit producers in Indonesia.
PROMOTION OF DRAGON FRUIT PRODUCTION AND MARKETING

Efforts to Increase Production
Development of dragon fruit area was carried out by considering agronomy, potential region, agro-climate, human resources, facilities and infrastructure, as well as economical aspects. The development program was conducted through two approaches. First approach is through strengthening the existing area through optimization of cultivated management such as fertilization, irrigation, and control of pest and diseases. The second approach is using good quality of seedlings followed by application of Good Agricultural Practices (GAPs) based on Standard Operating Procedure (SOP). Good Handling Practices (GHPs) are also needed to maintain good quality of dragon fruit. The orchards that have implemented GAP were then registered. The registration number reflected that the dragon fruit produced from the orchard is safe for consumption.

Efforts to Increase Marketing
Institutional farmers, such as those belonging to farmers’ groups or associations play an important role in promoting their production. The existence of farmers’ associations can provide the assistance, financing and marketing process to become easier. The strong association will enhance farmers’ bargaining position and they will not easily be manipulated by middlemen. The association can also facilitate the network and partnership in marketing the product.

Application of cultivated technology, postharvest handling, the provision of facilities and infrastructure are the important components in the dragon fruit business. The selection and use of suitable facilities and infrastructure will maintain good quality of dragon fruit and give good price and high competitiveness.

FOCUS IN RESPONSE TO FUTURE TREND AND MARKET DEMAND

Dragon fruit has the potential to be further developed in Indonesia in order to meet the demand of domestic and export markets. Domestic market demand is increasing every year along with population growth and increasing of public awareness on healthy living. But Indonesia has not been able to fill in those markets. Development focus of dragon fruits in Indonesia is to meet domestic demand, reduce import and increase farmers’ income. Therefore it is necessary to increase the production which is focused on expansion of planting areas and improvement of production management. Extending planting areas is possible as Indonesia has wide areas which are suitable for the development of dragon fruit. Extending the area around the equator is better than the area far from equator since the plants could be flowering and fruiting throughout the year. Formation of areas for dragon fruit production is important to achieve economies of scale which can lead to efficient cultivation, marketing, and facilitate the empowerment of farmers. Improvement of cultivation techniques can be performed through optimal fertilization, irrigation, and pest and disease control. Drip irrigation technique is important to overcome the difficulties in water supply on the dry land.

Postharvest activities and the development of dragon fruit processed products like jelly, jam, syrup and cake are needed to overcome the problem of over-production when harvest time occurs simultaneously in various locations. In addition, the development of processed products can support the agriculture bioindustry, which is one of the
Improving Pitaya Production and Marketing programs of the Department of Agriculture. In East Kalimantan province the dragon fruit has been processed into flour and on Batam Island processed into various types of food that are unique to these areas.

RESEARCH AND DEVELOPMENT PROGRAM

Research on dragon fruit in Indonesia is still limited. Research activities of dragon fruit in ITFRI have started in 2013. The activities focus on identification and control of the diseases, and the application of chemical and organic fertilizers. Other research on the extension of flowering period with the use of artificial lights is carried out especially in the Java region. Field observation on several dragon fruit orchards in Indonesia found various varieties of dragon fruit. Selection and evaluation of superior varieties based on morphology, horticultural traits and molecular markers need to be done, especially for self-compatible and autogamous red-fleshed varieties.

CONCLUSION

There are many aspects that must be considered to improve productivity and quality of dragon fruit in Indonesia. Superior varieties, planting system, fertilization, irrigation, pruning, proper harvest time and post-harvest storage are some of the things that determine the success of the dragon fruit business. And the farmers need to be well informed with these techniques before they embark on this kind of business.

White/yellow spot (scab) disease is one of the serious disease attacks on dragon fruit plants in some areas. The disease destroyed a great number of dragon fruit orchards. The clones that are resistant to this disease, along with its effective management measures, have yet to be developed. Moreover, issues and challenges such as problems in peak harvesting of dragon fruit, preparation for marketing, postharvest handling and reducing transportation costs, which impact upon horticultural chain management and marketing need to be overcome.

REFERENCES

Rahmawati, B and E. Mahajoeno. 2009. Variation of morphology, isozymic and vitamin C content of dragon fruit varieties. Bioscience 1:131-137