Dragon Fruit Production and Marketing in Indonesia: Standard Quality in the Global and Regional Levels

Irwan Muas, E. Mansyah, S. Yuliati, and Hendri
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., is one of the introduced fruit crops in Indonesia. This plant became popular and cultivated since 2000. Red flesh dragon fruit variety is the most widely cultivated. Indonesia has two types of dragon fruit region based on flowering and fruiting seasons. The first type is the area near the equator, the flowering and fruiting season occurring throughout the year. The second type of region is in the Southern Hemisphere, more than 50 S, with the flowering and fruiting season occurring from November to April. Most of Indonesian dragon fruit production are sold in the local markets and small portion for export markets. Some problems in production of dragon fruit include pests and diseases, and low productivity. Stem canker, caused by Neoscytalidium dimidiaturn, is the main disease which destroyed more than hundreds of hectares of dragon fruit orchard in Indonesia. The enhancement of production and fruit quality are done through following the Good Agricultural Practices (GAP), Integrated Pest Management (IPM), using resistant pests and disease, variety, and organic cultivation. Reduction application of pesticides and inorganic fertilizers and increasing organic fertilizer must be promoted to the farmers. In order to fulfill export standards the dragon fruit orchards which have been applied with good production system should be registered. The main quality standard in the local market based on fruit size which were categorized as grade A (> 400 g), B (200 - 400 g) and C (<200 g). Meanwhile, the quality standard for export market are depend on the importer country. Besides grade, the quality standards for global market were free from pests and diseases, no pesticide residue and post-harvest handling is done at registrated packing houses. To enhance dragon fruit quality standard, some importer countries have collaborated with Indonesian Agricultural Quarantine Agency (IAQA).

Keywords: Dragon fruit, cultivation, marketing, quality, global, regional, Indonesia

INTRODUCTION

Dragon fruit, Hylocereus, spp., is a native American cactus which is widely distributed in the tropical and sub-tropical forest regions of Mexico, Central and South America (Mizrahi et al. 1997). Most Hylocereus species are found in Mesoamerica in varied landscapes ranging from a few meters to 1840 m above sea level and with rainfall from 350 to more than 2000 mm (Ortiz-Hernández 1999). From the center of its origin, dragon fruit spread to tropical and sub-tropical America, Asia, Australia and the Middle East (Patwary et al. 2013). These fruits are being cultivated in at least 22 countries in the tropics and sub tropics region, such as, Australia, Cambodia, China, Israel, Japan, Nicaragua, Peru, Philippines, Spain, Sri Lanka, Taiwan, Thailand, South Western USA and Vietnam etc. (Mizrahi and Nerd 1999; Nobel and Barrera 2002). The fruit crop is now extensively planted on a commercial scale in many tropical regions, particularly in Vietnam and other South-East Asian countries.

Other common names of dragon fruit are pitaya, pitahaya, dragon pearl fruit, green dragon, dragon crystal, and strawberry pearl. This Cactacea family, in Indonesia is called "Buah Naga". It
began to be planted and developed since 2000 and since then, the popularity of this dragon fruit is fast developing in the community, owing to its good taste, and also its many health benefits. In Indonesia, dragon fruit with red flesh is a type that is widely grown and preferred by consumers. Red flesh dragon fruit has a higher antioxidant activity compared to some other types of fruits and vegetables (Mahattanatthewee et al. 2006).

Dragon fruit plants can adapt well in Indonesia with varied agro-climate conditions, ranging from coastal areas to an altitude 800 meters above sea level. This plant can also grow well on sandy soil, marginal land such as acid dry land and peat. Central Kalimantan is one of the provinces in Indonesia which has developed a lot of dragon fruit on peatlands. In general, the area with the highest production of dragon fruit in Indonesia is in the Banyuwangi District, East Java Province. Production from this province dominates the dragon fruit market in this country. Besides marketing for domestic consumption, the production of dragon fruit from Indonesia has also begun to be exported to several countries.

**DRAGON FRUIT PRODUCTION**

**Planting area**

Dragon fruit plants began to be developed in Indonesia since 2000. Initially, it was thought that these commodities can only grow and produce, if it was planted in fertile coastal and sandy areas. Related to those assumption, the development of dragon fruit orchards in several regions is indeed quite common in coastal areas, such as in South of Yogyakarta, East Java, Padang Pariaman district, West Sumatra and in the Riau Islands region. However, since the last few years, dragon fruit plants have been widely developed by farmers in areas far enough from the coast, even to an altitude of about 800 m above sea level. The land for planting dragon fruit is not limited to fertile sandy soils, but has also expanded to other marginal lands. On marginal land with low fertility and poor physical properties, such as clay, loam, and even peat, dragon fruit plants can grow and produce well.

Nowadays, dragon fruit plants have spread to almost all regions in Indonesia, such as the islands of Sumatra, Kalimantan, Java, Sulawesi, Bali, and several other islands. More about the regions as the main dragon fruit producer in Indonesia is presented in Table 1.
Table 1. The main dragon fruit growing areas in Indonesia

<table>
<thead>
<tr>
<th>Island</th>
<th>Province</th>
<th>District</th>
<th>Cultivated Area* (ha)</th>
<th>Productivity (Ton/ha/year)</th>
<th>Destroyed Area* (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sumatra</td>
<td>North</td>
<td>Deli Serdang, Tapanuli Selatan, Toba Samosir Pekanbaru, Siak, Bengkalis</td>
<td>15</td>
<td>22 - 28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Riau</td>
<td></td>
<td>50</td>
<td>15 - 20</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Kepulauan Riau</td>
<td>Batam, Bintan, Karimun, Tanjung Pinang Padang Pariaman, Solok, Pasaman, Agam Kapahiang Lampung Timur, Tulang Bawang, Lampung Selatan</td>
<td>200</td>
<td>15 - 20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>West</td>
<td></td>
<td>225</td>
<td>20 - 30</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Sumatra</td>
<td></td>
<td>25</td>
<td>22 - 28</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Bengkulu</td>
<td></td>
<td>50</td>
<td>22 - 26</td>
<td>90</td>
</tr>
<tr>
<td>Java</td>
<td>West Java</td>
<td>Bogor, Bekasi, Sumedang, Purwakarta, Indramayu Serang Boyolali, Karanganyar, Kendal, Semarang, Pati, Wonosobo, Purbalingga, Pemalang, Banjarnegara, Sragen, Sukoharjo, Sleman, Bantul, Kulonprogo Jember, Pasuruan, Malang, Lumajang, Banyuwangi.</td>
<td>75</td>
<td>24 - 28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Banten</td>
<td></td>
<td>55</td>
<td>26 - 30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Central</td>
<td></td>
<td>150</td>
<td>24 - 30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Java /</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yogyakarta</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Java</td>
<td></td>
<td></td>
<td>5841</td>
<td>24 - 30</td>
<td>20</td>
</tr>
<tr>
<td>Kalimantan</td>
<td>East</td>
<td>Kutaikartanegara</td>
<td>1500</td>
<td>22 - 28</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Kalimantan</td>
<td>West Kalimantan</td>
<td>Sambas</td>
<td>75</td>
<td>20 - 26</td>
</tr>
<tr>
<td></td>
<td>Central</td>
<td>Kalimantan</td>
<td>Palangka Raya, Pulang Pisau</td>
<td>50</td>
<td>18 - 24</td>
</tr>
<tr>
<td>Sulawesi</td>
<td>South East Sulawesi</td>
<td>Konawe Selatan</td>
<td>30</td>
<td>20 - 26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>South Sulawesi</td>
<td>Sinjai</td>
<td>40</td>
<td>20 - 26</td>
<td></td>
</tr>
<tr>
<td>Bali</td>
<td>Bali</td>
<td></td>
<td>30</td>
<td>20 - 28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>East Nusa Tenggara</td>
<td>Buleleng, Badung</td>
<td>40</td>
<td>18 - 25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>West Nusa Tenggara</td>
<td>Lombok Tengah</td>
<td>40</td>
<td>20 - 26</td>
<td></td>
</tr>
</tbody>
</table>

*) Estimated until 2019, compiled from various sources

The region that produces the most dragon fruit in this country is Banyuwangi District, East Java Province. In 2019 it has a planted area which has reached 5841 ha, with 2321 ha as harvested area (Sinar Tani 2019). In East Kalimantan, until the end of 2014, the area of dragon fruit cultivation had reached about 1500 ha, mostly located in Kutai Kartanegara district (source: Dragon Fruit Farmer Association, East Kalimantan). However, more than 700 ha of dragon fruit orchards in this area have been affected by stem canker. With the impact of the stem canker's attack, there is an area that used produce dragon fruit. For example, Batam Island (Kepulauan Riau Province) and Padang Pariaman District (West Sumatra Province), until 2014 were still producing dragon fruit, but now the dragon fruit orchards in the area are mostly already damaged and no longer productive. The new developing dragon fruit planting areas in the West Sumatra province are in Solok and Agam districts.
Cultivation system

Planting material from stem cuttings (vegetative propagation) is more commonly chosen by dragon fruit farmers in Indonesia. This method of propagation is relatively easiest, cheapest, and fastest. Cuttings can be obtained from branches of plants that have been old, healthy, dark green, such as the branches that have produced fruit. The branches are cut about 20 - 30 cm long, then sown in nursery beds or on polybags that contain growing media (Figure 1). Fertilizing, watering, and controlling pests and diseases need to be done in order to obtain healthy seeds. After the seeds have strong roots and the shoots have grown well (± 50 cm high), the seeds can be planted in the orchard.

Figure 1. Dragon fruit stem cuttings (left) and seeds ready to be planted (right)

The planting area must be cleared from disturbing materials such as woody growth and shrubs. Weeding is required on all dragon fruit planting sites, at least 1 m in diameter around the planting hole. As the dragon fruit is a climbing cacti, so its needs a post, such as concrete pillars, solid wood, live tutors, for support (Figure 2). The post used must be strong, sturdy and durable to support dragon fruit plants. In commercial dragon fruit orchards, concrete post with a size of 10 cm x 10 cm with a height of about 2–2.5 m are widely used. This climbing post is implanted ± 50 cm deep. At the top or end of the pole, mounted a circle with a diameter of about 40-50 cm, can be made of iron ring or old motorcycle tires that serve to hold the branches of the dragon fruit plant.

Figure 2. Concrete climbing post (A and B), live tutors (C)

In general, the planting system of dragon fruit in Indonesia is carried out with a single post system. The spacing between posts, can be used about 2 - 3 m x 2.5 - 4 m. Four dragon fruit stem cuttings planted around the post, it also called a typical Vietnamese trellis system (Mizrahi 2015). After planting, tied the stem in the post. The area needs to managed well and operations like stem binding, training, pruning, fertilizing, irrigation, pest control, disease and weeds need to be done. Organic and inorganic fertilizers greatly affect plant growth and productivity. Organic fertilizers have also been widely used in Indonesia to improve the quality and productivity of plants, including dragon fruit. General guidelines for dragon fruit plants, of fertilizers should be done to plants up to one year
old with the following prescribed volume 200 - 300 g N, 300-400 g P₂O₅, 200-300 g K₂O, and 10 kg of organic fertilizer per post per year. For plants that are one year old or more, fertilization can be done by using about 300 - 500 g N, 500-700 g P₂O₅, 300-500 g K₂O, and 20 kg of organic fertilizer per post per year, with an interval of 2-3 months.

Pests and diseases can also threaten the health and production of dragon fruit. Stem rot caused by *Sclerotium rolfsii*, and wilt by *Fusarium oxysporum* pretty much attacks dragon fruit plants. Besides that, there is also an indication that one of the triggers for a stem rot attack is the scaly tick (*Pseudococcus* sp). The disease attacks can be reduced through constant monitoring and applying other control methods as early as possible.

Dragon fruit plants begin to enter the generative phase at the age about 8-10 months. Dragon fruit can be harvested around 28-32 days after the flowers bloom, which is indicated by the fruit color changing from green to red. The fruit is harvested manually, the base of the fruit is cut with scissors without damaging the stems. The harvested fruit is collected into a basket, then taken to the collection point. The harvested fruits are sorted by size (Grade A, B and C), then packed with paper boxes or wood boxes and then marketed.

**Flowering and fruiting season**

Astronomically, Indonesia is located in the 6°08' N (North Latitude) - 11°15 'S (South Latitude) and between 94°45'E (East Longitude) - 141°05' E (East Longitude). In relation to this position, Indonesia has a high level of humidity, relatively high rainfall and tropical rainforest ecosystems. Indonesia receives sunlight for a longer period of time, always exposed to the sun throughout the year.

According to flowering patterns and harvesting time of dragon fruit, Indonesia has two types of region (Table 2). The first region has a flowering pattern and harvesting time throughout the year, which occurs in areas close to the equator such as Sumatra, Kalimantan, Sulawesi and West Papua. The second region has a flowering pattern and harvesting time for six months from November to April, which occurs in the area southern hemisphere, more than 5°S such as parts of Sumatra (Lampung province), Java, Madura, Bali, West Nusa Tenggara, and East Nusa Tenggara. Sometimes 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 to November (Thomson 2002).

Under optimal management of dragon fruit vines, such as pruning, fertilizer application and watering, flower buds will appear at intervals of about two weeks. It takes about one month from flower buds to blooming flowers, and from blooming flowers to harvesting time, it also takes about one month. In areas close to the equator, harvesting time of dragon fruit can take place at intervals of about two weeks and throughout the year. However in Indonesia, the area of dragon fruit cultivation near the equator is less than in the Southern Hemisphere region (more than 5° S) (Figure 3). The peak harvest season of dragon fruit in Indonesia is from November to March.
Pests and diseases

The main pests in dragon fruit cultivation in Indonesia are ants, *Pseudococcus* sp, aphids, borers, and fruit flies that cause damage to the stems, branches and fruit. Some of the dragon fruit plants that are attacked by stem rot are often preceded by the development of a population of large scale lice (*Pseudococcus* sp) on the stems of these rotten plants. It is highly suspected that living lice scales attach to the stems of the dragon fruit plant, also suck the liquid stem and cause injury. As a result of this injury, it will provide an opportunity for the entry of pathogens that cause stem rot disease. Another pest that also attacks dragon fruit is the red ant *Formica rava*, and this can also trigger stem rot. Some diseases that attack the dragon fruit plant include white/yellow spots (scab) that attack the stem and fruit (*Alternaria* sp. and *Pestalotiopsis* sp.), yellow stem rot (*Fusarium* sp., *Schlerotium* sp., *Phythophora* sp., and bacteria), anthracnose (*Colletotrichum* sp.) and stem canker disease caused by *Neoscytalidium dimidiatum*. Stem canker attacks are still the most feared disease of dragon fruit farmers (Figure 4). The effect of this stem canker attack has been found among dragon fruit farmers in several production centers in Indonesia such as in the Riau Islands Province, West Sumatra, West Java and East Java with an attack rate of 20% to 90%, which caused many crop failures (Riska et al. 2016). This stem canker disease attack has even been able to change the status of an area that was once a dragon fruit producing region and is now no longer a producer of dragon fruit. Areas that experience this condition are, for example, Padang Pariaman district, West Sumatra Province, Riau Islands Province and Lampung Province with a total planting area of around 600 ha.

![Figure 4. Attack of *Neoscytalidium dimidiatum* on stems (A), on fruit (B) and destroyed dragon fruit orchards in Padang Pariaman District (C) and in Riau Islands Province (D)](image-url)
Some disease control efforts continue to be carried out, such as mechanically or by using pesticides. Part of the plants that have been attacked have symptoms and are immediately pruned and destroyed, then sprayed with fungicides containing copper at the recommended dosage and application time. The alternate use of fungicides with different active ingredients can be recommended in controlling stem canker.

MARKETING

The development of dragon fruit plants in Indonesia is quite rapid, and does not take a long time to spread to other regions. The farmer’s interest to cultivate dragon fruit plants is quite high because this commodity has several advantages. The appeal of the community to move to the dragon fruit agribusiness sector due to the plant’s age is relatively short and long productive periods and can be harvested throughout the year. In addition, the selling value of dragon fruit is quite high in the domestic market.

Indonesia’s population is very large (more than 260 million people), it is a potential market for dragon fruit. The facts show that dragon fruit is a fairly saleable fruit in the market. About ten years ago, dragon fruit was generally only sold in modern markets with consumers belonging to the middle and upper classes. Nowadays, dragon fruit is also widely available in traditional markets, like the roadsides with various types and are widely bought by all circles of society. Dragon fruit is generally consumed directly as fresh fruit or processed into juices, jams, cakes, syrups, and other by-products.

Marketing of dragon fruit in Indonesia has a simple path, for example from dragon fruit farmers collected by traders, the fruit is sold to fresh fruit shops, supermarkets or directly marketed to consumers. In general, the marketing chain of domestic dragon fruit, can be grouped into three patterns (Figure 5).

Pattern I, marketing dragon fruit is considered inefficient. Generally the farmer share is less than 50%. This marketing pattern has not provided the desired level of satisfaction for all parties, because this pattern has the longest chain compared to the other two supply chains. In Pattern II the farmer’s share (50%) is higher than in pattern I and the retailer gets a higher profit ratio. Pattern III is the most efficient marketing pattern besides the shortest marketing chain compared to other supply chain patterns. The most widely used dragon fruit quality standard in the regional market is its fruit size. In general, dragon fruit is grouped according to three classes, namely grade A (> 400 g), grade B (200 - 400 g) and grade C (<200 g).
The dragon fruit has the potential market, not only in the domestic market, but now there is a lot of demand for export markets too. Since 2013, Indonesia has begun to export dragon fruit to several countries, although it is still in small quantities and continues to show an increase. In 2013, the export of dragon fruit from Indonesia was recorded around 1.1 tons, and is continuing to increase in 2014 and 2015, 10.2 tons and 49.4 tons respectively. The export destination countries include Singapore, Malaysia, Vietnam, Hong Kong, China, Thailand, Japan, United Arab Emirates, Saudi Arabia, Timor Leste, Kuwait, Qatar, Oman and Germany (IAQA 2016).

QUALITY STANDARDS

Effort to increase production and quality

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

Several approaches have been taken to increase the dragon fruit production through expansion of planting areas, selection of varieties, and the application of good cultivation technology. The development of the dragon fruit area in Indonesia is carried out through two approaches; strengthening the existing area and developing a new area by expanding the planting area. In developing new areas of dragon fruit, to produce high production and high quality of fruit, one of the determining factors is using good quality of seeds. The use of certified dragon fruit seeds guarantees that the products produced are in accordance with what is desired and in accordance with market demand. The use of good quality seeds must also be followed by crop management such as fertilization, irrigation and good pest and disease control.

Plant management using excessive inorganic material has begun to get the attention of consumers of dragon fruit. Consumers prefer organically produced dragon fruit, even though the price is more expensive. Organic dragon fruit, besides being safe for consumption, is also more resistant to storage, the skin color is brighter and the fruit tastes sweeter. Increased demand for organic dragon fruit, not only from consumers in the region but also from several importing countries. The development of organic management of dragon fruit is continuously carried out to improve the quality of product. One of the activities that has been carried out is assisting farmer groups to set fruit fly traps using attractants facilitated by the Directorate of Horticultural Protection. In one hectare of dragon fruit garden there must be a minimum of 20 traps and every week an observation is made of how many fruit flies are trapped.

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 dragon fruit plants that are grown in Indonesia are classified as self-incompatible. Some of the autogamous Hylocereus clones only produce fruit weighing about 350 grams on average, if the flowers are not hand pollinated. This condition is something that is less favorable for dragon fruit farmers. To solve this problem, Hylocereus clones that have automatic self-pollination, anthers and stigma positions are not separated, can produce fruit with a minimum weight of 500 grams.

Another approach that has been made by some farmers to increase the productivity of dragon fruit is lighting at night. The addition of this lighting is carried out by dragon fruit farmers, especially from May to October, for areas in the Southern Hemisphere (more than 5° S), like in Java island. The addition of lighting is done for 6-8 hours per night through artificial lighting using 6-10 watt Light Emitting Diode (LED) bulbs are installed between the dragon fruit poles with a height of about 2 m from the ground surface. With supplemental lighting it can induce the dragon fruit to flowering on out off season.

Improvement of the quality of dragon fruit products in order to meet consumer demand is done through the application of Good Agricultural Practices (GAPs) which are elaborated by the application of Standard Operating Procedures (SOPs). To maintain the quality of dragon fruit products, carried out Good Handling Practices (GHPs). For farmers that have implemented GAP, an orchard registration is conducted. Giving the orchard registration number is a guarantee and proof for farmers that they have implemented GAP in their cultivation business, so that it produces products that are of good quality and safe for human consumption. Currently, there are enough dragon fruit orchards in Indonesia that are registered for export. Most of them are small orchard of 0.01 - 0.25 hectares with several large orchards operated by farmer groups or cooperatives.
Effort to increase global marketing

Promotion is one of the common strategies used to increase the marketing of a product, including dragon fruit. The results of promotions that have been carried out since a few years ago, have given results that dragon fruit products from Indonesia have begun to enter the global market to several countries in Asia, Europe and is now overtaking Australia. Besides promotion, farmers' institutions will continue to be strengthened such as farmer groups, or other associations. Through good farmer institutions, it will be easier in fostering, establishing partnerships, accessing capital and in helping market access.

For farmer group members who have received technical guidance, it is expected to record every activity, orchard sanitation, environmentally friendly cultivation and refraining from using pesticides. Control of fruit flies is done by installing fruit fly traps. Furthermore, after the harvest, the members of the farmer group can already do the cleaning, sorting and grading at the collecting house owned by the farmer group. The implementation of a quality assurance system from upstream to downstream (on farm to off farm) is expected to increase competitiveness in the international market. One of the requirements of the importing country is the packing house which has been registered because it is considered to have met the minimum aspects required in GAPs.

Some potential dragon fruit importing countries from Indonesia have shown good responses, for example Australia and China. The two countries have sent a delegation to Indonesia to conduct field visits, verification to areas of dragon fruit production centers, such as Banyuwangi and Bali. The initial step has been taken by the General Administration of Customs of the People's Republic of China (GACC) as a representative of the Chinese Government to visit Banyuwangi in October 2018, to conduct, coordinate and prepare preparations for the protocol for the smooth implementation of exports to China. Verification of the orchard and packing house is carried out in relation to the preparation of export protocols. Mitigation of the risk of plant-disturbing organisms must be carried out in an integrated manner from upstream to downstream, so that the resulting product can be guaranteed quality and free from plant-disturbing organisms. The Ministry of Agriculture through the Indonesian Agricultural Quarantine Agency (IAQA) will also oversee the quarantine protocol of each agricultural product that will be traded in the global market. The Directorate General of Horticulture Republic of Indonesia's team also actively assisted farmer groups on the application of GAP, GHP and pest control, especially fruit flies, as requested by the Chinese Quarantine assessor team (GACC). One of the activities carried out is facilitating and assisting farmer groups to set fruit fly traps using attractants. The farms that have implemented GAP, the registration number of the orchards is carried out, which is a guarantee and proof that they have carried out good cultivation, as well as producing safe and good quality products.

Indonesia and Australia have also agreed to collaborate on marketing activities for horticultural products. This time, there are two types of fruits from Indonesia that are allowed into Australia, such as mango and dragon fruit. This happened, after the Agriculture Quarantine Agency Ministry of Agriculture signed a MoU with the Australian Department of Agriculture and Water Resources during the 21st Working Group on Agriculture, Food and Forestry Cooperation (WGAFFC) which was held in February 2018 in Melbourne.

The Australian Government’s Department of Agriculture and Water Resources has prepared this review of biosecurity import requirements to assess the proposal by Indonesia for market access to Australia for fresh dragon fruit. This final report recommends that importation of fresh dragon fruit to Australia from commercial production areas in Indonesia be permitted, subject to a range of biosecurity requirements (Australian Government Department of Agriculture and Water Resources 2018).

This report contains details of pests that are of quarantine concern to Australia and are potentially associated with the importation of fresh dragon fruit from Indonesia, the risk assessments for the identified quarantine pests and the recommended risk management measures to reduce the biosecurity risk to an acceptable level.

Seven pests have been identified as requiring risk management measures. These pests are melon fly (Bactrocera cucurbitae), oriental fruit fly (Bactrocera dorsalis), grey pineapple mealybug (Dysmicoccus neoebrevipes), papaya mealybug (Paracoccus marginalis), coffee mealybug (Planococcus lilacinus), Pacific mealybug (Planococcus minor) and Jack Beardsley mealybug (Pseudococcus jackbeardsleyi). These pests have been assessed previously by the department and risk management measures for these pests already exist to meet the appropriate level of protection (ALOP) for Australia on the fresh dragon fruit pathway.
CONCLUSION

Dragon fruit can be adapted and spread in various environmental conditions in Indonesia. This plant can grow on marginal land such as acid soils or peat. Indonesia's position which is located in the equatorial area, will provide an opportunity for some of its territory to naturally produce dragon fruit throughout the year.

In some areas, this commodity has developed very rapidly, so that it has become a regional center for dragon fruit production, such as the province of East Java. Dragon fruit production from this area, most of which have been distributed to most parts of Indonesia to meet domestic needs. Since the last few years, a small portion of this dragon fruit product has been exported to a number of countries.

Efforts to increase production and improve quality continue to be done in various ways, including through socialization of the application of GAP and GHP, and accompanied by orchards registration. The success of improvement efforts with global quality standards is expected to facilitate marketing promotion. The implementation of a quality assurance system from upstream to downstream (on farm to off farm) is expected to increase competitiveness in the international market.

REFERENCES


IAQA 2016, Technical information of dragon fruits of Indonesia, Ministry of Agriculture, Indonesia Agriculture Quarantine Agency, Center for Plant Quarantine and Biosafety, Indonesia.


Date submitted: September 10, 2019
Reviewed, edited and uploaded: October 19, 2019