STATUS OF DRAGON FRUIT PRODUCTION IN MALAYSIA

M. Zainudin and B. Ahmad Hafiz
Horticulture Research Centre
Malaysian Agriculture Research and Development Institute (MARDI)
P.O Box 12301, 50774 Kuala Lumpur, Malaysia
E-mail: zmeon.mardi@1govuc.gov.my

ABSTRACT

Dragon fruit is one of the most popular fruits grown in Malaysia even though it was not originally considered native of this country. Dragon fruit planting has become one of the potential export fruits beside existing local fruits. It has fast return on investment which could raise farmers income for small and large cultivation. Between the years of 2006 until 2009, many growers in Malaysia produce dragon fruit due to high demand and good price. Dragon fruit production area reached its highest peak in 2008 with 2,200 hectares compared with only 920 hectares in 2006. Its production reached highest in 2009 with 15,700 metric tons compared with 2,500 metric tons in 2006 with average 12.5 t/ha of yield. However the production of this fruit decrease steadily starting in 2011 (1,525 ha) and till 2013 only 452 ha actively produce this fruit. This is because of outbreak of soft rot caused by Xanthomonas compestr. High rainfall and humidity caused disease outbreak in Malaysia. However, some dragon fruit farms managed to escape from the catastrophe. This is due to the patience and relentless efforts to combat disease problems. Farmers had managed to move forward from their past experiences to uphold this lucrative industry. Several steps have been taken to enhance this industry such as disease and resistant planting materials, improved crop management practices, post-harvest handling and storage management, as well as efficient transfer of technology.

Keywords: dragon fruit, production, diseases

INTRODUCTION

Dragon fruit (Hylocereus polyrhizus) or ‘buah naga’ and ‘buah mata naga’ in the local language is one of the most recent newcomers in the Malaysian fruit industry. The dragon fruit originated from the South America, and was brought by the US Army to Vietnam during the Vietnam War. Since then, it has been cultivated in Vietnam and slowly became a commercial product. Dragon fruit has been grown in large scale in Vietnam since 1990 to provide fruits to the local and export markets in South East Asia. It also became an attractive product for foreign consumers. Dragon fruits have been introduced to Malaysia when Malaysians imported the product from Vietnam 15 years ago.

Dragon fruit has oval shape, red in color and its fruit between 10-15 cm; weighs between 300 to 500 grams. It has sweet to light sour taste and has many tiny black seeds which can be eaten. Yellow dragon fruits are small size and with average weight of about 100 grams and are very sweet. Dragon fruit has been reported to be a long day plant. It belongs to the Crassulacean Acid Metabolism (CAM) species which means that
it only opens their stomata at night for carbon dioxide intake. A dragon fruit plant is an epiphytic where it needs pillars to support it soft stems and branches.

Dragon fruits are rich in vitamins and minerals that can help improve body metabolism. It is good for digestion and blood circulation. Reports have shown that dragon fruits have positive response to reduce high blood pressure and neutralize toxins in the body. Red flesh dragon fruit has high antioxidants content which has high medical value. Besides consumed fresh, the red dragon fruit can also be processed into cordial, jam, wine and other products. There are reports that the content and the skin of dragon fruit can be used as natural food coloring for lipsticks. This natural food coloring is safe to be used because it does not have any side effects and no known harm to our health.

**VARIETY**

Nowadays, the dragon fruit has been cultivated on a large scale in Malaysia as well as in other countries. The dragon fruit growing areas are in the states of Johor, Perak, Negeri Sembilan, Pahang, Pulau Pinang and Sabah (Table 1). They are three varieties of dragon fruits grown in Malaysia namely; white flesh dragon fruits (*Hylocereus undatus*), red flesh dragon fruit (*Hylocereus polyrhizus*) and yellow skin dragon fruit (*Selenicereus megalenthus*). However, there were two varieties that suitable planted in Malaysia i.e. red and white flesh varieties (Figure 1).

<table>
<thead>
<tr>
<th>States</th>
<th>2008 Hectarage (Ha)</th>
<th>2008 Production (Mt)</th>
<th>2009 Hectarage (Ha)</th>
<th>2009 Production (Mt)</th>
<th>2010 Hectarage (Ha)</th>
<th>2010 Production (Mt)</th>
<th>2011 Hectarage (Ha)</th>
<th>2011 Production (Mt)</th>
<th>2012 Hectarage (Ha)</th>
<th>2012 Production (Mt)</th>
<th>2013 Hectarage (Ha)</th>
<th>2013 Production (Mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johor</td>
<td>591.0</td>
<td>3,842.3</td>
<td>571.0</td>
<td>11,175.0</td>
<td>510.3</td>
<td>2,876.2</td>
<td>366.6</td>
<td>2,497.1</td>
<td>190.5</td>
<td>1,515.7</td>
<td>91.9</td>
<td>4,143.1</td>
</tr>
<tr>
<td>Kedah</td>
<td>69.3</td>
<td>145.2</td>
<td>46.9</td>
<td>211.1</td>
<td>46.4</td>
<td>71.6</td>
<td>18.2</td>
<td>38.0</td>
<td>12.1</td>
<td>48.6</td>
<td>12.2</td>
<td>128.3</td>
</tr>
<tr>
<td>Kelantan</td>
<td>170.0</td>
<td>462.1</td>
<td>76.2</td>
<td>105.0</td>
<td>28.3</td>
<td>69.6</td>
<td>12.1</td>
<td>100.9</td>
<td>4.2</td>
<td>46.2</td>
<td>1.9</td>
<td>10.7</td>
</tr>
<tr>
<td>Melaka</td>
<td>138.0</td>
<td>771.5</td>
<td>166.0</td>
<td>1,005.0</td>
<td>169.0</td>
<td>977.5</td>
<td>159.0</td>
<td>1,168.0</td>
<td>151.0</td>
<td>1,208.0</td>
<td>105.5</td>
<td>1,034.8</td>
</tr>
<tr>
<td>Negeri Sembilan</td>
<td>506.4</td>
<td>687.7</td>
<td>78.4</td>
<td>280.1</td>
<td>76.3</td>
<td>238.8</td>
<td>31.4</td>
<td>365.4</td>
<td>29.4</td>
<td>484.6</td>
<td>50.8</td>
<td>885.9</td>
</tr>
<tr>
<td>Pahang</td>
<td>364.9</td>
<td>1,293.8</td>
<td>307.0</td>
<td>593.8</td>
<td>128.1</td>
<td>478.4</td>
<td>23.1</td>
<td>219.5</td>
<td>19.7</td>
<td>97.5</td>
<td>10.9</td>
<td>60.0</td>
</tr>
<tr>
<td>Perak</td>
<td>57.7</td>
<td>197.7</td>
<td>60.9</td>
<td>104.2</td>
<td>58.6</td>
<td>137.6</td>
<td>18.2</td>
<td>60.8</td>
<td>40.7</td>
<td>75.0</td>
<td>11.9</td>
<td>99.7</td>
</tr>
<tr>
<td>Perlis</td>
<td>2.1</td>
<td>4.7</td>
<td>2.1</td>
<td>4.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pulau Pinang</td>
<td>53.5</td>
<td>165.6</td>
<td>52.1</td>
<td>383.9</td>
<td>39.5</td>
<td>397.4</td>
<td>36.3</td>
<td>402.5</td>
<td>6.0</td>
<td>210.7</td>
<td>13.8</td>
<td>1003.0</td>
</tr>
<tr>
<td>Selangor</td>
<td>220.2</td>
<td>759.4</td>
<td>211.0</td>
<td>1,129.2</td>
<td>248.5</td>
<td>4,332.5</td>
<td>215.5</td>
<td>2,887.8</td>
<td>279.8</td>
<td>2,127.5</td>
<td>87.3</td>
<td>913.6</td>
</tr>
<tr>
<td>Terengganu</td>
<td>16.1</td>
<td>59.6</td>
<td>34.5</td>
<td>30.2</td>
<td>59.3</td>
<td>32.8</td>
<td>31.7</td>
<td>32.6</td>
<td>11.8</td>
<td>42.4</td>
<td>5.6</td>
<td>9.2</td>
</tr>
<tr>
<td>Peninsular M’sia</td>
<td>2,189.2</td>
<td>8,389.6</td>
<td>1,606.2</td>
<td>15,022.0</td>
<td>1,364.2</td>
<td>9,612.3</td>
<td>912.1</td>
<td>7,772.5</td>
<td>745.3</td>
<td>5,856.3</td>
<td>391.8</td>
<td>8,288.3</td>
</tr>
<tr>
<td>Sabah</td>
<td>75.7</td>
<td>622.6</td>
<td>78.7</td>
<td>637.9</td>
<td>89.1</td>
<td>532.4</td>
<td>41.3</td>
<td>130.3</td>
<td>59.5</td>
<td>358.0</td>
<td>52.0</td>
<td>258.8</td>
</tr>
<tr>
<td>Sarawak</td>
<td>-</td>
<td>-</td>
<td>75.5</td>
<td>36.60</td>
<td>69.9</td>
<td>43.7</td>
<td>7.1</td>
<td>36.6</td>
<td>7.1</td>
<td>36.6</td>
<td>8.0</td>
<td>29.9</td>
</tr>
<tr>
<td>WP Labuan</td>
<td>2.5</td>
<td>4.0</td>
<td>2.0</td>
<td>4.00</td>
<td>2.5</td>
<td>3.5</td>
<td>2.3</td>
<td>3.5</td>
<td>0.6</td>
<td>0.6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>2,267.4</td>
<td>9,016.2</td>
<td>1,762.4</td>
<td>15,700.5</td>
<td>1,525.7</td>
<td>10,191.9</td>
<td>962.8</td>
<td>7,942.9</td>
<td>812.5</td>
<td>6,251.5</td>
<td>451.8</td>
<td>8,577.0</td>
</tr>
</tbody>
</table>

Source: Department of Agriculture
Improving Pitaya Production and Marketing

Figure 1. Three varieties of dragon fruits that could be grown in Malaysia

PRODUCTION

Malaysia has hot humid climate which permits the cultivation of many different types of fruit. Some of the fruits grown here are native to this part of the world. These includes indigenous fruits like mangosteen, durian, rambutan and a number of species of bananas. Dragon fruit production in Malaysia started with the public sector and was not included in Malaysian government’s development plan. After many trials and errors, dragon fruit cultivation has finally made its way in the Malaysian fruit industry. Unlike Vietnam and Thailand which had long history of dragon fruit growing, Malaysia is keeping good pace to lead its niche market due to high local demand.

The years 2006 until 2009 showed many growers in Malaysia producing dragon fruit because it has high demand and commanded good price. This crop also has good return on investment because it is yields fast and starts to produce fruit as early as one year after planting. Besides fruits, growers also make profit in supplying planting materials for new growers and hobbyists that offer high prices. Its production reaches highest in 2009 with 15,700 metric tons compared 2500 metric tons in 2006 with an average of 12.5 met/ha of yield. However the production of this fruit decreased steadily starting in 2011 (1,525 ha) and till 2013 only 452 ha actively produced this fruit (Figure 2). This is because of the outbreak of soft rot disease caused by *Xanthomonas comestri*.

![Figure 2. Dragon fruit hectarage and production in Malaysia 2006-2013. Source: Department of Agriculture](image)
Dragon fruit can be harvested all-year round and it bears fruits after one year of planting. The peak seasons are around April and September but in some places the harvesting time might vary. The average production in one hectare for second year of planting ranges between 2 to 8 tons and later increases to more than 10 t/ha once the crops mature.

The size of fruits depends on several factors such as good pollination, sufficient water and farm management practices. Bigger fruit size will command higher prices compared with the small ones. Dragon fruits are graded into ‘AA’ for 500-800g, grade ‘A’ for 350-450g, grade ‘B’ for 250-350 g and grade ‘C’ below 250 g.

**MAJOR CONSTRAINTS**

Bacterial and fungal diseases are considered the major constraints for dragon fruit production. The major enemy is stem and collar rots which is caused by *Xanthomonas campestris*. This disease was the reason why many dragon fruit farms did not survive and production decreased dramatically. Once infected, the disease will spread all over the farm if they are not controlled with bactericides. Good agricultural practices must be implemented to avoid this disease. It is to be noted that pruned branches that are infected with disease should not be left freely in the field due to buildup of more diseases instead they should be burnt or thrown far away. Another disease is fungal infection by *Phomopsis* and *Dothirella*, which is caused by black spots on the fruits. Regular control using fungicides could reduce disease infestations.

Despite disease outbreak in Malaysia, some dragon fruit farms managed to survive from the catastrophe. This is due to the patience and relentless efforts to combat the disease. Farmers had managed to move forward from their past experiences to uphold this lucrative industry. While researchers at their utmost doing research to support the industry be it in farm production or by products. Research must be geared up in order to find new innovations and technological advancements to cater to future problems like climate change and organic farming.

**MARKETING: LOCAL, NATIONAL AND INTERNATIONAL**

The marketing of dragon fruits are mainly local. As far as international market is concerned, countries like Singapore, Hong Kong and Middle East countries as well as UK are keen on buying the fruit. The red flesh variety is the most popular due to its high price at RM 8.00 (USD 2.00) per kg compared to white at RM 5.00 per kg (USD 1.50). Lately in 2013, the production of dragon fruit in Malaysia was reduced to 8,577 metric tons due to diseases.

**ORGANIZATION OF PRODUCTION AND MARKETING**

The Malaysian authorities had taken positive measures to enhance the growing of dragon fruits in the country. For instance, the Malaysian Standards (SIRIM) has produced standard operating procedures (SOP) and specifications on planting materials
Improving Pitaya Production and Marketing

(Figure 3). The Department of Agriculture had also come out with farming practices with Good Agriculture Practices through MyGAP or SALM (Figure 4).

Figure 3. Malaysian Standard on dragon fruits planting materials specification

Figure 4. Logo MyGAP or SALM, Farm accreditation scheme of Malaysia
Early research on dragon fruits was carried out on yield performances and varietal evaluation. Zainudin (2005) found that dragon fruits yielded from 5 to 8 t/ha. after second year of planting and increased by 10–15% as the crop matures. Red flesh cultivar (*H. polyrhizus*) was found to better accepted compared to white flesh (*H. undantus*) by farmers basically due its high consumer preferences. Other research aspects on flower biology, flower initiation and development by Realiza et al. (2007) revealed that poor fruit set of 10-20% in pitaya is the main constraint in producing high yield.

Hamidah et al. (2008) studied the diseases of dragon fruits which were heavily infested by *Dothirella* and *Phomopsis* which caused black spots on the fruits, and *X. campestris*, which caused soft rot. Pests like *Xylopetrus* and *Dacus dorsalis* are common. This was mainly due to non-accredited planting materials and crop husbandary problems. However, the Malaysian Standards (SIRIM 2010) has come out with dragon fruits planting specifications guidelines for growers to overcome such problems.

Marini et al. (2008) studied the growth, yield and fruit quality of red dragon (*H. polyrhizus*) fruit as affected by plant support system and intercropping with long bean (*Vigna sinensis*). They found that dragon fruit plants grown using the pole system showed 17-38% more flower buds, 15-36% more fruits and 24% heavier total fruit weight compared to those of the T bar trellis and V shape systems, respectively. There were also significant effects of plant support systems on soluble solid concentration (% Brix) where T bar trellis and pole systems showed 7% higher soluble solid concentration than that of the V shape system. Intercropping had no influence on all the parameters measured. Support systems did not have any significant effect on the stem diameter, chlorophyll concentration of stem, and days to attain fruit maturity in red dragon fruit and in the yield of long bean. Similarly, fruit quality including fruit pH, fruit diameter, fruit length, peel and pulp color and titratable acidity were not affected by different support systems or intercropping.

Nazarudin et al. (2011) found that extraction from dragon fruit peels (*H. polyrhizus*), a by-product of processing contained an alternative source of pectin. They found that the extracted pectin from dragon fruit peels was 20.1% (dry weight basis) by ammonium oxalate/oxalic acid extraction with 11.2% moisture and 6.9% ash. Extraction by deionised water yielded 15.4% pectin, 11.3% moisture and 11.6% ash. Whereas, the acid extraction gave the lowest yield (15%), 11.1% moisture and 12% ash. The amount of pectin from all extraction conditions were comparable to pectin obtained from commercial apple (12%) or citrus (25%).

Metabolites studies in dragon fruits carried out by Sew et al. (2010) on red pitayas were with different ripening index. Total RNA of red pitaya fruits with 35 days after anthesis (DAA) were extracted and purified to get high quality total RNA. The purified total RNA was then subjected to Solexa sequencing using paired-end mRNA-seq method. The mRNA-seq sequencing results showed that total number of red pitaya paired-end reads obtained was 18,530,028 sequences and total number nucleotides obtained was 1,389,752,100nt. Sequence assembly using Velvet software revealed a total of 106,867 nodes. After the sequence filtering process (set value as >80bp/node), we obtained 62,333 nodes. The homology search on the filtered sequences against non-redundant nucleic acid database (NR) showed that 31,423 nodes with significant E-
value $\leq 10^{-5}$. It was found that there were at least 97 nodes mapped to secondary metabolic pathways via Blast2Go analysis, particularly the biosynthesis pathways of phenylpropanoid, betalain, flavonoid, carotenoid and monoterpenoid. They concluded that identification of genes involved in secondary metabolism and their corresponding biochemical pathways would enable harnessing the potential of red pitaya as functional food with optimal level of beneficial phyto-chemicals and also to control the production of those phyto-nutrients through genetic manipulation.

Post-harvest of dragon fruit maturity indices were done by Abdullah (2006) and it was found that red pitaya fruits were harvested eight stages of fruit development. They found that farmers would normally fruit index at stage 6 for local markets and at stage 5 for distant markets (Figure 5).

Figure 5. Fruit index 1 to 8 in dragon fruits with TSS and PH.

**CONCLUSION**

There is no doubt that dragon fruit planting has become one of the potential export fruits beside existing local fruits in Malaysia. It has fast return on investment which could raise farmers income for small and large cultivation. Besides, the fruit’s future is bright due to untapped downstream activities of its by products which could be developed by the agriculture sector. Several steps should be taken to enhance this industry such as disease and resistant planting materials, improved crop management practices, post-harvest handling and storage management, as well as efficient transfer of technology.
REFERENCES

Abdullah, H. 2006. Development of effective storage and handling techniques for selected highly perishable fruits (dokong, salak, wax apple and dragon fruit) with good market potential. 05-03-08-SF0026. (unpublished).


