DEVELOPMENT OF INTEGRATED CROP MANAGEMENT SYSTEMS FOR PITAYA IN TAIWAN

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ABSTRACT

The harvested area for dragon fruit or pitaya in Taiwan reached 1,587 hectares, according to agricultural statistics yearbook of 2014. Of this figure, 53.6% and 35.6% of the harvested fruits were located in the middle and southern plain area of west Taiwan. The production industry for pitaya belongs to Taiwan’s intensive agriculture, which emphasizes more on stable production of high quality fruits and demands high cultivation technique. Thirty percent of the common grown clones/varieties belongs to Hylocereus undatus, while 70% of them belongs to red flesh H. sp. ‘Da Hong’ and ‘Fu Gui Hong.’ Those are the two most popular H. sp. cultivars with 60% and 25% market occupancy. In an orchard, shoot management affects productivity regardless of ordinary or off-season production. Pruning before previous December along with heading cut before April would increase early yield. On the other hand, continuous thinning of floral buds may delay large harvest peak at the end of the ordinary schedule. By applying night breaking treatment, off-season production can be achieved both in autumn and winter in H. sp. The fruit’s appearance is already an assurance that pitaya can already be bagged.

Keywords: floral thinning, heading cut, night-break, off-season, pitaya,

INTRODUCTION

Dragon fruit has been introduced in Taiwan since the 1980s and have since increased in terms of popularity (Hsu, 2004; Jiang, 2005; Jiang et al., 2011; Yen and Chang, 1997). The productivity was approximately 25 metric tons/ha in recent years (Fig. 1) and the price ranged from $US2 to $US6/Kg. According to Taiwan’s 2014 Agricultural Statistics Yearbook, the harvested area for dragon fruit or pitaya reached 1,587 hectares, with 53.6% and 35.6% located in the middle and southern plain area of west Taiwan (Fig. 2A). Majority of the fruits are for domestic demand, and a small quantity is for exports.

Of the total foreign sales of nearly 158 metric tons of pitaya in 2014, 85% of those were exported to China. Other exporting countries are Japan, Singapore, Hong Kong, Canada etc. The average exporting price was $US2.69/Kg. We also imported 202 metric tons of dragon fruits at a price of US$1.63 Kg from Malaysia.
Pitaya production in Taiwan

Pitaya’s commercial production began in 1983. The production activities were fueled by farmers including Tu-Sha Chen from Dali, Huo-Quan Shi and Pei-Ran Wu from Chichi, Lian-Fang Wu from Mingjian, and Qun-Guang Wang. The original species was directly introduced to Taiwan and came from Vietnam and Central/South America. Through years of intra- and interspecies breeding, varieties of pitaya with various peel and flesh color were developed in Taiwan, some well-known clones/varieties such as 'Jan Long', 'Chouzou Large', 'Xi Long' and 'Xiang Long' were eventually released. Thirty percent of the common grown clones/varieties belong to *H. undatus*, while 70% of them belong to *H. sp.* (Fig. 2B). 'Da Hong' and 'Fu Gui Hong' are the two most popular *H. sp.* cultivars with 60% and 25% of market occupancy, respectively.

![Graph of pitaya production in Taiwan from 1999-2014](http://agrstat.coa.gov.tw/sdweb/public/book/Book.aspx)


![Partition of production area in Taiwan](image)

![Major species/cultivars grown in Taiwan](image)

Fig. 2. (A) The partition of production area in Taiwan; (B) The major species/cultivars grown in Taiwan.
In the early years, the production system was complicated because the nursery system was not yet established. Some of the nurserymen used to sell seedlings to the growers. As a result, the fruit quality and some other fruit characteristics could not be predicted such as color, shape, cracking, self-compatibility, etc. Thus, the development of dragon fruit production was restricted until 1999 when the true-to-type clones/varieties were released. The first rapid expansion was between 1999 and 2004 (Figure 1), the cultivation area and average yield per hectare increased rapidly, and the major varieties belonged to *H. undatus*. In the period between 2005 and 2009, the development of the industry was much lower and was halted mainly because the growers were not familiar with *H. sp*. The second rapid expansion started from 2012 with the introduction of the self-compatible *H. sp.* clones and a stabilizing of off-season production techniques.

**INTEGRATED CROP MANAGEMENT SYSTEM**

**General practice**

Red pitaya (*H. sp.*) is a long-day plant whose flowering and major sprouting processes switched at the equinoxes in subtropical Taiwan. The time between Spring and Autumn equinoxes is called the inductive period. The areoles on the newly matured shoots that sprouted in the previous year are induced to enter reproductive growth after the Spring equinox and the appearance of the first flower at the end of May. Meanwhile, the old shoots resume their evocation and flowers a little bit earlier than the newly matured shoots. The shoots will flower naturally in two to three waves in an inductive period. In Taiwan, pitaya production system belongs to intensive agriculture, which focuses on fruit quality rather than yield. The general practice of the system could be explained in three categories, shoot, flower, and fruit management (Fig. 3). Training and pruning are the most important practices to assure productivity at all times, particularly in early spring for ordinary production. Flower management is meant to control pollinated flower number for fruit size which includes floral thinning, pollination, and floral corolla removal after pollination. Finally, fruit management is able to guarantee the fruit appearance (Fig. 4A). In tropical and subtropical regions, preventing insect bite is a very important issue (Fig. 4B); therefore, the two types of bags, light transmittable and un-transmittable, are developed for pitaya fruits. The coloring of pitaya fruit is independent of light and if exposed to too much light will hinder coloring in the exposed side (Fig. 4C). However, perfect coloring may have a trade off with fruit bracts shelf life if light is not transmitted. Fig. 4a represents the effect of bag materials on fruit appearance (Huang, 2015).

![General practice schedule for ordinary production](image)

*Fig. 3. The general practice schedule for ordinary production in southern Taiwan.*
Fig. 4. Fruit appearance (A) perfect fruits, (B) fruit with insect bites, (Photos by Huang, S. H.) and (C) uneven coloring fruit. ( (): represented sunshine.

Off-season production

Through market analysis, an integrated off season production has been proposed (Fig. 5). Within the inductive season, a minor adjustment can be achieved by heading cut and floral thinning to increase early and late yield, respectively. For heading cut, 10 % of the length was suggested to cut off in newly matured shoots before April (Jiang and Yang, 2015), and pruning between November and December was suggested for the number of the competent shoots. For put off large harvest peak, it was suggested that there should be continuous floral buds thinning before mid-August. Off-season production means producing fruits in non-inductive season by night breaking treatment. *H. sp.* is more responsive to NB treatment, the production can be achieved both in autumn and winter (Jiang et al., 2012). Autumn trial can be initiated any time before mid-November in southern Taiwan and mid-October in central Taiwan, and the winter trial is suggested to halt until mid-February. The sensitivity of *H. undatus* towards night breaking treatment is different from *H. sp.*, whose autumn trials were suggested to start from mid-September and the harvest time towards the end of December.
CONCLUSION

The pitaya production industry belongs to intensive agriculture in Taiwan, which emphasizes more on stable production of high quality fruits and demands high cultivation technique. In an orchard, shoot management affects productivity regardless of ordinary or off-season production. Pruning before previous December along with heading cut before April would increase early yield, while continuous thinning of floral buds may delay large harvest peak at the end of an ordinary schedule. By applying night breaking treatment, off-season production can be achieved both in autumn and winter in H. sp. The fruit appearance can be assured through bagging.

REFERENCES