

Tropical and Subtropical Fruit Production in the Ryukyu Islands, Japan

HIDAKA Tetsushi

Research Center for the Pacific Islands, Kagoshima University

南西諸島における熱帯・亜熱帯果樹類の栽培

日高哲志

鹿児島大学多島圏研究センター

要旨

鹿児島県の奄美諸島から沖縄県に至る南西諸島では、バナナ、パパイヤなど、種々の熱帯・亜熱帯果樹類が古くから栽培されていた。その当時は、ほとんどが庭先栽培であったが、第二次大戦後、台湾からの移住者がパイナップルで商業栽培を行うようになり、また、近年は、種々の熱帯・亜熱帯果樹類において、商業栽培が行われるようになってきた。パイナップルに代表されるように、これまでは露地での商業栽培も多かったが、台風の襲来や冬期の低温、降雨を避けるため、近年はビニールハウスなどの施設栽培も増加しつつある。パパイヤでも、ハウスを利用した商業栽培が開始され、他の樹種においても、種々の試みが行われつつある。高価格が期待できるマンゴーなどでは、鹿児島県本土、宮崎県だけでなく、その他の九州あるいは本州の県においても加温ハウスを利用した栽培が行われるようになり、その生産量も急速に伸びつつある。そのような状況のなか、本地域では、台風の被害と冬期の低温、日照不足をどのように解決するかが課題となろう。

Abstract

Various tropical and subtropical fruits are grown in fields or under greenhouses in the Ryukyu Islands in southern Japan. Pineapple has been cultivated commercially for more than 50 years and almost all fruit has been processed for canning. Because of the severe competition with foreign products in the last decades, the industry is gradually turning to the fresh fruit market. Mango is grown in greenhouses and the growing area is increasing. Papaya is also grown

in green houses for the fresh fruit market. Other tropical and subtropical crops such as banana and passion fruit are produced mainly for local consumption. The industry is facing major challenges, in particular, typhoons in summer and the short duration of sunshine in winter, which are characteristic of the area.

Introduction

The Ryukyu Islands are composed of two prefectures, Kagoshima and Okinawa, which are located between Taiwan and Kyushu, one of four main islands of Japan. They stretch 1000 km from latitude 24° north (Okinawa Prefecture) to latitude 31° north (Kagoshima Prefecture) (Fig. 1). The area has a subtropical climate with very warm winters, however, strong typhoons hit the area very often in summer.

People have been growing tropical and subtropical fruits such as banana, papaya, guava and passionfruit for centuries in the area. Pineapple was introduced 140 years ago. Settlers from Taiwan started modern commercial cultivation of pineapple after World War II and it became an important industry for the area. Papaya is traditionally considered as a vegetable in Southeast Asia and immature green papaya fruit for cooking has been sold in local markets. Some of them are grown in greenhouses for the fresh fruit market. Mango is also grown in greenhouses and is becoming very popular among fruit growers for decades. The main growing area is spreading to southern Kyushu now.

Except for banana and pineapple, tropical and subtropical fruits are not familiar for most Japanese consumers. In 2003, 1.9 million tons of fresh fruit were imported by Japan (2). The crop which was imported the most is banana. In the year 2003, 987 thousand tons were imported. Imports of various other tropical and subtropical fruits such as mango and papaya are increasing rapidly.

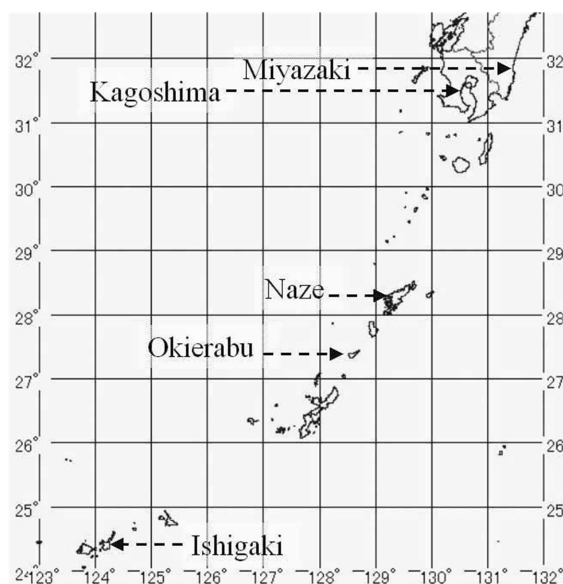


Fig. 1. Map of southern Japan (Ryukyu

Some Fruit Crops Growing Commercially in the Area

Pineapple

Pineapple commercially grown in Okinawa which produces 99% of total production in Japan (3). The main variety is of Smooth Cayenne, N-67-1 which was selected from Hawaiian strains by the experimental station of Okinawa prefectural

government. The industry is declining these

days because it has focused only on processing (mainly for canning) so far. The production and growing area reached maxima of over 100 thousand tons in 1969 and 54 hundred hectares in 1967, respectively (Fig. 2) (1). After 1967, because of severe competition from foreign products, the industry has declined and some canning factories gave up

1 governments tried to promote liberalization of import of canned pineapples. In 2001, the production was 250 thousand tonnes. About half of this is produced in Okinawa. The industry is now moving gradually towards fresh market. More than 100 thousand tonnes of pineapples are produced in greenhouses. New cultivars for fresh market, released in 1

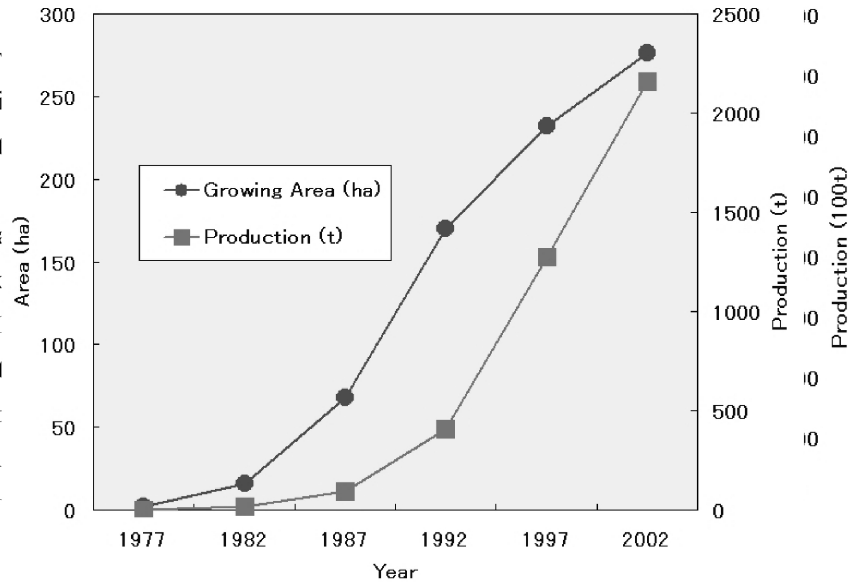
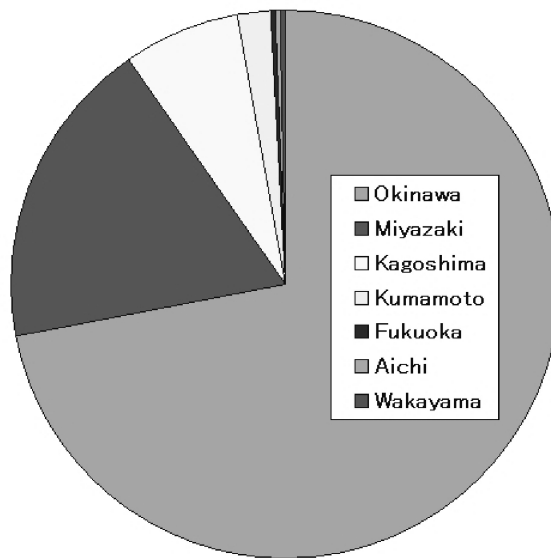


Fig. 3. Mango production in Japan.



Mango

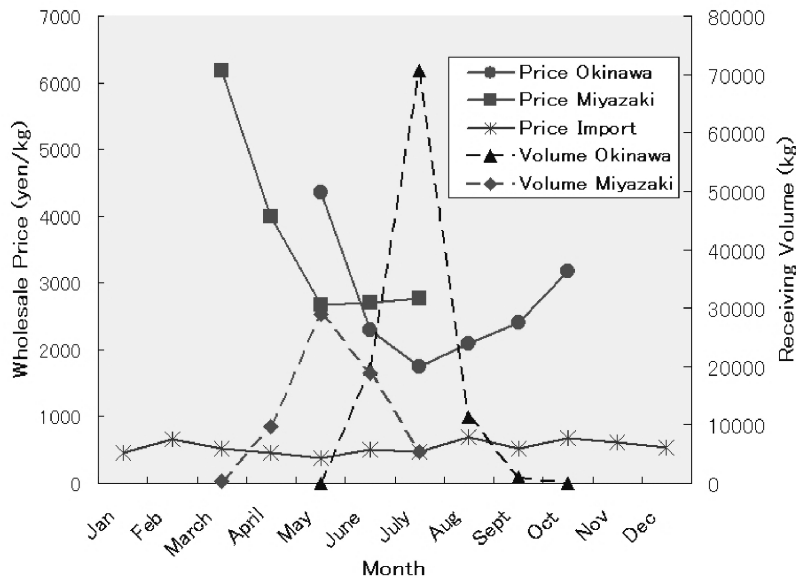
Commercial mango cultivation started about 30 years ago in Okinawa and Kagoshima. Thereafter, the production and growing area have increased rapidly (Fig. 3) (4). It is grown commercially in some prefectures in Kyushu and Honshu now (Fig. 4). The main cultivar is Irwin which is popular for Japanese consumers because of its fine texture of pulp and sweet smell. A strain from Taiwan is widely used for rootstocks for traditional reasons. They are grown in greenhouses sometimes with oil heating.

Some growers envelope each fruit in a white paper bag to protect the fruit from pests and diseases. The production averages about 15 - 20 tons per hectares.

In Okinawa, commercial production of mango has been carried out in greenhouses because the flowering season is in winter with rainfall. Greenhouses are constructed with plastic film, usually without heating system. Flowering occurs from January to mid-March. Growers use flies for pollination because of low temperatures. Setting of fruit is completed by mid-March and they are harvested from late June to August. In 1991, the growing area was 120 hectares and the production was 261 tons. In 2002, the growing area and the production increased to 204.4 hectares and 1,551 tons, respectively (4). The production of fruit per hectares was 4.0 tons in 1991 and 7.6 tons in 2002. Many growers sell their products directly to consumers including supermarkets or department stores in mainland Japan. On average, growers in the Okinawa area sell their fruits at a price of 1,500 to 2,000 yen per kg recently (Fig. 5). The problems in the area are low temperature and rainfall in winter when blooming occurs. Using of oil heating system is recommended for more stable production.

Mainland Kyushu is rather cold in winter compared with Okinawa.

Fig. 4. Main prefectures producing mango in 2002(quantity).



Mango is grown mainly in greenhouses to protect them from the cold in winter in the area. Mango cultivation started in 1986 with 0.5 hectares in Miyazaki. The growing area was 4.3 hectares and the production was 26.3 tons in 1991. The growing area and the production were 40.0 hectares and 396.0 tons in 2002 respectively, and they are increasing. Starting time of heating depends on the harvest season. Growers start heating from October to mid-November for harvesting from June to July. Temperature is gradually raised to 20 to 22°C before budding of flower. After flowering, temperature must be kept at 23 to 26°C until harvesting. Comparing to the Okinawa area, growers of the area can control flowering season by the time of commencement of heating in winter. That is, growers of the mainland can ship mango fruit earlier than those on Okinawa (Fig. 5). The price of early fruits is much higher than later ones. Costs of building greenhouses is lower than in the Okinawa area because the number of typhoons which hit Kyushu area is less than Okinawa.

The price of mango produced in Japan cannot be compared with those of fruit imported from abroad. Fig. 5 shows receiving volume and wholesale price of mango at Tokyo Wholesale Market in 2003 (5). In 2003, total receiving volume of domestic mango fruit was 168.1 t and those of imported fruit was 585.1 t. The first domestic mango fruit of the year were received from Miyazaki in March and the price of them was over 6,000 yen per kg, however, the price declined to less than 3,000 yen per kg after May. The larger the receiving volume became, the lower the price declined. In May, the first fruit from Okinawa appeared in the market and the price was more than 4,000 yen per kg. However the price of fruit from Miyazaki seems to have been unaffected by the arrival of fruit from Okinawa. The price of fruit from Okinawa also declined when receiving volume became larger. The lowest price of fruit from Okinawa was in July (however, it was still more than three times higher than those of imported fruit), then, the price became higher because receiving volume became lower. Generally the price of fruits from Okinawa were lower than those from Miyazaki. According to imported fruits, the lowest receiving volume was in January, 15.5 t, and highest was in May, 92.4 t (data not shown), however, the wholesale prices were around 400 - 700 yen per kg, not so variable as for domestic fruits. This might be because Japanese consumers prefer safer product (low utilization of chemicals) in addition to high quality of domestic fruits.

Other tropical and subtropical fruits

Other tropical and subtropical fruits such as banana, papaya, guava and passionfruit are grown in the Ryukyu Islands. Some of their production are increasing as shown in Fig. 6 (4). Papaya is mainly produced in Okinawa and only about 10% of total production is in other prefectures, mainly Kagoshima. The growing area and production in 1992 were 48 hectares and 542 tons respectively. The growing area was 37 hectares and production was 424 tons in 2002. The production per hectares with fruit bearing trees is 15 to 18 tons. Although high quality fruits can be produced in open fields especially for vegetable use, papaya plants are grown usually in greenhouses or covered with screens to protect them from typhoons in summer, especially for the fresh fruit market. In such a system,

papaya trees are planted at angles because they grow very fast and reach the roof after two years of planting. This system, however, cannot be continued for more than three or four years

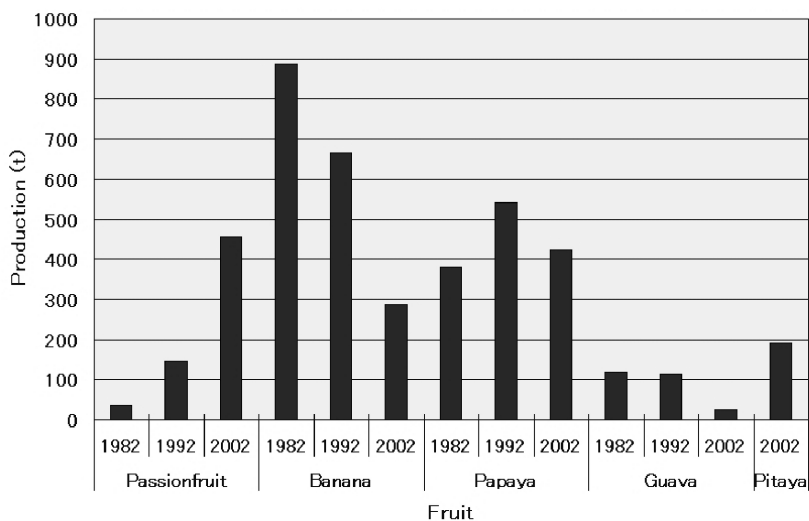


Fig. 6. Production of some tropical fruit crops in Japan.

because the trunks cannot support the heavy weight of the top of the trees. Grafting is carried out to reduce the height of plants as well as to proliferate female plants. In this system, however, plants reach the roof of greenhouses in two to three years. The dwarf varieties developed from tissue culture system are being introduced to avoid the problem now. Passionfruit is mainly grown in Amami Oshima Island of Kagoshima prefecture and the production is increasing rapidly because of its high price (1,000 to 2,000 yen per kg, data not shown).

Future of tropical and subtropical industry in Japan

In east Asia, about thirty typhoons appear annually. Several of them hit the

Ryukyu Islands severely, where agriculture is one of the main industries. To protect from typhoons, growers in Ryukyu Islands need stronger greenhouses than those in other parts of Japan, even stronger than those of southern Kyushu. Greenhouses cost \$ 45 to \$ 200 per square meter to build depending on the structure in the area. In other parts of Japan, growers need greenhouses and heating systems to protect from winter coldness. These make production costs higher.

Low temperature and insufficient quantity of light in winter affect the photosynthesis of plants and cause low production and quality of fruit. Controlling plant growth by selecting varieties and methods of cultivation must be very important to avoid such effects, i. e. choosing varieties tolerant of low temperature and low quantity of solar irradiation, and using appropriate method of cultivation to promote plant growth such as using liquid fertilizer should be needed.

In spite of the low quality of imported fruit because of its premature harvesting, large amounts of tropical and subtropical fresh fruit are imported into Japan and the trend is increasing. Since Japanese consumers prefer safer and higher quality fruit, and have such strong demands for exotic fruit, the requirement for tropical and subtropical fruit industry will grow further in Japan.

References

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- (3) Fruit and vegetable production year book. 2003. Agricultural Production Bureau, Ministry of Agriculture, Forestry and Fisheries.
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- (5) Yearly report of Tokyo Wholesale Market. 2004. Tokyo Wholesale Market.

[成果の概要]

現在、我が国は、いまだ経済的な回復は十分ではないというものの、ここ20年来熱帯・亜熱帯果樹に対する需要は増大の一途をたどっており、それにつれて海外から輸入されるその種類及び量とも増加しつつある。一方、我が国の南西諸島、鹿児島県の奄美諸島から沖縄県にかけては、古くからバナナ、パパイヤ、グアバ等の熱帯・亜熱帯果樹が栽培されているが、それらのほとんどは伝統的に庭先栽培であった。このような熱帯・亜熱帯果樹の需要の増加に対応して、マンゴー等、ごく一部の果樹では商業的な栽培が行われているが、他の多くの熱帯・亜熱帯果樹類における取り組みはまだ十分ではない。そこで、我々は、病害も比較的少なく結果年数も短いパパイヤに注目し、商業的栽培のための研究を開始した。2003年における我が国のパパイヤ生鮮果実の輸入量は4,000tで、そのほとんどをアメリカとフィリピンからの果実が占めている。また、同年における米国産果実の平均卸売価格（東京卸売市場）は655円/kgで、輸入果実としてはかなり高価なものとなっている。一方、同年の我が国における生産量は、輸入量の1/10以下の345tとなっており、もし、高品質の果実を生産、販売することができれば、輸送コストを考慮しても、農家の経営は十分に成り立つと思われる。

通常、パパイヤは種子で繁殖されているため、雄株の出現や果実品質のばらつき、品質の劣化など、商業栽培には多くの問題がある。そのため、輸出を目的とした商業栽培が行われているハワイでは、品種作出に当たってはまず品種の固定が行われ、その結果、「ソロ」やそれに連なる優秀な品種が作出、栽培されている。しかし、それらの品種は、年間を通じて高温及び低温の期間がないハワイに適応するように育種されているため、夏期は高温で、冬期には低温となるような我が国の南西諸島における栽培には不適當で、また、樹高も2年目には10mに達してしまうなど、南西諸島で前提となっているハウス栽培にも適さない。そこで、パパイヤの商業栽培のための基礎的基盤として、南西諸島に適した矮性品種の作出と組織培養を利用した種苗増殖システムの開発を試みた。品種作出に当たっては、糖度などの品種特性が優秀であることはもちろんであるが、南西諸島における夏期の高温及び冬期の低温にも十分に耐性を持ち、また、ハウス栽培が前提となっているため、矮性であることも条件とした。また、組織培養については、農家自身でも行えるよう、簡便化とマニュアル化を進めた。

現在、これらの手法は石垣島の農家栽培で試行されており、また、開発された品種についても、近い将来、登録、利用が進められる見込みである。近年の地球温暖化の真偽は別として、もし温暖化が進むということであれば、台

風という自然の障害はあるものの、南西諸島は、熱帯o亜熱帯果樹の栽培にとって好適な条件となっていくということになる。熱帯o亜熱帯果樹の栽培により、その地域の経済的基盤が強化され、それにより島の自立にも貢献できることが期待される。また、我が国消費者の「安全」及び「高品質」という需要にも応じることが可能となり、消費者の利益にもつながるものと思われる。

[拠点形成に関する具体的見通し]

これまで、上述したような研究を通じて活動を継続してきているので、ある程度、市役所や農家など、拠点形成は可能と思われる。

[短い展望]

現在までに、かなりの成果が得られているが、増殖から栽培までのシステムについてはまだ改良の余地がある。特に商業栽培のためには

- ① 増殖方法のさらなる簡便化と効率化、特にコストの低減。
- ② ハウス栽培の好適化、特に、ポット栽培における樹勢維持のため、夏期及び冬期における施肥（液肥）の至適化。
- ③ 野菜及び果実両用品種の開発。
- ④ パパイア消費拡大のための消費者への啓蒙、宣伝。

これらの問題を解決するため、今後とも継続的な研究活動が必要と思われる。それらの研究の結果、現在試行している農家が成功すれば、南西諸島の他の島々、あるいは農家への栽培拡大も見込まれる。