

FOREWORD

This Bulletin discusses citrus production in Thailand. Pummelo is the main export crop, but most citrus fruit produced in Thailand are consumed domestically. These include a large numbers of acid lime used in cooking.

The Bulletin discusses the problems of growing citrus fruit in a warm, humid climate. Greening is the most serious citrus disease, and a program is now under way to provide growers with disease-free planting materials. Efforts are being made to reduce pesticide applications by developing techniques of integrated pest management.

This Bulletin will be of great interest to all those involved in citrus production in a tropical or subtropical climate, where problems of pests and disease are often severe. However, as the author points out, there are also advantages, in that both trees and fruit grow rapidly.

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CITRUS PRODUCTION IN THAILAND

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ABSTRACT

Citrus production in Thailand is found on all types of soil and under a wide range of climatic conditions. Many orchards are located in the central plain, although some are scattered in the tropical rain forest of the southern peninsula, while others are found in the subtropical climate of the north. The three main types of citrus grown in Thailand are tangerine, pummelo and acid lime. The total production of citrus in Thailand in 1994 was 765 thousand metric tons. Most of this was consumed domestically, although a small quantity of pummelo were exported. Greening disease is the major threat to citrus production. A program to provide disease-free planting materials and IPM has been established in Thailand in recent years. The farm labor shortage as a result of Thailand's industrialization is also a major problem.

INTRODUCTION

Citrus growing in Thailand dates back several centuries. Many varieties of *Citrus* and its relatives have been found in the region. The first true commercial citrus orchard was established a few decades ago in Petchabun Province by the famous Kamnan Chun, who is considered to be the pioneer of modern citrus production in Thailand. However, it is Nakhon Chaisi, in the low-lying central plain of just west of Bangkok, which is considered to produce some of the world's best pummelos. At present, citrus growing in Thailand is spreading in every region, and total production is increasing rapidly.

CITRUS PRODUCTION IN THAILAND

Although Thailand is located just above the equator, the upper part of the northern and northeastern regions have a subtropical climate. Two major annual monsoons play an important role in the country's agriculture. The southwest monsoon brings ample rain and moisture from May to October, bringing the

trees sufficient moisture for vegetative growth. This is followed by the dry, cold weather of the north-east monsoon, from late October to March. Minimum temperatures of less than 10°C are frequently experienced in the north, and these give the citrus fruit a good color. The situation is totally different in the southern peninsula. In October-May, the same monsoon brings an abundance of rainfall once it has passed over the Gulf of Thailand. There is no cold weather in this part of the country, so that citrus fruit is yellowish green when it is harvested. Beside these two monsoons, Thailand also experiences tropical storms and typhoons. Massive flooding with devastating effects, especially in the central plain, has occurred several times in recent years. In fact, 10,000 ha of orchard were badly damaged in the Rungsit citrus-growing area in 1990 alone. After a flood citrus prices tend to rise, leading to a further expansion in the area planted in citrus.

The majority of citrus grown in Thailand are tangerines, pummelo and common acid lime (Table 1). These three make up more than 99% of total citrus production. The remainder are mainly sweet orange. Overall

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acreage in 1994 was 88.4 thousand ha, while total production in the same year was 765 thousand mt.

Most of the citrus fruit produced in Thailand is consumed domestically, but a small amount is exported. Pummelo, with its thick rind which makes it easy to transport and handle, is the top citrus export. Around 7-10,000 mt of citrus are shipped from Thailand each year, mainly to Canada and to Asian neighbors such as Malaysia, Singapore, Hong Kong, Taiwan and Laos.

Types of Citrus

According to Hodgson's classification of horticultural varieties (Hodgson 1967), citrus in Thailand can be divided into several groups.

Tangerine (Citrus reticulata Blanco)

Tangerine is the most important type of citrus in Thailand, contributing 40% of the citrus planted area and 76% of total production. The leading cultivar is 'Som Kiew Waan', followed by 'Shogun'. The latter cultivar was discovered about ten years ago. The quality of its fruit is superior to that of 'Som Kiew Waan', and newly established plantations tend to have mainly 'Shogun' trees. The main problem with this cultivar is that the fruit tend to crack.

Pummelo (Citrus maxima Merr.)

Pummelo are considered the world's largest citrus fruit. Thailand has famous pummelo-growing areas lying along the banks of the Tha Chin River, in the central plain just west of Bangkok. These trees have been used as pummelo germplasm resources worldwide, because of the excellent flavor of the fruit. The original cultivars were the necked 'Khao Puang', the flattened or rounded 'Khao Pan', and the pink-fleshed 'Tong Dee'. The newer 'Khao Nampueng' has white flesh but a superior flavor, and is becoming a favorite among fruit growers as well as consumers. In the Chainat area, a cultivar named 'Khao Tang Kwa', which resembles 'Khao Nampueng', is widely grown. Other pummelo cultivars are found in local areas, where they

seem to be native. They include the 'Khao Yai' of Samut Sognkhram, the 'Tha Khoi' of Phichit and the 'Hom Hadyai' of Songkhla Province.

Acid Lime (Citrus aurantifolia Swing)

Petchaburi Province is Thailand's largest production area for acid lime. Almost all the fruit are used in cooking. Only a small percentage is utilized as fresh juice or in canned soft drinks. Two leading cultivars, 'Khai' and 'Paan', are widely grown. Another cultivar with larger fruit, 'E-mun', has recently been developed and is being widely adopted by growers. There are two main problems in acid lime production. The first is citrus canker, a disease which shortens the life of the trees. The second is the difficulty of inducing the trees to bear fruit during the off season (March-April) (Sethpakdee 1991). The price of acid lime during the off season in some years can be as much as 100 times higher than the usual price. Several attempts have been made to produce off-season limes, but these have not been very successful.

Sweet Orange (Citrus sinensis Osbeck)

Two types of sweet orange are found in Thailand, the common orange ('Som Kliang'), and the acidless orange ('Som Tra' or 'Cheng'). Sweet oranges are not popular among Thai consumers, and production is very limited.

Leech Lime or Porcupine Lime (Citrus hystrix DC.)

There are no commercial orchards of these trees, which are widely grown in people's gardens. No production records are available, but the fruits and leaves can be found in markets at any time of the year. Utilization of this citrus, both the leaves and the fruit, is mainly as a spice in cooking.

Miscellaneous

Several other varieties of citrus, either indigenous or exotic, can be found in Thailand.

'Som Chook' or Necked Orange
(?Tangor?)

This citrus is native to southern Thailand. It has a characteristic necked shape, and an excellent flavor. Since this variety is very susceptible to sunburn, production is limited to the south, which has a high relative humidity and rainfall.

'Som Kaew' (Tangerine)

This variety is native to the Samut Songkhram area, and has richly flavored flesh and a deep, bright peel color. Production is limited, because there is a long interval of 14 months before the fruit reaches maturity.

Citron (*Citrus medica* Linn.)

Citron is grown as an ornamental plant in northern Thailand, but has no other commercial value.

Buddha's Hand Citron (*C. medica* var. *sarcodactylis* Swing.)

This citrus variety, with its hand-shaped fruit, is grown as an ornamental. It is also used in traditional Chinese medicine.

Others

Several other local citrus varieties are found, including various types of lemon (*C. limon* Burm. f.), 'Som Jeed' (Kumquat), Tahiti lime and others.

PRODUCTION TECHNIQUES

There are two patterns of citrus production in Thailand.

Raised-bed or Ridge Type

Soils along the banks of the major rivers have the richness of alluvial deposits. However, such areas are flat, with a high water table and poor drainage. A surrounding ridge or dyke is built, in order to control the water level within the raised-bed planting area. The standard bed is 4 m wide, with a canal 2 m wide between the beds. The water level in the canal must be controlled, and is usually

kept at a level 50 cm below the top of the bed, except at the flower induction period. Small boats are used to spray irrigation water and pesticides. Boats are also used to transport harvested fruit and all inputs. Recently, an air blast sprayer has been invented by a citrus grower. Locally made, it is much cheaper than imported sprayers and is being widely adopted.

The branches of tangerine and acid lime tend to droop. Bamboo stakes are needed to prop up branches which are heavily laden with fruit. Pummelo trees require fewer poles, even though their fruit are so big, because their branches are very strong. Either a single row or a crisscross double row of poles are used, usually placed 4 m apart.

Upland Orchards

Conventional citrus orchards are found in upland areas. Most of these are located on slopeland areas in the north, with some on high ground to the east and south. Increasingly, machinery is being used in orchards of this type.

PROBLEMS

Citrus production in tropical regions has both advantages and disadvantages. The main advantage is the fast growth of both vegetation and fruit, as a result of the warm climate and ample supply of water. The disadvantages of a tropical climate are the poor fruit color, and the diseases and insect pests which attack throughout the year. Hence, large quantities of pesticide are generally used. Increased awareness among Thai consumers and scientists of the dangers of heavy pesticide use in citrus orchards led to the decision to develop integrated pest management (IPM) techniques to solve the problem. A socio-economic study of seven Thai fruits — longan, durian, rambutan, tangerine, pummelo, mango and lychee — was carried out in 1990, in order to provide the basic background for researchers (Nayman *et al.* 1990). The major problems it showed in citrus production are listed below.

Greening Disease

This is the most devastating disease for

all types of citrus in Thailand. Infected trees, especially tangerines (both 'Som Kiew Waan' and 'Shogun'), have a reduced life-span as well as lower yields. A disease eradication program aimed at providing growers with healthy disease-free planting materials has been carried out in recent years.

Other Major Diseases

Several diseases commonly found in citrus growing areas include phytophthora root rot, citrus canker and melanose.

Major Insects

There are a number of common insect pests, including thrips, citrus leaf miner, boll worm, psyllids, Oriental fruit fly, fruit moth, scale insect and pummelo rind borer.

Mites

Two kinds of mite common in citrus orchards are the Oriental red mite and the citrus rust mite.

Physiological Disorders

There are several kinds of physiological disorders of citrus, three of which are particularly common.

Granulation

Granulation of citrus fruit, especially of tangerine and pummelo, is frequently experienced by growers. Granulation is found mostly on fruit which are over-mature, when growers try to extend the harvest period in order to get a better price at festivals (e.g. New Year, Chinese New Year, etc.). This granulation problem can become more serious if growers apply high rates of potassium fertilizer.

Malnutrition

Some nutrient deficiency symptoms are found in several citrus growing areas, even though most growers use ample fertilizer. Unbalanced fertilizer applications and an imbalance of nutrients are becoming

widespread. Some fungicides, especially those containing copper, zinc and manganese compounds, tend to increase the plant nutrient content. One case was found recently of tangerines with blue albedo (pith) because of the overuse of copper oxychloride.

Quality Control

Most of the citrus fruit produced in Thailand are of medium quality. Only very few fruit reach the premium grade. There are several constraints to improved fruit quality.

Cultural Practices

Growers are accustomed to maintaining three or four different crops of fruit throughout the year on the same tree. This practice minimizes the risk of low prices if there is only a single crop per year. At the same time, it gives growers a regular income all through the year. However, this practice means that growers are unable to produce high-quality crops, because they can not use appropriate fertilizer regimes for each growing stage.

Climatic Influences

Since Thailand is located in the tropics, diseases and insects readily attack the trees throughout the year, without any respite. If farmers delay spraying by even one day, this may result in the loss of the whole crop. Damage from sun-burn and wind scarring is another threat to fruit quality. Good color development of fruit is limited to the northern part of the country, and then only to the cold season.

FUTURE RESEARCH NEEDS

Since Thailand has become more industrialized, competition for labor between factories and the agricultural sector has become acute. Mechanization is seen as the only way of solving the farm labor shortage. However, more research is needed on how to mechanize tree training and orchard production, including systems of high density planting which can support such mechanization. More information is also needed on quality control, appropriate choice of rootstock, IPM, and irrigation.

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DISCUSSION

Participants discussed the reasons for the relatively low yields of citrus trees in Asia compared to Western countries. It was pointed out that in Thailand, average yields are only 16.5 mt/ha, and in Taiwan 15mt/ha. Some felt that these figures are rather worrying, since they imply that Asian producers may not be very competitive.

A participant from Taiwan pointed out that many farmers in Taiwan are part-time, earning most of their income in local factories or businesses. Part-time farmers spend little time attending to their orchards, and generally have low yields. These drag down the national average yield figures. Full-time farmers, however, can obtain yields as high as 60 mt/ha. Dr. Ravie also pointed out that the figures for Thailand are average figures across the whole nation, including unproductive trees. There is a wide range of educational levels among Thai farmers. Many citrus farmers, especially those with a higher level of education, are doing an excellent job and getting very high yields.

Participants also discussed the problem of greening disease. It was emphasized that supplying farmers with disease-free seedlings is a basic part of any control program. Dr. Ravie agreed that supplying disease-free seedlings is necessary, and described Thailand's recently established program to produce healthy nursery stock. Now that Thailand has some disease-free budwood, some growers are planting disease-free orchards with a longer life span. However, he emphasized the need for sanitation and removal of diseased trees, as well as the need to protect new plants from infection. He pointed out that if a farmer plants healthy seedlings near an orchard with infected trees, the disease is likely to spread to the healthy plants. In the warm humid climate of Southeast Asia, the vector psyllid can reproduce all year round, which means that citrus trees are in constant danger of infection.