A Report
on
Japanese-Thailand Consultation Experts
on Plant Quarantine Measures
for
Thailand-Produced Fresh Fruits and
on the Field Survey on Fruit Production in Thailand

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The Japan International Cooperation Agency

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A Report on Japanese and Thailand Experts Consultations on Plant Quarantine Measures for Thai-Produced Fresh Fruits and on the Field Survey on Fruits Production in Thailand

by

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I. Introduction

The Japanese Government has prohibited the import of certain kinds of fresh fruits grown in Thailand under the provisions of the Plant Quarantine Law. The import ban is imposed to prevent the invasion and spread into Japan of oriental fruit flies (Dacus dorsalis HENDEL) and melon flies (Dacus cucurbitate COQUILLETT), that are prevelant in Thailand.

The Government of Thailand has requested the lifting of the ban on fresh fruits. The request was first made at the fifth meeting of the Joint Japanese-Thailand Trade Committee in January 1973, and was repeated every year until the 8th session in July 1976.

At each session, the Japanese Government explained that the import ban was dictated by technical requirements in Japan's plant quarantine and that it could be lifted only by the establishment of disinfestation techniques in Thailand. Japan also has extended assistance to Thailand by accepting two inspection teams of Thailand plant quarantine experts (Two in 1977 and five in 1978).

However, Thailand remained unable to start experiments for the establishment of required disinfestation techniques, and in January 1979, it asked Japan to send experts to Thailand.

Japan accepted the request and decided to take the following steps.

① To hold consultations with Thai experts and to give them advice and suggestions on technical details of disinfestation experiments as well as on other prerequisites and procedures for the lifting of the import ban.

② To inspect activities of the Thai Government's organizations concerned and survey conditions of fruits production and pest control in Thailand.

This report is a summary of findings by the authors (a plant quarantine expert team) in their consultations with Thai experts and the field survey between May 28 and June 15, 1979.

The authors of the report express deep appreciation to cooperation and assistance extended for their survey by the people concerned at the Japanese Embassy in Thailand, the Bangkok Office of the Japan International Cooperation Agency, the International Cooperation Section of the Department of affairs of Ministry of Agriculture, Forestry and Fisheries, and the Plant Protection Division of Agricultural Production Bureau of the Ministry. The authors also express sincere gratitude to Mr. Takanori Igarashi, Senior Researcher at the Tropical Agriculture Research Center, Dr. Keizo Yasumatsu, Colombo Plan expert, as well as to Mr. Prakob K., Director-General, Mr. Sombhot S., Deputy Director-General, the Department of Agriculture of the Ministry of Agriculture and Cooperative, Mr. Tanonghit W., Director of the Department's Entomology and Zoology Division, Mr. Adul

W., Director of the Department's Agricultural Regulatory Division and the other experts at the Department who accompanied the authors during the trip.

II. Itinerary

Monday, May 28

Departed Tokyo at 10:50 a.m., and arrived in Bangkok at 4:30 p.m. Discussed the survey team's schedule in Thailand with Mr. Igarashi, Secretary at the Japanese Embassy, and Mr. Todoroki of the Japan International Cooperation Agency (JICA). (Stayed in Bangkok)

Tuesday, May 29

Morning: Visited the Japanese Embassy to pay respect to Ambassador Hitomi. Talked about the consultations with Thai experts and contents of the field survey with Mr. Yuge, Councelor, and Mr. Igarashi, Secretary, at the Embassy and Mr. Kitano, Head of the JICA office in Bangkok.

Afternoon:

① Paid courtesy calls on Mr. Wanchai, Deputy Director of DTEC (the Economic Cooperation Department of the Prime Minister's Office), and Mr. Tawal, Chief of the Colombo Plan Division and explained to them about the purposes of the team's visit to Thailand and the itinerary (at DTEC).

② Paid a courtesy call on Mr. Kanwang, Assistant Secretary of the Ministry of Agriculture and Cooperative, and explained to him about the purposes of the team's visit and its itineray (Stayed in Bangkok)

Wednesday, May 30

Morning:

① Paid courtesy calls on Mr. Prakob K., Director-General, and Mr. Sombhot S., Deputy Director-General, of the Department of Agriculture, the Ministry of Agriculture and Cooperative.

② Discussed the team's schedule in Thailand with Mr. Adul W., Director of the Agriculatural Regulatory Division of the Department of Agriculture, and other Thai experts and also exchanged views with them on the plant quarantine systems and organizations of Japan and Thailand (at a conference room of the Agriculture Department in Bangkhen).

Afternoon: Had a briefing on the current situation of fruits production in Thailand (at a conference room of the Horticulature Division of the Agriculture Department in Bangkhen). (Stayed in Bangkok)

Thursday, May 31

Morning:

① Held consultations on the plant quarantine system and organizations in Thailand at the Agricultural Regulatory Division of the Agriculture Department.

② Inspected facilities at the Plant Quarantine Headquarters.

Afternoon: Visited facilities at the Tropical Agriculture Research Center. (Stayed in Bangkok)

Friday, June 1

Morning: Held consultations with Thai experts at the Entomology and Zoology Division of the Department of Agriculture. Topics included procedures for the lifting of the import ban on Thai-produced fruits, details of the required disinfestation experiments to be undertaken by Thailand, etc..

Afternoon:

① Paid a courtesy call on the chief of the Pest Control Division of the Department of Agricultural Extention.

② Inspected facilities of the Entomology and Zoology Division of the Department of Agriculture. (Stayed in Bangkok)

Saturday, June 2

Morning: Travelled from Bangkok to Chacherngsoa (about 150 km), and inspected a mango plantation at Bang Khla.

Afternoon: Inspected the Huey Pong Field Crop Station, and travelled from Chacherngsoa to Chantaburi (about 230 km). (Stayed in Chantaburi)

Sunday, June 3 Inspected the Plew Horticulture Experiments Station and visited durian, mangosteen and rambutan plantations at Chantaburi. (Stayed in Chantaburi)

Monday, June 4 Travelled from Chantaburi to Bangkok (about 380 km) by car. (Stayed in Bangkok)

Tuesday, June 5

Morning: Travelled from Bangkok to Sampran (about 110 km), visited pomelo plantations and vineyards, and then proceeded on the Nakon Phatom (about 15 km) by car.

Afternoon:
① Inspected citrus grove at Nakon Phatom.
② Travelled from Nakon Phatom to Rajaburi (about 40 km), and inspected papaya and banana plantations. (Stayed in Bangkok)

Wednesday, June 6

Morning: Visited the Japanese Embassy to discuss business matters with Mr. Igarashi and Mr. Kitano.

Afternoon:
① Paid a courtesy call on Mr. Rapee S., Vice Minister of the Ministry of Agriculture and Cooperative and explained quarantine problems of Thai-produced fresh fruits to him.
② Paid a courtesy call on Minister Tanaka at the Japanese Embassy. (Stayed in Bangkok)

Thursday, June 7 Visited the Japanese Embassy to discuss business maters with Mr. Igarashi and Mr. Kitano. (Stayed in Bangkok)

Friday, June 8

Morning: Flew from Bangkok to Chiengmai. Travelled from there to Lanpoon (about 24 km) by car to visit longan plantations.

Afternoon: Inspected the Mae-jo Agricultural Expt. Station and visited mango, longan and pomelo plantations in Chiengmai. (Stayed in Chiengmai)

Saturday, June 9

Morning: Travelled from Chiengmai to Fang (about 170 km) by car.

Afternoon: Visited a lichi at the Fang Expt. Station. (Stayed in Chiengmai)

Sunday, June 10

Morning: Flew back to Bangkok from Chiengmai.

Afternoon: Dealt with Sundries. (Stayed in Bangkok)

Monday, June 11 Prepared a report on the survey and checked up its contents. (Stayed in Bangkok)

Tuesday, June 12

Morning: Paid a courtesy call on Mr. Chumphol D., Assistant Secretary at the Commerce Ministry and briefed him on the purpose of the team's visit to Thailand and on some general findings in the survey.

Afternoon:

① Reported to Ambassador Hitomi about the results of the survey and the teams impressions.

② Met Mr. Igarashi to prepare for the final consultations with Thailand. (Stayed in Bangkok)

Wednesday, June 13

Morning:	Examined the contents of a draft report to be submitted from Japan to Thailand at the final consultations.
Afternoon:	Held the final consultations with Thai officials at a conference room of the Department of Agriculture and reported on the team's survey in Thailand. The Thai panel included Mr. Sombpot S., Deputy Director of the Department of Agriculture, Mr. Tanonghit W., Chief of the Entomology and Zoology Division, Mr. Adul W., Chief of the Agriculautral Regulatory Division, and other experts at the department. (Stayed in Bangkok)
Thursday, June 14	Checked up data and prepared to return home. (Stayed in Bangkok)
Friday, June 15	Departed from Bangkok at 7:20 a.m., and arrived in Tokyo at 3:20 p.m.

III. Consultations and Results of the Survey

1. Plant Quarantine in Thailand

The survey team had a briefing on the plant quarantine in Thailand from Mr. Adul W., Director of the Agricultural Regulatory Division, and other experts of the division on May 30 and 31. Specific data was used for the briefing.

(1) The Plant Quarantine System

The plant quarantine system of Thailand was established with the enactment of the Plant Quarantine Act B.E. 2507 (to be abbreviated "P.Q. Act" hereinafter) in the Buddhist Era(B.E.) 2507, or A.D. 1964. The purpose of the law is to prevent the invasion of harmful pests by checking all plants that are imported into Thailand or pass through the country. At present, the plant quarantine stations are operating at 23 locations in major sea and air ports and along the borders. Whenever necessary, similar quarantine stations are set up elsewhere inside the country to prevent the further spreading of pests. Plants and plant products for export are inspected and phytosanitary certificates are issued, if so requested by the importing countries.

Under the P.Q. Act difinition, "plants" mean all kinds of living or dead plants, including their stalks, stumps, branches, folage sprays, new shoots, leaves, roots, bulbs, flowers, fruits, seeds, etc.. "Plant pests" as defined in the act mean any creature or thing harmful to plants, such as insects, animals, plant-harming plants and pathogens. And "carriers" mean packing materials, soil, sand, containers, organic fertilizers and all other possible media capable of transmitting of plant pests.

Import Quarantine:

The import items subject to plant quarantine fall under three categories - the prohibited plants, the restricted plants and the plants for import inspection.

The prohibited plants are so designated by their kinds and countries of origin. Their import, when necessary for research purposes, can be made only by those researchers specified in import Permits which they must get from the Director-General of the Department of Agriculture.

The restricted plants are certain kinds of plants other than the prohibited plants, which, after the import inspection, must be kept by those specialists who were found to be appropriate by quarantine officials.

The plants must be imported via specified ports (sea and air ports). Inspection is conducted also on hand baggages, mails and forms of cargoes as well as things coming into the country through the border checkpoints.

Whenever the plants for inspection are found to be infested with pests, they may be disinfested or fumigated at the expense of their owners Also quarantine officials may put such plants into custody of quarantine stations, or dispose of them, when they find it necessary.

Thailand also has an established system of post-entry quarantine and is carrying out the examination of virus diseases and other diseases, insect pests, weeds, etc.,.

All in all, the plant quarantine system of Thailand is almost similar to that of Japan, except for the fact that all the foreign insects and germs, whether they are useful or harmful, cannot be imported without special permission.

Export Quarantine:

Exporters of plants or plant products are required to submit export applications to the authorities concerned. Inspection of the exports are conducted either at quarantine stations or warehouses, depending on the volume of the exports. When the export items must be given disinfestation treatment at the request of importing countries, plant quarantine stations take care of those in small quantity. But the exports in large quantity are treated by exporters under the guidance of quarantine officials.

Domestic Quarantine:

In the event of occurrence of a hermful pest in Thailand, the Director-General designates the plant and the area for control and bans the transfer of the host plant and all the possible carriers of the pest out of the designated area without permission of quarantine officials.

(2) The Plant Quarantine Organization

The plant quarantine organization of Thailand belongs to the Agricultural Regulatory Division of the Department of Agriculture of the Ministry of Agriculture and Cooperative. Aside from the quarantine business, the Division is engaged in adjustment and regulation for plant production and necessary researches in order to protect and supervise Thai

formers in their efforts for increasing production. Besides the P.Q. Act, the laws relevant to the division's jobs are the Poisonous Article Act, B.E. 2510(1967); the Fertilizer Act, B.E. 2518(1975); the Seed Act, B.E. 2518(1975), etc.,.

The Agricultural Regulatory Division has the following five sub-divisions:

① Plant Quarantine Station Sub-Division

② Post-Entry Plant Quarantine Station Sub-Division

③ Poisonous Article Regulatory Sub-Division

④ Chemical Fertilizer Regulatory Sub-Division

⑤ Seed Regulatory Sub-Division

The Plant Quarantine Station Sub-Division supervises the plant quarantine stations, which are engaged in field quarantine business at 23 places across the country.

The Post-Entry Plant Quarantine Station Sub-Division has four branches in the central office at Bangkhen in Bangkok, which deal with practical business, investigation and researches pertaining to (i) plant pest germs (including nemetode), (ii) insects and animals, (iii) quarantine treatment (chemical treatment), and (iv) plants and weeds, respectively.

These branches keep close cooperation with the Plant Pathology and Microbiology Division and the Entomology and Zoology Division of the Department of Agriculture in carrying out investigation and researches.

The total number of staff engaged in plant quarantine and other related business is 90. Of this number, 10 are experts in the central office and the remaining 80 are the staff for the plant quarantine stations.

The plant quarantine stations, excluding those at the air and sea ports in Bangkok, are operated each by 2 or 3 officials, most of them by 2. This shortage of experts will have to be corrected in the future.

(3) Others

① Thailand keeps a careful watch for the invasion of the following pest germs and insects from abroad:

Mediterranean fruit fly
(Ceratitis capitata WIEDEMANN)

South American fruit fly
(Anastrepha fraterculus WIEDEMANN)

Khapra beetle
(Trogoderma granarium EVERTS)

Sweet potato weevil
(Cylas formicarius FABRICIUS)

Golden nematode
(Heterodera rostochiensis WOLLENWEBER)

Tabacco blue mould
(Peronospora tabacina ADAM)

Coconut Cadang - Cadang disease
(Viroid-like micro-organism)
= Coconut yellow mottle decline

② The facilities belonging to the central organization for plant quarantine include:

The Export-Import Plant Quarantine Office Building,

One Inspection station,

Two fumigation chambers (each having the capacity of 6 cubic meters and capable of evacuating the air. Made by Degesch of West Germany)

One Greenhouse for post-entry quarantine,

One net room,

Entomology and Pathology laboratories.

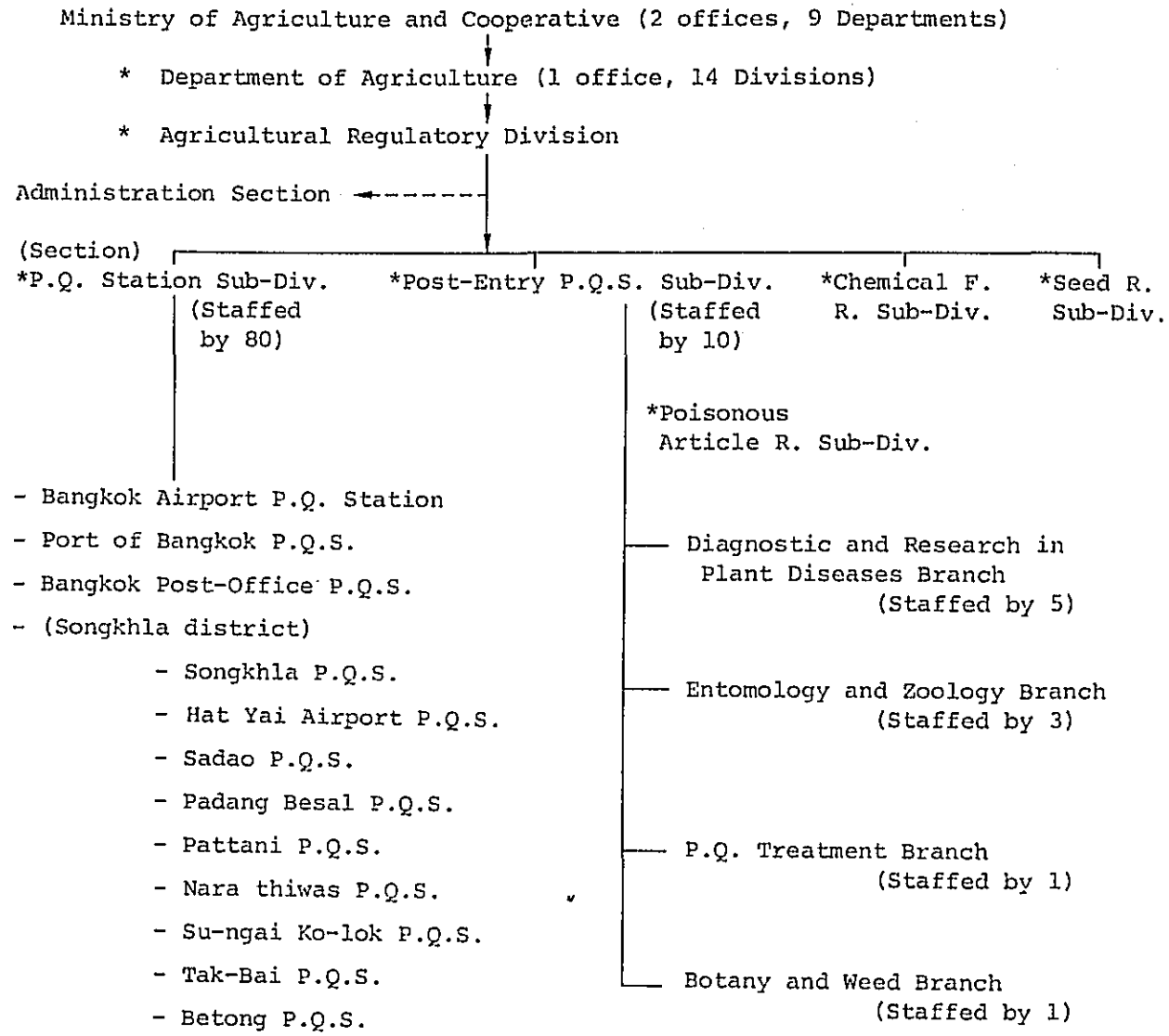


Figure 1 Organization Chart for Plant Quarantine in Thailand

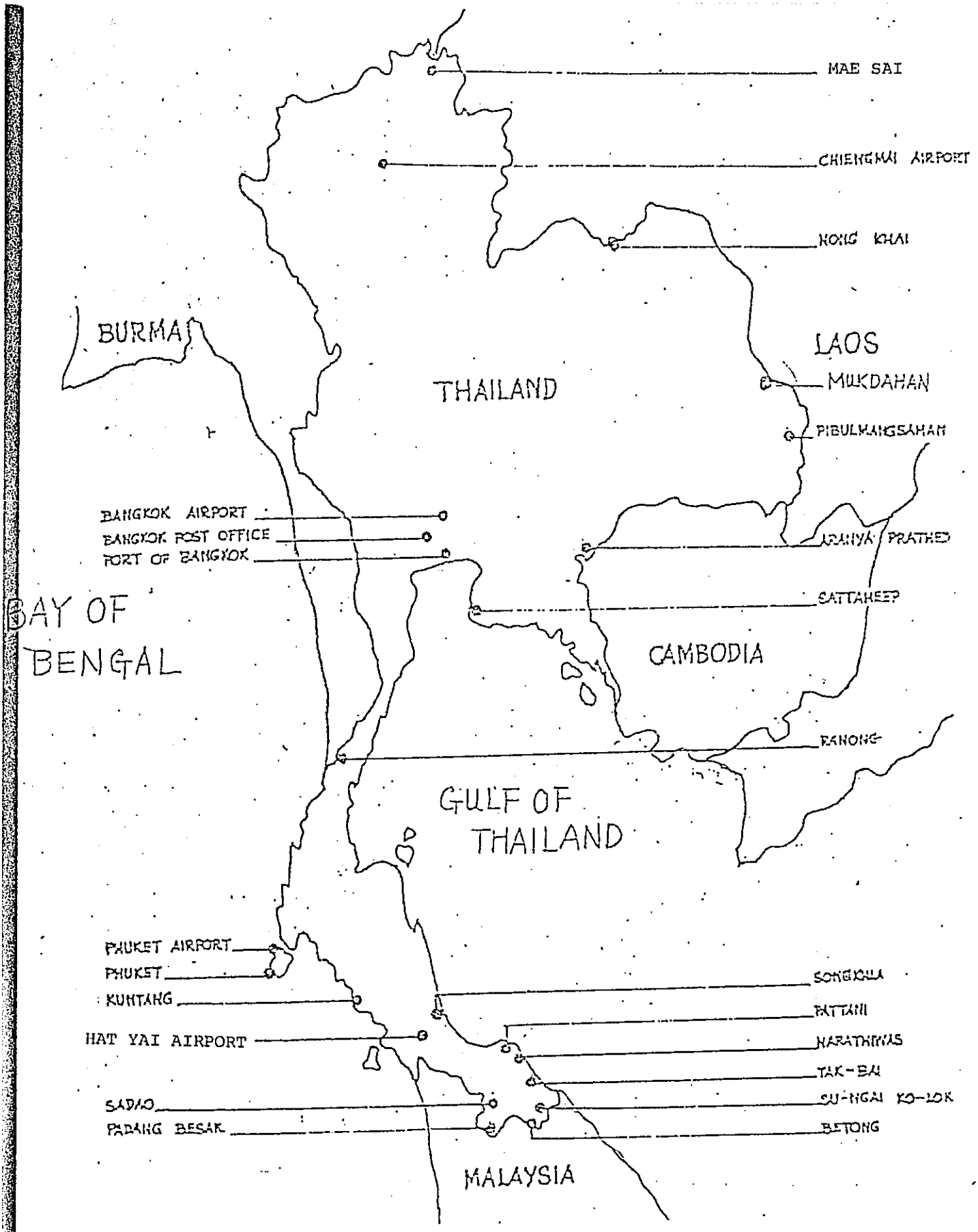


Figure 2 Site of Plant Quarantine Stations

(Copied from the original of the Agricultural Regulatory Division, partially revised)

2. The Import Ban and Procedures for Its Removal

On June 1, the Japanese team met Thai experts at a conference room of the Entomology and Zoology Division of the Department of Agriculture. The Japanese experts explained to their Thai counterparts about Japan's import ban under the Plant Protection Law and the ways to have it removed.

Thailand was represented at the meeting by Mr. Adul W. (Director, Agricultural Regulatory Division, Department of Agriculture), Mr. Montri R. (Assistant Director, Entomology and Zoology Division, Department of Agriculture), and nine other people, all experts of the Entomology and Zoology Division, the Agricultural Regulatory Division or the Horticulture Division. Japan was represented by the three authors of the report, Dr. Kyozo Yasumatsu (Colombo Plan expert), Mr. Takanori Igarashi (Senior Researcher at the Tropical Agriculture Research Center), and Dr. Terunobu Hidaka (Researcher at the Tropical Agriculture Research Center).

The Japanese side made the following explanation, which was fully understood by the Thai experts.

(1) The Import Ban

Japan prohibits the import of host plants for certain pests from the countries of their occurrence under provisions of the Plant Protection Law. The measure is designed to prevent the infiltration of such pests that have never occurred in Japan, and can cause serious damage to agricultural products in the event of their entry into Japan.

It is a purely technical step as those being taken by many other countries of the world from their respective viewpoints.

Table 1 Thai-Produced Fresh Fruits under the Import Ban and Pest Insects

Pest Insects	Banned Items (Host Plants)
Oriental fruit fly	citrus fruits, loquat, plum, peach, pomegranate fig, papaya, longan, lichi, carambola, guava, avocado, rambutan, betel nut, persimmon, santol, bread fruit, mango, jujube, passion fruit, sapodilla plum, malayapple, starapple, Syzygium jambos Alston, sweet-sop, mangosteen, tomato, egg plant, cayenne pepper, etc.,
Melon fly	papaya, mango, melon, water melon, oriental melon, cucumber, squash, tomato, egg plant, green pepper, kidney bean, asparagus bean, etc.,

Note: The import ban is not applied to those fruits that do not host oriental fruit fly and melon fly. Among them are pineapple, coconut, unripe banana, grapes, durian, apple, pear, apricot, cherry and walnut.

(2) Removal of the Import Ban and It's Procedures

The import ban Japan has placed on Thai-produced fresh fruits is a measure taken out of the purely technical necessity for plant quarantine. Its removal, therefore, can be considered, if Thailand fulfilled either of the following two requirements and submitted to Japan scientific data to prove it.

(i) To eradicate oriental fruit flies and melon flies in Thailand and take preventive measures against their recurrence.

(ii) To establish practical techniques capable of killing completely oriental fruit flies and melon flies hosted by candidate fresh fruits (items) for export.

Approach (i) can be taken only in such geographical conditions as in an island country where pest eradication is possible with little possibility of their recurrence.

Since Thailand is not in such geographical conditions, its alternative would be Approach (ii) rather than (i).

If the second approach is taken, the two countries must follow the specific procedures given below:

① Thailand must first develop disinfestation techniques and submit to Japan the data on experiments conducted with the techniques.

② Japanese experts study the data submitted by Thailand. (If the data is found to be technically inadequate, Japan problems involved and requests additional experiments.)

③ If the data is found to be technically adquate, Japanese experts make a field survey in Thailand to confirm the effectiveness of the disinfestation techniques and to learn whether the quarantine system is acceptable or not.

④ Experts of the two countries hold consultations in Japan on specific issues pertaining to the removal of the import ban.

⑤ The Japanese authorities concerned hold a hearing attended by men of learning and experience and other interested people. They are asked

to make comments so that the import ban on certain fresh fruits will be removed under the quarantine standards that could ensure safety identical to the import ban itself. (The standard here mean disinfestation measures and inspection by the exporting country, on-the spot confirmation by Japanese quarantine officials of the measures taken by the exporting country, steps for the preventation of pest recurrence, etc.,.)

⑥ With due consideration to the opinions given at the hearing, steps for the removal of the import ban are taken by revising the relevant laws and establishing specific requirements.

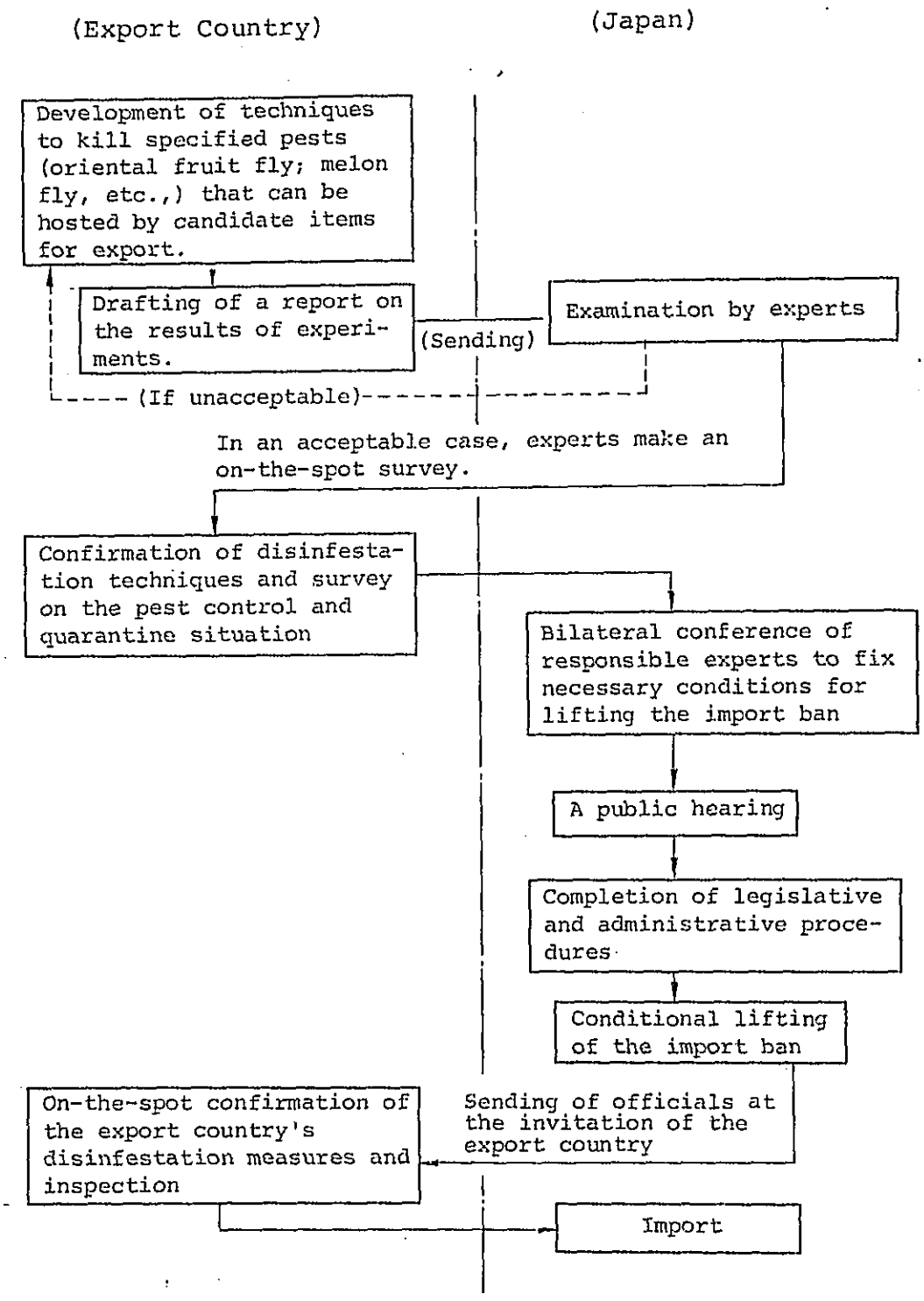


Figure 3 Procedures for Removal of Import Ban

(3) Examples of the Removal

Japan has already removed the import ban for citrus fruits, mango, papaya and other fresh fruits from 6 countries as shown on Table 2. All of them were exempted from the import ban after the establishment of disinfestation techniques by the export countries.

Table 3 is the process that led to the removal of the import ban on Philippine-produced mangoes.

Table 2 Examples of the Lifting of the Import Ban

Country	Fruit	Pest	Disinfestation Method	Year of Lifting
Taiwan	Chinese honey	Oriental fruit fly	EDB fumigation	1969
	Tankan			1975
	Papaya Mango	Oriental fruit fly Melon fly	Hot water treatment + EDB fumigation	1976
South Africa	Orange	Medite-rranean fruit fly	Cold treatment	1970
	Lemon, Grapefruit			1971
Swaziland	Orange, Grapefruit			1973
U.S.A. (Hawaii)	Papaya	Medite-rranean fruit fly Oriental fruit fly Melon fly	1 Vapour heat treatment 2 EDB fumigation	1969
U.S.A.	Sweet Cherry	Codling moth	Methyl bromide fumigation	1978
Israel	Orange, Lemon Grapefruit	Medite-rranean fruit fly	EDB fumigation	1972
The Philippines	Mango	Oriental fruit fly Melon fly	EDB fumigation	1975

Table 3 Process to the Lifting of the Import Ban on Philippine-Produced Mangoes

Year	Development
1958	The Philippin delegate to a FAO regional conference (Tokyo) requested the sending of a Japanese technical advisor with a view to developing necessary techniques for exporting mangoes to Japan.
1960	A Japanese expert on plant pests (Mr. Shizuo Kato of the National Institute of Agricultural Sciences) was sent to the Philippines to give advise for the development of disinfestation techniques. (October to December, 2 months)
1961	Three plant pests experts of the Philippine Ministry of Agriculture visited Japan and received disinfestation training at the Yokohama Plant Quarantine Station. (May to August, about 3 months)
1967	The Philippine Government submitted the data on disinfestation experiments for Mang-hosted oriental fruit fly. Japan replied that the results were not satisfactory.
1971	The Philippine Government submitted the data on the second series of experiments for the oriental fruit fly. Japan replied that the results were not satisfactory.
1972	1 The Philippin Government submitted the data on the third series of experiments for the oriental fruit fly. Japan replied that the results were satisfactory. 2 The Philippine Government submitted the data on the experiments for the melon fly. Japan replied that the results were not satisfactory.
1973	The Philippine Government submitted the data on the second series of experiments for the melon fly. Japan replied that the results were satisfactory.
1974	Two Japanese quarantine experts (from the Yokohama Plant Quarantine Station) were sent to the Philippines for a field survey. They confirmed that the required disinfestation techniques were established, and surveyed the situation of mango production. (July to August, about 1 month.)
1975	January: Japanese and Philippine experts held consultations in Tokyo on specific aspects on the removal of the import ban. June: A public hearing was held. July: The related laws were revised and the revised ones were enforced. (the removal of the import ban)

3. Establishment of disinfestation techniques

On June 1, the Japanese team met Mr. Adul W., Director of the Agricultural Regulatory Division and other experts of the Agriculture Department. The meeting was devoted to explanation and discussions on various experiments regarding the establishment of disinfestation techniques, which are necessary for removing the import ban.

(1) Requirements for Experiments

Test Insects:

Experiments must be conducted with the use of oriental fruit flies and melon flies collected in Thailand. Reproduced flies can also be used.

(Note: Test insects differ depending on what kinds of fruits are picked up for export. But in the case of mango or papaya, the test insects are the oriental fruit fly and the melon fly.)

Test Fruits:

Experiments must be conducted on all kinds and varieties of fruits which Thailand intends to export to Japan.

Method of Experiments:

Basic experiments

① Basic insecticidal experiments must be conducted on eggs and all stages of larvae of the oriental fruit fly and the melon fly. And out of the stages tested samples, one that is stage most resistant to the insecticidal method must be determined.

② The next experiment is to find out a method that can kill 100% of individuals of the most resistant stage. Accuracy is required for checking chemical concentration and treatment time and temperature.

(Note: In the basic experiments ① and ②, the numbers of test insects can be made fewer than those in experiments for practical purposes. And in determining conditions for the annihilation, the chemical dosage for the 100% killing ratio, as well as the dosages of two to three different levels of chemicals with the killing ratio of 80 to 95% must be obtained.)

③ When the fumigation treatment is used for killing the insects, the occupation ratio for the fumigation cell must be fixed at a certain practical value. A normal value is 50%.

(Note: The occupation ratio means a value obtained by dividing the volume of fresh fruits with the volume of the fumigation cell. When the fruits are wrapped, the total volume of wrapped fruits must be used in the calculation. The value is required to be 50% or below. And normally, the maximum value of 50% is used for experiments.)

④ It must be confirmed that the insecticidal method for use will not adversely affect the quality of fresh fruits and their durability in storage. Appearance taste and smell are important factors.

⑤ It must also be confirmed that the insecticidal method will not pose any problem to food sanitation.

(Note: This means that at the time of fruits' import into Japan, the amounts of chemicals used for killing insects or of agricultural chemicals used at places for cultivation will not exceed the permissible levels.)

Experiment for practical purposes

1 For this experiment, individuals of the oriental fruit fly and the melon fly of the most resistant stage must be used. 10,000 such individuals must be tested for each kind of fruit with the method that achieved the 100% killing ratio in the basic experiment. This experiment must be repeated three times so as to confirm that the method can kill more than 30,000 individuals (effective test insects).

(Note: For the test fruits, those hosting test insects at the most resistant stage must be used. The effective test insects mean the number of test insects that was adjusted by the average number of natural deaths in non-treated control.)

2 Treatment temperature, the occupation ratio and other conditions in the experiment must be set as in practical insecticidal treatment.

(2) Questions and Answers

Question 1 : What are the precautions for experiments?

Reply: (i) The insecticidal methods differ from one fruit to another. For example, the fumigation treatment or a combination of hot water treatment and fumigation treatment are used for mango. And for papaya, either the steam-heat treatment or the fumigation method is used. Therefore, full study must be made before picking up a insecticidal method. A change in the method after the start of experiment will cause heavy loss of manpower, time and money.

(ii) Small-sized fumigators are needed to ensure accuracy and efficiency of experiments. Especially recommendable for the aforementioned experiments is a stainless steel fumigation box with the size of 0.5 to 1 cubic meter and having such attachments as an EDB carburetor, a dosing devise, a gas circulation devise, a thermometer, an observation window, an exhaust and cleaning devise and a caster.

(iii) There are a variety of gas analysis methods for the experiments. But the most appropriate method is a combined use of the detection tube, the interferometer-type gas analyser and the gas chromatography. Those who conduct the experiments must have a mastery of measurement techniques to make sure that an exact level of gas concentration is maintained during fumigation with a correct dosage of a chemical.

(iv) In testing two or more species of pest insects as in the cases of the oriental fruit fly and the melon fly in experiments on mango and papaya, Basic Experiment ① must discover which one of the insects, and what stage of it is most resistant. Then the insect of this specific stage is tested in Basic Experiment ②.

Question 2 : What are the ways for mass reproduction of oriental fruit fly and melon fly?

Reply: The insects can be reproduced both on a natural diet such as fruits and vegetables, and an artificial diet. However, the artificial diet is preferable in order to ensure the constant supply of healthy test insects with an identical physical constitution in large numbers and at any time over a long period of time. Also the insects during mass reproduction must be kept in exclusive rearing cages or other facilities so that they are protected from pests and remain healthy. Moreover, these facilities should preferably be isolated and operated by the specialized people only.

Question 3 : What is the best way to proceed with ex-experiments on fresh fruits for export to Japan?

Reply: It is technically difficult to conduct tests on many fruits at one time, since a lot of time and energy are required for an experiment. Therefore, tests should be started with one or two selected kinds of fruits, which are considered most hopeful among candidates for export.

4. Relevant Governmental Organizations in Thailand

Figure 4, 5, and 6 show the organizational framework of the Ministry of Agriculture and Cooperative and its subordinate bodies, which are responsible for technical aspects of the fruit trade issue.

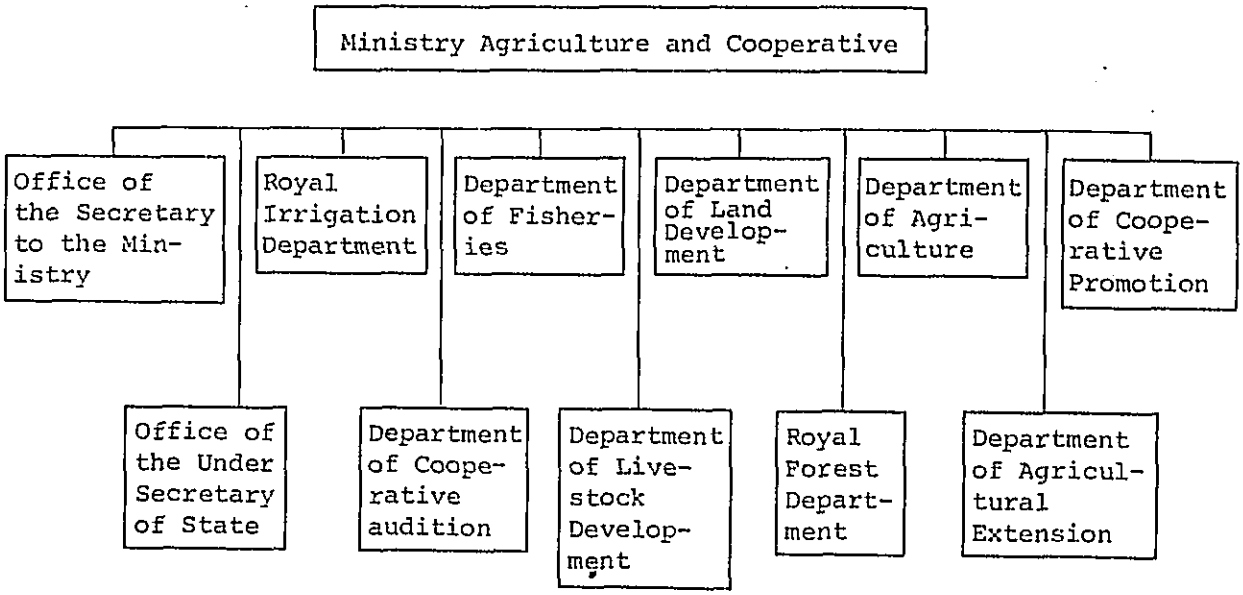


Figure 4 Organizational Chart of the Thai Ministry of Agriculture and Cooperative

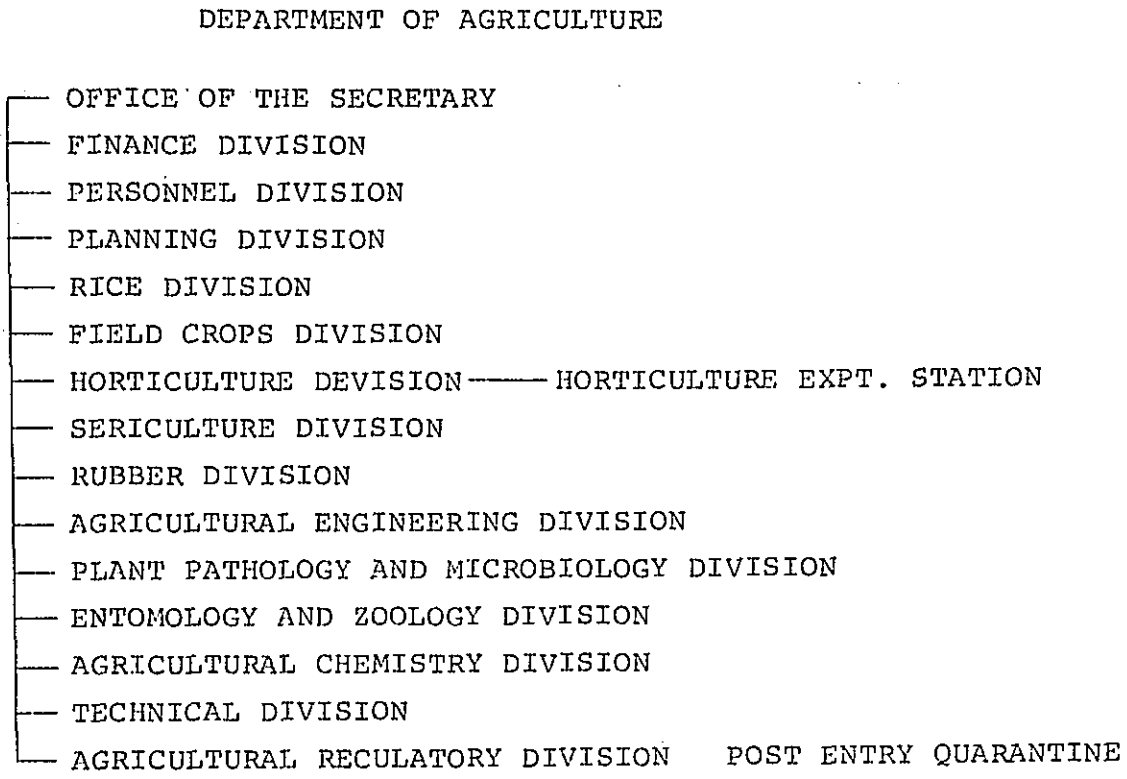


Figure 5 Organizational Chart of the Department of Agriculture

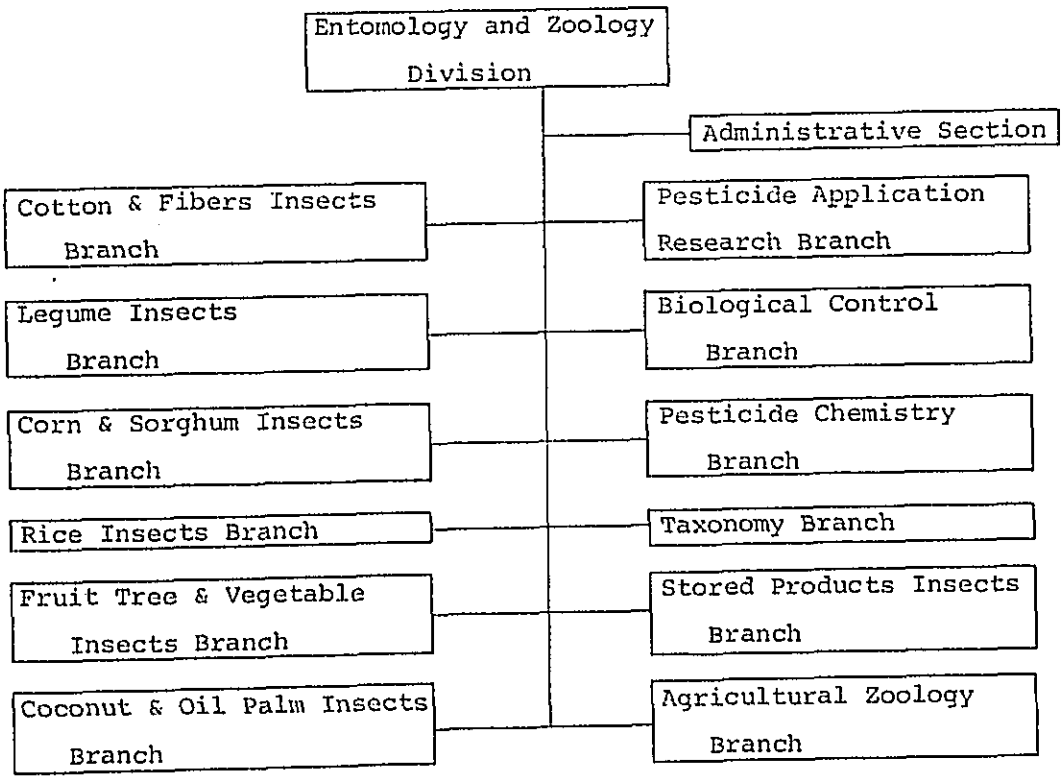


Figure 6 Organizational Chart of Entomology and Zoology Division

Out of these organizations, those directly related to technical aspects for the export of Thai-produced fresh fruits to Japan would be the following organizations (1 to 4).

(1) Organizations Related to Fumigation Experiments

The organizations responsible for fumigation experiments would be the Post-Entry Quarantine Section, The Entomology and Zoology Branch, The Plant Quarantine Treatment Branch of the Agricultural Regulatory Division. (See Fig. 1 and 6)

(2) Organizations Related to Mass Production of Fruit Flies

The Fruit Tree and Vegetable Insects Branch of the Entomology and Zoology Division would be engaged in mass production and rearing of fruit flies and other test insects (See Fig. 6). For mass reproduction, cooperation can be expected from Horticulture Experiment Stations across the country, which are subordinate bodies of the Horticulture Division.

Almost all the relevant organizations as cited in (1) and (2) are concentrated in Bangkhen in Bangkok. The agricultural department of Kasetsart University and the Tropical Agriculture Research Center of Japan are also located in the same area.

(3) Organizations Related to Fruits Production Guidance

The following figure shows the system of production guidance for fruits growing districts and households as explained by Thai officials.

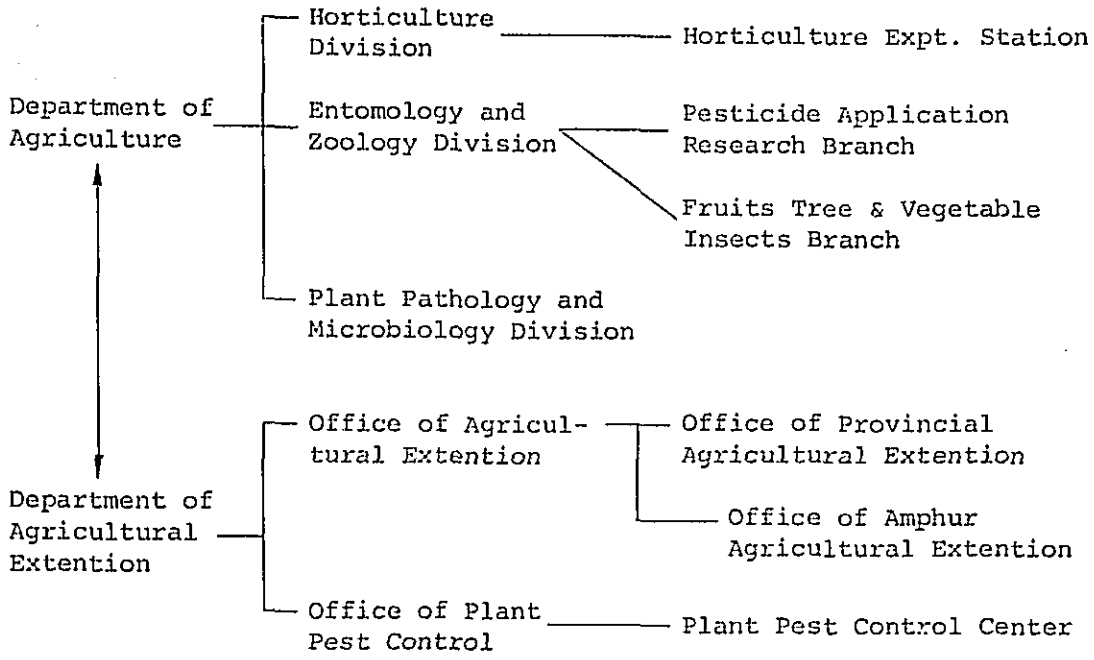


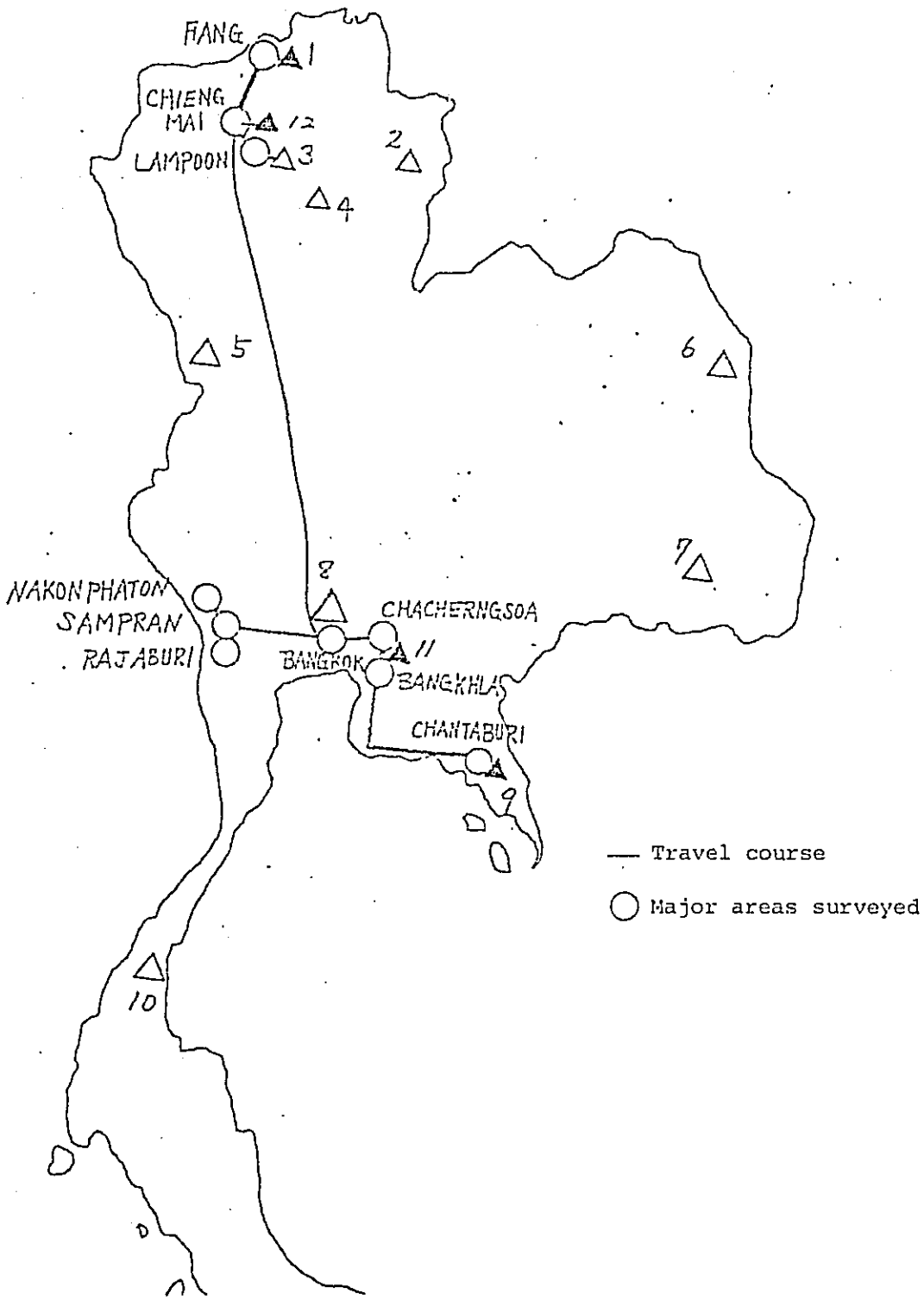
Figure 7 Agricultural Extension System for Fruits-Producing Districts and Households

The system shows that the results of survey and research made by relevant divisions of the Agriculture Department and local experimental stations can be channelled to agricultural cooperatives and individual farmers through the Department of Agricultural Extention and its agents at local extention offices. Demands and requests at producing ends can also be conveyed to the organizations for guidance and research through the reverse route.

The pest control guidance is also being made through a similar route. But the real job of guidance to formers and agricultural cooperatives is undertaken by the specialized plant pest control centers. Details of the pest control will be given later in the report.

(4) Activities of Horticulture Experimental Stations

The survey team inspected activities of horticulture experimental stations which represent the research and guidance side of governmental organizations' work in promoting the export of fruits. However, the areas of activities suveyed during the trip this time were very limited. Figure 8 shows the course of the inspection tour of experimental stations and fruits production centers.



Horticulture experimental stations

1. Fang, 2. Nan, 3. Lampang, 4. Tha Chai, 5. Doimu Sur,
6. Nakhon Phanom, 7. Sri Saket, 8. Bangkhen, 9. Plew, 10. Sawi

Other experimental stations

Note: Δ shows the location of experimental stations.
▲ shows the location of experimental stations surveyed.

Figure 8 Horticulture Experimental Stations in Thailand and the Travel Course

Thailand has a network of horticulture experimental stations. Its central station belonging to the Horticulture Division is located in Bangkok and there are ten major stations and many branch stations across the country. The real job of experiments, however, are executed by the stations other than the central one in Bangkok. Following are some findings by the survey team at a few experimental stations it visited.

o The Plew Horticulture Expt. Station:

The station, located about 380 km away from Bangkok, has such divisions as fruit trees, vegetables, flowers, industrial crop, soil, fertilizers and saplings, except for the general, accounting and personnel divisions. According to Thai officials, the station is conducting wide-ranging researches on cultivation, breeding, plant physiology and plant pests for each of such plants as durian, rambutan, mango, avocado, cashew nut, pomelo, pepper and orchid. However, the officials gave no clearcut explanation on the results of the station's researches.

o The Huey Pong Field Crop Station:

The station, located about 230 km away from Bangkok, has a large collection of mango varieties numbering about 80. Officials explained that the station is conducting various experiments - selection, layering, seeding - with emphasis on the improvement of quality and yield of the fruit. Saplings of selected varieties are said to be distributed to fruit growers. The trees at the station are generally young, many of them ranging from 5 to 20 years old.

It appeared that research activities at the two stations started not so long ago.

5. Fruits Production and Pest Control in Thailand

(1) Major Thai-Produced Fruits, Production Centers and Yields

The survey team was briefed on this topic ty officials of the Horticulture Division. Table 4 and 5 were used for the briefing.

Among fruits having export potential, those being produced in relatively large quantity, are pineapple, mango and papaya with their annual yields respectively reaching 1,315,000, 900,000 and 703,459 tons.

The Thai Government had listed mango, papaya, pineapple, banana, durian, rambutan, grapes, longan, mangosteen, pomelo, citrus fruits, etc., as fruit items it considered having export potential. Out of these, mango, papaya, pineapple, banana, grapes, pomelo and citrus fruits tended to be produced in specialized plantations. On the other hand, production of rambutan and longan tended to be localized in certain areas. And the production scale was small with growers having only several bearing trees each.

Figure 9 is a map of major fruits growing areas in Thailand. It was drawn on the basis of briefing by the Thai officials. Figure 10 is a map showing province-wise ratios of mango-growing households. It was reprinted from Report No. 26 of the Tropical Agriculture Research Center.

Table 4 Major Fresh Fruits Produced by Thailand

Based on 1977 figures

Crop	Planted Acreage (ha)	Production (ton)	Production Center	Harvest Time
Durian	59,280	486,333	Chanthaburi	Late May to early June
Rambutan	68,620	340,000	"	"
Mango	188,320	703,459	Central Thailand and Bangkok	February to April
Grapes	1,500	33,757	Bangkok	All Year
Banana	15,200	54,324	Chenburi and Bangkok	"
Papaya	48,000	900,000	Eastern Thailand and Bangkok	"
Pineapple	42,880	1,315,000	Chon Buri and Torina	"
Longan	34,600	178,432	Chiengmai	July to August
Lichi	9,360	21,739	"	Mid May to late in June
Mangosteen		46,016		
Sanpodilla plum		100,060		
Jackfruit		395,609		
Pomelo		123,685		
Cooking banana		542,239		
Langsat		68,843		
Guava		130,248		
Sugar apple		185,377		
Tangerine		516,516		
Sweet Orange		27,134		
Lime		107,312		

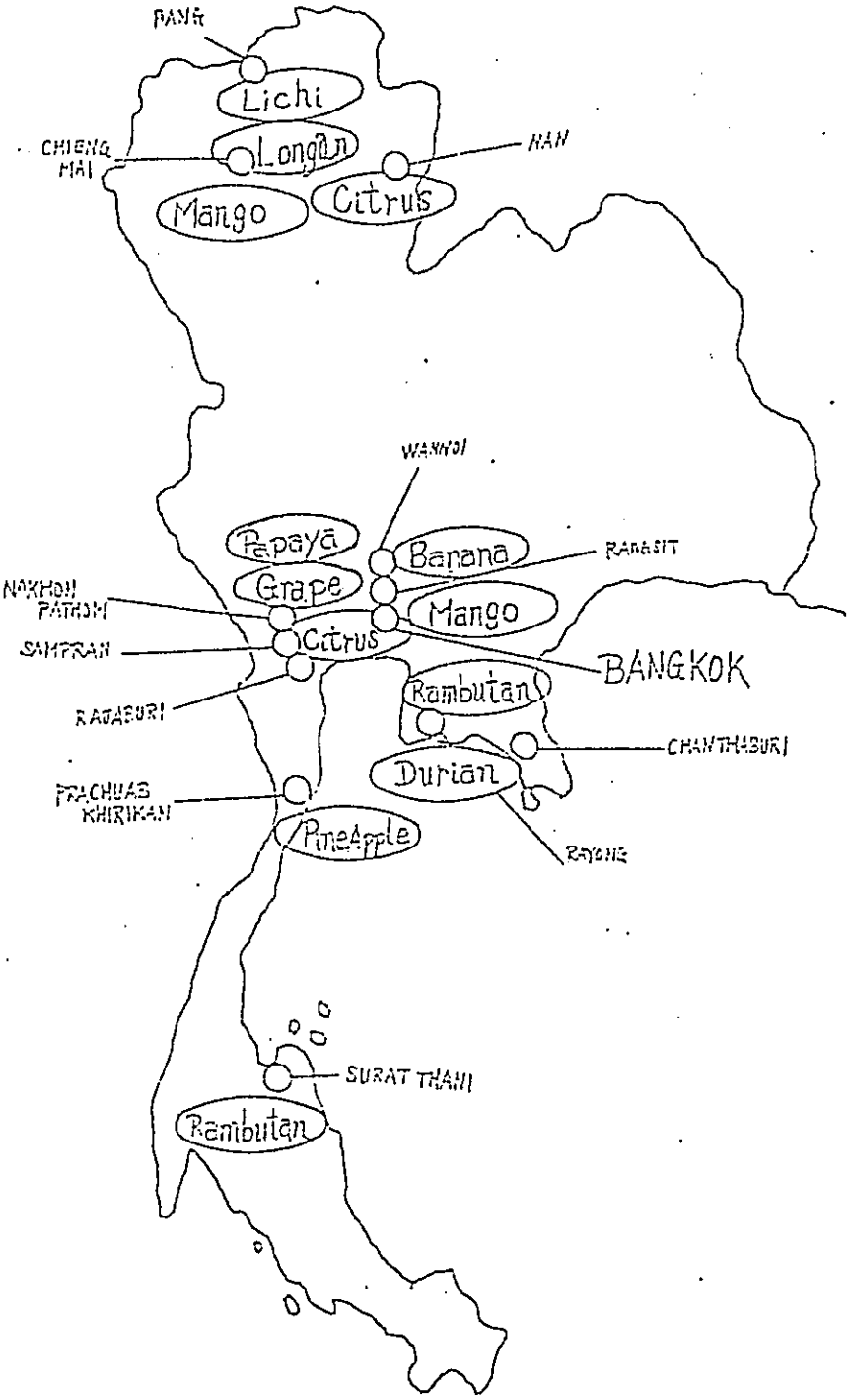


Figure 9 Major Fruits-Producing Areas in Thailand

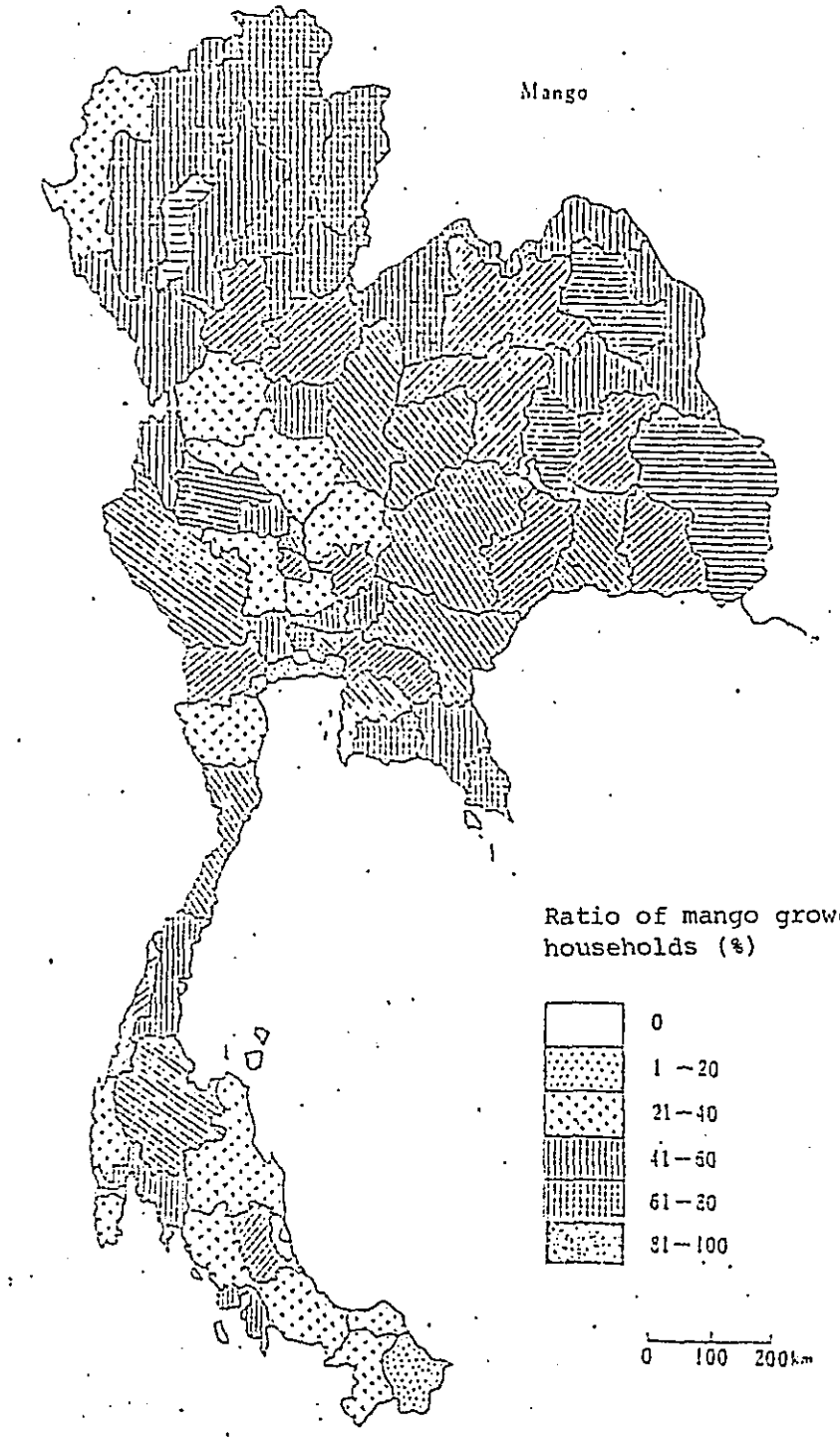


Figure 10 Province-wise Density of Mango-Growers

(Reprinted from Report No.26 of the Tropical Agriculture Research Center)

Among Thai-produced fresh fruits, longan and mango are the items currently exported, as shown on Table 5 by the importing country and the export volume. The export volume of both item, however, is very small, standing at around 2 tons each.

Table 5 Amount of Major Thai-Produced Fruits Exported

Based on figures in 1978

Destination	Longan	Mango
Hongkong	1,049 kg	636 kg
Malaysia	306	430
Singapore	643	1,085
France	0.2	5
Holland	0	9
Total	1,998.2 kg	2,165 kg

(2) Item-wise Situation of Fruits Cultivation

(i) Mango:

The planted area for mango, which extends over about 190,000 hectares, is the largest in those for Thai-produced fruits. The annual volume of production is about 700,000 tons. Major producing areas are Bangkok's outskirts, and the provinces of Chacherngsoa, Payong, Trat, Cheing Mai, Nan, Chianc Rai, Payan, Parae and Loei. However, commercial cultivation for exports would be possible only in Bangkok's outskirts and the neighboring provinces of Chacherngsoa and Payong. Two-thirds of Thai-produced mangoes are of the green variety, the remaining one-third being of the yellow variety. Thai people usually consume the green variety.

(The mangoes are eaten when turned yellowish-green and softened a little. This eating habit is predominant in Southeast Asia.)

① Findings in Farm Survey

A representative mango plantation surveyed by the Japanese team in Bang Khla had a planted area of 1,824 a. The total number of planted trees was 800. Out of these, trees of superior varieties totaled 90, 50 of the green variety and 40 of the yellow variety. The others were of native varieties. Most trees were rather young, the oldest ones being 20 years olds. There were many saplings aged even 4 to 5 years old. Thai Government officials had mentioned their policy of pedigree selection. However, owners of major mango plantations appeared to be adopting their own methods of selective layering for reproduction. A standard mango plantation in the area was said to be much smaller in scale than the surveyed one, with the planted trees numbering 20 to 50 each. It was impossible to learn fruit quality and plant pests at the time of the survey, because the harvest time (February to April) had already been over, and there was no fruits on the trees.

The survey team interviewed people at the farms about pest problems. But the findings were almost the same as in the survey at The Huey Pong Field Crop Station to be mentioned later in the report. With regard to the pest control, the survey team was told that the trees were sprayed about three times each before flowering and after harvest for the control of Mango hoppers. The chemicals for use were Sevin, Ethylthiometon, etc.,. The Chemicals were

recommended as effective also by people at the Plew Horticulture Expt. Station.

The survey team was told that the pest control measures are taken by individual growers on their own judgement, and that no collective pest control has been undertaken. Power sprayers are used by the growers.

Another plantation, this one surveyed at Chieng Mai, has a planted area of 6,400 a. The plantation was still at an initial stage and many of the trees were premature. Their density was rather sparse with about 25 trees planted in every 16 areas. As is the case with ordinary growers in the area, the trees at the plantation were mostly of green and yellow varieties of native kinds, but some of them were of the Hardin and Kite varieties introduced from Taiwan. The pest control at the farm was especially elaborate, since the farm was owned by a former head of an experimental station of the Monopoly Corporation and entomologist. The measures taken by the farm included; ① sanitation of the farmland (removal and burying of fallen and infested fruits), ② wrapping of fruits, ③ spray of chemicals (Thiopan at the budding time and Endsulfan or Dipterex mixed with mango juice for ripe fruits), ④ control of fruit flies with male attractant (methyl eugenal) plus poison.

The production scale of ordinary growers in this area, however, was minimal, each having 1 to 5 trees, and their production space would altogether total about 480 ares.

2 Quality Survey

The on-the-spot, pick-up survey of fruits was impossible since the harvest time in Thailand was between February and April. The following are the Japanese team's comments after inspecting mangoes stored at the Horticulture Division and those sold at markets in various parts of the country.

The mangoes surveyed at the Horticulture Division are of the green and yellow varieties kept for 40 days in cold storage. Those of the yellow variety were almost identical both in shape and color with Philippine-produced mangoes of the Manila Super variety. But the Thai ones seemed to be slightly more curved at their tips than the Philippine ones. In terms of sweetness, flavor and taste, both are almost equal, but an impression after a pick-up survey of several samples was that the Thai mangoes were less fibrous, less hairy and their seeds were smaller.

The survey team also visited the open market and the weekend markets in Bangkok as well as similar markets at Chachoengsno, Rayyong, Klaeng, Chanthaburi and Laem Sing. The ratio of the green and yellow varieties was 3 to 1 at every market, and the sizes of the mangoes of both varieties were small to medium, weighting 200 to 250 grams each. Most of them were of the native variety and were free from Anthracnose. They were generally not so good in quality, being fiburous and having bigger seeds. But their sweetness was excellent.

(ii) Papaya and Banana:

A plantation surveyed at a point about 40 km away from Nakhon Pathon was growing papaya and banana on a rotational basis. The planting density was 200 trees for every 16 a. The life of banana trees was one year and that of papaya trees two years. They were felled down after harvesting. But this kind of diversified cultivation was not seen in ordinary farming households nearby. Thai-produced papayas were 25 to 30 centimeters long, and weighed 1.2 kilograms each. Their pulp was red. They were not different from those of the ordinary variety seen throughout Southeast Asia in shape, weight and sweetness. Bananas produced in Thailand were generally cooking bananas or small bananas. Bananas of improved varieties as imported by Japan were not seen during the survey.

(iii) Pomelo and Other Citrus Fruits:

The main production center of pomelo was Sam Phram, about 110 km away from Bangkok. The fruit was produced mostly by growers having only several trees each. There were few plantations engaged in mass production. The fruit looked like shaddock of Japan, measuring about 12 to 16 centimeters in diameter. Pulp was yellow or pale reddish-purple and tasted sweet but inadequately sour. The average yield was about 80 fruits per a 10-year-old tree.

A large plantation (about 2,560 ares), located about 15 km from Sam Phran, was engaged in the production of a citrus fruit looking like Chinese honey of Japan. It was called Meikento. The fruits measured 6 to 7 centimeters in diameter. Their skin was green and pulp was yellow. It did not taste sour nor very sweet. The harvest period was between July to

October and the yield per one tree ranged from 100 to 150 kilograms. The planting density was 30 to 45 per every 16 ares.

(iv) Grapes:

The production center was Sam Phran, where about 20 farms each with the planted area of around 140 a are located. The grapes produced here are of the White Malaca variety, a table variety that can be harvested twice yearly. Pulp was yellowish green. The planting density was 80 trees for every 16 a and the yield was about 30 kilograms per one tree.

(v) Longan:

A major production center was located about 24 km from Chieng Mai. There were about 100 plantations of this fruit in the district, each having the planted area of 60 to 120 ares. Besides these, almost all growers in the district had 3 to 5 trees each. Pulp of the fruit was semi-transparent and tasted sweet. The planting density was about 20 trees for every 16 ares and the harvest period was July.

(vi) Lichi:

A major production center was located about 170 km north of Chieng Mai. The total planted area in the district was about 8,000 hectares. The planting density was about 60 trees for every 16 ares. The yield was about 50 kilograms per one tree and the harvest time was mid-May.

(3) Pests and Their Control in Thailand

(i) The survey on plant pests was conducted during visits to the Entomology and Zoology Division's Expt. Station, the Plew Horticulture Expt. Station, the Huen Pong Expt. Station and the plantations in various parts of the country.

The survey team god the impression that most plant pests appearing on textbooks on tropical fruit trees would be discovered. However, little was known about real damage done by them. As stated on page , there was an established policy of plant pest control, under which spray and dusting was to be carried out with the advise of the staff at the Pest Control Center on chemicals and times for control. However, the pest control system does not appear to be working well as far as fruit trees are concerned. This is probably because fruit trees in small numbers are scattered at numerous farms and the scale of cultivation is too small to justify chemical a controls. However, almost every specialized fruit grower was found to carry out the pest control for their plantations with chemicals and at times selected by themselves.

In short, major plantations only can use chemicals for the pest control, while individual growers lacked enthusiasm to do so in the seeming absence of the collective control by agricultural co-operatives or pest control centers.

According to Thai officials, the pest control equipments used by many are small-sized power sprayers with carriers or of the knapsack type. For spraying tall trees like mangoes, the nozzle of a machine is attached to the tip of a bamboo-pole, or, in some cases, scaffolds are erected.

No pest control center or specialized farmer keeps the spray calender.

(ii) Pests for Major Fruit Trees and Chemicals for Their Control

The following are a summary of findings by the survey team.

i Mango:

Anthracnose (Colletotrichum gloeosporiodes)

Scab (Elsinoe mangiferae)

Sooty mold (Capnodium mangiferum)

Diplodia (Stem-end rot) (Diplodia natalensis)

Other diseases include;

Pink diseases (Corticium)
Aspergillus Rot
Pestalotia Rot.

Insect pests include;

Mango hoppers (Idioscopus clypealis, Chumroceros nieveosparus, Typhlocyba nigrobineata, etc.,)

Mango twig borer (Niphonoclea albata)
Scale insects
Mealy bugs (Maconellicoccus hirsutus)

Chemicals for these pests are varied, but representative ones include Benomyl, Captan, Zineb, Sevin, Malathion and Endosulfan.

ii Pomelo and other citrus fruits:

Beetle and Caterpillar ingurious to pomelo were treated with Azodrin, Nuvacron, etc.,. For Leafmine and citrus canker hosted by citrus trees, Lannate, Benlate and Zineb are used.

iii Longan:

Serin was used against the occurrence of stink bug (Tessertoma javanica).

iv Grapes:

Captan, Benlate, carbon disulphide, etc., are used against Beetle, Mite and Caterpillar.

v Lichi:

There was no signs of pest control for the fruit although Mite, stemborer stinkbug, caterpillar and other pest insects were found in the trees.

(iii) Quality Control after Harvest

Care must be taken to prevent rotting and the breakout of diseases during transportation and storage of harvested fruits. Anthracnose of mangoes as reported in other countries, requires the most careful watch for Phytophthora, Fusarium and Anthracnose for papaya.

(4) Fruits Production System in Thailand

The survey team learned in a briefing by Thai officials that farming guidance in Thailand was being given by agricultural extention offices and agricultural cooperatives which are the regional ends of the Thai Federation of Cooperatives. However, they said that any such systematic approach was yet to be taken to fruits production. In other words, fruits production in Thailand depends on mass production at plantations opened through private efforts of only a few specialized farmers and on minimal but collective production by farmers in certain production centers. In order to

begin a full-scale export of fresh fruits, production must be made more systematic through planning and farming guidance. And for this purpose, the aforementioned organizational framework should be fully utilized.

6. Requests from Thailand at the Final Consultations

On June 13, Japanese experts held the final consultations with Thai experts to wind up their field survey. The consultations took place at a conference room of the Department of Agriculture.

Thailand was represented by Mr. Sombpot S., Deputy Director, Mr. Tanonghit W., Chief of the Entomology and Zoology Division, Mr. Adul W., Chief of the Agricultural Regulatory Division and other experts of the Department of Agriculture. Japan on the other hand was represented by Mr. Yushita, Counselor, Mr. Igarashi, Secretary, of the Japanese Embassy, Mr. Kitano, Chief of the JICA Bangkok Office, and the three authors of this report. Dr. K. Yasumatsu, Colombo Plan expert, and Dr. T. Hidaka, Chief Researcher of the Tropical Agriculture Research Center, also took part in the consultations as observers.

During the consultations, the Thai side spoke highly of the results of the visit of the Japanese team and asked for continued Japanese cooperation for the fruits export issue, while making the following comments.

① The Thai side fully understood through discussions with Japanese experts what problems must be solved by Thailand for the settlement of plant quarantine issue.

② The Thai side expects various technical difficulties in establishing the required plant quarantine techniques in a short span of time. However, the solution of this question is an urgent necessity for Thailand to expand the export of fresh fruits. Thailand will try its best in that direction with the advice of experts, but also needs Japan's continued cooperation for the acqusition of necessary techniques and equipments.

③ The Thai side intends to start the experiments as soon as possible. And in order to pave the way for the experiments, it will make the following requests to the Japanese Government. A note to this effect will be submitted at an earliest possible date.

(i) To receive two or so Thai technical officials for the training in mass rearing of fruits flies and pesticidal techniques.

(ii) To send Japanese experts on fumigation experiments to Thailand at an appropriate time.

(iii) To grant facilities for mass rearing of fruit flies and fumigation experiments.

IV. Conclusion

Following are the main points for consideration in solving plant quarantine problems standing in the way of Japan's lifting of its import ban on Thai-produced fresh fruits.

(1) The Japanese experts had a full exchange of views with Thai officials at the consultations on the method of experiments, their scale and other concrete aspects in establishing disinfestation techniques that can completely kill oriental fruit fly and melon fly. The organizations concerned in Thailand should henceforth proceed with experiments and submit the data to Japan.

(2) Thailand should take note of the following points in carrying out the experiments:

① The specific kinds (as well as varieties) of fresh fruits for export must first be selected, and experiments must be conducted on them.

② The disinfestation methods adopted by other countries are fumigation or steamheat treatment. Whichever method is adopted by Thailand for establishing its disinfestation techniques, ample safety must be assured for food sanitation.

③ In case the fumigation method is adopted, the fumigation cell possessed by the Thai plant pest control station can be used for practical experiments. But its capacity and attachments are not appropriate for basic experiments.

In order to ensure the efficiency of basic experiments, a fumigation box with a smaller capacity of 0.5 to 1 cubic meter as well as its necessary attachments must be prepared for the exclusive use.

④ In case the steamheat treatment method is adopted, a treatment tank and related facilities will become necessary.

⑤ The exclusive facilities must be set up for rearing the test insects - fruit flies.

⑥ Since the experiments are extremely technical in nature, a special project team should preferrably be formed for this job and experts for exclusive duty should be assigned to it.

⑦ The experts assigned to the job must have a complete mastery of basic techniques for experiments, such as the rearing of fruit flies, inoculation of test insects to fruits and fumigation. In this repect, specific technical training must be given to those directly engaged in the job before the start of experiments.

⑧ Japan needs to consider providing as much cooperation as possible, if requested formally by Thailand to give guidance and advice during experiences.

(3) The Japanese team had the following impressions for the future of fruits production in Thailand during its field survey.

① The production system should be improved through consolidation of farmlands and diversification of production, so that the supply of fruits for exports will become stable and quarantine treatment facilities can be operated efficiently.

② The system for pest control at farmlands should be established/in order to increase production and to improve the quality of produced fruits.

Also ample care should be taken to maintain the quality of harvested fruits and to prevent the occurrence of diseases during their storage.

③ The improvement of production and pest control systems and other efforts should be made to export those fruits free from Japan's import ban.

JICA