

## 6. VIRUS DISEASES OF ECONOMIC CROPS IN THAILAND

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In comparison with other diseases intensive research work on virus affecting various crops in Thailand was started rather recently. From the work carried out so far it becomes evident that some of these diseases cause severe damage to several crops in the Kingdom. One factor which appears to be of importance here is the continuity of vectors present throughout the year, as well as availability of susceptible crops grown during all seasons, which leads to continuous spread of the viruses throughout the year.

I shall describe here some of the viruses infecting crops in Thailand.

### Field Crops

**Cotton:** Cotton leaf roll is one of the serious problems in cotton growing areas of the country. It is not seed and sap transmissible. The symptoms are induced on new leaves which are reduced in size and which show crinkling and curling at the edge. The aphid can acquire the disease within 6 hours and can transmit it to healthy plants within a few minutes. The pathogen can be retained by the aphid even through moulting but not through young ones of the next generation. The aphid transmits the disease best at 20–22°C. Attempts to transmit the disease with other insects including *Bemisia tabaci* Genn. which is found to transmit cotton leaf curl in some countries failed to transmit the disease here.

The causal agent of the disease is still unknown. Electron microscopic examination of infected cotton leaves by various methods did not reveal any particle of a virus.

**Soybean:** Viruses which occur naturally in soybean are soybean mosaic, and soybean yellow mottle virus. These two viruses are mostly similar in methods of transmission but slightly differ in symptom, host-range and size of particle. Soybean mosaic has narrow host range and leaf symptom is accompanied by reduction in the size and puckering of the leaves along with alternate light and dark-green patches, which soybean yellow mottle virus induces initial vein-clearing, vein yellowing, broken yellow flecks or spots, and leaf rugosity in younger leaves, followed by bright chlorotic mottle and stunting. Occasionally, older trifoliates show sort of asteroid mottle with broad, irregular, yellow peripheral zones surrounding central area of normal green. The particles of both viruses are filamentous particles of *circa* 750 nm for soybean mosaic and has an average about 650 nm for soybean yellow mottle virus.

**Peanut:** Peanuts are grown mainly in the Central, Northeastern and Northern areas of Thailand. In 1965, the area planted to peanut was approximately 621,000 rai (100,524 ha).

Peanut blotchy mottle virus is similar to the virus reported from Mauritius, Venezuela and United States. The peanut blotchy mottle disease occurring in Thailand might be a complex consisting of more than one virus. Infected plants sometimes show ringspot symptoms, dark green spots enclosed by a single light green or chlorotic ring.

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This symptom is similar to that produced by the ringspot virus described from South Africa, and the ring mottle from India. Other symptoms occasionally found are small leaves and a stunting of peanut plants. The virus is transmitted by insect vector, *Aphis craccivora* Koch, by grafting and mechanical transmission but only with difficulty. The results of seed transmission are not conclusive as the percentage of seed transmission might be very low. The experiment has to be repeated. An electron microscopic study of phosphotungstic acid stained preparations revealed that the causal organism is a flexuous elongated rod virus with an approximately length of 759 nm. The virus therefore falls in the group of potato virus Y.

**Mungbean:** Mungbean mosaic virus. Seedlings grown from seeds collected from diseased plants, produced typical, though mild, mottling of trifoliolate leaves. Mungbean mosaic virus was easily recovered from such seedlings. Mottling or chlorosis of subsequent leaves may or may not be followed by recovery of the plant. Infected seedlings are stunted and are highly susceptible to other pathogens and root rot damage, and may be killed. Critical estimates of losses have yet to be made but there are indications of over 50% losses in highly infected populations. The virus is easily transmitted by sap inoculation to several cultivars of mungbean, bean and also to *Phaseolus acutifolius* var. *latifolius* and *P. calcaratus*. The virus particles are filamentous, flexuous particles averaging *circa* 750 nm.

**Mulberry:** Only mulberry mosaic virus occurs widely. Infected leaves show typical mosaic symptoms and are frequently distorted. Other leaf symptoms sometimes observed are yellow blotches, vein banding or brilliant yellow mosaic. Severely infected plants are stunted and show depression of shoot growth and leaf size. The virus is graft transmissible. Attempts to transmit the virus by sap and other mechanical methods have been unsuccessful. Insect vector to date is not known. Experiments with insect vector are under way.

**Sugarcane:** Sugarcane mosaic virus is known to be of widespread occurrence. It usually causes longitudinal light-green or pale-yellow stripes. In older leaves the symptoms become faint. The virus is sap and aphid transmissible. Transmission through setts is very common and is considered to be an important mode of its spread. The losses due to this disease are not as heavy as white leaf which is caused by a mycoplasma.

### Vegetable Crops

**Tomato:** Tomato yellow top leaf curl disease is commonly found and is the most serious disease of tomato in Thailand. It is transmitted by grafting as well as by the whitefly *Bemisia tabaci* Genn but not by sap and seed. Affected tomato plants are markedly less developed than healthy ones, their branches and petioles tend to assume an erect position. Leaflets are rolled upwards and inwards, and show a severe interveinal chlorosis. Fruit set is greatly reduced, and tomato plants infected from the earlier stages of their growth do not produce any flowers and fruits. As the disease is not mechanically transmissible, no data are available regarding suitable indicator host, thermal inactivation point, dilution end point and longevity *in vitro*.

**Hot-pepper (Chilli):** Mosaic diseases are most commonly occurring in hot-pepper causing serious losses of yield.

Shoestring is another virus disease of plant. The virus is prevalent throughout the country. The axillary buds produce clusters of small leaves presenting a bushy appearance. Only a few small flowers and fruits develop on infected plants.

**Asparagus bean:** A mosaic disease is commonly found in the crop and it causes severe damage if infection takes place early. It is mechanically transmissible, and is carried in seed produced by infected plants. Its insect vectors in Thailand are *Aphis craccivora* Koch., and *Myzus persicae* Sulz. The virus does not persist in its vectors.

Symptoms observed on plants in the field are a vein-banding mottle of varying intensity, in the shape of irregularly distributed areas of yellow, light green and dark green color, puckering; and downward curling of the leaflets. In many cases mottle is the only symptom observed on the affected plants, but sometimes they exhibit a general chlorosis and dwarfing. The virus has *circa* 750 nm long, flexuous particles.

Phyllody is another disease of asparagus bean. Apparently, it is widely distributed throughout the growing areas. In some fields up to 60% of plants are infected while in others as low as 1 or 2% of the population may show distinct symptoms. Infected plants develop abnormal, bunched leafy structures in axillary positions. Probably depending upon the time of infection, infected plants are stunted and are sterile. The disease has been induced readily by grafting alone. Vector has not been determined yet but from the pattern of distribution of infected plants in the field, most probably a leafhopper type of vector is involved. Electron microscopic examinations have failed to reveal any viruslike particles. Also, the symptoms are characteristic of a mycoplasma infection. Study is being made with ultrathin sectioning and the electron microscopy. Work is also being done with tetracycline treatment of infected plants.

### Fruit Crops

**Citrus:** Earlier, tristeza was unknown to the orchard grower of the country. Fifteen years ago it was believed that only mineral deficiency and root rot organisms were the main causes of the disease. The most susceptible variety of plant is manao or lime (*Citrus aurantifolia*). The virus, a causal agent of the disease is transmitted easily by bud grafting and by certain aphid species. By leaf grafting on manao, symptoms are expressed as vein-clearing on young leaves in 3–4 weeks after grafting. By trial with insect vector *Aphis citricidus* Kirk., symptoms are expressed as vein clearing in about 6 weeks. There are at least two strain of the virus, mild and severe strain that cause the disease. Losses from tristeza have not been great, perhaps because prevalent strains of the causal virus are not virulent (many trees known to have been infected for 5–10 years still show no clear symptoms) and because spread by aphid vectors occurs only during occasional years when insect populations are high.

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### Discussion

**E. W. Kitajima, Brazil (Comment):** We have similar disease to cotton leaf roll, although without importance, in Brazil. It is also aphid-borne, and it is called vein-

mosaic. Morphology is unknown probably spherical but certainly it is not MLO.

**Y. Nagai**, Japan: The peanut blotchy mottle virus disease occurs widely in Japan, but we don't know certainly the economical losses in yield by the mosaic disease in Japan.

I would like to ask you that the virus disease causes any economical losses in your country?

**Answer:** It causes economic losses in some season when the plants are weak and the population of insect vector is high. Critical estimates of the losses have yet to be made.

**H. Kitajima**, Japan: When I visited Thailand, I found that citrus greening, mycoplasma disease, is very severe especially on mandarin. I think it is very important to control this disease for citrus industry in Thailand. Have you a plan to eliminate this malady?

**Answer:** Yes, we plan to eliminate the malady by replacing another crops.

**K. C. Ling**, IRRI: Is there any profuse tillering of white-leaf diseased sugarcane plants?

**Answer:** Yes, some plant has profuse tillering.

**D. A. Benigno**, Philippines: 1. You said soybean mosaic and mottle are different because of size of virus particle. To which group of plant viruses will they belong?

2. What is the vector of mungbean mosaic virus?

**Answer:** 1. The virus particles of these two viruses will be in potato virus Y group.

2. The vector of mungbean mosaic virus is not known, but experiments with insect transmission of the virus is under way.

**M. D. Mishra**, India: Coming to "cotton little leaf" or "cotton stenoses" again, Capoor et al from India has demonstrated presence of MLO. It is different from the cotton little leaf described from Thailand. And how it differs?

**Answer:** Cotton little leaf in your country is caused by a mycoplasma like organism. The causal agent of cotton leaf roll in my country is still unknown. So at present, I, don't know how they are different.