Prevention and Control of Harmful Insects on Tropical and Subtropical Fruits in Vietnam

Nguyen Ngoc KIEM*

Abstract

Pests and diseases, in particular harmful insects have caused heavy losses to the production of tropical and subtropical fruits.

A large number of species of insects affecting tropical and subtropical fruits have been reported in the world. However, in different regions of the tropics and subtropics, the number of insect species and the extent of their destructive effects are different. This paper focused on the most serious insects affecting the major fruits occurring in Vietnam, a country in the Asia-Pacific Region with natural conditions conducive to the production of many tropical and subtropical fruits. Such insects include: banana core borer weevil (*Odoiporus longicollis* Olivier), pineapple root-borer (*Adoretus chinensis* Thunber), pineapple aphid (*Dismicoccus brevipes*), citrus core borers, citrus. leaf weevil (*Hypomeces squamosus* Fabr. and *Platymycterus sirversi*), citrus. sucking moths (*Chelidonium argentatum* (Dalman), *Nadezhdiella Contoni* (Hope) and *Anaplophora chinensis* Forester) (*Othreis fullonia* Clerck and others), Citras oriental fruit fly (*Dacus dorsalis*), citrus. leaf miner (*Phyllocnistis citrella*), *Diaphorina citri*, litchi stink bug (*Tessaratoma papillosa*), litchi erinose mite (*Eriophes litchi*), etc.

Research projects have been carried out to promote the production by applying different measures including chemical control, biological control, etc.

Introduction

Vietnam, a country in the Southeast Asia-Pacific region, with a monsoon-tropical climate and cold winter, produces many tropical and subtropical fruits, including 130 species belonging to 39 botanical families (Tran The Tuc, 1982). However, fruit production in the country has developed slowly due to various reasons, including the destruction by insect pests and diseases.

In this paper some of the most serious harmful insects on the main tropical and subtropical fruits in Vietnam will be presented with some information from other countries.

Harmful insects on banana

Champion (1972) listed about 20 species of banana harmful insects in many countries. In Vietnam, a survey conducted during the period 1967-1968 was enabled to identify 9 species of banana insects.

Among these insects, banana core weevil borers are harmful insects attacking banana in many countries. Many authors such as Champion (1972), Hely et al (1982) and Quilici (1993) have reported on *Cosmopolites sordidus* Germ only, which attacks the banana corms. In Vietnam in addition, there is *Odoiporus longicollis* Olivier (Curculionidae family, Coleoptera Order). This borer weevil attacks the banana stem above the ground only, and rarely penetrates into the corms. Nguyen Duy Trang (1980) showed that *Odoiporus longicollis* Olivier is the main borer weevil and most serious insect on banana in Vietnam. The

Presented at the 1 st International Symposium on "Fruit Production in the Tropics and Subtropics —Symposium of the XXIVth International Horticultural Congress—", Kyoto, Japan, 22-23 August 1994, held by Japan International Research Center for Agricultural Sciences (JIRCAS)

* Vietnam National Vegetable and Fruit Corporation (VEGETEXCO) (2 Trug Tu, Dong da, Hanoi, Vietnam)

adults are brown to shiny black, 16 mm in length (including a proboscis of 4 mm). The larvae are ivory-white, 16.5 mm in length. All the growing stages occur on banana stems. The stems are destroyed mainly by the larvae, and by some adults. All the banana cultivars can be attacked, and Cavendish banana is most severely affected. The bananas planted in hill areas are more severely affected than those in the river delta areas. The grown banana plots are more severely attacked than the sterile plots. The adults often like to invade and destroy the new cutting sections of stems and petioles. Control measures should be based on the laying-egg habit of the adults.

Table 1 Laying-egg positions of banana borer adults

Banana plants (50 plants averaged per kind)	Amount of eggs detected	Rate in parts of plants (%)			
		Corm	Stem base (30 cm)	Middle of stem	Top of stem
Small plant (non-true leaves)	0	0	0.0	0.0	0.0
Small plant with true leaves	14	0	0.0	0.0	100.0
Middle plant	27	0	0.0	0.0	100.0
Mature plant (non-bearing)	155	0	0.0	21.2	78.8
Mature plant with bunch	1,557	0	12.6	14.9	45.4
Old plant (harvested)	515	0	8.3	60.2	31.5

Suitable temperatures for laying eggs range from 15-23°C. Control of this borer: before cultivation of small plants with more than 2 true leaves, the tops of the stems must be cut away to eliminate the eggs inside them. The banana plots should be cleaned and petioles and other plant residues should be removed. By trapping with sticks (20-30 cm) of banana stems cut into two pieces in length and putting them over the ground to attract the adults at night, the insects can be collected. Chemical control with DDT, 666, Wofatox, etc. may kill 70-90% of the adults. However, these insecticides are no longer used nowadays.

In New South Wales, Australia, to control *Cosmopolites sordidus*, beside standard measures, biological control can be applied. Braithwaie (1958) reported that the blue planarian worm, *Geoplana caerulea* Moseley, was commonly sucking out the body juices of the weevil. The predatory hydrophilid beetle, *Dactylosternum hydrophiloides* Macleay was introduced from Malaysia in 1938-39 to Queensland. In France, Quilici (1993) reported that instead of using the main active ingredients (chlordecone, aldicarb) that are banned, some substitute compounds were enabled to effectively control *C. sordidus*, including Bullit (Pyrimiphos-ethyl), Counter (terbuphos) and Aztec (MAT 7484) (Tebupirimphos). The insect-plant interactions have been studied for varietal susceptibility, banana borer weevil's behavior (olfactometry), host plant emission of volatile compounds and pheromonal communications. Biological control through action on receptors was reported for some *B. thuringiensis* toxins (using histoimmunology). In Cuba, favorable results were obtained by using predatorial ants (*Pheidole tetramorium*) (*Roche and Abreu*, 1983, *Castineiras et al.*, 1991).

Harmful insects on pineapple

Py and Tisseau (1973) reported more than 10 various insects on different parts of the pineapple plant, and emphasized that *Dismicoccus brevipes* was closely related to wilt disease on pineapple. In addition the pineapple root borers have been observed in many countries.

1. Pineapple root borers

Various species of borers (Coleoptera) attack pineapple roots. Their grubs feed on the roots and penetrate into the rhizomes of the plants. They make tunnels in the soil from plant to plant. The plants so attacked become yellow-red, stunted and they can be easily pushed over, since almost all their roots are cut and eaten by the grubs. *Phyllophaga portoricensis*, was reported in Guinea, Benty and Caribbean

areas and *Paradiaphorus creanatus* in Brazil (Py and Tisseau, 1973). In New South Wales (Hely *et al.*, 1982) *Rhopaea* spp. was observed.

In Vietnam, symptoms of pineapple root damage have been found since 1970. Heavy damage involving 90 to 100 hectares occurred in Dong Giao (Ninh Binh Province) in 1987. A research project on this problem carried out by the Phu Ho Research Center associated with the Agr. Tech. Department of Vegetexco (1990-92) showed that the grubs of *Adoretus chinensis* Thunber (Scarabicidae : Coleoptera) were the main agent. After the roots are cut and eaten by the grubs, the nematodes in the soil invade the roots through the injury. Then, *Thiellaviopis* sp. fungus invades continuously and causes black rot of the plant rhizomes. About 50-100% of the plants are damaged. The density of the grubs increases with the growth of pineapple plots : the more vigorous the growth the higher the density (Table 2).

Table 2 Density of the grubs on pineapple plots

Pineapple plots	Number of grubs/m²
Non-bearing	0.25
Before first harvest	6.40
Before second harvest	9.01

Control : Adults can be caught (at night) by spraying of Chlorophos 90 WP-0.1% on wild host plants. Lindafor 90 WP (2 kg/ha) can be sprayed or mixed in soil (5-10 cm deep) to kill the grubs after hatching. Pineapple areas with heavy damage should be rescinded and rotated with other crops in 1-2 years. Grubs parasitized (10-25%) by *Bolivia* sp. fungus die rapidly.

2. *Dismicoccus brevipes*

In Vietnam, *D. brevipes* can be found in almost all the pineapple areas. However, wilt disease is limited, because the cultivars planted mainly belong to the group of Queen pineapple, while smooth Cayenne pineapple is the main variety infected with wilt disease (Py and Tisseau, 1973). Control of *D. brevipes* : spray of methyl parathion 50 EC-0.1%, or Bi-58.50 EC-0.2%. The planting materials should be treated before planting with methyl parathion 50 EC-0.4% (dip the base of suckers in the solution for 5 minutes).

Harmful insects on citrus

There are 352 species of insects on *Citrus* listed in the world (Vu Cong Han, 1987). In Vietnam, 67 species of insects on *Citrus* were investigated in 1967-68. The harmful insects have caused serious damage directly to citrus production in Vietnam. The most important insects are :

1. Citrus core borers *(C. C. B.)*

There are 3 species (Cerambycoidae : Coleoptera) as follows (Ho Khac Tin, 1982) :

- Branch borer : *Chelidonium argentatum* (Dalmann).
- Stem borer : *Nadezhdiella cantoni* (Hope).

Table 3 Morphological characteristics of C. C. B.

Kinds of borers	Adults		Larva length (mm)
	Length (mm)	Color	
Branch borer	25-32	Dark grey blue	35-50
Stem borer	36-55	Dark brown	45-60
Base borer	20-40	Black and some 30 white points	45-50

– Base borer: *Anoplophora chinensis* Forester.

Damage is mainly caused by the larvae. They make zigzag tunnels in the wood of branches, stems and bases of trees. After the stems or branches are cut with a saw, the wood sections appear to be full of holes similar to bee-hives. These borers have destroyed many citrus orchards, especially in plantations or concentrated areas of *Citrus*. Control of C.C.B: catching the adults by hand (in May and June); breaking the young branches which have just died to kill the larvae inside them (in June and July); pumping methyl Parathion 50 EC-0.2% or Dimecron 100 SCW-0.1% in new holes on branches (in August and September) to kill the larvae of branch borers before their pupation; painting the trunks and tree bases with Lindafor 90 WP mixed on the clay soil and water at a rate of 1/5/20 to kill the eggs laid in the tree barks (in March and April).

2. Citrus leaf weevils *or* Citrus leaf beetles

There are two species (Pham Van Vuong *et al*., 1993): the bigger one is *Hypomoces squamosus* Fabricius (1.3-1.5 cm × 0.6-0.7 cm) and the smaller one is *Platymycterus sirversi* (0.6-0.7 cm × 0.3-0.4 cm). Damage is mainly caused by the adults which feed on the young leaves, mature leaves and young fruits. Five to seven adults per one young branch, after 7-10 days, can eat all the leaves. The adult appearance is closely related with summer and autumn flushes. Control: catching the adults by hand and rackets, use of chemicals (spraying of Supracide 40 EC-0.15% or Sevin 85 WP-0.15%) when 10-12 adults appear per tree only, do not spray periodically to avoid resistance.

3. Citrus sucking moths *(C. S. M.)*

There are many species of C. S. M. in the Asian countries especially in Southeast Asia. In Vietnam, C. S. M. appeared many years ago. But they have suddenly developed since 1987 in the northern part of the country (1988). Particularly in 1987, in some orange state farms, C. S. M. caused the loss of 750 MT of fruit (12% of production). Investigations (Doan Van Vien *et al*., 1990) carried out in 1988-89 showed the presence of 12 main species of C. S. M. (Noctuidae: Lepidoptera). Among them 3 species often cause serious damage: *Othreis fullonia* Clerck, *Ophiusa coronata* Fabricius, *Artena dotata* Fabr. Damage is caused by the adults with a long proboscis which suck the fruit juice at night, crowding at 20-22 o'clock. The fruits sucked fall within several days. In the day time, the moths rest outside the orchards and in the evening they fly there to suck fruits. The moths also feed on other fruits with a sweet smell (pineapple, guava, banana, jackfruit, etc.). After sucking, the adults copulate and lay eggs. One female moth can lay 233 eggs (*O. coronata*). The eggs are hatched easily at 28-32°C, RH 90-95%. Control of C. S. M.: spraying insecticides on wild host plants near the orchards to kill the moths and their larvae; use of jackfruit cut into pieces hanging outside the orchards. The flavor will attract the moths, using battery light to catch the adults by hand and rackets.

4. Citrus oriental fruit fly *(Dacus dorsalis* Hendel*)*

This fly is mainly distributed in Southeast Asia. It is also one of the major pests on *Citrus* in Vietnam which may cause a loss of 5-10% production. The eggs are laid in the pulp under the rind of ripening citrus fruits. The larvae feed on fruit sections, leading to rot and the fruits fall. One female fly can lay 200-400 eggs. Control of the fly: use of sex-pheromone with bait traps put in methyl-eugenol mixed with 7% Naled to kill the male flies. However in other countries, hydrolyte protein put in bait traps can be used to attract both the male and female flies.

5. Citrus leaf miner *(Phyllocnistis citrella)*

This insect damages leaves only, leading to the impairment of the growth of citrus trees. The adults (moths) in the day time hide in the canopy of trees, by night they fly out and lay eggs on young leaves (2-4 cm in length) mainly under the surface of the leaves. The larvae (0.5cm) mine the leaf epidermis to feed on the leaf flesh and chlorophyll, making zigzag tunnels separately and leaving clear membranes. The infected leaves become deformed and their photosynthetic activity decreases. Control: spraying of insecticides (Decis, Sherpa, Bi 58, Supracide, etc.) when the young leaf is less than 2cm long only, and avoidance of periodial spray.

6. *Diaphorina citri* Kuwayama

This sucking insect is a vector of greening disease which is a serious disease of *Citrus* in the Asia – Pacific region. The control of *D. citri* is one part of the strategy to control greening disease in the region. This disease is the most serious disease on *Citrus* in Vietnam. A research project on *D. citri* (Hoang Lam, 1991) in 1982-85 showed the following.

Table 4 Density of *D. citri* (per branch) and some climatic factors

Items	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.
Adults	0.08	0.3	1.6	2.7	3.0	3.2	3.6	3.7	2.6	1.3	0.5	0.1
Eggs	0.00	0.0	14.5	10.6	1.6	6.8	3.1	18.5	12.7	2.8	0.0	0.0
Larvae	0.00	0.0	8.6	3.7	1.2	4.4	2.5	8.5	3.6	0.1	0.0	0.0
Temperature (°C)	14.90	15.8	19.2	23.5	26.9	28.7	29.1	28.0	26.9	24.3	21.3	15.6
R. H. (%)	88.30	89.6	88.0	88.3	84.0	82.3	82.3	86.3	86.0	87.0	84.6	83.0
Rainfall (mm)	42.60	33.1	33.7	88.9	161.0	224.0	227.0	263.0	523.0	305.0	117.0	35.1

One female adult can lay up to 600 eggs. The adults overwinter with 80% of the females. The use of adults to transmit greening disease showed that after 5.5-8 months, 40-90% of the trees showed the specific symptoms of the disease. Examination by electron microscopy showed that the agents causing greening disease exhibit a round – oval shape (300-500 n.m) and long shape (300 × 500-700 n.m) and black color. Control: spraying of Bi-58 0.2% or Supracide 0.1% for every flush. However, control of *D. citri* is a very important problem which was discussed during the Asia Pacific International Conference on Citriculture (in Thailand, 1990). Biological control with parasites on *D. citri* body is the optimum method of control of *D. citri*. Among them, there are two species: an ectoparasite *Tamarixia radiata* and an endoparasite *Diaphorencyrtus aligarhensis* recorded as primary parasites (Tang Yu Qing, 1990).

Harmful insects on litchi

Seventeen groups of insects and one group of mites were recorded on litchi (Lychee) (Galan Sauco and Menini). In Vietnam, 26 species of insects have been detected on litchi (Vu Manh Hai *et al.*, 1986). The important species are:

1. Litchi stink bug *(Tessaratoma papillosa)*

The bug damages the young growth flushes and developing inflorescences in spring by piercing and sucking the panicle stalks and flower pedicles. They also sting the fruit and suck the juice, resulting in the fall of the fruit. It is a very harmful insect, causing heavy loss of litchi over a large area. Control: catching the adults in the cold months (Jan., Feb.) since during the winter rest period of the bugs they are very weak and do not move; spraying of Chlorophos 50 EC-0.2% before flowering and after fruit set to kill the larvae (1987). Some parasites have been reported on the eggs of the bug in India such as: *Anastatus* sp. and *Microphanurus* sp. which could be used for biological control (Galan Sauco and Menini).

2. Litchi Erinose mite *(Eriophes litchi)*

This is a major litchi pest found in all the litchi production areas (Galan Sauco and Menini). The eggs are laid on the underside of leaves. The mite damages the leaves by piercing the leaf tissues and sucking the cell sap (Menzel, 1991). The symptoms consist of blistering on the leaf surface and a brown velvety cover on the underside. Affected leaves are curled, can not develop normally and drop. The mite can move from leaves to flowers and young fruits, resulting in fruit set impairment and reduction of yield. Control: spraying of Bi-58 0.1-0.2% or sulphur + wettable lime at 0.3–0.4° Baumé, before the flush emerges until it hardens off. Damaged leaves should be removed, gathered and burnt (1987). On the other hand, species of predatory phytoselid mites from China could be used for biological control (Menzel, 1991).

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Discussion

Uritani, I. (Japan): You showed that many harmful insects attack banana and pineapple in Vietnam. Are these insects also distributed in other countries of Southeast Asia ?

Answer: Lizada, M. C. C. (Philippines): In the Philippines, we have to follow a program of pest management on bananas during production which, however, is not of quarantine significance. We can export bananas to Japan without quarantine treatment since fruit flies do not infest green fruits.

Martin-Prevel (France): When I visited Vietnam, I was interested in the use of yellow ants by the farmers to control aphids, scales, mites and other pests of *citrus*. Could you comment on this subject ?

Answer: Ants have been used to control citrus pests in Cuba. In Vietnam, ants have been used mainly by the farmers in the southern part of the country to control some insects in citrus orchards and in watermelon fields.

Nguyen, V. Q. (Australia) : I was told that yellow ants were used to increase the sugar concentration in fruits.

Phan Van Kim (Vietnam) : In the southern part of Vietnam many farmers use yellow ants to control many insect pests on *Citrus*. However, this method is not effective for the control on *D. citrus* and some leaf scales.