

# Integrated control of Citrus pests in Taiwan.

CHIOU-NAN CHEN\*

## INTEGRATED CONTROL OF CITRUS PESTS IN TAIWAN.

CHIOU-NAN CHEN

*Fruits*, Jan.-Feb. 1990, vol. 45, n° 1, p. 33-36.

**ABSTRACT** - This paper briefly describes the current practices and researches in Citrus IPM in Taiwan. Special focus was emphasized on the integrated control of the Citrus greening disease, the oriental fruit fly and some minor pests. A team approach involving administrators, researchers, extension workers and grower's association was taken to deal with the problems. Further improvements were also pinpointed.

## LUTTE INTEGREE CONTRE LES RAVAGEURS DES AGRUMES A TAIWAN.

CHIOU-NAN CHEN.

*Fruits*, Jan.-Feb. 1990, vol. 45, n° 1, p. 33-36

**RESUME** - Le présent document décrit un ensemble de pratiques culturelles qui s'inscrivent dans les actions de recherche engagées sur la lutte intégrée des ravageurs des agrumes à Taiwan. Une attention particulière est apportée aux deux problèmes majeurs posés à l'agrumiculture formosane : 1) la maladie du greening transmise par psylle, et 2) la mouche orientale des fruits. D'autres ravageurs d'importance mineure sont également abordés. La stratégie adoptée fait intervenir une démarche globale, incluant les responsables administratifs, les chercheurs, les vulgarisateurs et les associations professionnelles de planteurs.

*Ce document complète le précédent article de CHIN CHIN CHIEN paru dans FRUITS et traitant de la lutte biologique contre Diaphorina citri à Taiwan. Est abordée ici la stratégie d'ensemble développée dans cette île pour promouvoir un système de lutte intégrée en vergers d'agrumes, les deux objectifs majeurs restant le contrôle du greening et celui de la mouche orientale des fruits.*

B. AUBERT

## INTRODUCTION

Citrus ranks number one among fruit industry in Taiwan. In 1988, the planted area was 48,000 ha, with a total yield amounting to 475,000 tons, among them 3.4% were exported to other countries. The most important varieties are liucheng, ponkans and tankans. Because of labor shortage and high salaries, the cost of labor accounts for 43% of total production cost, (which is about US \$ 9,000/ha currently), pesticides and fertilizers amounting for 19% respectively.

Like every crop, Citrus is attacked by various pests including insects, mites, fungi, bacteria and viruses at different stages up to harvest and in storage. This paper will briefly report the current status of Citrus protection in Taiwan with particular emphasis on our approaches to deal with the Citrus greening, the oriental fruit fly and other minor pests.

## GENERAL PRACTICES OF CITRUS PEST CONTROL

A practical pest control program should be easily adopted by the farmers. Because a crop protection program is usually a package of technical skill, it should be integrated in such a way that the crop protection activity

\* - Department of Phytopathology and Entomology - National Taiwan University.

is compatible with other crop management program. In this regard, a general guideline for Citrus management schedule including pest management is shown in Table 1. It is noted that, the schedule only indicates the proper timing for the chemical control of major target pests. However, it should be modified according to crop variety and pest ecology at different localities. The integrated control measure for some key pests is discussed underneath.

### SOME NATIONAL PROGRAMS FOR THE IMPROVEMENT OF CITRUS PEST CONTROL

There are two limiting factors in the commercial production of Citrus in Taiwan. The first is the Likubin (i.e. the greening disease or Huanlungbin) which has threaten the Citrus industry since 1951. The second is the Oriental fruit fly which attacks various fruits and is listed as one of the targets in international plant quarantine. In order to control these key pests and other minor ones we have established specific national programs.

#### The Likubin Program.

Major emphasis on the integrated control of Likubin includes (1) elimination of the diseased plants from the orchards ; (2) replacement by pathogen-free healthy seedlings ; and (3) strengthening vector control by chemical control in the orchard and innoculative release of the introduced parasitoid, *Tetrastichus radiatus*, in the *Murraya* hedge which serves as a reservoir of the Asiatic Citrus psylla.

In order to provide pathogen-free healthy seedlings, a propagation program has been initiated and granted by the Council of Agriculture and then implemented by the Tai-

wan Provincial Department of Agriculture and Forestry under the Guidance Committee of Taiwan Citrus Industry, consisting of 6 committee members, and according to the following system since 1983.

(1) Pathogen-free foundation stocks are produced by means of improved shoot-tip grafting method in the Plant Virus Laboratory of National Taiwan University by professor H.J. SU. The stocks indexed to be free of pathogens are transferred to the Provincial Citrus Foundation Stock Collection (PCFSC) in screen-houses at Chiayi Agricultural Experiment Station (CAES).

(2) Foundation scions, propagated in PCFSC, are provided for growing potted parent trees for propagating pathogen-free scion woods in screenhouses at CAES.

(3) The pathogen-free scions are used to produce pathogen-free seedlings in 12 nurseries established under screenhouse and operated by 5 branch offices of Taiwan Fruit Marketing Cooperative. The healthy seedlings are then distributed to the Citrus growers. The annual production was about 281,000 seedlings in 1988.

#### The Oriental Fruit Fly Program.

The Oriental fruit fly (*Dacus dorsalis*) is the No. 1 insect pest in fruit production in Taiwan. It attacks almost every economic fruit with an infestation area ca. 145,000 ha, causing a loss of more than 71 million US dollars each year. Because of its great economic importance, a working team has been organized since 1960's in which the Council of Agriculture is the planning and funding agency. For the development of control technology, the research institutions such as the university and the Academia Sinica are responsible for basic research, while the district agricultural improvement stations conduct field trials. Technologies developed are then transferred to commercial sector and adopted by the extension channels through the Taiwan

TABLE 1 - Citrus management schedule in Taiwan.

Month	Crop status (*)			Management and target pests
Jan.				Pruning, sanitation : control of aphids, spiny whitefly, scale insects, mites
Feb.	S			Deep plowing, organic fertilizers
Mar.	S	B		Irrigation, weeding
Apr.		B	F	Leafminers, aphids, root nematode, spiny whitefly
May			F	Thinning, fertilizers (P, K) : black spot, longhorn beetle, spider/rust mites
Jun.	S		F	Aphids, leafminers, psylla
Jul.	S		F	Rust mites, thrips, stink bugs, spider mites, melanose
Aug.			F	Weeding
Sep.	S	H	F	Fruit fly
Oct.	S	H		Collect fallen fruits
Nov.		H		Harvest, preharvest spray : 4 days before harvest
Dec.		H		Sanitation, dipping for storage (green mold rot, stem end rot)

\* S : shooting or flushing    B : blooming    F : fruiting    H : Harvesting

TABLE 2 - Time to set up the trap for the control of *Dacus dorsalis*.

Crop	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Guava	● ■		■	●	■		● ■		■	●		
Carambola	● ■		■	●	■		● ■		■	●		
Mango			● ■		■	●	■		● ■			
Citrus							● ■		■	●	■	
Wax apple					● ■		■	●	■			
Pomelo							● ■					

● Chung-hsiung trap    ■ toxic fiberboard

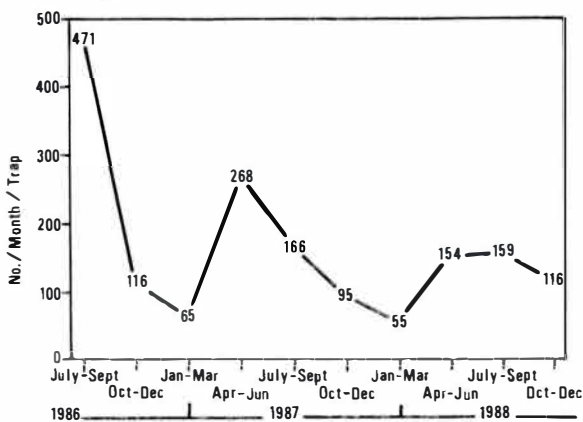


Fig. 1 \* Mean monthly population density of the Oriental fruit fly in Taiwan.

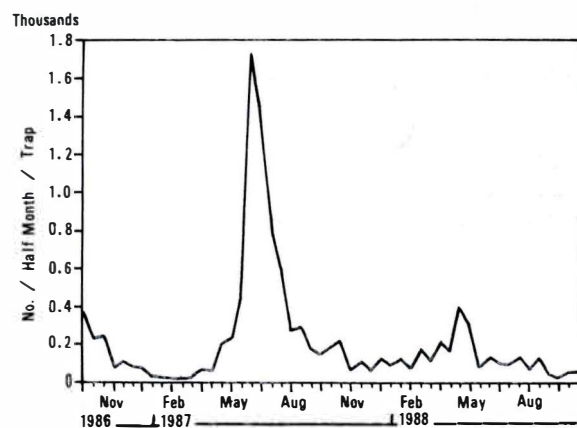


Fig. 2 \* Population fluctuation of the Oriental fruit fly at a hot spot control area in Kaohsiung.

Fruit Marketing Cooperative under the supervision of the Provincial Department of Agriculture and Forestry. The basic research team then evaluates the extension project and comments on the improvement for the whole program.

The current IPM program for the control of this pest includes the integration of the following tactics : (1) mass-trapping of males by a mixture of methyl eugenol and DDVP ; (2) killing both sexes by spraying a mixture of protein hydrolysate and fenthion ; (3) biological control by inoculative release of both larval and pupal parasitoids; and (4) quarantine treatment by either cold treatment and storage for Citrus or vapor heat treatment and cold storage for litchi and mangoes.

An island wide campaign in 69,000 ha orchards against the oriental fruit fly by setting up traps by the growers has been conducted since 1985. Four container traps (Chung-hsiung trap) or 3 fiberboard traps per ha are used, lasting 3 and 2 months respectively. The proper time to set up the trap in different kinds of orchards is shown in Table 2. Furthermore, fiber boards were dropped by helicopter 6 times a year since 1988 at the rate of 1 board per 50 m apart, covering 1,365 Km flight path in 26,000 ha bushes, longan and litchi orchards which harbour the oriental fruit fly.

In order to evaluate the effectiveness of the control project, 3 researchers each at northern, central and southern Taiwan were asked to take charge of the supervision of 78 monitoring spots distributed island wide and analyze the half-monthly and monthly monitoring data. They also conduct orchard survey every 3 months to assess the infestation rate in some major fruits. It is noted that the fly population fluctuated between 100 to 500 flies/month/trap in 1986, 65 to 300 in 1987 and then 55 to 220 in 1988 (fig. 1). In a hot spot at southern part (Kaohsiung), a drastic decline in its magnitude of fluctuation was observed since the incorporation of the aerial dropping of the fiberboards in this campaign in 1988 (Fig. 2). Citrus damage decreased from 120 infested fruits per 10,000 fruits examined in 1985 to 0.7 in 1988 (Table 3).

**Other biological and integrated control projects.**

There are some more on-going projects aimed at improving the Citrus IPM. Among them, (1) screening of selective insecticides ; (2) screening of new pesticides for better control and (3) mass rearing of natural enemies for field release, such as *Chrysopa boninensis* for the control of both scale insects and mites, which are under study. Moreover, a pilot project of Citrus IPM was initiated since

TABLE 3 - Citrus losses caused by *Dacus dorsalis*\*.

Year	No. fruits examined	No. infested fruits	No. infested/10,000 fruits
1984	258,321	29	1.0
1985	62,886	755	120.0
1986	67,680	259	38.3
1987	86,504	78	9.0
1988	98,477	7	0.7

\* - Island-wide release of sterile males from 1975 to 1984 ; trap of males by methyl eugenol since 1985.

1987. In this project, cultural practices, chemical control and biological control are integrated and practiced in an orchard. This will also serve as a demonstration plot for technology transfer to the Citrus growers.

#### CONCLUDING REMARKS

Although Citrus IPM program has been practiced in Taiwan as do in many other countries, many aspects remain to be improved. First of all, farmer's education has to be strengthened. They still rely heavily on chemical control, and are reluctant to remove the severely diseased plants from their orchards. Secondly, domestic quarantine measu-

res such as regulations on the production and distribution of seedlings and propagules, enforcement of the regulatory control to destroy the severely diseased plants in the orchards, etc. have to be effectively implemented. And thirdly, the crop surveillance technology, such as sampling techniques, use of traps and sex pheromones etc. needs to be developed.

#### ACKNOWLEDGEMENTS

*I thank Prof. H.J. SU (NTU) for providing the information concerning the Likubin, and my colleague Mr. H.Y. Chang, for his assistance in figure preparation and manuscript typing.*

---

#### LUCHA INTEGRADA CONTRA LOS DEPREDADORES DE LOS AGRIOS EN TAIWAN.

CHIOU-NAN CHEN.

*Fruits*, Jan.-Feb. 1990, vol. 45, n° 1, p. 33-36

RESUMEN - El presente documento describe un conjunto de prácticas de cultivo que se enmarcan dentro de las acciones de investigación emprendidas sobre la lucha integrada de los depredadores de los agrios en Taiwan.

Se presta una atención particular a los dos problemas mayores que se plantean a la agrumicultura formosana : 1) la enfermedad del Greening transmitida por psylla, y 2) la mosca oriental de los frutos. Se aborda igualmente el estudio de otros depredadores de importancia menor.

La estrategia adoptada hace intervenir un enfoque global que incluye a los responsables administrativos, los investigadores, los divulgadores y las asociaciones profesionales de plantadores.

