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Population management of the fruit-sucking moth Othreis fullonia (Clerck) in New Caledonia.

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Fruit-sucking moths are found everywhere in the world : the genera Calpe and Calyptra in Japan ; Gonodonta in America ; Achaea, Serrodes and Anua in Africa (mainly South Africa) ; and Othreis in the indian-australian Pacific area - particularly in New Caledonia (an island 2000km of the Queensland coast) - in Australia, and also in Africa.

They feed on the juice of fruit like citrus and tomatoes, piercing the skin with their very strong proboscis ; a lot of commensal moths feed through these punctures, and fungi like Oospora and Penicillium often infect the fruit afterwards.

These pests may be absent from a locality for years, then suddenly attack the fruit in ofchards overnight ; these unpredictable invasions are the result of flights from outbreak sites, sometimes very far from the orchards where the damage is inflicted.

In New Caledonia, there are no large industrial citrus orchards ; if small family orchards are excepted, most orange and mandarine trees are interplanted with coffee trees which cover extensive areas in mountain valleys and also in the coastal plains, mainly in the East. Various species of shade trees are used - e.g. Albizzia, Leucaena, and especially Erythrina - which are the host plants of Othreis fullonia ; so three levels of vegetation can be seen : coffee trees, citrus trees, and, above them, shade trees dominant. Other fruit sucked by the moth (tomatoes, melons, custard apples, anona, etc...) are cultivated on a small scale in market gardens. They also occur in kitchen gardens and private orchards.

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Fruit losses caused by Othreis fullonia have been estimated in an orchard of mandarine trees in a low population year (1968) ; they reached about 4 %, that is, less than the losses from fruit bats and birds. In an outbreak year (1969), losses reached 95 %. In 1964, another outbreak year at localities on the east coast, the yields were reduced below the average values, as follows :

	ORANGES		MANDARINES	
	Mean year	1964	Mean year	100 MT
HOUAILOU	420 MT	130 MT	450 MT	100 MT
PONERIHOUEN	40 MT	10 MT	60 MT	8 MT
POINDIMIE	20 MT	5 MT	25 MT	3 MT
HEINGHENE	150 MT	Nothing	100 MT	Nothing
TOUHO	25 MT	Nothing	20 MT	Nothing
Totals	655 MT	145 MT	655 MT	111 MT

These figures represent losses of 70 % to 100 %. In 1969, general losses were even heavier. In the literature, damage on this scale is reported for many kinds of fruit, in Australia, South Africa, Japan, Pacific Islands, India, Ceylon, Central Africa, and Central America. Migrations of moths lead to sudden widespread destruction in orchards ; the affected growers then call loudly for an immediate solution to the problem. But by then it is too late ; outbreaks of caterpillars have been building up for a long time on wild plants, often far from orchards, and often unoticed.

The biological characteristics of the pest are such that little can be done at the time the orchards are infested ; in contrast to most moth species -

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whose larvae are the injurious stage, feeding on the vegetative of reproductive parts of cultivated plants - in Othreis fullonia, it is only the adults which are injurious. In these circumstances, what recommendations have been made ?

After a through investigation in South Africa, MYBURGH (1965) advises learning to live with the fruit-sucking moths, and adjusting estimates of yields and production costs for an outbreak occuring once in every five years.

However, in South Africa, WHITEHEAD and RUST (1967) achieve effective protection of apricot and peach orchards using a method developed in Japan by NOMURA (1961) : complete illumination of orchards with mercury vapour lamps emitting light in the green and yellow wave bands. This light repels the moths, or induces them to remain inactive on the fruit. But such a method needs an electric power source and homogenous industrial orchards, and increases the net cost of crops. Although that solution is valid for developed and industrial countries, it cannot be recommanded on a large scale elsewhere.

Many other methods described in the literature are less efective and more difficult to apply :

- trapping with overripe bananas and water melons exposed in orchards.
- poisonous baits which have to be changed very often.
- hand-picking of the moths after they have been immobilized by strong illumination.
- the smoking of orchards with different fuels so that the smell of fruit is masked and obliterated.
- protection of each fruit with a paper bag or a small basket (if the fruit is of sufficiently high value).
- premature harvesting of fruit before the moths fly in ; but this procedure has disadvantages, for fruit juices especially.

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- systematic collection of sucked fruit, the smell of which attracts the moths to adjacent healthy fruits.
- artificial suppression of the fruits maturing at the times of expected attacks ; this loss is partly compensated by heavier cropping later on.
- finally, planting varieties which bear fruit when moths are uncommon.

Many people agree that a complete economic control of the pests cannot be achieved by such methods.

One can consider light traps, but Othreis fullonia is not attracted by light ; we have pointed out that light even repels Japanese species.

One can also consider a rational use of insecticides. But, in that case, host plants have to be sprayed ; they are often wild plants, sometimes of unknown identity, including forest species like Acacia in South Africa. In New Caledonia, the main host plants for Othreis fullonia are tree species of Erythrina ; they form small forests established by man to shade coffee trees ; they also serve as living posts for enclosures, form hedges in built-up areas, or grow along rivers. Insecticidal treatment of this vegetation would need aerial spraying from a helicopter - a campaign which for economic and also ecological reasons is not feasible. Treatment of fruit would require repeated applications and a persistent chemical acting through contact with the tarsi and proboscis of the moths resting and feeding on the fruit ; furthermore, it is not acceptable to poison the juice of fruits with a systemic insecticide.

In New Caledonia we have studied the life-system of Othreis fullonia in a remote valley in the middle of that island, by following on host plants of the genus Erythrina (Leguminosae) the population fluctuations of this moth during thirty months ; that covers about twenty-two generations of the pest. This work has been described in an other paper during this Congress.

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The findings of that work are briefly as follows. A whole living controlling system of parasites and predators revolved around Othreis : on eggs (hymenopterous, bugs, chrysopids, a fungus), on caterpillars (birds, a wasp, a bug and a tachinid fly). Factors like the food of young larvae just hatched, and group effects on swarming caterpillars which show a dark phase also act vigorously. The most important fact is the moth behaviour in migrating from the mountain valleys to the coastal plain and inversely.

Masses of eggs appear following conditions of physiological stress, being associated with extended drought (disturbing climatic factor) and a very low level of population. Because huge layings of eggs are soon followed in space and time by egg-parasites, and then by heavy attacks of predators on larvae, outbreaks of caterpillars spread out widely among of Erythrina, firstly in pockets which rapidly become confluent, to disappear for want of food because of intraspecific competition ; this happens only in the plain ; moths bred in these plain areas spread out everywhere and especially fly up the valleys and suck all available fruit.

The life - system of Othreis, as studied in these circumstances, is applicable to the whole island New Caledonia. In 1969 hundreds of hectares of Erythrina have been defoliated, following a general drought on the whole.

Pest management now requires selected manipulations so as to reduce the damage on fruit below the economic injury Level.

Among the methods already reviewed, we have kept only one idea suitable to New Caledonian conditions (that is with an economy based on the nickel industry, in which there is a lack of workers and high wages). This idea is the mechanical protection of fruit crops of high profitability and which are concentrated on small surfaces (tomatoes, melons, egg plants, capsicums etc...),

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with nylon nets of mesh one centimeter or less, as used against hail damage in temperate regions. These nets, suitably arranged, prevent the moths from reaching the fruit. But the ultimate aim is to devise ecological procedures for the prevention of damage. The coral trees Erythrina are the main element in the situation. As a shade tree in and near orchards exposed to invasions by the moth, and serving also as the main larval host in current circumstances, Erythrina tends to allow invading females to create lasting infestations in orchards.

An experiment was conducted with a view to protecting orchards by eliminating all Erythrina trees in an isolated district of 1x3km, in a mountain valley where biological control is always working well, but so that the moths which come to feed do not stay there but fly out to lay their eggs on their host plants. About 2000 trees were destroyed in the process. In 1969, a year of severe outbreaks resulting in almost 100 % destruction everywhere, 15 metric tons of mandarines were produced in the experiment area. 42 % of the crop were lost however, as against 4 % in normal seasons.

To be fully successful, the procedure would need to be applied uniformly through the whole range of the industry, which is not possible in New Caledonia. For this reason, the experiment in Erythrina suppression has been transferred to Lifou, an island in the centre of the Loyalty group where coffee plantations shaded by coral trees are not widespread. The aim there, is to gain comparative records of the moth situation before and after eradicating Erythrina.