Research and Control Programmes Against Fruit Flies in Réunion

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Fruits, vol. 49, n°5-6 p. 417-420 (English) p. 493-495 (French) The bioecology of the Natal fly, a fruit crop pest, is now almost fully characterized and supervised pest control techniques have been improved, thus prompting certain development-oriented activities in Réunion, *i.e.* public awareness campaigns and the distribution of control compounds to fruit producers.

introduction

In recent years, the CIRAD-FLHOR entomology laboratory in Réunion has refocused its activities on fruit flies, a group of pests that have a major economic impact. The Natal fly, *Ceratitis (Pterandrus) rosa* Karsch, causes the most fruit crop damage on the island by far; this could be explained by the fact that it is highly polyphagous and widely distributed.

Three types of activity on this topic have been under way since 1991:

- baseline research, aimed at further characterizing the bioecology of this pest,

 applied research, aimed at improving supervised control techniques against fruit flies,

 development activities, aimed at fully informing fruit producers as to the situation and distributing control compounds and equipment.

In 1991, a new Tephritidae species, *Bactrocera (Bactrocera) zonata* Saunders, was identified on the island. A control programme focusing on this pest was immediately set up in conjunction with several other organizations.

baseline research

These studies are specifically focused on defining the underlying mechanisms that guide *C. rosa* females in choosing ovipo-

sition sites and on the reproductive potential of this species.

The importance of some visual stimuli, e.g. host colour and size, in determining female oviposition site choices, was clarified in the initial studies. Artificial wax hemispheric domes (Boller, 1968; PROKOPY & BOLLER, 1971) of given size and colour were presented to females in choice experiments. Wild larval fruit flies of the same origin were collected from infested guavas. The female fruit flies used in most of the tests were naive with no prior contact with an oviposition substrate.

The results showed a significant effect of host size on the extent of ovipositions in C. rosa, i.e. there were more eggs laid in large-sized domes. Colour was also found to influence oviposition site choices; females generally preferred yellow and red, and black to a lesser extent. Of all seven colours tested, the highest numbers of eggs were laid in yellow domes. The results also indicated no significant effect of background colour (white or black) in the females' host colour choices. Moreover, it was found that preconditioning females on a red substrate had little effect on their ultimate substrate colour preferences.

The studies also highlighted an important effect of olfactory stimuli in *C. rosa* oviposition site choices. In these trials, fruit

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extracts were placed under the wax domes out of the fruit flies' reach. In choice experiments with odourless domes and those smelling of peach (pulp) or orange (peel), almost all eggs were laid in the latter domes. It seemed that other factors such as dome colour and size did not limit the high attractivity of the orangeodoured domes, indicating that olfactory stimuli are more important than visual stimuli.

The female fruit flies were also very attracted to other fruits such as rose apples, *Sizygium jambos* (L.) Alston. Bilberries (*Solanum auriculatum* Ait.) were not as attractive, and the odour of guava (*Psidium cattleianum* Sabine) was not at all attractive to females. Otherwise, grape, which is not infested by *C. rosa* in field conditions, induced some response under experimental conditions; damaged grapes were more attractive than sound fruit.

In other tests, females did not respond, at the tested concentrations, to different chemical compounds used separately (acetic acid, limonene, linalool and fluorene). Laboratory studies analysing changes in volatile discharges from citrus fruits (mandarin) during ripening (i.e. fruit odours at different maturity stages) relative to female fruit fly responses are currently under way. They are aimed at fully defining the relationships between *C. rosa* and various host plants.

Studies have also been carried out on other biological and behavioural aspects of *C. rosa.* The effects of temperature on the reproductive potential of the species has thus been investigated. For pre-adult stages, the thermal constant and zeropoint of egg and pupa development have been determined, i.e. 32.8 degree-days-11.1°C and 141.5 degree-days-12.6°C, respectively. Other studies revealed that female fecundity was maximal at 20°C.

Natal fly behaviour under semi-natural conditions (large cage) was also studied. Some preliminary data were thus obtained on the fly's activities and positions on the plant during the day. Studies on the sexual behaviour of the pest, especially the pheromonal marking of males, revealed similarities with the known behaviour of *C. capitata.* However, in *C. rosa*, phe-

romonal marking generally begins late in the afternoon, around 1700 hours. The lek phenomenon that has already been reported in various Tephrididae species, was observed for the first time in *C. rosa*.

An ecological study on Tephritidae host plants in Réunion, aimed at updating data obtained about 20 years ago by ETIENNE (1982), has also been under way for 2 years. Samples are being collected from a wide range of fruit hosts at many locations and at different times of the year. This survey revealed new host-plants and dominant fruit fly species on the whole range of host plants.

In addition, there has been an IOBC¹ task force study on the responses of local *Ceratitis (Ceratitis) capitata* Wiedemann strains to pheromone marking (BOLLER *et al.*, 1994).

Biological control studies were first focused on optimizing methods for mass rearing local Tephritidae strains. In preparation for acclimatization experiments, bioethological studies have been conducted with an ovo-pupal parasitoid, *Biosteres arisanus* Sonan (Hym.: Braconidae), that was imported from Hawaii in early 1993 (generously donated by Dr. E. Harris, USDA²).

applied and developmentoriented research

Various tests have been carried out in recent years to improve supervised control techniques. The first were focused on perfecting sexual trapping techniques to monitor fruit fly populations. The efficacies of various types of traps, slow-release sexual attractant dispensers, and different sizes of dichlorvos insecticide strips (DDVP) were thus compared.

The results of several orchard tests carried out since 1991 have confirmed the efficiency of the spot treatment technique (protein + malathion hydrolysate) against local fruit fly species present in *Citrus* and mango orchards. To assess the limitations of this method, experiments were undertaken with other more susceptible fruit species (loquat, strawberry guava

 IOBC: International Organization for Biological Control of Noxious Animals and Plants.

(2) USDA: United States Department of Agriculture. and peach); the results so far are not very convincing. Moreover, several orchard tests were carried out to determine optimal hydrolysate and insecticide concentrations. Mortality rates at different compound concentrations were estimated by hanging sticky trays in the foliage of treated trees.

A parallel programme was launched in 1991 to extend the use of supervised fruit fly control to all potentially applicable situations. The advantages of this type of pest control over the techniques currently used by fruit producers are: fewer treatments (with the use of sexual trapping), lower control costs (reduced insecticide volumes, quantities and labour), thus reducing harmful effects on non-target fauna.

A widespread public awareness campaign (leaflets, posters, radio and TV ads and videos), conducted in collaboration with the chamber of commerce of Réunion, was able to reach many farmers and much of the general public. Essential equipment and products (traps, attractants, etc.), which were partly funded by local governmental agencies (i.e. regional and county councils), were distributed in conjunction with many agricultural cooperatives. In 1992, sexual trapping was used to control about 450 ha of susceptible crops, and fruit flies were controlled on about 115 ha with spot treatments.

A fruit fly pest watch network, involving sexual trapping with methyleugenol, was set up in Réunion by the mid-1990s. It aims at early detection of infiltrations by Bactrocera (Bactrocera) zonata Sanders, an Indian species that has been infesting fruit crops in neighbouring Mauritius over the past few years. A few flies of this species were actually detected near the airport in February 1991. A control program was immediately set up jointly with various collaborating organizations (Service de la protection des végétaux, Fédération des groupements de défense contre les ennemis des cultures, Chambre d'agriculture de l'île de la Réunion) to try to eradicate this new pest. The sexual trapping network was substantially reinforced in the zone and extended over the whole island. Simultaneously, an intensive campaign involving chemical control and destruction of susceptible host fruits was carried out around the outbreak area. Network captures decreased progressively during the second half of 1991 and were nil' by February 1992. Only three flies were trapped in 1993 and no new upsurges were noted. At the end of 1993, the species was considered to have been completely eradicated from Réunion. Nevertheless, the fruit fly watch network must be kept up to enable very quick interventions if any more of these pests are detected.

conclusion

Studies carried out over the last few years in Réunion by the CIRAD-FLHOR entomology laboratory have aimed at fully characterizing the bioecology of Tephritidae fruit crop pests on the island, particularly the Natal fly. Insect-plant relationships, pest behaviour and their natural enemies are priorities for future research.

Supervised control techniques are currently being extended in Réunion. They will eventually be combined with biological control, which could be very useful for treatment of areas with communities of wild host plants, and with biotechnical control, which will require further experiments.

acknowledgements

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