



Principal methods for integrated control of fruit flies in West Africa

LEAFLET 6



Background

Mango production in West Africa has suffered from fruit fly infestation for decades. The arrival and spread of *Bactrocera invadens* throughout West Africa has considerably worsened the damage to marketable fruit crops, including mangoes (Photo 1). Until now, no single control method for these pests has been able to guarantee sustainable control of fruit flies. It is therefore crucial to introduce a combination of effective and efficient methods, which must be mutually compatible and economically viable if they are to be adopted by planters.

Main objective

Provide everyone involved in fruit production at all levels with information about the main pest control methods for use against the fruit flies.

Notes:

1. The followings are the main control methods (referred to as an IPM package) which should reduce the fly population below the Economic Injury Level (see Information Leaflet No. 7).
2. For a control method to be effective, it should be planned with the whole production basin in mind.
3. Only the most appropriate control methods should be used at any time.



Photo 1: External damage on cv Eldon



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A – SANITARY METHOD

• Principle (see Leaflet No. 10)

- The sanitary method aims to destroy fruit fly populations at the pre-imaginal stages either in punctured fruit and /or fallen fruit.
- The eggs and larvae inside the fruit are destroyed through solar heating at high temperature.

• Materials required

- Black plastic bags (garbage bags), in perfect condition (no holes).
- Labour for collecting the fruit three times a week.

• Methods

- Damaged and fallen fruits are collected three times a week (Photo 2a).
- The collected fruits are put in plastic bags and sealed (Photo 2b).
- The black plastic bags are left in the sun for at least 48 hours to destroy all eggs and larvae developing inside the fruits.
- The degraded fruits can be used as animal feed or as compost.

• Advantages and disadvantages

- This sanitary method reduces the fruit fly population and increases the effectiveness of Success Appat (GF-120) treatment when there is a large fruit fly population.
- Gathering of infested fruits is both necessary and effective for the control of Tephritidae in all fruit plantations (mangoes, citrus).
- High labour requirement.



Photo 2 a: Collect of fallen fruits



Photo 2 b: Fruit sealed in black plastic bags and left in the sun

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B – TREATMENTS USING SUCCESS APPAT (GF-120) or BAT (see Leaflet No. 4)

• Principle

- > GF-120 is a liquid bait composed of very diverse food substances and a spinosad-based insecticide.
- > The adult fly is attracted to the bait on which it gorges itself and then dies rapidly (within an hour) due to the insecticide (Photo 3).



Photo 3: Dead female *C. cosyra* after ingesting GF-120

• Equipment required (see Leaflet No. 4)

• Application methods (see Leaflet No. 4)

• Advantages and disadvantages

- GF-120 is effective when the protocol is rigorously followed (Vayssières et al., 2009).
- Compatibility: the product meets the requirements for use in an integrated control programme, i.e. (i) it is pest-specific (Tephritidae), and (ii) not attractive to auxiliary insects (parasitoids such as *Fopius arisanus*, and predators such as *Oecophylla longinoda*).
- Heavy rainfall leads to bait leaching and lower product effectiveness.



C – MALE ANNIHILATION TECHNIQUE (MAT)

• Principle

MAT aims to reduce the male population of fruit flies to such a low level that it precludes any mating with females, thereby eradicating the targeted species. Numerous lures are set up in the treatment area, using a block of wood soaked in a mixture of insecticide and para-pheromones to attract the males which are killed by the insecticide.

• Materials required

- A block of compressed wood fibre, or cardboard (Photo 4) soaked for one night in a mixture of male attractant and biopesticide (e.g. Spinosad).
- Metal wire to hang the blocks from trees.
- Protective clothing for those involved in the procedure.



Photo 4: Blocks of wood

• Methods

- Determine the infestation level and the localization of the Tephritidae before starting the programme:

=> Conduct detection trapping (see Leaflet No. 3) till the beginning of the pest control programme.

=> Traps are set up using a precise geographical grid.

- Carry out the method with at least the following activities:

=> Place between 4 and 20 blocks/hectare on host plants not carrying traps, at 20 to 50-metre intervals between blocks.

=> Renew the blocks every 8 weeks, over a 32-week period (minimum duration of the MAT).

- Maintain a minimum number of traps (McPhail and Torula) to keep track of fly populations.

- Undertake between 1 and 4 additional MAT programmes in areas where residual fly populations persist (hot spots).

- Important: sample the fruit to evaluate control efficacy.

• Advantages and disadvantages

- MAT meets the requirements for use in an integrated control programme, i.e. it is pest-specific (Tephritidae), and (ii) not too toxic for useful insects (*Fopius arisanus*, *Oecophylla longinoda*).
- The main drawbacks of MAT are its cost and its high labour needs.
- The method requires to be adapted according to agro-ecological zones for West Africa.

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D – BIOLOGICAL CONTROL (BIOCONTROL)

Biological control means that useful organisms are used to control harmful organisms. In the case of the fruit fly, the main biological control agents are: *Oecophylla longinoda* (red ants), *Fopius arisanus* (parasitoids) and *Metarhizium* (fungus).

D 1 – BIOCONTROL USING *OECOPHYLLA LONGINODA* (Hymenoptera: Formicidae)

• Principle (see Leaflet No. 5)

The presence of weaver ants (Photo 5) in mango and other orchards can reduce the damage caused by Tephritidae through: a) predation of adult fruit flies (rare), b) predation of third-stage larvae (quite frequent) and, especially, c) the repulsive effect of “pheromones” left by the ants on the fruit so that flies are discouraged from egg-laying (Adandonon et al., 2009).

• Materials required and timing (see Leaflet No. 5)

• Methods (see Leaflet No. 5)

• Advantages and disadvantages

- Compatible use of weaver ants with other integrated pest control methods (GF-120 for instance) is well-documented.

In four years of field observations, ants have never been attracted by GF-120, and do not show predatory behavior towards parasitoids.

- The main drawbacks associated with weaver ants are:

- (i) they protect scale insects (although populations of scale insects are generally low) and (ii) ant bites during harvesting, although these can be avoided if (1) the fruit is picked using a pole, (2) the trees are climbed during the hottest part of the day, (3) wood ash is rubbed into hands and feet to repulse the ants.



Photo 5: Ant nest

D 2 – BIOCONTROL USING *FOPIUS ARISANUS* (Hymenoptera: Braconidae)

• Principle

F. arisanus (Photo 6) is an ovo-pupal parasitoid. The majority of its known hosts belong to the *Bactrocera* genus. Egg-laying takes place within the fly egg. The parasitoid egg hatches just after the host egg which continues developing normally while the parasitoid remains at first instars. At the pre-pupa stage of the host, the parasitoid matures and develops inside the host pupa from which it, rather than a fly, eventually emerges. It is classical biological control.

• Materials required

- Mass rearing of *F. arisanus* in the laboratory.
- System for releasing and monitoring *F. arisanus*.

• Methods

- Introduction/acclimatization of *F. arisanus* in the laboratory
- Mass rearing of *F. arisanus* braconids.
- Identification of areas with suitable micro-climates (lengthy rainy season, large range of host-plants of *B. invadens*) where the insects can be released.
- Release of *F. arisanus* in these identified areas.
- Field monitoring of *F. arisanus* acclimatization and establishment.



Photo 6: *Fopius arisanus*

• Advantages and disadvantages

- The compatibility of the use of *F. arisanus* with BAT (with GF-120) has been validated.
- Rearing of *F. arisanus* is a very delicate and costly process (US\$ 2000 per million parasitoids).

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D 3 – USE OF A FUNGUS AS BIOLOGICAL CONTROL AGENT

• Principle

Fungal isolates of *Metarhizium anisopliae* are used. The spores germinate, penetrate the cuticle and grow inside the host when they come into contact with a larva, pupa or adult, resulting in host death.

• Application techniques

- Soil inoculation with the fungus so the third instar/pupae/adults are contaminated as they emerge.
- Adult flies are attracted into insecticide-free traps containing the fungus so that they contaminate further adult flies with fungal spores when they leave the traps.

• Advantages and disadvantages

- The fungus is non-toxic to parasitoids.
- Validation of its use on a large scale is pending.

E – STERILE INSECTS TECHNIQUE (SIT)

• Principle

The SIT technique can be considered as a method of insect “birth control”. It comprises (i) mass rearing of the males of the target pest; (ii) sexual sterilization of these males without affecting mating behavior; (iii) release of the irradiated males in the control area to mate with females of wild species which then lay eggs with incomplete developed embryos.

• Materials required

- Mass rearing system of males (Photo 7) combined with sterilization by radiation.
- Mass-reared sterile males.

• Methods

- Mass rearing of the males of the target pests.
- Male sterilization using radiation. Hormone treatment and protein supplements given to sterilized males to accelerate maturity and sexual performance.
- Release of sterile males treated with hormones and with protein supplements.
- Monitoring of pest populations.

• Advantages and disadvantages

- Effective use of SIT requires: i) low-density pest population, ii) well documented pest biology, ecology and behaviour, iii) expertise in rearing methods.
- SIT is compatible with biological control methods.

Photo 7: SIT centre in Brazil



F – OTHER METHODS

F1 – Fruit bagging: fruit is protected with a paper bag (clear) before reaching the prematurity stage.

F2 – Promotion of cultivars less attacked: factors intrinsic to some cultivars and/or production during periods when the fly population is low (for early maturing cv) (see Leaflet No. 9).

F3 – Early harvesting: fruit harvesting at the pre-maturity stage.

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