Controlling mango fruit fly in Benin

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Summary
The mango fruit fly is causing huge losses to mangoes in the export market, practices that can be used to control the invasion of the two main species of fruit flies are being applied to reduce the probability of infestation.

Description
The mango tree suffers from numerous physiological, phytopathological and entomological problems. In West Africa, the economic importance of the damage caused by mango fruit flies (Diptera tephritidae) is growing in home garden mango trees as well as in small-scale and industrial mango orchards. The introduction and pan-African propagation of Bactrocera invadens, a fly species from Sri Lanka, first discovered in West Africa in 2004 by IITA in Benin, could jeopardise the recent commercial success of the whole mango sector.

Since fruit flies are classified as “quarantine insects”, if a consignment of mangoes containing even a single fruit infested with larvae is exported to Europe, the whole batch may be rejected and totally destroyed by the European phytosanitary services. Fruits showing the slightest trace of a fly bite must be identified, removed, and destroyed during harvesting and in-station sorting.

Each year whole containers of fruit from Africa are intercepted, confiscated and destroyed in incinerators in European harbors and airports because of these insects, thus causing major economic losses for the exporters.

The exporter who is unable to keep his business commitment runs the risk of losing the client and his reputation. The confiscation of a single batch can ruin the efforts of a whole campaign.

1. What are fruit flies and how do they proliferate in the fruit?
Out of 12 Tephritidae diptera species that attack mangoes, the two considered the most harmful are Ceratitis cosyra and Bactrocera invadens (even though three other Ceratitis species also cause economically significant damage).

![Ceratitis cosyra](image)

2. The life cycle of Tephritidae species
The life cycle of most Tephritidae species is similar.
The female implants its eggs in the young fruit of the host plant, which become attractive as they reach maturity. The larvae or maggots develop in the flesh of untreated fruit by digging tunnels (which provide opportunities for secondary infections when the larvae emerge from the fruit).

The growth of the larvae accelerates maturation of the fruit, which detaches and falls to the ground. The larvae leave the fruit and the pupae develop in the top layer (top few inches) of the soil. Upon emergence, the adult soon starts looking for the nourishment it needs to reach sexual maturity, couple, and lay eggs.

2.1 Methods for controlling the fruit fly

If the fly population becomes too large, there is no control method that will be genuinely effective and profitable. The only effective method for interrupting the fly’s development cycle is to remove the dropped fruit every day and prevent the adults from implanting eggs in the fruit (baited traps, preventive insecticide treatments). Hence all preventive and prophylactic measures with demonstrable effects should be used in the orchards. To limit proliferation, it is essential to control the fly population at the beginning of the season.

3. How to interrupt fly proliferation and bring down the infestation level in the production zones

Because of attacks by Ceratitis cosyra and Bactrocera invadens, harvest losses that are held down to 10 percent at the beginning of the growing season can reach 80 percent by the end of the season. In Guinea and Mali, losses for the main commercial cultivars such as Irwin, Amélie, Eldon, Kent, Smith and Keitt, can reach 40 percent in the middle of the season, and can exceed 50 percent for later maturing varieties such as Brooks.

3.1 How to decrease fly populations by capturing male Bactrocera invadens flies in the orchards

Parapheromone traps are generally used to capture male flies of certain species. At present they are the best tool for detecting the flies and, if used on a large scale and in large quantities, can hold down population growth early in the season.

The technique: at the beginning of the season, install a strip impregnated with a specific attractant and treated with a contact insecticide (malathion or deltamethrin). The traps should be installed in the orchard at least one month before the fruit becomes appealing. It is advisable
to install these traps in other orchards with fly-sensitive fruit trees, e.g. citrus orchards.

Small blocks of wood or strips are cut into pieces (Triplex-type chipboard) and soaked in a solution containing methyleugenol to attract the male B. invadens. A nail is driven through each strip and into the trunk of the mango tree. A concentrated solution (a malathion or deltamethrin emulsion prepared using an EC – emulsifiable concentrate – diluted in water) is then applied to the strip with a brush and left to dry. The strips (1 for 10 trees, or about 10 per hectare) are then hammered into the trees. To ensure easy replacement, the nail should not be totally driven in. The strip has to be renewed once a month.

A container, such as a water bottle cut in half, can be attached under the strip to collect the capture.

4. Intervention strategies

Population control strategies are based on infestation observation (trapping) and step-by-step interventions: localized treatment, and, under exceptional cases, throughout the orchard. Only locally registered products are to be used. As an example, the following threshold values are applied in Reunion (see Figure 5).

5. Localised treatment in orchards

5.1 When to treat?

Foodstuff attractant traps and insecticide strips (e.g. DDVP) are installed throughout the orchard (approx. 1 trap per 10 trees).
Treatment should be started either when the first flies (female Bactrocera sp. or Ceratitis sp.) have been found in the trap or when the fly-prone fruit are present (for Ceratitis, at the attack-prone ripening stage, sooner for the Bactrocera).

The first treatment must be applied on time since the product only has a preventive effect, not a curative effect (the larvae is protected while growing in the fruit).

5.2 What product?
SUCCESS APPAT® produced by DOW AGROSCIENCES (1 l/ha of CS – concentrated suspension – with a base of 0.24 g/l of Spinosad and an incorporated foodstuff attractant) can be used for a localised treatment in mango orchards (treat every third tree or every third line). The European Union authorises the use of Spinosad in organic production.

If fly captures in the trap continue, the treatment is to be renewed every 7 to 10 days, depending on the population intensity. Treatments should be repeated in the event of rainfall of over 10 - 25 mm (depending on rainfall intensity). This type of treatment has very little effect on the orchard’s natural enemies, and risks for the operator are low.

5.3 How?
The product should be applied by using a knapsack or towed sprayer equipped with a hose and a 1-2 mm (diameter) nozzle. The nozzle disc should be removed so that droplets are between 1 and 5 mm (do not use an atomiser, lower pressure as much as possible). The spray volume should be between 4 and 10 litres/ha. Apply the mixture to the top layer of leaves (about one m²), rotating around the tree (do not always treat the same leaf areas) and try to penetrate the foliage slightly. It is better...
not to treat the fruits. This type of localised application using a knapsack sprayer is acceptable just prior to harvest, and even during harvest since the operator can avoid spraying the fruit.

6. Full treatment throughout the orchard

6.1 Under what conditions?
The decision to fully treat the whole orchard will depend on the results of the capture, i.e. if there are dense swarms of flies at the beginning of the growing season and when the fruit is becoming more sensitive (the tolerance threshold still needs to be thoroughly defined in the various agro-ecological zones).

Many bio-control agents (i.e. natural enemies) have been identified in the orchards and can be used to restrict pest development, e.g. mealy bugs and thrips. Full treatment is risky because of the potential destruction of a major part of the bio-control agents and could trigger an upsurge of certain pests that, until then, have been of lesser importance.

To protect the auxiliaries, it is preferable to limit the number of full treatments in the orchard, per season, to no more than two applications, with an interval of 10 days.

6.2 What product?
Products are selected on the basis of their spectrum, their effectiveness on the flies, the MRL (maximum residue limit) for mangoes, and the pre-harvest intervals (PHI). With a 7-day PHI, certain active ingredients (e.g. bifenthrin and lambda-cyhalothrin) can be used, even during the harvesting period, as long as the MRL is respected.

The following insecticides can be recommended: lambda-cyhalothrin at 25 g/ha (1 kg/ha of Karate Max 2.5 WG® produced by Syngenta) or bifenthrin at a dose of 50 g/ha (0.5 m/ha of Talstar 100 EC® produced by FMC).

7. Validation of the practice
The practice has been successfully tested in Benin.