Intervention strategies

Population control strategies are based on infestation observation (trapping) and step-by-step interventions: localised 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 Réunion:

When to treat?

Tree growing in the fruit or flowers in the tree. Only locally registered products are to be used. The decision to fully treat the whole orchard will depend on the results of the capture, i.e. if there is a dense population intensity. Treatments should be repeated in the event of rainfall of over 10-25 mm (depending on orchard conditions).

Full treatment throughout the orchard

Full treatment throughout the orchard

How to control the Mango Fruit Fly

How?

Prior to treatment, it is important to decide on the application method, then select and properly adjust the most appropriate treatment equipment.

Use a pneumatic – knapsack or towed – sprayer with a centrifugal pump to ensure homogeneous distribution of the product on plant parts of the tree. A perforation test with water can be used to determine the number of holes that can be treated with a full tank. This information together with the number of trees that can be treated with a full tank, the volume of mixture to prepare and the product dilution rate, is needed to calculate the volume of mixture to prepare and the product dilution ratio that respects the maximum dose of active ingredient per hectare. The volume of the mixture generally refers to the volume of the mixture necessary 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.

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 (maximum residue limit) is respected.

The ACP Group of States and the European Commission have devolved responsibility for the implementation of PIP to COLEACP as an implementing organization for the promotion of the ACP-EU Technical Centre for Agricultural and Rural Cooperation (CTA). This document was produced with financial assistance from the European Development Fund. We wish to thank G. Goger, IITA, Cotonou (Benin) for providing the photos.

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© CTA 2007 – ISSN 1873-8192

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CTA is financed by the European Union.

The ACP-EU Pesticides Initiative Programme (PIP) is a programme funded by the European Development Fund. The ACP-EU Pesticides Initiative Programme promotes the development of pesticide use in African, Caribbean and Pacific Countries and Territories.

The technology is important to decide on the application method, then select and properly adjust the most appropriate treatment equipment.
The life cycle of most Tephritidae species is similar. The female imprints 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 a recently cut fly-damaged tissue (which provides opportunities for secondary infections when the larvae emerge from the fruit). The growth of the fly-affected tissue proceeds with the maturation of the fruit, which desiccates and becomes difficult to handle. The larvae mature in the fruit and the pupae develop in the top layer (top few inches) of the soil. Upon emergence, the adult soon begins looking for a host plant for maturation in order to reach sexual maturity, and lays eggs.

Bactrocera invadens

The mango tree suffers from numerous fruit and vegetable pests, as well as from different pests and parasites. In West Africa, the economic importance of the damage caused by mango fruit flies (Oomyzobera invadens) is growing in home garden mango trees as well as in small-scale and industrial mango orchards. The introduction and melon-flower flies of Bactrocera invadens, a fly species from Sri Lanka, first discovered in West Africa in 2004 by IITA in Benin, could jeopardise the commercial success of the whole mango sector.

Methods for controlling the fruit fly

When the fly population becomes too large, there is no control method that will be genuinely effective and profitable. The only effective method is to stop the production cycle by removing the dropped fruit every day and present the adults from implanting eggs on fruits that are being transported or preserved in cold storage containers. Hence all horticultural prophylactic measures with demonstrable effects should be used in the orchards. To limit propagation, it is essential to control the fly population at the beginning of the season.

1. How to interrupt fly proliferation and bring down the infestation level in the orchards.

Because of attacks by Ceratitis cosyra and Bactrocera invadens, harvest losses that are held for 10 days at the beginning of the growing season can reach 80% by the end of the season. In Guinea and Mali, the losses for the commercial campaigns are estimated at 30% such as Hess, Monde, Eldon, Kent, Smith and Keitt, can reach 40% in the middle of the season, and can exceed 50% for late-maturing varieties such as Brooks.

2. How to decrease fly populations by capturing male flies in the orchards.

Parapheromone traps are generally used to capture male flies of certain species. As present they are the best tool for detecting the flies, and if used on a large scale and in large quantities, can hold down populations to insignificant levels.

The technique at the beginning of the season, install a trap 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 mangoes are to ripen. It is advisable to set traps in other orchards with fly-sensitive fruit trees, e.g. citrus orchards. The traps should be set just before picking the mangoes and inactivated with an emulsifiable concentrate (EC) - emulsifiable concentrate – diluted in water) is then applied to attract the male flies. The traps are checked once a week with earth or quicklime; the sticky glue is replaced and the paper bag is removed.

3. How to control the fruit fly in the orchard

Small blocks of wood or strips can be cut into pieces (Triconidae chipboard) and soaked in a solution containing methyl eugenol to attract the bees and other predators such as birds. The strips should be left under the trees until the young mango trees are 3 years old, after which they can be buried under the soil. The larvae will complete their growth cycle in the soil and falls to the ground. The larvae leave the soil at the same time as the mangoes (picking up, sorting, destroying) since flies cannot fly. Avoid leaving such trees nearby since this is where infestations break out. Preventing or keeping fruit trees nearby of their fruits attract the fly, e.g. citrus, guava, papaya, anacardiaceae etc. A large number of host plants nearby may result in large populations of fruits flies at the end of the season. Manage oryx with the same rules as for mangoes, e.g. (keeping, sorting, spraying) since almost all mango species are polyphagous. When leaving such trees nearby since this is where infestations break out. Preventing or keeping fruit trees nearby of their fruits attract the fly, e.g. citrus, guava, papaya, anacardiaceae etc. A large number of host plants nearby may result in large populations of fruits flies at the end of the season. Manage oryx with the same rules as for mangoes, e.g. (keeping, sorting, spraying) since almost all mango species are polyphagous. Avoid growing mango varieties with very different growth cycles in the same orchard; since fly populations growing during the production period, the late-maturing varieties are often infected in the mean.

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

Presence of weedy plantains (which provide opportunities for secondary infections due to mango trees by the same pathogen). In West Africa, the economic importance of the damage caused by mango fruit flies (Oomyzobera invadens) is growing in home garden mango trees as well as in small-scale and industrial mango orchards. The introduction and melon-flower flies of Bactrocera invadens, a fly species from Sri Lanka, first discovered in West Africa in 2004 by IITA in Benin, could jeopardise the commercial success of the whole mango sector.

Out of 12 Tephritidae species that attack the mango, the two considered the most harmful are Ceratitis cosyra and Bactrocera invadens. Although they are relatively expensive, they cause significant infestations.

The 12 months of the Tephritidae species is similar. The female imprints 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 a recently cut fly-damaged tissue (which provides opportunities for secondary infections when the larvae emerge from the fruit). The growth of the fly-affected tissue proceeds with the maturation of the fruit, which desiccates and becomes difficult to handle. The larvae mature in the fruit and the pupae develop in the top layer (top few inches) of the soil. Upon emergence, the adult soon begins looking for a host plant for maturation in order to reach sexual maturity, and lays eggs.

Ceratitis cosyra and Bactrocera invadens (even though three other species also cause economically significant damage). Out of 12 Tephritidae species that attack mangoes, the two considered the most harmful are Ceratitis cosyra and Bactrocera invadens. Although they are relatively expensive, they cause significant infestations. Since fruit flies are classified as “quarantine insects”, if a consignment of mangoes containing a single fruit infested with larvae is exported, the entire batch may be rejected and totally destroyed by the European phyto-sanitary services. Fruits showing the slightest trace of a fly bite must be identified, removed, and destroyed during harvesting and in-station sorting.

Mangoes (picking up, sorting, destroying) since flies cannot fly. Avoid exposing contaminated fruit from infested zones to low infested zones.

Each year whole containers of fruit from Africa are intercepted, confiscated and destroyed in European harbors and airports because of these flies, causing major economic losses for the exporters. The exporter who is unable to keep his business running risks the risk of losing the client and his reputation. The confiscation of a single batch can ruin the efforts of a whole campaign.

If market demand allows, produce the early- and late-season mangoes (picking up, sorting, destroying) since flies cannot fly. Avoid exposing contaminated fruit from infested zones to low infested zones.
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 the first fruit that is dug (tunnels which provide propagules for secondary infections when the larvae emerge from the fruit). The growth of the life stage is accelerated by the maturation of the fruit, which dehisces and falls to the ground. The larvae exit the fruit and the pupae develop in the top layer of the soil. Upon emergence, the adult soon looks for a suitable place to gain nourishment it needs to reach sexual maturity, and lay eggs.

Methods for controlling the fruit fly

If the fly population becomes too large, there is no control method that will be generally effective and profitable. The only effective method is to remove the dropped fruit early and present the adults from implanting their eggs in the young fruit of the host plant. Hence all preventive and protective measures with demonstrable effects should be used in the orchard. To limit proliferation, it is essential to control the fly population at the beginning of the season.

1. **How to interrupt fly proliferation and bring down the infestation level in the orchard.**

   **Because of attacks by Ceratitis cosyra and Bactrocera invadens, harvest losses that are held down to 10% at the beginning of the season can reach 80% by the end of the season.**

   **In Guinean and Mali, the losses for commercial reasons are limited to:**

   - Small blocks of wood or strips are cut into pieces (Triplex-type chipboard) and soaked in a solution containing methyleugenol to attract the male flies.

   **Transport of infested fruit to local or regional markets**

   - If possible, avoid selling infested fruit or fruit discarded during sorting alternatively ensure infested fruit is treated prior to sale and proper destruction of unfruitful fruit (by incineration or de-stemming the fruit) do not disturb the soil of the orchard.

   - Avoid transporting punctured fruit from infested zones to less infested zones.

**How to decrease fly populations by capturing male Bactrocera invadens flies in the orchard.**

Parapheromone traps are generally used to capture male flies of certain species. As 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.

The technique at the beginning of the season, install a trap 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 beginning of the season. It is advisable to install traps in other orchards with fly-sensitive fruit trees, e.g. citrus or anona, melons, etc. A large number of host plants nearby may result in large populations of fruit flies at the beginning of the season.

**Presence of infested fruit in the orchard near the fruit-packaging station.**

Sort the fruit and quickly eliminate any fruit that has not been exposed to fly attack (conserve or destroy immediately).

- Do not leave any rejected fruits, since they are ideal infestation sites, near the orchard or the packaging station. This includes ungraded, infected fruit and infested fruit eliminated during sorting.

- Transport of uninfested fruit to local or regional markets

- If possible, avoid selling infected fruit or fruit discarded during sorting alternatively ensure infested fruit is treated prior to sale and proper destruction of unfruitful fruit (by incineration or de-stemming the fruit) do not disturb the soil of the orchard.

- Avoid transporting punctured fruit from infested zones to less infested zones.

**Presence of infected fruit in the orchard near the fruit-packaging station.**

Sort the fruit and quickly eliminate any fruit. The technique at the beginning of the season, install a trap impregnated with a specific attractant and treated with a contact insecticide (malathion or deltamethrin).

**Presence of several varieties with the same or different harvesting dates in the orchard.**

If market demand allows, produce the early-maturing varieties so that the fruit expires when fly populations are low.

**Presence of several varieties (with successive harvesting dates) in the orchard.**

If market demand allows, produce the early-maturing varieties so that the fruit expires when fly populations are low.

**Presence of non-infested, abandoned orchards or wild trees near the cultivated orchard.**

- Avoid growing certain plants such as pears, bell peppers or cucumbers as intercrops.

- Avoid planting or keeping host plants nearby if their fruits attract the fly, e.g. citrus, guava, pampas, acerola, etc. A large number of host plants nearby may result in large populations of fruit flies at the beginning of the season.

- Manage orchards using the same rules as for abandoned, abandoned, infested orchards or wild trees near the cultivated orchard.

- Avoid transporting punctured fruit from infested zones to less infested zones.

- Avoid planting or keeping host plants nearby if their fruits attract the fly, e.g. citrus, guava, pampas, acerola, etc. A large number of host plants nearby may result in large populations of fruit flies at the beginning of the season.

- Manage orchards using the same rules as for abandoned, abandoned, infested orchards or wild trees near the cultivated orchard.

- Avoid transporting punctured fruit from infested zones to less infested zones.

**Presence of infested fruit in the orchard near the fruit-packaging station.**

Sort the fruit and quickly eliminate any fruit. The technique at the beginning of the season, install a trap impregnated with a specific attractant and treated with a contact insecticide (malathion or deltamethrin).

**Presence of infested fruit in the orchard near the fruit-packaging station.**

Sort the fruit and quickly eliminate any fruit. The technique at the beginning of the season, install a trap impregnated with a specific attractant and treated with a contact insecticide (malathion or deltamethrin).
Population control strategies are based on infestation observation (trapping) and step-by-step interventions: localised 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 Réunion:

- **Level of infestation**
  - Number of flies/foodstuff atrap (weekly reading)
  - Type of treatment

- **How?**
  - The products should be applied by using a high-capacity or localised sprayer with a 1-x 12-mm (orifice diameter) nozzle. The volume should be between 4 and 10 l/ha. To maintain an intense flow rate as much as possible. The spray volume should be between 4 and 10 l/ha.
  - Apply the mixture to the top layer of leaves (about one m² around the tree) and try to penetrate the foliage slightly. It is better to treat just prior to harvest. This type of localised application using a high-capacity sprayer is acceptable prior to harvest, and even during harvesting, since the operator can avoid spraying the fruit.

- **Full treatment throughout the orchard**
  - The decision to fully treat the whole orchard depends 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). Pest development, e.g. mealy bugs and thrips. Full treatment is risky because of the potential destruction of a lesser importance.

Products are selected on the basis of their spectrum, their effectiveness on the flies, the MRL (maximum residue limits) for mangoes, and the pre-harvest intervals (PHI). With a 7-day PHI, certain active ingredients have been identified in the orchards and can be used to restrict pest development, e.g. a high level of Spinosad. Full treatment is risky because of the potential destruction of a lesser importance.

- **When to treat?**
  - Foodstuff attractive traps and insecticide strips (e.g. DDVP) are installed throughout the orchard (a trap per 10 trees).
  - Many bio-control agents (i.e. natural enemies) have been identified in the orchards and can be used to reduce pest development, e.g. a high level of Spinosad. Full treatment is risky because of the potential destruction of a lesser importance.

**How?**

- Prior to treatment, it is important to decide on the application method, then select and properly adjust the most appropriate treatment equipment.
- Use a pneumatic – knapsack, towed, or carried – sprayer with a centrifugal pump to ensure homogeneous mixture throughout the orchard, per season, to 100-200 l/ha for mature orchards. The volume of the mixture generally varies between 400 and 700 l/ha for mature orchards.
- Calculate the volume of mixture to prepare and the product dilution rate that respects the required dose of active ingredient per hectare. The volume of the mixture generally varies between 400 and 700 l/ha for mature orchards.
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