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**Backgrounder: Pest management in mangoes**

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**Introduction**

***Why is this subject important to listeners?***

Because mango farmers should know:

* The pests that affect mango fruits and their impacts.
* How to identify mango pests.
* How to manage orchards to reduce pest incidence.
* How to manage the spread of pests between mango orchards.
* The chemical and non-chemical options for managing mango pests.
* The diseases spread by mango pests.
* The effect of pests on mango yields.

***What are some key facts about pest management in mangoes?***

* Farmers should always remove overripe mango fruits—they provide breeding sites for fruit flies.
* Collect and dispose of fallen and damaged mangoes in a separate environment, feed to livestock, or bury in a three-metre-deep hole and cover with black polythene, since fallen and damaged mangoes can act as breeding sites for pests.
* Harvest mangoes when they are physiologically mature\* instead of when they are overripe. At this stage, they are not at risk of fruit fly infestation.
* Prune mango trees to about 3.5 metres to ensure that all branches are at knee level (0.5 metres). Maintaining that height eases pest and disease management.
* Prune branches infested with pests and dispose of away from the orchard.
* Intercropping mangoes with papaya, pineapples, legumes, and fodder crops reduces pest pressure in orchards. However, these crops can be a source of scale insects, so farmers must take good care.
* Bag or net maturing mango fruits to protect them from infestation by fruit flies and other pests.
* Monitor maturing mango shoots to protect them from tip borers.
* Band trees by painting a 1-foot-wide band on the trunk with an insecticide at least two feet from the ground. This prevents pests from ascending the tree.

***What are the big challenges to managing mango pests?***

* Poor hygiene in mango orchards increases the buildup of pests such as fruit flies.
* Overgrown and bushy mango trees make pest management difficult.
* Failure to prune and dispose of pest-infested branches.
* Poor harvesting and post-harvest practices for mango fruits.
* Lack of knowledge of pest management.
* Climate change is increasing the populations of fruit pests.
* Failure by farmers to regularly monitor orchards for pest infestations.

***Predicted impact of climate change on pest infestation in mangoes***

* Research has shown that climate change, including increased levels of carbon dioxide in the atmosphere, can result in increased numbers of both mango seed weevil larvae and aphids.
* The warming climate is causing the spread of pests like fruit flies in regions that were previously unfavourable for the pests, and where fruits such as mangoes are grown.
* Rising temperatures increase the population of mealy bugs.
* Mutation of current pests is likely to result in greater resistance to current control methods.

***General measures to control pests in mangoes***

* Maintain hygiene in mango orchards by disposing of rotten and fallen mangoes away from the orchard since they host pests such as fruit flies.
* Prune parts of mango trees that are affected by pests and dispose of or burn away from the orchard.
* Regularly monitor mango orchards for pests such as the mango twig borer, whose presence is indicated by dry leaves in the tree canopy.
* Ploughing the mango orchard after the harvest exposes pest pupae to sunlight and thereby reduces infestation levels of the stone weevil and the inflorescence midge*.*

*For further information, please see documents 1-15.*

**Key information about managing pests in mangoes**

There are a number of key pests that affect mangoes.

1. **Fruit flies**

Depending on the environment, fruit flies have a lifespan of 12-28 days.

* Several types of fruit flies attack ripening mangoes and can cause yield losses of over 50%.
* Female fruit flies lay eggs inside the flesh of ripe or ripening fruit, just below the surface of the skin. Eggs hatch within 2-4 days and maggots feed on fruit pulp, causing premature ripening and fruit drop.
* As the maggots feed on the flesh, the infested part of the fruit becomes soggy and there is premature colouring of the mango.
* At the pupa stage, the pest drops to the ground near the mango tree, then is transformed into an adult fruit fly within 10 days.

**Fruit fly management**

*Bagging*

Bagging is done about 55-60 days after flower blossom, or when fruits are the size of a chicken egg. Bag and tie mangoes in waxed paper bags. Bagging prevents damage from fruit flies, fruit borers, thrips, and leafhoppers, and reduces the incidence of diseases such as anthracnose. Farmers can also bag with layers of old newspapers sewn together to make rectangular bags. Close the top end of the bag by tying with a string or a wire. In some cases, bagging has been effective enough to substitute for two applications of insecticide.

If plastic bags are used to bag mangoes, perforate bags with holes to release trapped moisture. An alternative to plastic bags is bags made with plant leaves. After harvest, destroy all bags.

*Fruit fly traps*

**Bottle traps**

To make a fruit fly trap, farmers can use 500ml or 1-litre plastic bottles laced with bait. Use a hot iron rod to make holes in the neck of the bottle and in the bottle cap, then pass a wire or string through the hole in the cap after placing the bait in the bottle. Hang the trap in a shaded part of the mango tree just above the lower branches. The bait attracts fruit flies, which are trapped inside the bottle, where they die. Depending on the type of bait used, the trap can attract or kill male or female flies or both. Traps also help farmers monitor fruit fly populations in the orchard, so that they can decide whether the population is sufficiently high to justify spraying.

**Bottle trap bait**

Farmers can make fruit fly bait from the following ingredients:

* Ripe banana peel sliced into tiny pieces and mixed with sugar, flour, and water.
* A mixture of two litres of water, one tablespoon of vanilla essence, two tablespoons of ammonia, and half a cup of sugar.
* A mixture of two cups of water, one tablespoon of honey, and one cup of vinegar.
* A mixture of sugar, soya sauce, and ammonia.
* Replace bait with these types of ingredients twice a week since fresh bait is more attractive to fruit flies.
* Hang traps in the shaded part of the tree above the lower leaves where the fruit flies prefer, and to ensure that the trap doesn’t become entangled in the branches.
* One trap is sufficient for two trees. If a farmer has, for example, 40 trees, they would need 20 traps.

*Yellow sticky traps*

Yellow sticky traps are baited with vials containing half water and half ammonia. The yellow colour attracts fruit flies, thrips, white flies, leaf miners, and aphids, which then become stuck on the trap and die. Yellow-coloured traps have been found to be more effective at trapping pests than traps of other colours.

*Spraying*

If traps are ineffective against fruit flies, mango farmers can blend and spray plant-based basil leaf or neem seed extracts.

* Grind 50 grams of basil leaves and soak overnight in 2-3 litres of water. Strain, then add 8-12 millilitres of liquid soap and stir. Basil leaf extract can also be used to manage caterpillars, red spider mites, red scale, spotted leaf beetles, fungal diseases, and nematodes.
* Pound 3-5 kilograms of de-shelled neem seeds, place in a clay pot, and add 10 litres of water. Cover the pot with a cloth, store for three days, then strain. Dilute every litre of the extract with nine litres of water, then add 100 millilitres of soap and stir.
* Spray from inside the mango tree canopy (above the tree and branches). Choose three spots on the edges of the canopy to spray, but do not directly spray fruits or spray every part of the tree.
* Note that these plant-based insecticides work by directly contacting fruit flies.

*Fruit Fly Mania*

Fruit Fly Mania is a commercial product that is a mixture of protein bait made from brewer’s yeast that attracts female fruit flies and to a lesser extent male fruit flies, and a poison that kills them. It was developed by the [International Centre of Insect Physiology and Ecology](http://www.icipe.org/) (ICIPE) and is commercially produced by Kenya Biologics.

**Application**

Spot spraying: Mix Fruit Fly Mania with a toxicant (poison) and spray the mango orchard. About 10 litres of Fruit Fly Mania are sufficient for one acre.

Bait trap: Farmers can add Fruit Fly Mania to traps to attract fruit flies, who become trapped and die. Farmers can use 30 traps per acre to trap fruit flies.

*Orchard hygiene*

Traps and insecticides will not be able to sufficiently manage fruit fly infestations if mango orchards are unhygienic. Unhygienic conditions can be caused by maggots growing in mangoes rotting on the ground. The mangoes pupate, then are transformed into adult fruit flies that lay eggs inside the mango. When the eggs hatch, the larvae feed on the fruit and destroy it.

* Farmers can break continuous cycles of fruit fly infestation by collecting rotten mangoes in black polythene bags and exposing the bags to sunlight to kill the fruit flies. Then, empty mango fruits from the polythene bag and bury.
* Farmers can take advantage of the natural enemies of fruit flies, including weaver ants that feed on fruit fly larvae and parasitoid wasps that lay their eggs on the larvae. These predators and parasitoids occur naturally, so all mango farmers need to do is leave a sufficient amount of natural vegetation between orchards where they can thrive. Dill, parsley, yarrow, zinnia, clover, alfalfa, parsley, cosmos, sunflower, and marigold are flowering crops that attract native wasp populations and provide good habitats for them.
* Twice a week for the entire season, remove all fruit with dimples and oozing, clear sap from the tree as well as all rotten fruit from the ground, and dispose of.

*For further information, please see documents 1, 2, 3, 5, 10, and 12.*

1. **Mango seed/stone weevil**

The mango seed weevil is spread by transporting infested mangoes. Weevils develop in seeds and are not easily noticed; affected mangoes appear normal but rot from the inside. The female stone weevil lays eggs over a 5-6-week period on fruits before they are half-grown. The hatching period is 3-5 days. Young larvae penetrate the fruit, eat, and develop into adult weevils. They destroy the stone of the fruit, leaving black, sooty, unsightly material inside the fruit, resulting in rotting. Mature weevils emerge by tunneling outwards through the flesh and skin of the fruit. When weevils emerge from mangoes, they shelter beneath loose tree bark or waste materials under mango trees in the orchard.

*Mango seed weevil management*

Mango seed weevils can survive on fallen mangoes for up to 300 days. To manage seed weevils, farmers should:

* Remove and destroy waste around the mango orchard at the end of every harvesting season.
* Spray with insecticides recommended by research and extension officers at the beginning of flowering. These either kill weevils or the eggs laid on the fruit. and thereby suppress its population. Wet mango tree bark and branches well during spraying or when using a brush or broom to apply an insecticide.
* Collect and destroy all fallen mangoes weekly until harvest. Fallen mangoes often become infested with mango seed weevils.
* Plough mango orchards after harvest to expose hibernating mango seed weevils and reduce their populations and infestation levels.
* Destroy mango seeds left over in orchards and processing factories.
* Apply sticky bands at the upper end of tree trunks when trees start flowering to reduce migration of weevils to branches for egg laying.
1. **Mango mealy bug**

The symptoms of feeding by the mango mealy bug are leaves that are yellow, stunted, and rolled up. Mango trees heavily infested by the mealy bug drop leaves and flowers, and fruits do not set. Mango fruits affected by the mealy bug drop prematurely. The bugs secrete a velvet, sooty mould that causes blackening and malformation of leaves, stems, and fruits. The eggs of the mealy bug are yellow and the adult’s body has a white mealy wax covering.

*Mango mealy bug management*

Farmers can manage the mango mealy bug in the following ways:

* Spray mango trees with a steady stream of pressurized water to knock the bugs off leaves and branches. Once mealy bugs fall to the ground, they are preyed on by predators, which reduces their population. Wet mealy bugs are also infected by fungal pathogens.
* Handpick mealy bugs to reduce their numbers. Handpicking causes mealy bugs to release chemicals that signal other mealy bugs to drop to the ground.
* Prune infested mango tree branches to reduce the number of breeding sites and decrease future populations.
* Prepare a chili spray by boiling four cups of ripe pods in a pot with five cups of chili seeds in water for 15 to 20 minutes. Remove the pot from the heat, add three litres of water, cool and strain, and add 30 grams of soap. This chili mixture also controls fruit flies.
* Mix one tablespoon of dishwashing detergent with a cup of cooking oil. Add five to eight tablespoons of the solution to a gallon of water, and spray.
* Rake the soil and weed around the mango tree trunk to expose mango mealy bug eggs to natural enemies and sun scorch.
* Spray the tree with insecticides recommended by research and extension officers, concentrating on young shoots as that is where the bugs attack.
1. **Mango tip borer**

The pale green larvae of the mango tip borer feed on fruiting twigs and panicles. The larvae burrow into or near the tips of young mango shoots, causing them to shrink and dry up. The eggs of the mango tip borer are creamy white, and are laid on stems and young shoots. Adult mango tip borers are greyish-black.

*Mango tip borer management*

* Prune affected parts of the mango plant and burn or bury them away from the orchard.
* Spray with a combination of chili, garlic, and ginger extracts.
* Use neem seed extracts to manage the mango tip borer. Add 50 grams of powdered neem kernel to a litre of water, let the mixture stand for six hours, add soap and stir. When applying the extract on the mango tree, continually shake and stir the extract.

*For further information, please see documents 6, 7, 9, 11, 13, and 15.*

**Definitions**

*Mature green*: The stage of growth when the mango is about to turn yellow or red ripe.

*Physiologically mature*: The stage of growth when maximum growth and maturation has occurred, usually associated with full ripening. Physiological maturity is shown through signs such as changes in colour, collapse of fruit shoulders, and softening of fruit.

**Where can I find other resources on this topic?**

*Documents*

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Contributed by: James Karuga, Agricultural journalist, Kenya

Reviewed by: Charles Murage, Business Advisor Agriculture, Technoserve

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