



Major pest and disease identification and management guide for mango, avocado, tamarillo and grevillea

Authors: Sheillah Cherotich, Willis Ochilo, Sammy Carsan and Zakayo Kinyanjui

© 2023 CIFOR-ICRAF



Content in this publication is licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0), <http://creativecommons.org/licenses/by/4.0/>

DOI: 10.5716/cifor-icraf/BK.34489

Cherotich S, Ochilo W, Carsan S. and Kinyanjui Z. 2023. *Major pest and disease identification and management guide for mango, avocado, tamarillo and grevillea*. Bogor, Indonesia: CIFOR (Center for International Forestry Research); and Nairobi, Kenya: World Agroforestry (ICRAF).

Photos credit:

In-text photo credits: All sources are acknowledged

Front cover photo: orange dog caterpillar on citrus (Source: ICRAF)

Back cover photos: A farmer in Kitui showing mealybug infestation in a mango orchard (Source: ICRAF)

Acknowledgements

This guide was produced by the Tree Health Unit, a department of Tree Genebank at CIFOR-ICRAF Nairobi, Kenya.

This publication was made possible through the Reversing Land Degradation by Scaling up Evergreen Agriculture (Regreening Africa) project funded by the European Union.

Photographic images were captured from farmers' fields unless otherwise stated.

Dedication

This guide is dedicated to all agroforestry farmers in Kenya and Rwanda, and all extension officers working with those farmers.

Disclaimer

The information in this guide is made available to assist users in the identification and management of pests and diseases occurring on tamarillo, avocado, mango and grevillea. The information provided here should be complemented with support from relevant experts, especially with regard to pesticide use. The authors do not in any way endorse the use of agrochemical brands indicated in sections of the guide. The Tree Health Unit and all persons acting for ICRAF disclaim liability with respect to any information provided in this guide. No liability can be accepted for error or omission, or any loss or damage arising from use of chemicals cited.

Individuals are responsible in the use of chemicals as per regulations of Pest Control Products Board (PCPB).

<https://www.pcpb.go.ke/list-of-registered-products/>

CIFOR
Jl. CIFOR, Situ Gede
Bogor Barat 16115
Indonesia
T +62 (251) 8622-622
F +62 (251) 8622-100
E cifor@cifor-icraf.org

ICRAF
United Nations Avenue, Gigiri
PO Box 30677, Nairobi, 00100
Kenya
T +254 20 7224000
F +254-20- 7224001
E worldagroforestry@cifor-icraf.org

cifor-icraf.org

The designations employed and the presentation of material in this publication do not imply the expression of any opinion on the part of CIFOR-ICRAF, its partners and donor agencies concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Introduction

Increasing demand for tree products has led to wide production of exotic and native tree species in forest and agroforestry plans. Pests and diseases incidences are at the same time a growing continental crisis. Diseases spread is accelerated by climate change dynamics and implications are concerning African farmers already challenged by weak intervention capacity, fragmented ecosystems, and porous borders. Impacts may also trigger loss of biodiversity, food crisis and constrain agroforestry adaptations strategies.

Field observations in parts of Rwanda and Kenya where mango, tamarillo, avocado and grevillea production is prominent, pest and disease incidence is reducing benefits of these production systems. This guide is therefore intended to provide vital information to help smallholders, extension and rural advisory services identify and manage pest and disease incidence before causing total crop failure. Major pest and diseases found in mango, tamarillo, avocado and grevillea are highlighted and possible management plans to reduce spread and losses are indicated as part of wider strategies to dealing with pest and disease break-outs.

Mango

Powdery mildew

Cause: *Oidium mangiferae*



Identification: Characterized by white superficial fungal growth on leaves, fruits, panicle stalks and flowers. High humidity and moderate temperature favour the fungi.



Treatment/management:

- Ensure adequate spacing
- Ensure air circulation and enough sunlight for stands to reduce humidity
- Regulate watering
- Remove infected plants, which act as sources of inoculum
- Use sulphur- and copper-based fungicides with the following active ingredients: Probineb and cymoxanil; Metalaxyl, Azoxystrobin and Difenconazole; Metaxyl-M and Chlorothalonil; Bacillus subtilis and sulphur.

Sooty mould

Cause: *Meliola mangiferae*



Identification: Most sap feeding insects produce sugary honey dew making plants susceptible to sooty mould. They occur as a result of interaction between sap-feeding insects and non-parasitic fungi. The honey dew acts as food for the fungi, which grows on the surface and turns black. Effects of sooty mould include reduced exchange of gas and photosynthesis.



Treatment/management: To control sooty mould you need to control the sucking insects to cut the supply chain of honey dew as well as ants, which tend to protect them.

- Use traps to control insect pests
- Moderate use of fertilizers
- Ensure crop rotation and sanitation
- Refer to <https://www.pcpb.go.ke/list-of-registered-products/> for registered chemicals against sooty mould
- You can use Jambo Clean or any effective available product in the market to clear sooty mould.

▼ Figure 1. Powdery mildew



▼ Figure 2. Sooty mould



Aphids



Identification: Aphids are tiny soft-bodied insects that attack mango plants and other fruit trees by sucking the fluid from young leaves. They appear brownish, greyish to blackish in colour. They produce honey dew, which encourages growth of sooty mould thereby inhibiting photosynthetic activities.



Treatment/management:

- Ensure frequent monitoring of orchards for early detection
- Practice orchard hygiene
- Ensure proper weeding
- Manage ants (which protect aphids from natural enemies) by putting a band of sticky material around the trunk to prevent ants from climbing up
- Spray effective insecticides with the following active ingredients: Pyrethroid, Lambda-cyhalothrin
- Use biopesticides such as *Metarhizium anisopliae* ICIPE 62

Scale insects



Identification: Appear as stationary shell-like oval, flat or pear-shaped insects. They suck sap from the tissues causing direct damage by removing biomass and water from the plant.



Treatment/management:

- Use material free from scale insects
- Ensure pruning and adequate spacing
- Use natural enemies e.g., ants, ladybirds, beetles, mantids, lacewings, *Chilocorus*
- Use traps, e.g., Entrap
- Apply insecticidal soap or horticultural (narrow range) oil
- Spray with Bifenthrin, Emerald, Malathion, Triazophos, Diazinon, Bifenthrin or Omethoate.

▼ Figure 3. Aphids



▲ Figure 4. Scale insects



▲ Figure 5. Anthracnose

Anthracnose disease

Causes: *Colletotrichum gloeosporioides*, *Glomerella cingulate*



Identification: Anthracnose symptoms occur on leaves, twigs, petioles, panicles and fruits. On leaves, it causes brown lesions; on fruit it causes dark-coloured, sunken irregular shaped lesions. Black spots occur on panicles and can be accompanied by resin. Such attacks can cause premature abortion.



Treatment/management:

- The fungus has long saprophytic survival on dead branches, therefore diseased parts should be pruned and burnt to reduce inoculums
- Infection can be reduced by applying fungicide spray after first appearance on panicles once the disease is observed
- Use disease free certified germplasm
- Avoid poor aeration in orchards and nurseries
- Keep plants healthy to avoid stress

- Ensure proper hygiene and sanitation e.g., disinfect tools used for pruning, conduct timely weeding, remove plant debris, and destroy infected plants or fruits to reduce inoculums
- Use resistant varieties like Tommy Atkins
- Apply copper-based fungicides with active ingredients like Azoxystrobin, Propineb, Azoxystrobin, Difenoconazole or Hexaconazole, among others, recommended by PCPB.

Gall midges



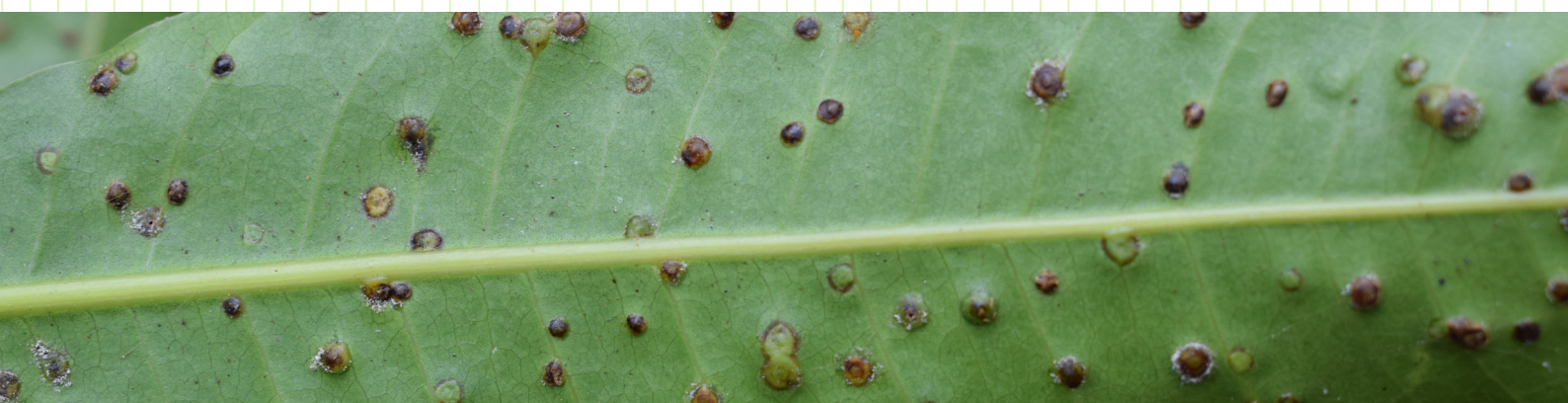
Identification: Gall midges are tiny insects that infest buds, shoots, leaves and fruits. They lay their eggs on leaves, causing larvae to mine the leaves and produce galls or swellings. Adult midges are dark in colour with long antennae.



Treatment/management:

- Proper orchard sanitation
- Proper weeding
- Prune infected parts to minimize spread
- Use clean certified germplasm
- Deeply plough land to expose the larvae and pupae to heating from the sun, which will kill them
- Dispose of infested panicles, leaves and twigs by burning
- Soil treatment can be done to kill larvae populations, e.g., by using Chlorpyrifos or Fipronil, among others recommended
- Spray using chemicals with active ingredients like Delfamethrin, Bifenthrin, e.g., Bestox or Teta Alpha; Lambda-cyhalothrin, e.g., Karate, Kingcode Elite or Dududthrin, among others. Always consult the recent PCPB list of registered pesticides <https://www.pcpb.go.ke/>.

▼ Figure 6. Gall midges





▲ **Figure 7. Mango scab**

Source: http://what-when-how.com/Tutorial/topic-146e6dso9/Diseases-of-Fruit-Crops-in-Australia_images/img-gen2230.png

Mango scab

Causes: *Elsinoe mangiferae* or *Denticularia mangiferae*



Identification: Corky, cracked lesions, which are circular to angular and dark brown to black in colour, occur on leaves and fruits. The brown spots occur with haloes, and lesions also occur on margins. Lesions on stems are slightly raised, oval shaped and appear black in colour during the dry season and can easily be confused with anthracnose. Leaves may be distorted and twisted during heavy infestation.



Treatment/management:

- Prune diseased parts to reduce inoculums
- Properly prune the stands to reduce disease incidence
- Use copper-based fungicides, e.g., Copper hydroxide or copper sulphate, among others.

Mango seed weevil

Cause: *Sternochetus mangiferae*



Identification: Adult weevils are characterized by their oval-shape with dark brown mottled markings. Adults feed on leaves and tender shoots. Females

pierce the fruit to lay eggs. After hatching, larvae burrow through the pulp to developing seeds, which causes fruit fall and decay. The pest is a quarantine pest.



Treatment/Management:

- Regularly inspect the orchard for adult weevils
- Maintain orchard sanitation
- Use resistant varieties
- Rotate and intercrop with non-hosts, like citrus
- Ensure proper weeding
- Destroy infested seeds
- Cut mature fruits to check for infestation
- Use chemicals with the following active ingredients: Imidacloprid, Pyrethroid or Lambda-cyhalothrin, among others.

▼ **Figure 8. Seed weevil**

Source: Photo by Peter A. Follet





▲ Figure 9. Mealybugs

Bacterial canker (Bacterial black spot) of mangoes

Causes: *Xanthomonas campestris* pv., *Mangiferaeindicae*



Identification: The disease occurs on leaves, twigs, stems, branches and fruits. It appears as irregular brown to black coloured necrotic patches. The fruit will appear as water-soaked spots, which later erupt and produce exudates. Severe infection can cause premature fruit drop. Cankerous lesions appear on petioles, twigs and fruits. The lesions often burst open releasing gummy ooze, which contains bacterial cells.



Treatment/management:

- Use disease free or certified germplasm
- Observe orchard hygiene and sanitation
- Use resistant varieties, e.g., Bombay green
- Prune infected parts
- Spray with copper-based fungicides, e.g., Streptomycin, or chemicals with streptomycin sulphate as their active ingredient.

Mealybugs



Identification: Mealybugs are small, 2–3 mm long, white waxy bodied, cotton wool-like insects. They produce a sugary secretion (honeydew), which provides protection from predatory ladybirds, parasites and other natural enemies. In some areas they are considered invasive species competing with and replacing indigenous species.



Treatment/management:

- Ensure frequent monitoring of your orchards for early detection
- Prune heavily infested branches
- Avoid alternative hosts for the pests
- Plant coreopsis, fennel and other flowering plants to attract beneficial small wasps
- Use a strong jet of water to dislodge and kill mealybugs for areas with sufficient water
- Use a spray of soap solution to remove mealybug infestations from plants
- Use clean farm tools to avoid transportation of mealybugs
- Encourage biological control build up e.g., *Menochilus sexmaculatus*, *Rodolia fumida* or *Cryptolaemus montrosieri*
- Use chemical control with the following active ingredients: Abamectin, Lambda-cyhalothrin, Cryprobug, Bufrofezin, Diazinon, Cypermethrin or Imidacloprid, among others

Note: For better penetration, include a wetter or sticker in the insecticide mix as mealybugs have a waterproof waxy coat, which can reduce the effectiveness of most chemical insecticides

- To avoid the development of resistance to pesticides, alternate between different active insecticidal agents in successive applications
- To achieve good results, it is important to practice an integrated pest management approach on an area-wide scale to prevent reinfestation from nearby farms.

▼ Figure 10. Bacterial canker

Source: Photo by Scot Nelson



Twig blight

Causes: *Lasiodiplodia theobromae*, *Colletotricum* sp.



Identification: Characterized by elongated black necrotic areas on the twigs. Death is observed from the tip downwards.



Treatment/management:

- Prune infected parts
- Use disinfected tools during pruning
- Ensure pruned diseased parts are destroyed to reduce inoculums
- Spray copper-based fungicides

Fruit fly damage

Causes: *Ceratitis cosyra*, *Bactrocera obliqua*, *Bactrocera frauenfeldi*, *Anastrepha* spp.



Identification: Female fruit flies puncture the outer walls of mature fruits with their pointed ovipositors and insert eggs inside the mesocarp of mature fruits. After hatching, larvae feed on the pulp of fruit, which appears normal from outside, but finally drops down.



Treatment/ management:

- Ensure proper aeration of orchard
- Avoid intercropping with alternative hosts, e.g., guava, citrus, pawpaw and melon, among others
- Avoid harvesting overripe fruits because they attract fruit flies
- Allow poultry to feed on pupae under trees
- Destroy infested fruits to break the pest cycle
- Use a structure that allows natural enemies to escape, but traps emerging fruit flies from infested fruits
- Trap fruit flies using pheromone traps with methyl eugenol (Bactrolure liquid) at one trap per five trees. Use fruit fly traps such as Auto Dissemination Device (ADD) by Real IPM or hydrolysed protein (CERA TRAP), among others

- Use natural enemies, especially parasitic wasps. Plant *Lantana camara* to attract and host natural enemies like ants, rove beetles, birds and parasitic wasps
- Use insecticides with active ingredients like Thiamethoxam, Lambda-cyhalothrin or Profenofos, and Cypermethrin all mixed with an adjuvant like INTEGRA.

▼ Figure 11. Twig blight



▲ Figure 12. Fruit fly damage

White mango scale insects

Causes: *Aulacospis tubercularis*, *Coccus* spp., *Ceroplastes* spp.



Identification: The insects suck sap from leaves, branches and fruits causing defoliation and poor blossoming, which affects fruit quality, and can cause retarded growth. Their presence is characterized by irregular flat or pear-shaped, tough, white or dirty white eggs. The eggs hatch into crawlers and crawl towards a feeding place.



Treatment and management:

- Use planting material free from scale insects
- Ensure adequate spacing and pruning
- Conserve natural enemies, e.g., parasitic wasps, ladybird beetles, lacewings
- Control using pesticides with the following active ingredients: Deltamethrin, Azadirachtin and Bifenthrin.

Mango decline, stem gummosis

Causes: *Botryosphaeriaceae* spp., *Physalospora* spp.



Identification: Characterized by intervenal chlorosis and marginal necrosis. Dieback of young stems and eventually death occur. Gummosis is observed on necrotic tissue over time.



Treatment/Management:

- Increased application of iron, manganese and zinc micronutrients helps reduce the problem
- Avoid wounding trees, as wounds can provide an entry point for pathogens
- Use disinfected farming tools during pruning
- Prune infected parts
- Use biological control, e.g., *Trichoderma* spp.
- Use integrated pest management approaches (cultural, chemical and biological)
- Apply fungicide on infected areas.

▼ Figure 13. White scale insects



▲ Figure 14. Mango stem gummosis

▼ Figure 15. Mango flower beetle feeding on panicle



Mango flower beetle



Identification: Adults are characterized by yellow and dark brown marks. They are found on panicles feeding on flowers for pollen and nectar. They are not known to cause economic damage.



Treatment/management:

- Hand pick if numerous beetles are found
- Use parasitoid wasps.

Bacterial black spot

Causes: *Xanthomonas axonopodis* pv.,
Mangiferaeindicae



Identification: Characterized by water-soaked lesions on leaves which become sunken.



Treatment/management:

- Prune off diseased twigs and branches
- Sterilize pruning and harvesting tools
- Use copper-based bactericides

Bark-damaging termites



Identification: They are white to colourless insects common in old mangoes. They make tunnels in branches and feed on plant tissue, forming soil mound. They disrupt movement of food and water up the plant.



Treatment/management:

- Prune old branches
- Ensure trees are not stressed
- Avoid injuring plants to avoid entry points for termites
- Use termite baits
- Use recommended termiticides.

Canker



Identification: Characterized by cracks on stems and branches, leading to rupturing of bark followed by resin exudation.



Treatment/management:

- Practice orchard hygiene
- Use resistant varieties
- Use clean pruning materials to avoid creating a point of entry for inoculum.

▼ Figure 16. Water-soaked lesion caused by bacteria on leaves



▲ Figure 17. Termite damage on mango branch

▼ Figure 18. Resinous canker on mango stem



Pest and diseases of tamarillo

Whiteflies



Identification: Whiteflies are tiny yellow bodied sap-sucking insects, with white wings. Affected plant turns yellow and die. They are also known to be vector of several viruses on tamarillo e.g., cucumber mosaic virus.



Treatment/management:

- Use pest free materials
- Destroy alternative hosts
- Ensure proper weeding
- Protect seedlings by using aerated mesh
- Use traps/pheromones like Roller Trap, Entrap or Monitrap. See <https://realipm.com/>
- Apply chemical treatment of Cyhalothrin at 14-day intervals.



Identification: Characterized by Patches of yellow-green, mosaic patterned mottling and leaf deformation, with reduced fruit quality. Leaves have reduced size and patches of dark green tissue alternating with yellowing.



Treatment/management:

- Remove trees showing virus symptoms to protect other stands from becoming infected
- Use virus free, certified nursery materials
- Avoid intercropping with alternative hosts
- Use resistant root stocks
- Avoid intercropping with alternative hosts like pawpaw, tomato or potato, among others
- Control vectors, e.g., aphids, whiteflies, thrips and grasshoppers by using insecticides with the following active ingredients: Lambda-cyhalothrin, Acetamiprid, etc.

Mosaic virus

Cause: Potyviruses, e.g., tamarillo mosaic virus, potato virus, potato aucuba mosaic virus, alfalfa mosaic virus, tomato spotted wilt virus

▼ Figure 19. Whiteflies



▼ Figure 20. Mosaic virus



Anthracnose disease

Causes: *Glomerella cingulata* or *Colletotricum* spp.



Identification: Mostly affects the fruit, causing dark or brownish concentric necrotic lesions.



Treatment/management:

- Use resistant varieties
- Ensure proper and timely weeding
- Intercrop with non-hosts of anthracnose to avoid inoculum build up
- Use disease germplasm from certified sources
- Apply a preventive fungicide programme from early onset of fruiting due to latent infection e.g., copper-based products.

Scale insects



Identification: Scale insects are immobile and look like small bumps. They are sap-sucking pests that attach themselves to the twigs, leaves, branches and fruits of the host. They exude wax for protection. They withdraw sap, and some species can transmit viruses.



Treatment/management:

- Use natural enemies like parasitic wasps and predators, e.g., beetles, bugs, lacewings and mites
- Prune heavily infested branches to open canopy and expose them to heat and parasites
- Use pesticide baits (insecticides mixed with an attractant)
- Apply neem oil, horticultural oils (e.g., Bonide horticultural oil or Monterey horticultural oil) or insecticidal soap.
- Use systemic insecticides.

Blight

Cause: *Alternaria* spp.



Identification: Initial infection occurs in older leaves, with concentric dark brown spots, which turn yellow with time and finally fall off. Lesions increase with severity.



Treatment/Management:

- Crop rotation with non-host plants
- Use resistant varieties
- Ensure proper weeding
- Use disease free germplasm
- Use foliar fungicide with active ingredients, like Metalaxyl-M, Mancozeb, Difenoconazole among others recommended by PCPB.

▼ Figure 21. Anthracnose



▼ Figure 22. Scale insects



▼ Figure 23. Blight on leaves



Powdery mildew

Causes: several species of fungi from order *Erysiphales* with the most common genera being *Erysiphe*.



Identification: Characterized by fungus growing on surface and producing spores, which appear white on the surface of the leaves and stems.



Treatment/management:

- The orchard should have adequate sunlight and good air circulation to prevent growth of the fungus by controlling humidity
- Control watering to reduce humidity and inhibit growth of the fungi
- Allow proper spacing
- Prune when necessary to reduce shaded leaves

- Remove infected plants to prevent inoculum sources
- In severe cases, chemical control can be applied using sulphur- and copper-based fungicides, e.g., with active ingredients like copper hydroxide, propineb and Cymoxanil. Use biopesticides like neem oil, etc.

Mealybugs



Identification: Characterized by white, waxy-bodied, cotton-like insects. They produce a sugary substance which attracts ants to feed on.



Treatment/management:

- Avoid alternative hosts, e.g., pawpaw, mango, etc.
- Prune heavily infested branches

▼ Figure 24. Powdery mildew



▼ Figure 25. Mealybugs on leaves



- Use clean farm tools to avoid transferring mealybugs
- Encourage natural enemies, e.g., parasitoids.

Aphids



Identification: They are characterized by tiny, brown, reddish brown to blackish brown bodies. They suck fluid from leaves and young shoots. Heavy infestation leads to leaves curling and yellowing. They produce honeydew, which attracts ants.



Treatment/management:

- Practice orchard hygiene, e.g., proper weeding
- Undertake crop rotation with non-host plants

- Use predators, e.g., lacewings, parasitic wasps, etc.
- Use biopesticides, e.g., the insect pathogenic fungus *Metarhizium anisopliae* ICIPE 62.
- Use effective pesticides with the following active ingredients: Lambda-cyhalothrin or Thiamethoxam, among others recommended by PCPB.

Diamondback moth caterpillars



Identification: Diamondback moth caterpillars are green in colour with chewing mouth parts. They feed on leaves, stems and all plant parts.



Treatment/management:

- Crop rotation
- Practice orchard hygiene

▼ Figure 26. Leaves infested with aphids



▼ Figure 27. Diamondback moth caterpillar feeding on a leaf



Pest and diseases of avocado

Aphids



Identification: They are tiny soft-bodied insects that attack fruit trees by sucking the fluid from young leaves. They are brown, reddish-brown to blackish-brown or greyish-green to blackish-green, and covered with a light powdery dusting. Infested leaves curl, stunt and turn yellow. Wilting can occur due to excess sap withdrawal. Aphids produce honeydew, a sugary substance that attracts ants and facilitates growth of sooty mould, which reduces photosynthesis activity in leaves.



Treatment/management:

- Timely weeding
- Orchard hygiene and sanitation is required
- Use natural enemies, e.g., parasitic wasps or lace beetles, among others
- Use resistant varieties
- Use contact and systemic insecticides with the following active ingredients: Imidacloprid, Acephate, among others
- Alternate various chemicals within a crop season to avoid the building up of resistance

- Mix the chemicals with Integra or any other sticker, penetrant and spreader to enhance their effectiveness
- You can use Jambo Clean to clear sooty mould or any other effective product available in the market.

Stem end rot

Causes: *Lasiodiplodi theobromae*, *Dothiorella* sp., *Phomopsis* sp., *Botryosphaeria*



Identification: Dark brown to black rot begins at stem ends and continues toward the other ends. Stem end rot may cause symptoms similar to those of anthracnose disease. The rate of rot development depends on storage temperature and transport.



Treatment/management:

- Avoid injuring fruit, as wounds provide an entry point for pathogens
- Reduce time between harvesting and consumption
- Apply fungicide to manage the disease in the field
- Treat the fruit with a fungicide after harvest.

▼ Figure 28. Aphids



▼ Figure 29. Stem end rot



Avocado scab disease

Cause: *Sphaceloma perseae*



Identification: Avocado scab disease causes lesions, which appear as small dark spots slightly raised on fruits. It gives a corky appearance to the surface of the fruit.



Treatment/management:

- Proper orchard sanitation, e.g., timely weeding, pruning, sterilizing pruning tools, and removing plant debris and rotten fruits, among others
- Ensure proper watering and pruning
- Apply a fungicide spray programme with the following active ingredients: Benomyl, Metiram, Propineb or Thiabendazole, among others at pre-flowering and after harvest.

Whiteflies



Identification: Characterized by two-winged, white-bodied insects. They suck sap from leaves causing them to turn yellow and fall off following heavy infestation.



Treatment/management:

- Ensure proper weeding
- Avoid alternative hosts
- Use traps like Roller Trap or Entrap, among others
- Use effective recommended pesticides, e.g., Pyrethroid.

Fruit flies



Identification: Fruit flies are two-winged insects, which puncture the surfaces of fruits, leaving holes and causing black lesions. They also puncture twigs and branches, and lay eggs, which hatch into maggots.



Treatment/management:

- Prune the orchard to improve aeration
- Harvest mature and not overripe fruits, which attract fruit flies
- Preserve natural enemies, e.g., beetles, ants, parasitic wasps and birds.

▼ Figure 30. Avocado scab



▼ Figure 31. Avocado leaves infested with whiteflies



▼ Figure 32. Avocado branch and fruit damaged by fruit flies





▲ **Figure 33. Stem borer**
Source: <https://avodemia.com/wp-content/uploads/2021/12/image-4.png>

Stem borers

Identification: Stem borers are larvae that burrow into avocado stems and feed on internal tissue. They can girdle young seedlings and cause older stands to stunt and produce less fruit.

Treatment/Management:

- Cut off infested branches
- Introduce parasitic wasps
- Plant repellent plants like Mexican marigold, which produce chemicals that repel stem borers.

Cercospora spot disease

Cause: *Pseudocercospora purpurea*

Identification: Characterized by irregular dark brown lesions, which eventually harden and crack. Leaves display brown spots surrounded by yellow halos. The twigs and pedicles may show dark brown lesions, which can cause premature fruit fall.

Treatment/management:

- Proper sanitation to avoid insect pests
- Avoid intercropping with alternative hosts
- Prune dead branches and remove any fallen fruit
- Disinfect farm tools before use
- Apply chemicals, e.g., Captan, Thiophanate-methyl, Dithiorcarbamates, copper hydroxide

Thrips

Causes: *Selenothrips* spp., *Heliethrips* spp.

Identification: Thrips are small slender insects that feed by sucking sap from leaves, flowers fruits and branches. Infested fruits show silver, brown discolouration. Scabby or leathery brown scars appear as fruits enlarge, sometimes stunting fruits.

Treatment/management:

- Prune trees to allow light to penetrate into the orchard.
- Conserve natural enemies and avoid persistent use of pesticide
- Use lambda-cyhalothrin-based products, e.g., Duduthrin; Imidachlopid-based insecticides, e.g., Tata Mida 200SL or Confidor; horticultural oil, Pyrethrin, Alonze, Profile, Defender, Fenthion, Carbaryl, Decamethion, Malathion, Omethoate, Diazinon, among others recommended by PCPB.

▼ **Figure 34. Cercospora**
Source: <https://www.cabi.org/>



▼ **Figure 35. Thrips on leaves**



Anthracnose

Cause: *Colletotrichum gloeosporioides*



Identification: Characterized by occurrence of brown spots, and premature fruit drop. Symptoms develop on flowers, fruits, leaves or twigs. After harvest, the lesions on fruit become darker, larger and sunken. The lesions eventually spread on fruit surfaces and in the pulp. The fruit rots, and decay advances.



Treatment/Management:

- Practice orchard hygiene
- Remove dead parts
- Ensure proper pruning
- Use resistant varieties e.g., Hass rather than Fuerte
- Use chemical control with copper-based fungicides e.g., with active ingredients like Mancozeb, sulphur, copper hydroxide, Benomyl, Metiram, Propineb, Thiabendazole or Triforine
- Apply treatment on fruit using Tecto 500 SC, for example, as a post-harvest treatment.

Mites

Cause: *Oligonychus perseae*



Identification: Mites cause development of circular chlorotic brown spots under the leaves and fruit surface. The colonies cause a silk webbing.



Treatment/management:

- Apply fertilizers
- Ensure proper pruning
- Water regularly to avoid plant stress
- Apply horticultural oil
- Use the predatory mite like *Phytoseiulus persimilis*.

▼ **Figure 36. Anthracnose**

Source: Scot Nelson <https://www.flickr.com>



▲ **Figure 37. Mite damage on fruit**

Avocado root rot

Cause: *Phytophthora cinnamom*



Identification: The fungus thrives best in soils with excess moisture. It is characterized by yellowing and falling of leaves; wilting and dieback of shoots; and little new leaf growth. Trunks can show water soak cankers and blackened roots, which rot and die with time.



Treatment/management:

- Use disease free germplasm
- Avoid alternate hosts, which include grevillea, acacia, eucalyptus, casuarina, etc.
- Remove and destroy diseased trees in the orchard
- Avoid moving soil or water from infested areas
- Sterilize farm tools before and after use
- Ensure proper drainage and avoid excess moisture in soil
- Seeds obtained from soil should be treated in hot water (50°C for 20 mins)

- Drench the soil with *Trichoderma* to limit spread
- Practice mulching and ensure good soil health
- Use resistant varieties, e.g., Puebla
- Use fungicides with the following active ingredients: Mancozeb, sulphur, copper hydroxide, Metalaxyl-M, Oxathiapiprolin, S-Isomer or Fosetyl-aluminium, among others around canopy areas as a soil drench at monthly intervals.

Mealybugs



Identification: Characterized by white, creamy-coloured insects with waxy bodies. They produce a sugary substance, which attracts ants and growth of sooty mould.



Treatment/management:

- Proper aeration of orchards by pruning
- Reduce inoculum sources by pruning heavily infested branches
- Avoid alternative hosts.

▼ Figure 38. Avocado root rot



▼ Figure 39. Avocado infested with mealybugs



Red rust



Identification: Also called algae spot, it is characterized by tiny, rust-coloured spots on leaves. It is caused by parasitic algae, *Cephaleuros* spp.



Treatment/management:

- Ensure proper pruning
- Sterilize pruning materials
- Use copper-based fungicides

Avocado lace bugs



Identification: Avocado lace bugs are small sap-sucking insects that suck sap from leaves, causing chlorotic blotches on leaves, which eventually dry out after heavy infestation. Lace bugs restrict their feeding to the undersides of leaves and insert their needle-like mouthparts into leaf tissue cells causing curling.

Dead areas appear salt damaged. Heavy feeding causes leaf drop.



Treatment/management:

- Apply insecticidal soaps, horticultural oils, neem oil or Pyrethrin.

Heart-shaped scale insects



Identification: They are small heart-shaped parasites. Adults are immobile and feed on phloem sap through their piercing-sucking mouth parts. They excrete honeydew, on which sooty mould can develop. They cause leaves to yellow and eventually drop off.



Treatment/management:

- Encourage natural enemies, e.g., parasitoids
- Use pesticides like Buprofezin during crawlers' active stage.

▼ Figure 40. Algae spot on avocado leaves



▼ Figure 41. A lace bug-damaged leaf



▼ Figure 42. Heart-shaped scale insects on avocado leaves



Pests and diseases of *Grevillea robusta*

Botryosphaeria canker

Cause: commonly caused by fungi from family Botryosphaeriaceae



Identification: Characterized by dark sunken lesions followed by gum exudate around the lesions.



Treatment/management:

- Remove infected trees
- Use proper pruning techniques to avoid unnecessary wounding, which can provide an entry point for pathogens
- Promote tree vigour by timely weeding and pruning
- Ensure proper site matching to avoid a stressful environment for trees
- Use disease-free seeds and seedlings
- Pruning tools should be disinfected, and wounds sprayed with fungicides to reduce chances of infection.

Termites

Cause: Genus Macrotermes



Identification: Termites are small or medium sized, whitish or colourless insects with short antennae. They have strong biting mouthparts and live in social groups. They are considered to be of economic importance, but some can cause considerable damage. They cause ring-debarking destructing vascular bundles.

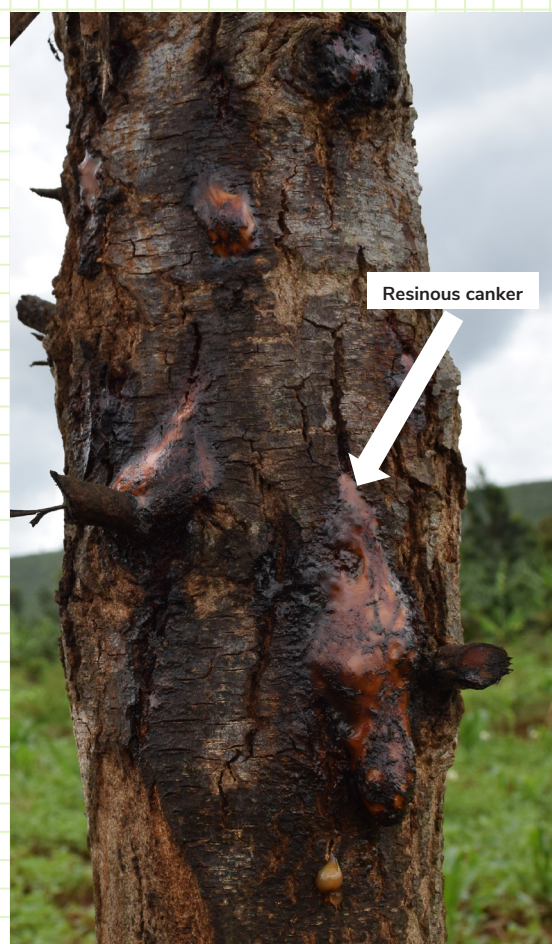


Treatment/management:

- Use tolerant tree species, e.g., *Melia volkensii* as an option for agroforestry in termite prone areas, or incorporate indigenous tree species of desired qualities in Arid and Semi-arid lands (ASALS)
- Use termite baits (Novaluron, Hexaflumuron)
- Use botanicals, e.g., *Melauleuca* spp., *Tagetes erecta*, garlic oil, *Aframomum meleguata*, *Azadirachta indica*, among others

- You can use bacteria, e.g., *B. thuringiensis*
- Apply termiticides regulated by PCPB, e.g., pyrethroids like Permethrin that repel termites from the treatment barrier, and those that kill by lethal contact, e.g., Fipronil or Imidacloprid.

▼ **Figure 43. Canker**



▼ **Figure 44. Termite damage on bark of *G. robusta***



Information source links

Beije, C.M., Kanyangia, S.T., Muriuki, S.J.N., Otieno, E.A., Seif, A.A. and Whittle, A.M. (1984). Horticultural Crops Protection Handbook. National Horticultural Research Station, Thika, Kenya.

CAB International (2005). Crop Protection Compendium, 2005 edition. Wallingford, UK www.cabi.org

Fully registered pest control products in Kenya, Version 2022. Website www.pcpb.go.ke

Griesbach, J. (2003). Mango Growing in Kenya. World Agroforestry Centre (ICRAF). ISBN 92 9059 149 8. www.worldagroforestry.org

Griesbach, J (2005). Avocado Growing in Kenya. World Agroforestry Centre, Nairobi, Kenya. ISBN: 92 9059 173 0. www.worldagroforestrycentre.org

OISAT (Online Information Service for Non-Chemical Pest Management in the Tropics). www.oisat.org.

Varela, A.M., Seif, A., Nyambo, B. (2006). A Guide to IPM in Mango Production in Kenya. ICIPE. Modern Lithographic Ltd., Nairobi, Kenya. www.icipe.org

<https://infonet-biovision.org/PlantHealth/Natural-enemies>

<https://www.plantwise.org/KnowledgeBank/pmdg/20157801494#>

<https://www.kefri.org/assets/questionnaire/ipm.pdf>

<https://www.agrifarming.in/mango-pests-diseases-and-control-methods-a-full-guide>

<https://oxfarm.co.ke/fruit-farming/blog-post/mango-farming/pest-and-disease-management-in-mango-farming-in-kenya/>



For more information contact:

Sheillah Cherotich, Plant Pathologist at CIFOR-ICRAF
s.cherotich@CIFOR-ICRAF.org



Funded by European Union

World Agroforestry (ICRAF)

United Nations Avenue, Gigiri
PO Box 30677, Nairobi, 00100, Kenya
T +254 20 7224000
F +254 20 7224001
USA T +1 650 8336645
USA F +1 650 8336646
Email: worldagroforestry@CGIAR.org
www.worldagroforestry.org

CIFOR-ICRAF

The Center for International Forestry Research (CIFOR) and World Agroforestry (ICRAF) envision a more equitable world where trees in all landscapes, from drylands to the humid tropics, enhance the environment and well-being for all. CIFOR and ICRAF are CGIAR Research Centers.

