National Agricultural Research and Extension Institute

# A Pictorial Guide

## to Insects, Pests & Diseases

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# PREFACE

This booklet is a compilation of information collected from plant samples submitted to the Plant Pathology, Entomology and Weed Science Department for analysis.

It highlights the common diseases (fungi, bacteria, virus, protozoa and nematodes); physiological disorders and insects that play a role in agriculture production.

The information generated will assist farmers and other stakeholders in the identification and management of common problems experienced.



National Agricultural Research and Extension Institute

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Guyana

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**PHYSIOLOGICAL DISORDERS**



**INSECTS**

# FUNGAL PLANT DISEASES

**Common Name:** Anthracnose
**Causative Agent:** *Colletotrichum spp.*
**Crops Affected:** Pepper, Papaw, Sour sop

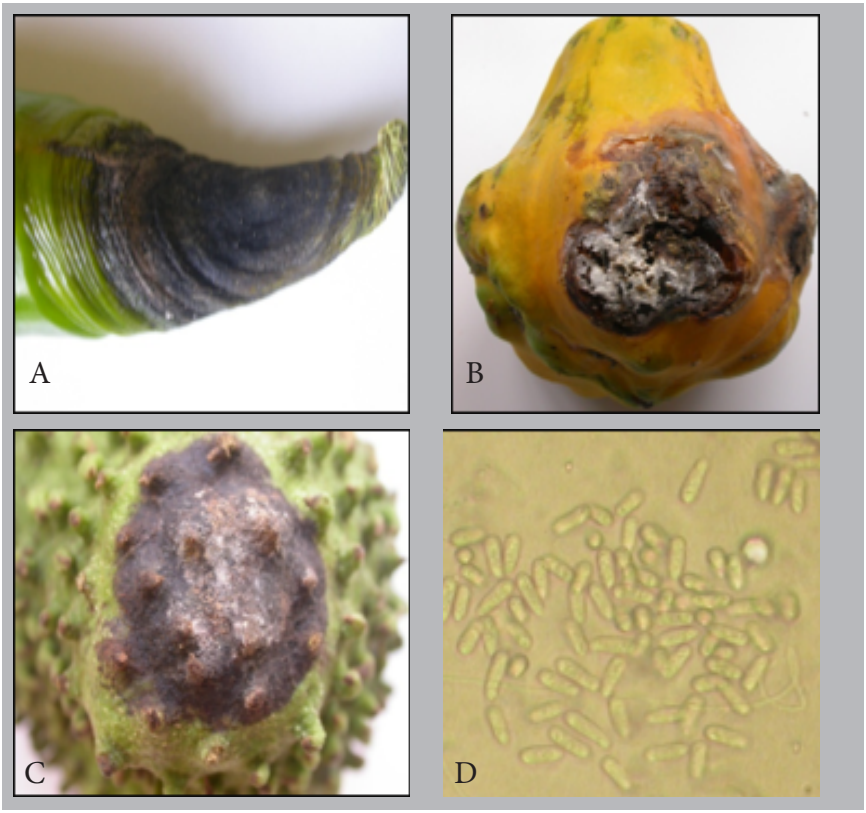



Figure 1: (A) Concentric lesions on the pepper surface. (B) White mycelial growth on papaw. (C) Oval shape, black lesion on Soursop (D) Conidiospores of Colletotrichum spp.

**Disease Management:**

- Avoid water splash in field during irrigation to prevent spread of the disease. Use clean seeds, resistant cultivars, adequate spacing, and practice crop rotation and field sanitation.
- Rotate appropriate fungicide e.g. Copper hydroxide, at fruit set and at regular intervals. Hot water dip at 48$^{o}$C for 20 minutes is effective.

**Common Name:** Black and Yellow Sigatoka Diseases
**Causative Agent:** *Mycosphaerella musicola Mycosphaerella fijiensis*
**Crops Affected:** Plantains and Bananas

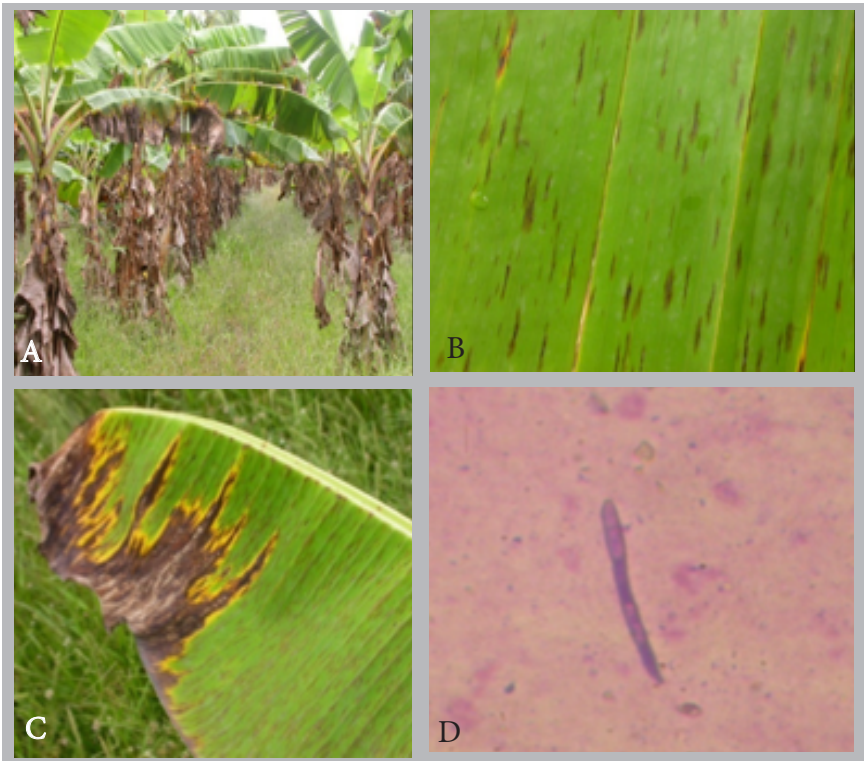



Figure 2: (A) Plantain field infested with Yellow & Black Sigatoka Diseases (B) Dark brown lesions on a plantain leaf (C) Leaf margin with necrotic areas (D) Asexual conidia of Black Sigatoka

**Disease Management:**
IPM practices include:

- Field sanitation, leaf surgery and leaf tip removal of diseased leaves. Provide adequate drainage, irrigation, weed control and use resistant cultivars if available.
- Provide adequate nutrition with high nitrogen and potassium levels.
- Timely application of contact and systemic fungicides should be rotated depending on weather conditions and disease severity.

**Common Name:** Brown Leaf Spot of Cassava
**Causative Agent:** *Cercosporidium henningsii*
**Crops Affected:** Cassava


Figure 3: (A) Chlorotic symptoms on cassava leaf. (B) Leaf with brown irregular lesions (C) Spore of Cercosporidium sp. X40 magnification

**Disease Management:**
IPM practices include:

- Field sanitation, crop rotation and weed control.
- Provide adequate drainage to reduce soil moisture.
- Use disease free planting material.
- Fungicide e.g. Cuprous oxide and copper oxychloride based fungicides provide good control.

**Common Name:** Cercospora leaf spot
**Causative Agent:** *Cercospora sp.*
**Crops Affected:** Poi

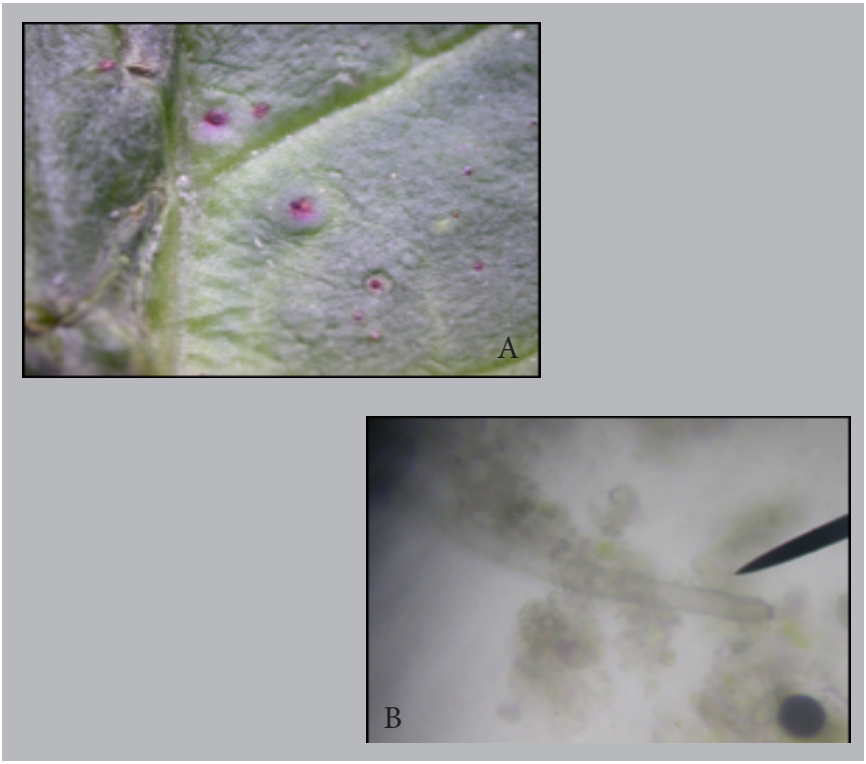



Figure 4: (A) Small, purplish, circular lesions on Poi. (B) Cercospora spore at X40 magnification.

**Disease Management:**

- Provide adequate weed control
- Use high quality, disease free seeds.
- Destroy infected plants after harvest to minimize disease spread to subsequent crops
- Rotate with non-host crop
- Avoid splashing irrigation water onto plant leaves.

**Common Name:** Fusarium Fruit and Stalk Rot
**Causative Agent:** *Fusarium sp.*
**Crops Affected:** Boulanger, Ochro, Tomato

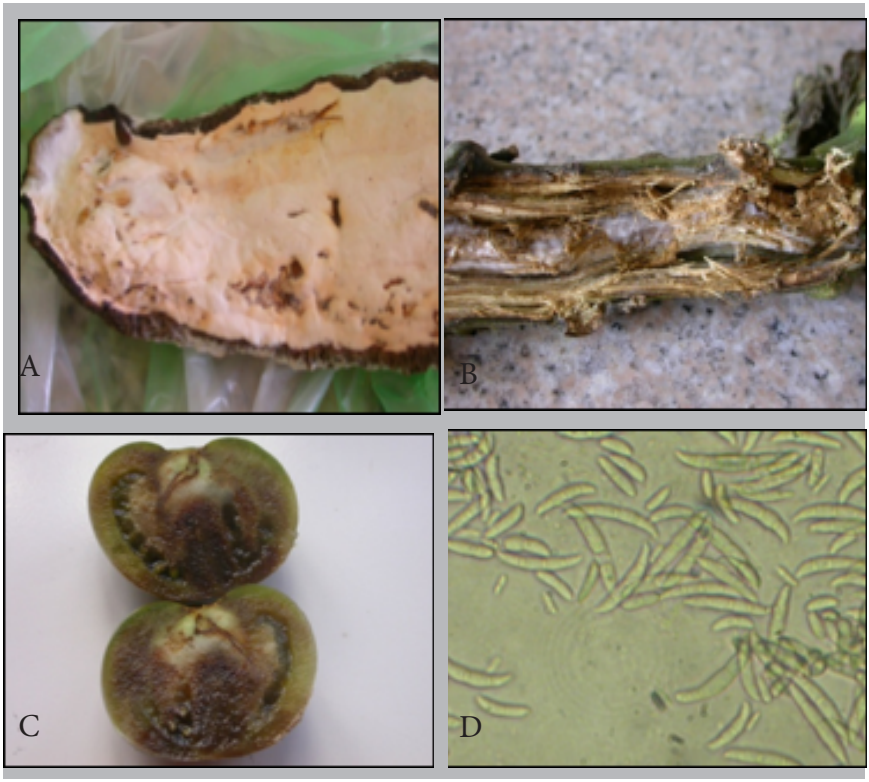



Figure 5: (A) Creamish-peach mycelial growth on the inner portion of the Boulanger. (B) White mycelial growth on Ochro. (C) Dark brown discoloration of tomato. (D) Fusarium spores (macro and micro conidia) at X40 magnification.

**Disease Management:**

- Practice crop rotation and use resistant varieties.
- Plant on ridges to reduce soil moisture.
- Plant in disease free soil using clean planting material.
- Soil fumigation, or treat soils using soil fungicides e.g. Ridomil Gold, Acrobat.

**Common Name:** Gummosis
**Causative Agent:** *Fusarium, Pestalotia, and Colletotrichum spp.*
**Crops Affected:** Pineapple

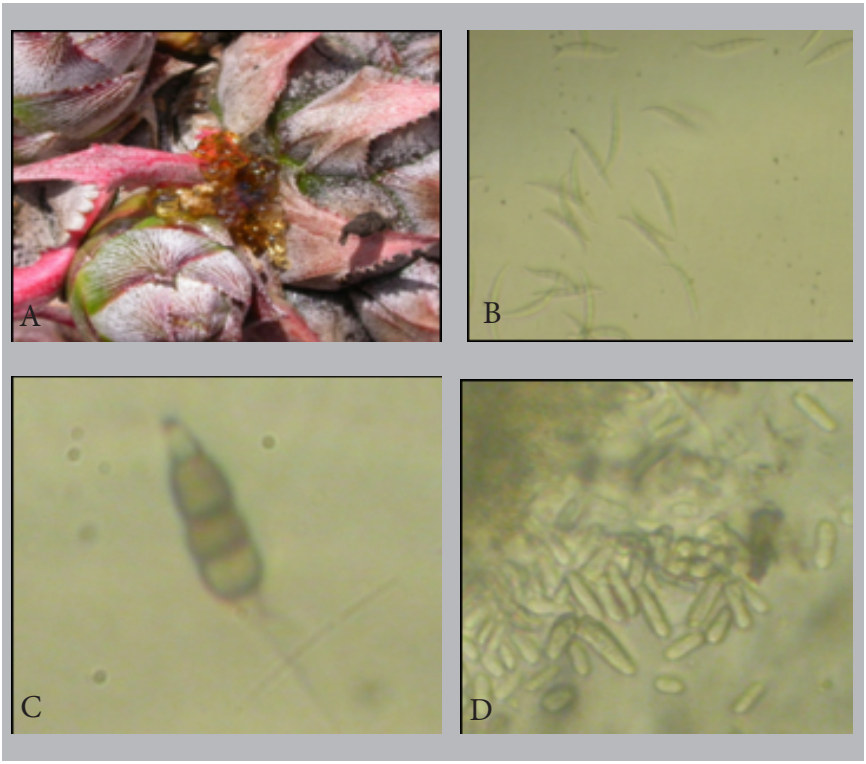



Figure 6: (A) Gummy material exuding from the fruit. (B, C, D) Spore of Fusarium, Pestalotia and Colletotrichum species respectively.

**Disease Management:**

- Provide adequate drainage and irrigation to reduce pathogen levels.
- Provide good weed control around plants.
- Injuries to the pineapple fruit must be avoided, since they provide entry points for pathogens.
- Systemic fungicides may be used to protect against infection.

**Common Name:** Leaf spot of Coconut
**Causative Agent:** *Curvularia sp.*
**Crops Affected:** Coconut

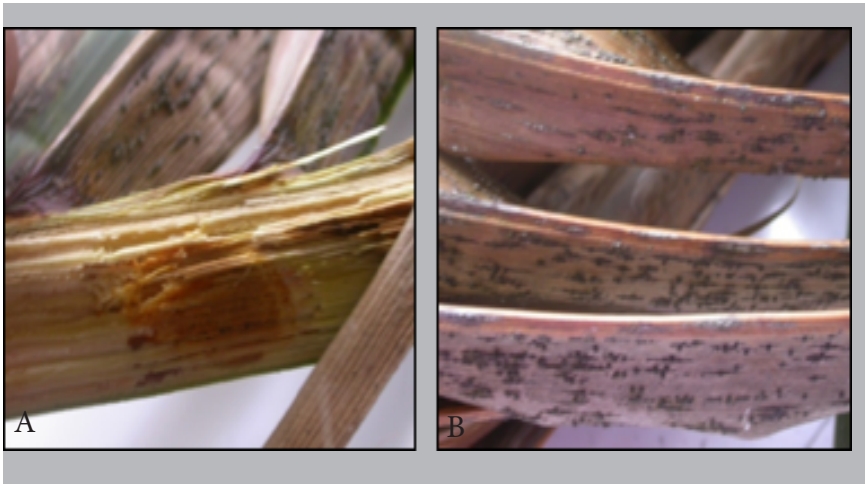



Figure 7: (A) Brown necrotic area on the midrib (B) Black perithecia on the leaf blade.

**Disease Management:**

- Space seedling at 60 x 60 cm triangular distance to provide adequate room for developing palms.
- Prune and collect damaged leaves and burn infected seedlings in nursery.
- Overcrowding predisposes young plants to infection.
- Provide adequate nutrition to allow for vegetative growth, vigor & resistance to the disease.
- Spray appropriate fungicides such as Captan or Mancozeb at 10ml per gallon water every 10-14 days.

**Common Name:** Leaf spot of pineapple
**Causative Agent:** *Botryodiplodia sp.*
**Crops Affected:** Pineapple

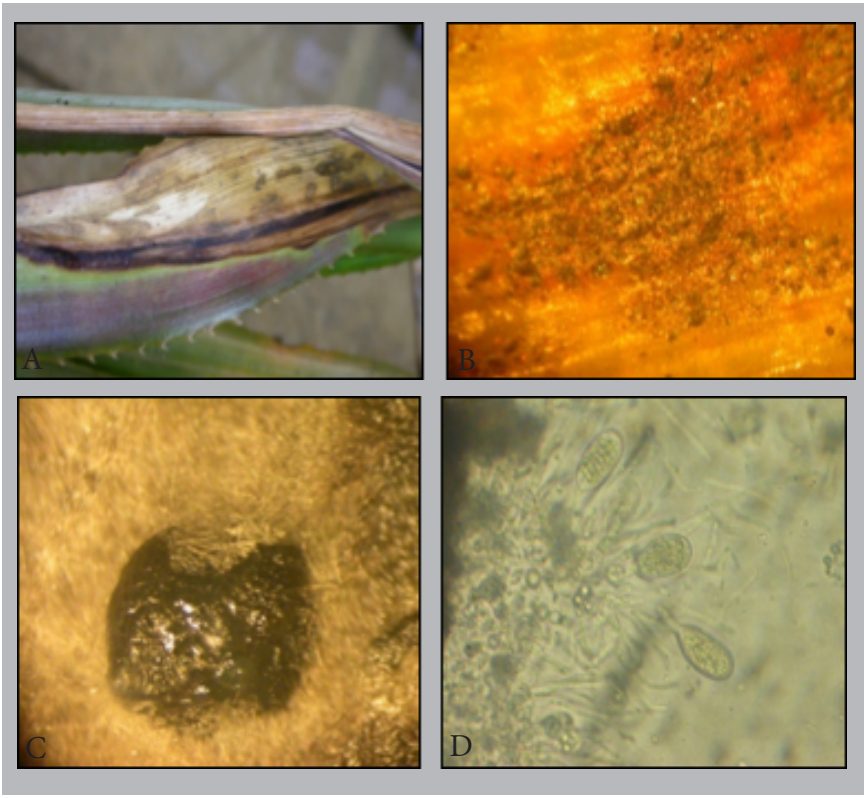



Figure 8: (A) Brown longitudinal lesion on the pineapple leaf. (B) Small, black pycnidia on the surface of the leaf. (C) Black pycnidia on Agar plates. (D) Botryodiplodia spores at X40 magnification.

**Disease Management:**

- Avoid planting pineapple in moist, shady areas and too close to each other.
- Prune plants to improve air circulation.

**Common Name:** Powdery mildew
**Causative Agent:** *Erysiphe sp.*
**Crops Affected:** Papaw

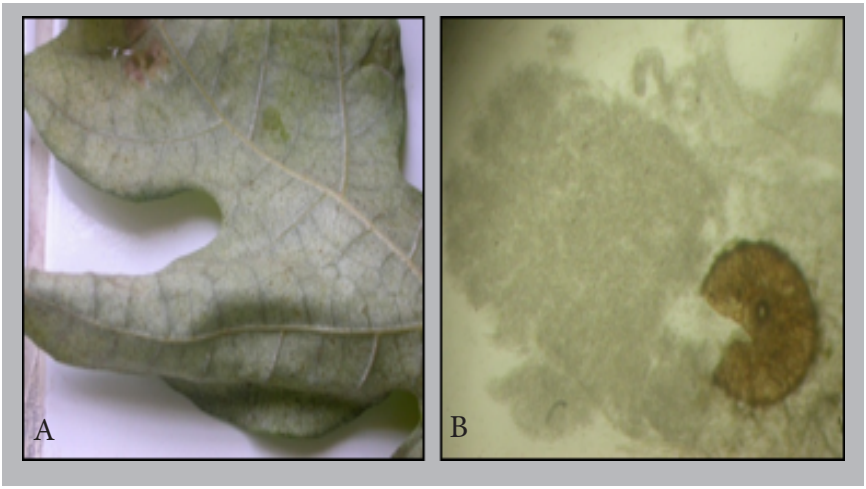



Figure 9: (A) White powdery appearance of leaf. (B) Pycnidia of Erysiphe with numerous spores at X40 magnification

**Disease Management:**

- Avoid planting in low areas with high humidity
- Keep plants well-spaced and properly thinned to promote good air circulation
- Use resistant varieties.
- Fungicides are most effective when applied immediately at the first signs of infection such as Kocide or Copper Hydroxide.

**Common Name:** Sclerotia Stem Rot
**Causative Agent:** *Sclerotinia spp*
**Crops Affected:** Pigeon Peas


Figure 10: (A) Brown lesion on the plant stem. (B) Small, brown and white sclerotia with mycelial growth on the plant stem. (C) Black Sclerotia at X40 magnification.

**Disease Management:**

- Avoid irrigation during flowering and maintain good weed control. Use appropriate plant spacing.
- Practice crop rotation this will limit the potential for damage to subsequent vegetable crop.
- Foliar fungicides are applied in seed fields with a history of severe disease development.

**Common Name:** White Leaf of Pineapple
**Causative Agent:** *Pestalotia sp.*
**Crops Affected:** Pineapple

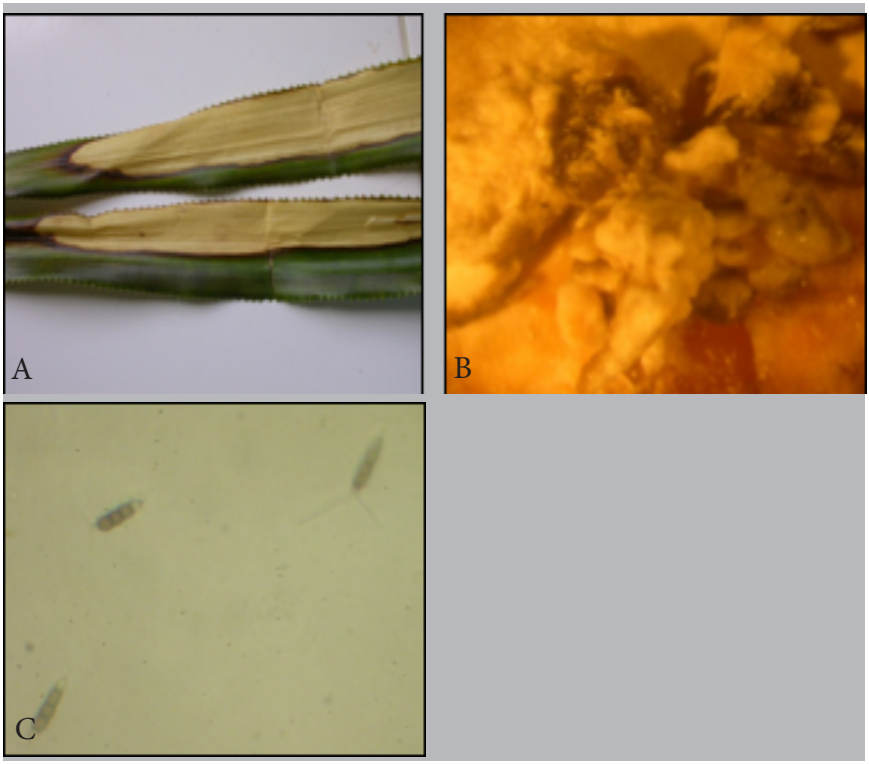



Figure 11: (A) Cream longitudinal lesion on pineapple leaf. (B) Whitish-cream acervuli on agar plate. (C) Pestalotia spores at X 40 magnification.

**Disease Management:**

- Use of copper based fungicides

# BACTERIAL PLANT DISEASES

**Common Name:** Bacterial Blotch of Watermelon
**Causative Agent:** *Acidovorax avenae subsp.citrulli*
**Crop Affected:** Watermelon

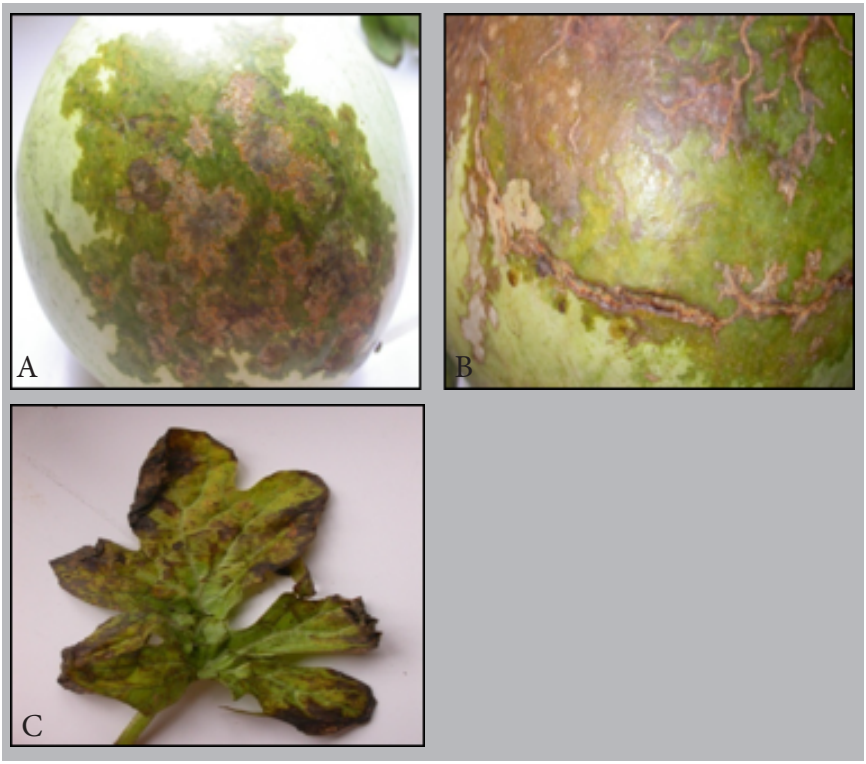



Figure 1: (A) Large, brown, water-soaked lesion on watermelon fruit. (B) Large cracks developed on the fruit (C) Brownish-black lesions on the leaf.

**Disease Management:**

- Use disease free planting material.
- Eliminate long periods of leaf wetness and provide adequate plant nutrients.
- Applications of copper-based fungicides e.g. Coback, Mankocide can be used to reduce disease incidence.

**Common Name:** Moko disease
**Causative Agent:** *Ralstonia solanacearum*
**Crops Affected:** Plantain and Banana

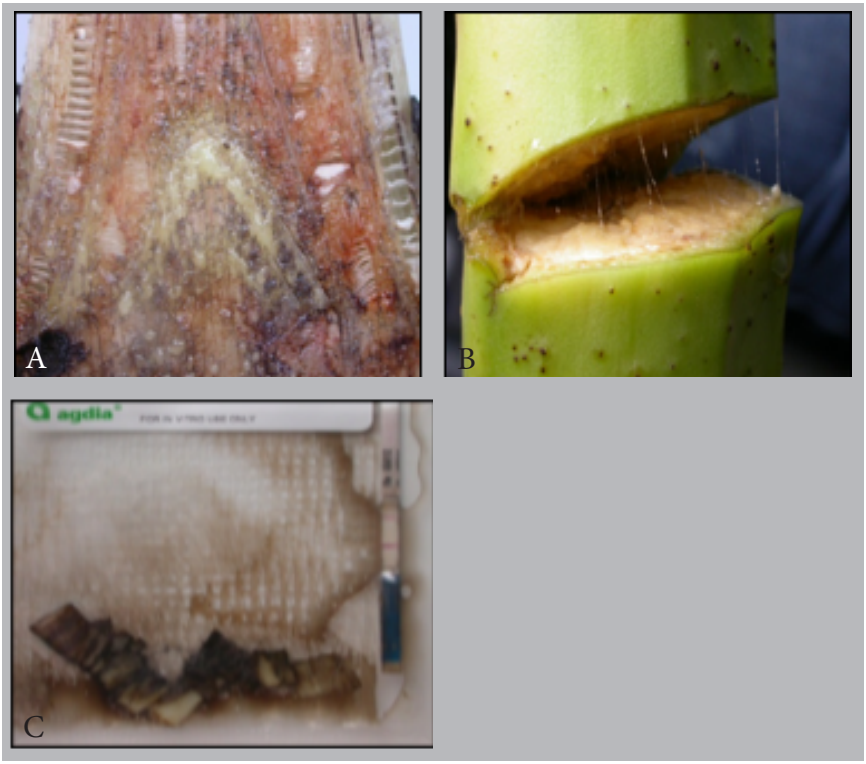



Figure 2: (A) Oozing of bacteria from the inner portion of the plantain sucker. (B) Bacteria sling on a plantain sample. (C) Test kit showing plantain sample +ve for R. solanaceraum

**Disease Management:**

- Use disease free planting materials from clean fields and remove all diseased plants. Remove weeds that are host of the bacteria. Practice crop rotation with non-host crops such as yams, sweet potatoes and eddoes.
- Disinfect field tools; boots etc. before and after using with 5% bleach for at least 10 minutes. Provide good drainage to avoid run-off water from contaminated fields.

**Common Name:** Bacterial wilt
**Causative Agent:** *Ralstonia solanaceraum*
**Crops Affected:** Tomato, Boulanger, Heliconias

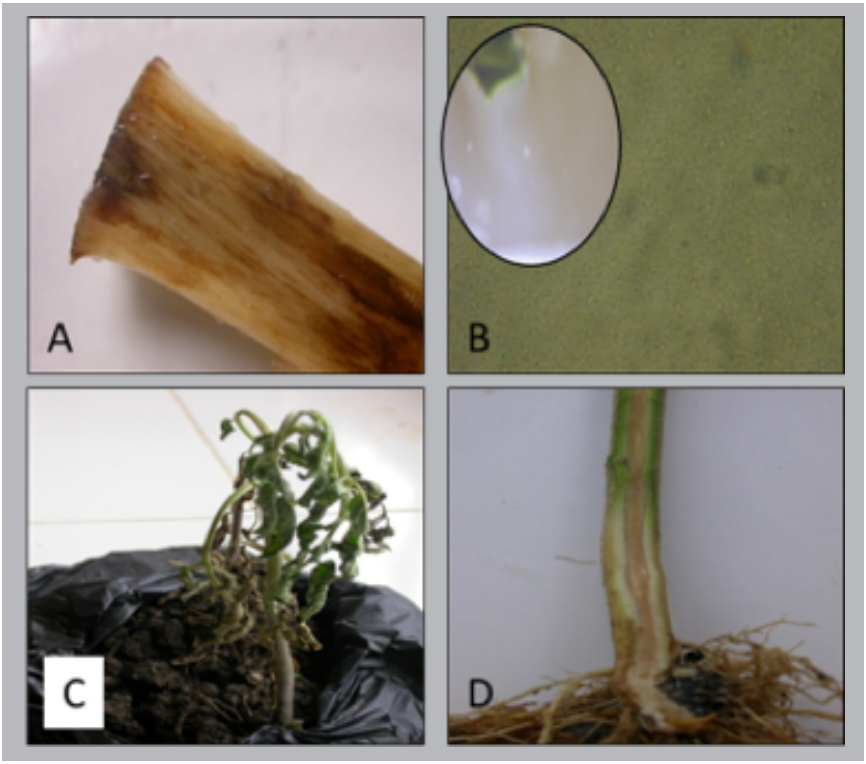



Figure 3: (A) Brown discoloration of the phloem and xylem vessels in Heliconias. (B) Bacteria at X40magnification (insert) bacteria oozing from the plant tissue. (C) Wilting symptoms on tomato plant. (D) Internal browning of the xylem vessels.

**Disease Management:**

- Practice crop rotation with non-susceptible crops or use resistant cultivars. Practice good field sanitation, removal of infected plants and avoid flooded conditions.
- Plants can be treated using bactericide/fungicide e.g. Serenade and copper based fungicides.

**Common Name:** Soft rot of cabbage
**Causative Agent:** *Erwinia spp*
**Crops Affected:** Cabbage

Figure 4: Black, brown discolouration on the cabbage.

**Disease Management:**

- Plant only certified, disease-free seeds or transplants.
- Plants in disease free fields and rotate cabbage with non host plants.
- Plant cabbage only in areas that provide good soil drainage and free air movement.
- Provide a balanced nutrition for the plant.
- Control all cruciferous weeds in and around the production area.
- Use copper-based or bactericide fungicide .

# VIRAL PLANT VIRUS

**Causative Agent:** *Citrus Tristeza Virus* (*Closterovirus*)
**Crops Affected:** Citrus

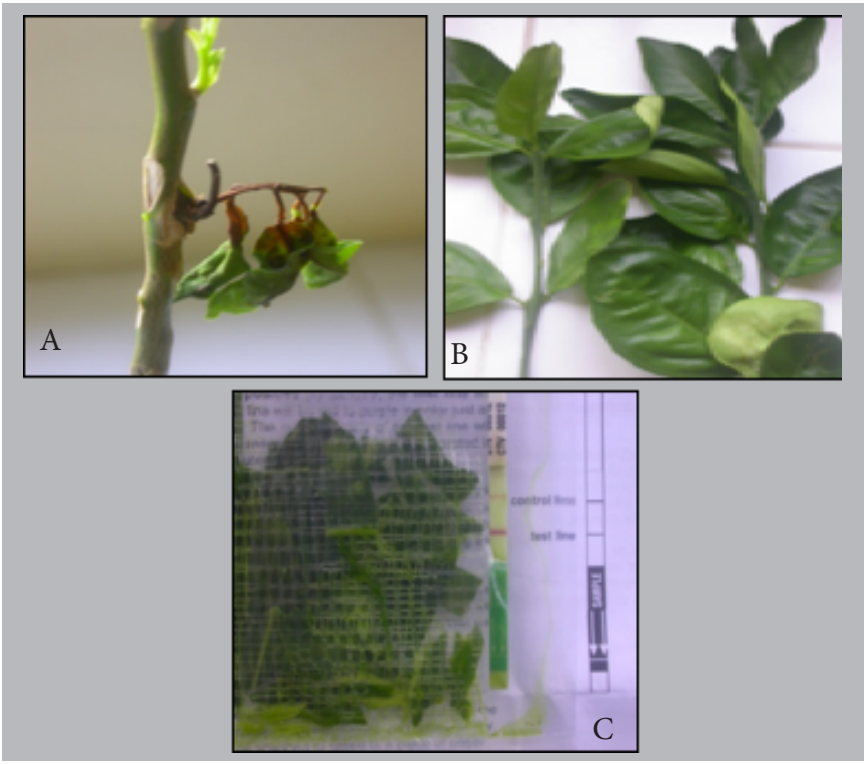



Figure 1: (A) Bud dieback on citrus. (B) Healthy looking citrus leaves infected with CTV. (C) Test Kit +ve for CTV.

**Disease Management:**

- Control the spread of citrus aphid (*Toxoptera citricida*) to reduce aphid populations.
- Use tolerant or resistant rootstock. Trim the sides and top of trees to encourage good air flow.
- Use natural enemies of citrus aphids to reduce migrant vector populations.

**Common Name:** Scarlet Tip Virus
**Crops Affected:** Pineapple

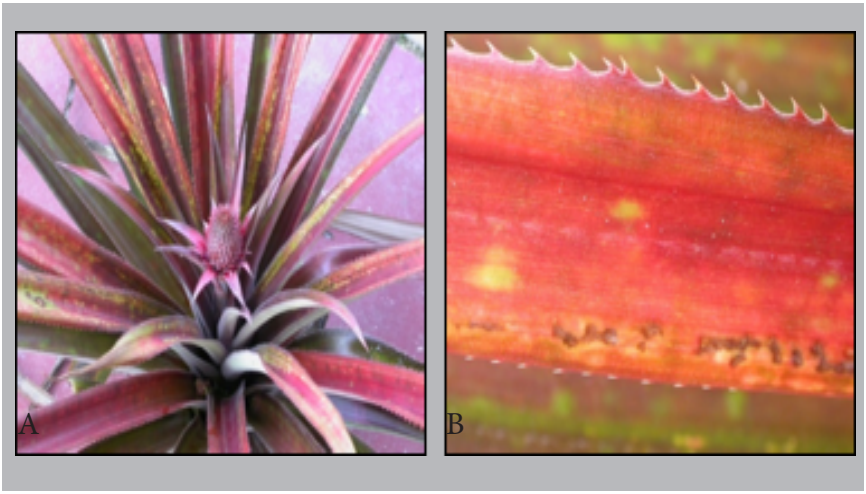



Figure 2: (A) Pinkish colour on the leaves of the pineapple plant. (B) Leaf showing symptoms of Scarlet tip disease.

**Disease Management:**

- Rogue and burn all diseased plants as soon as they are spotted in the field.
- Careful selection of planting material
- Mother plants should be green in color, erect with firm leaves and free from rots and gums.
- Materials infested with mealy bugs should not be selected.
- Selected material should be trimmed of old (dry) tissues around the bases and treated with a solution of insecticide (VydateL).
- Imidacloprid can be sprayed on to the plants at the recommended rate to control mealybug and ant populations.

**Common Name:** Watermelon Mosaic Virus (WMV)
**Crops Affected:** Watermelon and other cucurbits


Figure 3: (A) Variegated fruit. (B) Vein clearing, crinkling of the leaves. (C) Aphids that are vectors of WMV.

**Disease Management:**

- A possible line of defense against the disease may be the identification of the insect vector (aphids) and the use of broad spectrum insecticides.
- Rouguing of diseased plants is also helpful to prevent the disease spread.
- Provide the plant with adequate plant nutrients.

# PROTOZAL PLANT DISEASES

**Common Name:** Heartrot disease (flagellate protozoa)
**Crop Affected:** Coconut

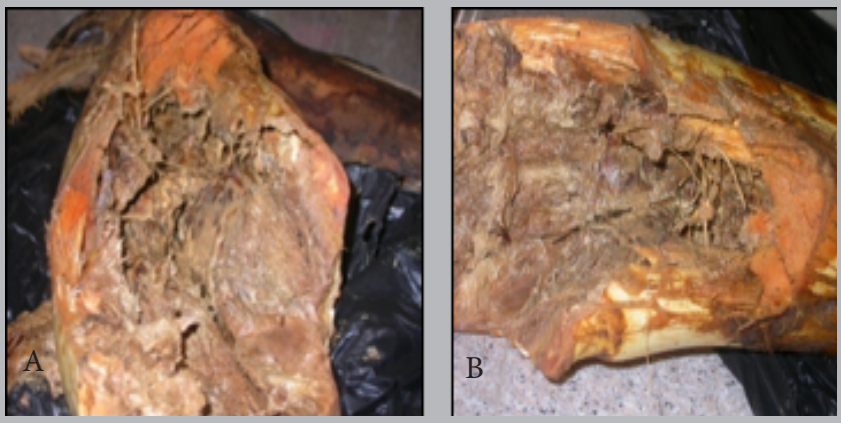



Figure 1: (A) Soft, decayed tissue in the coconut heart, often with a high odour. (B) Dark brown tissue with a muddy appearance.

**Disease Management:**

- A possible line of defense against the disease may be the identification of insect vector and the use of broad spectrum insecticides.

# PLANT PARASITIC/ NON PARASITIC NEMATODES

**Causative Agent:** Lance nematode (*Hoplolaimus galeatus*)
**Crops Affected:** Grass, Soil

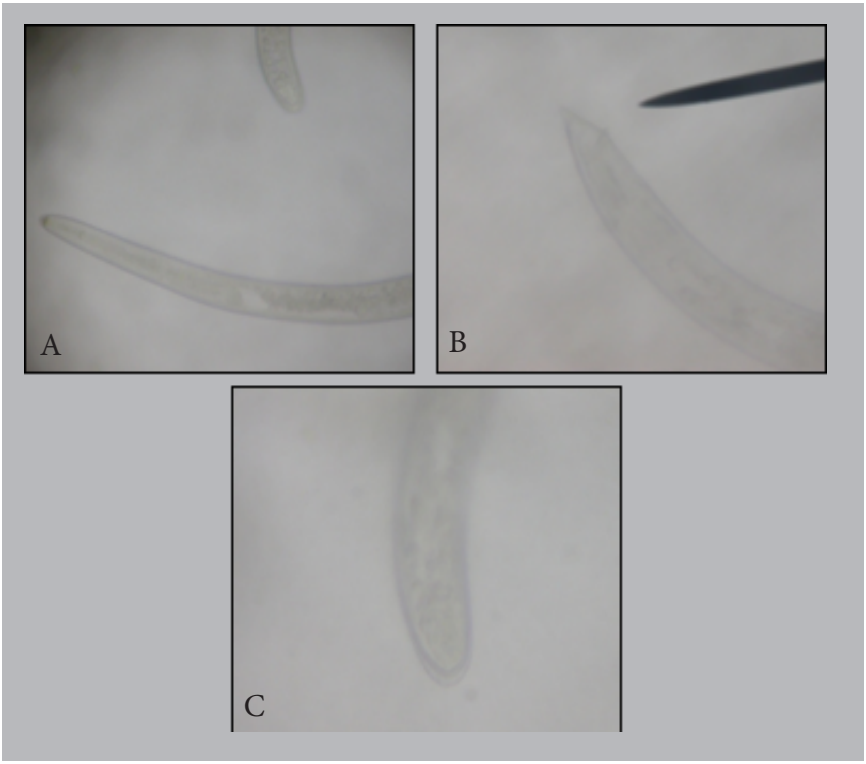



Figure 1: (A) Adult female with protruding stylet. (B) Posterior portion of an adult male. (C) Posterior portion of an adult female. X40mag.

**Disease Management:**

- Practice crop rotation with resistant or non-host crops.
- Balanced fertilizer application - reduced use of nitrogen
- Use of fumigants

**Causative Agents:** Root knot nematodes (*Meloidogyne and Heterodera spp*)

**Crops Affected:** Sweet pepper, Boulanger, Celery, Poi

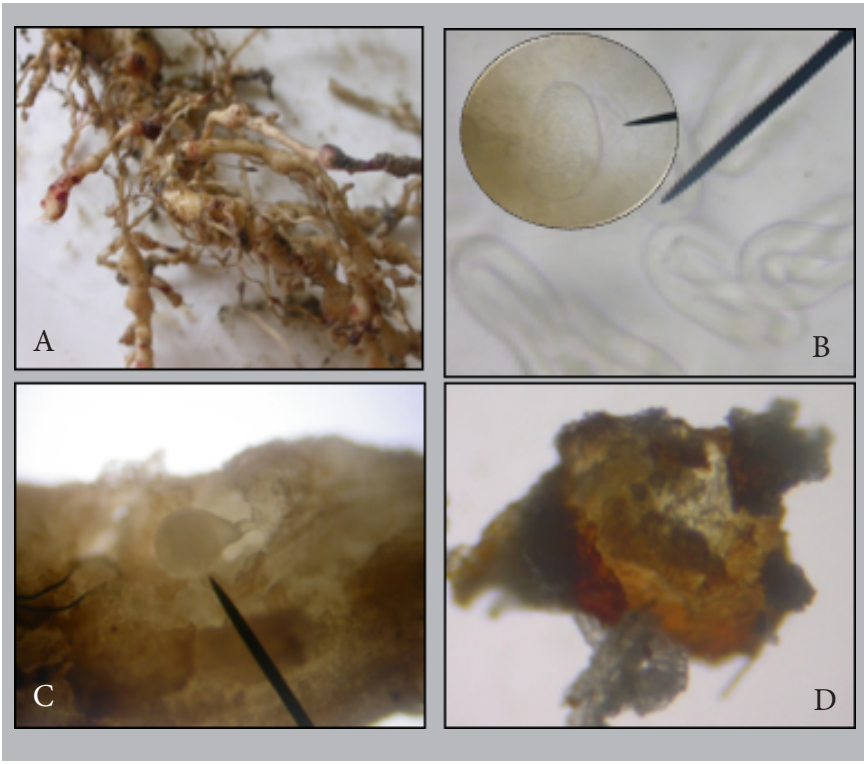



Figure 2: (A) Root knot symptom on Poi. (B) Second stage juvenile (Insert) egg. (C) Adult female – Meloidogyne sp. (D) Adult female with egg enclosed in cyst – Heterodera sp. X40 mag.

**Disease Management:**

- Resistant cultivars can limit the spread of the infection.
- Use of crop rotation is sometimes effective.
- Some plant residues such as marigold flowers, tulsi, and neem when planted or buried in the soil, reduce the level of infection.
- Use any approved nematicide e.g. VydateL

**Causative Agent:** *Rhabditis sp*
**Crops Affected:** Channa, Sorrel

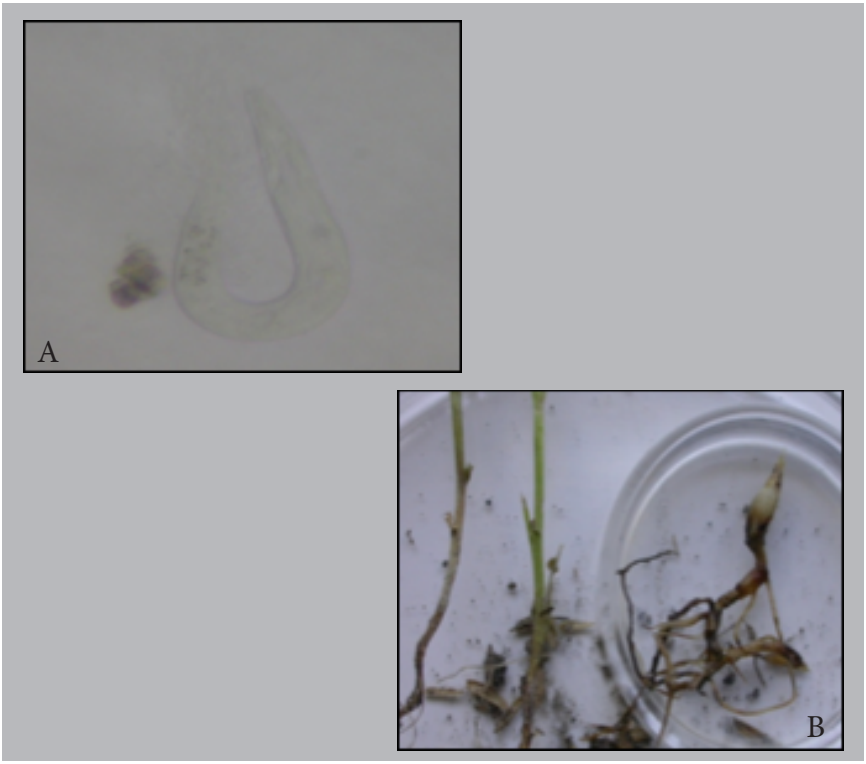



Figure 3: (A) Channa with root knot symptoms. (B) Adult nematode without protrusible stylet X40mag.

**Disease Management:**
A non-parasitic insect nematode found in large quantities in soil under shaded cultivation can be used to control diamondback moth, caterpillar moth and army worm.

# NON-PATHOGENTIC DISEASES (PHYSIOLOGICAL DISORDERS)

**Common Name:** Boron Deficiency
**Crop Affected:** Papaya

Figure 1: Papaya fruit with rough, distorted shape

**Disease Management:**

- Application of Borax as a foliar spray

**Common Name:** Calcium Deficiency
**Crops Affected:** Tomato, Sweet Peppers

Figure 2: Tomato with brown circular lesions on the bottom of the fruits.

**Disease Management:**

- Provide adequate irrigation.
- Maintain soil pH at or near 6.5. If soil ph is low limestone may be added.
- Apply mulch to minimize evaporation and help maintain consistent soil moisture.
- Use fertilizers that are low in nitrogen and high in phosphorous.
- Plants can be supplemented with foliar fertilizers during the growing season e.g. Calmax.

**Common Name:** Choke Throat
**Crop Affected:** Plantain

Figure 3: Newly emerged leaves are curled and constricted at the base of the growing point.

**Disease Management:**

- Use proper irrigation and avoid flooded conditions.
- Provide a balanced nutrition with adequate amounts of nitrogen and potassium.

**Common Name:** Nitrogen Deficiency
**Crops Affected:** Papaya

Figure 4: Yellowing of Papaya leaf.

**Disease Management:**

- Application of nitrogen based fertilizers e.g. Urea, 15:15:15 or 12:12:17:2

# INSECTS FOUND ON AGRICULTURAL CROPS

**Common Name:** Ambrosia Beetle
**Crop Affected:** Yam

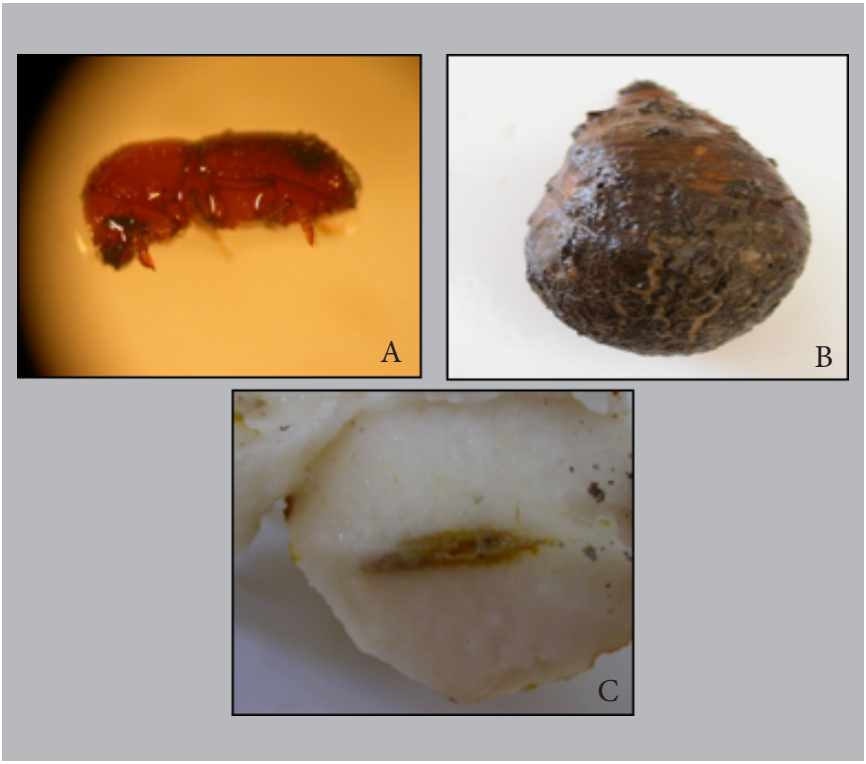



Figure 1: (A) Ambrosia beetle. (B) Tunneling on the surface of the yam. (C) Internal damage by the beetle.

**Disease Management:**

- Remove dead or infected plants and burn, if possible.
- Spray adults when they emerge with insecticide.
- Clerid beetle can be used to control the insect population.

**Common Name:** Brown Aphid
**Crops Affected:** Citrus, Bora, Boulanger

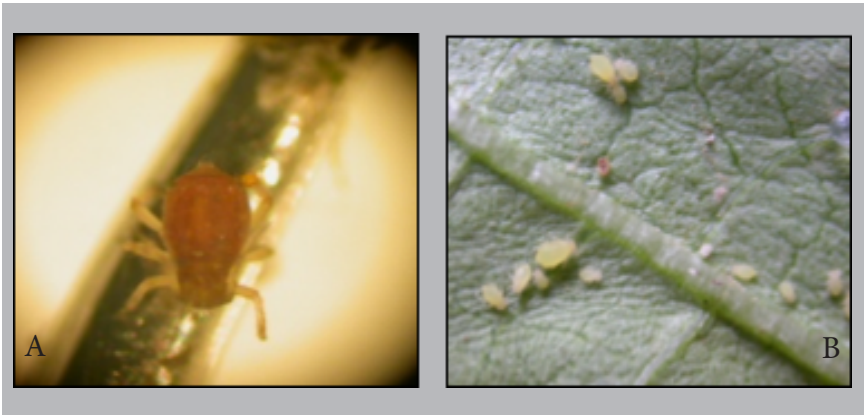



Figure 2: (A) Brown Aphid. (B) Immature nymphs on the leaves

**Disease Management:**

- Good field sanitation and integrated pest management is recommended.
- The natural predator, lady bird beetle, frequently feed on aphids.
- Contact or stomach insecticide may be used and sprays should be directed to underside surface of leaves.

**Common Name:** Coconut Moth Caterpillar (Brassolis sophorea)

**Crop Affected**: Mangrove

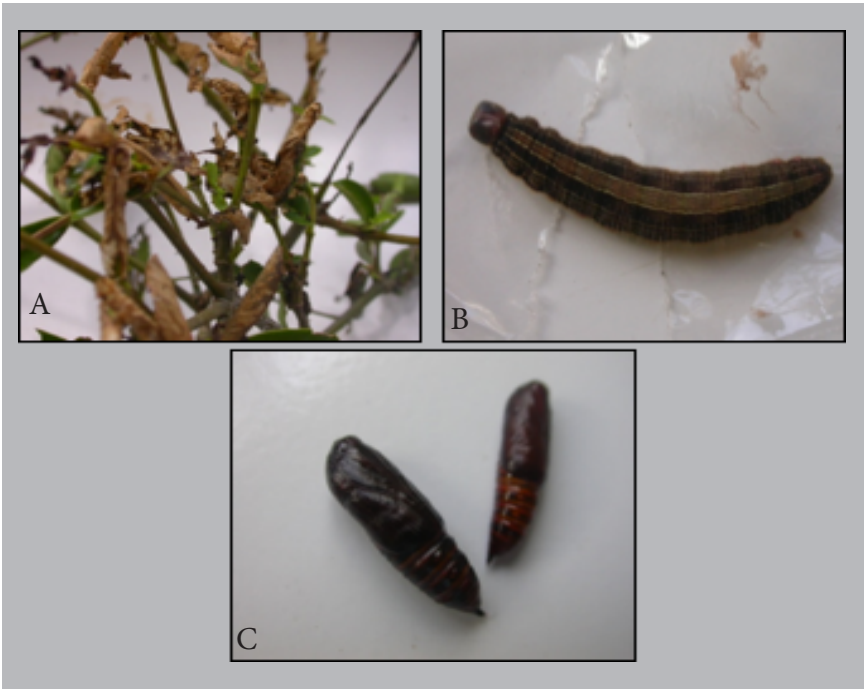



Figure 3: (A) Necrotic leaves after caterpillar feeds. (B) Caterpillar of the Coconut Moth (C) Pupa of the Coconut Moth.

**Disease Management:**

- Proper field sanitation reduces the incidence of the pest.
- All coconut husk and branches should be removed from the fields since these materials provide adequate breeding ground for pests.
- Fields should be kept free of weeds.
- Injecting the affected palm with Monocrotophos 60% E.C gives effective control of the pest.

**Common Name:** Buck Moth Caterpillar (*Hemileuca maia*)
**Crop Affected:** Mangrove

Figure 4: Adult caterpillar of the buck moth.

**Disease Management:**

- A relatively non-toxic pesticide can be used on early stage caterpillar.
- Synthetic pyrethroids are effective and provide rapid knockdown of the caterpillars.
- Use of BT (*Bacillus thuringiensis*) attacks the caterpillar.

**Common Name:** Whiteflies
**Crops Affected:** Citrus, Bora, Boulanger, Potato, Channa

Figure 5: Whiteflies present on boulanger leaf.

**Disease Management:**

- Use of natural enemies – predators (lacewings, big eyed bugs, minute pirate bugs) and parasitoids (*Encarsia spp.*).
- Removal of heavily infested leaves from plants.
- Mulches – aluminum or reflective mulches can be used to repel white flies.
- The use of traps- sticky traps can be used to trap the adult
- Insecticides have limited effect on whiteflies; insecticides oils such as neem oil can be used.

**Common Name:** Thrips
**Crops Affected:** Potato, Channa, Tomato

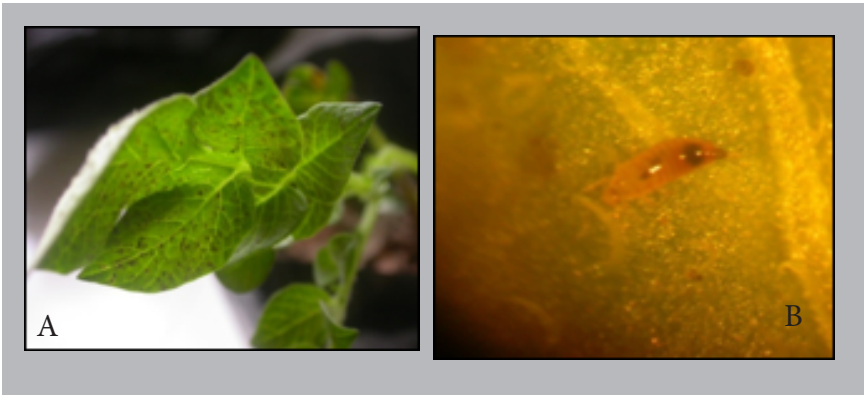



Figure 6: (A) Brown spots on the upper leaf surface of Potato. (B) Thrips on the underside of a leaf.

**Disease Management:**

- Control weeds which serve as host for thrips.
- Practice crop rotation.
- Use insecticides such as : Fastac and Karate.

**Common Name:** Coconut Leaf Miner - *Promecotheca sp.*
**Crop Affected:** Coconut

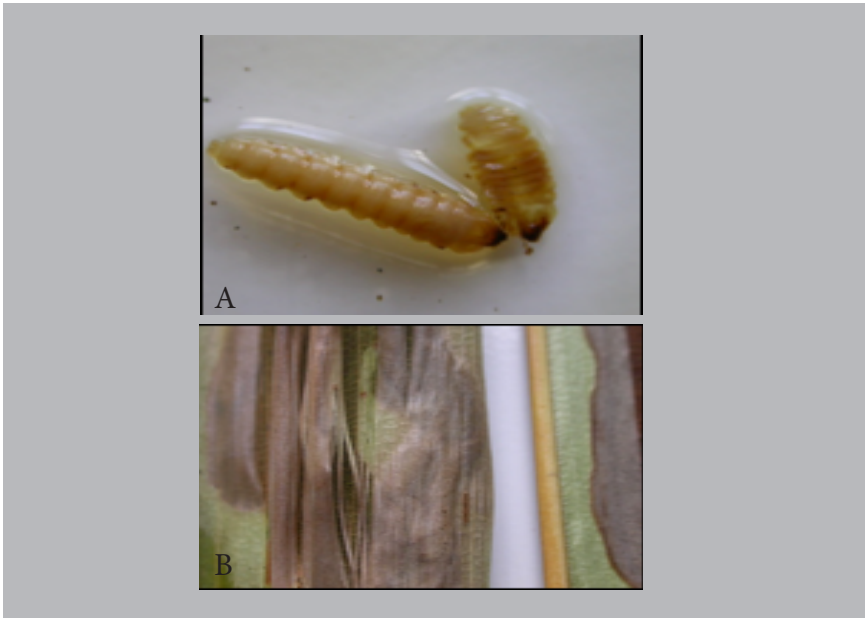



Figure 7: (A) Brown, necrotic area on the leaf surface where the insect tunneled. (B) Larval stage of the leaf miner.

**Disease Management:**

- Remove old leaves from infested palm and cut and burn infested fronds.
- Use natural enemies and parasitoids (*Sympiesis javanicus* and *Achrysocharis promecothecae*) for control if available.
- Spray adult beetle with pesticides – Triazophos.

**Common Name:** Caterpillar (Army worm)
**Crop Affected:** Vegetable crops

Figure 8: Brown green strip caterpillar.

**Disease Management:**

- Use of pheromone traps.
- Use of beneficial insects such as lacewings, ladybugs and minute pirate bugs
- Hand- pick larval stage of the pest and place them in soapy water.
- Use of botanical insecticides

**Common Name:** Stem Borer
**Crops Affected:** Cassava


Figure: 9 (A) Larva of the stem borer tunneling in the cassava stem. (B) Die back of cassava stem

**Disease Management:**

- Good field sanitation – rid the fields of weeds and plant residues from previous crops.
- Crop rotation – cultivation of vegetables that are not hosts to the pest.

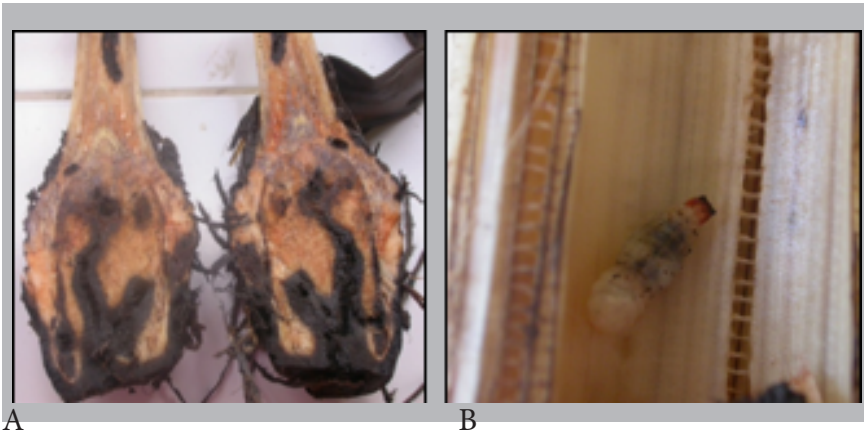
**Common Name:** Mealybugs (*Citrophilus sp.*)
**Crops Affected:** Boulanger, Sweet Pepper

Figure 10: Stem of pepper infested with Mealybugs.

**Disease Management:**

- Use of Integrated Pest Management
- Good field sanitation
- Crop rotation
- Use natural enemies such as predators, parasitoids and parasites, e.g. ladybirds.

**Common Name:** Plantain Weevil Larvae
**Crops Affected:** Plantain



A B

Figure 11: (A) Internal tunneling of larvae causing root rot symptoms. (B) Larva of the plantain weevil.

**Disease Management:**

- Use of clean pest free planting materials.
- Remove all trash from suckers and pare the corm to remove all roots and discolored portions.
- To protect suckers from weevil attack, dip in 4% Triazophos, Basudin or Vydate L solution and allow it to dry for at least 24hrs prior to planting.
- Control weeds and fertilizer plantains to enable good crop growth so the plant can better withstand the attack.
- De-sucker and clean matts regularly and remove all dead and decaying materials
- Remove all plant residues from the previous crop.

**Common Name:** Diamond Back Moth
**Crop Affected:** Cabbage

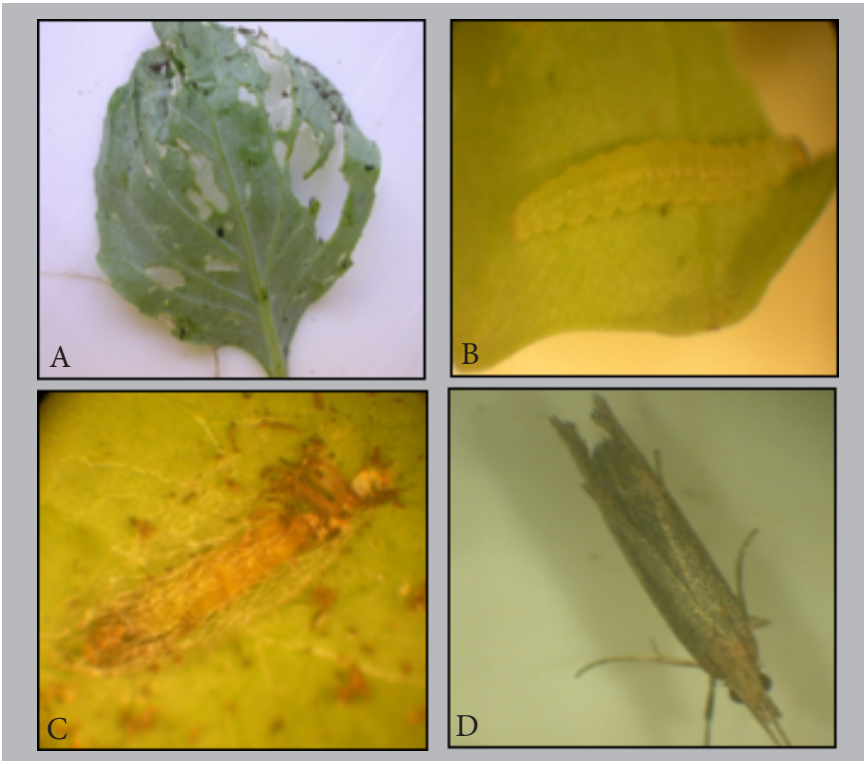



Figure 12: (A) Leaf damage caused by Diamond back larvae. (B) Diamond back larvae (C) Diamond back larvae pupating (D) Adult Diamond back moth.

**Disease Management:**

- Crop rotation
- Proper field sanitation
- Use of insecticides or pheromone traps– This pest has developed resistance to a large number of insecticides however; Terminator and Phoenix can be used.

**Common Name:** Scales
**Crop Affected:** Carambola

Figure 13: (A) Brown soft scales present on a leaf surface.

**Disease Management:**

- Scales are often controlled by small parasitic wasps and predators including beetles, bugs and lacewings.
- Pruning- increases scale mortality.
- Removal of infested leaves from plants
- Horticultural oil and systemic insecticides can be used.

**Common Name:** Leaf Miner
**Crop Affected:** Lime

Figure 14: Tunneling of larvae on citrus leaf surface.

**Disease Management:**

- Traps baited with a pheromone (insect sex attractant) are a useful tool for detecting leaf miners
- Avoid pruning live branches more than once a year, so that the cycles of flushing are uniform and short.
- Do not prune off leaves damaged by citrus leaf miner since undamaged areas of leaves continue to produce food for the tree.
- Do not apply nitrogen fertilizer at times of the year when leaf miner populations are high and flush growth will be severely damaged.
- Imidacloprid applied to the ground at the base of citrus trees provides the longest period of control, 1 to 3 months.

**Common Name:** Mites
**Crop Affected:** Cassava

Figure 15: Bronze appearance on cassava leaf affected by Mites.

**Disease Management:**

- Good field sanitation – rid the fields of weeds and plant residues from previous crops.
- During severe infestations chemical control may become necessary. Miticide may be used for their control such as Abamectin, Newmectin or Vertimec.

**Common Name:** Spur Grasshopper
**Crops Affected:** Vegetable crops

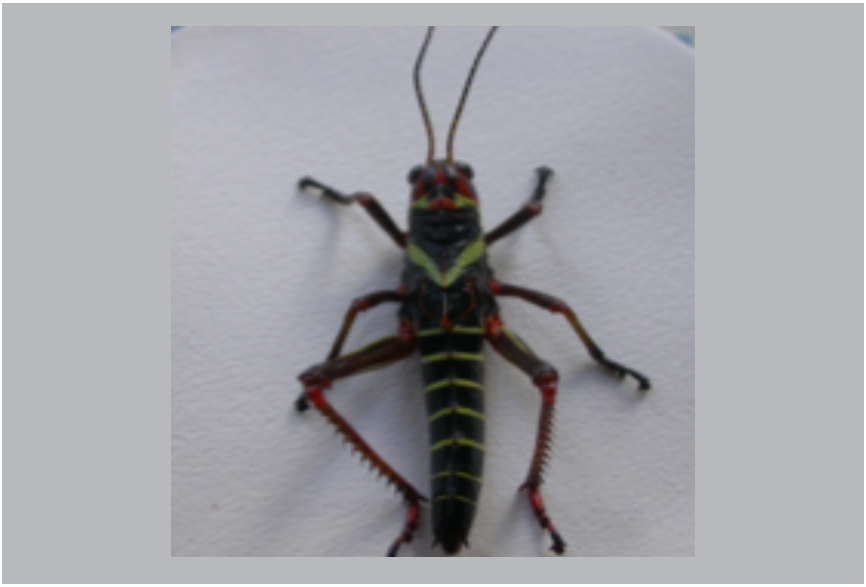


Figure 16: Immature spur grasshopper

**Disease Management:**

- Use of natural enemies-egg predators such as the bee flies, blister beetles, ground beetles, crickets and other insects.
- Use of sticky traps
- Early planting