PLANT PATHOLOGY

2 Semester BSc Botany

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Disease - definitions

The process in which a pathogen interferes with one or more essential plant cell functions

Physiological disorder or structural abnormality that is deleterious to the plant or its part or product, that reduces the economic value of the plant.

A condition in which functions of the plant are not properly discharged.

Harmful deviation from normal functioning of physiological processes.

Disease can be defined as a physiological disorder or structural abnormality that is deleterious or harmful to the plant or its part or product that reduces its economic value.

Disease can be defined as the result of interaction between host, pathogen and environment

Objectives of Plant pathology

- 1. Study of origin, causes or reasons. Study of living, nonliving and other causes of disease or disorder in plants **Etiology**
- 2. Study of mechanism of disease development i.e. processes of infection and colonization of the host by the pathogen. This phase involves complex host-pathogen interactions- **Pathogenesis**
- 3. Study the interaction between the causal agent and the diseased plants in relation to environmental conditions. Generally at the population level- **Epidemiology**
- 4. Development of management systems of the diseases land reduction of losses caused by them- **Control/ Management.**

Diseases affects normal physiological functions

What is health?

The ability to carry out normal physiological functions at a acceptable level consistent to genetic potential.

- Normal cell division, differentiation and development,
- Absorption of water and minerals from the soil and translocation
- Photosynthesis and translocation of photosynthates
- Utilization and storage of photosynthates
- Metabolism of metabolites and synthates
- Reproduction
- Storage of reserves for overwintering or reproduction.

How Pathogens affect Plants

- By utilizing host cell contents
- By killing host or by interfering with its metabolic processes through their enzymes, toxins etc.
- By weakening the host due t continuous loss of the nutrients.
- By interfering with the translocation of the food, minerals land water.
- They can suppress the chlorophyll content.
- They can reduce the leaf area.
- They can curb the movement of solutes and water through the stems.
- They sometimes reduce the water-absorbing capacity of the roots.
- They suppress the translocation of photosynthates away from the leaves.
- They sometimes promote wasteful use of the products of photosynthesis as in the formation of galls.

Types of diseases

- Based on type of symptoms
  - Blights
  - Rusts
  - Smuts
  - Rots
  - Wilts

- Based on type of crop
  - Cereal crop diseases
  - Vegetable crop diseases
  - Fruit crop diseases

- Based on type of organ affected
  - Fruit diseases
  - Root diseases

- Based on type of Pathogen
  - Fungal disesades
  - Bacterial diseases
  - Viral diseases
  - Viroid diseases
  - Virusoid diseases
  - Protozoan diseases
  - Nematode diseases
  - Algal diseases
  - Parasite diseases

Plant Disease Agents

- **Living organisms** - including fungi, bacteria, viruses and nematodes
- **Nonliving agents** - including unbalanced soil fertility, toxic chemicals, air pollution, frost, drought, sunburn, wind and hail

- **Infectious Plant Disease** caused by **biotic factors**
  - **Fungi**
  - **Bacteria**
  - **Viruses**
  - **Viroids**
  - **Virusoids**
  - **Protozoa**
  - **Nematodes**
  - **Algae**
  - **Parasitic Plants**

- **Non-infectious diseases** caused by **abiotic factors**
  - Environmental stress/ excess
    - Temperature e.g. high or low
    - Moisture e.g. excess- rotting or Stress- wilt/drying
    - Air
    - Light e.g. etiolation
  - Nutritional imbalance
  - Excess
  - Deficiency e.g. N deficiency, Zn deficiency

Disoder:

Can be an abnormal physiological change due to non-parasitic agent..

Or it can be a non-parasitic physiological malfunctioning due to either excess or deficiency in environmental factors or nutrients like Physiological wilt, sun scald, Nutrient deficiency etc.

Common symptoms of plant diseases

- Colour changes
- Overgrowth (hypertrophy)
- Atrophy (hypoplasia)
- Necrosis (Tissue death)

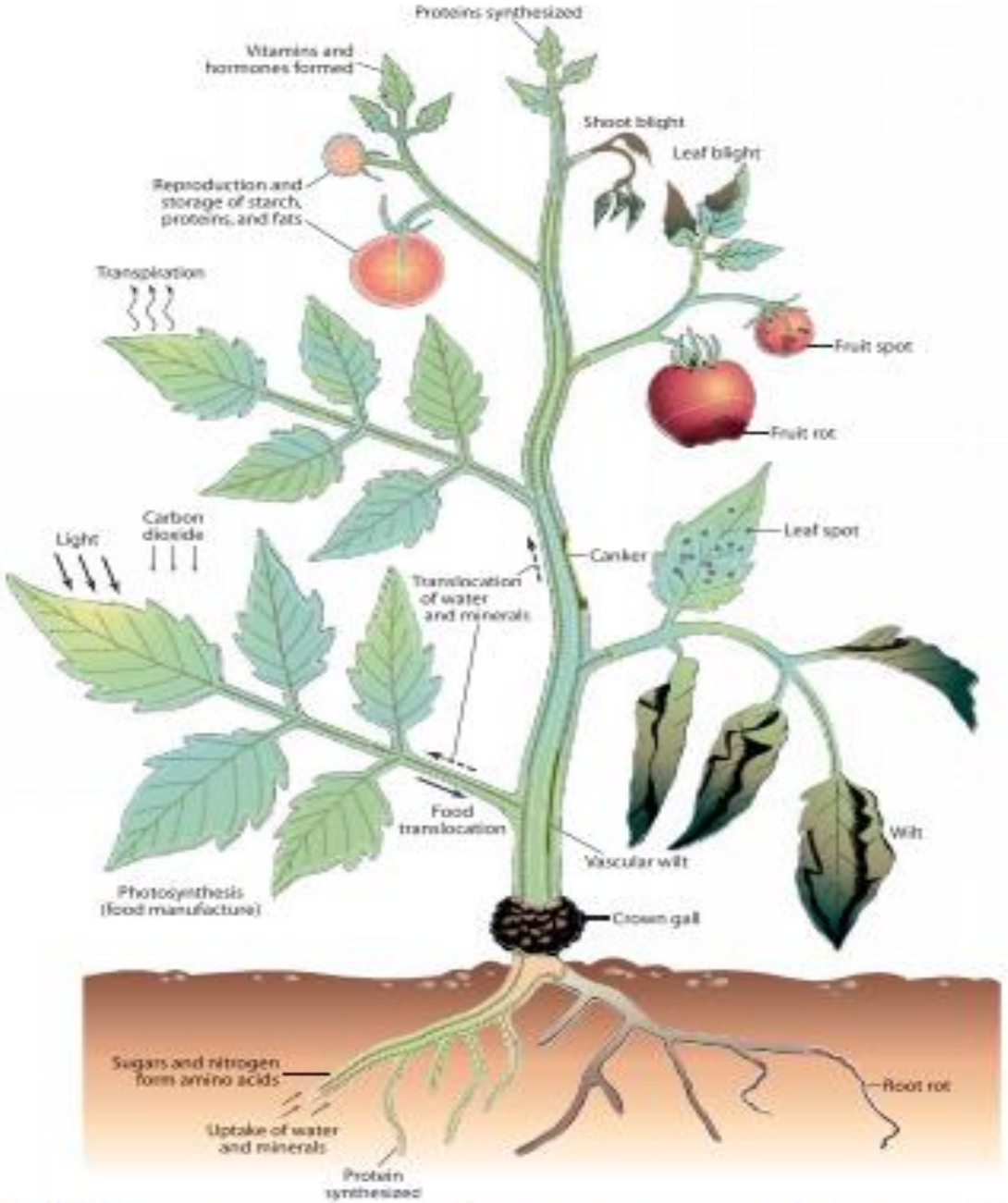

FIGURE 1-1 Schematic representation of the basic functions in a plant (left) and of the kinds of interference with these functions (right) caused by some common types of plant diseases.

Colour changes

Chlorosis

Mosaics

Variegation

Vein clearing

Hyperplasia/ Atrophy

Stunting

Rosetting

Overgrowth / Hypertrophy

Galls /tomours

Curls

Witches broom

Hairy roots

Necrosis

Spots

Blight


A
B
C
D
E
F


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Wilt

Rot

Canker

Gummosis

Smut

Rust

Damping off

Blister

Scab

Mildew

Cottony mildew

Downy mildew

Powdery mildew

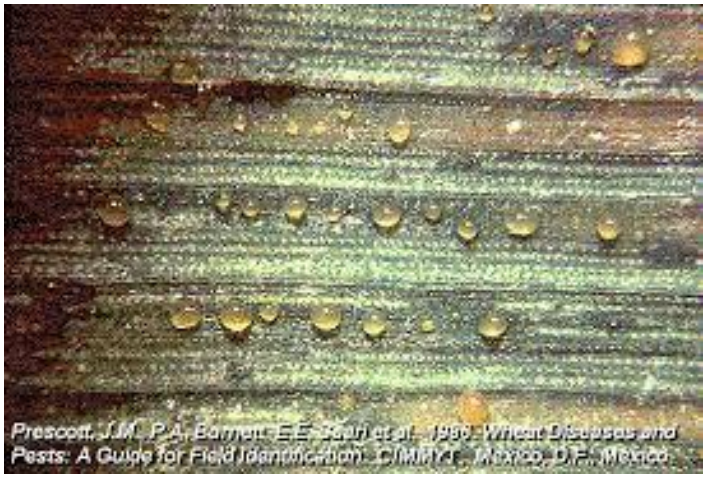
Sclerotia

Streak/ stripe

Die back

Symptoms of bacterial diseases

Exudation



1. CITRUS CANKER

Pathogen:
Bacterium ***Xanthomonas citrii***

Symptoms

- On leaves, twigs, branches, fruits etc.
    1. Round watery translucent spots
    2. Become raised, turn yellowish brown
    3. Spot surface become white greyish
    4. Centre ruptures, become corky & rough
    5. Enlarge, fuses with other spots & form large lesions
    6. Yellow, brown, green raised margin & watery yellow halo

Control measures

- Spraying with 1% bordeaux mixture before planting
- Pruning the affected twigs
- Burning infected plants
- Field sanitation
- Disease resistant varieties

2. MAHALI /KOLEROGA/ NUTFALL/ FRUIT ROT/BUD ROT DISEASE OF ARECANUT

Symptoms

- Characteristic **symptom** is rotting and extensive shedding of the immature nuts which lie scattered near the base of the tree.
- Initial **symptoms** appear as dark green/ yellowish water-soaked lesions on the nut surface near the perianth (calyx).
- The infected nuts lose their natural green lusture, quality and hence have a low market value.
- The lesions on the fruits gradually spread covering the whole surface before or after shedding which consequently rot.
- White mycelial mass envelopes on entire surface of the fallen nuts.
- As the disease advances the fruit stalks and the axis of the inflorescence rot and dry, sometimes covered with white mycelial mats.
- Infected nuts are lighter in weight and possess large vacuoles.
- When infection occurs later in the season, it leads to rotting and drying up of nuts without shedding (known as ‘Dry Mahali’).

- **Survival and spread:**
- Disease spreads through heavy winds and rain splashes.
- The fruit bunches infected towards the end of rainy season may remain mummified on the palm and such nuts provide inoculum for bud rot or crown rot or the recurrence of fruit rot in the next season.

- **Favourable conditions:**
- The severity, persistence and spread of fruit rot are related to the pattern of rain.
- The disease appears usually 15 to 20 days after the onset of regular monsoon rains and may continue up to the end of the rainy season.
- Continuous heavy rainfall coupled with low temperature (20 to 23 °C), high relative humidity 90%) and intermittent rain and sunshine hours favour the outbreak of fruit rot

Pathogen: Fungus

Phytopthora arecae

Control measures

- Spraying of fungicides
- Removal of infected bunches
- Root zone drenching with phosphoric acid or tridemorph

Before the onset of monsoon

- Follow phytosanitary measures such as removal of all dried and infected bunch of last season attached to the palm
  - Spray 1% Bordeaux mixture on the bunches before the onset of monsoon as a prophylactic measure
  - Cover the areca bunches with polythene covers (125-200 gauge 24 x 30 inches) before the start of the heavy monsoon showers.

Control measures

During rainy season

- **Spray 1% Bordeaux mixture:** The initial spray is to be done immediately after the onset of monsoon showers and the second spray after an interval of 40 to 45 days. If monsoon prolongs, third spray should be given. • A fine spray will be needed for effective spread of spray fluid over the surface of the nuts. Spraying operations are to be undertaken on clear sunny days.
  • Collect and destroy of all fallen and infected nuts to prevent the spread of disease.
  • Severe incidence of fruit rot during monsoon may lead to the incidence of bud rot and crown rot diseases. Hence, preventive measures to be taken up to control these diseases as well.
  • Remove the infected tissues from the crown and treat the wound/ cut end with 10% Bordeaux paste. Cover the treated bud with protective covering till the normal shoot emerges.

3. BLAST OF PADDY

Symptoms

- Brownish lesions or spots on leaf blade, leaf sheath, culms, panicles
- Spots – spindle shaped, central part greyish or white, boarders brownish or reddish brown
- Brown to black spots or rings on rachis
- Brown to black spots on ear heads
- Shriveled culms, with grey fluffy mycelium
- Bluish patches on stem neck
- Drooping panicle, chaffy grains
- Stunted growth

Symptoms on leaf, stem, culm, grain....

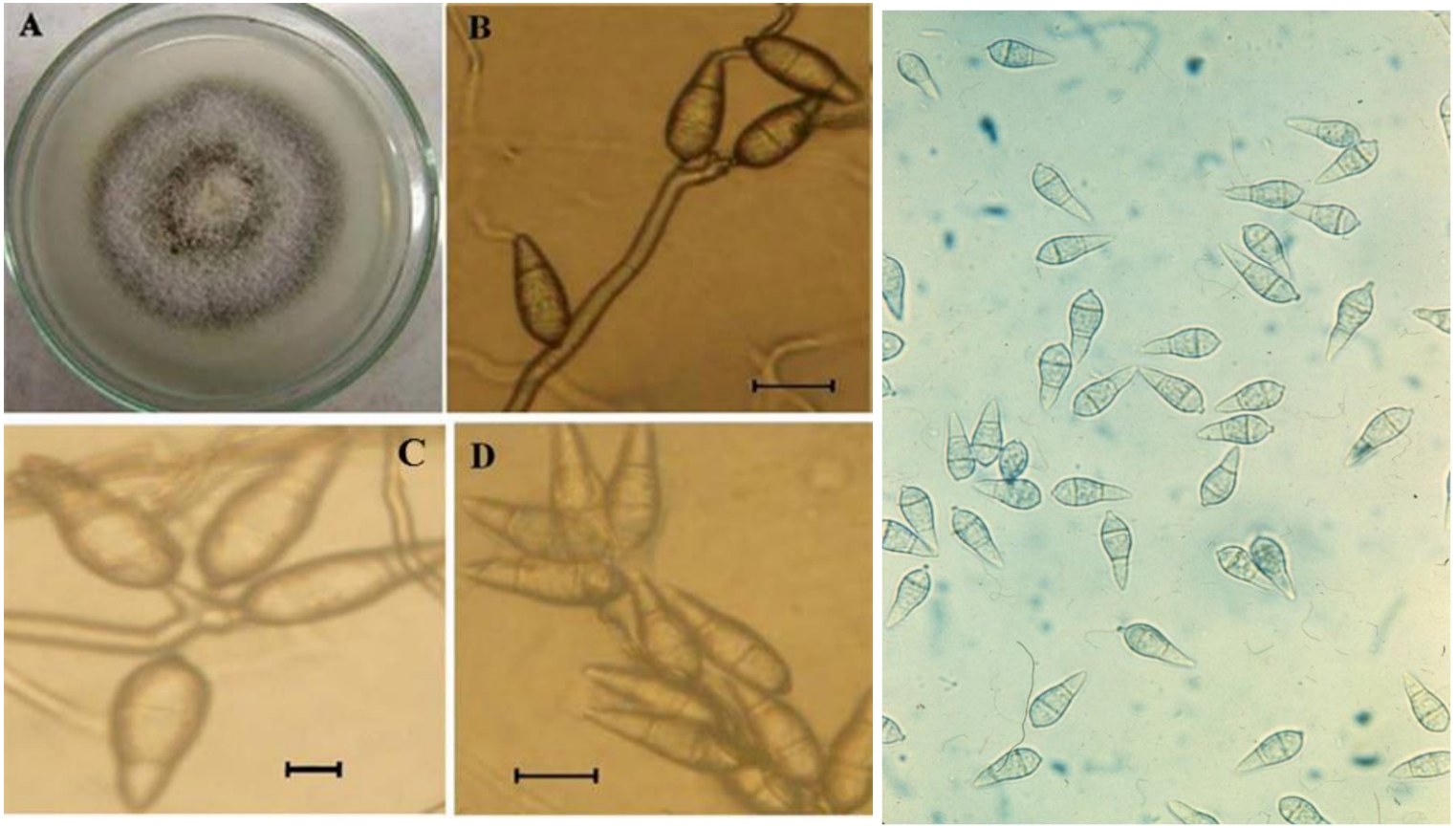






Pathogen: Fungus

Pyricularia oryzae



Control measures

- Foliar spray of copper fungicides & organo mercuric fungicides
- Antibiotics (blastin, blasticidin)
- Seed treatment using organo mercuric compounds
- Field sanitation
- Disease resistant varieties

4. QUICK WILT OF PEPPER
(foot rot of pepper)

Symptoms

- One or more black spots appear on the leaves which have a characteristic fine fibre like projections at the advancing margins which rapidly enlarge and cause defoliation.

- The tender leaves and succulent shoot tips of freshly emerging runner shoots trailing on the soil turn black when infected. The disease spreads to the entire vine, from these infected runner shoots and leaves, during intermittent showers due to rain splash.

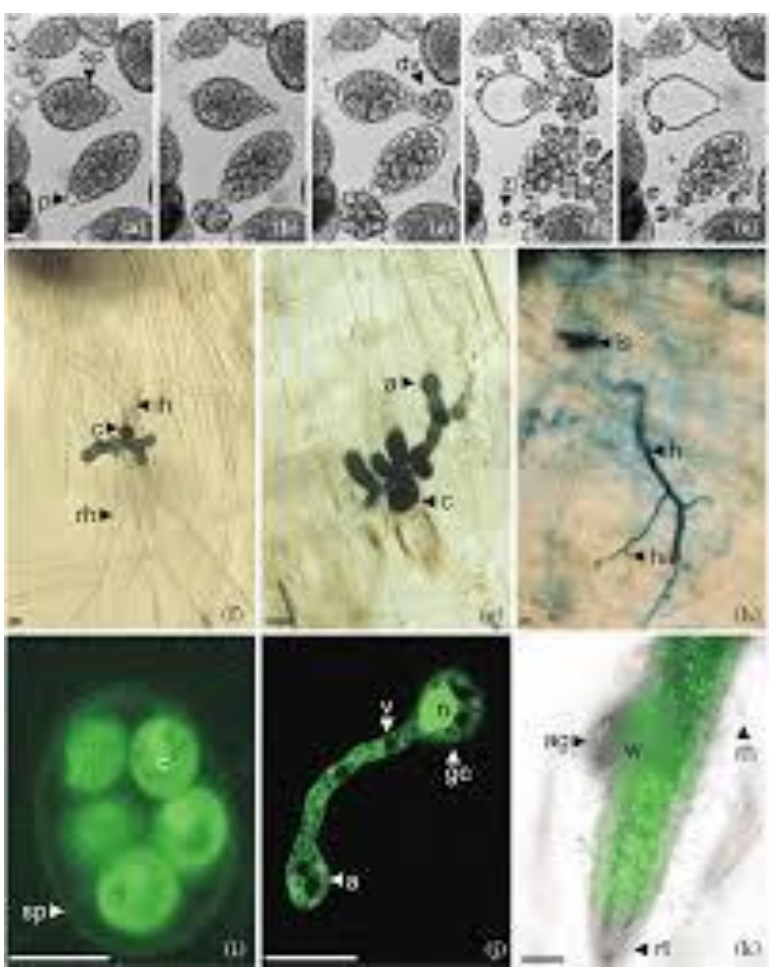
- If the main stem at the ground level or the collar is damaged, the entire vine wilts followed by shedding of leaves and spikes with or without black spots. The branches break up at nodes and the entire vine collapses within a month.

- If the damage is confined to the feeder roots, the expression of symptoms is delayed till the cessation of rain and the vine starts showing declining symptoms such as yellowing, wilting, defoliation and drying up of a part of the vine.

- **Survival and spread**
  Fungus survives in disease plant debris as well as soil. These vines may recover after the rains and survive for more than two seasons till the root infection culminates in collar rot and death of the vine.
- **Favourable conditions**
  Rainy season during October-November onwards favour the development of disease

Pathogen: Fungus

Phytophthora palmivora



Control measures

- Selection of healthy nursery material.
- Provide good drainage.
- Soil drenching with 1% Bordeaux mixture after removal of the affected plant.
- Spraying with 1% Bordeaux mixture (or) COC 0.25% (or) Alitte 0.3%
- Soil application of neem cake and *Trichoderma viride* or *P. fluorescens*

5. LEAF MOSAIC OF TAPIOCA

Pathogen: Virus

Tapioca Mosaic Virus

Transmitted by:
white fly *Bemisia tabaci*

- Symptoms
- Mosaic pattern on leaves – white, light green, yellow patches
- Stripped, mottled or circular patterns with vein clearing & vein thickening
- Distortion & malformation of leaf blade
- Stunted growth

Control measures

- Use insecticides to destroy the vector
- Burning infected plants
- Field sanitation
- Altered cultural practices (changing season)
- Disease resistant varieties

6. BUNCHY TOP OF BANANA

Symptoms

- The typical symptoms of bunchy top of banana are very distinctive and readily distinguished from those caused by other viruses of banana. Plants can become infected at any stage of growth and there are some initial differences between the symptoms produced in aphid-infected plants and those grown from infected planting material.

  In aphid-inoculated plants, symptoms usually appear in the second leaf to emerge after inoculation and consist of a few dark-green streaks or dots on the minor veins on the lower portion of the lamina. The streaks form 'hooks' as they enter the midrib and are best seen from the underside of the leaf in transmitted light. The 'dot-dash' symptoms can sometimes also be seen on the petiole. The following leaf may display whitish streaks along the secondary veins when it is still rolled. These streaks become dark green as the leaf unfurls. Successive leaves become smaller, both in length and in width of the lamina, and often have chlorotic, upturned margins. The leaves become dry and brittle and stand more erect than normal giving the plant a rosetted and 'bunchy top' appearance.

  Suckers from an infected stool can show severe symptoms in the first leaf to emerge. The leaves are rosetted and small with very chlorotic margins that tend to turn necrotic. Dark-green streaks are usually evident in the leaves.

  Infected plants rarely produce a fruit bunch after infection and do not fruit in subsequent years. Plants infected late in the growing cycle may fruit once, but the bunch stalk and the fruit will be small and distorted. On plants infected very late, the only symptoms present may be a few dark green streaks on the tips of the flower bracts

Control measures

- **Regulatory Control**

  BBTV has not been eradicated from any country where it occurs, but it is believed to have been eliminated from certain banana-growing districts in Australia. Here, the disease is kept in check by strict State Government legislation which controls the source and movement of planting material, controls the issue of planting permits and requires the destruction of feral plants and all plants with symptoms. Banana inspectors are also employed to police these regulations and locate diseased and feral plants. An ambitious programme of eradication is on-going which is based on replacing plantations where the disease regularly occurs, with BBTV-tested, tissue-cultured, planting material (Thomas et al., 1994). Another initiative to control the spread of BBTV in Africa, named ALLIANCE for BBTV control in Africa, aims to contain the spread of BBTV from disease-affected areas to new regions through quarantine regulations and the recovery of banana production by eradication of infected stools and replanting with health planting material (Kumar et al., 2016; www.bbtvalliance.org).
- **Host-Plant Resistance**

  When little work had been undertaken on testing germplasm for resistance, it was thought that all cultivars were susceptible, although some may take longer to develop symptoms and others may escape infection because of aphid preferences or host morphological factors. However, work in Australia suggested that *Musa coccinea*, a wild species, and the cultivar Kluai Teparot (ABBB/ABB) may have physiological resistance (J Thomas, QDPI, Indooroopilly, Queensland, Australia, personal communication, 1995). Several studies have since been undertaken to evaluate *Musa* genotypes for BBTV resistance and found genotypes with tolerance (no symptoms and near normal performance of virus infected plants (e.g. Gros Michel), delayed expression of symptoms (e.g. Dwarf Apple, also known as Santa Catarina) and difficult to infect (e.g. Fugamou) (Espino et al., 1993; Hooks et al., 2009b; Niyongere et al. 2011; Ngatat et al., 2017).

  Cultural Control

  Banana bunchy top disease can be effectively controlled by the eradication of diseased plants and the use of virus-tested planting material. Before destruction, diseased plants should first be sprayed with power kerosene or insecticide to kill all viruliferous aphids. The whole stool, including corm and all associated suckers, must then be destroyed by uprooting and chopping into small pieces or by herbicide treatment, as the virus will ultimately spread to all parts of the mat. Control must be practised across the whole production area to avoid the rapid re-infection of virus-tested planting material (Thomas et al., 1994; Kumar et al., 2016).

  Chemical Control

  Aphicides have been used in some countries to control populations of *Pentalonia nigronervosa*, the aphid vector of bunchy top, and a decrease in disease incidence has been reported. In Tonga, *Aphidius colemani*, a parasitic wasp, has been released in an attempt at biological control of the aphid vector, but its effects on disease incidence have been disappointing.
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7. GREY LEAF SPOT OF COCONUT (leaf blight)

Symptoms

- Early symptoms of gray leaf spot can be seen on leaves as small, spherical lesions with a yellow halo around them. These first lesions may be tan or brown before fungal sporulation begins. The initial disease can be hard to identify as gray leaf spot at this stage because it looks similar to eyespot and common rust. However, as the lesions mature, they elongate into rectangular, narrow, brown to gray spots that usually develop on the lower leaves and spread upward on the plant during the season. The lesions elongate and expand parallel to the leaf veins and can be 1.5 to 2 inches long. With favorable weather the lesions can rapidly merge and kill the entire leaf. Mature gray leaf spot symptoms can also be confused with symptoms of anthracnose leaf blight.

Pathogen:

fungus: Pestalotia palmarum

Control measures

- Prevention is the best option for management of Gray Leaf Spot as hyphae on plant debris is the primary source of inoculum. [1] There are various cultivars of St. Augustine grass, perennial ryegrass and tall fescue on the market that have variable resistance to gray leaf spot but none are confirmed as completely resistant. [3][4] [1] Cultural practices to reduce stress are the next step for Gray Leaf Spot prevention and control. Extended leaf wetness is a requisite for disease development; meaning irrigation time and duration management are essential to reduce long wetness periods and relieve drought stress. [4] Proper mowing technique is another management practice that will assist in control. Turf must be mowed frequently in order to reduce the leaf length and maintain low leaf wetness through increased drying. [3] Removal of clippings can help deter an epidemic in lower intensity situations but is not as feasible or effective on large areas of high intensity. [1] Relief of soil compaction through core aerification improves moisture uptake as well as reducing turf stress. [4] Excessive nitrogen application can cause increase in many diseases and should be regulated through soil testing. Managers should only apply fertilizer while not stressing the turf. [7] Additionally silicon amendments to soils lacking in plant available silicon have been shown to reduce the severity of Gray Leaf Spot. [6] Some developments have also been made in biological control where various bacterium species have been shown as an alternative to fungicides in control of Gray Leaf Spot. [1] Looking at the most common source of control would be the use of various wide spectrum fungicides. The most common active ingredients known to be effective in the control of Gray Leaf Spot are azoxystrobin, trifloxystrobin, thiophanate. [1] Trifloxystrobin and thiophanate are common ingredients in broad spectrum stress guards such as Compass, Exteris and Fame. [3] [2] Azoxystrobin is the most common and effective method used for Gray Leaf Spot and goes by its common name Heritage. [1] All fungicides need to be applied early in the disease cycle as spread is too quick to stop late in the season so most application must be done in early summer. [1] It Must be considered as well that all fungicides have the potential for resistance development when used in large amounts so rotation of various fungicides is recommended.