
Diagnosis Of
Plant Problems

Overview

- Process of diagnosing plant problems
- Plant diseases
- Plant insects and mites

Perspective

- Approximately 10% of plant problems are caused by insects and other pests
- Approximately 25% of plant problems are caused by biotic disease
  - About 85% of these are caused by fungi
- Approximately 65% of plant problems are caused by abiotic disease

Real Problem?
Identify the Plant

Variegated Date Palm

Collect Information

- Where do you live?
- Soil type and conditions
  - i.e. drainage
- Cultural practices
- Age of plant
- Weather conditions
- Look for symptoms or clues
- Look at the entire plant

Patterns for Abiotic Disorders

- All leaves of a certain age might show damage
- All foliage within a certain exposure might show damage
- Sharp margin between damaged and healthy tissue

Patterns for Biotic Disorders

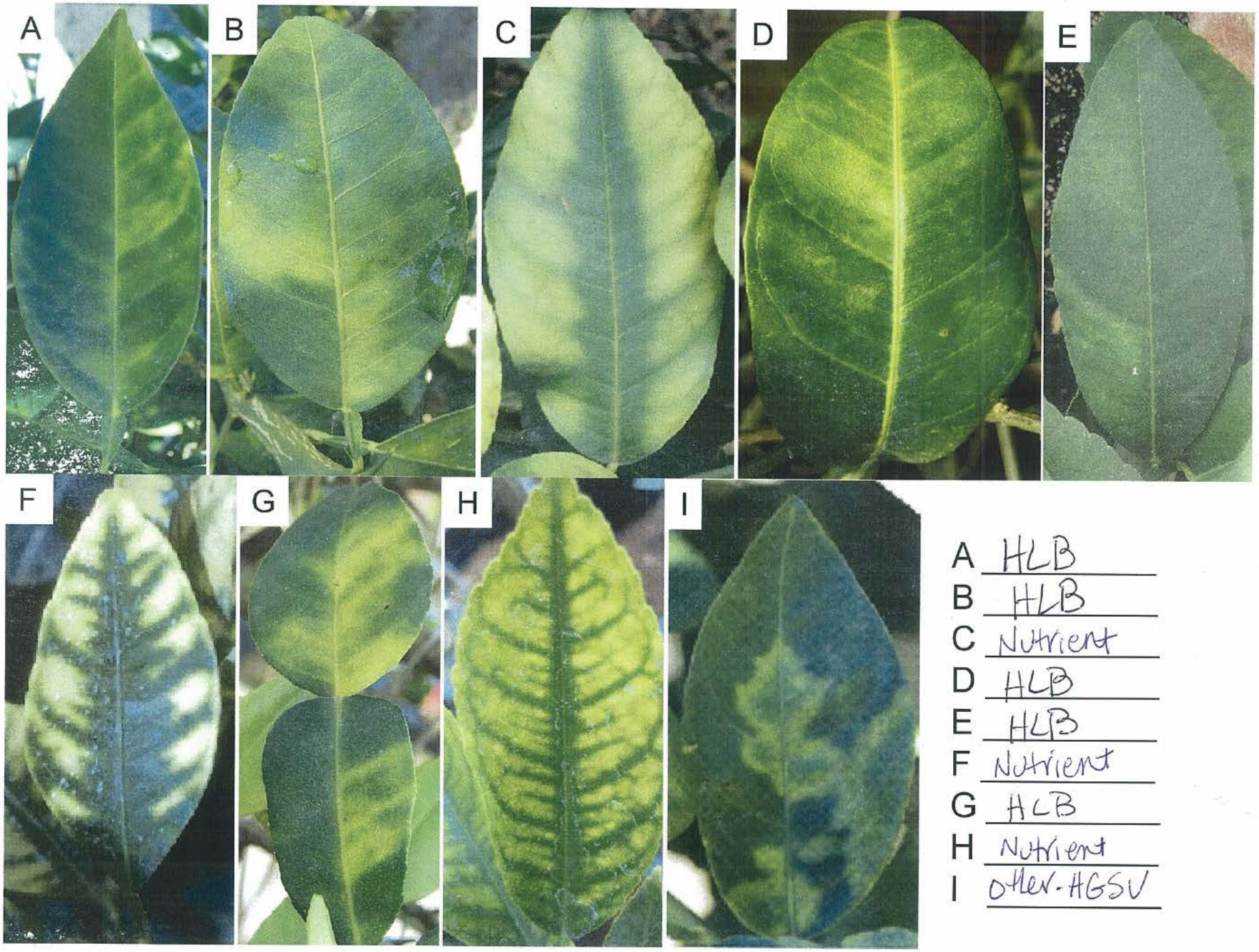
- Random damage patterns on individual plants or on a specific family or genus of plants
- Koa Wilt
- Fungal disease
- Fusarium

Patterns

Bacterial leaf spot on Hibiscus

Patterns

Iron deficiency on coffee



A HLB
B HLB
C Nutrient
D HLB
E HLB
F Nutrient
G HLB
H Nutrient
I Other - HGSV

The Process

- When did the problem begin?

Verticillium wilt on Naupaka

Sign: Evidence of the damaging factor.

Symptoms: Changes in growth or appearance of a plant in response to a damaging factor.

Evaluation of the Plant

- Problem originates in:
  - Roots
  - Stems
  - Leaves

Bacterial wilt on pepper

Secondary Problems

Sooty Mold

Consider the Possible Causes

- Biotic – living agent
  - Pathogens - parasitic microorganisms that cause diseases
  - Pests – insects, mites or mammals feeding on or damaging plants

Powdery mildew

Aphid damage

Consider the Possible Causes

- Abiotic – non-living agent
  - Damage from chemicals, weather, mechanical
  - Nutritional problems

Vog damage on roses

How do you tell the difference between abiotic and biotic disease?

- Biotic Disease
  - Persists
  - Changes over time
  - Interaction between plant and pathogen
- Abiotic Disease
  - One-time event
  - Remains constant
  - Caused by weather, mammals, humans

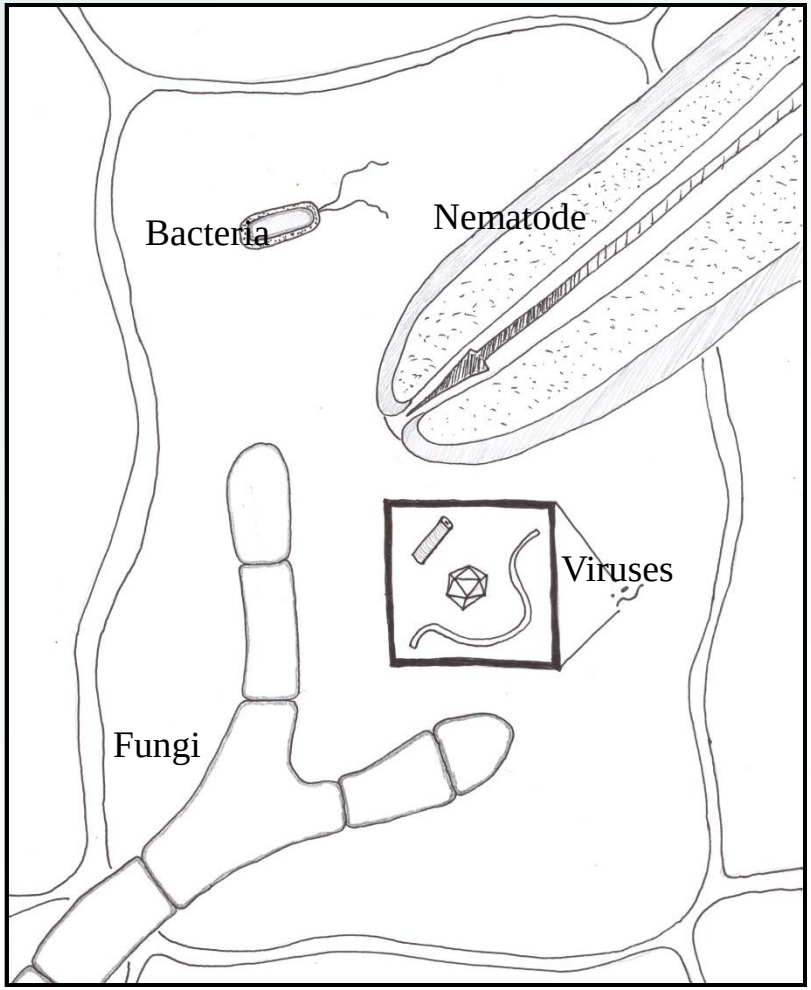
Biotic or Abiotic?

Dasheen mosaic of taro

Iron Deficiency of Taro

Biotic Diseases

- Fungi
- Bacteria
- Viruses
- Nematodes
- Account for 25% of plant problems



Adapted from: Agrios, George N. Plant Pathology 5th Ed. Elsevier Academic Press; Boston 2005.

Biotic Diseases

- Symptoms not uniform
- Show up gradually
- One - few species affected (often related)

Bacterial wilt on *Philodendron*

Rose Blackspot

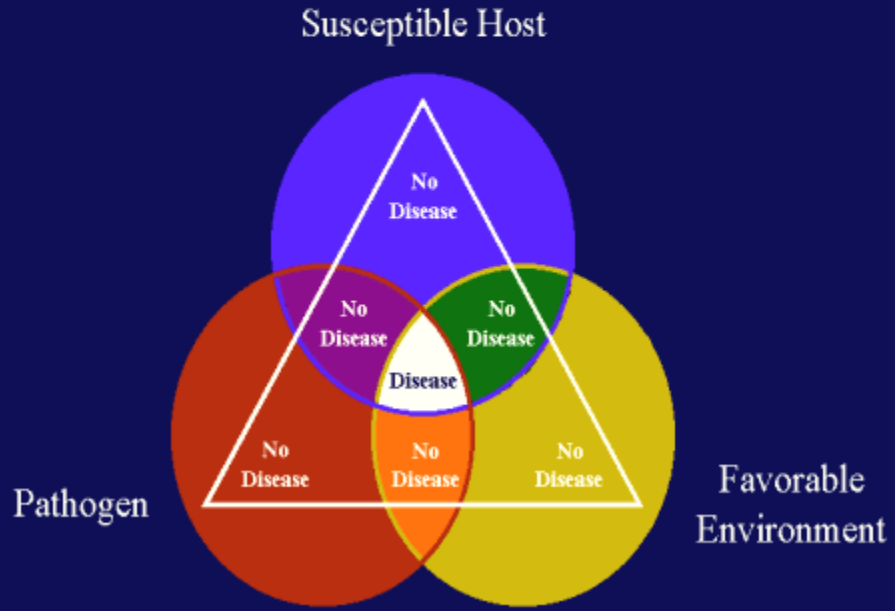
This organism only affects roses

Mango anthracnose

Symptoms are randomly distributed

Plant Diseases

The Disease Triangle



Conditions Necessary for Biotic Diseases

- Host plant:
- Will be attacked only by certain diseases
- Plant must be at risk to be attacked by disease organism

Late blight on tomato

Conditions Necessary for Biotic Diseases

- An active pathogen:
- Must be at the correct stage to infect the plant
- No pathogen, no disease

Environment

- Temperature
- Moisture

The Environment: Temperature

- Optimum temperatures for growth
- Verticillium wilt
  - 75° F is optimum with 55° F minimum and 86° F maximum

Temperature

Western flower thrips

- Warm, dry weather favors build up of aphids, leafhoppers, and thrips-
  - Spread viral diseases

Percentage Relative Humidity

Bacterial blight on lettuce

- Spore germination and penetration
- Development of storage rots
- Moisture on plant surfaces
  - Usually necessary for bacterial disease

Moisture

- High air humidity encourages fungal leaf diseases
- Phytophthora is most destructive at high soil moisture levels

Black flag on Noni (Phytophthora)

Phytophthora of Papaya

Plant Nutrition and Disease

- Nutrient deficiencies may encourage disease development
- Unhealthy plants are susceptible to disease attack

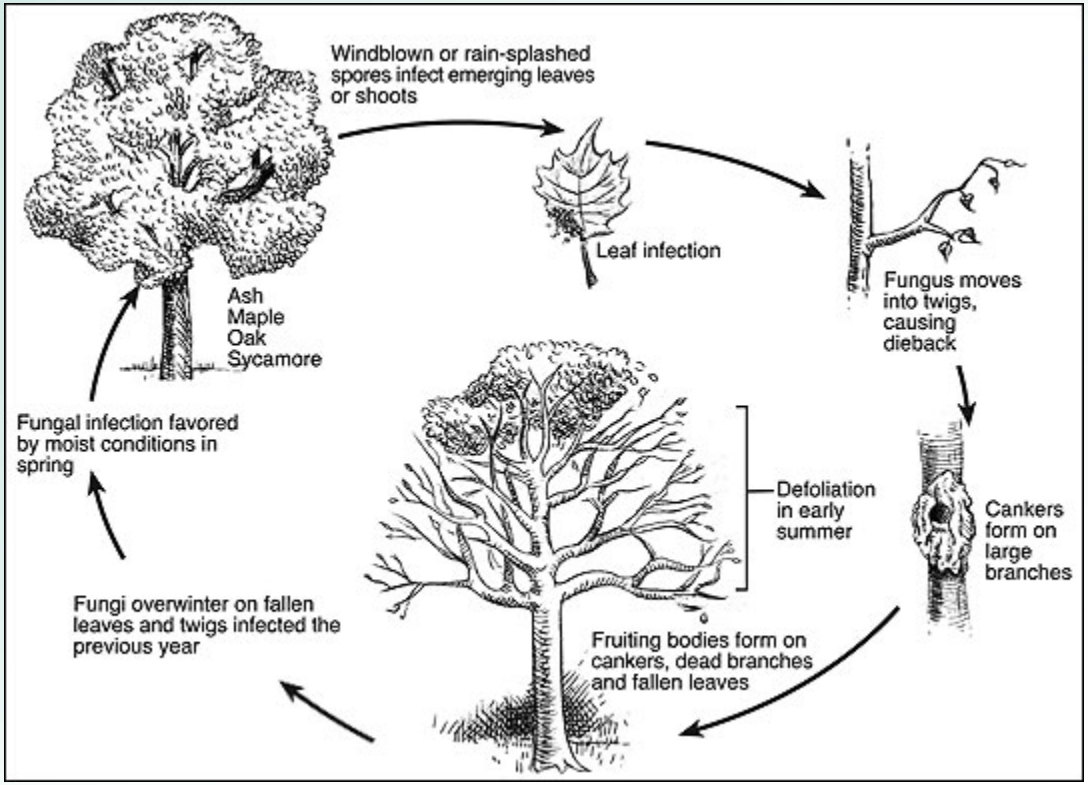
Iron deficiency of rose

Powdery Mildew

Powdery mildew on mango

- Excessive nitrogen pushes lush, new growth
- This growth tends to be more susceptible to powdery mildew

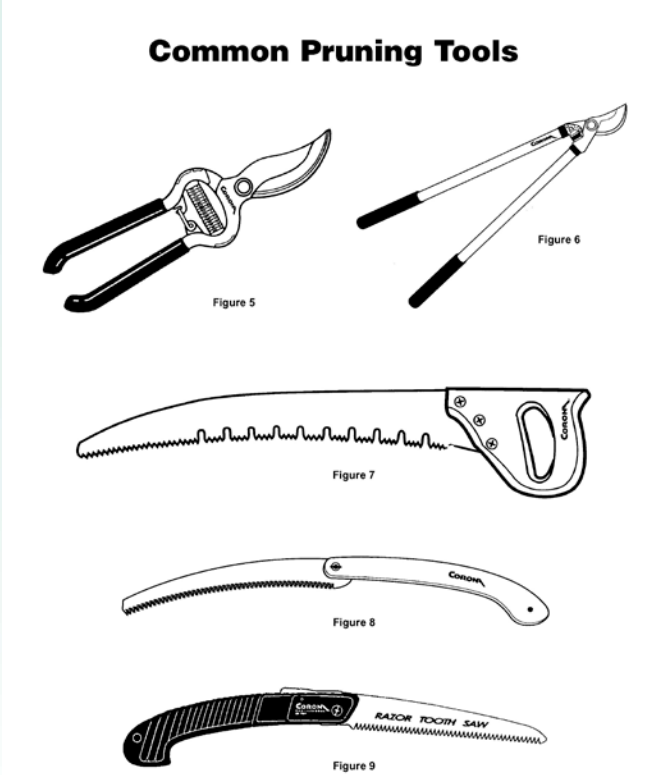
Disease Cycle



Inoculum

- The units of a parasite capable of initiating an infection
- Can be present in debris
- Can be spread from insects
- Can exist in weeds
  - Ivy gourd harbors cucurbit virus

Inoculum can be Present on Tools



Fungal vs. Bacterial Leaf Spots

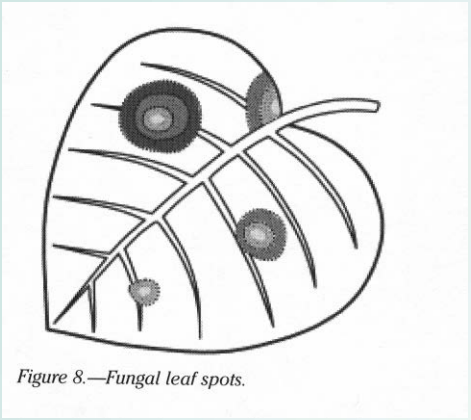


Figure 8.—Fungal leaf spots.

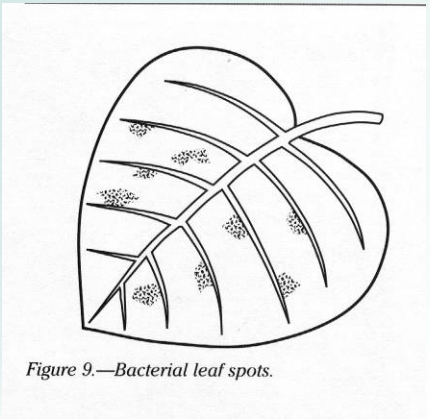
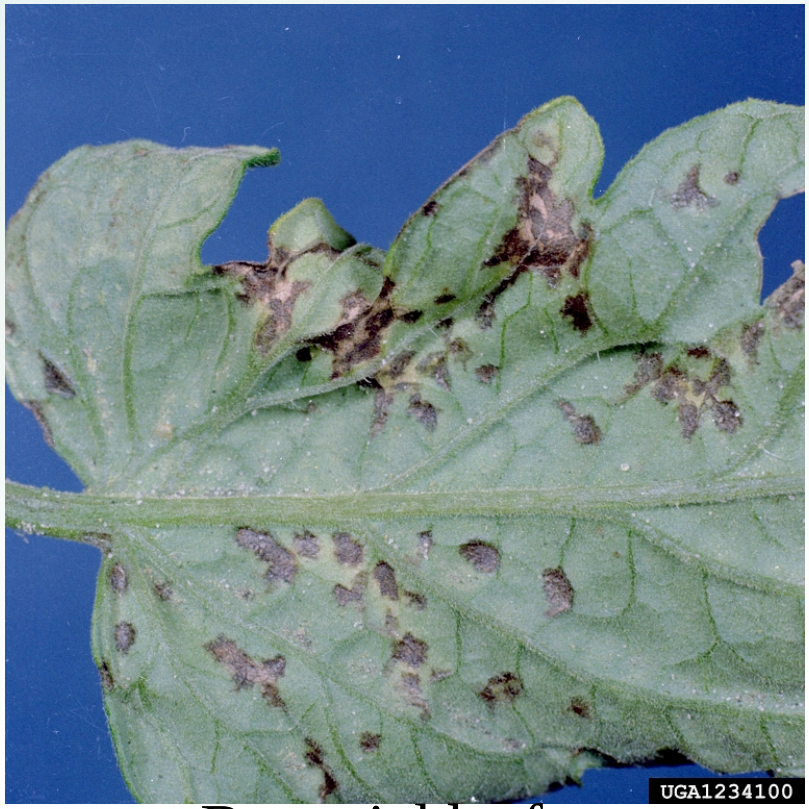


Figure 9.—Bacterial leaf spots.

- Fungal:
  - Irregular to circular; may have concentric rings
  - May have red, yellow, purple halos
  - Mycellium, spores or spore structures
- Bacterial
  - Angular, watersoaked appearance
  - May have irregular yellow halos
  - Wet or dried slime at edge of leaf spot
  - May have foul odor

Fungal vs. Bacterial Leaf Spots Tomato

Septoria leaf spot (fungus)

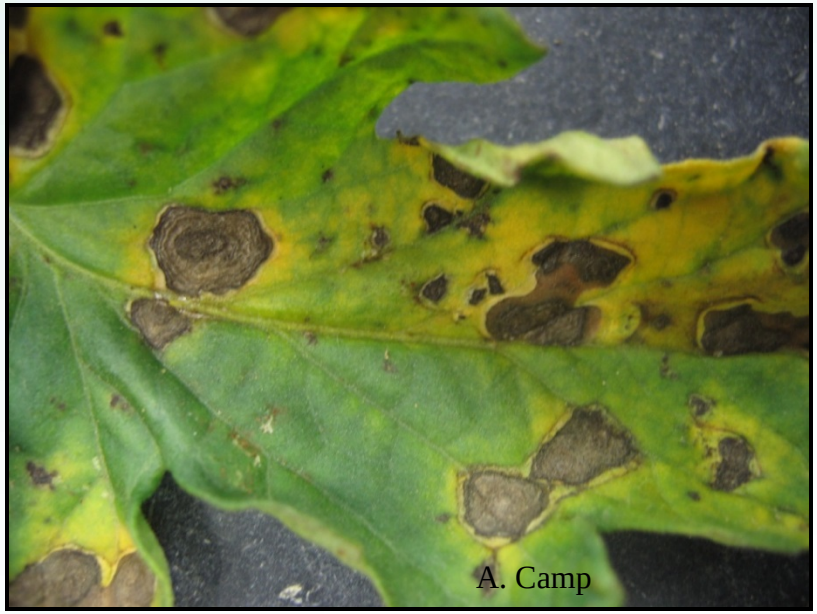


Bacterial leaf spot

Can you tell the difference?

A. Camp

Bacterial spot

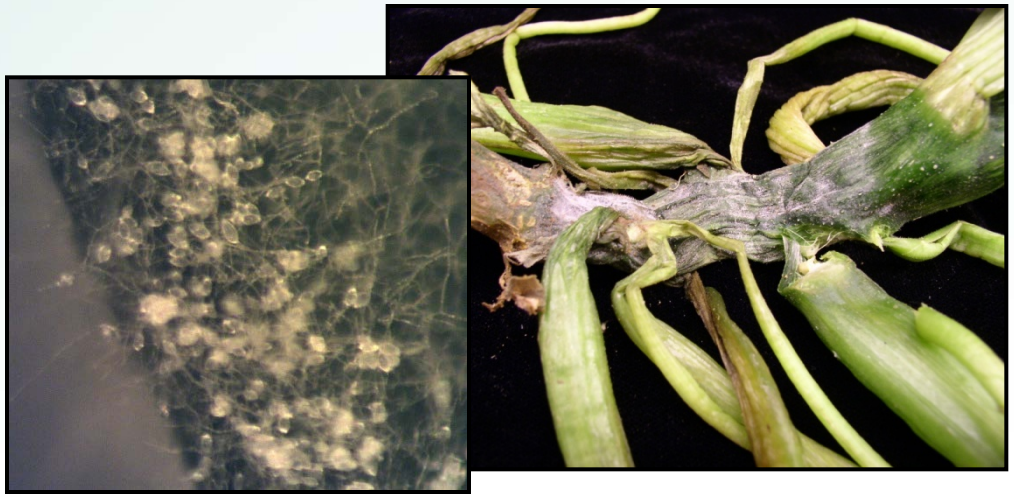


Fungal Alternaria leaf spot

Fungi

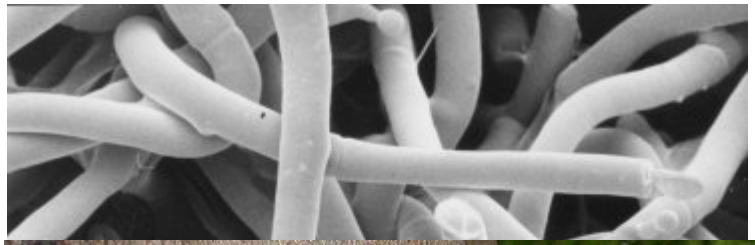
- The largest group of plant pathogens
- Signs:
  - Filamentous & fuzzy
- Symptoms:
  - Wilting
  - Rotting
  - Leaf spots
  - Distorted or disfigured plants
  - Damping off

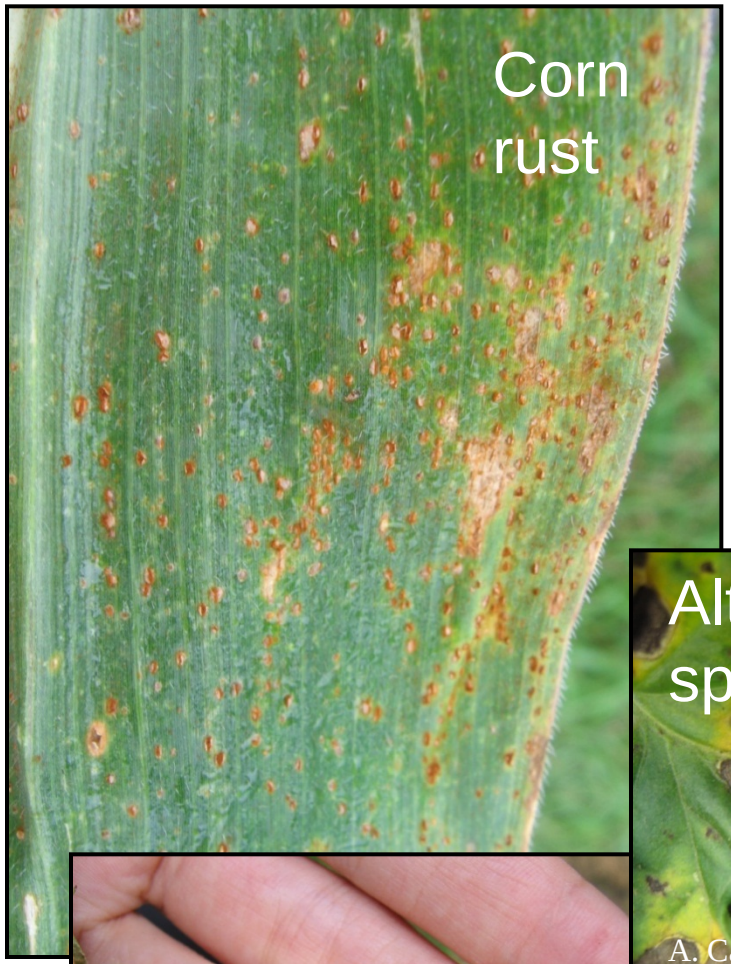
Brown rot on cherries

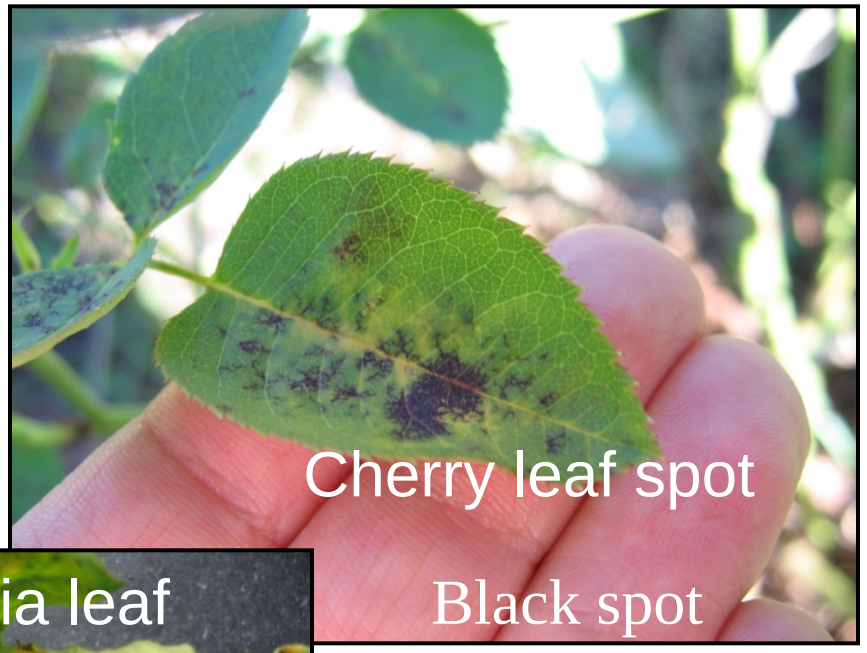


Phytophthora blight on summer squash

Fungal Structures




Corn rust


Cherry leaf spot
Black spot


Alternaria leaf spot
A. Camp


Phomopsis cane spot


Black knot
A. Camp

Verticillium Wilt

- A soil borne fungal disease that attacks the roots of plants
  - The fungus can exist in the soil for several years
- Fungus enters xylem and prevents water movement from the roots to the upper portion of the tree

Verticillium wilt

- Sudden wilting of leaves on one or several branches may occur-
- Often on only one side of the plant

Naupaka

Verticillium wilt

- The wood under the bark of wilting branches is discolored in streaks

Bacteria

- Signs:
  - slimy (if present)
- Symptoms:
  - Wilting
  - Rotting
  - Leaf spots
  - Distorted or disfigured plants

Bird's eye lesions – caused by bacterial canker

Pith discolored from *Clavibacter*

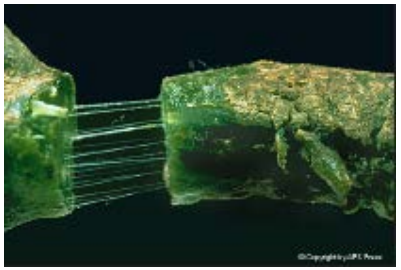
Bacterial Disease

In leaves:

Enter through stomata or natural openings

Bacterial Disease

- Crown gall bacteria genetically engineer their host to make galls and amino acids



Bacterial strands on cut stem

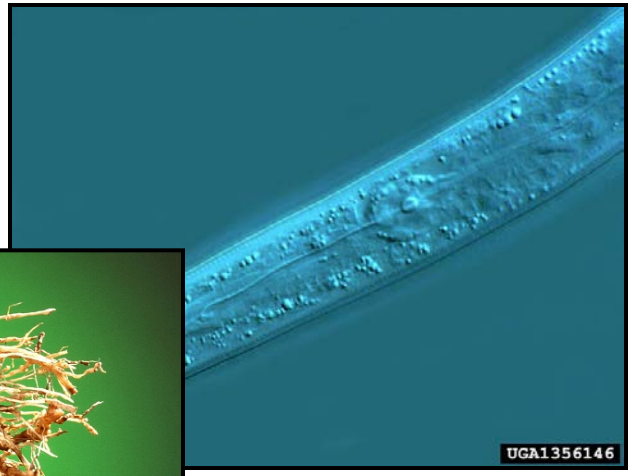
Potato scab

Bacterial spot

Bacterial Wilt Bell Pepper

Nematodes

- Nematodes are actually animals
- Only a few attack plants
  - Stylets
- Signs:
  - Sometimes cysts on roots
- Symptoms:
  - Wilting
  - Stunting
  - Disfigured plant structures
  - Root rots



Root-knot nematode on pepper. Photo courtesy of Scott Bauer, USDA Agricultural Research Service, Bugwood.org

Photo courtesy of Ulrich Zunke, University of Hamburg, Bugwood.org

~400x magnification

Plant Parasitic Nematode

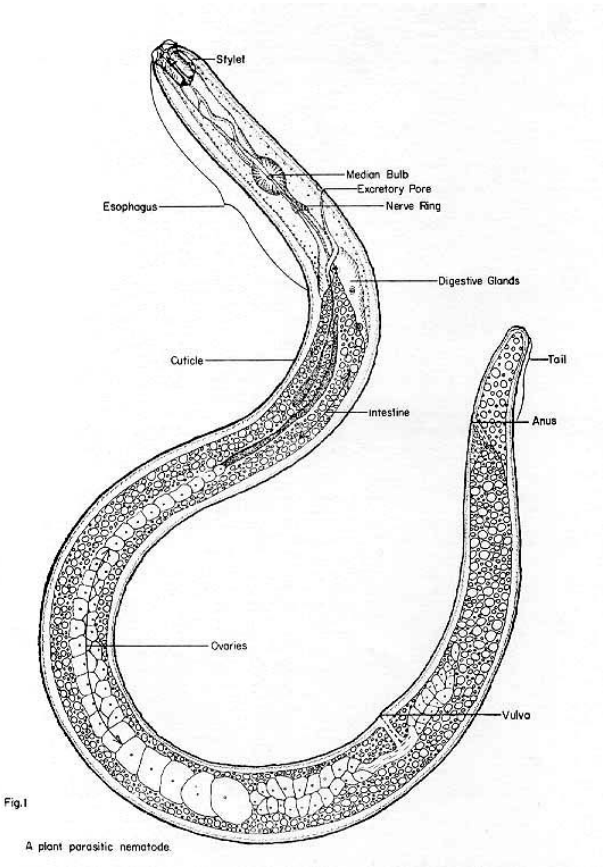


Fig.1

A plant parasitic nematode.


Host: String beans
Disease: Root knot
Pathogen: Root-knot nematodes (Meldoidogyne sp.)

Root Knot Nematode on Gardenia

Viruses

- Smallest plant pathogen
- Requires living plant cells

- Signs
  - Can’t see them!

- Symptoms
  - Mottling
  - Stunted plants
  - Distorted or misshapen fruits and leaves

Mosaic viruses

A. Camp

Dasheen Mosaic Virus on Taro

Viruses Spread By

- Insects and nematodes
- Using infected seed
- Handling plants
- Pruning
- Propagation
- Root grafts
- Sometimes by pollinating with infected pollen

Abiotic Diseases

- Do not spread from plant to plant
- These conditions account for about 65% of plant problems

Sunscald of tomato

Abiotic Disorders

- All leaves of a certain age might show damage
- All foliage within a certain exposure might show damage
- Often more than one type of plant
- Sharp margin between damaged and healthy tissue

Potassium deficiency on Guava

Be Aware Of:

- Symptoms common to several types of pathogens
- Above-ground symptoms caused by below-ground problems
  - Root injury, moisture stress, root diseases
- Multiple plant problems:
  - Non-living stresses leading to development of disease and insect/mite attack

Causes of Abiotic Stress

- Light and temperature
- Moisture, oxygen
- pH
- Mechanical injuries from weather, equipment
- Chemical injury from pesticides, fertilizer, pollution

Micronutrient deficiency most likely caused by pH

Vog damage on Akala

(Piercing) Sucking Mouthparts

- Leafhoppers
- Lace bugs
- Plant bugs
- Thrips (rasping, sucking)
- Aphids
- Psyllids
- Spider mites

Piercing and Sucking Insects

Southern Green Stink Bug

Rose Aphid

Cottony Cushion Scale on Koa

Torpedo Bug

Damage

Aphid damage

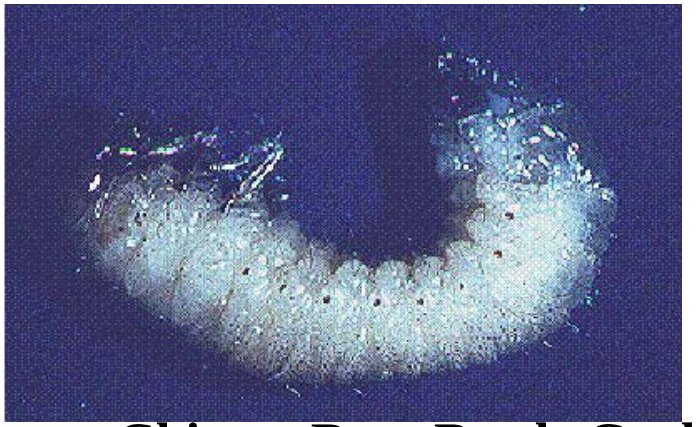
Scale and scale damage

Chewing Insects

Rose Sawfly aka Rose Slug

Chinese Rose Beetle

Gypsy Moth



Chinese Rose Beetle Grub

Chewing Insects

- Leaf miners (some flies, moths, and beetles)
- Larvae of moths or butterflies
- Sawfly larvae (wasps)
- Beetle larvae or adults
- Grasshoppers

Chinese Rose Beetle damage

Insects living within Plant Tissue

- Leafminers
- Weevils
- Twig borers
- Stem borers
- Root borers
- Fruit Flies

Mouthparts

Siphoning: Adult Moths and Butterflies

Sponging: Adult Flies

Master Gardener Helpline

Master Gardener History

- The Master Gardener Program was initiated in Washington State in 1972
- Two extension agents in King and Pierce Counties could not meet the demand for providing home gardeners gardening information
- They developed the idea of training volunteers to meet the demand

UH Master Gardener Program Mission

- Provide the public with unbiased, research based information and sustainable management practices in tropical horticulture suitable for home gardens, local landscapes, urban environments and the community

Where to Look for Information

- Sites should end in .edu
  - .gov
  - Sometimes .org
- First choice is CTAHR
- **http://www.ctahr.hawaii.edu**

Publication and Information Central

Search Publications

Browse CTAHR publications by general subject categories

NEW PUBLICATIONS

- Natural Farming: Fish Amino Acids
- Natural Farming: Oriental Herbal Nutrient
- Expanding Tree Diversity in Hawaii's Landscapes: Aalii, Kumakani; Dodonaea viscosa

TARO VARIETIES IN HAWAII

Niue-ulaula, Niue

The information in this online catalog is extracted from the book titled "Taro Varieties in Hawaii." First published in 1939, it contains detailed descriptions of 84 varieties of taro then found in Hawaii. To order the book, please download the order form here.

VIDEOS >>

Harvesting and Packing Lychee, Longan & Rambutan
[Windows Media | 00:31:52]

More videos >>

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OTHER INFORMATION SOURCES

Ask the Experts

This collection of questions and answers on topics in CTAHR's areas of expertise can be searched by crop or key word to find information on plants, farming, gardening, and more.

Publications Bibliographies

About 21,100 results (0.32 seconds)

[PDF] **Citrus** for Hawaii's Yards and Gardens - **ctahr**
www.**ctahr**.hawaii.edu/oc/freepubs/pdf/F_N-14.pdf University of Hawai'i
by R Ebesu - 2008
Fruits and Nuts. June 2008. F&N-14. **Citrus** for Hawai'i's Yards and Gardens. **Citrus** trees are among the favorite fruit trees grown around Hawai'i's homes.

[PDF] **Citrus** Melanose - **ctahr**
www.**ctahr**.hawaii.edu/oc/freepubs/pdf/PD-59.pdf University of Hawai'i
by S Nelson - 2008 - Cited by 1 - Related articles
of certain **citrus** species or varieties when the tis- sues grow and expand during extended periods of rainy or humid weather conditions. The symptoms of this.

[PDF] **CITRUS** FRUITS IN HAWAII. - **ctahr**
www.**ctahr**.hawaii.edu/oc/freepubs/pdf/B-09.pdf University of Hawai'i
by JE HIGGINS - Cited by 4 - Related articles
LETfER OF TRANSMITTAL. HONOLULU, HAWAII, September 1,1905. SIR: I have the honor to. transmit herewith a paper on **Citrus**. Fruits in Hawaii, prepared by ...

[PDF] **Citrus** Scab - **ctahr** - University of Hawaii
www.**ctahr**.hawaii.edu/oc/freepubs/pdf/PD-60.pdf University of Hawai'i
by S Nelson - 2008 - Cited by 1 - Related articles
CTAHR publications can be found on the Web site <http://www.**ctahr**.hawaii.edu/freepubs>. **Citrus** Scab. In 2006, Hawai'i imported more than 240,000,000.

Citrus Problems – Leaf Curling - **ctahr** - University of Hawaii
www.**ctahr**.hawaii.edu/UHMG/.../faq-**citrus**-curling.... University of Hawai'i
Curling leaves on **citrus** trees is a very common problem in Hawaii and is most likely caused by the presence of aphids. Broad mites are also mentioned in the ...

[PDF] **Citrus** culture in Hawaii - **ctahr**
www.**ctahr**.hawaii.edu/oc/freepubs/pdf/B-71.pdf University of Hawai'i
Citrus fruits of various kinds have been in cultivation in Ha waii for more than a hundred ... **Citrus** investigations have been in progress at the Hawaii. Agricultural ...

[PDF] **Citrus** Tristeza Virus in Hawai'i - **ctahr**
www.**ctahr**.hawaii.edu/oc/freepubs/pdf/PD-77.pdf University of Hawai'i
by S Nelson - 2011 - Related articles
Citrus Tristeza Virus in Hawai'i. Scot Nelson, Michael Melzer, and John Hu. Department of Plant and Environmental Protection Sciences. **Citrus** tristeza virus ...

Citrus Fertilization - **ctahr** - University of Hawaii

University of Hawaii

www.ctahr.hawaii.edu/UHMG/

UNIVERSITY of HAWAI'I at MĀNOA

Master Gardener Program

College of Tropical Agriculture and Human Resources (CTAHR)

- Home
- Programs
  - Kaua'i
  - O'ahu
  - Maui
  - East Hawai'i
  - West Hawai'i
- Gardening Helplines
- Helpful Links
  - Frequently Asked Questions
  - Hawai'i Gardening Basics
  - School Garden Resources
  - Tropical Topics
- Statewide Conference
- Advanced Training Resources for MGs

UH FOUNDATION Make a Gift

UNIVERSITY of HAWAI'I MASTER GARDENER

University of Hawai'i Master Gardener Program

Maui County Master Gardeners

Maui MGs support an extensive school gardening program.

ALERT: Little Fire Ant
LFA have been moved to O'ahu and Maui!

Check all new plants and materials for:

- Slow-moving, tiny red-orange ants
- Sharp sting if caught between clothes and skin

Call 643-PEST if you think you may have LFA!

- FAQ about Little Fire Ant

QUICK LINKS

- UH Seeds for Sale
- Soil and Plant Analyses (ADSC)
- CTAHR Publications

Statewide Master Gardener Coordinator

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Jody Smith
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Save the Date
2014 Statewide UH Master Gardener Conference

- October 24-26, 2014 on the island of Maui!

UNIVERSITY of HAWAI'I at MĀNOA

O'ahu Master Gardener Program

College of Tropical Agriculture and Human Resources (CTAHR)

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- O'ahu
- Maui
- East Hawai'i
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Gardening Helplines

Helpful Links

- Frequently Asked Questions
- Hawai'i Gardening Basics
- School Garden Resources
- Tropical Topics

Statewide Conference

Advanced Training Resources for MGs

UH FOUNDATION Make a Gift

O'ahu Master Gardener Program

Located on the island of O'ahu with administrative offices at the University of Hawaii, Manoa, the O'ahu Master Gardener program operates out of the UH Urban Garden Center (UGC) in Pearl City. We answer plant questions, provide hands-on training opportunities, maintain garden displays and conduct public demonstrations at this 30-acre garden.

Plant Helpline

The UH Cooperative Extension Service and the UH Master Gardener program is dedicated to disseminating local, research based information promoting sustainable practices that affect ourselves, our neighbors and our local and global environment. Many UH CTAHR publications are available to the public for free, accessible

O'ahu Gardening Questions

ALERT: Little Fire Ant

- SUBMIT a question through E-mail: OahuMg@ctahr.hawaii.edu
- Or CALL: 453-6055 M-F, 9am-12pm

Plant or Problem ID

- FIND US at Educational Outreach events
- Or VISIT in person (M-F, 9am-12pm) at the UGC

Second Saturday at the Garden!

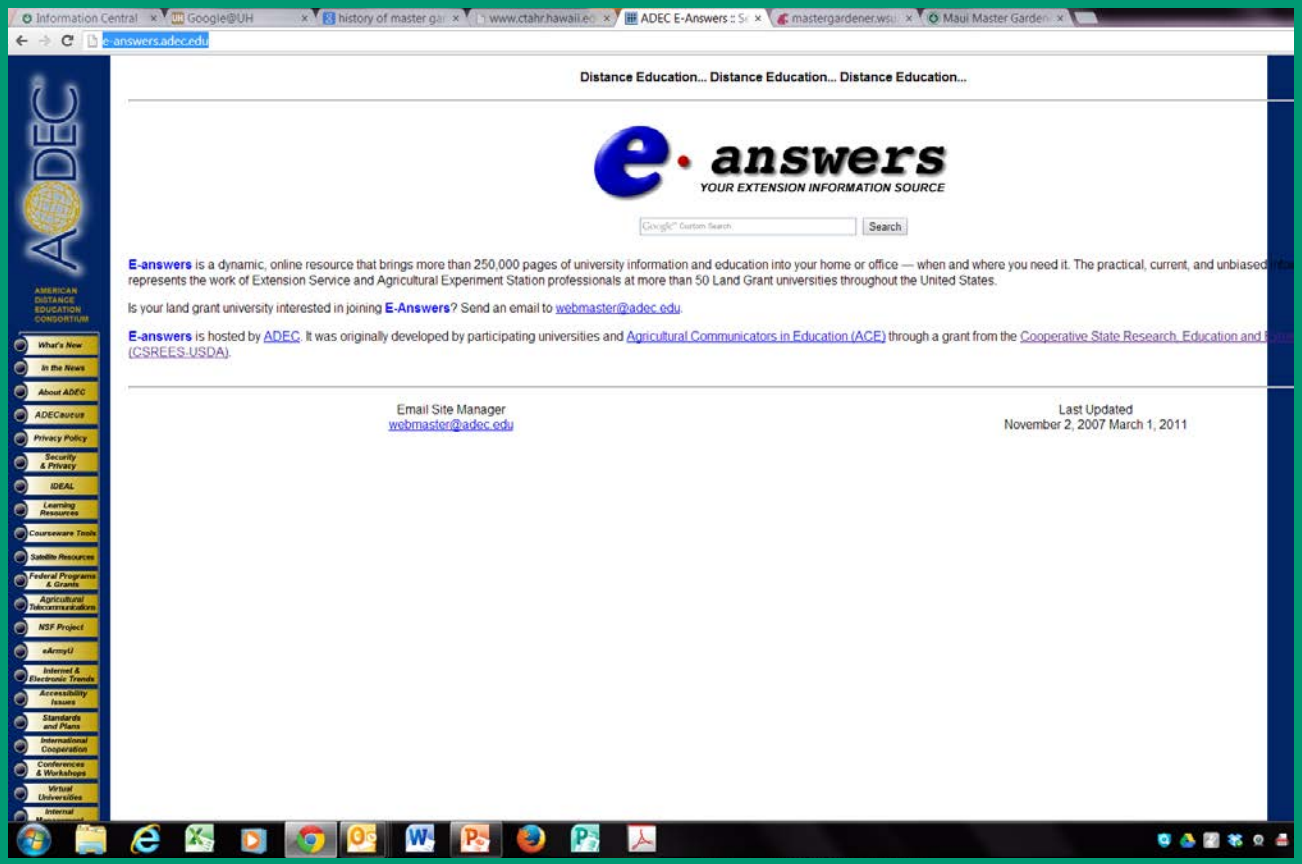
Visit our UGC website for monthly gardening topics and educational workshops.

Other Questions

- Request a Speaker
- Request for Master Gardener booth at

Other Sources

- http://e-answers.adec.edu



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Identification of insects found in Hawaii. * Post images that need identification. * Help identify images that get posted.

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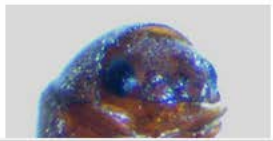

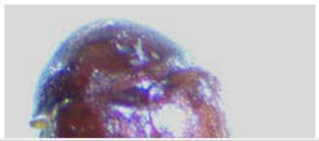

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Hawaii Plant ID

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Identification of plants found in Hawaii. * Post images that need identification.
* Help identify images that get posted.

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Hawaii Plant ID
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Where not to look for information

- Wikipedia
- Avoid .com sites
- Ehow.com
- **Remember, research-based information**

Where do you start?

- What is the plant?
- Where is the garden?
  - Is it near the ocean?
- Is the plant in the shade or sun?
- What are the symptoms?
  - Are there other plants showing the same symptoms?
  - Are the plants related?
  - Where are the symptoms found?
    - Are they randomly distributed?
    - Uniform?

Questions

- What is the watering schedule?
- What time of day do you water?
- How do you water (overhead, drip, etc.)?
- How long has this problem been going on?
- What type of soil do you have?
- Have you fertilized? With what?
- Have you used pesticides?
  - What have you used?
- Construction in the area?

Citrus

- Melanose (fungus)
- Citrus scab (fungus)
- Citrus Tristeza (virus)

Citrus Melanose

Citrus Melanose

Citrus Melanose

- Fungus
- One of the most common citrus diseases in Hawaii
- Typically attacks sweet orange, grapefruit, and pummelo
- Doesn’t affect pulp
- Dead wood in a canopy can harbor spores

Citrus Melanose

- Fruits are susceptible from about 3–5 months after petal drop,
- Approximately 8–24 hours of continuous moisture on leaf or fruit surfaces is required
  - Shorter periods at higher air temperature

Management

- May not affect yield
  - Juicing oranges may not need management
- Pruning
  - Allows for air flow
  - Inhibits survival of pathogen
- Citrus variety
  - Avoid planting susceptible citrus varieties or species (sweet orange, grapefruit, pummelo) in high-rainfall areas.

Management

- Choice of planting location
  - Plant citrus in sunny, low-rainfall regions
- Cropping system
  - Interplant citrus with non-susceptible hosts (avoid monocrops)
- Sanitation
  - Pick up and destroy plant materials that have fallen from the citrus canopy

Citrus Scab

- The pathogen affects the leaves, twigs, and fruits
- New growth most susceptible to pustules
- Most damage occurs during wet seasons or in high-rainfall areas
- 3 to 4 hours of surface wetness required for infection

Citrus Scab

- Light brown, circular scabs on twigs and petioles
- Brown scabs on leaves
  - Maybe upper or lower
- Light brown, raised, warty scabs on rind

Highly Susceptible

- Some tangerine (*C. reticulata*) varieties such as Fremont, Clementine and Murcott
- Rough lemon (*C. jambhiri*)
- Tangelo (*C. reticulata* x *C. paradisi*) (variety Orlando)
- Tahitian lime (Persian lime, *C. latifolia*)
- Rangpur lime (Mandarin lime, *C. limonia*)
- Frost Satsuma mandarin (*C. unshiu*)

Not Susceptible or Immune

- Sweet orange, navel orange (C. sinensis)
- Pummelo, shaddock (C. grandis)
- Grapefruit, pomelo (C. paradisi)
  - (however, grapefruit is reported as a host of the disease in Florida)

Management

- Choice of cultivar
  - Select a resistant species, hybrid, or cultivar
- Choice of planting location
  - Plant in a sunny, drier location
- Cropping system
  - Intercrop citrus with other types of non-citrus plants or trees that are not prone to infection

Management

- Irrigation
  - Reducing or eliminating overhead irrigation of susceptible varieties during the active growth
- Weed control
  - Do not allow tall weeds to grow around citrus plants
    - They increase the relative humidity in the canopy
- Pruning
  - Prune to increase air circulation

Citrus Tristeza Virus (CTV)

- The pathogen is CTV
- The diseases it causes:
  - Tristeza (Decline and Quick decline)
  - Stem pitting
  - Seedling yellows (nursery disease)
- No Hawaiian Island is free of the virus
- Diversity of strains, mild to severe

Tristeza

- Decline of different scion cultivars grafted onto sour orange rootstocks
  - Sour orange rootstocks not used anymore in Hawaii
- Appear water-stressed
  - Followed by defoliation and death

Stem Pitting

- Most commonly seen
- Found in grapefruits, sweet oranges, and some lime cultivars
- Trees are stunted with chlorotic leaves that often display “vein-clearing” symptoms

Stem Pitting

Vector of CTV[1]	Information
Humans (grafting, dispersal of infected plants)	The most effective vector of CTV.
	Virus has spread to nearly all citrus-producing regions of the world via transport of infected budwood and by grafting.
Toxoptera citricida (formerly *Aphis citricidus*): Brown citrus aphid	Virus acquisition time: less than 10 minutes.
	Single aphid transmission efficiency: 20% (the most efficient insect vector of CTV). Transmits most strains of CTV (72).
	The geographic range of the brown citrus aphid has been constantly expanding over the last few decades through South America, Central America, and parts of the continental United States (35, 65).
	The brown citrus aphid has a narrow host range and has been present in Hawai‘i since at least 1906, when it was first described (45).
Aphis gossypii: Melon aphid	Virus acquisition time: less than 30 minutes
	Single aphid transmission efficiency: 0.5-1.1%, much less efficient than the brown citrus aphid.
	Transmits most strains of CTV.
	The melon aphid has a much wider host range than the brown citrus aphid, including hundreds of plant species.
Aphis citricola/*Aphis spiraecola*: Citrus aphid/Spirea aphid	Virus acquisition time: not available.
	Single aphid transmission efficiency: not available.
	Transmits only a few strains of CTV.
	The citrus or spirea aphid is a poor vector of CTV but builds large populations on citrus trees, increasing the chance of transmission.
Toxoptera aurantii: Black citrus aphid	Virus acquisition time: not available.
	Single aphid transmission efficiency: not available.
	Transmits very few strains of CTV
	The black citrus aphid is a very poor vector of CTV but builds large populations on citrus trees, increasing the chance of transmission.

Vectors

- Brown Citrus Aphid

- Melon Aphid

Management

Stem pitting on Mexican orange

- Mild strains may protect from more severe strains (cross-protecting)
- Resistant or tolerant citrus varieties may include pummelo (C. maxima Merr.) and some mandarins (C. reticulata L.)
- Manage aphids