### Identification and Management of Common Greenhouse Diseases

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### Basics of Plant Diseases The Disease Triangle



### Basics of Plant Diseases The Disease Triangle & IPM



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- Botrytis blight (grey mold) was identified on the specimen.
- Use iprodione (Chipco 26019 50 WP) sprays or chlorothalonil (Termil) fumigant every 7-14 days at recommended rates (PATHOGEN)
- Avoid wetting foliage and overcrowding of plants. (ENVIRONMENT)
- Keep relative humidity below 90%. (ENVIRONMENT)
- Remove and destroy all badly infected plants and plant parts. (PATHOGEN)
- This fungus has become resistant to some fungicides. If control is poor change to a fungicide with a different active ingredient.

### Integrated Pest Management (IPM) is the Disease Triangle

Services and Fees

Turf Diagnostics 🗇

How to Submit a Sample

Plant Disease Fact Sheets

Insect Information Notes 📼

County Extension Centers and

OUICK HELP

Webinars and Training

NCDA & CS

Disease Problems:

919.515.3619

Insect Related:

919.515.9530

General Questions:



#### Welcome!

The Plant Disease and Insect Clinic diagnoses plant problems for farmers, growers, landscapers, homeowners, and gardeners. In consultation with expert faculty, we recommend ways to treat or prevent the problems we diagnose.

We work in partnership with your local County Agent or Master Gardener, who can diagnose many common plant disease and insect problems, or help you properly collect and submit a sample to the PDIC if necessary. Click these links to find a North Carolinia **County Agent** and **Master Gardener** near you!

#### News & Alerts 🚹

#### Navigate to "How to Submit a Sample" if you need our help.

News about diseases and insects, information about current plant problems, and news about upcoming events:

#### **Helpful hints:**

When submitting branches from trees and shrubs, be sure to include the transition zone, if any, between living and dead wood. Branches that are healthy and branches that are entirely dead are seldom useful for diagnosis. Also,

#### Alerts, Updates and Information

- Plant Pathology Portal
- Entomology Portal
- Boxwood blight
- Thousand Cankers in Tennessee and Virginia
- Emerald Ash Borer in North Carolina

### **Botrytis (gray leaf mold) - Identification**

### **Botrytis - Identification**

- wide host range many ornamentals, fruit, vegetables
- gray leaf mold produces gray "fuzzy" masses of spores
- Symptoms:
  - \*\*\*gray "fuzzy" sporulation\*\*\*
  - plant collapse whole or part
  - yellowing, browning or and/or water-soaking
  - flower speckling
  - bud rot
  - elongated dark cankers on stems

### **Botrytis – fuzzy gray mold**

### **Botrytis – Stem rot on vinca**

### Botrytis – plant collapse on million bells

### **Botrytis – flower speckling on petunia**

Clement, UME

### **Botrytis -- Management**

### Sporulates:

- under high humidity & temp around 70°F
- drives disease
  MANAGEMENT:
- Maximize air circulation
- Reduce relative humidity: <85-90%</li>
  - forced air circulation
  - increase heat (esp. at night)
  - avoid condensation on leaves (heat at night)

### **Botrytis – Life Cycle & Management**

### Survives on:

- infected and dead foliage (mycelium, spores, sclerotia)
- soil (sclerotia)
  MANAGEMENT:
- dispose of dead infected foliage and soil (sanitation)
- ...and dispose of material away/outside of greenhouse
- IF you must re-use soil
  - Steam: 180°F for 30 min; 160°F for 1 h
  - monitor temperature

### **Botrytis -- Management**

Attracted to:

- Rapid growth
- New, succulent growth
- Wounds
- Dead foliage in contact with new foliage MANAGEMENT:
- Avoid over-fertilization (esp. N)
- Avoid wounding plants

### **Botrytis -- Management**

### Fungicides:

- Last resort
  - disease CAN be managed through IPM
- Fungicide resistance in Botrytis:
  - boscalid, fenhexamid, pyraclostrobin, cyprodinil
  - MUST rotate FRAC groups (1, 7, 11, 9, 12)
  - e.g., Palladium, Medallion, Heritage, Pageant Intrinsic, Decree, Chipco, and others

### Foliar Diseases – Powdery Mildew on Viola



### Foliar Diseases – Powdery Mildew

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### Foliar Diseases – Powdery Mildew

- Host range (host specific):
  - chrysanthemum, begonia, zinnia, sunflower, phlox, dahlia, etc.
  - can survive on weeds in g/h
- Identification:
  - Powdery mat on leaf surface above & below
- Favors:
  - leaves, flowers, stems
  - prefers high humidity, and dry foliage

U. of Kentucky

### Foliar Diseases – Powdery Mildew

### MANAGEMENT:

- avoid susceptible plants
  - some varieties may be more tolerant (less susceptible)
- avoid low light levels
- keep RH <93%: heat in evening/early morning to reduce humidity at night
- sanitation (remove weeds in g/h)
- UC IPM: <u>http://ipm.ucanr.edu/PMG/r280110811.html</u>
- fungicide sprays: only when disease 1<sup>st</sup> appears
  - fungicide resistance reported in PM

# Foliar Diseases – Bacterial leaf spots (Xanthomonas spp., Pseudomonas spp.)

# Foliar Diseases – Bacterial leaf spots (Xanthomonas spp., Pseudomonas spp.)

- Host range:
  - many ornamentals
- Conditions that favor disease:
  - water and humidity
- Identification:
  - small, circular spots (centers may fall out)
  - water-soaked, especially on underside of leaf
  - spots in areas where water accumulates (leaf tips)
  - must be diagnosed in clinic; cannot distinguish from fungal leaf spots

### Foliar Diseases – Bacterial leaf spots (Xanthomonas spp., Pseudomonas spp.)



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# Foliar Diseases – Bacterial leaf spots (Xanthomonas spp., Pseudomonas spp.)

- MANAGEMENT:
  - strict sanitation: sanitize tools, use clean soil, pots, dispose of debris
  - water when foliage can dry (i.e., in morning)
  - avoid overhead watering, if possible
  - avoid handling plants when wet
  - heat from underneath helps dry foliage
- Once plants are infected, chemical control is ineffective

### Foliar Diseases – Fungal leaf spots

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- Host range:
  - many ornamentals
  - various species of fungal pathogens
- Conditions favoring disease:
  - water and humidity
- Identification:
  - small, circular spots; may enlarge
  - vary in size and color
  - may be able to see sporulation in center of lesion
  - must be diagnosed in clinic; cannot distinguish from bacterial leaf spots

### Foliar Diseases – Fungal leaf spots

## Foliar Diseases – Fungal leaf spots



### Foliar Diseases – Fungal leaf spots

- MANAGEMENT:
  - sanitation (tools, soil, pots, debris)
  - minimize overhead irrigation
  - water when foliage can dry (morning)
  - use resistant cultivars, if available
  - broad-spectrum fungicides
    - mancozeb, chlorothalonil, iprodione, thiophanate-methyl & combinations



### Soilborne Diseases – Black Root Rot (Thielaviopsis basicola)

**KY Pest News** 

## Soilborne Diseases – Black Root Rot (*Thielaviopsis basicola*)

- Large host range: annuals, perennials, woody plants
  - snapdragon, annual vinca, phlox, violet, pansy, zinnia, etc.
- Causes yellowing, defoliation, stunting, unthriftiness
- Identification:
  - \*\*black or dark colored roots\*\*
  - clinic diagnosis

### Soilborne Diseases – Black Root Rot (*Thielaviopsis basicola*)



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**KY Pest News** 

### Soilborne Diseases – Black Root Rot (Thielaviopsis basicola)

GPN Maga 100 µm

### Soilborne Diseases – Black Root Rot (*Thielaviopsis basicola*)

- Survives in/on:
  - roots and soil
- MANAGEMENT:
  - Avoidance
  - Avoid transplants with dark or black roots
  - Dispose of affected plants + adjacent plants
  - Sanitation
  - Preventative fungicides:
    - thiophanate-methyl, Banrot, Terraguard



- Host range: MANY greenhouse ornamentals
- Conditions favoring disease:
  - wet soil, roots
  - pooled water areas
- Causes:
  - wilting, unthriftiness, dieback, death
- Identification:
  - roots, lower crown affected; sometimes foliage
  - water-soaked areas on lower stem/crown
  - lack of root tissue; sloughing
  - outside part of root can be pulled off ('rat-tail')



- MANAGEMENT:
  - Avoid transplants unhealthy, poor root system
  - WATER management
    - avoid standing water and over-watering
  - Dispose affected plants + adjacent plants
  - Sanitation is important
  - Preventatives:
    - Segovis, Segway, Stature, Alliette, Subdue MAXX (resistance in Phytophthora & Pythium)

### What do we mean by sanitation?

- Used soil and dead plants:
  - dispose of away from production areas
- Used pots:
  - dispose; esp. if previous crop diseased
  - if you must re-use
    - remove organic debris, then sanitize (quat. ammonia, bleach, hydrogen peroxide)
    - OR steam
- Tools:
  - clean off debris, then sanitize
  - set for each house may be best idea
  - Sanitizers:
    - always remove debris before using product

#### Treatments for Sanitizing Tools, Equipment, Cultivation Surfaces, Pots and Flats

D. M. Benson, and Mike Munster, Professor and Diagnostician, respectively, Plant Pathology

Use All Products according to label.

All items should be free of organic debris before exposure to the treatments listed below. Sanitizing an entire greenhouse involves physically removing leftover debris and soil as a first step prior to disinfection, as soil and organic residues reduce the effectiveness of disinfectants. There are some commercial cleaners specifically designed for greenhouse use, e.g., Strip-It (best applied by spray, brush, or foam), which is a combination of cleaning and wetting agents formulated to remove algae, dirt, and hard water deposits. High pressure power washing with soap and water is also an option prior to disinfection as listed below.

#### Table 10-15. Treatments for Sanitizing Tools, Equipment, Cultivation Surfaces, and other Related Items

Material or Treatment	Trade name	Formulation	Remarks	Contact time
alcohol, ethyl and isopropyl (grain, rubbing, wood) (70-100%)	Various commercial brands; Lysol Spray (also includes quaternary ammonium)	Depends on formulation. Read label. Typically full strength for RTU (Ready To Use) formulations.	Evaporates quickly so that adequate contact time may not be achieved; high concentrations of organic matter diminish effectiveness; flammable.	10 min for equipment, pots, flats and surfaces. Tools can be dipped for 10 seconds and allowed to dry. Do not rinse.
hydrogen peroxide (hydrogen dioxide) and peroxyacetic acid mixture	ZeroTol 2.0; SaniDate 5.0; Oxidate 2.0	2.5 fl oz per gallon of water 0.5 fl oz per gallon of water 0.5 to 1.25 fl oz per gallon of water	Very corrosive; eye/skin irritant. Low odor. Use according to label. Must be stored in cool location.	1-10 min
quaternary ammonium	Physan 20;	Depends on formulation. Typically 1 tablespoon per gallon of water	Effective for non-porous surface sanitation, e.g. floors, walls, benches, pots. Low odor, irritation.	10-15 min Must remain wet for 10 min. Wipe dry with a clean cloth or sponge or allow to air dry.
	KleenGrow	For general disinfection use 0.5 to 1.0 fl oz per gallon of water	Hard, NON-POROUS surfaces use 1.0 fl oz per gal water; Tools, cutters & equipment use 0.5 fl oz per gal water. Apply solution with a cloth, mop, sponge, coarse spray device or by immersion until surfaces are wet. Prepare a fresh solution daily.	Must remain wet for 10 min. Wipe dry with a clean cloth or sponge or allow to air dry.
sodium hypochlorite (8.25%)	Clorox; Commercial bleach;	10%; or a 1:14 ratio of bleach : water	Inactivated by organic matter; fresh solutions should be prepared every 8 hr or more frequently if exposed to sunlight; corrosive to metal; irritating to eyes and skin; Exposure to sunlight reduces efficacy. Keep solution in opaque container.	10-15 min. for equipment, pots, flats and surfaces. Tools can be dipped for 10 seconds and allowed to dry. Do not rinse.
steam	NA	Cover or otherwise seal	For plastic pots and trays, heat center of steamer between 150 degrees F to 160 degrees F;	60 min.
			degrees F.	
solarization	NA	Place clean items on solid surface, cover tightly with CLEAR plastic	Clear plastic works much better.	140 degrees F, 4 to 8 hr/day for 7 days

Prepared by Kelly Ivors, former Extension specialist and Mike Munster, diagnostician. Revised by D. M. Benson and Mike Munster.

### What else can I do?

- Pathogen-free plants or seeds
- Keep media in a designated clean area where NO plants or debris are allowed
- Scout often
- Maintain healthy plants with proper growing conditions
  - feed, water, light, etc.
- Employ host resistance, where possible
- Crop rotation
- Record-keeping-know the problems you have
- Do ALL the above, make them habits



NCSU Plant Disease & Insect Clinic (PDIC) disease diagnostics & recommendations NC Ag Chem Manual current labeled fungicides, rates\*\* weeds, insects, fertilizers, PGRs, pesticide use available online & book form (UNC Press \$30) **NCSU Extension Agent / Area Agent NCSU/other University Extension Fact Sheets** 



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