

# Diagnosing Common Vegetable Diseases

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# Introduction

## Topics:

- **Disease Triangle**
- **Foliar & Fruit Diseases**
- **Soilborne Diseases**
- **Greenhouse Diseases**

## Covering:

- **Tomatoes, Peppers, Cucurbits, Brassicas/Cole crops**
- **Management**



# Disease Triangle

Soil moisture  
Soil type  
Drainage  
Leaf wetness  
Humidity  
Air flow

**Environment**

**Pathogen**

**Disease**

Exclusion  
Fungicides

**Host**

Resistance, Crop rotation



# Family Rotation

## Solanaceous

Tomato

Pepper

Eggplant

## Cucurbit

Cucumber

Squash

Watermelon

Pumpkin

Zucchini

## Brassicas

Cabbage

Broccoli

Collards

Kale

Cauliflower

Turnip



# Foliar & Fruit Diseases





# Bacterial spot (speck/canker)





# Bacterial spot/speck/canker

- **Hosts:**
  - Tomato, pepper
- **Spreads rapidly**
- **Management**
  - Treat seed – hot water (specific temp & time)
  - Clean greenhouse production
  - Avoid leaf wetness when handling plants
  - Fixed coppers, Regalia, Serenade
    - Resistance to copper present
    - copper accumulation in soil is a concern
  - Host resistance – not yet



# Early blight

(*Alternaria linariae* = *tomatophila* or *A. solani*)





# Early blight

(*Alternaria linariae* = *tomatophila*)

- Hosts: tomato, (potato)
- Soilborne
- Leaves, stem, fruit
- Management
  - Rotation – 2-3 years
  - Tolerant varieties
    - E.g., Mountain Magic
  - Adequate nutrition
  - Fresh potting mix, new trays
  - Double Nickel, Serenade – ok control





# Late blight

*(Phytophthora infestans)*





# Late blight

*(Phytophthora infestans)*

- Hosts: tomato, potato
- Early July
- Prolific sporulation
- Cool temps, fog, rain
- Resistant variety
  - “Ph2 & Ph3”
    - Iron Lady
    - Mtn. Magic
    - Mtn. Merit
- Copper fungicides







# USAblight

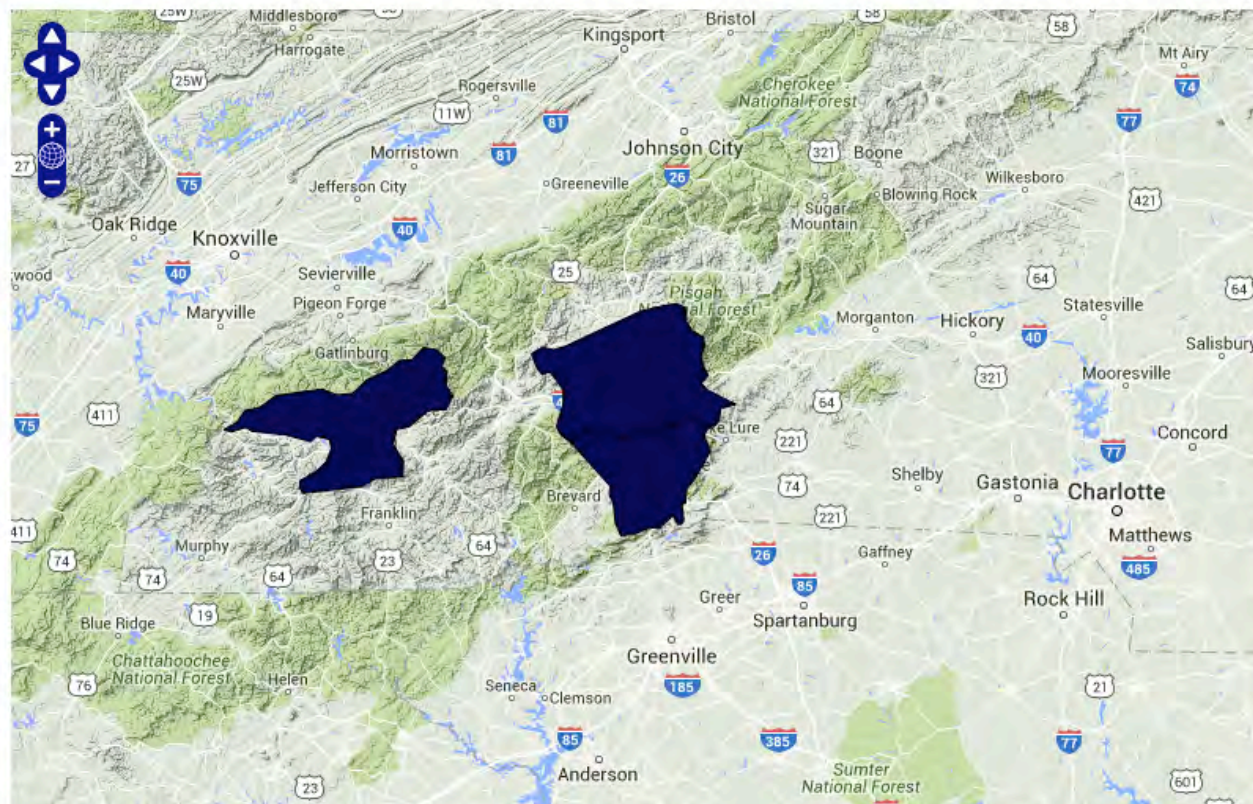
A NATIONAL PROJECT ON TOMATO & POTATO LATE BLIGHT IN THE UNITED STATES

[About Late Blight ▼](#)
[Occurrence Map ▼](#)
[Reporting Outbreaks ▼](#)
[Managing Late Blight ▼](#)
[Cornell DSS](#)
[Publications](#)
[About Us ▼](#)
[Internal Users ▼](#)
[News Item: Late blight and other Phytophthora diseases emerging in India](#)
[Phytophthora diagnostics workshop held in India](#)
[Occurrence Map ▼](#)

## Late Blight Map

Note: Not all states/regions currently report late blight to our web site. We encourage you to ask your local extension agent to report the disease.

Click on a county below for more report information.



### Henderson County, NC

[Back to County List](#)

#### 2015-09-15

Observed 64 days ago

Date Reported: 2015-09-28

Host(s) Tomato

#### Sample Analysis:

Genotype: [US-23](#)

Metalaxyl Sensitive

#### 2015-08-11

Observed 99 days ago

Date Reported: 2015-08-26

Host(s) Tomato

#### Sample Analysis:

Genotype: [US-23](#)

Metalaxyl Sensitive

#### 2015-08-11

Observed 99 days ago

Date Reported: 2015-08-26

Host(s) Tomato

#### Sample Analysis:

Genotype: [US-23](#)

Metalaxyl Sensitive

#### 2015-07-15

Observed 126 days ago



# Phytophthora blight, crown/root rot





# **Phytophthora blight, fruit rot, crown rot, root rot**





# Phytophthora blight, crown/root rot

- **Wide host range**
  - Cucurbits, peppers, tomatoes, eggplant
    - Wild geranium, black nightshade
  - Fruit, roots, crown
    - Depends on host
- Brought in by transplants, soil, contaminated equip.
- Soilborne & persistent
- Extended periods of heavy rain, humidity
- Poorly drained soils



# Phytophthora blight, crown/root rot

- **Management**
  - Resistant varieties
  - Improve drainage
  - Raised beds
  - Drip irrigation
  - Non-infested water source
  - Rotation: 2-4 years
  - Copper-based fungicides

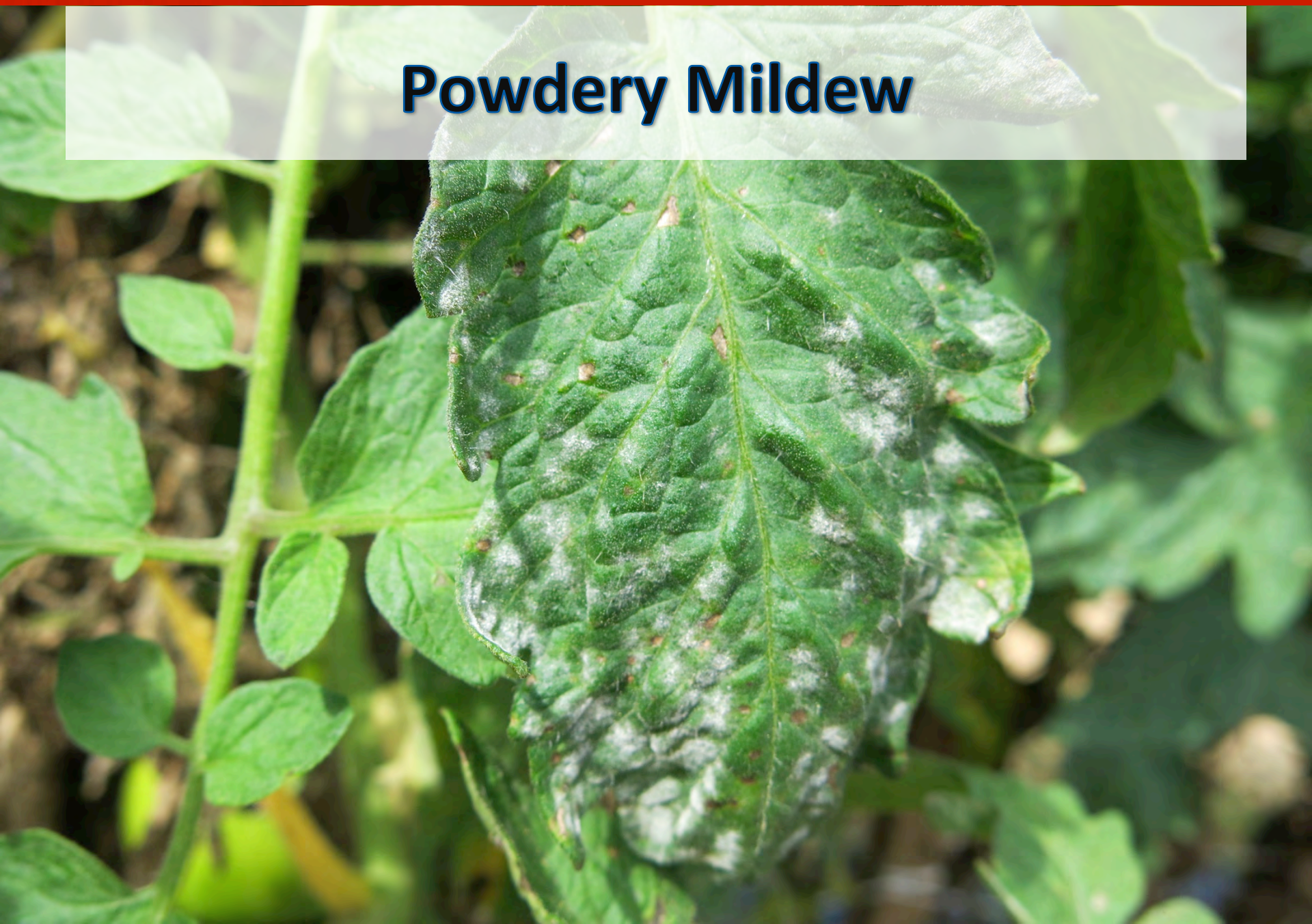


# Powdery Mildew





# Powdery Mildew



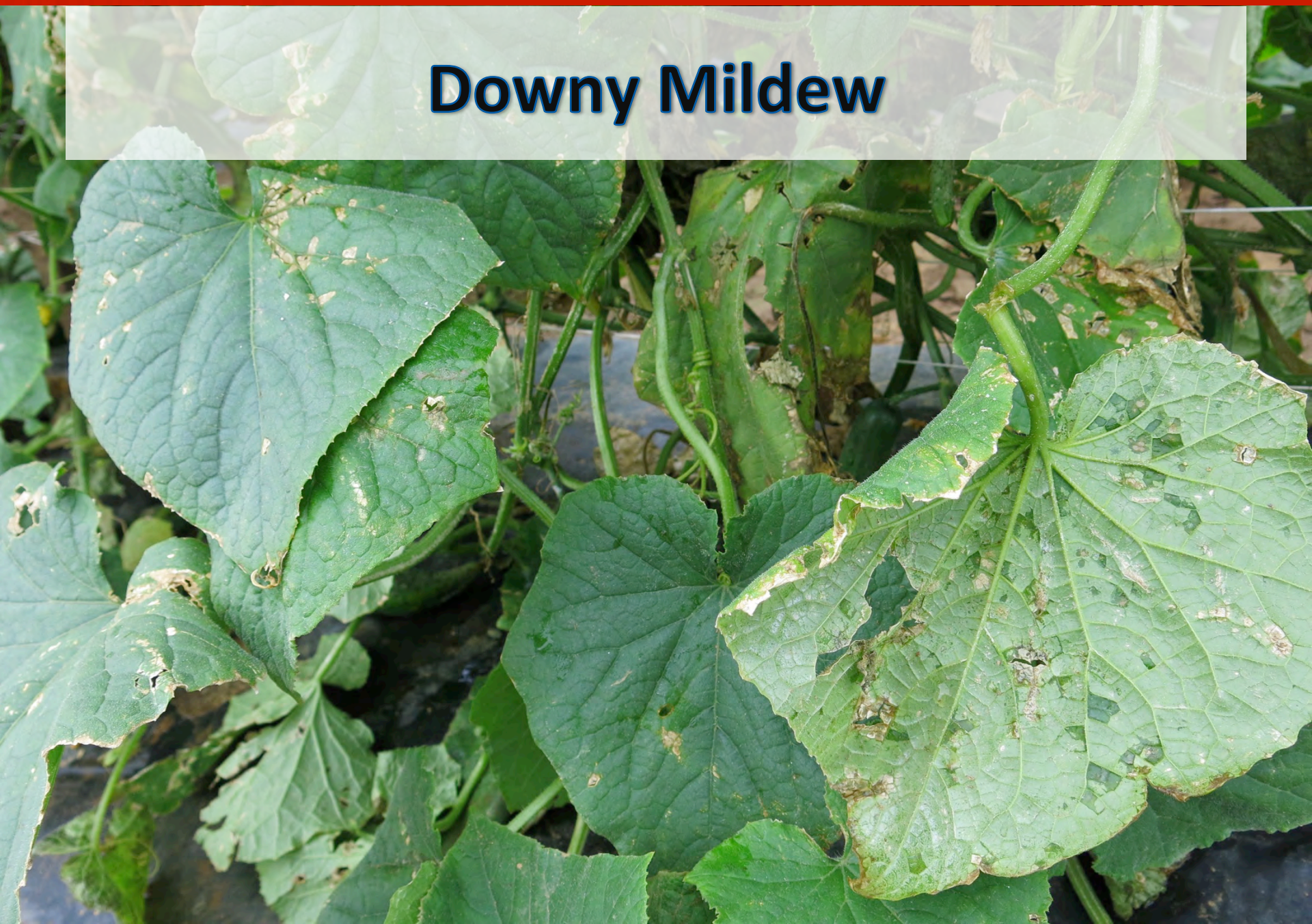


# Powdery Mildew

- **\*\*Cucurbit, \*Tomato, (Pepper, Brassicas)**
- **Different host - Different species of fungus**
- **Vine run, fruit onset – most susceptible**
- **Increases susceptibility to other diseases**
- **Management**
  - **Increase spacing between plants**
  - **Resistant variety**
  - **Sulfur, coppers**
    - **Coverage is key**



# Downy Mildew





# Downy Mildew





# Basil Downy Mildew





# Downy Mildew

- **\*\*Cucurbits, \*\*basil, broccoli, lettuces**
- **Different host = different species**
- **Does not overwinter in NC**
  - **Late July, August**
- **Management**
  - **Reduce canopy density**
  - **Avoid overhead irrigation**
  - **Resistant variety**
  - **Organics:**
    - **Copper, Ammonium or potassium bicarbonate**
    - **Serenade, Regalia, MilStop, Double Nickel (marginal control)**



# Basil Downy Mildew

- **Yellowing leaves, necrosis**
  - **black/gray spores on underside**
- **Other hosts: coleus, salvia**
- **Source:**
  - **Year-round production**
  - **Seed**
- **Plant tolerant varieties**
- **Treated seed**



M. McGrath



# Tomato Spotted Wilt Virus





# Tomato Spotted Wilt Virus & Tobacco Mosaic Virus



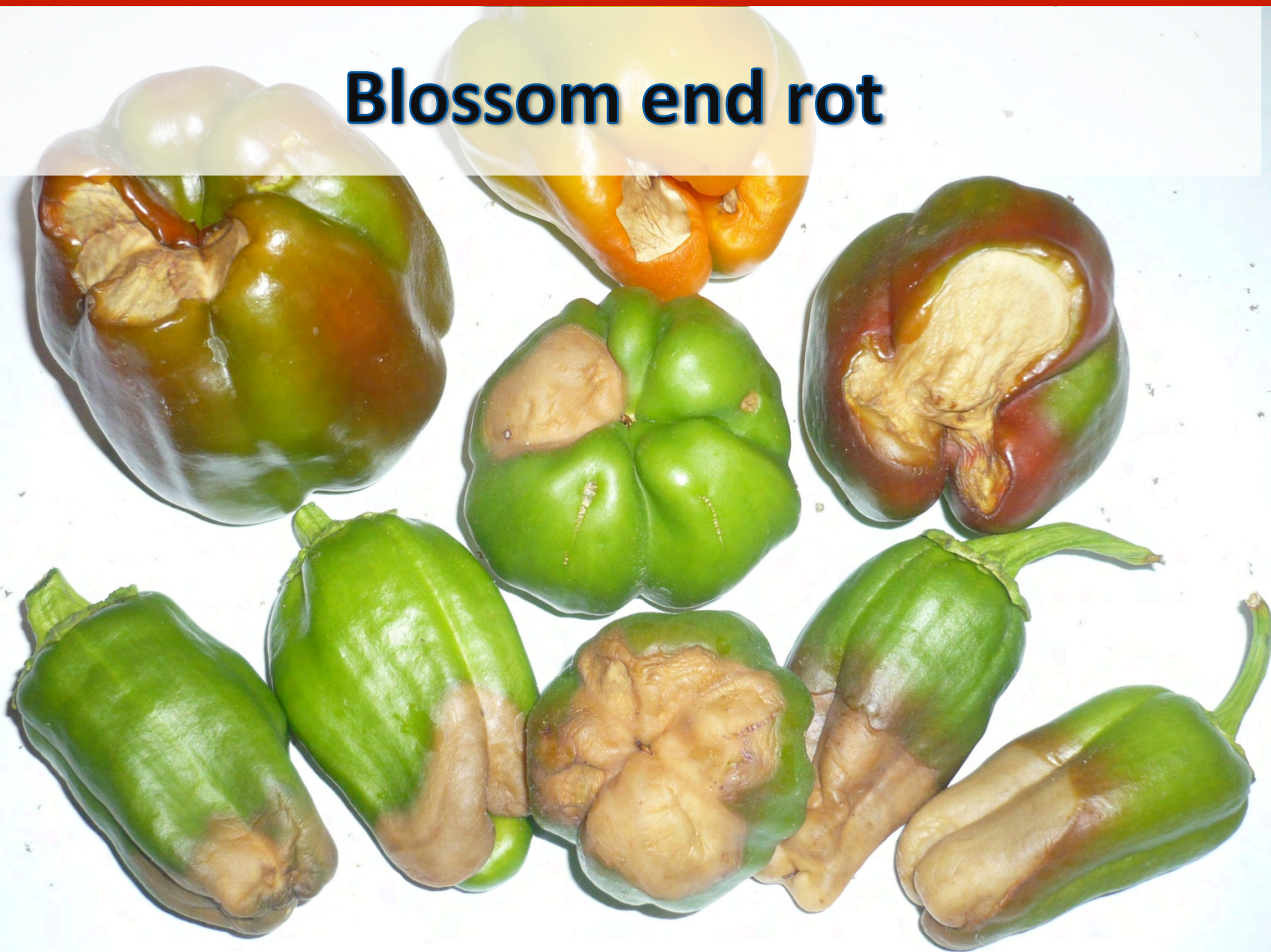


# Tomato Spotted Wilt Virus

- Tomatoes, peppers, eggplant, cucumber
- **WIDE** host range including many weeds
- Bronzed areas on leaves, light green/yellow rings
- Stunted, wilted
- Transmitted by thrips
- Management: exclude thrips = exclude the virus



# Blossom end rot





# Blossom end rot





# Blossom end rot/Ca deficiency



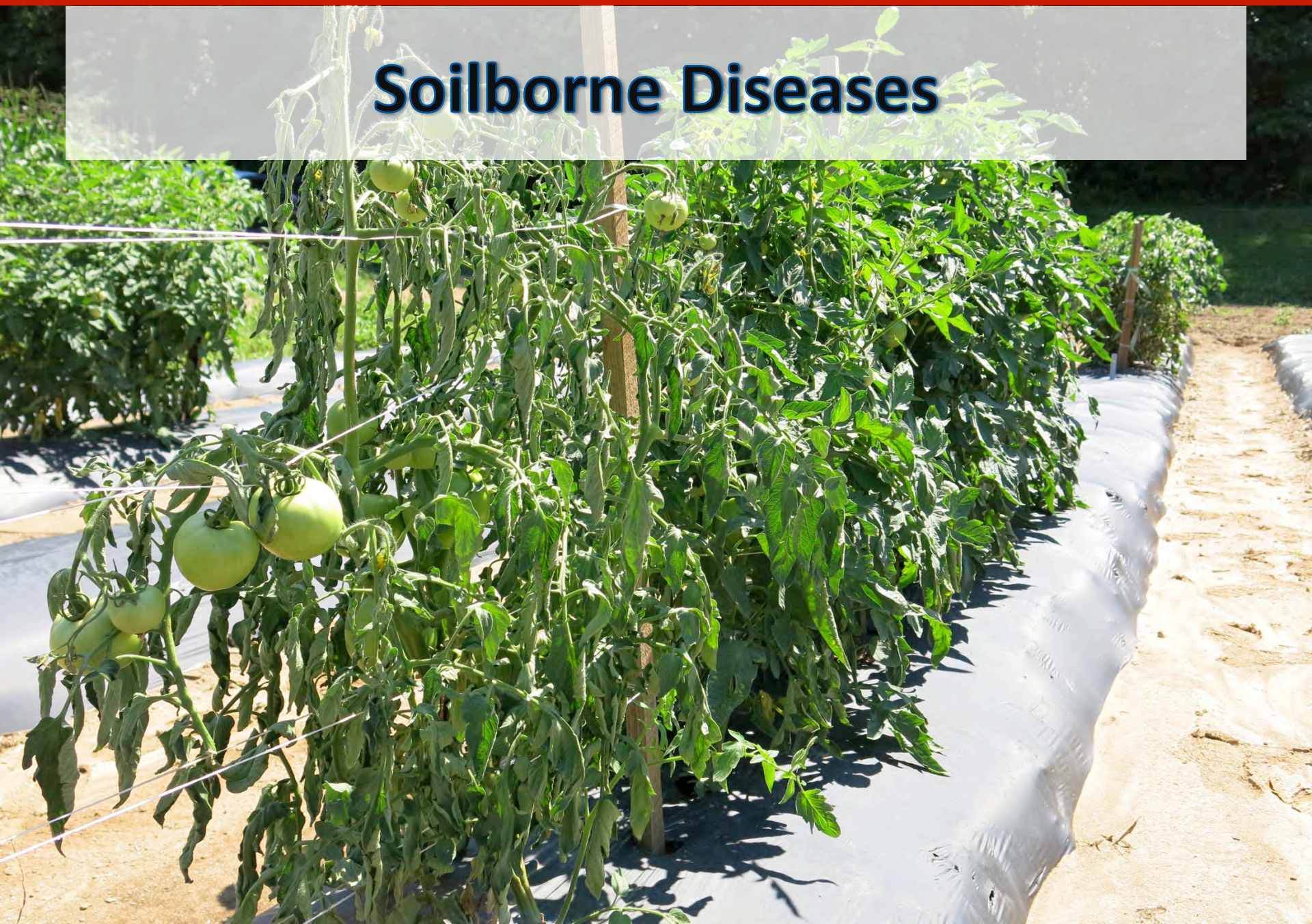


# Blossom end rot/Ca deficiency

- Tomato, crucifers, pepper, cucurbits
- Calcium deficiency in the plant
- Exacerbated by
  - Water stress x fruit development
  - high heat
  - acidic soils
- Regulate moisture
- Get your soil tested (NCDA)



# Soilborne Diseases





# Bacterial Wilt – Solanaceous Crops





# Bacterial Wilt Diagnosis





# Bacterial Wilt – Solanaceous Crops

- Tomato, eggplant, potato, pepper
  - Woody nightshade
  - Tobacco, banana, geranium, olive, rose
- Survives in soil long-term
- Spotty in mountains; can be severe elsewhere in NC
- Management
  - Rotation away from hosts, 2-3 years
  - Grafted tomatoes



# **Fusarium wilt, crown, foot rot, fruit rot- Cucurbits**





# Fusarium wilt, crown, foot rot - Cucurbits

- Multiple species of Fusarium
- Soilborne, persistent
- Seed-transmitted
- Damping-off, stem collapse
- Some can cause fruit rot
- Management
  - Use clean seed
  - Rotate away from cucurbits
  - Host resistance is race specific



# Fusarium wilt





# Fusarium wilt on tomato

- Unilateral yellowing, wilting
- Soilborne & persistent
- Management:
  - Resistant varieties
    - Race 1, 2 common
    - Race 3 resistance - few
  - Rotate – 3-5 years





# Verticillium wilt





# Verticillium wilt

- V-shaped lesions on leaves
- Dark brown vascular staining
- Large host range (400): annuals, perennials, woody
- Management:
  - Rotate away 2-3 years
  - Resistant varieties:
    - Race 1 - yes
    - Race 2 - not yet



# Gummy stem / Black rot





# Gummy stem / Black rot

- Cucurbits – symptoms vary
- Stem blight (oozing), blackish fruit rot
- Seed, soilborne
- Cuc. Beetle & powdery mildew increase susceptibility
- Management
  - Rotate: 2 years
  - Disease-free seed



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# Greenhouse Diseases





# Damping-off fungi

(Rhizoctonia, Pythium, Fusarium)





# Damping-off fungi

(Rhizoctonia, Pythium, Fusarium)





# Damping-off fungi

(Rhizoctonia, Pythium, Fusarium)

**In the greenhouse...**

- **Avoid cool & wet conditions**
- **Older seedlings not affected**
- **Cull diseased immediately**
- **Avoid saturated soil & high nitrogen**
  - (fertilize after first true leaves emerge)
- **Use new soil, trays**



# Botrytis gray mold

(*Botrytis cinerea*)

- Greenhouse & field
- Favors humid, cool conditions
- Management:
  - \*Reduce humidity
  - \*Increase air movement
- Sanitation
  - Pruning
  - Remove debris



M. Ferguson



# Resources

- **2016 SE US Vegetable Crop Handbook**
  - [www.thepacker.com/sites/produce/files/SEVegGuide\\_2016.pdf](http://www.thepacker.com/sites/produce/files/SEVegGuide_2016.pdf)
- **NC AG Chem Manual**
- **NCSU Plant Pathology Extension Portal**
  - Late blight, downy mildew, disease updates
  - Disease notes
- **USABlight, IPMPipe**
- **UGA Extension - Comm. Prod. Veg. Transplants**
- **Greenhouse Sanitation**
  - University extension programs



**Get your soil tested - NCDA**  
**Get proper disease diagnoses**  
**NCSU Plant Disease and Insect Clinic:**  
**[www.cals.ncsu.edu/plantpath/extension/clinic/](http://www.cals.ncsu.edu/plantpath/extension/clinic/)**

