What's the Matter with My 'Mater?

Matt Jones

Horticulture Agent

NC Cooperative Extension - Chatham County Center

What is Cooperative Extension?

World's largest **non-formal education** network

- Established 1914 by the Smith-Lever Act

Practical, non-degree programs

NC COOPERATIVE EXTENSION

N.C. A&T STATE UNIVERSITY

NC STATE UNIVERSITY

What is Cooperative Extension?

A nationwide network of

- Educators
- Researchers
- Volunteers

Additional Resources

Sustainable Vegetable Gardening Resources

- Many excellent Extension resources
- Slides from previous classes:
- Soils
- Pests & Diseases
- Warm season crops
- Cool season crops

https://go.ncsu.edu/chathamveggies

Additional Resources

NC State Tomato Disease Factsheets and Videos

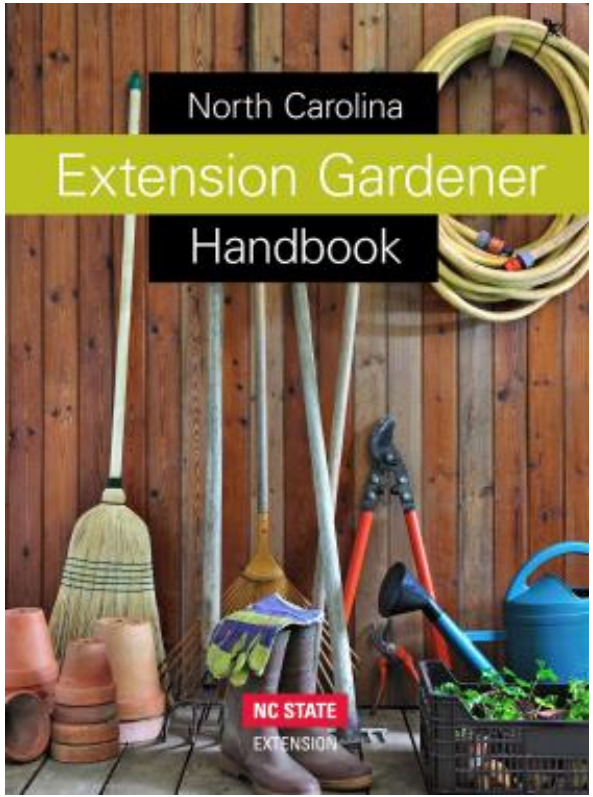
Inga Meadows
Extension Associate
Vegetable and Herbaceous Ornamental Plant Pathology
NC State University

https://go.ncsu.edu/tomato-diseases

NC STATE EXTENSION

NC Extension Gardener Handbook

https://go.ncsu.edu/eg-handbook



Free Online!

Hard copy – UNC Press ($60)

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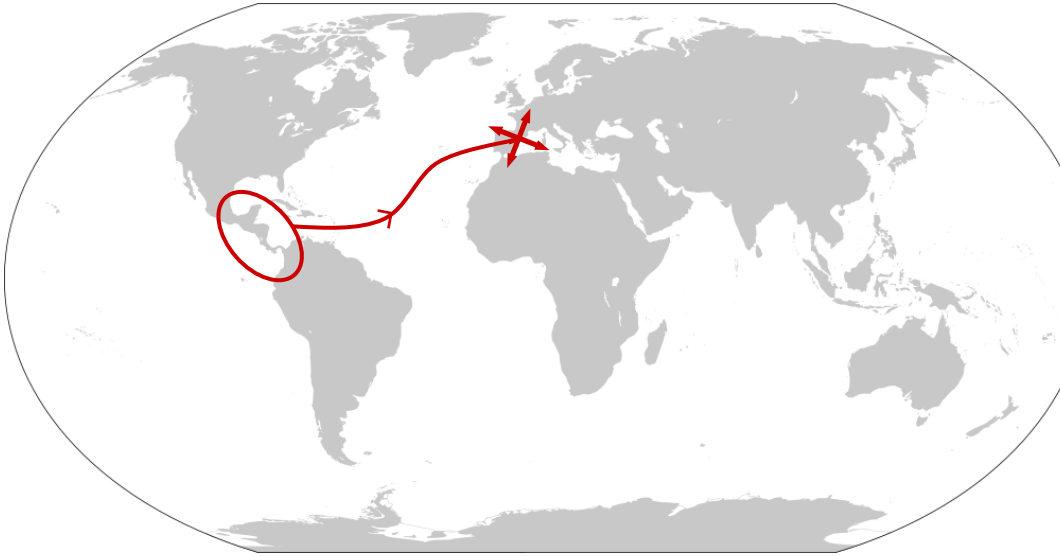
Tomatoes

Solanum lycopersicum (Solanaceae)

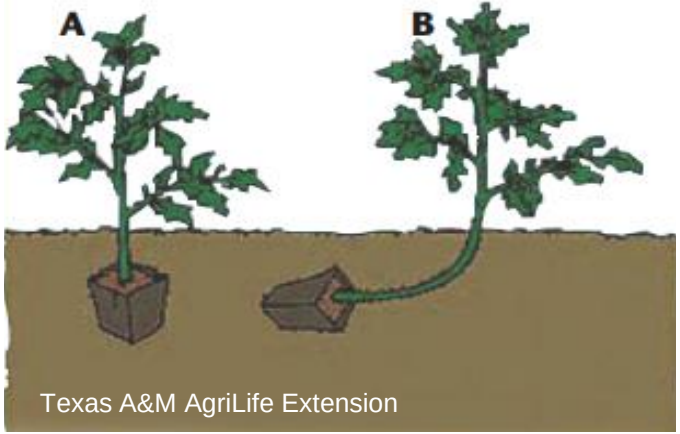
Buzz Pollination



Relatives: Potato, eggplant, pepper, nightshade

What you eat: Mature fruit (botanical berries)

Planting Tomatoes



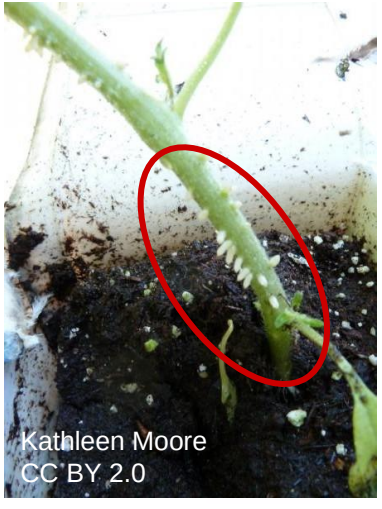
Texas A&M AgriLife Extension

Start Seeds Indoors

- ¼ in. deep
- Seed heating mat 65-85° F
- 5-7 weeks before last frost (Feb-Mar)
- https://go.ncsu.edu/veggieseedresources

Transplants (purchased or grown yourself)

- Mid-April to July, August
- Plant a little deeper than rootball, on side if leggy
- 18-24” apart, 3’ between rows


Kathleen Moore
CC BY 2.0

Planting Tomatoes

Cages

- Less pruning (suckering) required
- Allow 6 in. openings for accessibility

Stakes

- Train to 1 or 2 stems, remove suckers
- 6-8’ tall, 8-12” deep

Growing Tomatoes

Fertilizer

- **Soil Test!**
  - If unavailable: 3 lbs. 5-10-10 or 7.5 lbs. 3-4-3 (organic) per 100 ft^2
  - pH 6.0-6.5
- **Side Dressing**

  0.3 lb. actual N /100 ft^2 4 weeks and 8 weeks after transplant

  = 2 lbs. calcium nitrate or 3 lbs. of blood meal per 100 ft^2

Watering

- 1-1.5” per week equivalent
- Moisten to a depth of 6 inches
- Consistent moisture to reduce Blossom End Rot
- Organic or plastic mulches

Side Dressing

Choosing Tomato Cultivars

Growth Habit

- Dwarf (containers*)
- Compact/Determinate
- Indeterminate

Fruit Characteristics

- Color
- Size
- Fresh vs. Paste
- Acidity

Ripening Period

- Indeterminate vs determinate
  - Determinate: early, mid, late

Genetics

- Open Pollinated
- Hybrid

Disease Resistance

* https://chatham.ces.ncsu.edu/fall-vegetable-gardening-in-containers/fall-vegetable-gardening-in-containers-resources/

Tomato Disease Resistance

Look for abbreviations

V – Verticilim Wilt

F – Fusarium Wilt

(RK)N – Nematodes

EB – Early Bight

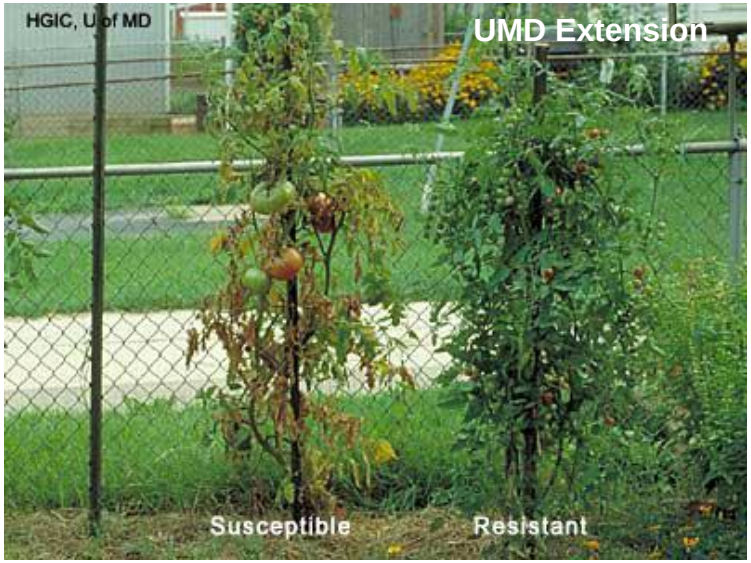
LB – Late Blight

T(MV) – Tobacco Mosaic Virus

S – Septoria leaf spot

Bacterial wilt (grafted)

- Extension Master Gardener Fundraiser next year!



Tomato Cultivars

Cherry

- ‘Sweet 100’
- ‘Sweet Million’
- ‘Sun Gold’
- ‘Juliet’

Main Crop Hybrids

- ‘Celebrity’
- ‘Better Boy’
- ‘Floramerica’

Early Ripening

- ‘Early Girl’
- ‘Bush Early Girl’

For Containers

- ‘Husky Gold’ & ‘Husky Pink’
- ‘Tiny Tim’

Heirloom

- ‘German Johnson’
- ‘Cherokee Purple’
- ‘Brandywine’
- ‘Green Zebra’

Harvesting Tomatoes

Harvest

- 60-85 days after transplant
- Full color but still firm
- Red pigment degrades > 86°F
- Green tomatoes can ripen off vine if blushed

Storage

- On the counter
- Light not a factor
- Respond to ethylene (climacteric fruit)

Types of Diseases

Abiotic Disorder (Disease)

- Caused by environmental or cultural conditions

Biotic Disease

- Caused by a pathogenic organism
  - Fungi and water molds (Oomycetes)
  - Bacteria
  - Viruses
  - Nematodes

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Abiotic vs. Biotic Diseases

Comparing Symptoms

Abiotic Disorders	Biotic Diseases
Appear suddenly	Appear gradually
Affects many species	Affect one or related species
Don’t spread	Spread
Geometric, linear patterns	Random, hotspot patterns
Distinct separation between healthy and non-healthy tissue	Gradual or ‘halo’ transition between healthy and non-healthy tissue

Lacking clear signs of pathogens, assume an abiotic cause until it can be ruled out.

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Abiotic Disorders

Blossom End Rot

Susceptible Crops

- Tomato, pepper, eggplant, squash, watermelon

Symptoms & Causes

- Fruit tissue collapse
- Localized calcium deficiency in developing fruit
- Inconsistent watering
- Low pH
- Excessive nitrogen fertilizers

Good review article:https://extension.unh.edu/resource/growing-vegetables-managing-blossom-end-rot-fact-sheet-0

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Abiotic Disorders

Blossom End Rot

Management

- Water deeply and consistently
  - Mulches help
- Maintain soil pH 6.3-6.8
  - Soil test
- Avoid high N fertilizers
  - Ammonium nitrate
- Remove affected fruits

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Abiotic Disorders

Physiological Leaf Roll

Susceptible Crops

- Tomato

Symptoms & Causes

- Leaves curl inward
- Excess N, heat stress, pruning, climatic factors
- Cultivar dependent

Management

- Does not cause growth or yield reductions
- Provide consistent moisture, proper fertilization

Washington State University

Abiotic Disorders

Blossom Drop

Susceptible Crops

- Tomato, pepper, eggplant, beans

Causes

- High Temperatures
  - Day > 85 ° F, Night > 70 ° F
- Humidity <40% or >70%
- Lack of pollinators

Management

- Plant earlier
- Provide partial shade
- Support pollinators

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Abiotic Disorders

Fruit Cracking

Causes

- Heavy rains following dry spells

Management

- Consistent soil moisture

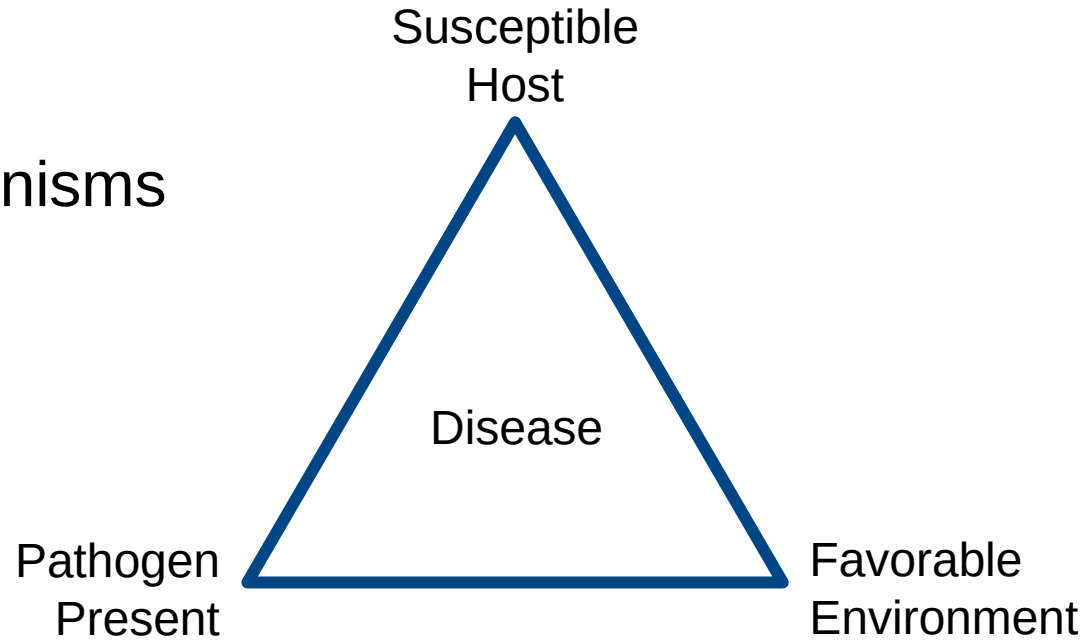
Biotic Diseases

- Restricted to certain hosts
- Symptoms appear slowly and get progressively worse
- Transition zone between healthy and unhealthy tissue
- Survive season-to-season in plant tissues, the soil, protective bodies
  - Sclerotia
  - Spores

Biotic Diseases Caused by pathogens

Causal Organisms

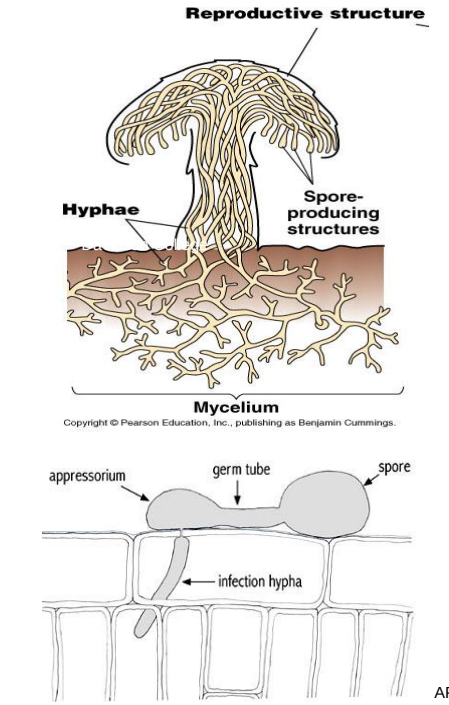
- Fungi & fungal-like organisms
- Bacteria
- Viruses
- Nematodes



Disease Triangle

All factors must be present for a pathogen to cause disease.

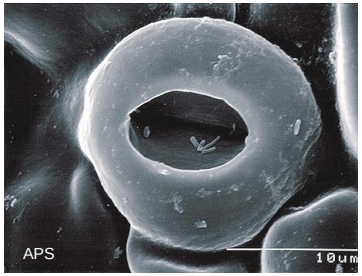
Types of Pathogens



Penetrate healthy tissue

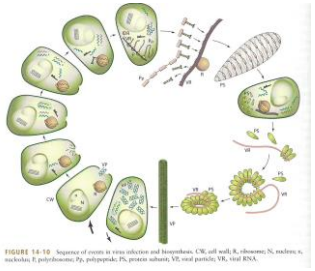
Fungi

Much smaller than fungi

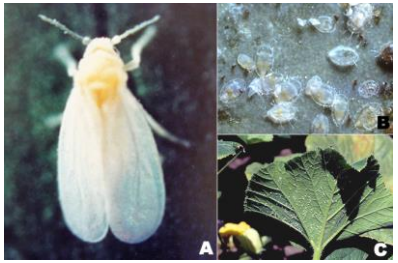


Enter wounds & stomata

Bacteria



Infectious DNA/RNA



Spread by vectors

Viruses

Early Blight *Alternaria linariae*

Inga Meadows
NC State University

Univ. of Minnesota Extension

Early Blight *Alternaria linariae*

Early Blight *Alternaria linariae*

Early Blight *Alternaria linariae*

Inga Meadows
NC State University

Early Blight *Alternaria linariae*

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Early Blight

Disease Management

Cultural Practices

- Remove diseased plants and debris
- Remove weeds
- Rotate out of Solanaceous crops
- Resistant cultivars

Fungicides

- Chlorothalonil
- Copper (Organic)

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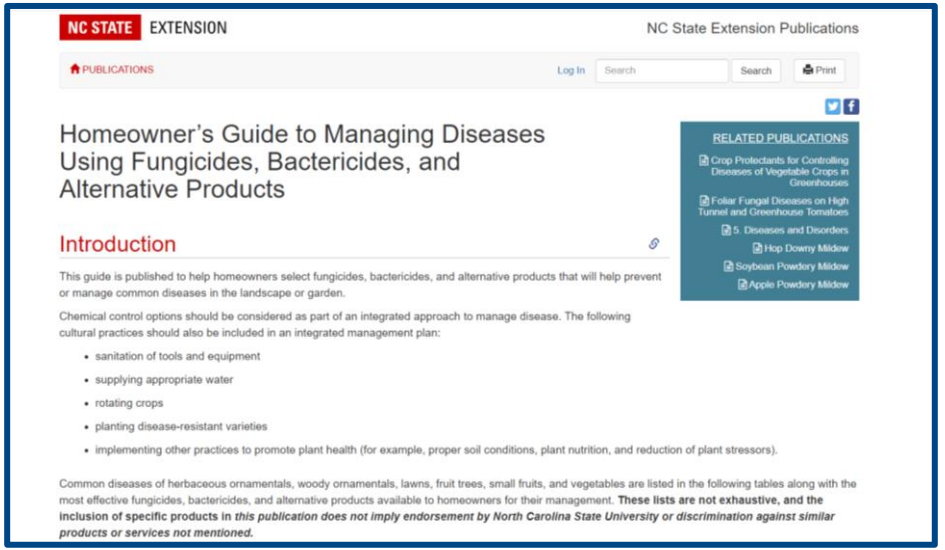
Homeowner's Guide to Managing Diseases Using Fungicides

https://go.ncsu.edu/homefungicides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NC State Extension Publications

PUBLICATIONS

Log In Search Search Print

Homeowner's Guide to Managing Diseases Using Fungicides, Bactericides, and Alternative Products

RELATED PUBLICATIONS

Crop Protectants for Controlling Diseases of Vegetable Crops in Greenhouses

Foliar Fungal Diseases on High Tunnel and Greenhouse Tomatoes

5. Diseases and Disorders

Hop Downy Mildew

Soybean Powdery Mildew

Apple Powdery Mildew

Introduction

This guide is published to help homeowners select fungicides, bactericides, and alternative products that will help prevent or manage common diseases in the landscape or garden.

Chemical control options should be considered as part of an integrated approach to manage disease. The following cultural practices should also be included in an integrated management plan:

- sanitation of tools and equipment
- supplying appropriate water
- rotating crops
- planting disease-resistant varieties
- implementing other practices to promote plant health (for example, proper soil conditions, plant nutrition, and reduction of plant stressors).

Common diseases of herbaceous ornamentals, woody ornamentals, lawns, fruit trees, small fruits, and vegetables are listed in the following tables along with the most effective fungicides, bactericides, and alternative products available to homeowners for their management. **These lists are not exhaustive, and the inclusion of specific products in *this publication does not imply endorsement by North Carolina State University or discrimination against similar products or services not mentioned.***

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NC COOPERATIVE EXTENSION

Early Blight

Disease Management

Tolerant or Resistant Cultivars

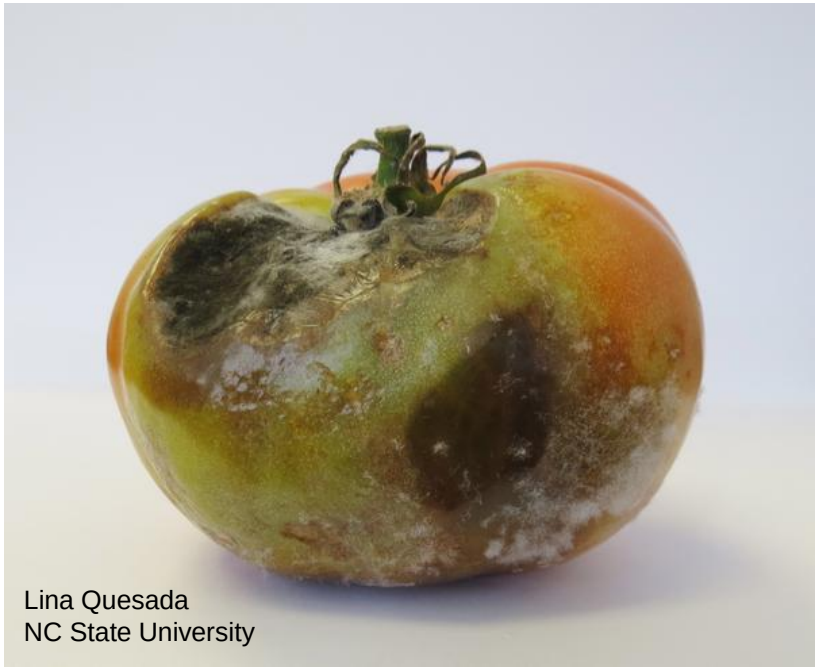
- ‘Big Beef Hybrid’
- ‘Bush Celebrity Hybrid
- Cabernet F1’
- ‘Celebrity Hybrid’
- ‘Iron Lady’
- ‘Jasper’
- ‘Juliet F1’
- ‘Matt’s Wild Cherry’
- ‘Mountain Fresh F1’
- ‘Mountain Magic’
- ‘Old Brooks’
- ‘Plum Dandy Hybrid’
- ‘Plum Regal Hybrid’
- ‘Rutgers’
- ‘Tommy Toe’

Late Blight *Phytophthora infestans*

Late Blight *Phytophthora infestans*

Late Blight *Phytophthora infestans*

Inga Meadows
NC State University



Lina Quesada
NC State University

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Late Blight

Disease Management

Cultural Practices

- Plant early
- Remove infected plants
- Avoid watering leaves
- Improve drainage

Fungicides

- Chlorothalonil
- Copper (Organic)

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NC COOPERATIVE EXTENSION

Late Blight

Disease Management

Tolerant or Resistant Cultivars

- ‘Defiant PHR’
- ‘Legend’
- ‘Lizzano’
- ‘Matt’s Wild Cherry’
- ‘Mountain Gem’
- ‘Mountain Honey’
- ‘Jasper Hybrid’
- ‘Mountain Merit’
- ‘Plum Regal Hybrid’
- ‘Red Grape’
- ‘Red Pearl’
- ‘Toronjina’

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Septoria Leaf Spot *Septoria lycopersici*

Septoria Leaf Spot *Septoria lycopersici*

Septoria Leaf Spot *Septoria lycopersici*

Septoria Leaf Spot

Disease Management

Cultural Practices

- Remove weeds
- Remove infected plants
- Avoid watering leaves

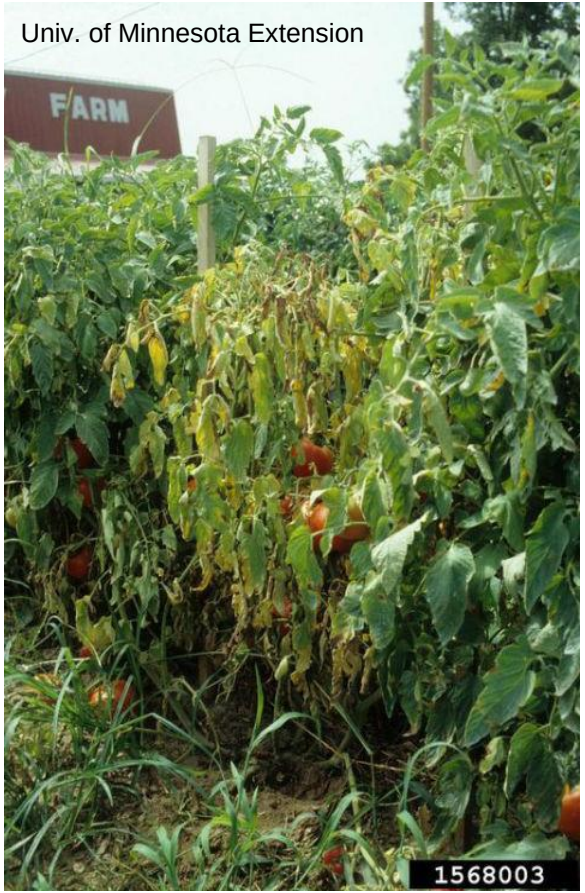
Fungicides

- Mancozeb
- Chlorothalonil
- Copper (Organic)

No resistant cultivars

Fusarium Wilt *Fusarium oxysporum f. sp. lycopersici*

Fusarium Wilt *Fusarium oxysporum f. sp. lycopersici*



Fusarium Wilt *Fusarium oxysporum f. sp. lycopersici*

Fusarium Wilt *Fusarium oxysporum f. sp. lycopersici*

Disease Management

- Soilborne
- Fatal
- No fungicide treatments
- Rotate out of Solanaceae
- Grow in containers
- Use resistant cultivars

Look for cultivars with ‘F’ , ‘FF’, ‘FFF’ or F_1 F_2 F_3, etc.

Botrytis Gray Mold *Botrytis cinera*


University of Maryland Extension


Univ. of Minnesota Extension

Botrytis Gray Mold *Botrytis cinera*

Botrytis Gray Mold *Botrytis cinera*

Shawn Butler
NC State University
Plant Disease and Insect Clinic

Sally Miler and Ashlina Chin
Ohio State University

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Botrytis Gray Mold
Disease Management

Cultural Practices

- Remove infected plants and debris
- Avoid watering leaves
- Temps above 70º F discourage disease

Fungicides

- Chlorothalonil

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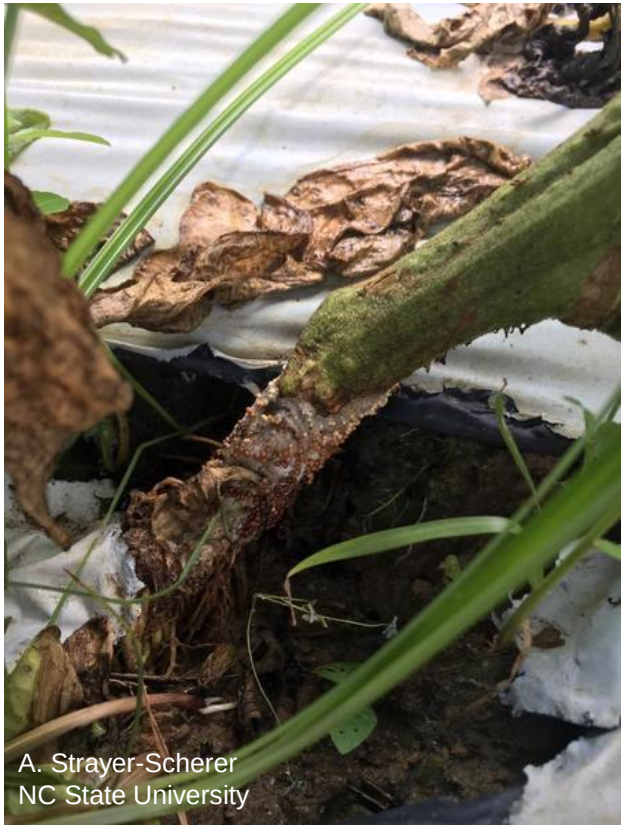
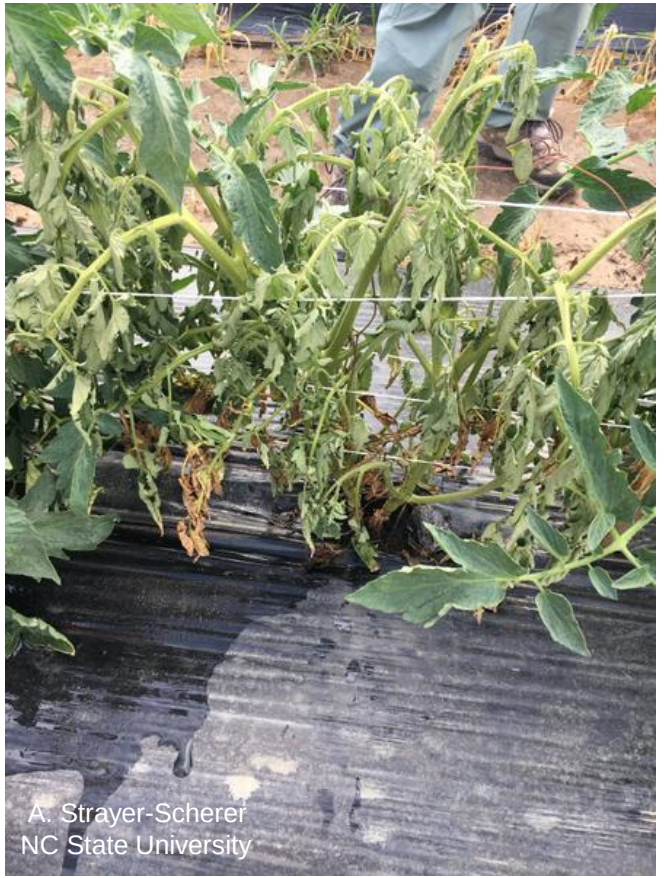
Southern Blight *Athelia rolfsii*



Southern Blight *Athelia rolfsii*



Southern Blight *Athelia rolfsii*

A. Strayer-Scherer
NC State University

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Southern Blight
Disease Management

Cultural Practices

- Remove infected plants and debris
- Rotate with a grain crop or grass cover crop for at least two years
- Soil solarization
- Fungicides only available to farmers

https://go.ncsu.edu/yvppxyr

W 363

SOIL SOLARIZATION IN TENNESSEE:

A PESTICIDE-FREE METHOD FOR CONTROLLING SOIL-BORNE PESTS IN HOME GARDENS

Craig Canaday, Former Associate Professor
Steve Bost, Professor
Department of Entomology and Plant Pathology

Soil solarization is a pesticide-free method for controlling many of the common soil-borne plant pathogens, weeds, nematodes and insects. It has been used for many years in many parts of the world where summer temperatures are quite warm and solar radiation is abundant. It involves covering the surface of bare soil with a layer of clear plastic to allow sunlight to pass through to heat the soil, then subsequently trap the heat. During this period, soil temperatures are frequently raised to 120-125 F. This environmentally friendly procedure may be an effective method for managing soil pests in home gardens or small field plantings.

STEPS FOR SUCCESSFUL SOIL SOLARIZATION IN TENNESSEE

1. Plan to solarize when solar radiation is optimal, from June through August.

2. Avoid areas with shadows or north-facing slopes. Best results will be obtained in open, unshaded gardens.

3. Loosen the soil by rototilling to a depth of 6 inches to improve heat penetration. It is helpful to first clear the area of plant debris (weeds, crops, mulch, etc.), as it may interfere with heat conduction. Remove any sticks, sharp stones or other objects that could puncture the plastic.

4. If the soil is dry, moisten it. Water helps conduct heat, but avoid excessive soil wetting as it can be detrimental.

5. Cover the soil with a clear, 2- to 4-mil plastic sheet or strip. The plastic sheet must be clear. Other types of plastic reduce the amount of sunlight transmission.

6. Stretch the plastic tight and bury the edges with soil. It is important that the edges are well-sealed to prevent loss of heat and loosening of the plastic by the wind. Covering the edges with soil in a trench, about 6 inches deep, helps to hold the plastic in place and minimizes spread of the soil across the plastic.

7. To achieve the highest solarization temperatures, cover the first sheet with another sheet of clear plastic (Figure 1). (The first sheet may be black if the top sheet is clear.) The top sheet provides an insulating layer of warm air, maintaining higher soil temperatures during the night. If you use two layers, create an air gap between the layers of sheeting with strips of foam insulation, small blocks of wood, old garden hose, etc, every 2 feet. Avoid materials with sharp edges. The edges of both sheets should be buried.

Figure 1. Installing two layers of plastic sheets with foam insulation strips.

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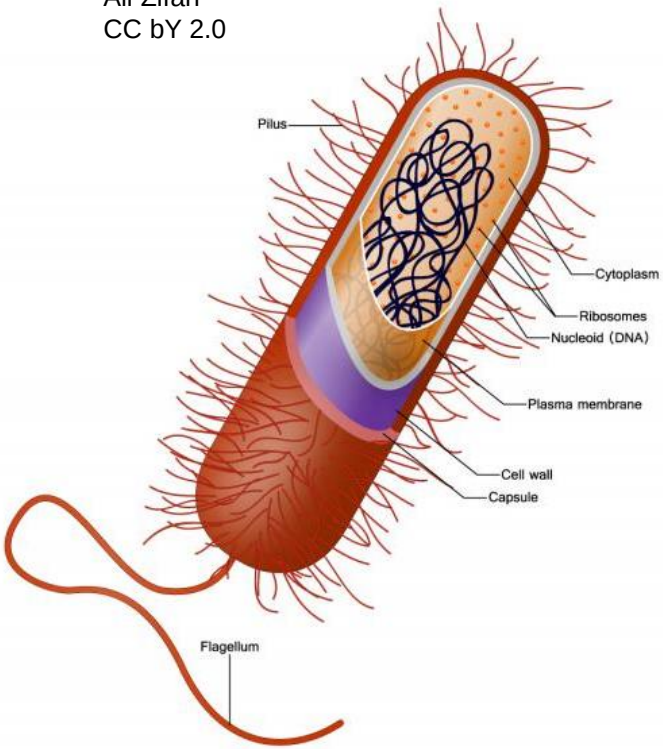
Bacteria Basic Biology

- Unicellular, divide rapidly by fission
- Heterotrophic and Autotrophic
- Ubiquitous in the environment
  - On plants
  - In the soil
- Spread by animals, splashing water
- Enter plants by wounds or stomata

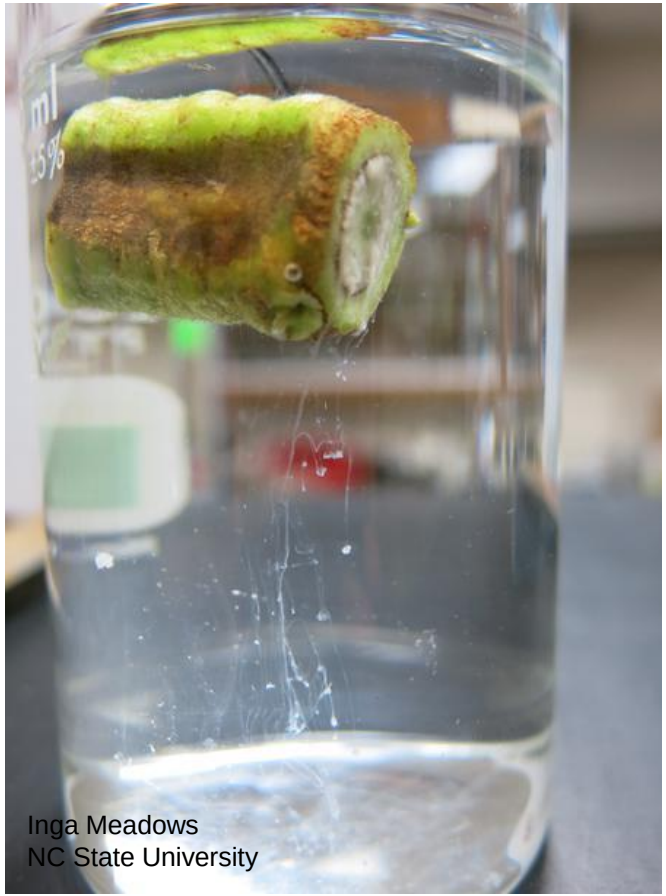


Southern Bacterial Wilt

Ralstonia solanacearum

Southern Bacterial Wilt

Ralstonia solanacearum



Southern Bacterial Wilt

Disease Management

Cultural Practices

- Remove infected plants
- Rotate crops
- Resistant rootstocks

Resistant Rootstocks

- RST-05-113-TE
- RST-04-105-T
- Bowman
- Shin Cheong Gang
- Armada

No effective chemical treatments

NC STATE EXTENSION

Master Gardener | Chatham County

GRAFTED GROWERS™

Grafted Heirloom Tomato Sale

Spring 2024

- MGVs grow heirloom tomatoes grafted by Grafted Growers to bacterial wilt resistant rootstocks.
- Notified of next sale via Chatham Gardener Newsletter

Pith Necrosis

Pseudomonas corrugata

Pith Necrosis

Pseudomonas corrugata

Pith Necrosis

Pseudomonas corrugata

Univ. of Minnesota Extension

Margaret McGrath
Cornell University

Pith Necrosis

Disease Management

Cultural Practices

- Remove infected plants
- Avoid over fertilization
- Avoid wounds
- Clean tools

No bactericides

No resistant cultivars

Bacterial Spot

Xanthomonas spp.

Bacterial Spot

Xanthomonas spp.

Bacterial Spot

Xanthomonas spp.

Ooze Test

Check for bacteria streaming

Bacterial Spot

Xanthomonas spp.

Bacterial Spot

Xanthomonas spp.

Bacterial Spot

Disease Management

Cultural Practices

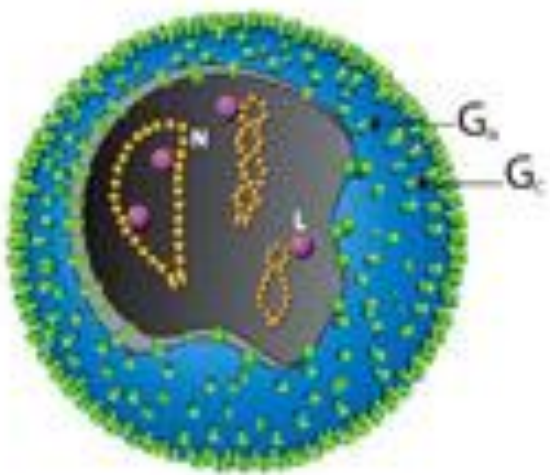
- Use clean seed stock and transplants
- Minimize wetting and handling of plants
- Remove infested plants
- Rotate out of Solanaceous crops

Bactericides

- Copper fungicides
- Serenade® (*Bacillus subtilis*)

Viruses Basic Biology

- DNA or RNA in a protein capsule
- Use other cells to reproduce
- Transmitted by **vectors**
  - Insects, mites, nematodes, fungi, propagation, infected sap & seeds
- Cannot be treated
- Usually not fatal, but cause distorted growth



Tomato Spotted Wilt Virus

Tobacco thrips

Western flower thrips

UGA

Tomato Spotted Wilt Virus

Tomato Yellow Leaf Curl

Viral Infections

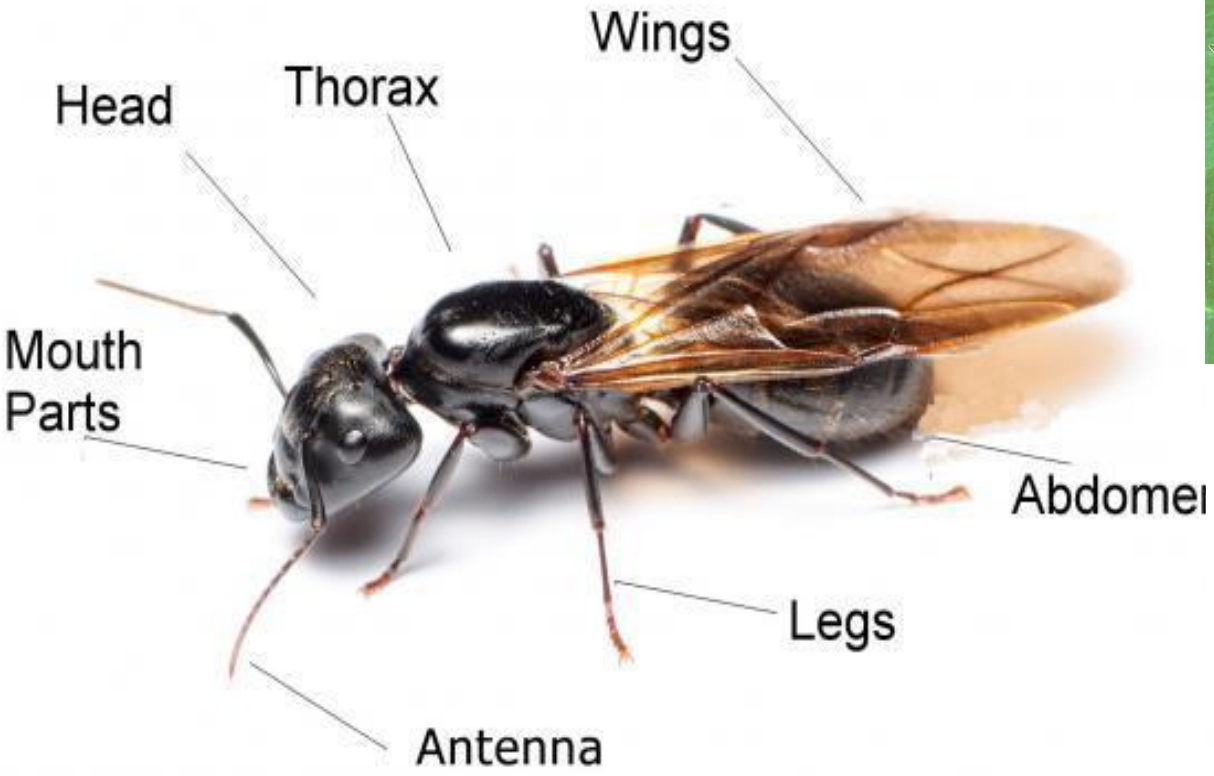
Disease Management

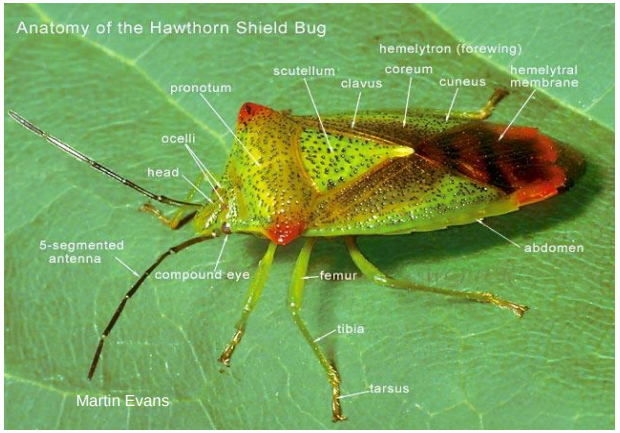
Cultural Practices

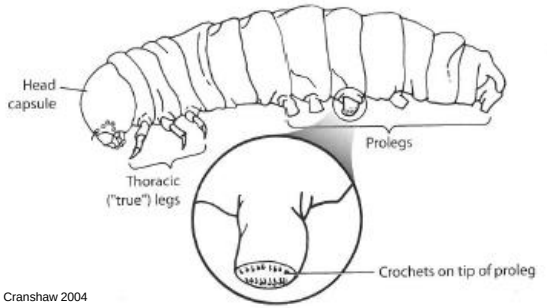
- Remove infected plants
- Remove weeds
- Control vectors if possible

Look for resistant cultivars

Insect Anatomy





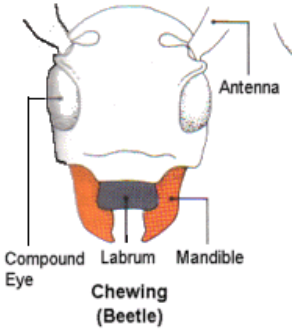


Cranshaw 2004

Larvae may have pr

Insect Mouth Parts and Feeding Methods

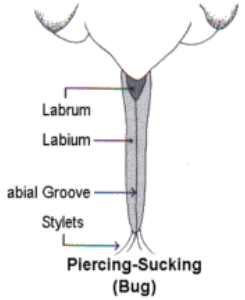
Matt Bertone NCSU



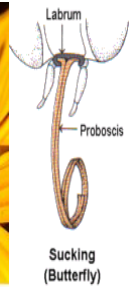
Chewing Mouthparts

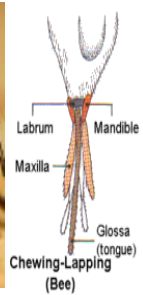
Cause plant damage

Matt Bertone NCSU



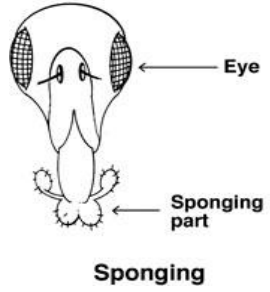
Piercing/Sucking Mouthparts





Siphoning/Chewing-Lapping Mouthparts

The Robinson Library
Univ. of Missouri



Sponging Mouthparts

How Insects Damage Plants

Feeding

Chewing Mouthparts

Leaf, Fruit, Root Feeders

Signs & Symptoms

- Chew marks and holes
- Frass
- Webbing

Examples

- Butterflies & Moths (Larvae)
- Beetles (Adults and Larvae)
- Grasshoppers (Adults and nymphs
- Sawflies (Larvae)
- Slugs and Snails

Piercing-Sucking Mouthpart Damage

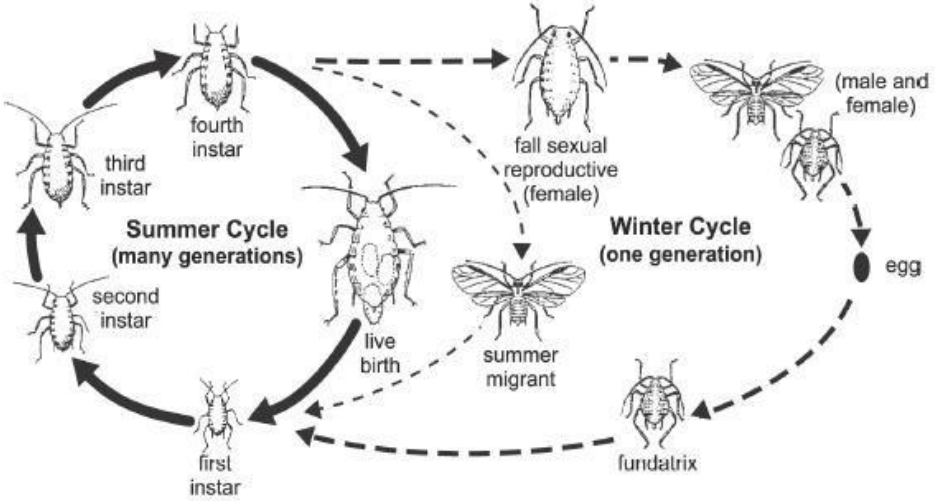
Signs & Symptoms

- Discoloration
- Stippling
- Growth distortions
- Honeydew & Sooty Mold

Examples

- True bugs
- Aphids
- Whiteflies
- Leafhoppers

Aphids Hemiptera



Rapid Proliferation

Piercing-sucking

Honeydew & sooty mold

Predator & parasitoid natural enemies

Aphids on Vegetables

Hosts

- Brassicas, curcurbits, legumes, Solanaceous crops, etc.

Signs & Symptoms

- Infestations, cast skins
- Growth distortions, stunting
- Honeydew & sooty mold

Management

- Natural enemies
- Water
- Insecticidal soap

Stink Bugs (Hemiptera: Pentatomidae)

Green Stink Bug

Chinavia hilaris

Leaf-footed Bug

Leptoglossus phyllopus

Stink Bugs (Hemiptera: Pentatomidae)

Hosts

- Many fruiting vegetables, leafy greens

Signs & Symptoms

- Cloudy spots on fleshy fruits
- Wart-like growths on beans and okra
- Stippling/yellowing of leaves

Management

- Monitor and handpick
- Insecticidal soap (nymphs)
- Row covers
- Kaolin clay

Caterpillar Pests of Tomatoes

Hornworms

Manduca sexta, M. quinquemaculata

Tomato Fruitworm

Helicoverpa zea

Hornworms & Fruitworms

Hosts

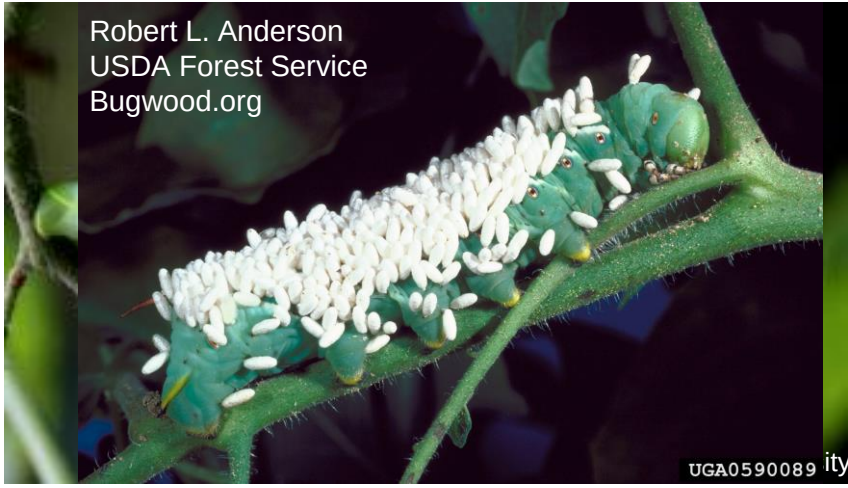
- Tomatoes & other Solanaceous crops; corn, beans, okra, cotton

Signs & Symptoms

- Defoliation (hornworms)
- Fruit chewing damage
  - Usually on stem end (fruitworms)

Management

- Handpick + a brick
- *Bt kurstaki*
- Support natural enemies



Two Spotted Spider Mite

Tetranychus urticae

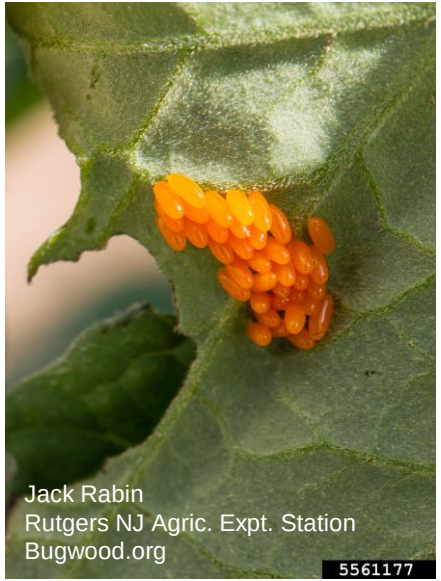
Two Spotted Spider Mite

Tetranychus urticae

Colorado Potato Beetle

(Chrysomelidae: *Leptinotarsa decemlineata*)

Adults



Eggs

Larva

Colorado Potato Beetle

(Chrysomelidae: *Leptinotarsa decemlineata*)

Hosts

- Potatoes, Eggplant, Tomato, *Solanum* spp.

Signs & Symptoms

- Chewing damage on leaves
- Defoliation
- Larvae and adults

Management

- Handpicking
- Spinosad
- Azadirachtin
- Bt *tenebrionis*

NC COOPERATIVE EXTENSION

Need Help with Garden Problems?

NC STATE EXTENSION

Master Gardener | Chatham County

Plant Clinic: MW 1:00-4:00, F 9:00-12:00

chathamemgv@gmail.com

919-545-2715

(Except during COVID-19, email is preferred)

Send us your (plant) problems!

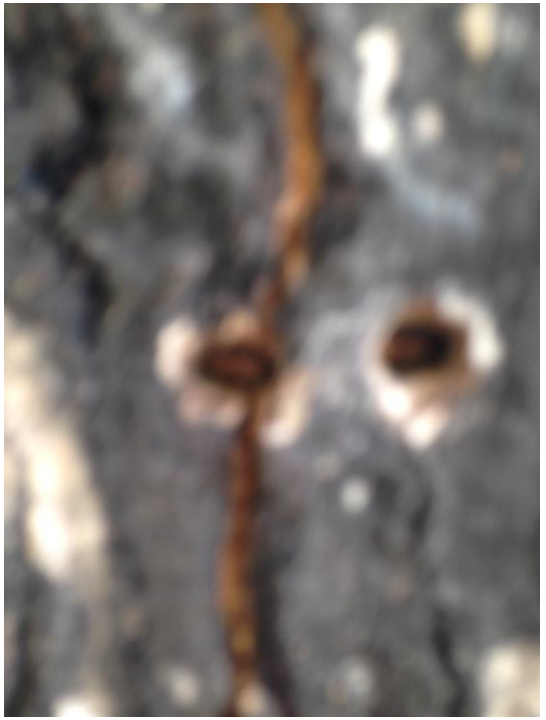
Questions we may ask:

- Crop and cultivar
- Describe signs and symptoms
  - Include photos!
- When you started noticing problems
- Cultural conditions
  - Light, soil, water, planting time etc.

Send Us *Good* Photos!

Photos should:

- Include healthy and unhealthy parts
- Have a scale object
- Be in focus
- Show an up-close image
- Show the whole plant
- The more, the better



Diagnosis: cataracts?

NC COOPERATIVE EXTENSION

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N.C. A&T STATE UNIVERSITY

NC STATE UNIVERSITY

Questions from this class?

Matt Jones

matt_jones@ncsu.edu

919-542-8243

Please complete the evaluation!

Leave it on the table