Extension Gardener Short Course:

Sustainable & Organic Vegetable Gardening

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NC State University
A&T State University
COOPERATIVE EXTENSION
Empowering People · Providing Solutions

Class 3:
Managing Pests & Weeds

1. Weeds
2. Critters
3. Integrated Pest Management for Insect Pests and Diseases

Course webpage:

http://go.ncsu.edu/veg-short-course

Controlling Weeds

- Weeds steal **sunlight, water and nutrients** from plants
- Can harbor **insect pests** and **reduce air circulation**
- Start weed control **before weeds get out of control!**

Too late for weed control!

Weeds!
Two basic types:

Perennial Weeds

- **Live for multiple years** – return from same roots
- **More difficult to control** – eliminate with herbicides before planting
- Most are able to sprout from **root segments**

Annual Weeds

- Germinate, grow, flower, set seed, die **all in one season**
- **Easier to control** – to break cycle, control before they flower and set seed
- **Seeds** this year become next year's weeds

Weeds!
Two basic types:

Perennial Weeds

- Control focused on eliminating roots

Annual Weeds

- Control focused on preventing seeding

Controlling Weeds

No magic bullet!

Use a combination of methods:

- **Eliminate perennial weeds before planting!**
- **Mulch** minimizes annual weeds
  - 1”-2” layer of ground leaves, straw, ground pine bark in beds
  - Wood chips, hardwood mulch, leaves, pine straw for rows

Mulch beds and rows

Controlling Weeds

- **Hand weeding/hoeing**
  - When weeds small
  - Disturb soil as little as possible
- **Herbicides** - use carefully, many vegetables sensitive
- **Organic herbicides** only burn weeds – effective for small weed seedlings, not established perennials
  - **Not selective**= must apply carefully to avoid damaging vegetables

Hoeing can control weed seedlings

Glyphosate injury –
bleaching of young leaves

2-4, D injury –
Twisting, strapping, cupping of young leaves

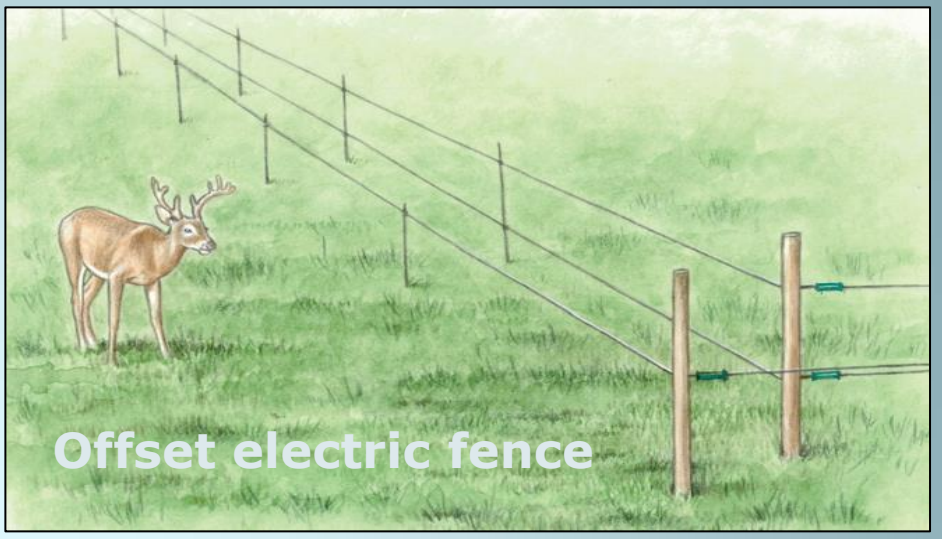
Deer and Other Critters

- **Fencing only effective method of keeping critters out**
- **Complete enclosure**
  - Deer will search for openings!
- **At least 8’ tall if not electric**
- **Extend 6” into soil**

Wire Mesh Fencing

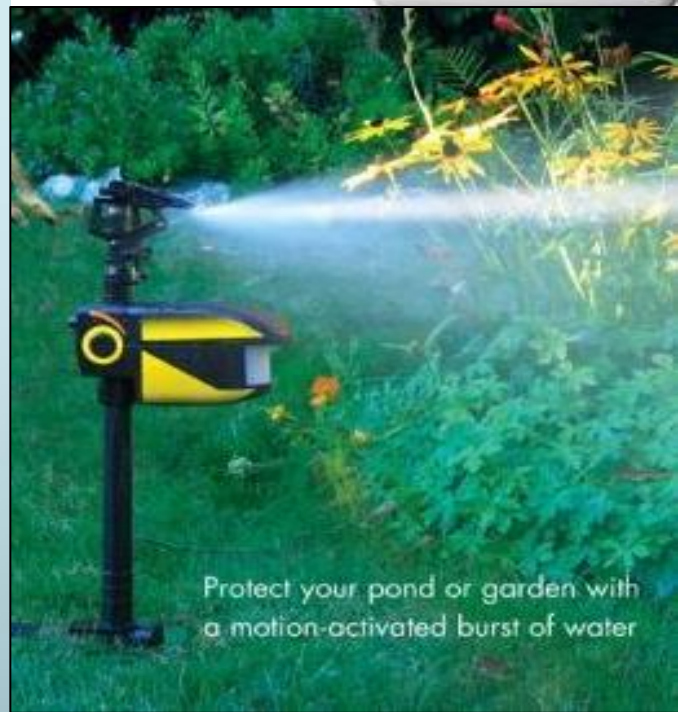
Electric Fencing

- **Single wire at 30” or double wires, 18” and 36”**
  - Bait with peanut butter
- **Offset and slanted designs**
  - Take advantage of poor depth perception
- **Design diagrams:**
  - NCWRC
  - Controlling Deer Damage
  - Wildlife Damage Mgmt



Deer Repellents

- **Most cannot be applied directly to edible plants**
- Can apply a band around garden perimeter **if low deer pressure**
- **Scare devices** – effectiveness reduced over time as deer get use to them



ScareCrow Deer Sprinkler

Managing Insects and Diseases

- **If you plant it, they will come!!!**
- **Scout** regularly to find problems before they become widespread
- Most insects and diseases **only infest a specific crop or crop family** (eg. Tomato family = tomatoes, peppers, eggplants, potatoes

Integrated Pest Management:

- **Maximize Plant Health**
  - Build healthy soils!
  - Sanitation
  - Plant selection
  - Reduce stress
- **Encourage Beneficial Insects**
- **Treatment when necessary**
  - Natural/less toxic products

Best Practice to Avoid Pests

- **Start with a good site**
  - Sunny and well drained soil
- **Support healthy growth!** Prepare soil – add organic matter/compost
  - Adds some nutrients
  - Increases soil's ability to hold nutrients and moisture
  - Improves drainage
  - Supports beneficial microbes

Crop Rotation

- Avoid planting crops in the same family in the same location year after year
- **Minimum 3 year** rotation ideal
- Include **cover crops** in rotation
- Requires **planning and record keeping**!

Plant Families

Brassicas (Mustard Family):

- Broccoli, Brussel Sprouts, Cauliflower, Cabbage, Collards, Kale, Mustard, Radish, Turnips, Rutabaga, Kohlrabi

Cucurbits (Squash Family):

- Cucumbers, Squash, Zucchini, Winter Squash, Pumpkins, Cantaloupe, Watermelons

Solanaceous (Nightshade Family)

- Tomatoes, Peppers, Eggplant, Potatoes

Legumes (Bean Family)

- Garden peas, peanuts, green beans, lima beans, southern peas

Plant Families

Alliums (Onion Family)

- Onions, garlic, leeks, scallions

Carrot Family

- Carrots, parsnips, dill, fennel, parsley, cilantro

Goosefoot Family:

- Spinach, Swiss Chard and Beets

Vegetables with no close relatives:

- Lettuce, endive
- Sweet Corn
- Sweet Potato
- Okra

Diversity

- Avoid placing all plants of one kind together
- If space, plant in different areas of the yard
- Alternate groups of different plants within rows or patches
- **Flowers help attract beneficials and confuse pests**

Variety Selection

- Choose **resistant cultivars** when possible – research possible diseases and resistant varieties
- Purchase **disease- & insect free -** plants
- Select crops that have less known pest problems/pests that can be effectively controlled organically

White firm roots = Healthy

Brown soft roots = Unhealthy

Planting Dates

Optimum for crop

- cool season
- warm season

Avoid known pest problems by planting early or late.

Corn earworm is more severe in late crops – plant as early as possible

Proper Spacing

- **Plan for mature size**
- Allows air flow between plants to **promote drying** & prevent disease
- **Allow adequate space to minimize:**
  - Competition for water, nutrients, & light
  - Habitat for pests

Proper spacing depends on mature size of plant – most plants do best when leaves just touch at full size

Fertilization

- **Based on soil test results!**
- **Adjust pH for optimum nutrient uptake**
- **Compost** usually does not supply all the nutrients crops need
- Fertilizers from natural sources support soil microbes and provide slow release nutrients
- **Too much N = more problems!**

Watering

- **Application method: avoid wetting leaves**
  - Most leaf diseases require 4 hrs + of continual leaf wetness to infect
- Keep top 6-8” of soil moist to **prevent stress**

Drip irrigation delivers water through pipes directly to the soil – helping with disease and weed management

Exclusion

Floating row covers can keep **flying adult insects** from laying eggs on vegetables – e.g. Cabbage whites

Will also keep out pollinators – not an issue for leafy crops

Cover when insects are active – stake down edges

Lay directly onto crop or install PVC supports

Handpicking

- **Inspect** plants for egg clusters and insect pests
- Squish or drop them in sudsy water
- Remove diseased leaves early

Sanitation

- **Pull out infested plants early!**
- Remove infected leaves
- **Clean up crop debris at end of season**
- Do not compost unless reaching 140 degrees

Early Blight on Tomato – begins lower leaves

Colorado potato beetle eggs

Soil Solarization

- **Kills weed seed, diseases and insects** in soil surface (3″-4″)
- Till beds, water, and cover with clear plastic **for 6-8 weeks in July-August**
- **Disturb soil as little possible afterward** to avoid bring untreated soil up to the surface.

Protect and Encourage Beneficials

- **Plant flowers** to attract pollinators and beneficial insects

Best flowers for beneficials:

- **Herbs:** fennel, dill, cilantro, basil, lemon balm
- **Flowers:** purple coneflower, black eyed Susans, Salvias, Asclepias, Zinnia, Yarrow
- **Cover Crops**: buckwheat, hairy vetch

Fennel Flower
Plants with lots of small flowers attract more beneficials

Protect and Encourage Beneficials

- **Protect: Minimize use of pesticides**
- Most **synthetic insecticides** are very harmful to beneficial insects and pollinators
- Organic insecticides are less harmful because they have **less residual activity**

Honeybees are very susceptible to most insecticides

Hover Fly adults look like bees or wasps

Beneficials

- Learn to recognize all **life stages** of beneficials
- **Must have pests** as food source – strive for balance
- Pest levels may build up to damaging levels before beneficials provide effective control

Hover fly larvae look like small slugs or caterpillars – voracious aphid eaters

Lacewing

Eggs

Juvenile – ‘Aphid Lion’

Adult

Control aphids and thrips

Parasitic Wasps

Aphid mummies – parasitized by aphidiid wasp

Braconid Wasps

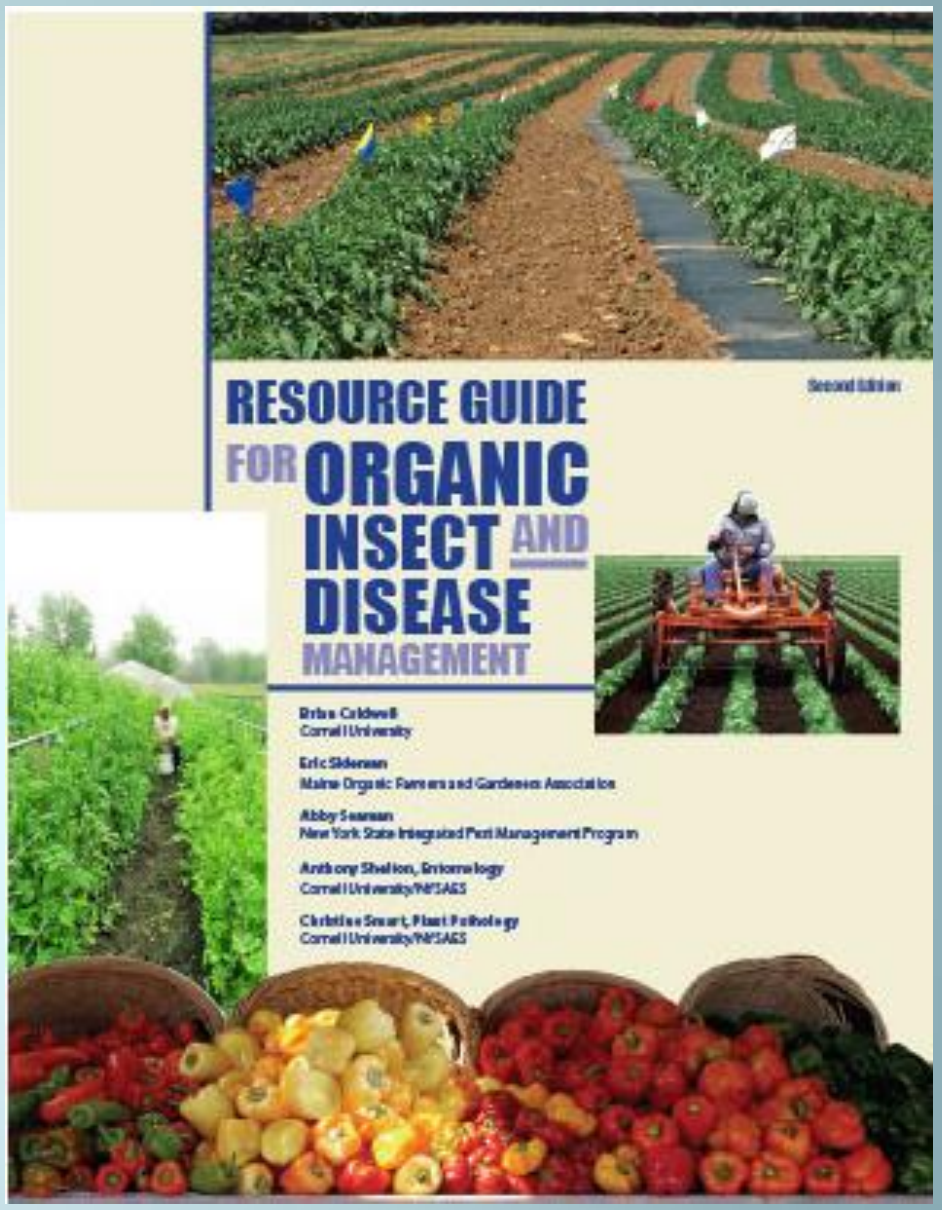
Ladybugs

Larva are more voracious feeders

Both adults and larva feed on aphids, mites, insect eggs

Treating Pest Outbreaks

- **Correct ID essential!** Don't treat until you know what the problem is and that treatment is necessary
- Treatment most effective when applied **very early** in outbreak
- **Must monitor crop health** – scout regularly (weekly!)
- Know which **products and practices** work for a specific pest



Resource Guide for Organic Insect and Disease Management – available free online from Cornell University

Know What Pests to Expect

- **Do your homework** – be familiar with common pests of your crops!
  - http://search.extension.org
- Invest in a **magnifying glass**!
- **Bring a sample to your local Extension office!**

Take samples or submit pictures online for ID and diagnosis

Good pictures are clear and close up!

Good samples are fresh and show all the details!

DEAD PLANTS TELL NO TALES!

Common Insect Pests

Two Main Groups

Chewing Insects

Piercing Sucking Insects

Chewing Insects

- Caterpillars/worms
- Beetles
- Grasshoppers
- Wireworms, cutworms

- **Symptoms:**
  - Holes in leaves
  - Frass →

Chewing Insects

Colorado
Potato
Beetle

Larvae

Squash Vine Borer

- Chewing insect – feeds inside squash vines
- 2 generations: May/June and August
- **Plant as early as possible**
- Crop rotation helps, but adults fly
- **Spray** Pyrethrin or Neem beginning mid-May, every 7-14 days, stems and underside of leaves
- Surgical removal or inject Bt into stem as soon as entrance hole seen

Insect Injury

- **Sap Feeding Insects**
  - Aphids
  - Whitefly
  - Stink bugs
  - Spider mites
  - Thrips
- **Symptoms:**
- Distortion
- Discoloration
- Vector diseases

'Cloudy Spot' caused by stink bug feeding

Aphids cluster on leaf underside, cause leaf distortion

Sap Feeding Insects:

Most are very small and found on back of leaf

True Bugs

- Much larger than other S-F insects
- Harder to control
- Mostly feed on **fruits and seeds**

Leaf footed bug

Squash Bug

Stink Bug

True Bugs

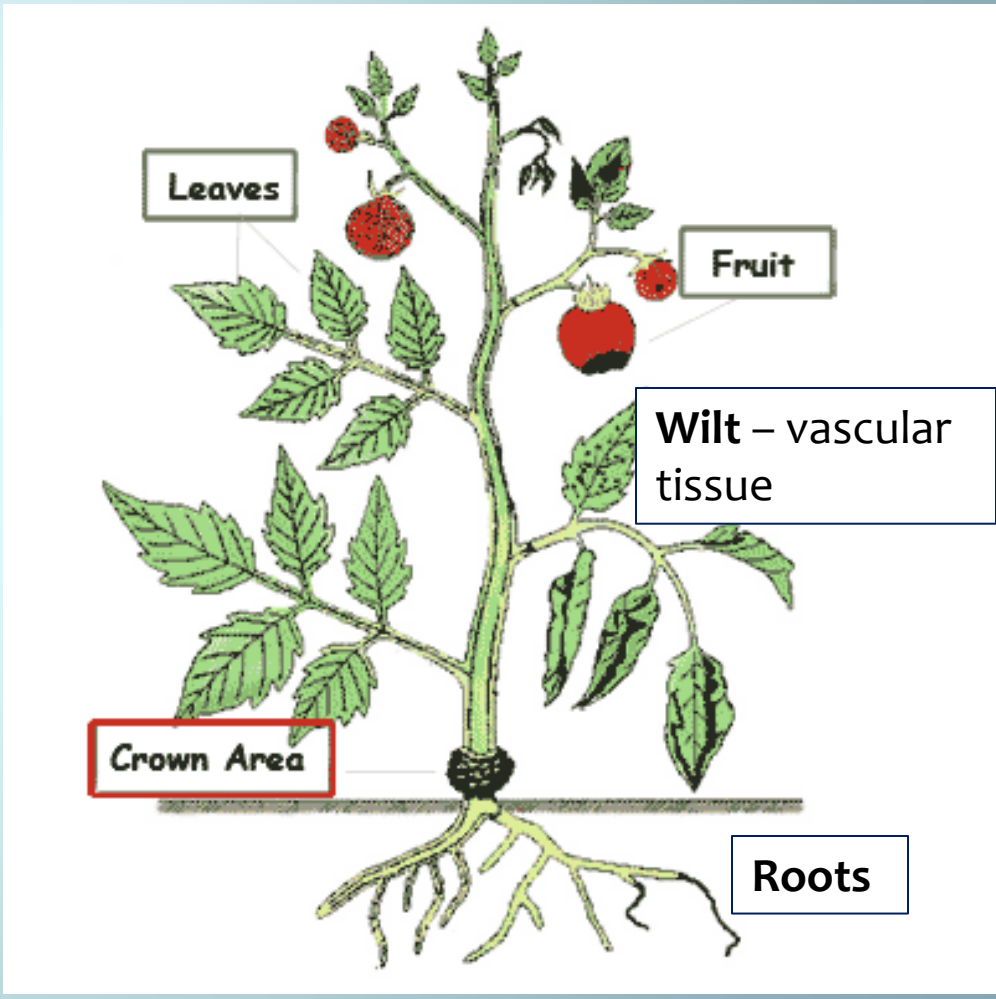
- Immature bugs (nymphs) look very different to adults

Squash bug nymphs

Leaf footed bug nymphs

Plant Diseases

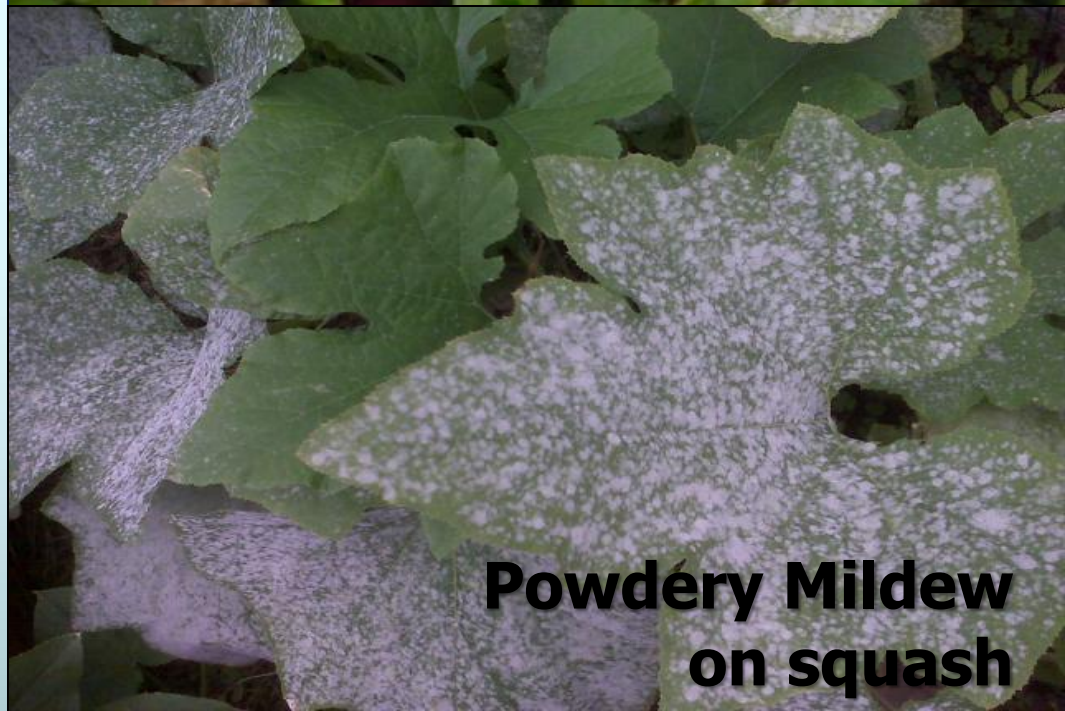
- **Can affect:**
  - Leaves
  - Fruits
  - Stems
  - Roots
  - Vascular Tissue
- Only **leaf diseases** are realistically treatable
- **Prevention is the key for all!**



Disease Symptoms

- **Foliage Diseases**
  - Leaf Spots
  - Powdery Mildew
  - Downy Mildew
  - Blights
- More severe in **wet weather**
- More treatable than other diseases


Septoria Leaf Spot on Tomato


Powdery Mildew on squash

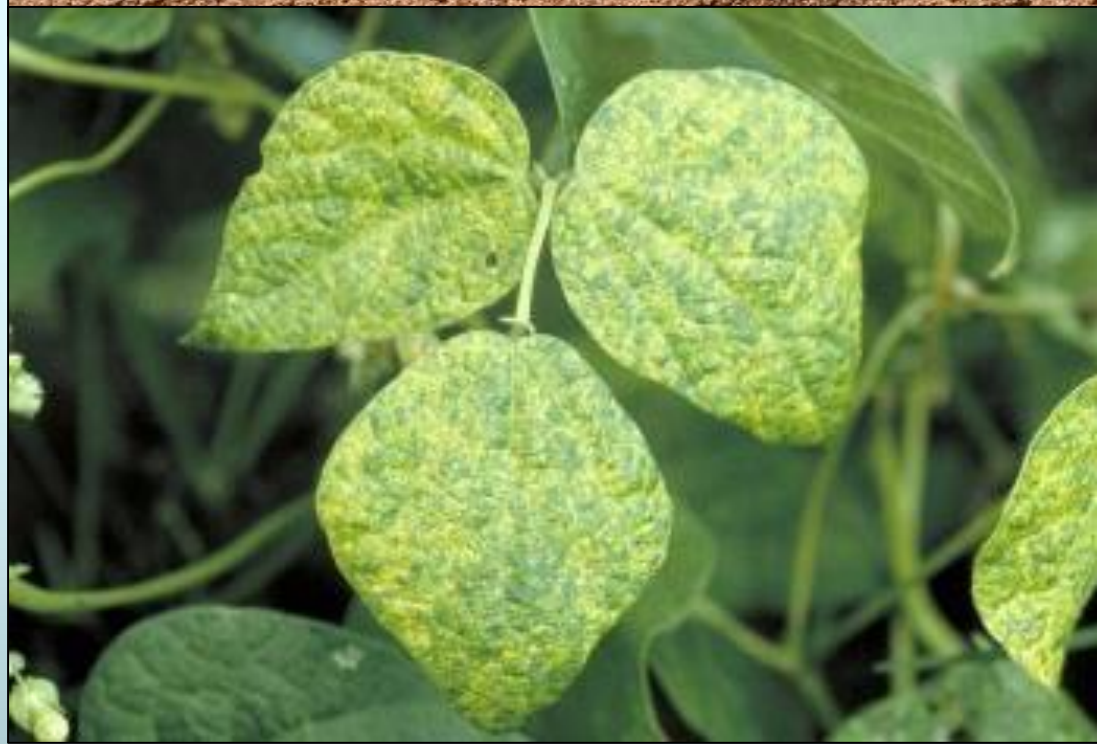
Disease Symptoms

- **Wilts and Root Rots**
- **Most are soil borne**
- Cause wilting and death
- No way to treat or eradicate

Southern Bacterial Wilt on Tomato

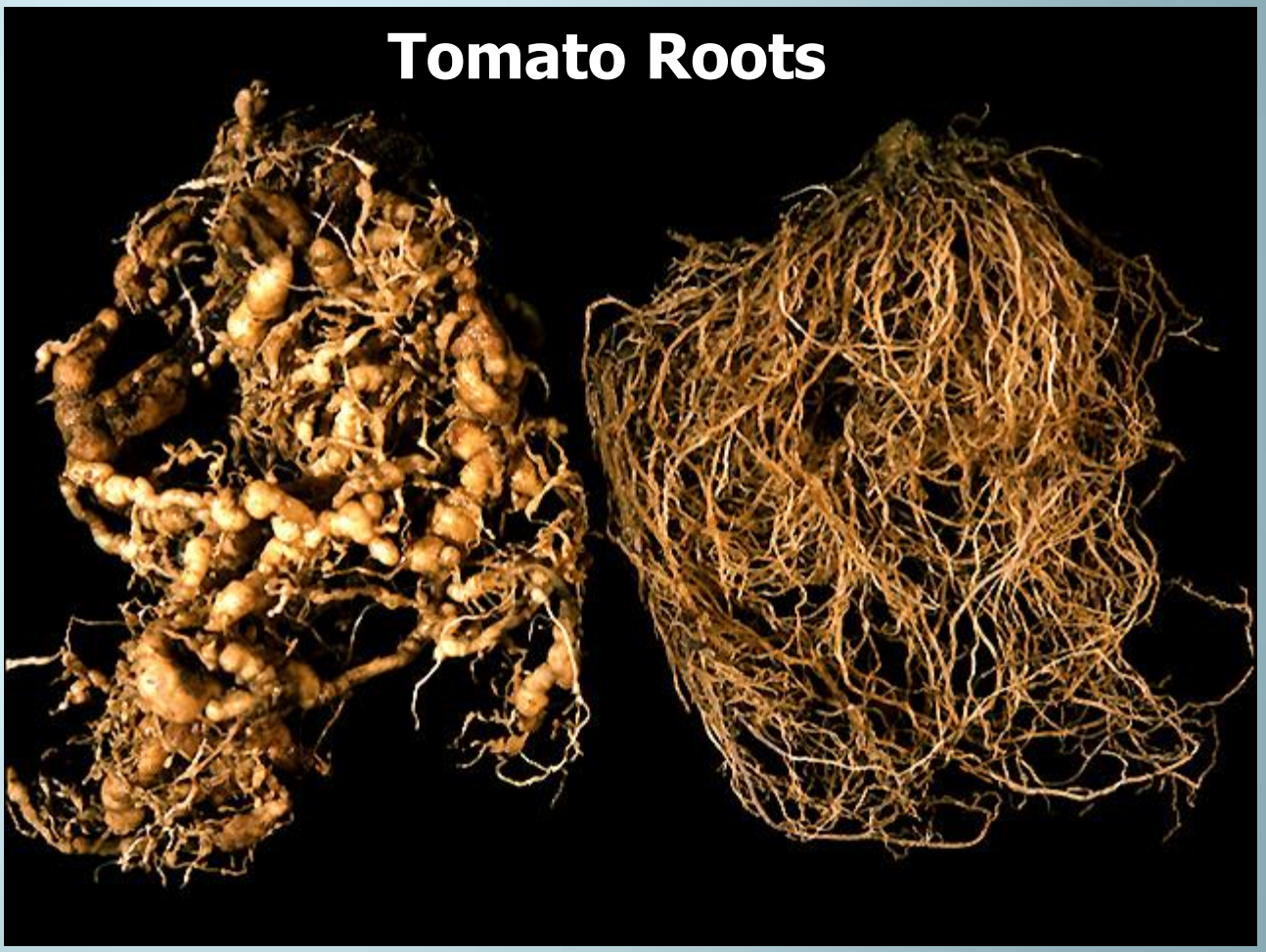
Disease Symptoms

- **Virus**
- **Spread by insects** (sap feeding) and pruning tools
- Not usually deadly, often cause **strange patterns or color breaks** on leaves and fruits
- No way to treat or eradicate once infected – remove plants



Root Knot Nematodes

- Infect many **vegetables, figs, peaches, gardenias**
- Live in the soil, microscopic worms
- **Plants stunted, low yields**
- **Some varieties are resistant**



RKN infected roots **Healthy roots**

Environmental and Physiological Disorders

- **Blossom End Rot**
  - Calcium deficiency most often due to fluctuating water levels
  - Low pH can also cause
- **Heat and drought** cause leaves, flowers, and fruits to drop

B.E.R. affects tomatoes, peppers, squash and melons

Once Problem Correctly ID'd

Choose appropriate product – active ingredients can be:

- **Synthetic** = man-made
- **Natural** = derived from naturally occurring materials
  - Minerals
  - Plants
  - Microbes
  - Soaps and Oils

Read and follow label directions for ALL products!

Always Read the Label

The label is the law! It includes:

- **Directions** for mixing/application
- Where the product can be legally used/what type of plants can be treated
- **Pre-Harvest Interval** – how long you have to wait after treating to harvest
- **Environmental hazards** – including bee warnings
- **First aid**

Pre-harvest Interval

MONTEREY GARDEN INSECT SPRAY

Insect Control Product
Easy-To-Use • Liquid Concentrate

Producto Para el Control de Insectos
Fácil de Usar – Concentrado Líquido

OMRI Listed
Organic Materials Review Institute

For Organic Production
Para la Produccion Organica

Contains Spinosad
Contiene Espinosad

For control of foliage feeding worms (caterpillars), thrips, fire ants and other listed pests in:

- ***Lawns • Outdoor Ornamentals***
- ***Vegetables, Apples, Citrus and Stone Fruit***

Home Garden Treatment Recommendations

Crops	Pests Controlled	Maximum Number of Applications Per Season	Minimum Days To Wait Before Reapplying	Minimum Days To Wait From Last Application To Harvest
Apple and other Pome Fruits including, but not limited to: pears, crabapples, mayhaw and quince	Codling moth Leafminers Leafrollers Oriental fruit moth Tufted apple budmoth	6	10	7
Asparagus (post-harvest to protect ferns)	Asparagus beetles	4	7	60
Bushberries and Caneberries, including, but not limited to: blueberry, blackberry, raspberry, loganberry, currant, gooseberry, huckleberry, elderberry, juneberry, lingonberry, and salal	Armyworms Fireworms Fruitworms Leafrollers Loopers Thrips Fruitfly (suppression)	6	6	3
Citrus Trees, including, but not limited to: oranges, grapefruit, lemons, limes, and tangerines (to prevent fruit scaring from thrips, treat when fruit is marble size)	Katydids Leafminers Thrips Worms (caterpillars)	6	6	1
Cole Crops (Brassica Vegetables), including, but not limited to: broccoli, Chinese broccoli, broccoli raab,	Cabbage Looper Diamondback moth Imported cabbage Worm Leafminers	6	4	1

How Do You Know if a Product is Organic?

- **Active ingredients** listed on the label
- **OMRI listed** – approved for use by certified organic farmers
- **Some products have natural active ingredients but are not OMRI approved**

OMRI™
Listed
Organic Materials Review Institute

Active ingredients are listed on the label

Pesticides and Beneficials

- **Insecticides most toxic** pesticides to beneficials and pollinators
- Check for beneficials and bees before spraying
- **Apply pesticides late in evening once bees have returned to hive**
- Use natural products when possible – less residual activity

Characteristics of Organic Pesticides

- **Not persistent**
  - Break down quickly, sometimes in a day
  - Most are much safer to beneficials!
- **No residual activity or systemic uptake**
  - Must reapply often
- **Insecticides kill by contact or ingestion**
  - Thorough coverage essential
  - Pest must be present

Treat after insect pests are present – re-treatment usually necessary

Insecticidal Soaps & Horticultural Oils

- **Insecticidal Soap**
  - kills soft body pests: aphids, whitefly, mites
  - Kills only what it contacts – not eggs
  - Repeated applications often necessary
- **Horticultural Oil**
  - kills by smothering,
  - kills all life stages (eggs must be exposed)
  - great for scale, spider mites, aphids, whitefly
  - Can damage plants at high temperatures
- **No residual activity for either!**

Pyrethrin

- **Broad spectrum** – helps control many pests
- **More harmful to beneficials** than most organics
- Many synthetic insecticides are based on Pyrethrin

Pyrethrin is made from the flowers of a Chrysanthemum relative (*Tanacetum cinerariifolium*) commonly known as Pyrethrum

B.t.– *Bacillus thuringiensis*

naturally occurring disease effective for **caterpillar control**

- Most effective when caterpillars are young
- Stop feeding within a few hours, slow death
- Spray in evening, breaks down in sunlight
- Separate strain for **Colorado potato beetle** control

Neem Oil

- Derived from Neem tree seed oil
- Over 70 cmpds, **Azadirachtin** believed most active
- **Controls** aphids, mites, thrips, whitefly
- May help control powdery mildew
- Primarily acts as **growth regulator** – works best on young insects
- Breaks down in sunlight

Spinosad

- Developed from soil dwelling bacterium
  - Causes death within a few days
  - A little more persistent than B.t. and neem (3-5 days)

- **Effective for**
  - **Caterpillars,**
  - **Colorado potato beetle,**
  - **Fire ants (baits)**

Natural Disease Control Products

- **Protect plants** from disease as part of integrated system
- **New growth protected**
- **Neem and oils** may have some effect on diseases, particularly powdery mildew

Only foliage diseases (leaf spots, blights, mildews) can be effectively treated with fungicides

Minerals

- **Sulfur** – fungal disease control
  - **Lime-Sulfur** – dormant season only
- **Copper** – fungal and bacterial diseases
  - **Bordeaux Mix**
  - copper sulfate + hydrated lime

- Contact protectant
- Apply carefully - Leaf damage can occur

Natural Fungicides

- ***Bacillus subtilis***
  - For leaf diseases
- **Potassium bicarbonate**
  - Especially effective for powdery mildew
  - Sold as 'Remedy' and other brands
- **Must apply at first symptoms!**

Serenade is one brand name of B. subtilis

Learn More!

Course webpage:
http://go.ncsu.edu/veg-short-course

- **Chatham Gardener** email list
  - Sustainable gardening information
  - Upcoming classes and events
- **To subscribe:**
  - http://go.ncsu.edu/subscribecg
- Also posted on http://chatham.ces.ncsu.edu

Next Extension Gardener Class:

- May 5: Growing Culinary Herbs
- AM and PM session
- Registration posted soon!

Become an Extension Master Gardener Volunteer

- Applications due April 8
- Training begins April 20

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