

Pest, Disease, and Weed Management in Vegetable Gardens



Matt Jones

Horticulture Extension Agent
NC Cooperative Extension - Chatham County Center

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Part III

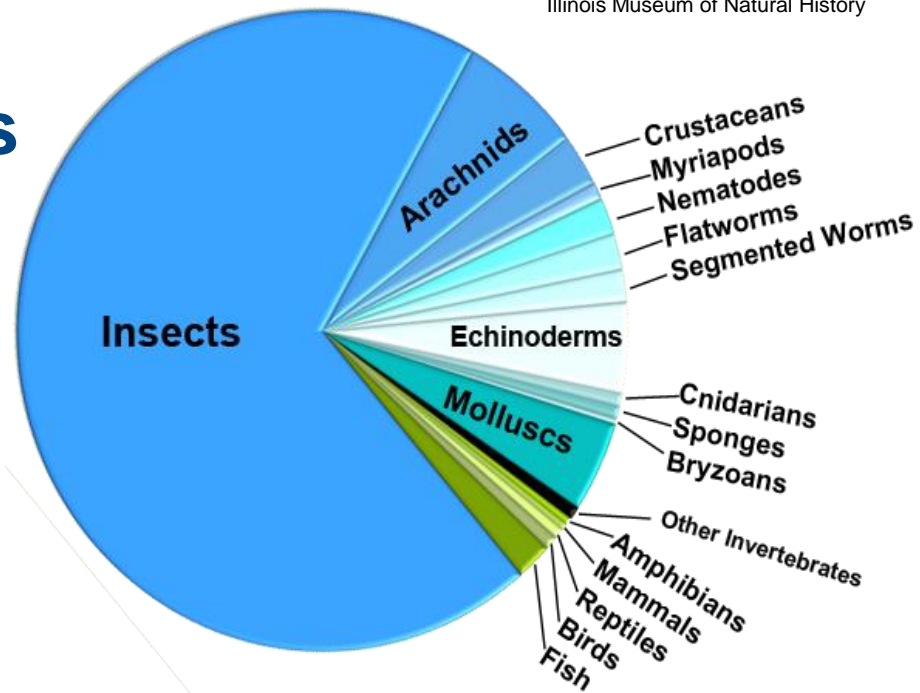
Insects

Insect Diversity

6-10 million spp. of insects

- 400,000 spp. of plants
- 4,000 spp. of mammals

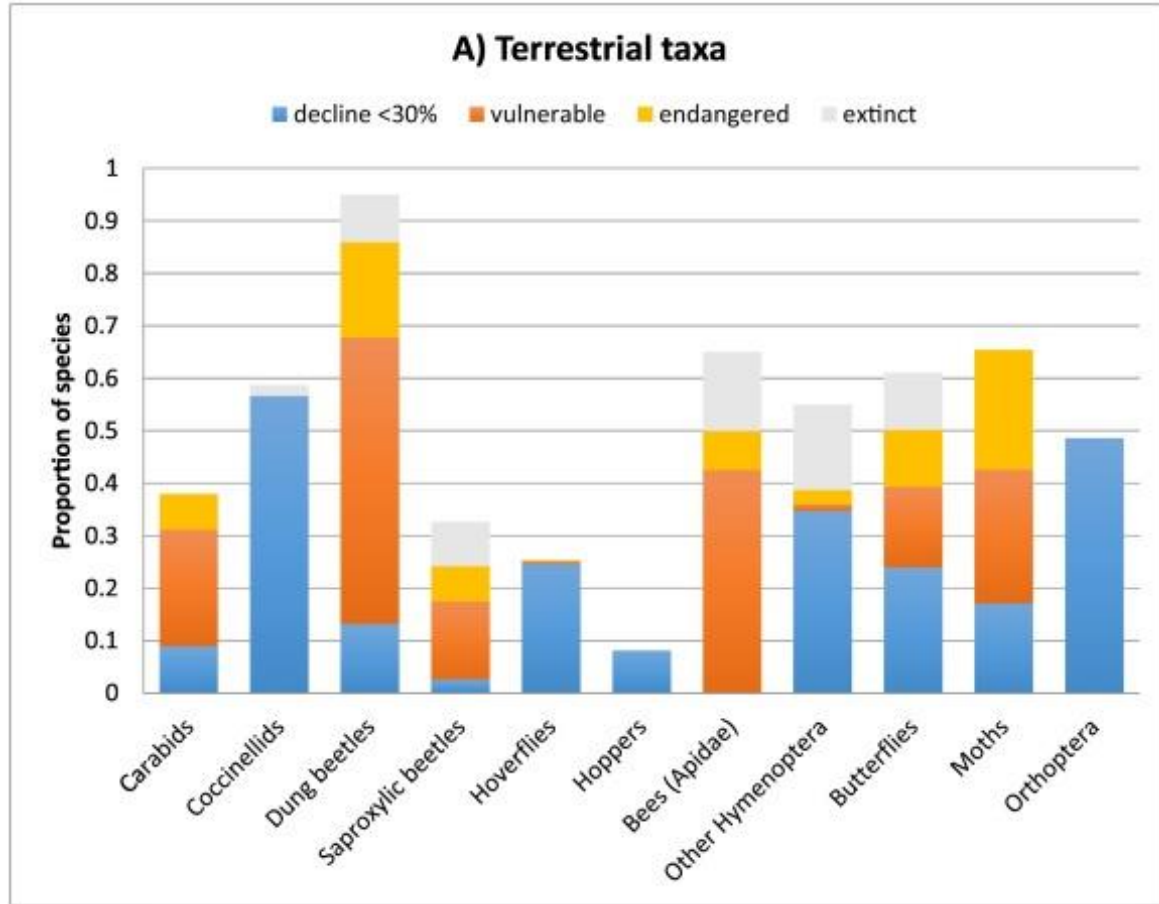
Illinois Museum of Natural History



<< 0.1% of insects are considered pests!

Arthropod Diversity is Declining

Proportion of Insect Species in Decline



Improve Soil



Provide Food



Provide Beauty



Pollinators



Producers



Pest Predators

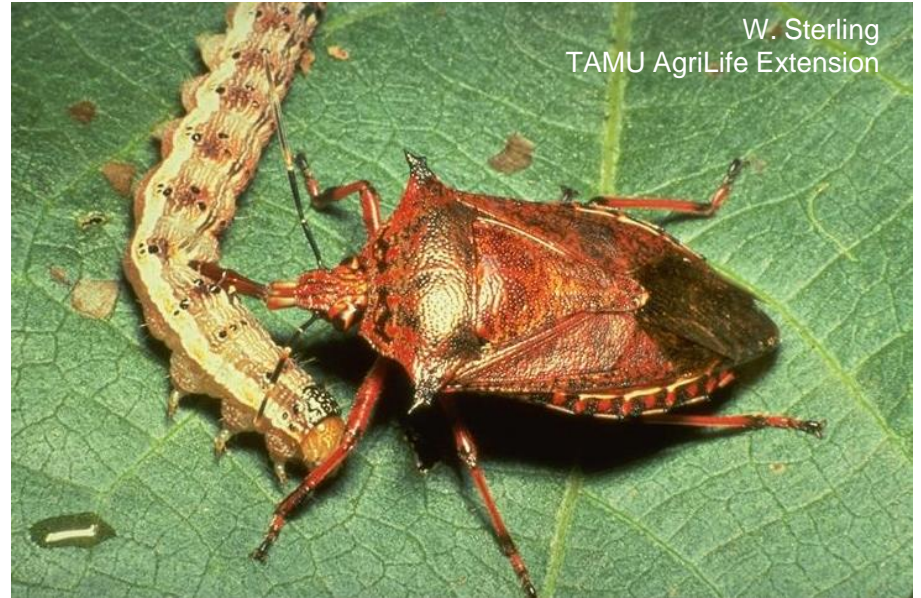


Beneficial Insects **Hemiptera**



Debbie Roos
growingsmallfarms.ces.ncsu.edu

Wheel Bug (nymph)
Arilus cristatus (Reduviidae)



W. Sterling
TAMU AgriLife Extension

Spined Soldier Bug
Podisus maculiventris (Pentatomidae)



Megha Kalsi
Univ. of Florida

Milkweed Assassin Bug
Zelus longipes (Reduviidae)



Big Eyed Bug
Geocoris spp. (Geocoridae)

Beneficial Insects



Black and Yellow Garden Spider
Argiope aurantia: (Araneidae)



Dragonflies and Damselflies
Odonata

Beneficial Insects **Coleoptera**



Ric Bessin
University of Kentucky



Kansas Dept. of Ag. Archive

5512199



David Cappaert
Michigan State University

UGA5255038

Ladybird Beetles (larva)
(Coccinellidae)

Ladybird Beetles (adults)
(Coccinellidae)

Beneficial Insects **Hymenoptera**



Parasitoid Wasps
(Chalcidoidea, Ichneumonoidea)

Beneficial Insects **Neuroptera**



Green Lacewing (adult and egg)
Zelus longipes (Reduviidae)



Green Lacewing (larva)
Geocoris spp. (Geocoridae)

Pollinators



Photos: Debbie Roos, NCCE Chatham

<https://growingsmallfarms.ces.ncsu.edu/growingsmallfarms-pollinorgarden/>

Pollinators



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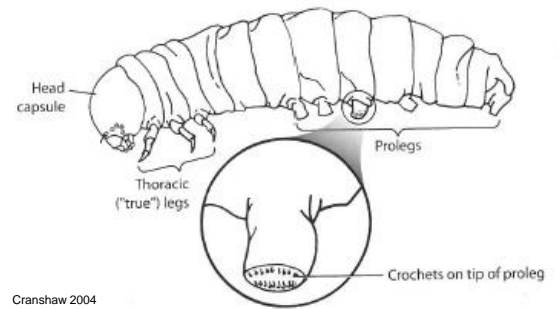
Pollinators



Photos: Debbie Roos, NCCE Chatham

<https://growingsmallfarms.ces.ncsu.edu/growingsmallfarms-pollinorgarden/>

Insect Anatomy



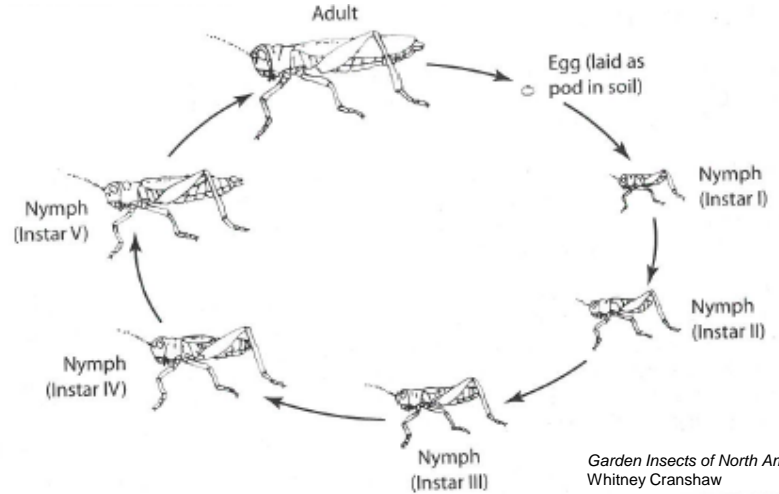
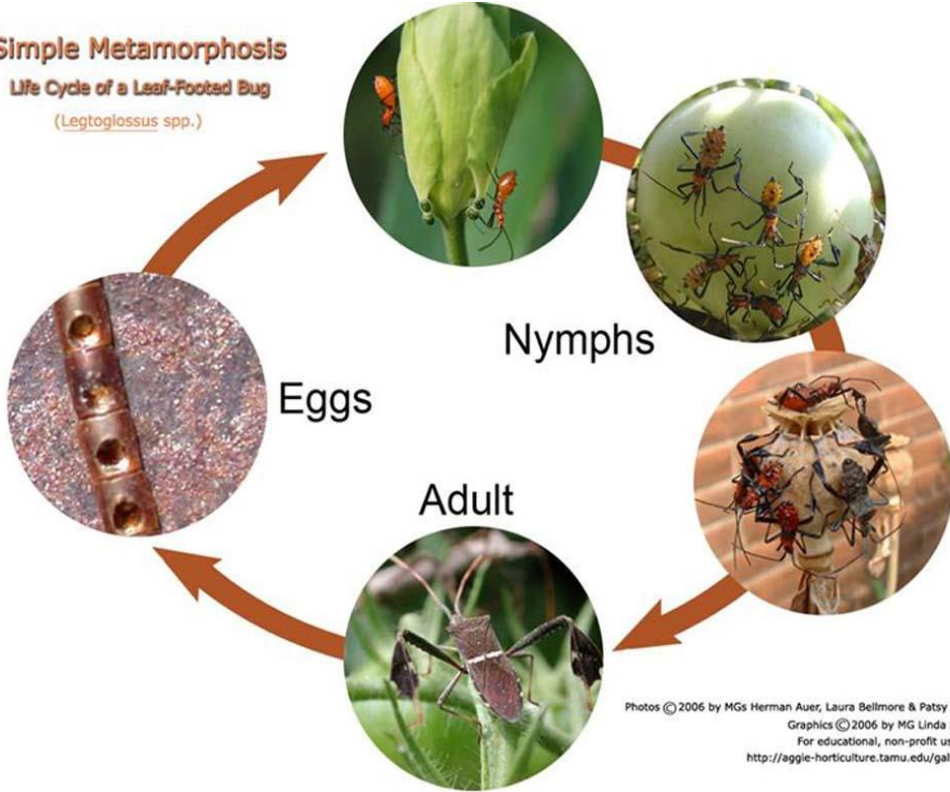
Cranshaw 2004

Gradual Metamorphosis

Simple Metamorphosis

Life Cycle of a Leaf-Footed Bug

(*Leptoglossus* spp.)



Garden Insects of North America
Whitney Cranshaw

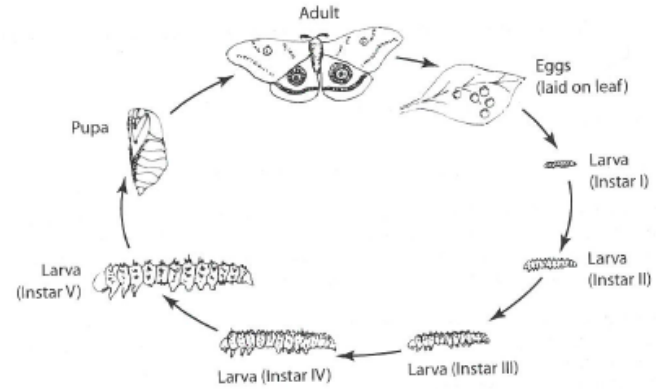
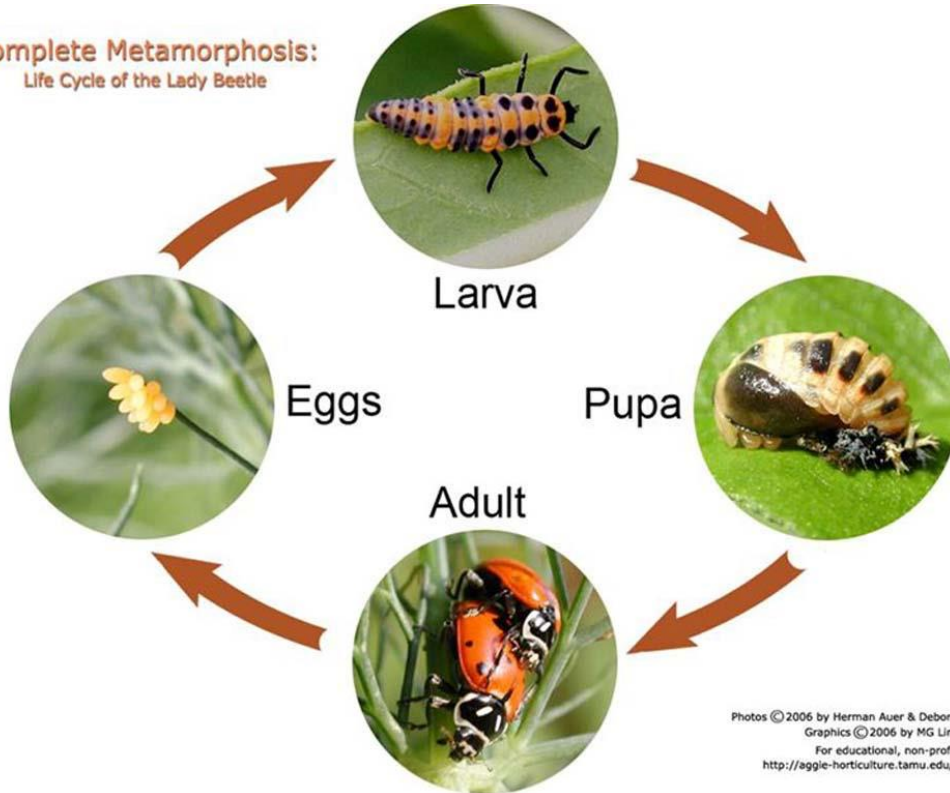
Examples



Photos © 2006 by MGs Herman Auer, Laura Bellmore & Patsy Jewell
Graphics © 2006 by MG Linda Steber
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<http://aggie-horticulture.tamu.edu/galveston>

Complete Metamorphosis

Complete Metamorphosis:
Life Cycle of the Lady Beetle



Examples



Photos © 2006 by Herman Auer & Deborah Repasz
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<http://eggle-horticulture.tamu.edu/galveston>

Easter Egg ~~Black Swallowtail~~ Papilio polyxenes



Insect Larvae

Larvae vary within and
among insect Orders

Garden Insects of North America
Whitney Cranshaw



Grubs

Larvae of Coleoptera
(Beetles)



Maggots

Larvae of Diptera
(Flies)



Caterpillars

Larvae of Lepidoptera
(Butterflies and Moths)

Signs and Symptoms

Sign: evidence of pest

- Excretions
- Secretions
- Body parts

Symptom: plant response to pest damage

- Distorted growth
- Disease symptoms
- Feeding damage



Frass



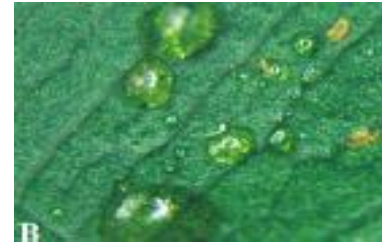
Gall



Silk Webbing



Cast Skin



Honeydew

Slime Trails



How Insects Damage Plants



Whitney Cranshaw

Nesting & Egg Laying



USDA Forest Service

UGA3056042



Utah State Univ.

Disease Vectors



Utah State Univ.

**Generally
Not Harmful**

**Can Cause
Injury & Death**

Disease Transmission

200+ plant diseases spread by animal vectors

- Mostly viruses
- Bacteria
- Fungi

Direct transmission

- Feeding
- On animal body

Indirect Transmission

- Secondary infection



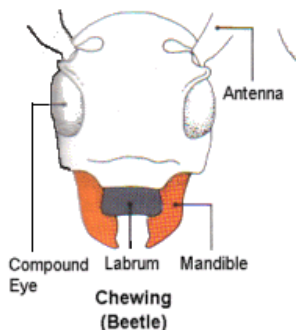
Tomato Spotted Wilt Virus: Spread by thrips

How Insects Damage Plants

Feeding



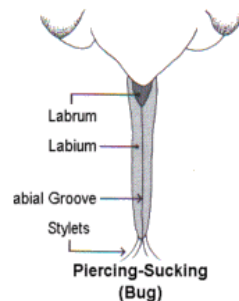
Matt Bertone NCSU



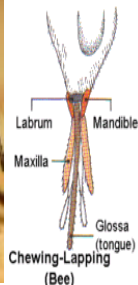
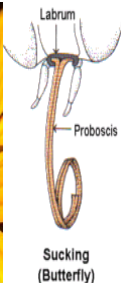
Chewing Mouthparts

Cause plant damage

Matt Bertone NCSU

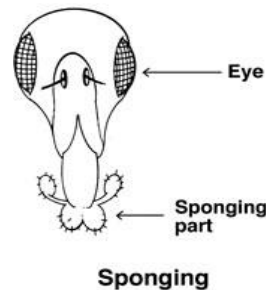


Piercing/Sucking Mouthparts



Siphoning/Chewing-Lapping Mouthparts

The Robinson Library
Univ. of Missouri



Sponging Mouthparts

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



Signs and Symptoms

- Sawdust
- Holes
- Tunnels
- Secondary disease
- Death in some cases

Examples

- Beetles (Larvae & Adults)
- Moths (Larvae)
- Sawflies (Larvae)



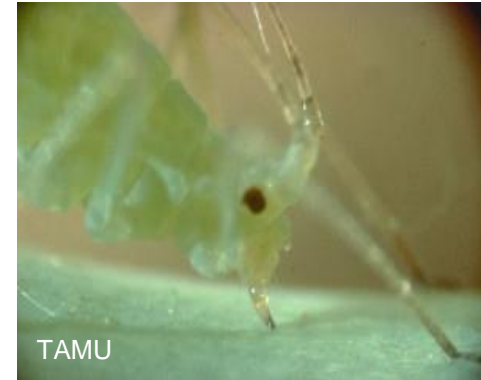
Piercing-Sucking Mouthpart Damage

Signs & Symptoms

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

Examples

- True bugs
- Aphids
- Whiteflies
- Leafhoppers



Need Help Identifying Insects?

NC STATE EXTENSION

Master Gardener | Chatham County

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

chathamengv@gmail.com

919-545-2715 (Except during COVID-19,
email is preferred)

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**

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**



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**



Active ingredients are listed on the label

Insecticidal Soaps & Horticultural Oils

Insecticidal Soap

- Soft body pests: aphids, whitefly, mites, scales
- Kills only what it contacts – not eggs
- Repeated applications often necessary

Horticultural Oil

- Kills by smothering,
- Kills all life stages (eggs must be exposed)
- Scale, spider mites, aphids, whitefly
- Can damage plants at high temperatures

No residual activity for either



- **Broad spectrum**
- **More harmful to beneficials**
- **Inspiration for pyrethroid insecticides**

Pyrethrin



Kenpei CC BY-SA 3.0

Tanacetum cinerariifolium

B.t.– *Bacillus thuringiensis*

- Derived from soil bacteria
- Sporulate and produce toxin
- Must be ingested
- Stop feeding within a few hours, slow death
- Different strains target different insects
 - Bt *Kurstaki* – caterpillars
 - Bt *Tenebrionis* – beetles
 - Bt *Israelensis* – flies (mosquito dunks)



Neem Oil

- Derived from Neem tree seed oil
- Over 70 compounds
 - **Azadirachtin** believed most active
- **Controls** aphids, mites, thrips, whitefly, caterpillars



Spinosad

Developed from soil dwelling bacterium

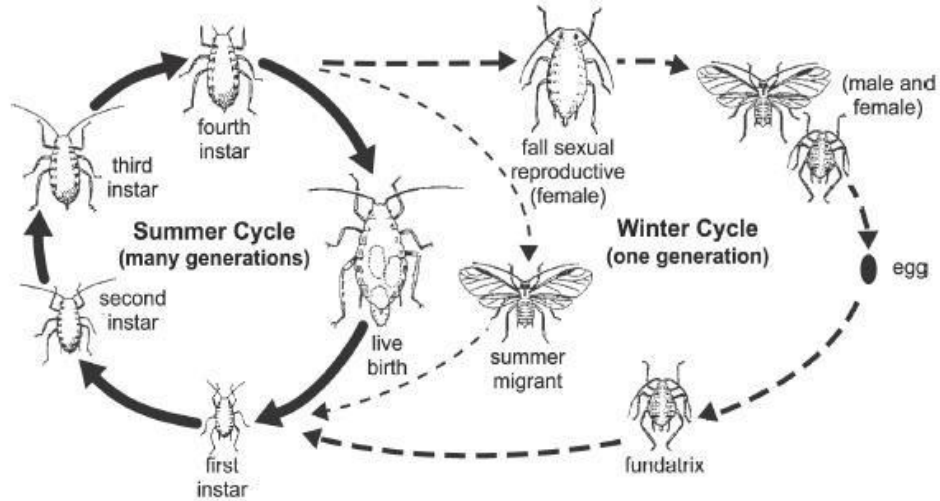
- Causes death within a few days
- A little more persistent than B.t. and neem
 - 3-5 days
- Toxic to bees too, so bee careful!

Effective against

- Caterpillars
- Colorado potato beetle
- Fire ants (baits)



Aphids Hemiptera



Rapid Proliferation



Piercing-sucking



Honeydew & sooty mold



**Predator & parasitoid
natural enemies**

Aphids on Vegetables

Hosts

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

Signs & Symptoms

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

Management

- Natural enemies
- Water
- Insecticidal soap



Squash Bug (Coreidae: *Anasa tristis*)

Eggs



Nymphs



Adult

Squash Bug (Coreidae: *Anasa tristis*)

Hosts

- Cucurbits (squash, cucumber, melons)

Signs & Symptoms

- Stippling, yellowing of leaves
- Reduced growth and yield
- Fruit damage and 2° rot
- By nymphs and adults

Management

- Scouting and handpicking
- Neem, insecticidal soap on nymphs
- Reduce mulch



Stink Bugs (Hemiptera: Pentatomidae)



Debbie Roos
NC State University

Green Stink Bug

Chinavia hilaris



Debbie Roos
NC State University

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 Cole Crops



Imported Cabbageworm
Pieris rapae



Cabbage Looper
Trichoplusia ni

Caterpillar Pests of Cole Crops



Cross-striped Cabbageworm
Evergestis rimosalis



Diamondback Moth
Plutella xylostella

Caterpillar Pests of Cole Crops

Hosts

- Cruciferous vegetables

Signs & Symptoms

- Windowpane chewing patterns on the undersides of leaves (young larvae)
- Chewing hole (older larvae)
- Frass (droppings)

Management

- Handpick
- Floating row covers
- *Bt kurstaki*



Charlotte Glen
NC State University Extension

Caterpillar Pests of Tomatoes

Eddie McGriff
University of Georgia
Bugwood.org



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



Squash Vine Borer

(Lepidoptera: Sesiidae, *Melittia curcurbitae*)

Larva



Adults

Squash Vine Borer

(Lepidoptera: Sesiidae, *Melittia curcurbitae*)

Hosts

- Summer & Winter Squashes

Signs & Symptoms

- Wilting leaves, mushy stems
- Frass, entrance holes on stems
- Death

Management

- Crop rotation, remove all debris
- Al foil around base
- Cut out larvae
- *Cucurbita pepo* “Tromboncino” is resistant



Flea Beetles

(Chrysomelidae: Alticini)

Hosts

- Many vegetables, host specific species

Signs & Symptoms

- Small, irregular chewing holes on leaves

Management

- Floating Row Covers
- Spinosad
- Azadirachtin
- More mature crops usually tolerant



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*



Mexican Bean Beetle

(Coccinellidae: *Epilachna varivestis*)

Eggs



Larvae



Adult

Mexican Bean Beetle

(Coccinellidae: *Epilachna varivestis*)

Hosts

- Snap beans, lima beans, southern peas

Signs & Symptoms

- Chewing damage on leaves
- Defoliation
- By larvae and adults

Management

- Row covers
- Handpicking
- Spinosad
- Azadirachtin

