

# Organic IPM

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# Identifying Pests

- Proper identification is critical so utilize the Soil, Plant and Pest Center and digital diagnostics
- Learn the biology and the habits of the pest
- Learn what the most susceptible life stages in order to target control options

# Field Scouting

- Still considered the backbone of most IPM programs
- Both pests and beneficial organisms are sampled to give critical up-to-date information needed for the decision making process for each crop/field
- Most economic thresholds are based on field scouting

# Manage Insects on Your Farm, A Guide to Ecological Strategies

By M. A. Altieri & C. I. Nicholls with M. A. Fritz

This handbook is an excellent resource

Let us explore some of the key concepts

# Healthy Soils Key to Organic Pest Control

- Harbor more diverse and active populations of soil organisms
- More diverse soil arthropods provide a more complex ecological web
- Tends to suppress soil pest outbreaks

# Wireworm

- Especially a problem in fields following sod



# Long Crop rotations

- Many insect pests have a narrow range of host plants on which they feed
- Some pests such as Colorado potato beetles and squash bugs do not go far from the field to overwinter
- Long rotations of solanaceous crops (potatoes, tomatoes, eggplant) or cucurbits will reduce infestations of these two pests

# Squash Bugs



**Eggs**



**High populations can cause fruit to collapse or be unmarketable**



# No-Till

- Soil retains more moisture which is important during hot, dry periods
- Important for weed control because tillage increases weed germination
- Crop rotation and cover crops are also important for weed control

# Minimal Tilling

- In spring, minimal tilling 6-8 inches wide and 3 inches deep within the row will warm and dry soil for improved germination and seedling growth

# Cover Crops

- Such as hairy vetch, crimson clover and rye combinations:
- Provide a refuge for beneficial insects, mites and spiders
- Become an impediment to movement of Colorado potato beetles into potatoes and cucumber beetles into pumpkins and other cucurbits

# Colorado Potato Beetle



# Cover Crops

- The organic mulch produced lessens splashing of disease organisms from the soil onto tomato plants
- And keeps pumpkins cleaner and less prone to rot

# Cover Crops

- The increased organic matter can lead to more slugs especially during wet seasons

# Green Manure

- Increases organic matter in soil
- Increases soil biotic activity
- Improves soil structure



# Nitrogen Levels

- High nitrogen levels in plants most often seen when using conventional sources of nitrogen can increase levels of pests such as aphids and spider mites
- Conventional nitrogen sources can spike nitrogen levels in plants



# Nitrogen Levels

- Organic soil amendments generally provide lower levels of nitrogen to crops
- Plants may be less attractive to egg laying by pests such as fewer European corn borer eggs laid in organically managed sweet corn in an Ohio greenhouse study

## Other mechanical controls

- A forceful spray of water can dislodge pests such as aphids and repeated sprays can help reduce twospotted spider mite populations
- Hand picking of insects and their egg might be practical on small plantings

# Natural Enemy Refuge Plantings

- Plantings of flowering plants such as buckwheat, Alyssum, and tansy leaf (*Phacelia tanacetifolia*) can be made along the field perimeter or in strips within the field every 165 to 330 feet
- These plantings attract prey insects (food for the beneficial organisms) and provide a favorable habitat for building populations of beneficials

# Natural Enemy Refuge Plantings

- Additionally, flower plantings provide both pollen (a protein source) and nectar (a carbohydrate) that increase survival rates, longevity, and egg laying of beneficial insects (lady beetles, parasitoid wasps and others)
- Try not to use plants that could serve as an alternative hosts to a major pest of one of your crops

# Less Frequent Mowing

- Supports more beneficial insects and spiders
- Reduce mowing to once per month in orchards
- Do not mow when fruit trees or small fruit plants are blooming since this could move plant bugs from flowering weeds to the fruit crops

# Perimeter Trap Cropping

- Plants that are particularly attractive to target pests are planted completely around the cash crop
- In Florida a USDA-ARS study used a collard perimeter trap crop around cabbage helped to prevent diamondback moth from exceeding economic thresholds and acted as a refuge planting to increase parasitoid and predator populations

# Perimeter Trap Cropping

- An Ontario, Canada study used ‘Southern Giant’ mustard around fields of cabbage, cauliflower and broccoli helped reduce flea beetle damage to the cabbage

Dr. Blake Layton, Extension Entomology Specialist at Mississippi State University has an on-line publication entitled “Organic Insect Control for Commercial Vegetable Production”

- Suggests planting southern peas around tomato crops to bring the stink bugs to the peas
- Sunflowers are a good perimeter trap crop for leaffooted bugs

<http://msucares.com/insects/vegetable/organic.pdf>



# Perimeter Trap Cropping

- The pitfall of trap crops is that you need to kill the pests that are attracted to the trap crop before they move to the cash crop
- Unfortunately, we lack really effective organic insecticides for stink bugs & leaffooted bugs

## Using insecticides in organic production

- Since the insecticides available for organic production are few in number and tend to be less effective, reliance on insecticides as the primary means of pest control will generally be disappointing

<http://msucares.com/insects/vegetable/organic.pdf>

# Perimeter Trap Cropping

- One potential alternative to insecticides is the use of vacuum devices to capture and destroy insects in trap crops before they can move into the cash crop
- I have not found a source for commercial vacuums designed for use in agriculture but there are some backpack vacuums available that might be useful at <http://www.vacsrus.com/CartGenie/prod-633.htm>
- There are also inexpensive landscape leafblowers that can be reversed to suck up debris & insects?

# Grow crops with relatively few insect pests

- Blueberry is the hands-down leader for fruit crops and possibly brambles as other options
- Okra, onion, snap beans, especially bush beans, sweet peas, eggplant, sweetpotato, and possibly asparagus and watermelon

# Grow crops when pests are least abundant

- Early-planted crops generally experience less insect pressure
- Pests such as corn earworms (tomato fruitworms), stink bugs, whitefly, beet armyworm can be quite numerous by August

# Delay planting to miss movement of overwintering pest

- Plant beans and peas later to miss the peak movement of bean leaf beetle into crops
- Plant melons and squash later to miss the peak movement of cucumber beetles



# Bean Leaf Beetle



## When possible, choose varieties that are resistant to key pests

- Generally, there are more disease resistant varieties available (these are clearly labeled)
- Note that thrips control is less important on tomato varieties resistant to tomato spotted wilt virus



# Vegetable varieties with insect tolerance

- Broccoli (De Cicco)- striped flea beetle
- Cabbage (Early Globe) - cab. looper, imported cw (Red Acre, Round Dutch)
- Chinese cab. (Michihli) – diamondback moth
- Collard (Georgia)- striped flea b., harlequin bug
- Corn (Merit, Golden Security)- corn earworm because of good shuck extension
- Cucumber (Poinsett) – spotted cucumber beetle (Ashley) – pickleworm, spotted cu. b.

# Southern Corn Rootworm or Spotted Cucumber Beetle



# Vegetable varieties with insect tolerance

- Kale (Yates)- diamondback moth
- Mustard (Florida Broadleaf)- db moth, striped flea b.
- Radish (Cherry Belle)- db moth, harlequin bug  
(White Icicle)- harlequin bug
- Rutabaga (Am. Purple Top)- db moth, striped flea b.
- Squash (Early Prolific [SN], Straight neck, White Bush Scallop) – pickleworm, striped cucumber b.  
(Zucchini)- striped cucumber b., squash vine b.

# Vegetable varieties with insect tolerance

- Sweetpotato (Centennial, Jewel)- sweetpotato flea b.  
southern potato wireworm  
(Beauregard)- soil insects (except flea b.  
whitefringed b.)

# Vegetable varieties with insect tolerance

- Tomatoes (TSWV resistant varieties)
- Turnip (Seven)- diamondback moth, striped flea b.
- Watermelons (Crimson Sweet)- pickleworm,  
spotted cucumber beetle

# Crop rotation

- Some insect pests rarely fly and tend to overwinter in crop residue or in nearby ground litter
- Crop rotation is beneficial for Colorado potato beetles in potatoes and other susceptible solanaceous crops, vegetable weevils in turnips, and cowpea curculio on southern peas
- Crop rotation is also important in controlling many diseases

# Do not grow successive plantings of the same crop in close proximity

- This is especially important when the pests have multiple generations per year
- For example, growing 3 successive organic pea crops in close proximity, each planted 2-3 weeks apart, will probably attract many stink bugs to the later plantings

# Stink Bugs





# Think about where you plant crop in relation to other crops

- For example, do not have a late tomato crop near corn, sorghum, soybeans, or peas that generate large numbers of tomato fruitworms and stink bugs

# Destroy old crop residue as soon as possible after final harvest

- This destroys many pest insects before they can become adult and lay eggs on nearby crops or enter overwintering sites
- This also removes the crop as a pest breeding site for future generations and as an overwintering site
- Helps with disease and weed control

# Know when to quit on a crop

- Since pest pressure tends to increase the longer the crop is in the field, it may be best to grow the crop for a shorter duration by bailing out when pest pressure builds

# Plant into weed free fields and maintain good weed control

- Mechanical tillage to destroy weeds should be performed at least three weeks before planting
- This will help control cutworms, false chinch bugs, vegetable weevils, spider mites, slugs, and crickets that often begin developing on weeds in the field
- Tillage will also help control pests that overwinter in soil such as imported fire ants

# Use of metalized reflective plastic mulches

- This disorients flying insects such as thrips, aphids, and whiteflies which can greatly reduce the number of these insects attracted to seedling crops
- Some studies have shown reflective mulches to be more effective in reducing TSWV incidence in tomatoes and peppers than weekly insecticide sprays

# Physical exclusion

- Floating or hoop-supported row covers (spun-bond fabric) can keep early season insects from attacking tender seedlings
- They can be used to exclude cucumber beetles from melons or squash
- This light fabric cover which can aid in early frost protection should be removed at bloom to allow pollination

# Grow healthy, vigorous plants

- Drought stressed plants or those with a potassium deficiency are more susceptible to spider mites

# Use mating disruption when appropriate

- The idea is to flood the field with synthetic pheromone so that the male moths can not find mates, resulting in many moths laying unfertilized eggs
- Mating disruption is only available for a few vegetable insects (Tomato pinworm is OMRI approved, DBM is not)



# Use organic (OMRI approved) insecticides when necessary

- Treat before pests reach damaging levels
- Choose insecticides that are effective against the most susceptible stage of the target pest (usually the most immature stage)

## Be aware of the limitations of organic insecticides

- Spinosad (Entrust) and Bts are effective against most caterpillar pests, provided that they are applied when caterpillars are small
- The type of Bts for lepidoperan caterpillars do not control sawflies
- If good coverage is achieved, azadiractin, oils, and insecticidal soap can usually be used to control aphids and whiteflies
- There are no highly effective organic insecticides for most beetles and stink bugs

<http://msucares.com/insects/vegetable/organic.pdf>

# Some insecticides extremely target specific

- Spod-X is only active against beet armyworms
- Pyganic has a wide range of activity but only provides short-term control
- Thus many organic insecticides need to be applied more frequently than conventional insecticides
- Good spray coverage is particularly important since most organic insecticides only work by direct contact

# Beet Armyworm



Larvae feed in mass until about 1/2 inch long



Small black spot above Second pair of true legs

# Tomato Scouting (The Seedling Stage)

- Walk the field twice per week to look for blank spots and damage
- Where plants are cut off, look under clods for cutworms (can still find on surface at dawn)



# Wireworms



# White Grubs



Photograph by Marlin Rice  
Iowa State University

**Also can be a problem in fields following sod**



# Black Cutworm (Soil Insect Pest)





# Black Cutworm (Moth)



Black arrows  
point together

# Thrips

Adult  
(wings present)



J. Reed

Fringed Wings



# Eggplant Flea Beetle



# Tomato Scouting (Transplanting to Fruit Set)

- Check for tomato fruitworm, beet armyworm, yellowstriped armyworm and tomato pinworm that can attack fruit later
- For tomato pinworm, look for their leaf mines
- Check for foliage pests such as cabbage loopers, hornworms, potato aphids, and leafminers



# *Green Peach Aphid - Honeydew and Sooty Mold Interferes with Curing*



Sooty Mold and  
Dead Areas on Leaf

# Melon Aphid

- Aphids can transmit viruses as can whiteflies
- Insecticide sprays do not help because aphid probing with their mouthparts can transmit the virus quickly before insecticides can take effect

# *Aphid Live Birth*





# Colorado Potato Beetle





# Blister Beetles

- Can cause severe defoliation of tomatoes



# Transplanting to Fruit Set

- For tomato fruitworms, beet and yellowstriped armyworms tally approximate size categories separately
- Small (1<sup>st</sup> & 2<sup>nd</sup> instars), medium (3<sup>rd</sup> & 4<sup>th</sup> instars) and large (5<sup>th</sup> and 6<sup>th</sup> instars)
- If mainly small larvae are found, more eggs may hatch soon so recheck field in a couple days
- Small larvae are also easier to control

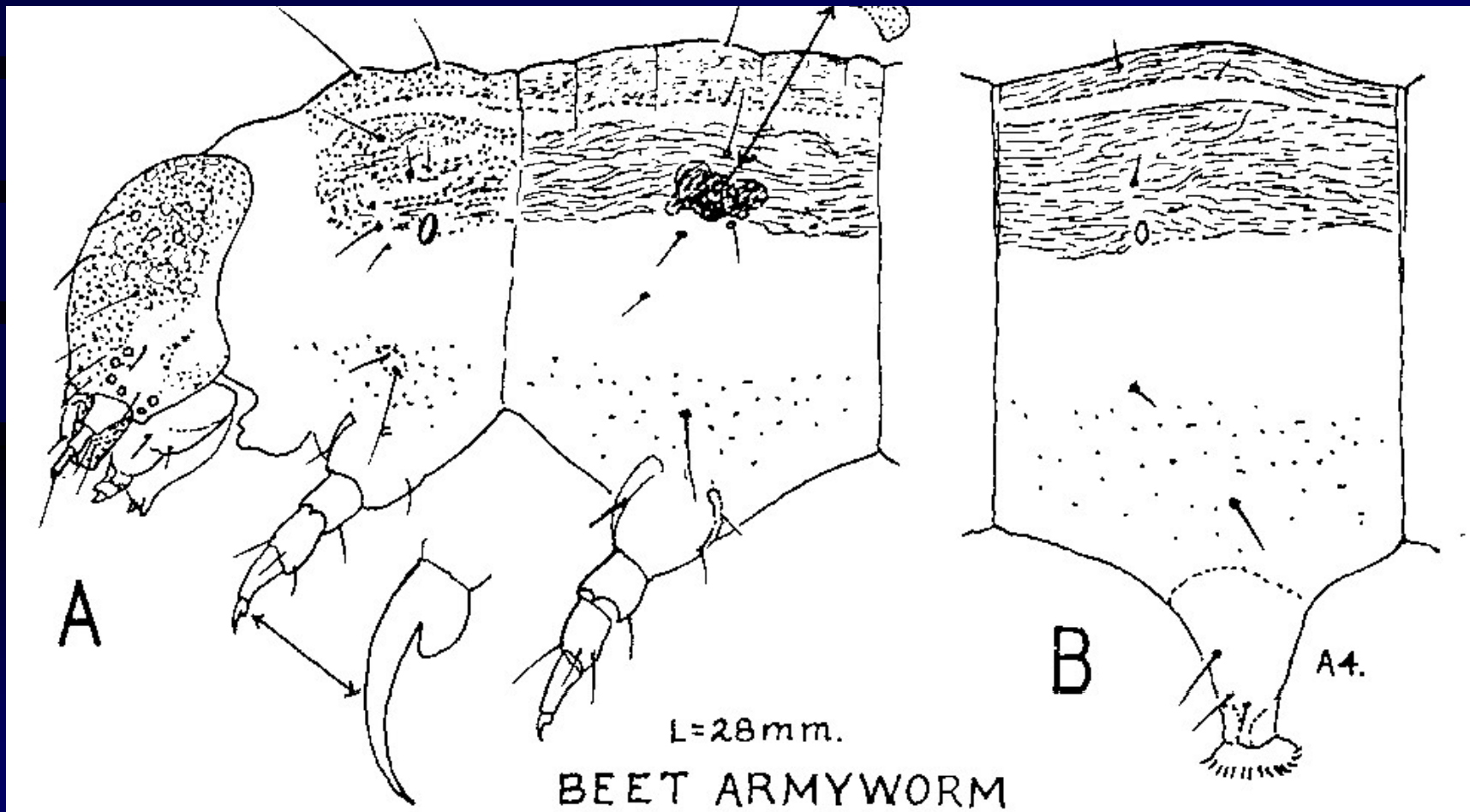
# Beet armyworm



Egg mass



# Beet Armyworm





# Yellowstriped Armyworm

Barrel-chested appearance of larva

Large black spot above last pair of true legs



# Tomato transplanting to fruit set

- Know how to identify caterpillar eggs and use a hand lens (singly laid eggs of cabbage looper and tomato fruitworm and egg masses from beet and yellowstriped armyworms)
- Tomato fruitworm eggs are usually on the underside of leaflets close to flowers at the outer edges of plants or frequently on the third leaf back from the growing tip
- If eggs are seen, check closely for larvae

# Budworm/Bollworm Eggs



Eggs are usually laid singly

# Transplanting to Fruit Set

- Scout for twospotted spider mites that first cause yellow stippling on leaves
- Look for silken webs and the mites and eggs on the undersurface of leaves
- Heavily infested leaves turn pale and can dry up and fall off
- Also check new growth for green peach aphids



# Twospotted Spider Mites

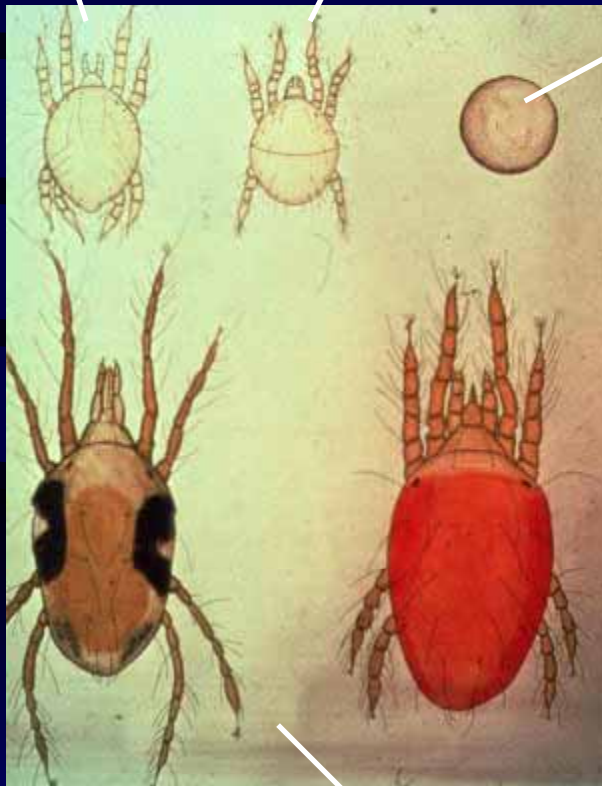


# Twospotted Spider Mites

Nymph

Larva (6 legs)

Egg



Adults

# Fruit Set to Harvest

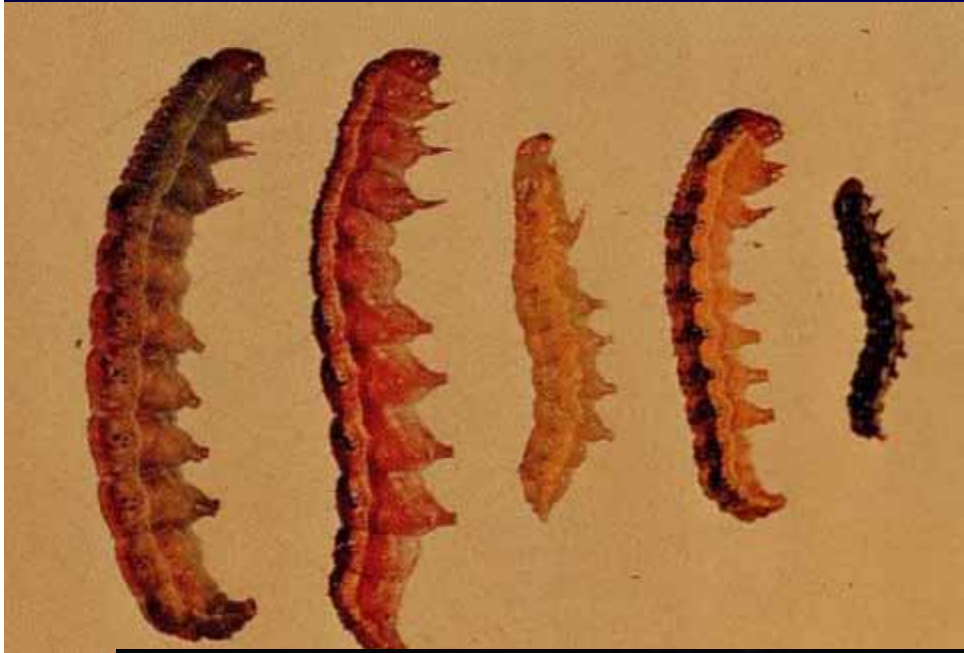
- Continue to sample plants twice per week
- Check 10 fruit at random from each 6 feet or row sampled

# Tomato Fruitworm

- The economic threshold for this fruit damaging pest is the low average of  $\frac{1}{2}$  percent damage or one fruitworm damaging fruit per 200 fruit examined
- In a 10 acre field you would check 10 fruit in each of 8 stops for a total of 80 fruit checked
- Just one fruitworm in those 80 fruit would reach the threshold



# Tomato fruitworm (corn earworm, cotton bollworm)



# Budworm vs. Bollworm (Moths)

Sergeant Chevrons  
On Forewings



Tobacco Budworm

Dark Spot  
on Forewing



Bollworm (Corn Earworm)



# Budworm/Bollworm Larvae



Light-colored Head Capsule



# Tomato Pinworm

- Adults are gray  $\frac{1}{4}$  inch long moths
- Field infestations in Tennessee usually come from greenhouse infestations
- Larvae are light orange at first becoming  $\frac{1}{4}$  inch long and purplish black with maturity
- Early larval feeding is similar to leafminer damage



Image courtesy of U. of California Cooperative Extension



Image courtesy of Texas A&M University

# Tomato Pinworm

- Maturing larvae invade stems and fruit



Image courtesy of University of California  
Cooperative Extension



Image courtesy of Texas A&M University

# Tomato Pinworms

- Count mines on 3 randomly selected top leaves (fully expanded ones) per 6 foot sample
- The ET is an average of 1 mine per 3 top leaves or one mine per 6 foot sample



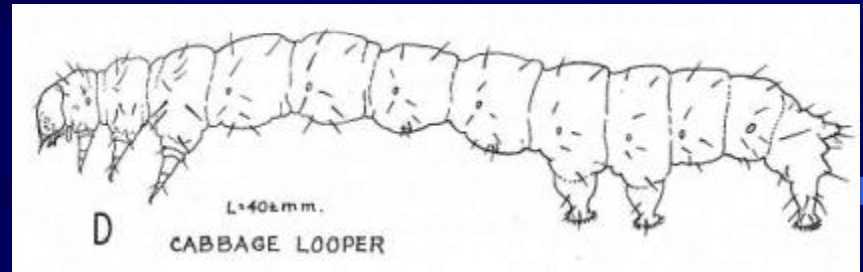
# Loopers

(Lepidoptera: Noctuidae)

- Cabbage looper  
(*Trichoplusia ni*)
- Soybean looper  
(*Pseudoplusia includens*)



# Cabbage Looper



- General feeders on plants such as geranium, cabbage and other crucifers, carnation, snapdragon, nasturtium, tomato and lettuce





# Cabbage Looper on Geranium



# Cabbage and Soybean Loopers



Both Species  
Have 3 Pair  
of Prolegs



Pupa

Black true legs or  
black spots on body  
usually soybean  
looper



# Soybean Looper Moth

Gold Flecking on Forewings



Fresh Specimens with  
A “Mohawk” on Thorax





Tobacco  
Hornworms  
(White Cocoons of  
*Apanteles* wasp  
Parasitoids)



# Hornworms and Loopers

- The ET is an average of 1 hornworm damaged plant per 6 foot sample
- The ET is an average of 2 live loopers or looper damaged plants per 6 foot sample

# Stink Bugs





# *Stink Bugs*

- They stick their beaks into the tender midribs of tobacco leaves and tender tops of plants
- During warm weather. Leaves about feeding areas wilt badly and may develop brown areas called sun scald



# Stink Bug Eggs

**Southern Green Stink Bugs  
(compact egg mass)**



**Green and Brown Stink Bug  
(looser egg mass)**



# Brown Stink Bug (Nymphs)



# Brown Stink Bug vs. Spined Soldier Bug

Rounded  
'Shoulders'



**Brown Stink Bug (Pest)**

Pointed  
'Shoulders'



Wings extend  
Beyond tip of  
abdomen

**Spined Soldier Bug (Predator)**

# Stink Bugs

- The ET for live stink bugs is 0.5 stink bug per 6 foot sample (or 1 stink bug per two of the 6 foot samples)
- The ET for stink bug fruit injury is  $\frac{1}{2}$  % fruit damage or one damaged fruit per 200 fruit



# Leaf-footed Bug



**Feeding on tomato**



# Leafminers



# Leafminer Adults and Feeding Marks



# Leafminers

- Record the average number of leafminer adults per 6 row feet
- The economic threshold is 6 adults per 6 row feet
- For larvae, sample 6 row feet by examining 6 trifoliolate leaves from the 4<sup>th</sup> fully expanded leaf from the top of the plant
- The economic threshold is an average of one live leafminer larva per trifoliolate leaf

# Silverleaf Whitefly



# Peppers



# European Corn Borer



Tunneling into corn



# European Corn Borer in Pepper



**Enter at cap end**



# Pepper Weevil

- Adults are black weevils with a sparse covering of tan-to-gray hairs
- They are about 1/8 inch long



Image courtesy of Texas A&M University

# Pepper Weevil

- Larvae are white grubs with brown heads
- Larvae tunnel and damage the seed area of the pepper pods

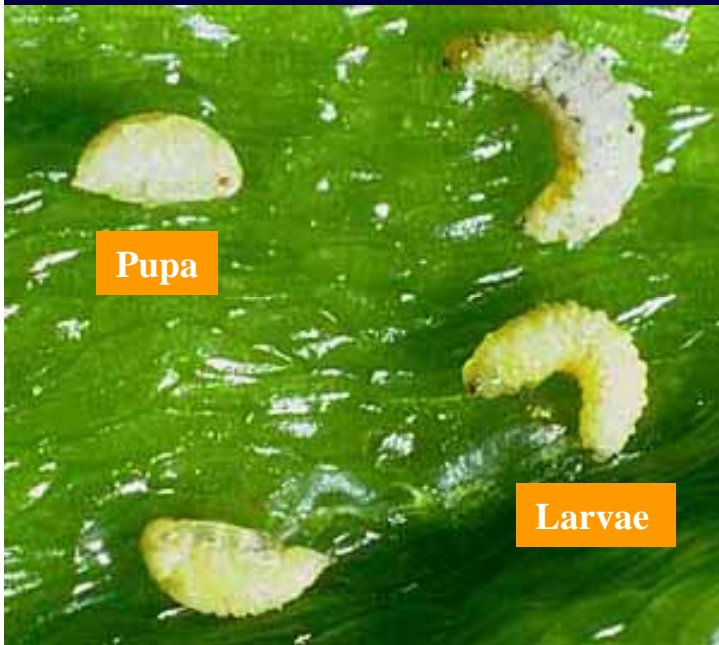
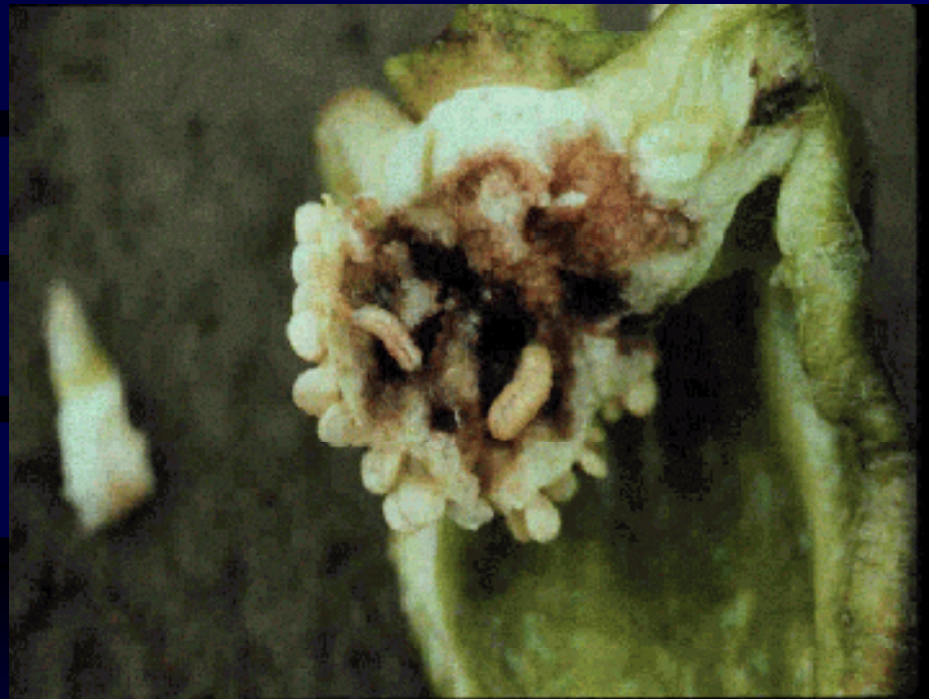


Image courtesy of Texas A&M University

Image courtesy of Texas A&M University



# Pepper Maggot



Maggot feeding in seed area



Adult



Maggot in pepper

# Cucurbits

- Cucumber
- Squash
- Pumpkins
- Cantaloupes and melons
- Watermelon



# Cucumber Beetles



# Striped Cucumber Beetle

## Feeding Damage on Squash



# Bacterial Wilt

- Transmitted by cucumber beetles
- The bacterial is defecated by the beetles and gets into the plant via feeding wounds

# Bacterial Wilt Susceptibility

- Jack-o-lantern pumpkins and most varieties of squash are rarely susceptible
- Hubbard and butternut squash are susceptible
- Some processing pumpkins that are a cross between jack-o-lantern and butternut are susceptible
- Muskmelons and cucumbers are very susceptible



# Cucumber Beetles

- Since jack-o-lantern pumpkins are rarely susceptible to bacterial wilt, insecticides are justified only to stop beetles from defoliating plants or feeding on the fruit



# Aphids

- Aphids can transmit viruses to cucurbits
- Crop losses of up to 50% have been documented

# Squash Bug





# Squash Bugs on Pumpkin



# Squash Bugs

- Squash bugs prefer squash and pumpkins over other cucurbits
- The key to management is early detection and control of nymphs

# Horned Squash Bug





# Squash Vine Borer



**Adult is a clearwing moth  
related to dogwood borer**

# Squash Vine Borer

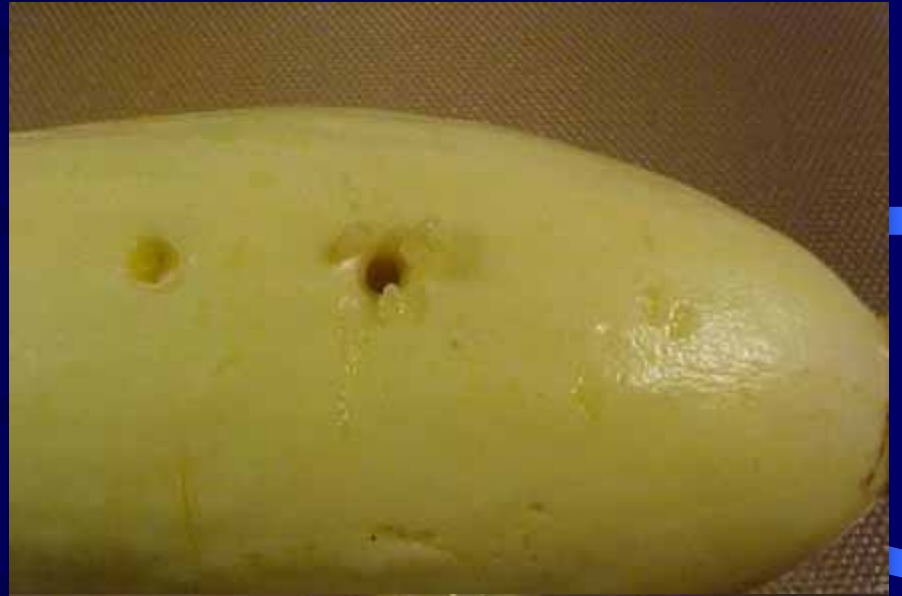
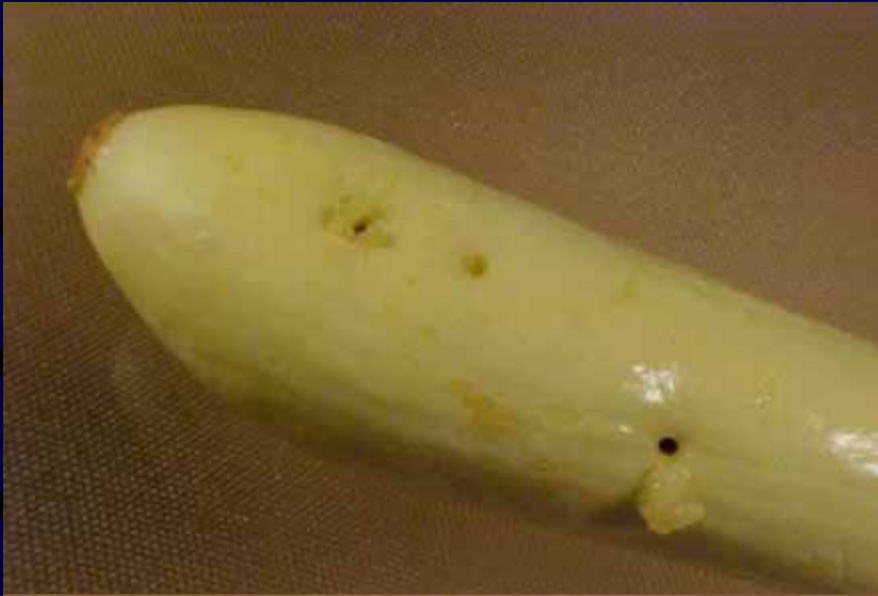


**Look for first sign of borer frass at entrance holes in stems in May-June. Two insecticide applications spaced 5 to 7 days apart will control the majority of newly hatching larvae before they enter vines**

**A second generation occurs in August**



# Pickleworm



# Pickleworm



# Pickleworm Pupa and Moth





# Brown Marmorated Stink Bug

- An exotic pest from Asia first found in the U.S. in Pennsylvania in 2001
- Since then it has been found in New Jersey, West Virginia, Virginia, Oregon, California, Tennessee (2009) and it is probably more widely distributed than we are aware



Brown marmorated stink bug  
Image courtesy of D. R. Lance USDA APHIS  
PPQ



## Brown Marmorated Stink Bug (BMSB)

Heteroptera: Pentatomidae  
*Halyomorpha halys* (Stål)

- Adults are approximately 17 mm (5/8 inch) long with a mottled brownish grey color
- The next to last (4th) antennal segment has a white band
- Several of the abdominal segments protrude from beneath the wings and are alternatively banded with black and white
- Legs are brown with faint white banding



first instar nymphs



fourth instar nymph



adult female



# Questions?



Squash bugs