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
• 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

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 cucurbitas
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 to help 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

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

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, sweet potato, 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

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.

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 ½ 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

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)

Larva

Fringed Wings

J. Reed
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 (1st & 2nd instars), medium (3rd & 4th instars) and large (5th and 6th 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

L = 28 mm.
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 ½ 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

Dark Spot
on Forewing

Tobacco Budworm

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

Black true legs or black spots on body usually soybean looper

Pupa
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’
- Wings extend beyond tip of abdomen

Brown Stink Bug (Pest)

- Pointed ‘Shoulders’

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 ½ % 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 trifoliate leaves from the 4th fully expanded leaf from the top of the plant

- The economic threshold is an average of one live leafminer larva per trifoliate 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
Pepper Maggot

Maggot feeding in seed area

Maggot in pepper

Images courtesy of University of Connecticut IPM
Cucurbits

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

Adult is a clearwing moth related to dogwood 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
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
Questions?

Squash bugs