

## Insect Control and Scouting for Organic Producers

Frank A. Hale, Ph.D.  
Professor  
UT Extension

## Organic Materials Review Institute (OMRI)

- OMRI is a national nonprofit organization that determines which input products are allowed for use in organic production and processing.

## OMRI Products List

- OMRI listed or approved products may be used on operations that are certified organic under the USDA National Organic Program
- The OMRI Products List is found at:  
[http://www.omri.org/complete\\_company.pdf](http://www.omri.org/complete_company.pdf)
- Note that some of the listed OMRI products may not be registered for sale in Tennessee through the Tennessee Department of Agriculture

## Examples of Organic Pesticide Use Restrictions in OMRI Products List

- “May be used as a pesticide if the requirements of 205.206(e) are met, which requires the use of preventative, mechanical, physical, and other pest, weed, and disease management practices.”
- Some pesticide groupings also state that the pesticide “May be used as a pest lure, repellent, or as part of a trap, or as a disease control.”

## Bio-Rational Pesticides

- Very selective, usually targeting just the pest
- Usually do not persist long in the environment
- Safer to handle and apply
- Tend to preserve beneficial organisms

## Bio-Rational Pesticides

- Insect growth regulators (IGRs)
- Oils
- Insecticidal soap
- Mined minerals (Kaolin, boric acid, diatomaceous earth)
- Sticky barriers or traps
- Entomopathogenic (beneficial) nematodes
- Botanically derived pesticides (botanicals)
- Biological pesticides (biopesticides)
  - A) Microbial and microbe derived pesticides
  - B) Biochemical pesticides (pheromones)

## IGRs

- Interfere with the normal growth processes of immature insects, not adult insects
- Additionally, some IGRs reduce the production of viable eggs by adult female insects
- Molting is a critical process that insects and other arthropods utilize in order to grow
- IGRs can be imitations of naturally occurring chemicals that regulate molting or other critical growth processes
- Or they can be other synthesized chemicals that deleteriously effect these growth processes

## Oils

- Oils kill insects and mites by damaging the cell membranes or covering and suffocating the pest
- Oils used in organic production are either from nonsynthetic sources or are narrow range petroleum based)
- These oils are more highly refined and evaporate quicker (less chance of phytotoxicity) than the dormant type

## Advantages of Oils

- Kill exposed pests, especially soft bodied ones such as aphids, scale, mealybugs and mites on contact (all life stages including eggs)
- No insecticidal residual after spray dries, thus not harmful to beneficial insects and mites that arrive on the plant later
- Resistance to oils rarely occurs if at all
- Relatively inexpensive

## OMRI Listed Oils Nonsynthetic Sources

- Worry Free brand Vegol Year-Round Pesticidal Oil
- Concern Pesticidal Spray Oil, ECO E-RASE, Golden Pest Spray Oil
- Green Cypress Organic Spreader, GreenMatch EX, Lilly Miller Vegol Pesticidal Oil, Permatrol
- SeaCide, Trendcide, Vegol Insecticidal Oil, and others

## Narrow Range Petroleum-Based Oils

- Petroleum distillates that are half evaporated at temperatures between 415 and 440 degrees F
- Less toxic to humans and plants, but can be used to suffocate insects and disrupt cell membranes

## OMRI Listed Oils Narrow Range Petroleum-Based

- BFR 4440 Supreme Spray Oil, BVA Spray 10, BVA Spray 13,
- Leaf Life Organics Brand Glacial Spray Fluid, Organic JMS Stylet-Oil, PureSpray Green
- Saf-T-Cide, SAF-T-SIDE Spray Oil Emulsion Insecticide, Fungicide and Miticide
- SPARROW 888 PLUS, SuffOil-X

## Insecticidal soap

- Work best against soft bodied insects including young caterpillars and some spider mites although usually not effective against eggs
- Kills by disrupting the membranes in the inter-segmental fold of the exoskeleton which causes a lethal loss of body fluids
- Like oils, soaps are not insecticidal once they have dried (do not apply more than twice in a row or foliar discoloration may result)

## OMRI Listed Insecticidal Soaps

- Concern Multi-Purpose Insect Killer, Garden Safe Brand Insecticidal Soap Concentrate, M-Pede, Safer Brand Insect Killing Soap Concentrate, SureFire Tomato & Vegetable Insect Killer, and many others

## Minerals

- Kaolin – a type of clay that when sprayed on a plant forms a barrier or feeding deterrent to some insects (Surround WP Crop Protectant)
- Boric Acid – a stomach poison when ingested (MotherEarth Granular Scatter Bait, NiBan Granular Bait, Terro Multi-Purpose Insect Bait)
- Diatomaceous Earth – high in silica from diatoms – scratch insect cuticle and cause desiccation (Insecta-Kill, Safer Brand Fruit & Vegetable Insect Killer, Barn Fresh, R.L.E. [Red Lake Earth], Concern Diatomaceous Earth)

## Minerals

- Ferric Phosphate -- (First Choice Sluggo Snail and Slug Bait, Garden Safe Slug & Snail Bait)
- Scott's EcoSense Slug and Snail Bait, Sluggo, Sluggo Slug & Snail Bait
- Sluggo-AG, Worry Free Brand by Lilly Miller Ferramol Slug & Snail Bait

## Sticky Barriers or Traps

- Stikem Special, Tangle-Trap Insect Trap Coating, Tree Tanglefoot Pest Barrier



## Nematodes

Nematodes are simple roundworms, colorless and unsegmented.

More than 15,000 known species.

Found in marine, freshwater, and soil habitats.

Free-living, predaceous, and parasitic.

Feed on bacteria, fungi, algae, other nematodes, plants, animals, and humans.

One teaspoon of healthy garden soil may contain from 5 to 500 beneficial nematodes.



## Beneficial or Entomopathogenic Nematodes

Nematodes enter host through natural body openings or penetrate cuticle.

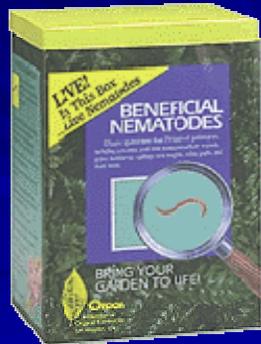
A symbiotic bacterium is released from the nematode gut, which multiplies rapidly and causes rapid insect death.

Nematodes feed upon the bacteria and liquefying host, and mature into adults.

The nematode life cycle is completed in a few days, and thousands of new infective juvenile nematodes emerge in search of fresh hosts.

Can kill insects in 24 to 72 hours.

The bacterium is dependent upon the nematode to locate suitable hosts.



## Entomopathogenic Nematodes

- Nematodes require very moist conditions such as in soil (fungus gnat larvae, black vine weevil and other beetle larvae) or in tunnels made beneath the bark of trees by clearwing borers (peachtree borer, rhododendron borer, ash borer, dogwood borer etc.)
- Moisture levels need to be just right (too much moisture and the nematodes float helplessly in the saturated soil, too little moisture and they will become dormant)

## Insect specific beneficial nematodes

Do not infect plants!

Can be applied in water through regular spray equipment



Text and images courtesy of D. Held, Auburn

## Entomopathogenic Nematodes

- Commercial products are available
- Common species commercially available are *Steinernema carpocapsae*, *S. feltiae* and *Heterorhabditis bacteriophora*
- When applied to the soil or potting media, it may control some species of thrips that pupate in that substrate

## Botanicals

- D-limonene - from citrus (Orange Guard Ornamental Plants, Safer Brand Fire Ant Killer, Worry Free Brand Moss & Algae Control, and others)
- Garlic – a repellent (Garlic Barrier AG+, Bio Crack + Plus, BioLink Insect Repellent, BioRepel, Repeller, Technocidal Allicin, XtraGarlic)

## Botanicals (Neem)

- Available as the active ingredient azadirachtin or as neem oil, both derived from the neem tree
- It has been used in some cultures for centuries although it is relatively new as a commercial insecticide
- It has IGR, deterrent, repellent and anti-feeding activity so it has activity on eggs, immatures and adults (needs to be applied at least once per week while the pest is active)

## Neem

- Usually composed of neem extract and derivatives
- Agroneem Plus, AMAZIN PLUS, Azahar, AzaMax, Azatrol, Ecozin Plus, Green Light Neem Concentrate, NeemGard, Neemix, Triact 70 EC, Organica K + Neem Insecticide, Trilogy, Triple Action Neem Oil, UltraStop Fruit Tree 3-In-1 Spray Concentrate, and others

## Botanicals (Pyrethrum)

- Pyrethrum is derived from a type of chrysanthemum and is the base molecule of the synthetic pyrethroid class of insecticides (pyrethrin is the most widely used botanical because it poses little hazard to humans while being highly irritating to insects and provides a rapid “knockdown”
- PyGanic Crop Protection EC (5.0 and 1.4), PyGanic Pro, Safer Brand Yard & Garden Insect Killer Concentrate

## Biopesticides or Biological Pesticides

- Certain types of pesticides derived from such natural materials as animals, plants, bacteria and certain minerals
- At the end of 1998, there were about 175 registered biopesticide active ingredients and 700 products according to the EPA

EPA

## Advantages of Biopesticides

- Inherently less harmful than conventional pesticides
- Designed to affect only one specific pest, or in some cases, a few target organisms
- Often are effective in very small quantities and often decompose quickly (lower exposures and pollution problems than caused by conventional pesticides)

EPA

## Registration of Pesticides

- Since biopesticides tend to pose fewer risks than conventional pesticides, EPA generally requires less data to register a biopesticide
- New biopesticides are often registered in less than a year, compared with an average of more than 3 years for conventional pesticides
- This is an incentive for agrochemical companies to produce biopesticides

EPA

## Major Categories of Biopesticides

- A) Microbial pesticides
- B) Biochemical pesticides

EPA

## A) Microbial Pesticides

- Contain a microorganism (bacterium, fungus, protozoan, virus or alga) as the active ingredient
- The most widely known microbes are varieties of the bacterium *Bacillus thuringiensis*, or Bt which are very specific in what they control and thus preserve beneficial insects and mites

EPA

## Microbial Pesticides *Bacillus thuringiensis* (Bt)

- \* A naturally occurring soil bacterium.
- \* 1911, discovered as a pathogen of flour moths.
- \* 1938, first used as a commercial insecticide in France.
- \* 1950's, used as a commercial insecticide in the USA.
- \* Produced commercially under various trade names.
- \* Commercial products are powders containing a mixture of dried spores and toxin crystal.



## Microbial Pesticides (Bt)

- There are different strains of Bt that are active against different pests (some kill lepidopterous caterpillars, some control mosquito and black fly larvae while some are used to control leaf beetles and Colorado potato beetle larvae)
- Bt is somewhat slow acting because it has to be ingested so that the toxic proteins can break down the wall of the insect's midgut and cause septicemia (some have used it mixed with bran and molasses as a bait for cutworms)

## Bt subsp. *kurstaki* (Btk)

- \* This common strain of Bt is used to control leaf-eating caterpillars (larvae of butterflies and moths).
- \* Available as a dust, wettable powder, or liquid.
- \* Marketed under various trade names such as Biobit, Dipel, Javelin, etc.



## Btk

- Bactospeine DF, Biobit HP, Britz Bt Dust, BT 320 Sulfur 25 Dust
- Deliver, Dipel DF, Dipel 2X, Dipel Pro DF
- Javelin WG, Safer Brand Garden Dust

## Bt subsp. *aizawai*

- Agree WG
- XenTari
- XenTari W.D.G.

## Microbial Pesticides (*Beauveria* spp.)

- *Beauveria* spp. (Mycotrol O, Naturalis L Home & Garden Biological Insecticide, Naturalis L) is a fungus that seems to work best on some of the small greenhouse insect pests such as aphids, whiteflies and thrips
- This product needs to be applied before insects build up to high populations

## *Beauveria bassiana*

- Best applied as a fine mist in the greenhouse on pests such as thrips where humidity levels are kept above 35%

## Virus Insecticide Sprays

- CYD-X (for codling moth on apples, pears, prunes, and walnuts)
- GemStar LC (for corn earworm and tobacco budworm on various vegetable and field crops)
- Spod-X LC (for beet armyworm on various crops)
- Virosoft CP4 (for codling moth on apple, pear, plum, prune, and walnut)

## Protozoan Insecticide

- Semaspore Bait (grasshopper control)

## Microbe-Derived Pesticides

- Spinosad is the common name of an actinomycete derived insecticide
- Brand names include Justice Fire Ant Bait, Conserve Fire Ant Bait, Conserve Professional Fire Ant Bait, Green Light Fire Ant Control with Conserve
- Safer Brand Granular Fire Ant Bait, Entrust Naturalyte Insect Control, GF-120 NF Naturalyte Fruit Fly Bait, Monterey Garden Insect Spray and others

## B) Biochemical Pesticides

- Naturally occurring substances that control pests by non-toxic mechanisms
- Conventional pesticides, by contrast, are synthetic materials that usually kill or inactivate the pest

## Biochemical Pesticides

- Include substances that interfere with growth or mating
- Insect pheromones are used to attract pests for monitoring, mass trapping and for mating disruption

EPA

## Types of Monitoring (Pheromone Traps)

- Insect trap catches indicate adult pest activity and some economic thresholds (when to treat) are based on trap catch numbers
- Mating and egg lay by females closely follows so field scouting should be a priority
- Timing of control options often corresponds to egg lay or newly hatched pest stages which are often the most susceptible to control

## Mating Disruption Pheromone Products

- Biomite, Isomate-M Rosso, Isomate-C (Plus, TT), Isomate-OFM TT, Isomate-OmLR, IsoMATE-CM/OFM TT
- CheckMate (CM, CM-OFM, SF Dispenser, PTB-XL Dispenser, CM-XL 1000, OLR, OFM-SL+, OFM Dispenser, TPW)
- NoMate CM-O Spiral, PB-Rope L, Red Scale Down

## Degree Day Concept

- Insect and mite development is dependent on temperature (development does not occur below a certain base temperature which varies by species)
- Degree days or heat units are the accumulation of temperatures each day above the base temperature for a pest
- By monitoring the temperature, degree day accumulations can be used to predict when a new generation of the pest will occur later in the season

## Light Traps

- Light traps catch adult insects and help determine potential pest pressure and timing of control options

## What is IPM?

- Integrated pest management utilizes all available pest-control techniques in a unified management program that is:
  - Environmentally sound
  - Economically sustainable

## Steps in the IPM Process

- Identify the pests
- Define the management unit (field, farm, region) and assess the site
- Develop pest management options
- Set economic thresholds
- Determine a plan to manage plant stress
- Develop monitoring techniques
- Evolve descriptive and predictive models

## Identifying Pests

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

## Define Management Unit & Assess Site

- For a field or farm have maps with irrigation, drainage, and soil types
- Include assessment of past pest activity
- Determine which fields/crops or areas of those fields are most vulnerable to pest attack
- These areas should be monitored more closely

## Pest Management Options

- Pesticides
- Biological control and the conservation of naturally occurring beneficial organisms
- Host plant resistance in crops to pests or disease
- Cultural controls (crop rotation, tillage, planting date, reflective mulch etc.)

## Economic Injury Level (EIL) & Economic Thresholds (ET)

- EIL is the pest density at which injury can no longer be tolerated without experiencing economic damage
- ET is the pest density (lower than EIL) at which control measures should be applied to prevent a pest population from reaching the EIL

## 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

## Managing Plant Stress

- Maintain ideal growing conditions by managing fertility, soil moisture levels, compaction, and weeds to allow for optimum productivity

## Kinds of Sampling

- Absolute = density per unit area such as per square meter
- Relative = density per sampling technique such as:
  - Per drop cloth (or per row foot)
  - Per sweep (or per 25 sweeps)
  - Per plant (or per 25 or 100 plants)
  - Per trap (such as a pheromone trap)

## Scouting

- On an outline map of the field, mark it off in grids or stops
- 1-5 acres = 6 stops
- 6-10 acres = 1 stop per acre (maximum 8 stops)
- Above 10 acres = 1 stop every 2 acres (minimum of 8 stops)

## Scouting

- A sample of 6 feet of row is taken at each stop in the block
- Each 6 foot sample is taken at random within the grid
- Each field should be checked twice per week

## 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)

## 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

## Budworm/Bollworm Larvae



- Light-colored Head Capsule

## Tomato Pinworm

- Adults are gray ¼ inch long moths
- Field infestations in Tennessee usually come from greenhouse infestations
- Larvae are light orange at first becoming ¼ inch long and purple 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

## Loopers (Lepidoptera: Noctuidae)

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



## 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

## Beet Armyworm



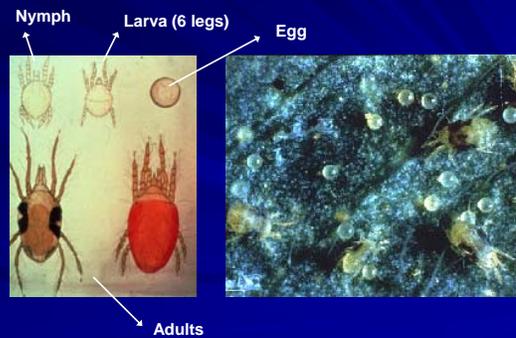
## Transplanting to Fruit Set

- 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



## Fruit Set to Harvest

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

## Questions?

