Insect Management in Tomatoes

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Insect Pest Management in Tomatoes

- Several key and minor insects and mites ... not all will be present and require control
- Start with good horticultural practices ... varieties, training, pruning, timely harvests
- Know what pests to look for, life cycles, identification
  - Use printed and online references
  - Details differ for outdoor versus high-tunnel production
- Scout regularly
- Spray only when needed ... use labeled and effective insecticides
- Calibrate sprayers
- Follow label directions to protect bees, applicators, and consumers

Common pests of tomatoes

- Cutworms
- Flea beetles
- Colorado potato beetle
- Thrips
- Tomato hornworm
- European corn borer
- Corn earworm
- Cabbage Looper, etc.
- Strik bugs
- Tomato pinworm
- Aphids
- Mites
- Whiteflies

Clemson University’s Tomato Insect Pests …
- http://www.clemson.edu/extension/hgic/pests/plant_pests/veg_fruit/hgic2218.html
- http://www2.ca.uky.edu/agcomm/pubs/id/id172/id172.pdf

Early season cutworms

- Black cutworm (migrates from south each spring), variegated cutworm, others
- Feed mostly at night
- Cut plants at ground level (just as in corn)
- More common in the southern part of the Midwest

Black cutworm management

- Till / remove weeds well in advance of planting tomatoes
- Use plastic mulch versus bare ground
- Scout every 5-7 days!
- Threshold = 1 larva per 100 plants (fully grown larvae will not cut many more plants)
- Insecticides: Pyrethroids such as Brigade, Warrior, Baythroid, Mustang Max, Pounce, Asana (as well as others)

Flea beetles (rarely significant in tomatoes)

- Potato flea beetle, palestriped flea beetle, others
- Adults overwinter and move to tomatoes, peppers, potatoes, and related plants
- Threshold = 30 percent defoliation or > 4 beetles per plant when seedlings are < 4 inches tall
- See the Midwest Vegetable Production Guide for effective insecticides (including pyrethroids listed for cutworms)
Colorado potato beetle

- Adults overwinter, move to fields and lay eggs April - June; second generation in midsummer
- Adults and larvae feed on foliage of plants in the nightshade family

Colorado potato beetle management

- Rotate crops !!!
  - Don’t plant next to last year’s infested nightshade crops - tomatoes, potatoes, peppers, and eggplants
  - Trenching, straw mulching, trap crops (potatoes), and flaming are alternatives
  - Scout every 5-7 days!
  - Threshold = 1 adult, larva, or egg mass per plant
  - Insecticides: Pyrethroids (Asana, Baythroid, Brigade, Danitol, Mustang Max, Warrior, and others), Assail, Admire, Actara, Agri-Mek, Radiant, Entrust, Surround … resistance to many insecticides is common but not universal

European corn borer

- Mature larvae overwinter.
- Moths fly / lay eggs in June and August (timing varies by location and year)
- Larvae tunnel into fruits … peppers more than tomatoes
- Overall population densities are low from Bt corn, but fruiting tomatoes can be attractive to moths in late summer

European corn borer management

- Monitor during fruiting.
  - Use cone-shaped Heliothis traps, baited with Iowa (Z-strain) ECB pheromone lures placed in tall weeds near field edges. (Light traps with UV bulbs are better but impractical for most growers.)
  - Scout every 5-7 days for egg masses and stem boring! (And for fruit injury … too late, but …)
  - Initiate insecticide applications when egg masses (or fruit injury) are observed OR one week after trap captures >7 moths per week and nearby corn is NOT silking.
- Insecticides: Pyrethroids (Baythroid, Brigade, Danitol, Mustang Max, Warrior, and others, but NOT Asana), Assail, Coragen, Exirel, Entrust, Radiant

Thrips on tomatoes

- Image of thrips on tomatoes

Thrips management

- Don’t grow bedding plants in tunnels or greenhouses ahead of tomatoes
- Scout every 5-7 days! More common in greenhouses and high tunnels.
- See http://edis.ifas.ufl.edu/in169
- Insecticides … Pyrethroids (including Baythroid, Brigade, Danitol, Warrior … see labels and Florida link above), Radiant, Assail, Entrust, neem products (Azatin, Aza-Direct, etc.)
**Tomato hornworm**

- Pupae overwinter, adults fly in late spring and early summer
- One generation per year
- Scout every 5-7 days!
- Threshold = 0.5 - 1 larva per plant (but don’t wait to find that one when it’s 3 1/2 inches long)
- Parasites often limit populations
- Insecticides: Pyrethroids, Coragen, Radiant, Entrust, Sevin, or Bt products (Agree, Biobit, Dipel, Javelin, Cutlass, etc.)

**Tomato fruitworm**

= corn earworm
= *Helicoverpa* [Heliothis] zea
- Larvae feed on the fruits of many crops, including corn, peppers, tomatoes, and green beans

**Tomato fruitworm injury to tomatoes**

- Pupae overwinter in some areas, but populations result mainly from migration of adults from the south on weather fronts
- Traps indicate their presence and relative density. See the Sweet Corn section of the Midwest Vegetable Production Guide for suppliers.
- Threshold = 5 - 10 moths per trap per night (more if nearby corn is silking)

**Tomato fruitworm**

- Insecticides
  - Pyrethroids (Asana, Baythroid, Brigade, Danitol, Mustang Max, permethrin, and Warrior)
  - Sevin XLR Plus
  - Coragen, Entrust, or Avaunt
  - Bt products (Agree, Biobit, Dipel, Javelin, Cutlass, etc.)
Cabbage looper and variegated cutworm

- Treat if 2 to 3 percent of plants have fruit that shows feeding damage
- Same insecticides as listed for tomato fruitworm

Stink bugs

- Brown stink bug and green stink bug feed on tomatoes and many other crops. They may show up in high numbers as other hosts (including soybeans) dry down or are harvested.
- Stink bugs “hide” when disturbed
- Shaking plants can help to dislodge them so you can detect them
- Detecting early damage is often key to knowing control is necessary

Stink bugs

- Scout every 5-7 days for stink bugs and fruit damage.
- White to yellow, corky, pithy areas develop beneath the skin where stink bugs inserted their beaks to feed.
- Stink bugs are not easily controlled
- Insecticides: Baythroid, Belay, Brigade, Danitol, Warrior, and Mustang-Max are among the most effective choices. See the neonics listed for BMSB control. All are toxic to bees.

Brown marmorated stink bug

- *Halyomorpha halys*
- Introduced (NOT intentionally) from Asia, first detected in Allentown, PA, in 1998
- Now established in several locations in IL
- Overwinters as an adult, aggregates in large numbers in homes and other shelters
- Expect 2 generations per year
BMSB and other stink bug control

- Insecticides generally recommended against stink bugs:
  - Belay, clothianidin, a neonicotinoid highly toxic to bees
  - Brigade, bifenthrin, a pyrethroid highly toxic to bees
  - Venom, dinofuran, a neonicotinoid highly toxic to bees
  - Also
    - Actara, thiamethoxam, a neonicotinoid highly toxic to bees
    - Lannate, a carbamate, highly toxic to bees and humans
    - Endigo, a mixture of Actara and Warrior (a pyrethroid), highly toxic to bees
    - Leverage, a mixture of imidacloprid (Admire) and cyfluthrin (Baythroid) (neonicotinoid and pyrethroid, highly toxic to bees)

Tomato pinworm

Tomato pinworms overwinter in greenhouses or high tunnels or come in on shipped transplants. 4-5 generations may develop each year. Young larvae tunnel into leaves and feed in leaf mines. Older larvae fold leaves, and live and feed within the fold. Older larvae also tunnel into fruit. Mature larvae drop to the soil on a silk thread, spin a loosely woven pupal cell mixed with soil particles, and pupate at or near the soil surface. Moths fly at night, with most mating occurring just after sunset.

Tomato pinworm monitoring and control

- Inspect transplants or young plants for mines, folded leaves, webbing, or frass deposits at leaf mines. Look under the calyx near fruit stems for tunnel entrance. Look for mine blotches under the fruit skin.
- Pheromones/traps are available.
- Disc / destroy crop residues immediately after harvest completion. Crop rotation is of minimal value and would need to include the removal of solanaceous weeds.
- Check transplants for evidence of pinworm larvae and avoid infested plants.
- Effective insecticides include Avaunt, Agri-Mek, Coragen, Intrepid, Lannate, Proclaim, and several pyrethroids (see labels). Coragen and Proclaim are less likely to kill natural enemies.

Aphids

- Pink form of potato aphid is most common; also green peach aphid
- Threshold = 25 - 50 percent of plants with colonies
- Actara, Admire Pro, Assail, Belay, Beleaf, Dimethoate, Fulfill, Lannate, Malathion, M-Pede, others

Spider mites

- In the heat of summer, in dry weather … and in high tunnels
- Appear first along field edges
- Overhead irrigation reduces numbers … but is a bad idea for other reasons
- Acramite, Agri-Mek, M-Pede, Nealta, Oberon, Portal, Zeal

For broad mite / russet mite control ...
- Agri-Mek, M-Pede, Oberon, wettable sulfur, Portal, Pylon (greenhouse only), Zeal. See http://extension.psu.edu/plants/vegetable-fruit/news/2015/broad-mites-in-fruiting-vegetables
**Whiteflies**
- Late-season pests in the southern portion of the state ... and in the fall in high tunnels
- Actara, Assail, Provado, Endosulfan, Movento, Fulfill, Knack
- M-Pede, Align or Neemix (neem)

**Some useful references**
- 2017 Midwest Vegetable Production Guide
  - Production and pest management information; updated annually; especially useful for listings of insecticides, fungicides, and herbicides
  - [http://www.btny.purdue.edu/pubs/id/id56/](http://www.btny.purdue.edu/pubs/id/id56/)
- Illinois Fruit and Vegetable News
  - [http://ipm.illinois.edu/ifvn/](http://ipm.illinois.edu/ifvn/)
- Purdue's Vegetable Crops Hotline
  - [https://vegcropshotline.org/](https://vegcropshotline.org/)
- Vegetable Insect Management: With Emphasis on the Midwest. Foster and Flood, eds.
- Garden Insects of North America, by Whitney Cranshaw
  - ISBN: 9780691095615

**Resources**
- Wire trap from:
  - Kevin Poppe, 309-365-3651, email kpdpope99@hotmail.com.
- Lures - Hercon zealures and other traps and lures from:
  - Great Lakes IPM, 10220 Church Road, Vestaburg, MI 48891-9746. Ph 989-268-5693. [www.greatlakesipm.com](http://www.greatlakesipm.com)

**Insects especially troublesome in high tunnels**
- Certain “Leps”
- Aphids
- Whiteflies
- Twospotted spider mite
- Western flower thrips
- Spotted wing Drosophila (and tomato pinworm)

**“Lep” larvae**
Species most likely to continue to cause problems well into fall are those that do **not** consistently diapause (enter dormancy) according to day length in late summer ... corn earworm (= tomato fruitworm), cabbage looper, and diamondback moth, for example. European corn borer and tomato hornworm do **not** persist into mid- or late fall in tunnels or greenhouses.

- Tomato fruitworm (= corn earworm)
- Cabbage looper and other “Lep” larvae persist on crucifers, leafy greens, and tomatoes
“Lep” larvae … control

- All crops: Bt products, including Agree, Biobit, Dipel, Javelin, Lepinox, and Kentari (0), and Entrust (1) ... best against early stage larvae. Bt must be eaten to be toxic. All OMRI-approved.
- Tomatoes and peppers
  - Baythroid (0 tomatoes, 7 peppers), Brigade (1), Coragen (1), Hero (1), Intrepid (1), Mustang Max (1), Pounce (3), Sevin XLR-Plus (3), Warrior (3)
- Salad greens
  - Baythroid (0), Hero (7), Intrepid (1), Mustang Max (1), Pounce (1), Proclaim (7), Radiant (1), Warrior (1, lettuce only)

(Numbers in parentheses indicate required preharvest interval. See the current Midwest Vegetable Production Guide, Midwest Small Fruit and Grape Spray Guide, and product labels for more information.)

Additionally, screening the roll-up or roll-down openings for side walls and all doors / end openings and vents can exclude most adult moths.

Aphids … green peach aphid, cabbage aphid, turnip aphid, others

- -1/16-1/8 inch long
- Winged or wingless
- Pear-shaped bodies
- Cornicles ("tailpipes") often present
- Variable colors
- Species identification difficult
- Adult females give birth to live young
- Susceptible to many predators, parasites, and pathogens

Aphid control

Avoid unnecessary applications of pyrethrins, pyrethroids, Sevin, and other insecticides that kill natural enemies

- All crops: Insecticidal soaps, including M-Pede (0), horticultural oils, and neem products including Neemix (0) ... start early. OMRI-approved products are available.
- Tomatoes and peppers
  - Actara (0), Admire (21 soil, 0 foliar), Assail (7), Fulfill (0), Malathion (1 for tomatoes, 3 for peppers), Movento (1), Orthene (1, peppers only), Voliam Flexi (1)
- Salad greens
  - Actara (7), Admire (21 soil, 7 foliar), Assail (7), Fulfill (7), Movento (7), Voliam Flexi (7)
- Herbs
  - Admire Pro (14 soil, 7 foliar)

Numbers in parentheses indicate required preharvest interval. See the Midwest Vegetable Production Guide and product labels for more information.

Biological control suppliers sell parasitic wasps for various aphid species.

Twospotted spider mite

- 1/50th inch long
- 8 legs as adults ... not insects
- Dark blisters on both sides of abdomen
- Round, translucent eggs
- Symptoms = mottling or russetting of leaves, along with webbing
- Primary natural enemies are predaceous mites

Twospotted spider mite

- Populations build rapidly in the absence of rain ... hence common problems in greenhouses and high tunnels. They also persist year-around in heated greenhouses (and even in high tunnels).
- Heavily infested leaves brown and drop ... yields and quality decline as a result.
- Tomatoes, peppers, cucumbers, strawberries, and brambles are common hosts in high tunnels.
- Frequent use of Sevin or pyrethroids kills natural enemies and may trigger outbreaks

Scouting for twospotted spider mite

- Use a 10-X hand lens and examine the undersides of leaves.
- Examine leaves from all areas in the high tunnel or greenhouse; infestations MAY start near open sidewalls.
- Thresholds ... not well established. Use an average of 1-2 mites per leaflet or treat areas where infestations are greatest.
Miticides for twospotted spider mite

- All crops: Insecticidal soaps or horticultural oils ... start early.
- OMRI-approved products are available.
- Tomatoes and peppers:
  - Acramite (3), Agri-mek (7), Oberon (7), Portal (1)
- Cucumbers:
  - Acramite (3), Agri-mek (7), Danitol (7), Oberon (7)
- Brambles:
  - Acramite (1), Danitol (3), Savey (3), Zeal (0)
- Strawberries:
  - Acramite (1), Agri-mek (3), Danitol (2), Kanemite (1), Oberon (3), Fujimite (1), Savey (3), and Zeal (1)
(Numbers in parentheses indicate required preharvest interval. See the Midwest Vegetable Production Guide and the Midwest Small Fruit Spray Guide and product labels for more information.)

Biological control suppliers sell predaceous mites to suppress twospotted spider mite infestations.

Whiteflies ... greenhouse whitefly, silverleaf whitefly, others

- Mostly late season on tomatoes, peppers, cucumbers, some herbs; persist year round in heated greenhouses
- Adults lay eggs in circular pattern
- Immatures settle and become immobile. A "pseudopupal" stage allows transition to adults
- Waxy covered white wings are held tent-like over the body
- Greenhouse whitefly is parasitized by Encarsia formosa

Biological control suppliers sell parasitic wasps to suppress whitefly infestations.

Whitefly control

- Yellow sticky traps for monitoring ... many more traps for direct control
- All crops: All crops; insecticidal soaps, including M-Pede (0), horticultural oils, neem products including Neemix (0), and Encarsia formosa for biological control ... start early
- Tomatoes and peppers
  - Actara (0), Admire (21 soil, 0 foliar), Assail (7), Brigade (1, tomato only), Danitol (3, tomato only), Fulfill (0), Knack (14), Movento (1), Oberon (7), Voliam Flexi (1)
(Numbers in parentheses indicate required preharvest interval. See the Midwest Vegetable Production Guide and product labels for more information.) Populations vary in susceptibility to pyrethroids such as Brigade and Danitol.

Biological control suppliers sell parasitic wasps to suppress whitefly infestations.

Western flower thrips on tomato

- Don’t grow bedding plants in tunnels or greenhouses ahead of tomatoes
- Insecticides ... Radiant, Assail, Entrust
- Thrips-proof screening for exclusion; predaceous mites and predaceous thrips for biological control

Biological control suppliers sell parasitic mites to suppress thrips infestations.

Spotted wing Drosophila

- Native to East Asia, where it is a pest on fruit.
- Detected in CA in 2008, OR, WA, BC, FL in 2009, UT, SC, NC, MI, WI in 2010
- Widespread in IL surveys since 2012 ... damage primarily to fall raspberries ... outdoors and in high tunnels

Fruit affected by SWD

Highest risk
Strawberries
Raspberries
Cherries
Nectarines
Blueberries
Blackberries

Moderate risk
Peaches
Grapes
Pears
Apples

Alternate hosts
Wild plants with berries, such as:
Snowberry
Elderberry
Pokeweed
Dogwood

Snowberry
Elderberry
Pokeweed
Dogwood
Monitoring SWD

- Plastic cup with side holes
- Commercial lures plus “drowning solution” or apple cider vinegar bait or yeast-plus-sugar-water bait
- Add a small yellow sticky trap to capture flies. Or, use only the bait with a drop of unscented soap.
- Hang in fruit canopy near fruit and in the shade
- Change bait weekly, and dispose away from trap.
- Best detection potential expected as fruit ripens.
- Check weekly, and record catches.

Less than $1/trap for materials and construction.

See: [http://www.ipm.msu.edu/invasive_species/spotted_wing_drosophila](http://www.ipm.msu.edu/invasive_species/spotted_wing_drosophila)

Insecticide characteristics

- OMRI-approved
  - Bt products (Agros, Biodin, Dipel, Javelin, Lepineo, and Xintari) are effective against Lepidopteran larvae if they eat spray residue.
  - Entrust ... primarily effective against Lepidopteran larvae, also against a few other pests including thrips and SWD
  - Neem products (Neemix, Azatin, others) ... primarily effective against aphids, whiteflies
  - Insecticidal soaps (M-Pede) and horticultural oils... primarily effective against mites, aphids, whiteflies
  - Pyrethrin (Peganic) ... primarily effective against beetles (some other pests)

With the exception of Entrust, these insecticides provide very short residual control. Soaps and oils are effective only if they contact the target insects while the spray is still wet.

Insecticide characteristics

- Pyrethroids
  - Asana, Baythroid, Brigade, Danitol, Hero, Mustang Max, Pounce, Warrior, Vialam Flexi (partially), and Vialam Aroxip (partially) and many generic versions of the same active ingredients
  - Effective against a range of Lepidopteran larvae and beetles, sometimes against whiteflies, generally not effective against aphids or mites
  - Toxic to a wide range of natural enemies

- Organophosphates
  - Diazinon, Dimethoate, Malathion, Orthene
  - A range of target pests but most often used in certain fruits and vegetables for aphid control

- Carbamates
  - Sevin, Lannate
  - Sevin is often used for beetle control, Lannate against a range of pests including aphids. Lannate’s high toxicity to mammals makes it unsuitable for use in greenhouses and high tunnels.

Insecticide characteristics

- Neonicotinoids
  - Admire, Actara, and Platinum are very systemic, used primarily against aphids ... very toxic to bees
  - Assail is used against aphids, Lepidopteran larvae, and certain beetles

- Alternative Chemistries
  - Avaunt, Coragen, Delegate/Radiant, Entrust, Fufill, Noventis, Knack, and others ... more selective (killing a narrower range of insects and fewer natural enemies) and present fewer risks to applicators

- Miticides
  - Acramite, Agri-mek, Danitol, Fujimite, Kanemite, Oberon, Savey, and Zeal

Common natural enemies

- Ground beetles
- Green lacewings
- Lady beetles
- Parasitic wasps
- Predaceous mites
Biological control opportunities

- **Conservation**
  - Recognize beneficial species, don’t overuse insecticides, apply selective insecticides when effective, maintain stable habitats, provide alternate foods (pollen, nectar)

- **Augmentation**
  - Lepidopteran larvae ...
  - Aphids ...
  - Thrips ...
  - Whitefly ...
  - Spotted wing Drosophila ...
  - Neoseiulus neosolitarius
  - Leptothrips mali
  - Aphelinus sp.

Screening and row covers for exclusion

- To exclude moths
- To exclude thrips, aphids, and spotted wing Drosophila
- Suppliers include Hummert’s and Growers Supply (FarmTek)
- Comparison of Greenhouse Screening Materials for Excluding Whitefly (Homoptera: Aleyrodidae) and Thrips (Thysanoptera: Thripidae). Michelle L. Bell, a, b and James R. Baker a http://www.ecaa.ntu.edu.tw/weifang/Hort/screens/i0022-0493-093-03-0800.pdf

Suppliers for biological control organisms include

- **Koppert Biological Systems, Inc. - USA**
  - 28465 Beverly Road, Romulus, MI 48174. Tel: +1 800 928 8827; fax: +1 734 641 3799. Email: asktheexpert (at) http://www.koppertonline.com. Web: www.koppert.com

- **Biobest**
  - International Technology Services, Richard Gerhart, Wayzata, MN 55391. Tel.: +1 877 505 9701; Fax: +1 303 592 5747. e-mail: rcg@intertechserv.com; website: www.beesandbugs.com

- **MGS Horticultural Inc.**
  - 50 Hazelton Street, Leamington, On N8H 3W1. Phone: +1 519 326 9037; Fax: +1 519 326 5861 e-mail: info@mgshort.com; website: www.mgshort.com

Supplier for monitoring equipment, sticky traps, hand lenses, etc.

- **Great Lakes Ipm, Inc.**
  - 10220 Church Rd Ne
  - Vestaburg MI 48891
  - 989-268-5693; 989-268-5911; 800-235-0285
  - Fax: 989-268-5311
  - http://www.greatlakesipm.com/

References on insect pest management in high tunnels

- **Midwest Vegetable Production Guide**
  - http://www.btny.purdue.edu/pubs/id/id-56/

- **High Tunnel Integrated Pest Management: Insects and Mites**