Tomato & Pepper Insects

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Insect Management

• Pests commonly found in high tunnels & field

• Understanding use of control products

• Integrated pest management strategies

• Scouting for pests
Common Insects

- Catepillars
- Aphids
- Flea Beetles
- Spider Mites
- Whiteflies

Stinkbugs
Colorado potato beetle
Fungus gnats (HT)
Thrips
SWD?
Caterpillars

Evidence and damage:

- frass excrement
- pupae
- larvae
- feeding holes in leaves
Tobacco & Tomato Hornworms

• Well-known
• Only occasionally require special control
• Abundant some years
• Slender “horn”
  – Red = tobacco
  – Black = tomato
  – Harmless !!
Tobacco & Tomato Hornworms

• Both species feed on tomato, tobacco, eggplant, pepper, potato
• Feed on foliage and fruit
Adult Hornworm

Wingspan of 4-5 inches
Tomato Hornworm

July – September

Threshold
1/2 Larvae per Plant

Management
Spot Spray When Needed
Tomato Fruit Worm
Tomato Fruit Worm Damage
Tomato Fruitworm
AKA Corn Earworm

July - September

Threshold

7 Moths/Trap and Fruit Present
Cutworms

Variegated cutworm damage on tomato
[ Picture by Purdue University ]
Cutworms

Black Cutworm    May-June
Variegated Cutworm    May-August

Threshold
One per plant
Management of Cutworms

Winter annuals and cover crops need to be removed two weeks prior to planting.

Plastic mulch can reduce problems.
Stink Bug
Stink Bug

July - September

Management

Check Field Edges

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Extension and Outreach
Brown Marmorated Stink Bug
Aphids
Aphids

- Several species which are not easy to ID
- Many hosts
- Prolific reproducers
Cultural Control of Aphids

• High levels of nitrogen fertilizer favor aphid reproduction

Never use more nitrogen than necessary

Apply it in small portions throughout the season rather than all at once
Management

Conserve natural enemies

Many crops especially pepper
Flea Beetles

May – June

Thresholds

< 6” 4/plant
> 6” 8/plant
Flea Beetle Damage on Foliage
Management of Flea Beetle

- Overwintering generation most damaging
- Monitor field edges
- Spot spray as necessary
Colorado Potato Beetle

May-July

Threshold

One Beetle/Larvae/Egg Mass per Plant
Management of Colorado Potato Beetle

Rotate Crops

Scout Field Edges

Bt is an Option for Small Larvae
Fungus Gnats

• Diptera: Sciaridae

• Damage
  – Larvae feed on young roots
  – Adults are a nuisance
Fungus gnats

• Complete life cycle

• Adults
  – 1/8 inch long
  – Dark, long slender body
  – Long legs and antennae
  – 2 wings
  – Distinctive Y-shaped vein in end of wing
Fungus Gnats

• Long legs and antennae

http://mrec.ifas.ufl.edu
Fungus Gnats

- Eggs
  - Laid in damp areas
  - Cracks and crevices of media surface
  - Near fungal food source
  - Up to 150 eggs per female
Fungus Gnats

• Larvae
  – up to 1/4 inch
  – legless maggots
  – thread-like
  – white to translucent
  – shiny black head
  – Pupate in the media
Fungus Gnats

Continuous, overlapping generations

3 to 4 weeks at warm temperatures
Fungus Gnats

• Monitoring
  – Adults: Yellow sticky cards
  – Larvae: Inspection
Fungus Gnats

- **Management**
  - Nematodes
  - *Bacillus thuringiensis israelensis*
    - *Bt-i* (Gnatrol)
  - Predatory mite
    - Feeds on fungus gnat larvae
  - Rove beetle

[Link to website](www.biowise-biocontrol.co.uk)
Fungus Gnats

• Management
  – Larval Control
    • Insect Growth Regulators
    • Neonicitinoids
  – Adults
    • Pyrethroids
Spider Mites

• Two spotted spider mite
  – 1/50 inch, oval
  – Yellow-orange to green
  – Dark patches along sides
  – Prefer dry areas
    • low humidity
  – Egg, larva, nymph, adult
  – 7 to 20 days
  – May be inactive in winter

http://pnwpest.org
Two Spotted Spider Mite Damage
Thrips Damage on Fruit
Spider Mites

• Damage
  – Stippling or flecking
  – Fine webbing

• Control
  – Remove weeds and old plants
  – Predatory mites
  – Miticides
  – Avoid broad-spectrum insecticides
  – Resistance management (class rotation)

http://www.hort.uconn.edu
Thrips
Western Flower Thrips

• Damage
  – Scarring and distortion of flowers and foliage
  – Virus transmission
    • TSWV
    • INSV

www.hort.uconn.edu

www.ppdl.purdue.edu
Thrips Damage on Fruit
Thrips Damage on Leaves
Tomato Spotted Wilt Virus
Western Flower Thrips

- rapid life cycle
- high reproductive capacity
- broad host range
- resistant to insecticides
- virus vector
- feeding habit
  - 1/8 inch
  - yellowish
Thrips Life Cycle

<table>
<thead>
<tr>
<th>Stage</th>
<th>Duration (68° - 98° F)</th>
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<tbody>
<tr>
<td>Egg</td>
<td>2 - 4 days</td>
</tr>
<tr>
<td>1st instar</td>
<td>1 - 2 days</td>
</tr>
<tr>
<td>2nd instar</td>
<td>2 - 4 days</td>
</tr>
<tr>
<td>Pre-pupal</td>
<td>1 - 2 day</td>
</tr>
<tr>
<td>Pupal</td>
<td>1 - 3 days</td>
</tr>
<tr>
<td>Adult</td>
<td>300 eggs / ♀</td>
</tr>
<tr>
<td></td>
<td>30 - 45 days</td>
</tr>
</tbody>
</table>
Thrips

• Monitoring
  – Sticky cards
  – Look under leaves

• Control
  – Weed and carry-over plant control
  – Fallow greenhouse
  – Micro-screening
  – Entomopathogenic nematodes
  – Predatory mites
  – Insecticides / small droplets
Whiteflies

1/16\textsuperscript{th} inch, powdery white

- Sweet potato or silverleaf whitefly
  Yellowish white; wings tight against body; broad host range.

- Greenhouse whitefly
  Bright white; wings loose against body

Whitefly Knowledgebase http://whiteflies.ifas.ufl.edu/
Whitefly
Whiteflies

Hot, dry weather during the summer can favor rapid buildup of the silverleaf whitefly on wild and cultivated hosts outside and crops inside the high tunnel.
Silverleaf Whitefly life cycle

- **Egg**: 9 – 16 days
- **Nymphs (Crawlers)**: 8 – 12 days
- **4th instar (pupa)**: 4 – 6 days
- **Total (days)**: Summer: 18 - 28 days
- **Adult**: 9 – 16 days

**Total (days)**: Summer: 18 - 28 days
Whiteflies

• **Damage**
  – Nymphs (undersides of leaves)
  – Stunting
  – Honey dew / sooty mold

• **Control**
  – Weed & carry-over control
  – Parasitic wasps
  – Insect growth regulators
    • Repeated applications
Spotted Wing Drosophila

1/8th Inch long
Spotted Wing Drosophila

1/8th inch
Cultural Control of Spotted Wing Drosophia

Maintain good sanitation

• Pick all fruit when harvesting
• Remove and destroy any fallen, damaged and overripe fruit.
Tunnel production is neither field nor greenhouse.

- No rain
  - Favors thrips and mites
- Passive ventilation
  - Some field pests will enter the structure
Pesticide Label Laws

High Tunnel = Greenhouse?

“... the EPA says that as long as the pesticide is labeled for the plant/crop & pest to control ... that's all that is required for use in a high tunnel.”

Avoid products that prohibit greenhouse use
<table>
<thead>
<tr>
<th>Labeled for</th>
<th>Label Prohibits Greenhouse Use</th>
<th>Label Silent on Greenhouse Use</th>
</tr>
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<tbody>
<tr>
<td><strong>Botran®</strong></td>
<td>Cabrio®</td>
<td>Acrobat®</td>
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<tr>
<td><strong>Champ®</strong></td>
<td>chlorothalonil2</td>
<td>Actigard®</td>
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<tr>
<td><strong>Contans®</strong></td>
<td>Endura®</td>
<td>Agri-Fos®</td>
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<tr>
<td><strong>Cuprofix®</strong></td>
<td>Flint®</td>
<td>Agri-mycin®</td>
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<td><strong>Dithane®</strong></td>
<td>Forum®</td>
<td>Aliette®</td>
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<td><strong>Fontelis®</strong></td>
<td>Merivon®</td>
<td>Curzate®</td>
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<tr>
<td><strong>Kocide 2000®</strong></td>
<td>Presidio®</td>
<td>Gavel®</td>
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<tr>
<td><strong>Kocide 3000®</strong></td>
<td>Priaxor®</td>
<td>Gem®</td>
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<tr>
<td><strong>Luna Privilege®</strong></td>
<td>Pristine®</td>
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<tr>
<td><strong>Previcur Flex®</strong></td>
<td>Quadris®</td>
<td>Inspire Super®</td>
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<tr>
<td><strong>Procure®</strong></td>
<td>Quadris Opti®</td>
<td>Kocide 20/20®</td>
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<tr>
<td><strong>Procure 480SC®</strong></td>
<td>Quilt®</td>
<td>Luna Experience®</td>
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<tr>
<td><strong>Ranman®</strong></td>
<td>Reason®</td>
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<td><strong>Scala®</strong></td>
<td>Ridomil®</td>
<td>Luna Tranquility®</td>
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<tr>
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<td>Satori®</td>
<td>Manzate®</td>
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<td>Quadris Top®6</td>
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<td>Torino®</td>
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<tr>
<td><strong>Terrachlor®</strong></td>
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<td>Ziram®</td>
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</table>
Considerations before using control measures in a high tunnel

- Spot treatment may be adequate for “hot-spots”
- High temperature in tunnel – phytotoxicity
- Structural damage due to drift

Use alternatives:
cultural control, natural enemy conservation, biological control, etc.
Insect Control Products

Select materials that are least toxic to humans, beneficial insects, including pollinators
Insect Control Products

“soft pesticides”

Examples:

• Insecticidal soaps
• Horticultural oils
• Botanical pesticides
• *Bacillus thuringiensis* (Bt)
Insecticidal Soaps

- Effective on soft-bodied insect pests
- Low toxicity to humans, pets, and many beneficial insects
- Work only on direct contact with the pests
  - No residual activity
  - Not a preventative spray
- Repeated applications needed at relatively short intervals to control spider mites
Insecticidal Soaps

• Have little efficacy against insect eggs

• Control decreases if hard-water sources are used

• Phytotoxicity – do not apply if temperature is above 90° or plant is in full sun
  - apply in early morning
Insecticidal Soaps

trade names

• M-Pede®

• Safer® Brand Fruit & Vegetable Insect Killer II

• Des-Ex™ (CertisUSA)

• Natural Guard® Insecticidal Soap
Neem-derived insecticides

contains azadirachtin (trade names):

Azatin®
Bioneem®
Margosan-O®
Neemazad®
Aza-Direct®
AzaSol®
Neemix®

Contains Neem oil:

Trilogy®
Integrated Pest Management

- Integration of techniques
- Scouting
- Pest life cycle & behavior
Integrated Pest Management

- Scouting
  - Regular
  - Frequent
  - Thorough
- Sticky Traps
- Visual Inspection
- Hand lens
- Record keeping

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Proper Identification

http://paipm.cas.psu.edu/ghmanual.html
Sticky Traps

- Place near side vents, doors and other areas where pests may enter
- Consider traps outside to help detect insects that might move in
- Use at least 4-5 traps/acre
- More to monitor whiteflies (1 trap per 1,000 sq ft)
Sticky Traps

• Monitor winged aphids, leafminers, thrips, whiteflies, fungus gnats and shore flies.

• Place horizontally for fungus gnats
• Place just above the growing medium surface for fungus gnats, thrips and leafminers
Sticky Traps

• Inspect traps at least weekly
• Record trap locations and insect infestations
• Consider hot-pink and blue traps for detecting western flower thrips

www.biocontrol.ucr.edu/WFT.html
Other Insect Pests

• Leafminers
• Wireworm
• Fruit Flies
• Psyllid
• Leafhoppers

Mealybugs
Pinworms
Stalk Borers
Slugs
Iowa State University Extension & Outreach
Plant and Insect Diagnostic Clinic

http://www.ent.iastate.edu/pidc/

(515)294-0581

sickplant@iastate.edu
Plant Diagnostic Clinics

**Missouri**
- Plant Diagnostic Clinic
  - 28 Mumford Hall
  - Columbia, MO 65211
  - (573) 882-3019
  - plantclinic.missouri.edu
- Contact:
  - Patti Wallace (573) 882-3019
    wallacepk@missouri.edu
- Plant Nematology Lab
  - 23 Mumford Hall
  - University of Missouri
  - Columbia, MO 65211
  - (573) 884-9118
  - Fax: (573) 882-0588
  - soilplantlab.missouri.edu/nematode
- Contact:
  - John Dempsher
    DempsherJ@missouri.edu

**Kansas**
- Plant Disease Diagnostic Lab
  - Extension Plant Pathology
  - 4032 Throckmorton Hall
  - Kansas State University
  - Manhattan, KS 66506-5504
  - (785) 532-5810
  - Fax: (785) 532-5692
  - www.plantpath.ksu.edu/p.aspx?tabid=49
- Contact:
  - Judith O’Mara
    jomara@ksu.edu

**Iowa**
- Iowa State University Plant and Insect Diagnostic Clinic
  - 327 Bessey Hall
  - Iowa State University
  - Ames, IA 50011
  - (515) 294-0581
  - Fax: (515) 294-9420
  - www.plantpath.iastate.edu/pdc
- Contact:
  - Laura Jesse
    ljesse@iastate.edu
**Chemistry:**
Name: Azadirachtin A and B
Common Name: Aza-Direct
Class of Chemistry: Tetranortriterpenoids
Formulation: Emulsifiable Concentrate
Empirical Formula: Azadirachtin A $C_{35}H_{44}O_{16}$
Azadirachtin B $C_{33}H_{42}O_{16}$
CAS Number: N/A
Mode of Action: Insect growth regulator inhibiting molting and development of immature insects. Controls target pests on contact or by ingestion. Safe to beneficials including bees.

**Application Considerations:**
- Spray when UV and heat exposure is low (early morning preferred)
- Use multiple applications to enhance insect control
- Shortened spray intervals – spray more often rather than increase rate
- Tank mix flexibility
- Can be applied up to day of harvest
- Adjust the spray mixture pH between 5.5 and 7 for optimal performance

**Application Methods:**
- Chemigation use allowed.
- Good spray coverage is critical. Rainfast in 3 hours.

**Good Agricultural Practices:**
- Compatible with many commonly used pesticides, however a compatibility test is recommended before using in a tank mix with other pesticides as alkaline products may cause problems
- For best results, apply at first sign of insect activity when immature stages are most susceptible
<table>
<thead>
<tr>
<th>Key Pests Controlled with AZA-DIRECT®¹</th>
<th>Caterpillars</th>
</tr>
</thead>
<tbody>
<tr>
<td>And Others</td>
<td>Aphids</td>
</tr>
<tr>
<td>Mealybug (<em>Pseudococcidae</em>)</td>
<td>Caterpillars</td>
</tr>
<tr>
<td>Midge</td>
<td>Armyworm</td>
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<tr>
<td>Psyllids</td>
<td>Cutworm</td>
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<tr>
<td>Scale Insects (<em>Coccidae</em>)</td>
<td>Leafroller</td>
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<tr>
<td>Thrips (<em>Thysanoptera</em>)</td>
<td>Looper</td>
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<tr>
<td>Weevils</td>
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<tr>
<td>Flies</td>
<td>True bugs</td>
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<tr>
<td>Fungus Gnat (<em>Bradyisia spp.</em>)</td>
<td>Lygus (<em>Lygus hesperus</em>)</td>
</tr>
<tr>
<td>Leafminer (<em>Liriomyza spp.</em>)</td>
<td>Stink Bugs</td>
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<tr>
<td>Walnut Husk Fly (<em>Rhagoletis completa</em>)</td>
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<tr>
<td>Aphids</td>
<td>Borers</td>
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<tr>
<td>Pea Aphid (<em>Acrithosiphon pismum</em>)</td>
<td>Peach Twig Borer (<em>Anarsia lineatella</em>)</td>
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<tr>
<td>Rosy Apple Aphid</td>
<td>Peachtree Borers</td>
</tr>
<tr>
<td>Japanese Beetle (<em>Popillia japonica</em>)</td>
<td></td>
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</tbody>
</table>

¹Consult Aza-Direct® label or contact us for specific pest information.

<table>
<thead>
<tr>
<th>Uses for AZA-DIRECT®²</th>
<th>Vegetables</th>
<th>Tree Fruit and Nuts</th>
<th>Perennial and Annuals</th>
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<tbody>
<tr>
<td>Bulb Vegetables</td>
<td>Citrus</td>
<td>Cereal grain</td>
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<tr>
<td>Cole Crops</td>
<td>Nuts</td>
<td>Cotton</td>
<td></td>
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<tr>
<td>Cucurbits</td>
<td>Pome Fruit</td>
<td>Herbs</td>
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</tr>
<tr>
<td>Fruiting Vegetables</td>
<td>Stone Fruit</td>
<td>Tobacco</td>
<td></td>
</tr>
<tr>
<td>Leafy and Brassica Vegetables</td>
<td>Tropical Fruit</td>
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