Insect Pests in Greenhouse and Nursery Crops

Diane Alston
Utah State University Extension
Utah Green Conference
January 22, 2007
Topics

- Integrated Pest Management Techniques
- **Greenhouse/Interiorscape Pests**
  - Whiteflies
  - Thrips
  - Spider mites
  - Aphids, Mealybugs, Fungus gnats, Shore flies (will not cover today)
- **Outdoor Nursery Pests**
  - Scales
  - Aphids
  - Lilac root weevil
  - Tree borers
- **On-line Resources**
Greenhouse IPM Techniques*

- Integration of cultural, mechanical, biological, and chemical tools
- Scouting
- Thresholds

*Modified from *Greenhouse IPM with an Emphasis on Biocontrols*, Pennsylvania IPM Program, Pennsylvania Dept. of Ag. & Penn State U.
Exclusion

- Clean transplants!
  - Inspect incoming plants & materials
- Keep doors closed!
- Screen openings
  - Doors, ventilation openings
- Barren/Clean floor surfaces
  - Concrete, black plastic, weed barrier
- Limit access
  - People, “pet plants”, nonessential materials
Cultural Control

- Maintain healthy, resistant plants
- Choose resistant species and cultivars when available
- Greenhouse environment
  - Temperature, light/dark cycles, humidity
- Time of planting and harvest
- Irrigation
- Fertilization
- Rotate crops between houses
- Soil/soil-less media
Sanitation

- Weed management
  - Weed-free inside and zone around outside perimeter
- Post-harvest clean up
  - Remove and destroy all plant materials including weeds
  - Pressure-wash, disinfect
  - Increase temperature to >80°F
  - Constant light
  - Eliminate standing water & algae (food, shelter)
  - Sterilize soil/growth media
  - Place sticky traps to monitor pests before moving in new plants
Scouting

- **Cornerstone of IPM**
- **Allows for early detection & treatment**
- Scout weekly
- Designate 1-2 employees & provide training
- **Tools**
  - Hand lens, sticky traps (yellow & blue), record book, flagging, vials, forceps, pH meter, soluble salt meter, min/max thermometer
Scouting (cont.)

- Maintain a notebook/records
- Allow at least 3 hr per acre
- Scout least-infested first, heavily infested areas last
- Zigzag pattern, minimum of 10 spots per 1,000 sq ft
- Combine sticky traps with crop inspection
- Flag pest hotspots for extra treatment (biocontrol release, pesticide)
Sticky Traps

- Early detection of adults
- May not be a good indicator of actual injury
- Presence, thresholds, timing, evaluate effectiveness
- Color
  - Yellow, Blue (thrips)
- Placement
  - At least 1 card per 1,000 sq ft
  - Replace weekly & after a treatment
  - 1-2 inches above plant canopy
  - Near favored hosts
  - Reduce number if releasing winged beneficial insects
  - Eliminate blue traps if using bumble bees for pollination
Identifying insects on sticky traps

**Aphids**
- Parallel veins
- Legs & antennae long & thin

**Fungus gnats**
- Y-shaped vein
- Long antennae
- Small, dark, mosquito-like flies with gray wings

**Thrips**
- Segmented antennae
- Hairy wings

**Shore flies**
- Short antennae
- Pale spots on wings
- Size of fruit fly

**Whiteflies**
- White wax dissolves in adhesive
- Orange underneath
Other Scouting Methods

- **Indicator plants**
  - Susceptible varieties provide an early detection system
  - Petunia varieties – thrips; not a reservoir for viruses
  - Cucumbers – whiteflies; concentrate release of parasitic wasps on cucs

- **Plant inspection**
  - Count the number of pest insects per leaf or per plant – use to assess if threshold’s been reached

Indicator plant for thrips: 'Carpet Blue' Petunia
Pest Thresholds

**Economic**
- Pest density when economic losses are reached (point when value of crop loss exceed cost of treating)

**Aesthetic**
- Pest density that causes unacceptable visual injury

Thrips injury to leaves & flower petals
Whiteflies

- Homoptera: Aleyrodidae
- Piercing-sucking mouthparts
  - Suck sap
  - Produce sticky honeydew
- Silverleaf whitefly
  - *Bemisia argentifolii*
  - Poinsettias, ornamentals
  - Transmits > 25 viruses
- Greenhouse whitefly
  - *Trialeurodes vaporariorum*
  - Vegetables, ornamentals

Silverleaf whitefly holds wings close to body, roof-like

Greenhouse whitefly holds wings flat, horizontally
Whiteflies

- 1st instar nymph - crawler
- 2nd & 3rd instar nymphs - feed
- 4th instar - doesn’t feed, pupa
- 30 day life cycle
- Foliage pest; secrete honeydew; sooty mold
- Leaves turn yellow, dry, drop from plant

UC Staging / PM Project © 2000 Regents / University of California
Whitefly Scouting

- **Monitor to detect presence** - yellow sticky cards
- **Trap threshold** = $\frac{1}{2}$ per card per day when crop is young, 2 per card per day when crop approaches maturity
- **Inspect plants** - hand lens
- **Leaf threshold** = 10 nymphs per leaf
Whitefly Management

- Biocontrol can be very successful
- Insecticide options
  - Range of modes of action
  - Reduced toxicity choices
- Problems with insecticide use:
  - Develop resistance quickly
  - Rotate chemical type regularly
  - Confined system – applicator safety concerns
  - Fresh market crop – short residuals
  - Phytotoxicity to crop
Whitefly Insecticides*

- IGR - Juvenile hormone mimic:
  - kinoprene; Enstar
  - fenoxycarb; Precision
  - pyriproxyfen; Distance
- IGR - Ecdysone disruptor:
  - neem oil; Azatin
- IGR - Chitin synthesis inhibitor:
  - diflubenzuron; Adept
  - novaluron; Pedastal
- Chloronicotinyl:
  - imidaclorpid; Marathon
  - acetamiprid; Tristar
  - thiamethoxam; Flagship
- Pyrethroid:
  - bifenthrin; Talstar
  - cyfluthrin; Decathlon, Tempo,
  - fenpropathrin; Tame
  - lambda-cyhalothrin; Scimitar
- Organochlorine:
  - endosulfan; Thiodan
  - pyridaben; Sanmite
- Miscellaneous:
  - flonicamid; F1785 GH
  - pymetrozine; Endeavor
- Suffocants, cuticle disruptants:
  - Insecticidal soap; Horticultural mineral oil

*Registered on commercial, non-edible greenhouse crops
Whitefly Biocontrol

• Can be very successful
• Parasitic wasps – *Encarsia, Eretmocerus*
• Predators – *Delphastus* ladybeetle, lacewing
• Pathogenic fungi – *Beauveria* (BotaniGard)
Encarsia Program

- Parasitizes whitefly early nymphal stages
- 10 nymphs per leaf will sustain wasp
- 2 schemes for use:
  - At whitefly threshold density, release wasps at 1/sq-ft greenhouse space, check for whitefly hotspots and release more
  - Cucumber plants at ends of rows; whiteflies will concentrate on cucs, target cucs for wasp release
- Cannot use insecticides
Thrips

- **Western flower thrips**
  - *Frankliniella occidentalis*
  - Vector of major viruses
    - Impatiens necrotic ringspot
    - Tomato spotted wilt
  - Virus acquired by 1\textsuperscript{st} instar nymphs, transmitted by adults
  - Eggs inserted into leaves & buds; 150-300 eggs per female
  - 10-14 day life cycle
Thrips Injury

- Punch-and-suck feeding style
- Tissue appears rasped, streaked, silvery
- Vector viruses
Thrips Scouting

- Early detection is critical
- Blue sticky traps
  - 1 trap per 1,000 sq ft
  - Place just above canopy
- Inspect blossoms, buds, leaves
- Tap leaves & blossoms over white sheet of paper
- ETs:
  - 5-20 per trap in chrysanthemums
-Indicator plants - place every 20-30 ft
  - 'Carpet Blue' and 'Blue Madness’ Petunias
  - Not reservoirs for INSV
Thrips Management

- Difficult, insecticide resistance
- Biocontrol alone often is not enough
- Sanitation is key!
  - Clean stock, no debris
  - Exclusion, screen vents
  - 20-ft vegetation free zone around house
Thrips Biocontrol

- Predatory mite, *Neoseiulus cucumeris*
- Predatory soil mite, *Hypoaspis miles*
- Minute pirate bug, *Orius insidiosus*

*Neoseiulus cucumeris*  
*Hypoaspis miles* feed on thrips pupae in the soil  
Minute pirate bug adult
Twospotted Spider Mite

- Foliage pest; feeds on epidermis & mesophyll, suppresses photosynthesis
- Causes stippling, bronzing of leaves
- Produce fine webbing
- Mites go dormant in fall, orange in color (photoperiod induced)
Cultural Management of Mites

- Prevent diapause of mite in the fall
- Interrupt night with 2 hr light
- Keeps mites active
- Remove crop & starve mites
- Clean up with insecticidal soap, horticultural oil or acaricide
Mite Biological Control

- **Predatory mite –*Phytoseiulus persimilis***
- Release predator in ground corn cob carrier
- **1st year:** 1/5 plants infested with TSSM or release TSSM with predator, release predator (4 preds/infested TSSM plant), monitor, redistribute TSSM if preds consume all prey in an area
- **Subsequent years:** release preds in TSSM hotspots; can establish for many years
- **No toxic pesticides**
Spider Mite Management

- **Soft Controls:** pressurized stream of water, horticultural oils, insecticidal soap

- **New miticides:**
  - Acequinocyl (Kanemite, Shuttle)
  - Bifenazate (Floramite)
  - Pyridazinone (Akari, Nexter, Sanmite)
  - Chlorfenapyr (Pylon)
  - Etoxazole (Tetrazan)
  - Hexythiazox (Ovation, Hexagon)
Outdoor Nursery Pests
Scale Insects

- Soft scales feed in phloem, produce sticky honeydew
- Armored scales feed on mesophyll of plant cells, do not produce honeydew
- Multiple years of scale feeding can kill limbs; cause dieback

European fruit lecanium scale

San Jose scale & injury
Scale Biology

- 1-2 generations per summer
- Overwinter as eggs or young nymphs
- Females are sessile
- Males have wings
- "Crawler" stage is the best target for control

Oystershell scale female surrounded by crawlers
Delayed Dormant Control is effective for soft scales & some armored scales: Dormant oil + Pyrethroid (at first bud break)

- Use sticky tape in late spring to early summer to time a spray for “crawlers”

- Soft scales: Merit (systemic), Precision, Flagship, horticultural oil, insecticidal soap

- Armored scales: pyrethroids or others timed with crawlers
Aphids

- Suck sap from phloem tubes in leaves and stems
- Curl leaves, produce sticky honeydew that promotes growth of black sooty mold, reduce plant vigor at high densities
- Populations increase rapidly, low numbers can be tolerated
- Only control if honeydew is a nuisance problem or distortion of leaves is severe and aphid numbers are very high
- Many generations per summer
Aphid Biology

Alternate hosts

Woody overwintering host

Aphid eggs on tree limbs

Woody or herbaceous summer host

Only females, bear young live
Continual, overlapping generations

Fruit tree aphids
plum, peach, rosy apple, cherry
Spirea
Dogwood
Woolly elm
Woolly alder
Honeysuckle
Rose
Woolly Maple
Poplar
Ash
Cottonwood

Mostly a spring pest
Aphid Biology

Single host

Produce overwintering eggs in colder climates

Birch aphid

Cinara conifer aphid

Season-long pest

Apple
Birch
Poplar
Cottonwood
Walnut
Conifers
Sycamore
Maple
Pecan
Hackberry
Elm
Aphid Management

- **Delayed Dormant Spray:** Dormant oil + Pyrethroid (at bud break)
- **Spring and Summer control:** hard spray of water, horticultural oil, insecticidal soap, imidacloprid (Merit, systemic), Conserve, Aria, azadirachtin, Orthene, pyrethroids, others
- **Biological control:** lady beetles, lacewings, syrphid flies, parasitic wasps
Insecticide Resistance Management

- **Rotate chemical classes / modes of action**
  - Within a generation
  - Between generations within a season

Aphid giving birth to live nymph
Lilac Root Weevil

Drought related
Observed heavy injury
to shrubs & small trees
**Lilac Root Weevil**

*Otiorhynchus meridionalis*

- **Common hosts:** lilac, peony, dogwood, yew, privet, cotoneaster, arbovitae, spruce, others
- **Adults** chew irregular notches in leaf edges - target with foliar insecticide (Orthene, Merit, Sevin, Azadirachtin, Pyrethroids) - in late spring with first leaf notching
- **Larvae** feed on roots - target with soil insecticide (Merit), insect-attacking nematodes, *Beauveria* fungus - late spring or early fall
Tree and Shrub Insect Borers

- **Attack trunks & limbs:**
  - Roundheaded & Flatheaded Beetles, Clearwing Moths

- **Attack cambium under bark:**
  - Bark Beetles - *Ips*, Banded Elm Bark Beetle
Longhorned Beetles/Roundheaded Borers (Cerambycidae)

- Aspen borer
- Pine Sawyer
- Locust borer

Poplar
Cottonwood
Locust
Ash
Fruit trees
Pine

Most only attack stressed trees
Tunnel through cambium and into inner wood
Metallic Wood Boring Beetles/
Flatheaded Borers (Buprestidae)

Birch
Beech
Fruit trees
Maple

Most only attack stressed trees
Feed just under bark in cambium -
girdle trunk
Clearwing Moth Borers (Sessiidae)

- Lilac Ash Borer
- Western Poplar Clearwing
- Greater Peachtree Borer

will attack healthy trees
Tunnel into inner wood
Timing of Adult Tree Borer Activity

• **Adult flight periods for northern Utah**
  - Ash/Lilac borer – May 1- late June
  - Bronze birch borer – late May – June
  - Aspen borer – May-July
  - Peachtree (Crown) borer – late June – August
  - Locust borer – August – Sept.
  - Shothole borer – June and late Sept.
Insecticides for Preventive Trunk Sprays

- **Contact:**
  - carbaryl (Sevin), endosulfan (Thionex), pyrethroids (permethrin, bifenthrin)

- **Systemic (translocation activity):**
  - Taken up by roots & moved throughout plant through xylem & phloem
  - Can also act as a local systemic
    - imidacloroprid (Merit, Marathon, Bayer Advanced Garden Tree & Shrub Insect Control)
Imidacloprid

- Merit, Marathon, Bayer Advanced Garden Tree & Shrub Insect Control
  - Soil drench, soil injection, foliar
  - Soil: translocation delay of up to 60 days or longer
  - N containing fertilizer may enhance uptake
  - Target insects: soft-bodied pests on leaves and limbs (aphids, adelgids, leafminers, leaf beetles, mealybugs, psyllids, scale); white grub larvae; roundheaded borers (suppressive), flatheaded borers (control)
  - Clearwing moth larvae are not on the label
Considerations for Using Systemics

- Long-lasting activity
- Reduced degradation by UV & water
- Minimize plant surface residues
- Minimize human exposure
- Application can be more convenient
- Delayed uptake & availability
- Insect resistance concerns
Bark Beetles (Scolytidae)

Spruce
Pine
Fir
Prunus
Elm

Attack old or stressed trees & seemingly healthy trees
Trees at Risk for *Ips* Attack

- **Stressed trees:**
  - Drought-stressed, trees in dry sites
  - Newly transplanted
  - Root injuries from construction or other
  - Crowded trees

- **Trees surrounded by breeding populations of *Ips***
  - Slash (piles of prunings)
  - Stacks of green or infested wood
    - Freshly cut wood is a preferred breeding site
Management of *Ips* in the Landscape

- Maintain tree vigor, avoid stress (proper watering, planting site, avoid injuries)
  - 2-4” water every 2-6 weeks
  - Avoid planting in very dry sites
- Remove & dispose of infested material
  - Dispose 2-3 miles away from hosts
- Remove and treat infested material
  - Chip and spread to dry
  - Burn
  - Remove all bark
  - Cover logs with >10 ml clear plastic & heat to lethal temperatures
Management of *Ips* in the Landscape

- Apply preventive insecticide or apply to “lightly” infested trees:
  - Carbaryl (Sevin): flowable, 2% ai solution
  - Permethrin (Astro, Dragnet)
  - Treat in spring before beetle flight (April) or treat in fall (late Sep to Oct)
  - 12-18 months protection (carbaryl)
  - High-pressure sprayer (>250 psi) for large trees
  - Apply to entire bole & larger limbs
Banded Elm Bark Beetle

*Scolytus schevyrewi*

Elm  
Prunus  
Willow  
Russian Olive

Attacking American elm trees  
May vector the Dutch Elm Disease fungus
Utah IPM Web Page

http://utahpests.usu.edu/ipm
Greenhouse IPM Manual

Greenhouse IPM with an Emphasis on Biocontrols

Pennsylvania Integrated Pest Management Program

Free downloadable PDF file:
http://paipm.cas.psu.edu/NewsReleases/ghmanual.html

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