

Pests and Diseases in the Greenhouse



HOW TO NOT BE “BUGGED” BY PESTS

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Why Control Pests?



“The impact of plant pests on greenhouse crops is direct and significant. Disease-causing organisms, insects, and nematodes can cause serious problems in greenhouses if they are not adequately controlled simply because a greenhouse provides a protected environment in which pests can thrive”

(1). J. R. Rich, S. E. Webb, M. L. Paret, and M. T. Momol, 2013. Considerations for Managing Greenhouse Pests - Florida Greenhouse Vegetable Production Handbook, Vol 31

Why Control Pests?



- **Different environments & users = needs vary**
 - **Public spaces – high traffic, all ages**
 - Chemical free? Malls, conservatories, etc.
 - **Collections & Educational Environments**
 - May “leave” some pests for students to see, learn about
 - Yet need a healthy breadth of specimens
 - **Research projects – low pest tolerance**
 - Virus transmission issues? Unwanted pollinations?
 - **Biotrons, Biosafety projects**
 - May need very tight containment, extremely low tolerance for unwanted organisms

Elimination vs. Control



- **Figure out what your needs are, and shoot for that area of the spectrum**
 - Complete elimination may be nearly impossible
 - hitchhikers
 - new materials, turnover rates
 - facility limitations (screens, vents, etc.)
 - cost prohibitive?
 - Use diverse methods (cultural, chemical, biological) to do as much as you can
 - Entomologists? Might need non-chemical controls
 - **Communicate your needs to staff**, and work with us to help your research succeed!
- **Thresholds**
 - Determine the point at which pests are a problem, start treatment **BEFORE** that point is reached...

Common Greenhouse Pests

- **Aphids**

- ✦ Piercing-sucking, feed on plant sap (phloem)
 - Can readily spread viruses
 - “living balloons”
- ✦ Different species and appearances on different plants
 - Green, black, orange, etc.
- ✦ Honeydew, fungi & ants
- ✦ Reproduce quickly
 - Asexually or sexually
 - Usually live, hungry young
 - Very destructive



Image by MedievalRich

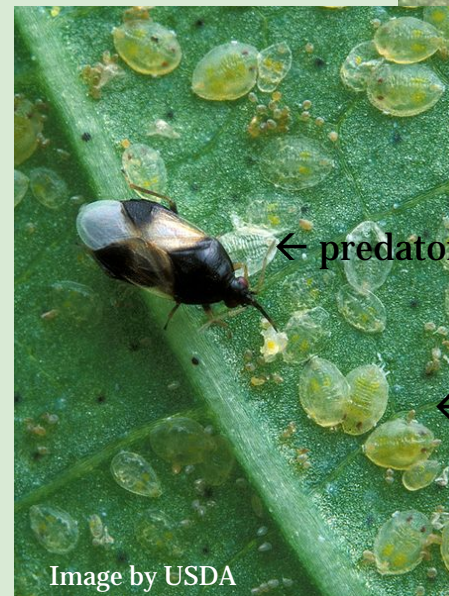
Common Greenhouse Pests

• Whiteflies

- ✦ Present on a wide range of plants
- ✦ Sucks phloem from plant, causes stunting, yellowing, leaf drop
- ✦ Adults fly and can spread to other projects/greenhouses
- ✦ Most immature stages are non-motile, look completely different, are found on undersides of leaves



Adult whiteflies



← predator: *Orius insidiosus*

← Whitefly nymphs

Image by USDA

Common Greenhouse Pests

• Spider Mites

- ✦ Usually 2-spotted spider mites (*Tetranychus urticae*)
- ✦ Wide range of plants, usually leaf undersides
- ✦ May see webbing in more severe infestations
- ✦ Mite, not insect

(6 legged larvae, 8 legged adults)

- ✦ Like hot, dry conditions
- ✦ May be blown around by air currents, or hitchhike – very small, hard to spot
- ✦ “Stippling” damage, suck out plant fluids, kill cells



Common Greenhouse Pests

• Thrips

- ✦ Usually Western Flower Thrips
- ✦ Feed widely
- ✦ Break leaf cells open (rasping) and suck fluids
- ✦ White/silvery patches of damage with black spots (frass)
- ✦ No such thing as a “thrip”
- ✦ Weak fliers, but spread via hopping, hitchhiking
- ✦ Like tight spaces (flowers)
- ✦ Vectors
 - Can spread tomato spotted wilt virus, impatiens necrotic spot virus, etc.

Image by Frank Peairs, Colorado State University, Bugwood.org



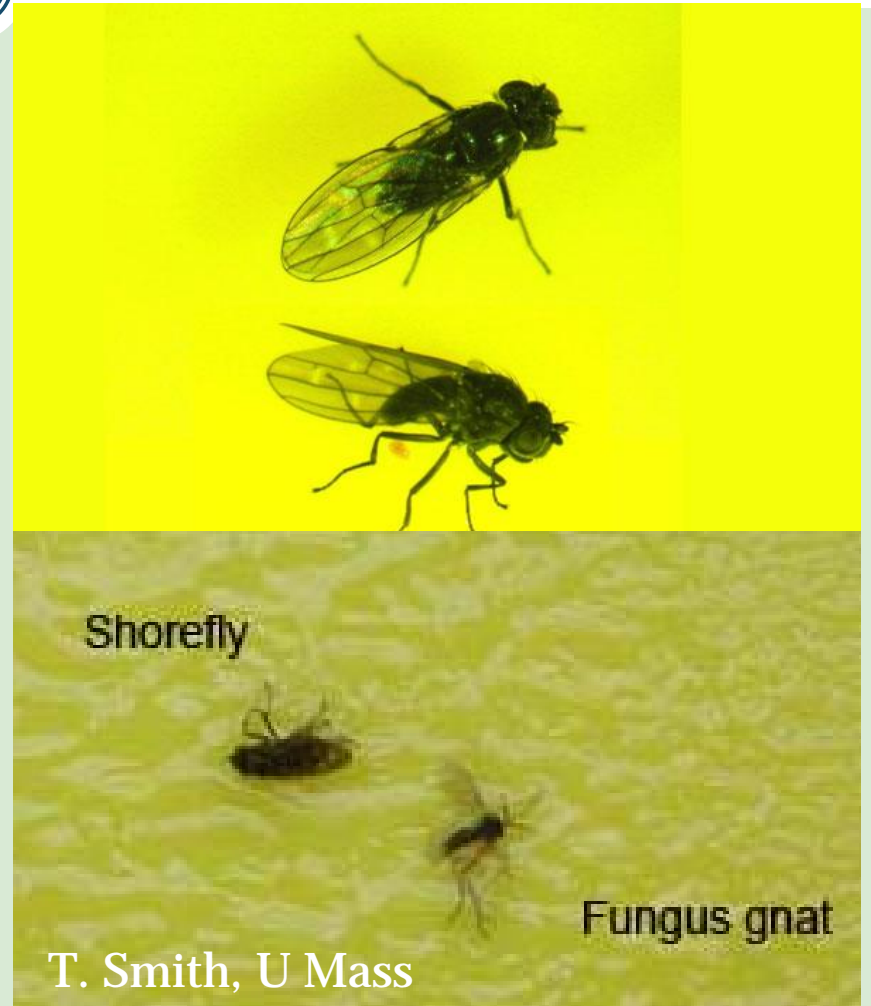
Photo by Arizona Cooperative Extension

Common Greenhouse Pests

- **Shore Flies**

- ✦ Not known to feed on healthy plant tissue
(both adult and larvae)
- ✦ Feed on algae and decaying organic matter
- ✦ Breed in moist environments
- ✦ Adults = strong fliers, more robust bodies
- ✦ Larvae = no black head capsule

- ✦ Mostly a nuisance



Common Greenhouse Pests

- **Fungus Gnat**

- **Adults mostly a nuisance**

- Weak fliers
- Eat fungi

- **Larvae feed on plant roots, fungi, decaying O.M.**

- Can tunnel into crowns, stems of plants
- Black head capsule
- Can leave wounds for pathogens, or carry pathogens
 - Pythium, fusarium, etc.
- Potato trick for scouting
- This pest & life stage (larvae) can be a big problem, especially on seedlings

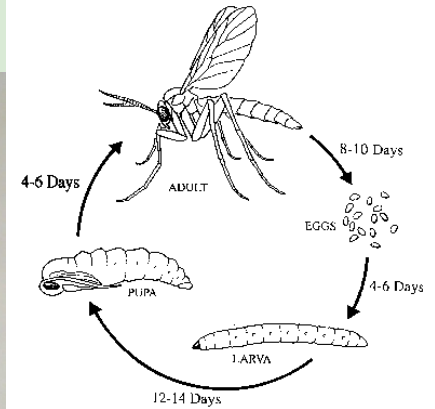


Illustration: U. Mass, Amherst



Common Greenhouse Pests

- **Mealybug**

- ✦ Unarmored scale insects
 - Secrete powdery/waxy layer for protection
- ✦ Males look totally different
 - “Like fluffy gnats”
- ✦ Feed on plant fluids
- ✦ Can induce leaf drop (heavy infestations)
- ✦ Can vector diseases



Sarracenia.com



California Agriculture

Common Greenhouse Pests

- Scale

- ✦ 8,000 species
- ✦ Feed on plant fluids
- ✦ Waxy coatings mean they're usually pesticide resistant
 - Usually target first instar "crawler" stage
 - May be "soft" – wax only, or "armored" – additional protective coverings
 - Hard to get rid of
- ✦ In many species, females lose their legs, are not mobile at maturity



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RHS, Horticultural Science

Common Greenhouse Pests

- **Powdery Mildew**

- ✦ Looks like a white dusting on leaves, stems
- ✦ Fungi, hyphal mats
- ✦ Affects a broad range of plants; each species attacks only certain plants though
- ✦ Can reduce yields, cause leaf distortion or loss
- ✦ Dispersed by abundant spores
- ✦ Need living tissue to grow, but can make resting spores
- ✦ Needs high humidity for spore germination – keep plants uncrowded, good air flow
- ✦ Can be prevented, and controlled, but not cured



Common Greenhouse Pests

- **Alternaria**

- ✦ “Early Blight”
- ✦ Fungi
- ✦ *Alternaria solani*,
Common on potatoes and tomatoes
- ✦ Typical bullseye pattern spots
- ✦ May result in defoliation, stem damage, and spots on fruit (tomato)
- ✦ Can cause yield reductions
- ✦ Not the same as late blight
(*Phytophthora infestans* - Oomycete)
Irish potato famine



Common Greenhouse Pests

- **Damping off Pathogens**

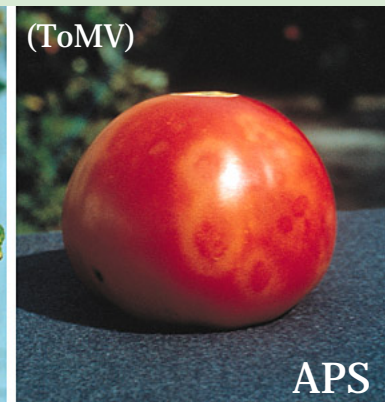
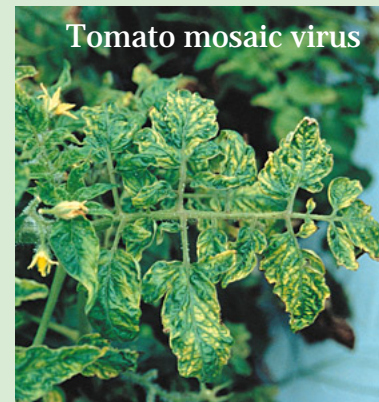
- ✦ Cause seedlings to not emerge, or stem tissue near the soil line decays and collapses
- ✦ Damage to roots, stem
- ✦ Organisms present in almost all soils
 - Control dependent on keeping seedlings healthy & growing vigorously, sanitation, timing
 - Avoid cold, wet, heavy/compacted soils, “green” compost, planting too deep
- ✦ *Pythium, Phytophthora*
 - Oomycetes - “water molds”
- ✦ *Rhizoctonia, Fusarium*
 - *Fungi*



Common Greenhouse Pests

- **Viruses**

- ✦ Diverse, usually somewhat host specific
 - TMV – tobacco mosaic virus
 - Tomato Spotted Wilt Virus
 - Cucumber Mosaic Virus
 - Potato viruses Y and X (PVY, PVX)
- ✦ Symptoms may include curling, discoloration, stunting or other growth abnormalities
- ✦ Transmitted by insects, sap contact, nematodes, protozoa, or on/in seeds



Common Greenhouse Pests

- **Rodents**

- ✦ Mice, rats, voles, raccoons, rabbits, etc.
- ✦ Outdoor OR indoor
- ✦ Dig up seeds, eat materials left out on benches, etc.
 - Store materials carefully!



Image by George Shuklin



Image by Darkone



Image by Harvey Henkelmann



Common Greenhouse Pests

- **Weeds**

- ✦ **Diverse species**

- Oxalis (clover)
- Lambsquarter
- Dandelion
- Spilled seeds, plants gone to seed

- ✦ **Grow in pots, on floors**

- ✦ **May compete with desired plants**

- ✦ **Harbor pests & diseases**



Greenhouse Grower

Scouting and IPM



- **Timing**
 - Check all plants at least weekly
 - Tell staff if you notice something that is/will be a problem
- **Techniques**
 - Tap test (*no-touch plants warning? Spreadable viruses?*)
 - Sticky cards – usu. yellow or blue
 - Look at plants for signs, symptoms
 - Sampling – check all phenotypes, ages, species, etc.
 - Stressed plants = VERY attractive to insects – do everything you can to keep plants healthy and NOT stressed...
 - High traffic areas – just inside door
- **State of pest(s)**
 - Is it alive?
 - Is it causing damage?

Cultural Controls



- **Sanitation**
 - Remove infested plants/plant parts
 - Don't leave debris, dead or dying plants around
 - Harbors pests and diseases
 - Stressed plants = attractive to insects
- **Exclusion**
 - Don't bring infested plants in to a greenhouse
 - Quarantine rooms
 - Common traffic areas – don't spread your problems to others
 - Think about where you've been, hitchhikers
 - Work in infested greenhouses/chambers last
 - Clothing – thrips love yellow & blue; lab coats if needed
 - Screening, blowers, etc
 - Keep in mind tiny size of pests, cooling equipment needs
(thrips screening may not be possible...)
 - Close doors between areas

Cultural Controls



- **Creating unfavorable environments**
 - Healthy plants = less susceptible
 - Humidity, temperature, etc.
 - Modify growing conditions, if possible, to inhibit pest growth
 - Water in morning, in pot = less stress, less humidity thru night, free water on leaves usually increases pathogen infection, splashing can spread spores/bacteria
- **Movement issues/contamination**
 - Again, don't bring plants in from outdoors, other sites
 - If you must, use a quarantine system, let staff know
 - Don't bring plants through other houses if you don't have to
 - Consider air, water, debris flowing into neighbors' spaces
 - Common spaces and tools – cleaning benches, carts, etc.

Chemical Controls



- **Pesticide definition**

- ✦ A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests. Under United States law, a pesticide is also any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.
- ✦ Canola oil, flea collars, insect repellent, etc. up to RUP's

- **Many different classes; different targets, modes of action**

- Organophosphates, Carbamates – cholinesterase inhibitors that cause neurons to continuously fire, overstimulates CNS of insect
- Neonicotinoids – stimulate CNS, structure is more specific to insects
- Pyrethrins, Pyrethroids (synthetic) – sodium channel modulators
- Chitin Synthesis Inhibitors – insects can't molt/grow
- Insect growth hormones (IGR's) – prevents metamorphosis, growth, reproduction

Chemical Controls



- **Rotation!**
 - ✦ Prevent resistance
 - ✦ See label for frequency, harvest and crop restrictions, etc.
- **Labels and MDS**
 - ✦ Safety (first aid) information and a legal document
 - ✦ MUST be followed
 - ✦ Also discusses known crop sensitivities, target pests
- **Legal issues & proper training**
 - ✦ RUP's – Restricted Use Pesticides, require an applicator's license
 - ✦ PPE
 - ✦ Must use appropriate signage, have documentation/application history
 - ✦ Take care when mixing chemicals – incompatibility
- **Phytotoxicity?**
 - ✦ Damage to plants from a chemical spray

Biological Controls



- Use of another living organism (beneficial) to kill or inhibit the target (pest)
 - May be:
 - Nematodes – *Steinernema* genus infect insect host, release bacteria *Xenorhabdus* from their gut. Bacteria kills insect, nematode eats bacteria & host insect, multiplies, and is released to seek new hosts.
 - Insects – *Orius insidiosus* will kill thrips, spider mites, whiteflies and aphids
 - Fungi – *Beauveria bassiana* for grasshoppers and crickets, thrips, whiteflies and aphids
 - Bacteria - *Bacillus thuringiensis* (Bt) for many caterpillar pests
 - Mites - *Phytoseiulus persimilis* for spider mites
- Can be difficult to create a good balance
 - Pesticides & residues can kill off “good” bugs
 - Populations may rise and fall
 - If all prey is eliminated, what does the beneficial feed on?

Biological Controls



- **Other tricks**
 - ✦ Banker plants to provide alternate food source for mobile predators (wasps, etc.)
 - ✦ Have to watch environment carefully
 - Beneficial can go into diapause, be less active with the wrong daylength or temperature cues
- **If you can achieve a healthy population, you can have ongoing control with relatively little effort**
- **Chemical free – good for public spaces**
 - Insects present though, and not usually 100% control

Summary



- **Cultural methods YOU can utilize & help with**
 - Healthier plants = better
 - Look at your plants frequently, report concerns early
 - Remove dead/dying material promptly
 - Avoid weeds
 - Don't contaminate by bringing outside plants, "pet" plants in
 - Keep hitchhikers in mind, visit infested rooms/chambers last
 - Minimize standing water, puddles, algae
 - If possible, keep conditions unfavorable for pests (temperature, humidity)
 - Usually spaced-out plantings – lower relative humidity in canopy
 - Cooler temps = longer life cycles, less generations for most insects
 - If growing space is to be unoccupied for a while, can turn up or down heat to kill off insects, some pathogens.
 - Cleaners can be used to sterilize the space (esp. growth chambers)

Summary



- **Diverse pests – must identify what & where**
 - Aphids, Mites, Whiteflies, Thrips, Shore Flies, Fungus Gnats, Weeds, Rodents, Powdery Mildew, Viruses, Bacteria, etc.
- **Complete elimination may not be possible or practical**
 - Consider the needs of your project, damage thresholds, who and what is coming in contact with the plants
- **Communicate with other staff, work out a control plan that meets your needs**
 - Options may be cultural, chemical, or biological controls

Questions?



- Specific pest issues you've encountered?
- Success stories you want to share?