GREENHOUSE PEST AND CONTROL OPTIONS

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NEW PEST TO WORRY ABOUT - EUROPEAN PEPPER MOTH
EUROPEAN PEPPER MOTH – HIDE OUT PLACE
Photo: Carmelo Peter Bonsignore, Università degli Studi Mediterraneo di Reggio Calabria
THRIPS

Western flower thrips

Thrips damage on poinsettia

Photo: Frank Peairs, Colorado State University, Bugwood.org
SANITATION

• Remove old leaves, old flowers and the stuff that accumulates in odd corners which provide refuge for thrips
• Discard in the compost or autoclave
• Never bring potentially infested plant material into the greenhouse
Traps should be placed just above the crop canopy, about one per 200 square meters (approx. 2,000 square feet) in large houses. In houses under 2,000 square feet, use a minimum of three traps, regardless of house size.
Developing egg of *Scirtothrips dorsalis* extracted from oviposition site on underside of Capsicum annuum leaf
After egg hatch, there are two feeding life stages (called the first and second instar larva), followed by two immobile non-feeding stages (the propupa and pupa) that both occur in the soil. Adults emerge from pupae and are winged. Adults feed, mate, disperse, and females lay eggs.

P.M.J. Ramakers, Applied Plant Research, Bugwood.org
• In chrysanthemum and gerbera flowers, feeding results in distorted petals, discoloration, and extensive streaking

• In geranium, feeding causes young leaves to grow in a deformed manner, curling upwards, and to have whitish bumps on the upper leaf surface (Tommasini and Maine 1995)

• In young poinsettia and impatiens, thrips feeding distorts the outline of developing leaves
Biocontrol

- Apply *Hypoaspis* predatory mites soon after potting up, several days after drenching with Marathon
- *Hypoaspis* miles mite is a soil mite that goes after pupae
- Introduce *N. cucumeris* predatory mites biweekly
- Don’t kill them with miticides
- The biocontrols keep thrips’ population from exploding, but they can be overwhelmed if an outbreak is ignored
BIOL0GICAL CONTROL

• Use Amblyseius cucumeris at 1000 mites per 200 sq ft of growing area.
• Amblyseius cucumeris – Controlled release packs
• Controlled release packs contain various life stages from egg thru adult. The bags act as miniature breeding units and are to be hung on plants throughout the greenhouse. Over a 4 week period each bag can produce over 1,000 A. cucumeris.
**Amblyseius cucumeris**

- When feeding on WFT, *A. cucumeris* completes its life cycle in 11.1, 8.7, and 6.3 days at 68, 77, or 86°F (20, 25 and 30°C).
- The lower threshold for larval development is 46°F (7.7°C).
- A pair of mites on average eats 5 first instar larvae of WFT each day, but older life stages are immune to attack because of their larger size and more effective defensive behaviors.
• A general caveat about predacious mites is that many, if not most, eat a variety of materials, including plant pollen and fungal spores, in addition to arthropods.

• Consequently, the crop plant on which mites are expected to provide biological control of a pest can strongly influence their success or failure.

• Biological control of WFT, for example, works better on sweet pepper than on many other crops because populations of predatory mites build up by feeding on the abundant pollen supply on this plant.

• In contrast, on plants which are not producing pollen, or on short cycle crops in which time for population increase is lacking, mites may fail to provide biological control of pests.
PREDACEOUS MITES

• Over time, mites move off banker plants onto the crop, a process that can be accelerated by increasing the number of banker plants and moving banker plants to new locations every few weeks.
MARIGOLD AND PURPLE FLASH PEPPERS ARE USED FOR THRIPS – RELEASE ORIUS INSIDIOUS ON PLANTS
**METARHIZIUM ANISOPLIAE**

- *Metarhizium anisopliae* was found to be a more aggressive pathogen for thrips control.

- *M. anisopliae* appears to penetrate and infect the insect soon after germination (Schreiter et al. 1994, Vestergaard et al. 1995). WFT mortality from fungal infection is dose-dependent; the more spores that contact the insect, the more rapid the kill and the higher the rate of infection (Brownbridge et al. 1994, Vestergaard et al. 1995).

- Temperature influences infection and different pathogens work best at different temperatures. *Metarhizium anisopliae* strains tested by Vestergaard et al. (1995) were most virulent at 73°F (23°C). A drop in temperature of just 5-9°F (3-5°C) increased the time of death by one day, which could be critical in heavily infested greenhouses.
• Not all WFT developmental stages are equally susceptible to fungal infection.
• Eggs, for example, are laid in host plant tissue and are thus protected from contact with the pathogen.
• Larval and pupal stages are more resistant than adults, presumably because fungal inoculum is shed when the insects molt.
• Molting is an important factor in insect resistance to infection, especially in an insect like WFT in which the time between molts is short. Pupae are more susceptible to infection by *M. anisopliae* than are larvae (Vestergaard et al. 1995).
• Adults are the most susceptible stage; however, infected adults continue to lay eggs for a few days. Re-treatment of an infested crop is, therefore, usually necessary to ensure good control.
• While in some cases three to five sprays at 3-5 day intervals have provided control of high populations, it is better to monitor thrips and begin fungal applications as soon as thrips are detected. This allows lower dose rates to be used and applications to be made less often.

• Most WFT pupate in the soil and fungi can be applied to soil to kill this stage. Brownbridge & Adamowicz (1995) showed that drench applications of *P. fumosoroseus*, *B. bassiana* and *M. anisopliae* effectively suppressed WFT in potting soil. In addition, *B. bassiana* and *M. anisopliae* inoculum levels actually increased over time, potentially providing a long-term control of thrips pupae in soil.
STORING BIOPESTICIDES

- Fungal biopesticides must be held under appropriate conditions at all times - in transit and in storage on the farm. Fungi are sensitive to high temperatures and even warm conditions can be damaging if prolonged. Generally, if the products are kept cool (< 60°F [15°C]) and dry, quality will be maintained for at least a year. Short term storage (under two hours) at higher temperatures is unlikely to have a significant effect, but if fungi are held under warm conditions for extended periods, the spores are inactivated and the rate of germination in the survivors declines (Brownbridge 1996). In general, the higher the storage temperature, the more rapid the rate of inactivation. Temperatures >104 °F (40 °C) are not uncommon in pesticide storage sheds and are unsuitable for fungi. Products can be rendered totally inactive within a few weeks or less at such temperatures.
MINUTE PIRATE BUGS, *ORIUS* SPP.

FOUR BUGS, *O. LAEVIGATUS, O. MAJUSCULUS, D. TAMANINII, AND M. CALIGINOSUS*, ACCOUNTED FOR 95% OF THE WFT PREDATORS ENCOUNTERED.

- Of the various *Orius* species tested for control of WFT, all but *O. albidipennis* appear to be inadequate during fall and winter because of diapause induced by short days which stops oviposition by females.

- *Orius albidipennis* seems not to enter diapause, even at very short daylength and may be the most suitable of the *Orius* species for fall and winter use.
Aphids are a big problem in the horticultural sector. Through their enormous reproductive capability, aphids can cause severe damage to several crops. Resistance to pesticides is increasing. Important aphids occurring in glasshouses are the cotton aphid, *Aphis gossypii*, the potato aphid, *Macrosiphum euphorbiae*, and the green peach aphid, *Myzus persicae var. persicae*.
Aphids

• In greenhouses aphid populations always consist of viviparous females.
• Young aphids are born and immediately start feeding on plant sap. They grow quickly and molt four times before they become adult.
• The resulting characteristic white skins highlight the presence of aphids.
• Winged aphids develop at high densities, enabling rapid spread through the greenhouse from hotspot areas.
APHID PRONE GREENHOUSE PLANTS

- Salvia
- Fuschia
- pepper
- Tomatoes
- Portulaca
- Pansy
- Mums
• The green peach aphid is found on tip growth and populations can explode in spring (March through – early June).

• Look for the long cornicles on the rear end with black tips and a notch in the antennae.
Green Peach Aphid
GREEN PEACH APHID ON TERMINAL GROWTH
WINGED GREEN PEACH APHID - THIS MEANS THEY ARE GETTING READY TO DISPERSE

Photo: Scott Bauer, USDA Agricultural Research Service, Bugwood.org
Melon aphids start building up on major branches in the center of the plant. As populations build they move to other plant parts. They accumulate around flowers when a plant matures.
MELON APHID MOTTLED GREEN FORM
POTATO APHID

• The primary hosts for the potato aphids are portulaca, potatoes and tomatoes in the summer and wild or cultivated rose in the winter and spring. They are also found on kale, lettuce and spinach in the autumn and may overwinter on these hosts.
• Since the potato aphid is not an efficient virus vector relatively high numbers can be tolerated.

• Two distinct color forms, green and pink.
• The nymph of the potato aphid (0.03 - 0.08 in long) is yellowish green or pink with long cornicles with dark tips.
STOCK PLANTS – BIOLOGICAL CONTROL OPTIONS

• Stock plants is where you start your biological control
• Need to use preventative biological control early in season on aphid prone plants
Aphidius colemani is a wasp that parasitizes aphids, causing aphid mummies (golden-brown and leather-like).

Good Searchers

Aphidius ervi
- Paraistic wasp that is good for potato aphids and other species

Aphidius colemani is a wasp that parasitizes aphids, causing aphid mummies (golden-brown and leather-like).
PARASITIC WASPS

- Female lays eggs inside aphid
- Larva develops inside and cuts hole for exit
TO CONTROL ANTS – VASELINE PUT ON LIP OF POT
RATE USED IN SHARP’S GREENHOUSE
- 4 potted plants per 2000 sq ft of growing area

• If you are thinking of trying biological control of aphids, plan to start your barley plants in February or March to get the bird cherry oat aphid population established early. It is important to get the parasitic wasp established early in the season before aphids can become established in the greenhouse.

• See more at:
  http://extension.umd.edu/ipm/commercial-greenhouse-production/biological-control
WASPS – RELEASE RATE

In 2009, the aphid parasitoid, *Aphidius colemani*, was released at the rate of 500 *Aphidius* wasps on eight barley plants. The parasitic wasp, *A. colemani*, was selected because it is prove to parasitize green peach aphid and melon aphid.

Bird cherry oat aphid
GROW STOCK BARLEY PLANTS IN CAGE TO KEEP PARASITE OFF BIRD CHERRY OAT APHIDS
Banker plants for early establishment and continuous production of *Aphidius colemani*.

Banker Plant System

Barley plants infested with cherry oat aphid, also called cereal aphids (which only attack monocotyledonous plants).
Bird cherry oat aphids – *Rhopalosiphum padi* - obtain these aphids from a biological supply house
**BANKER PLANTS**

- Start barley seed in greenhouse in 6 – 8” pots.
- Put on aphids on barley
- Move aphid infested barley into greenhouse and introduce *Aphidius colemani*
- Works well on melon aphid and green peach aphid
- If potato aphid is a problem use *Aphidius ervi*
APHID MUMMIES
RATE OF BANKER PLANTS WITH APHIDiUS

• Use 1-4 banker plants per 10,000 sq ft
• BioBest suggests using lower rate of 1 plant per acre
• Do not use the bird cherry oat aphid if growing lemon grass or lilies because aphids will move onto them
Green peach aphid mummy parasitized by *Aphidius colemani*
Green peach aphids

Photo: Whitney Cranshaw, Colorado State University, Bugwood.org
IF APHID HOTSPOT OCCURS SHARP FARMS USES LACEWINGS

• In some years Sharp Farm released an average of 1 green lacewing larvae per plant per week during 8 weeks which has effectively controlled potato aphid and green peach aphid outbreaks.
GREEN LACEWING

- The elegant green lacewing is a general predator and will consume many soft bodied insects and their eggs, including mites and pest thrips.
- Lacewing is the most economical commercially available general predator for many different pest situations.
- Releasing lacewing eggs is easily done using lacewing egg cards.
- Lacewings suck out the inside of the insect, and then lay the shriveled body on the side
The aphid midge, *Aphidoletes aphidimyza*, offers long-term, low-density aphid control after lacewings knock down high aphid populations.
APHID CONTROL

- *Aphidoletes aphidimyza* (predatory midge)
- Eats wide range of aphids.
- Works well on all crops.
- Preventive and curative applications.
- Kills more aphids than necessary for development.
RELEASE RATES FOR APHIDOLETES APHIDIMYZA

• Make piles of Aphidoletes – 200 -250 near aphid hotspots

• If releasing throughout the greenhouse use 100 Aphidoletes per 1000 sq ft of growing area
OTHER OPTION FOR APHIDS

- *Beauveria bassiana* (BotaniGard) and Molt-X (Azadirachtin) mixed together. The Azadirachtin slows down the molting process so spores can germinate on aphids.
- Alternate with SuffOil-X
- Pure Spray Horticultural oil
- Azadirachtin – Neem-X, Molt-X, Azatin
OTHER ENTOMOPATHOGENIC FUNGI

- Nofly = *Isaria fumosoroseus* strain FE9001
- PreFeRal = *Isaria fumosoreseus* strain Apopka
- Met-52 = *Metarhizium anisopliae-* used for root aphids on marijuana crops