GROWERTALKS

Features

3/31/2016

Fighting Fungus Gnats

John Sanderson

Fungus gnats (*Bradysia sp*.) are among the most common insects to be found in a greenhouse. Everyone seems to have at least a few of these around, but they can become serious pests. This article will cover basic information about fungus gnats and their management, including some brief comments on recent knowledge we've gained via research at Cornell University.

Damage and importance

The first few weeks of a crop are usually the most critical for fungus gnat control. Chewing by the soil-dwelling larvae can cause direct root damage. Seedlings, unrooted cuttings and young plants without fully developed root systems are particularly susceptible to their damage. Larval feeding can interfere with callus formation and, thus, root initiation on unrooted cuttings. Adult fungus gnats don't cause direct damage to plants, but are considered a nuisance pest to consumers.

In addition, adults and larvae have been implicated in the transmission of pathogens that cause root diseases, including Thielaviopsis, Verticillium and Fusarium. Larvae may transmit fungal plant diseases via their excretion. Adults may transmit these diseases via excretion or by carrying pathogen spores on their bodies.

In the past, it was assumed that Pythium root rots could also be transmitted by fungus gnats, but Dr. Sarah Braun's Ph.D. research at Cornell showed that fungus gnat adults do not transmit this pathogen, though they readily can transmit Thielaviopsis. She also showed that fungus gnat larvae are very unlikely to transmit Pythium root rots.

Figure 1. Fungus gnat adults have long gangly legs, many-segmented antennae that are longer than their heads and have a single pair of grayish transparent wings.

Figure 2. A fungus gnat adult captured on a yellow sticky trap. Note the Y-shaped vein near each wing tip, which is diagnostic for fungus gnats.
Figure 3. Adult shore flies differ from fungus gnats by their more robust bodies, short antennae and distinctive whitish spots on their gray wings.



Figure 4. Shore fly captured on a yellow sticky trap. Note the diagnostic whitish spots on the wings.
Figure 5. Fungus gnat larva. Note the translucent body and distinctive black head capsule.
Figure 6. Fungus gnat larva that's been infected by Steinernema feltiae nematodes, which can be seen inside this larva.

Identification

Adult fungus gnats are small (approx. 1/8-in. long), blackish gray, gnat-like flies with long gangly legs, many-segmented antennae that are longer than their heads, and have a single pair of grayish transparent wings with a Y-shaped vein near each wing tip (see Figures 1 and 2). They're weak flyers and may be found running/flying near soil or pot level. It's easy to confuse fungus gnat and shore fly adults because they generally are found in the same moist-soil environment and are both very common. Adult shore flies differ from fungus gnats by their more robust bodies, short antennae and distinctive whitish spots on their gray wings (see Figures 3 and 4).

Fungus gnat larvae are the plant-damaging stage of this insect. They're usually concentrated in the top 1 to 2 in. of the growing media, but may be found throughout the pot. The larvae are translucent, worm-like, with a distinctive black head capsule, and are about 1/4-in. long at their largest, just prior to pupation (see Figure 5). Larvae might be seen crawling at the surface of the growing medium if the population is very high. Very careful observers may note some very fine webbing that the larvae spin in little spots on the soil surface.

Biology

Mated adult females deposit up to 200 eggs singly or in clusters in crevices on the surface of the growing media. Sarah's Ph.D. research also showed that adult females prefer to lay eggs on substrates with lots of microbial activity, whether bacterial or fungal organisms. Larvae prefer to feed on fungi rather than healthy plant tissue. Although fungus gnat larvae can eat plant material, they need fungi in their diet for optimal survival, development and reproduction. At 68F (20C), they can develop from egg to adult in 27 days and their development speeds up to only 21 days at 86F (30C). They take a much-longer 62 days at 59F (15C), which is important to know when growing at cooler, energy-saving temperatures. They don't appear to thrive at very high temperatures.

Management

Fungus gnat adults can be monitored along with most other flying greenhouse pests by positioning yellow

sticky cards vertically just above the crop canopy (see Figure 2). Count them weekly and record the numbers to see if the infestation is increasing or decreasing. Because fungus gnats are often particularly damaging to young plants, monitor for adults several weeks before a crop is started and continue to monitor as the infestation is cleaned up before the new crop is started. To monitor whether larval control is being achieved, use raw potato slices (at least 1-in. thick) or wedges, placed cut-side down on the surface of the growing medium. Check the slices after a week and note the numbers of larvae found on the potato slices and on the soil surface beneath the slices. If larvae are still found on the slices soon after an insecticide application that targeted the larvae, then the application may not have been effective.

Cultural/mechanical: Adults are strongly attracted to microbial activity in soil/media. Good sanitation is vital. Clean up spilled growing media, clean up algae and fix plumbing leaks. Avoid overwatering and sloppy irrigation. Weed control inside and outside the greenhouse is important. Keep compost piles well away from production areas. Cycle plants through the greenhouse as quickly as possible. Some growers have greatly reduced fungus gnat and shore fly adult levels by stretching strips of 6-in. wide sticky yellow plastic ribbon throughout the greenhouse near the soil level along the sides of benches, or beneath benches, in areas of adult activity.

No growing mixes are immune to fungus gnat infestation, but fungus gnat numbers can vary among growing mixes. We conducted experiments at Cornell University with several conventional and organic substrates to determine their attractiveness to adult fungus gnats and to see if fungus gnats reproduced in higher numbers in some mixes than in others. Interestingly, we found that none of the growing mixes we tested, whether conventional or organic, was more attractive than the others to fungus gnat adults. However, there were large differences in the number of adults that developed in and emerged from the different substrates.

On average, more than three times as many fungus gnats emerged from the organic substrates than the conventional ones. Either more eggs were laid in the organic substrates with microbially active components or more of the eggs that were laid successfully developed into adults.

Furthermore, it seemed that substrates that held more water tended to produce more fungus gnats. Our assumption was that wetter substrates encouraged the growth of the microbes on which the larvae fed. Should organic substrates be avoided? Not necessarily—the advantages of using organic substrates may outweigh the possible fungus gnat problems. But growers should be forewarned with a fungus gnat management program ready, regardless of growing medium. Careful attention to growing as dry as possible can reduce numbers.

Biological: Biocontrol of fungus gnats is among the most successful greenhouse biocontrol programs, especially when combined with good cultural practices. Releases of natural enemies should begin when populations are low—at or before the start of a crop. There are a number of beneficial organisms that attack fungus gnats, some of which are purchased and some that may appear naturally.

1 | Nematodes | Recent research at Cornell University has confirmed that Steinernema feltiae nematodes (Nemasys, Steinernema-System, Entonem, Scanmask) are more effective than S. carpocapsae nematodes for fungus gnat larvae under greenhouse temperatures in temperate regions (Figure 6). If using overhead watering, make the first application at planting, or soon after, then repeat every two weeks. Irrigate the day

before application to be sure that the mix is moist because nematodes require moisture for dispersal. Follow the distributor's application directions. We've recently seen that nematodes may persist in the growing mix and remain effective for more than four to six weeks after a single drench application, if sub-irrigation is used, so that the nematodes aren't washed or leached out of the containers, as might be the case with overhead watering. Nematodes aren't usually good at reducing a serious infestation—one reason why applications should begin at the start of the crop. Steinernema feltiae will also attack Western flower thrips pupae in the soil.

2 | Bacteria | Gnatrol is applied as a soil drench. The active ingredient is a bacterium (Bacillus thuringiensis var. israelensis) that must be ingested by fungus gnat larvae. The bacterial toxin that kills the fungus gnat larva is only effective for 48 hours after application, so repeated treatments with higher label rates at three to five-day intervals might be needed for serious infestations.

3 | Predators | Releases of the predaceous mite Strateolaelaps (formerly known as "Hypoaspis") spp. may also give good control. Release soon after planting. A single release has provided six to eight weeks of control in some cases. The predators are capable of establishing and spreading throughout a greenhouse if the environment is favorable. They live in the top layer of soil and feed on any small arthropods they encounter (including thrips pupae). Check each shipment for viability—gently rotate the bottle to mix, then shake a small amount of vermiculite carrier onto a sheet of paper. Using a hand lens, look for rapidly moving, light-brown mites. Potato slices used for fungus gnat larval monitoring may also be useful for Hypoaspis monitoring.

4 | Rove beetles | A predaceous rove beetle, Dalotia (formerly known as "Atheta") coriaria, is also commercially available and easy to release and establish in the greenhouse soil. These are voracious predators, mostly active at night, eating almost any soil-dwelling insect or mite. Some growers are boosting their rove beetle populations with "Atheta boxes" (see Figure 7). An inch or two of growing mix is placed into a plastic or Styrofoam box that has drainage holes to avoid soggy soil and a 2-in. diameter hole in each side covered with window screen so the small beetles can escape but fungus gnats can't enter. A small amount of commercial trout food or turkey-rearing crumbs are placed on the soil surface to feed the beetles. About 50 to 100 beetles are then added to the box, which is then covered and placed in the greenhouse. Check for beetles at least weekly and keep the media moist, but not soggy.

Figure 7. Styrofoam box used to rear the predaceous rove beetle, "Atheta," and allow the beetles to escape from the box and disperse into the greenhouse to eat soil-dwelling pests, such as fungus gnat larvae and Western flower thrips pupae.

5 | Others | A small parasitoid wasp, Synacra paupera, often occurs naturally in greenhouses and parasitizes

fungus gnat larvae. Also, Cornell research by M.S. student Emily Sensenbach and postdoctoral scientist Dr. Todd Ugine measured the voracious predation by the predaceous hunter fly, Coenosia attenuata, that now occurs naturally in many greenhouses. Hunter fly adults readily attack adult fungus gnats and shore flies, killing 100 over their adult lifespan. And hunter fly larvae are soil-dwelling predators, each capable of killing more than 200 fungus gnat larvae.

Chemical: Some insecticides used for fungus gnat control are insect growth regulators and only affect larval stages, not adults. Both an adulticide and a larvicide may be needed against serious infestations, though it's generally best to target the larvae. Adept, Citation, Distance/Fulcrum and Pylon tend to be effective, though each label should be checked and followed carefully for application instructions, crop restrictions and to avoid plant damage on certain crops. TriStar, Flagship, Marathon/Discus and generics, and Safari are also effective against the larvae, though these are all neonicotinoid insecticides that some growers may be avoiding. **GT**

John Sanderson is a Professor of Entomology at Cornell University in Ithaca, New York.