Management of Fungus Gnats and Shore Flies

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Fungus gnats and shore flies are commonly associated with greenhouse plant production. Fungus gnats are flies in the Family *Sciaridae*. There are several fungus gnat species in the genus *Bradysia*. Shore flies are in the Family *Ephydridae* and are often confused with fungus gnats. This confusion probably is because the two insect groups are found in similar locations within the greenhouse. The most common species found in greenhouses in the U.S. is *Scatella stagnalis*. Fungus gnats and shore flies have four developmental stages—egg, larva, pupa and adult.

In addition to being nuisances, both insect groups can cause other problems. Fungus gnat larvae can damage healthy roots, stunting or killing young plants during propagation. There have been reports of 20% to 40% of plants lost in propagation due to fungus gnat injury. Shore fly adults and larvae feed on algae. They do not normally injure plants through direct feeding. There are links between fungus gnats and/or shore flies and several plant pathogen genera, including *Pythium*, *Verticillium*, *Cylindrocladium*, *Sclerotinia* and *Theilaviopsis*. Both adults and larvae may carry spores on or in their bodies and may carry them from diseased to healthy plants.

Fungus gnats normally follow a predictable cycle in any planting. The first two generations are the largest, followed by a leveling-off or decline in numbers. Continuous production (i.e. adding new plants in fresh growing media) may keep fungus gnat numbers high, because the insects will keep moving to the potting mix containing the

fresh media. Shore flies often appear after the fungus gnat numbers begin to decline and after algae becomes widespread.

Yellow sticky traps are useful for detecting adults of both insect groups. Vertical or horizontal traps can be used, but horizontal traps are more effective. Check the traps weekly to determine whether numbers are increasing or decreasing. Fungus gnat larvae can be detected by placing potato slices on the potting mix surface. Lifting the slices after 24 hours or so will show larvae on the potting mix surface as well as the potato slices. This method will not work for shore fly larvae.

Integrated management consists of cultural, chemical and biological methods. There are possibilities in all of the categories.

Cultural Methods

Potting mixes vary in their attractiveness to fungus gnats, and/or capacity to produce these insects. "Immature" composts, less than six months old, may be more attractive to fungus gnats and promote higher survival.

Water management may help reduce fungus gnat and shore fly numbers. Overwatering will contribute to their development, as will areas under benches that remain constantly wet due to poor drainage, leaks, etc. Algae will grow in these areas as well, providing a food source for shore flies. Too little water may increase fungus gnat injury, because the larvae may enter plant stems searching for moisture.

Sanitation within the production areas will help. Greenhouses with weedy areas may have more problems with fungus gnats and shore flies than clean facilities. If fungus gnats are constant problems in propagation areas, separating these areas (e.g. using screening) from the main plant production areas and the outside will help.

Chemical Methods:

Table 1 lists the insecticides specifically registered for fungus gnat larval and adult control. A combination program involving larval and adult control will be necessary, if the infestation is well established. Fenoxycarb is registered for shore fly control.

Table 1. Insecticides registered for control of fungus gnats in the U.S.		
Pesticide	***Adults***	***Larvae***
azadirachtin (Azatin)		X
Bacillus thuringiensis-H14 (Gnatrol)		X
chlorpyrifos (Duraguard)	X	X
fenoxycarb (Precision)		X
kinoprene (Enstar II)		X
oxamyl (Oxamyl 10G)		X
cyfluthrin (Decathlon)	X	
resmethrin (resmethrin EC26, PT 1200)	X	
pyrethrum (PT1600A, PT 170)	X	

Biological Control

Biological controls include predatory mites and entomopathogenic (beneficial) nematodes. Nearly all of the experimental data have been obtained against fungus gnats, not shore flies. The predatory mite *Hypoaspis miles* are being successfully used for fungus gnat control on greenhouse vegetables and ornamentals. The tiny mites are released at a rate of five to 50 per container and will feed on fungus gnat larvae. The mites can even be pre-mixed in the potting media.

Beneficial nematodes are available for fungus gnat control and are also being evaluated against shore flies. Worldwide, several nematode species and isolates within species are now available for fungus gnat control. In the U.S., *Steinernema carpocapsae* isolates are commonly used, but other species, notably *S. feltiae* and *Heterorhabditis* sp. are, or soon will be, available.

Nematodes do not kill the insects directly but enter bodies through openings and release bacteria, which multiply rapidly. The bacteria, which are harmless to humans and other animals, kill the insect. The insect usually dies one or two days after invasion by the nematodes. The nematodes reproduce in the body of the insect, feed on the bacteria and leave the dead insect to seek or await other hosts.

Figure 1 shows results of a laboratory experiment in which nematodes and *Hypoaspis* were used for fungus gnat control. Fungus gnat larvae were placed in moist potting mix in plastic petri dishes. A single application of nematodes or *Hypoaspis* was made. Percent mortality was calculated based on the number of larvae placed in each petri dish and subsequent adult emergence. All nematodes provided some control, but there were differences. *S. carpocapsae* from Biosys (=Exhibit™ from Ciba) was the least effective nematode.

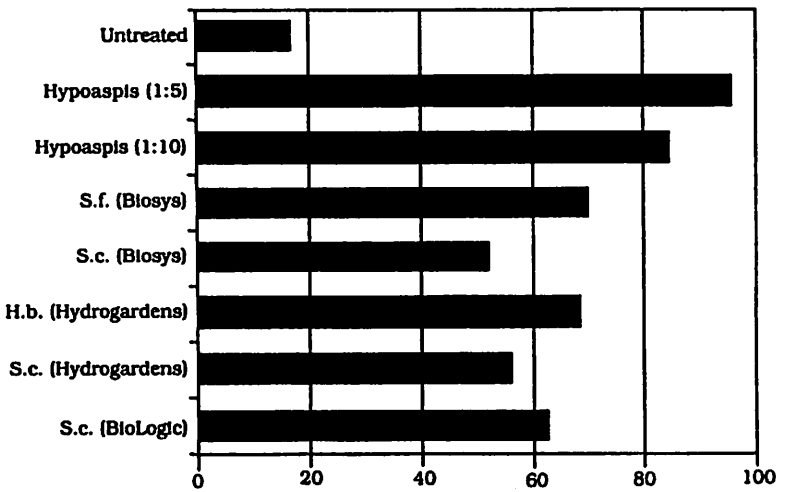

Figure 1. Laboratory evaluation of nematodes and Hypoaspis predatory mites for fungus gnat larval control. Bars represent percent mortality, based on adult emergence. All nematodes applied once at 3 billion/acre. S.c. = Steinernema carpocapsae; S.f. = Steinernema feltiae; H.b. = Heterorhabditis bacteriophora. Numbers in parenthesis after Hypoaspis are predator:prey ratios. Words are company sources of the nematodes.

Most experiments in North America and Europe have generally shown *S. feltiae* to be the better nematode to use against fungus gnats. *Hypoaspis* mites at predator:prey ratios of either 1:10 or 1:5 were more effective than any nematode evaluated. As mentioned above, these mites have been quite successful in controlling fungus gnats. A combination of mites and nematodes also is effective. Results against shore flies have not been as clear, possibly because of the habitats in which the larvae are found. The nematodes and predatory mites used for insect control are not aquatic organisms and may not survive well in areas containing shore fly larvae.

For fungus gnat management, the first few weeks of establishing a new planting are the most important. Shore flies usually appear later. Monitoring for fungus gnat adults (and shore fly) larvae is very important.

(Reprinted from the *Proceedings of the 1994 New England Greenhouse Conference*, pp 110-112. Note: If you missed the 1994 NEGC and would like a copy of the proceedings see instructions on page 28.)