FUNGUS GNATS, SHORE FLIES, MOTH FLIES, AND MARCH FLIES

Integrated Pest Management in the Home, Interior Plantscapes, Greenhouses, and Nurseries

Fungus gnats, shore flies, moth flies, and March flies occur around damp, decaying vegetation, algae, and fungi. These flies can appear in large numbers in or around buildings, prompting complaints, and also can be a problem in greenhouses, nurseries, and interior plantscapes.

Fungus gnats infest soil and container media, where larvae feed on organic matter and roots. Shore flies live in or on algal scum or very wet, decomposing organic matter and are common in greenhouses and outdoor areas where conditions are damp. Moth flies commonly occur in bathrooms or kitchens, where larvae feed on muck in shower and sink drains. March flies live outdoors and are a nuisance when large numbers are attracted to lights.

DAMAGE

Adult fungus gnats, shore flies, moth flies, and March flies primarily are a nuisance. March flies, for example, are so named because adults of some species appear in large numbers during spring and fly to windows or porch lights. Adults may swarm along roads, annoying motorists by fouling windshields. Although March flies can enter buildings, they do not reproduce or develop in buildings. Fungus gnats and moth flies, however, can both enter buildings as flying adults and develop indoors through all life stages. Shore flies are unlikely to reproduce indoors, except in greenhouses. Fungus gnats, shore flies, moth flies, and March flies do not bite people or animals and, in the United States, are not known to carry human pathogens.

Only fungus gnats commonly damage plants (Fig. 1). Larvae of these flies feed on roots, thus stunting plant growth. Root damage can occur in interior plantscapes and in houseplants if high populations infest moist, organic-rich soil. Fungus gnat larval damage can be especially serious in greenhouses, nurseries, and sod farms. In addition to larvae chewing on roots, both larvae and adults can spread plant pathogens and may promote disease in commercial crops.

Abundant numbers of adult shore flies can leave unsightly frass spots (fecal droppings) on foliage. Root feeding by larvae is relatively uncommon. Shore flies may spread soil-dwelling pathogens, but this is uncertain and may be of little importance. Shore flies are frequently confused with fungus gnats, and they often occur together. Fungus gnats are usually more important pests, because they damage plant roots.

Moth fly larvae sometimes chew plant roots in greenhouses, but this is relatively uncommon. Moth flies in buildings feed primarily inside drain pipes but are not damaging to plumbing.

Although larvae of these species may feed on plant roots outdoors, none causes serious damage outside the home. Any root feeding by these species in gardens or landscapes is usually minor in comparison with their beneficial role as decomposers in helping to convert dead vegetation into nutrients for plant growth.

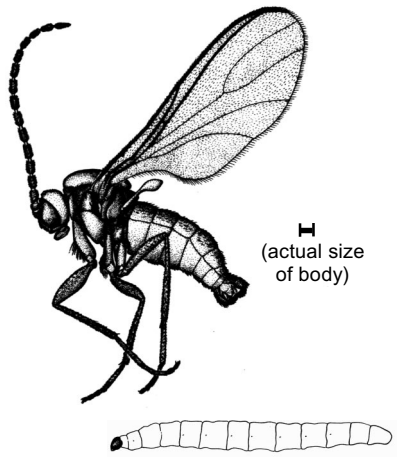

Figure 1. Fungus gnat adult and larva.

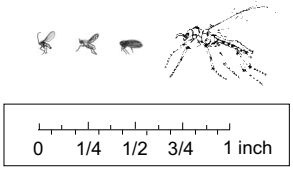

Figure 2. Relative sizes of (from left) fungus gnat, shore fly, moth fly, and March fly.

IDENTIFICATION

Fungus gnats (families Mycetophilidae and Sciaridae), shore flies (family Ephydridae), moth flies (family Psy-

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chodidae), and March flies (family Bibionidae) are all flies (order Diptera). The adults are sometimes confused with each other (Fig. 2) and with species in other families of small flies not discussed here, including black flies (family Simuliidae), midges (family Chironomidae), and mosquitoes (family Culicidae). If you are unable to determine what kind of fly you have, take samples to your county Cooperative Extension office or university entomology department for identification. Some nurseries and garden supply stores will also help you identify flies.

Fungus Gnats

Adult fungus gnats are dark, delicate-looking insects, similar in appearance to mosquitoes. Adult fungus gnats have slender legs with segmented antennae that are longer than their head. Although a few species are up to ½ inch long, adults commonly are about 1/16 to ⅛ inch long. Wings are light gray to clear; the common *Bradysia* species have a Y-shaped wing vein as illustrated in Figure 1. Fungus gnats are relatively weak fliers and usually are not found flying around indoors. They generally remain near potted plants and often run or rest on growing media, foliage, or litter.

Females lay tiny eggs in moist organic debris or potting soil. Larvae have a shiny black head and an elongate, whitish to clear, legless body. They eat organic mulch, leaf mold, grass clippings, compost, root hairs, and fungi. If conditions are especially moist and fungus gnats are abundant, larvae can leave slime trails on the surface of media that look like trails from small snails or slugs.

Shore Flies

Adult shore flies, like the common species *Scatella stagnalis*, are robust with short legs (Fig. 3). Antennae are bristlelike, shorter than the head, and not obvious. Their wings are dark, with five light spots. Shore flies are stronger, faster fliers than fungus gnats but are less likely to take flight than the more easily disturbed fungus gnats.

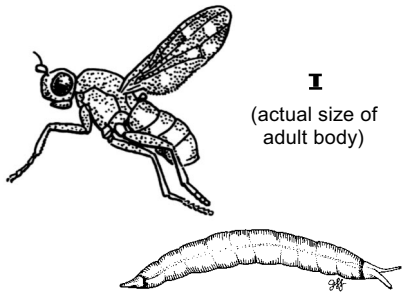

Figure 3. Shore fly adult and larva.

Shore fly larvae have a plump, brownish yellow, maggotlike or wedge-shaped, legless body, up to about ⅛ inch long. Larvae have no distinct head capsule, but their dark mouthparts and internal organs may be visible through their outer skin. Shore fly larvae have a distinctive forked, dark-tipped breathing tube at their tail. Shore flies have several generations each year.

Moth Flies

Moth flies are also called drain flies, filter flies, or sewer flies. Adults appear grayish or dark because of the many fine hairs covering their wings and body (Fig. 4). Moth flies indoors are commonly observed resting with their wings held rooflike over their body on bathroom walls and around drain surfaces.

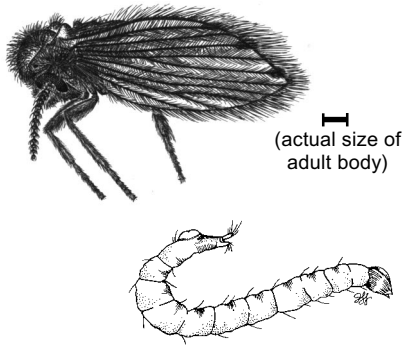

Figure 4. Moth fly adult and larva.

Mature larvae are less than ¼ inch long. They are somewhat flattened, have a distinct head, and small suction discs along their underside for adhering to slippery surfaces. Like other fly larvae, they have no true legs. Larvae feed in decaying organic matter, commonly within drains on the gelatinous film underneath drain plugs and screens and inside of pipes.

March Flies

March flies are usually dark brown or black, although the midbody of some species is reddish or orange. Its head points downward and is relatively small in comparison with body size (Fig. 5). Most adults are larger than the other flies discussed here; about ⅜ inch is a common size. March flies are relatively slow fliers and usually remain within a few feet of the ground. Adults may be seen on the ground or on sidewalks lying on their back struggling to upright themselves. Mating pairs of some species spend long periods flying or resting with their tails linked together. In Florida and Gulf Coast states where March flies are especially abundant, they are called lovebugs.

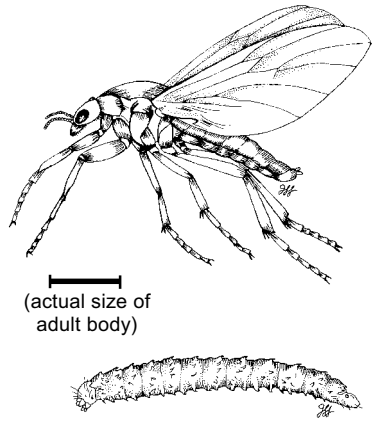

Figure 5. March fly adult and larva.

The larva is ⅜ to 1 inch long at maturity. It has a legless, cylindrical body that is dirty white, yellowish, or dark brown, with short spinelike projections

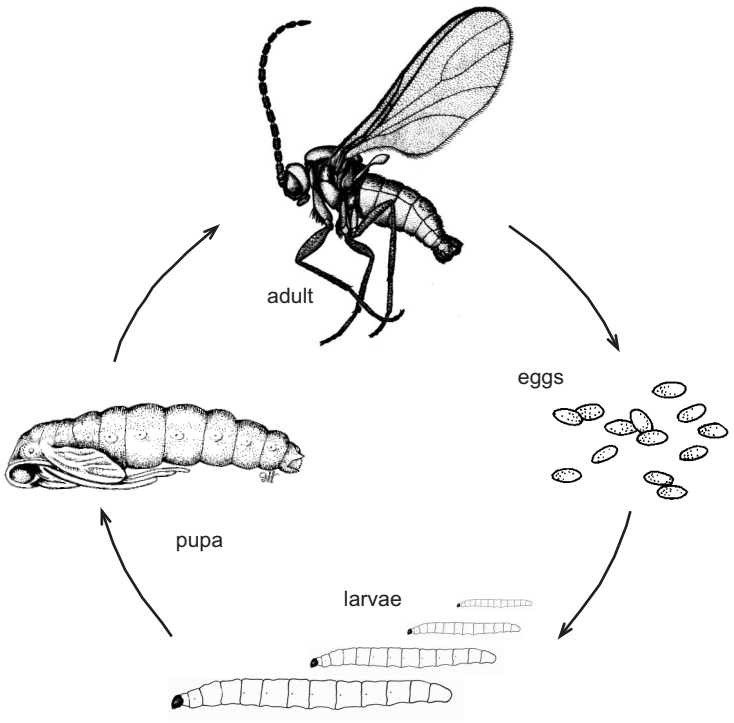

Figure 6. Life cycle of a fungus gnat.

on most segments and a distinct dark brownish head. March fly larvae feed primarily on decomposing plant matter including vegetables and fruit, but have also been found (at nondamaging levels) feeding on grass roots in lawns.

LIFE CYCLE

All four flies develop through four stages as illustrated for fungus gnats: egg, larvae (four larval stages or instars), pupa, and adult (Fig. 6). Fungus gnats, shore flies, and moth flies have many generations each year. Outdoors they are most common during winter and spring in interior areas of California. They occur anytime of year in moist coastal regions and indoors. Some species of March flies have only one generation a year. Each March fly species tends to be abundant during a certain season, usually spring.

Adults feed very little, consuming only liquids, such as water or flower nectar. The tiny eggs and oblong pupae occur in damp places where larvae feed.

MANAGEMENT

Physical and cultural methods—primarily screening windows and doors as well as reducing moisture and organic debris—are recommended for managing all of these flies. Biological control agents are also available to control fungus gnats. Insecticides are used in commercial plant production, but are not generally recommended for control around the home. Most of these insects' life span is spent as larvae and pupae in organic matter or soil, so most control methods target the immature stages, not the mobile and short-lived adults.

Monitoring

Visual inspection for adults is usually adequate to determine whether there is a problem. Adults can be observed resting on plants, soil, windows, or walls, or they may be seen in flight. Besides looking for adults, check outside near buildings for excessively moist conditions and organic debris where larvae may be feeding. These are the places to take control actions, as discussed in "Cultural Control." Yellow sticky traps or potato pieces for monitoring may be warranted as discussed in "Management Tools for Professionals" if you suspect that container plants or interior plantscapes are infested with fungus gnats or shore flies.

Cultural Control

Fungus gnats, shore flies, moth flies, and March flies thrive under moist conditions, especially where there is an abundance of decaying vegetation and fungi; avoid overwatering and provide good drainage. Allow the surface of container soil to dry between waterings. Clean up free-standing water and eliminate any plumbing or irrigation system leaks. Moist and decomposing grass clippings, compost, organic fertilizers, and mulches are favorite breeding spots. Avoid using incompletely composted organic matter in potting media unless it is pasteurized first, because it often is infested with fungus gnats. Minimize organic debris around buildings and crops where larvae feed. Avoid fertilizing with excessive amounts of manure, bloodmeal, or similar organic materials.

Physical Control

Keep doors, vents, and windows closed or screened to prevent insects from flying into buildings. Do not bring plants with infested soil indoors. Periodically turn and aerate compost piles where fly larvae feed. Locate compost away from doors and windows and keep it covered. Purchase and use only pasteurized container mix or treat potting soil with heat or steam before using it; this will kill flies as well as the algae and microorganisms they feed on. Store pasteurized potting soil in closed containers to prevent it from becoming infested before use. Generally the only control needed for moth flies developing indoors is to fix leaking plumbing and clean muck that collects in drains or under dripping taps. Brush or wash away slime under drain plugs, screens, and inside the top of drain pipes, above the water level in

the J-trap (the U-shaped pipe under sinks).

Biological Control

Predators, such as rove beetles (family Staphylinidae) and ground beetles (family Carabidae), help control fly larvae outdoors in areas not sprayed with broad-spectrum insecticides. Commercially available *Steinernema* nematodes, *Hypoaspis* mites, or the biological insecticide *Bacillus thuringiensis* subspecies *israelensis* (Bti) can be applied to control fungus gnat larvae in container media.

Nematodes can provide relatively long-term control of fungus gnat larvae and they can be self-reproducing after several initial applications to establish their populations. *Steinernema feltiae* is apparently more effective against fungus gnats than other commercially available nematode species. Bti does not reproduce or persist; infestations in media may require repeated applications at about 5-day intervals to provide control. Mix Bti or nematodes with water and apply as a soil drench or spray onto media using conventional spray equipment.

Chemical Control

Insecticides are rarely, if ever, warranted to control these flies around homes. However, if insecticides are required for fungus gnats, consider using *Bacillus thuringiensis* subsp. *israelensis* or *Steinernema feltiae* nematodes to control the larvae in plant containers (see "Biological Control").

If Bti or nematodes are not available and high populations are intolerable, pyrethrins or a pyrethroid can provide temporary, fast-acting control. Pyrethrins have low toxicity to people and pets and are the active ingredients in the botanical pyrethrum, from flowers of certain chrysanthemums. Pyrethroids (e.g., bifenthrin, permethrin) are synthesized from petroleum to be chemically similar to pyrethrins, but often are more effective and persistent, as well as being more toxic to beneficial insects. When using these on houseplants or interiorscape containers, it may be best to move plants outdoors for treatment and wait about a day after application before bringing them back inside.

MANAGEMENT TOOLS FOR PROFESSIONALS

In commercial situations, management options include those discussed in Table 1, special monitoring methods, and insecticides. When using biological pesticides to control these pests, apply them as soon as fungus gnats are present. If large populations of fungus gnats are already present, these materials may be less likely to provide satisfactory control. A good monitoring program will help detect fungus gnat populations when they are at low levels.

Potato Cubes or Slices

Fungus gnat larvae migrate to feed on the underside of potato pieces placed in media. To determine whether container media are infested, use 1-inch cubes or slices of peeled raw potato imbedded about ⅜ inch deep into media. Pick up and examine the underside of each potato and the soil immediately beneath it about once or twice a week. Compare numbers of larvae before and after any treatment to determine whether larvae are being controlled.

Sticky Traps

Bright yellow traps, 3 x 5 inches or larger, are used to detect and identify flying insects. Traps containing insects can be wrapped with clear plastic (e.g., Saran Wrap) and taken to an expert for identification. Numbers of insects caught are not often a good indication of the number of pests infesting plants. Sticky traps are unlikely to provide pest control.

Orienting traps horizontal to the ground (facing the soil) is sometimes recommended when monitoring fun-

Table 1. Commercially Available Biological Pesticides and Natural Enemies for Controlling Fungus Gnat Larvae.

Biological: *Bacillus thuringiensis* subspecies *israelensis* (Bti) (Gnatrol)

Comments: A naturally occurring, spore-forming bacterium produced commercially by fermentation. Bti applied at labeled rates provides temporary control and is toxic only to fly larvae, such as mosquitoes, black flies, and fungus gnats. Repeat applications commonly are needed for long-term control. This Bt is a different subspecies from that applied to foliage to control caterpillars. Bt labeled for caterpillars is not effective against fly larvae.

Biological: *Hypoaspis* (=*Geolaelaps* or *Stratiolaelaps*) *miles*

Comments: A light brownish predaceous mite adapted to feeding in the upper layers of moist soil. Preys on fungus gnat larvae and pupae, thrips pupae, springtails, and other tiny invertebrates. Commercial mites commonly are shipped in a shaker type container used to apply them. Recommended rates in commercial nurseries are about one-half dozen to several dozen mites per container or ft^2 (0.1 m^2) of media. Make applications before pests become abundant. *Hypoaspis* probably will not perform very well in individual houseplants and probably is not a good choice for use in homes.

Biological: *Steinernema feltiae*

Comments: Nematode effective when temperatures are between 60° to 90°F (16° to 32°C) and conditions are moist. Can be applied as a soil drench and to media using conventional spray equipment. Nematodes reproduce and actively search for hosts, so under moist conditions they may provide season-long control after several initial applications to establish populations.

NOTE: These materials are essentially nontoxic to people and are compatible for application in combination. Bt and nematodes are available from many well-stocked nurseries and garden supply stores. Predaceous mites, and also Bti and nematodes, are commercially available through mail order from special suppliers (see *Suppliers of Beneficial Organisms in North America,* listed in "References").

gus gnats emerging from media. Vertical trap orientation (perpendicular to the soil surface) is more efficient overall if traps are also being used to monitor adults of other kinds of insects. Orient vertical traps so their bottom is even with the top of the plant canopy. Regularly adjust traps upward as plants grow. Hang traps from wires or use clothespins to clip the trap to a stick placed in media. Inspect traps at the same regular interval, once or twice a week. Count and record the number of each type of pest caught. Counting only the insects in a vertical, 1-inch-wide column on both sides of the trap gives results that are representative of the entire trap. Do not reduce trap size to 1-inch vertical strips.

Insecticides

Insect growth regulators (e.g., azadirachtin, kinoprene, diflubenzuron, cyromazine) applied to container media can be the most effective insecticides for controlling larvae. Drenching media with an organophosphate (acephate, malathion) or carbamate (carbaryl) also kills larvae, but this can be hazardous and will kill many different organisms, including beneficial species. For greenhouse applications, be sure the label specifically allows this use. Strictly follow all directions and precautions on the pesticide label.

Hydrated lime and certain registered materials like Agribrom and copper hydroxide are available to control algae under and around container-grown plant benches. Good control of algae can largely eliminate shore flies and may help to control fungus gnats and moth flies. Agribrom is effective and easy to use when applied through greenhouse irrigation systems at a rate of 10 to 35 ppm bromine for an initial application, followed at the recommended intervals by 5 to 10 ppm treatments as maintenance applications. These rates are generally not phytotoxic and give effective control.

Copper hydroxide can be applied about once per month as labeled. A slurry of 1 to 1½ pounds lime per gallon of water applied about every 3 to 4 months controls algae. Prevent contact with plants because copper hydroxide can be phytotoxic. Some counties may restrict growers' use of hydrated lime. Avoid contaminating water with these materials.

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Fig. 1 larva–17th St. Studio; adult–from Gorham, J. R., ed. 1991. *Insect and Mite Pests in Food: An Illustrated Key*. Washington, D.C.: U. S. Dept. Agric. Handb. 655
Fig. 2–adapted from other figures.
Fig. 3 larva–J. L. Lockwood; adult–17th St. Studio
Fig. 4 larva–J. L. Lockwood; adult–from Gorham, J. R., ed. 1991. *Insect and Mite Pests in Food: An Illustrated Key*. Washington, D.C.: U. S. Dept. Agric. Handb. 655
Fig. 5 J. L. Lockwood
Fig. 6 eggs and pupa–J. L. Lockwood; larvae–17th St. Studio; adult–from Gorham, J. R., ed. 1991. *Insect and Mite Pests in Food: An Illustrated Key*. Washington, D.C.: U. S. Dept. Agric. Handb. 655

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