Managing Fungus Gnats in Container Nurseries
By Thomas D. Landis

Way back in the late 1980's, when I was working on the nursery pests chapter for the Container Tree Nursery Manual, I did a lot of research on fungus gnats because I'd found them to be a serious pest in my nursery. The entomologists that I talked to then considered them to be more of a nuisance than a real threat to container stock but I'd observed injury to both seeds and seedlings. Boy, have things changed. In the past 25 years, there have been many articles published on fungus gnats and their control.

Fungus gnats (*Bradysia* spp.) are small, black flies that are a common nuisance in greenhouses, but actually, the adults are harmless. The larvae, however, can feed on the roots of young succulent tree seedlings, cuttings, or fleshy seeds when conditions are favorable. In a survey for the Container Tree Nursery Manual, fungus gnats placed fifth in the ranking of insect pests. The role of these insects in disease transmission has always been suspected and now has recently been confirmed. The adult gnats can carry spores of fungi and bacteria from one container to another and may be one of the primary reasons for the formation of disease pockets.

Hosts. The larvae normally feed on soil fungi and organic matter, but larger larvae can attack healthy root tissue of many plants including tree seedlings. Seeds and cuttings of many native plants have also been damaged.

Symptoms & damage. The first evidence of a fungus gnat problem is the presence of the adults, which hover around the host plants and fly when disturbed. Fungus gnat adults are small, dark, mosquito-like flies that are initially difficult to distinguish from to many other small flies common in greenhouses. In particular, growers often confuse fungus gnats with shore flies which are harmless. If you look at a fungus gnat under a hand lens, you can see the "Y"-shaped vein in the wing which is diagnostic (Figure 1A)

Symptoms of injured seedlings include wilting and sudden loss of vigor. Examination of affected plants with a hand lens may reveal the presence of larvae in the upper layer of the growing media. Fungus gnat larvae are legless, semitransparent worms with black heads and range up to 0.5 cm (0.2 in) in length (Figure 1B). Several websites contain excellent color photographs of both fungus gnat adults and larvae which is a great help in identification.

The larvae may consume small roots completely or just the exterior of the larger roots, leaving just the stripped vascular tissue (Figure 2). By the time symptoms become evident, damage is usually so severe that control of the larvae is not practical. Instead, the adults should be controlled as soon as they are noticed.

Life history. Female gnats lay eggs on moist surfaces, preferring growing media that are rich in organic matter. Infestations appear to be most severe in containers that

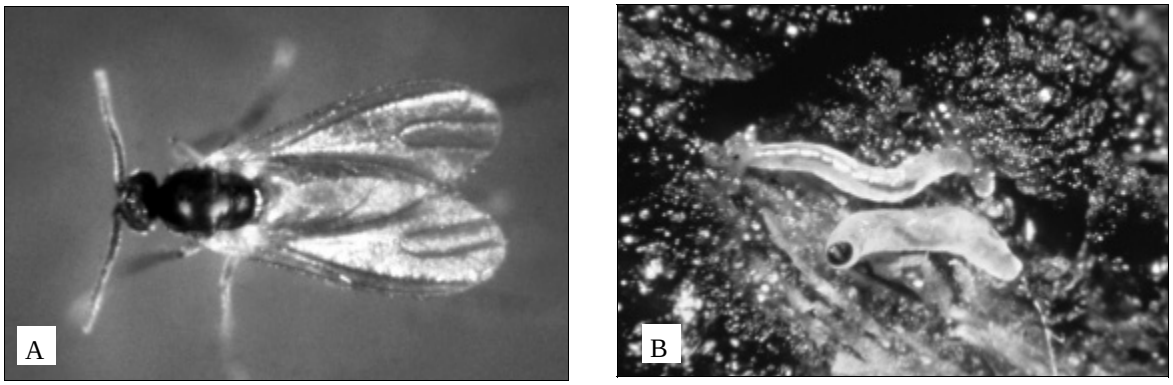

Figure 1—Use a hand lens to confirm the identity of fungus gnat adults – the "Y"-shaped vein in the wing help distinguish them from shore flies (A). Larvae are small, clear worms with black heads (B) which can be difficult to find in the growing medium. (Photos courtesy of Robin Rosetta)

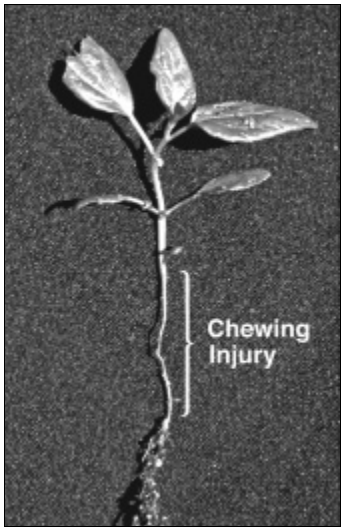

*Figure 2—The larvae of fungus gnats chew on germinating seeds and the roots of seedlings like this quaking aspen (*Populus tremuloides*). These injuries serve as entrance wounds for pathogenic fungi which the adults have been shown to transmit.*

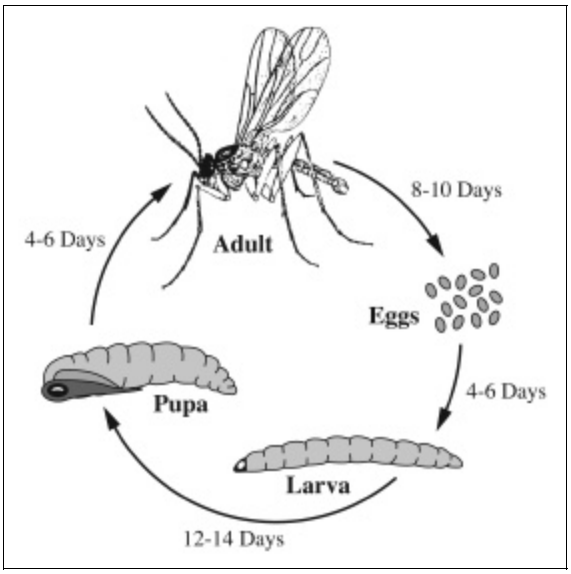

Figure 3—The life cycle of fungus gnats can be less than a month in the warm, humid environment of a greenhouse. Controls should target the larval stage which does the real damage.

contain algae or moss, which develop in response to overwatering. Eggs hatch in about 6 days, and the larvae feed for a couple of weeks and pupate in the growing medium. After 5 to 6 days, the adult flies emerge, completing the life cycle (Figure 3). Because of this short life cycle, populations of dark-winged fungus gnats can build-up rapidly in warm, moist greenhouse environments where algae and moss are present.

Pest management. Prevention and early detection are the keys to controlling fungus gnats and, in my experience, sanitation and proper irrigation practices are crucial.

Monitoring - The most effective way to identify the presence of fungus gnats and monitor their populations is with yellow sticky cards (Figure 4). Adult fungus gnats are attracted to the color and become stuck, and the relative numbers of gnats per card per unit of time gives a good estimate of fungus gnat populations. We are more interested in the number of larvae, however, and so a more recent survey technique has real application. Freshly-cut slices of potato are stuck into the growing medium and left for 48 hours. Recording the number of larvae on or near the discs provided a useful indication of fungus gnat larvae populations (Cabrera and others 2004).

Traditional Pesticides - Insecticides can be used to control either larvae or adults but, since the larvae are doing the damage, it makes more sense to target them. Insecticides can be applied as drenches to control the larvae, but all surfaces where the gnats are breeding must be treated. Hamlen and Mead (1979) tested 12 common insecticides on fungus gnats and found that all were effective, and that surface-applications were as effective as drenches. Today, many more insecticide options are available (Table 1). A recent test of several registered pesticides showed that some are better than

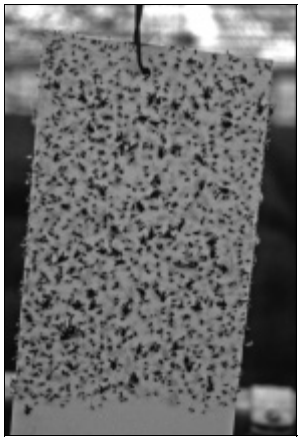

Figure 4—Yellow sticky cards are the most popular way to identify adult fungus gnats but potato slices have also proven useful for monitoring larval populations

Table 1—Insecticides commonly used to control fungus gnats				
Trade Name	**Active Ingredient**	**Type of Pesticide**	**Safety Class**	**Restricted Entry Interval (hours)**
Traditional Pesticides				
DuraGuard™	Chlorpyrifos	Insecticide	Caution	24
Adept®	Diflubenzuron	Growth regulator	Caution	12
Distance®	Pyriproxyfen	Growth regulator	Caution	12
Marathon®	Imidacloprid	Systemic insecticide	Caution	12
Citation®	Cyromazine	Insecticide	Caution	12
Safari™	Dinotefuran	Systemic insecticide	Caution	12
Organic Controls				
Azatin®	Azadirachtin	Growth regulator	Caution	4
Nemasys®	*Steinernema feltiae*	Parasitic nematode	None	0
BotaniGuard® Naturalis O®	*Beauveria bassiana*	Incetivorous fungus	None	4
Predatory Mite	*Hypoaspis miles*	Predatory mite	None	0
Gnatrol®	*Bacillus thuringiensis israelensis*	Pathogenic bacteria	None	0
Sterilants				
ZeroTol™ OxiDate®	Hydrogen dioxide	Algaecide & fungicide	None	0

others and that multiple applications are more effective (Figure 5**)**. Due to their short life cycle, multiple treatments will be necessary to completely eliminate severe fungus gnat infestations.

Although they are not specifically labeled for fungus gnats, chemical sterilants such as hydrogen dioxide kill the spores of algae and moss which reduces their food source. They can be injected into the irrigation system, and when used regularly, operational experience suggests that these products are very effective in controlling fungus gnat populations.

Organic Controls - One encouraging development is the variety of organic controls for fungus gnats that are now available (Table 1). Some have been more effective than others so it makes sense to give some thought to their mode of action. Pathogenic bacteria and fungi are not very mobile and so must come in direct contact with the larvae. On the other hand, parasitic mites and nematodes will actually search out their prey which is extremely helpful when larvae have migrated deep into the growing medium.

Cultural Controls - As previously mentioned, the presence of algae and moss and overwatering provide the ideal conditions for fungus gnats. Cultural control methods involve general greenhouse sanitation: removing infested containers, avoiding excessive irrigation, controlling algae and mosses, and sterilizing containers and surfaces. The type of growing medium affects fungus gnat populations and also the efficacy of

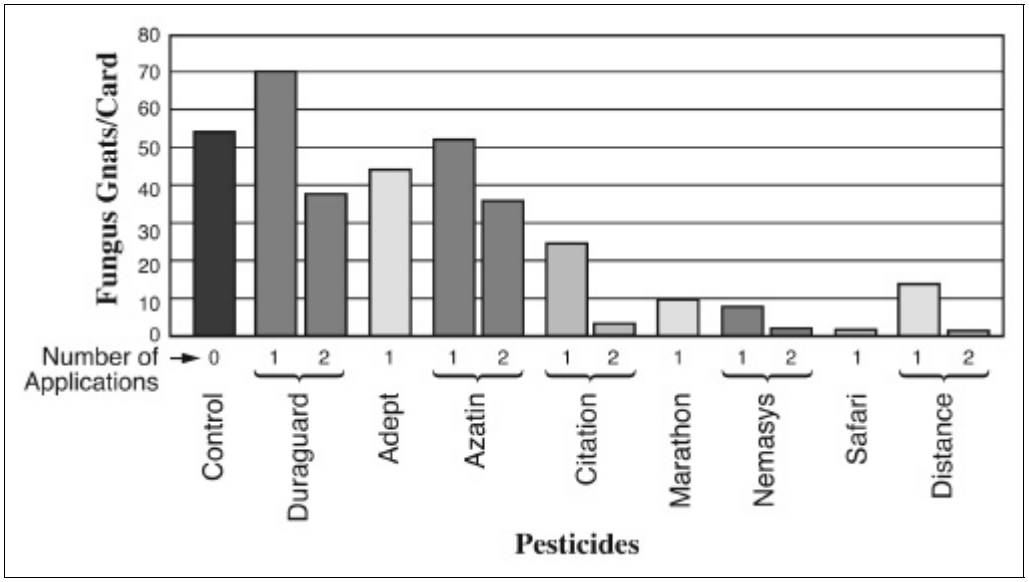

Figure 5—A recent comparison of commercial pesticides and organic controls showed that some products were much more effective than others and that multiple applications are necessary (modified from Fisher and others 2006).

insecticides: more adult fungus gnats emerged and insecticides were less effective in a medium containing composted bark (Lindquist.1996). The type of seed coverings is extremely important. Moss and algae thrive on wet, fertile growing medium surfaces which are an open invitation to fungus gnats. On the other hand, seed coverings such as grit, perlite, and coarse sawdust create a dry surface layer that is not attractive to these common greenhouse pests.

Summary

Fungus gnat larvae are common in greenhouse environments and can do considerable damage to germinating seeds, cuttings, and young seedlings. They are attracted to moss and algae and thrive in wet, humid conditions and prevention is much easier than control. Therefore, growers should regularly sanitize their facilities between crops, clean greenhouse surface and floors regularly, and irrigate only when needed. Yellow sticky cards and potato disks work well for monitoring. For existing populations, several new effective insecticides and organic controls are available.

Sources

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