Fungus Gnats—Common and Damaging!©

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Fungus gnats are a pest of production nurseries, hydroponic growers, media suppliers, and plant retailers. Fungus gnats have a very wide host range and their economic impact appears to be increasing throughout the Australian nursery and propagation industries especially if present in combination with plant pathogenic fungi (Frodsham, et. al., 2000; Goodwin et. al., 2000). Both adults and larvae of this mosquito-like fly can damage plants—by direct feeding of the larvae on roots, and by spreading fungal diseases. A key to fungus gnat management is to improve drainage and avoid overwatering. Biological controls are commercially available and effective but you should liaise with the suppliers to ensure the maximum benefit.

APPEARANCE

Adult fungus gnats (*Bradysia* spp., Sciaridae) are small (~2.5 mm long), dark, mosquito-like flies, with delicate long legs, long antennae, and one pair of wings that have a distinctive Y-vein pattern close to the wing tip. Adults are weak fliers typically found drifting over and around nursery plants, under benches, or running over the pot or media surface. Fungus gnats are related to mushroom flies.

The eggs are minute, shiny white, and rarely seen without the aid of a microscope. They are deposited close to the surface of the growing medium or at the base of seedlings and plants.

The larval stage is a tiny legless, soil-dwelling maggot (~5 mm). Maggots are white, translucent, shiny, and threadlike, with a distinctive black head. A good 10× hand lens is needed to detect their presence. Fungus gnats pupate in the growing medium — either in pot media, soil or gravel, or beneath benches. Pupae are brown, legless, do not feed or move much, and are rarely seen.

DAMAGE

The damage caused by fungus gnats can be confused with seedling “damping off,” and other fungal diseases, phytotoxicity, or nutritional problems and is frequently misdiagnosed. Maggots may be found throughout the pot media profile or burrowing into the plant stem near the soil line. Adults are attracted to moist media that is high in organic matter and which contains good populations of microorganisms, particularly fungi. Rotting plant material acts like a magnet. Maggots feed primarily on

fungi and other microorganisms, but will also attack soft plant tissue such as root hairs, new roots, seedling stems, and the base of cuttings. Damaged tissue provides an entry point for fungal disease.

Heavy maggot infestations can cause seedling collapse through root or stem damage. Severe infestations of cuttings and established plants may lead to poor callus formation, root establishment and development, and subsequent wilting or death. Most importantly the maggots spread fungal pathogens when feeding and may greatly increase crop losses due to diseases caused by *Pythium*, *Phytophthora*, *Chalara*, *Fusarium*, *Rhizoctonia*, and *Verticillium* fungi. Adult gnats do not feed on plants but may spread fungal diseases including *Chalara* and *Botrytis* from pot to pot, bench to bench, and between production areas. Large numbers of adults are a nuisance to staff and a frequent cause of customer complaints when they emerge from pots after sale.

LIFE CYCLE AND BIOLOGY

The complete life cycle from egg to adult is about 1 month, faster in warm weather, slower when cool. Adults mate soon after emergence and the female begins egg laying within a few days. Females live for about 1 month, laying over 100 eggs. There will typically be all stages of development present at any time (overlapping generations) which makes control difficult.

Fungus gnats are pests of potting media suppliers, production nurseries, hydroponic growers, retail nurseries, and indoor landscapes. They have been reported from unused potting media, and are a particular problem in propagation areas, plugs, and seedling flats, and in crops such as ferns, poinsettias, *Eustoma* (syn. *Lisianthus*), *Gerbera*, and other potted colour lines.

Heavy infestations of fungus gnats have been found in nurseries in both tropical and temperate Australia. Infestations may be greater in autumn or early spring in southern Australia (all year round in heated nursery structures).

MANAGEMENT

Because of their widespread occurrence and preference for moist organic potting mix and, more recently, resistance to some organophosphate insecticides, fungus gnats can be difficult to manage. Fungus gnat management requires an integrated pest management program that includes management of diseases, media, irrigation, drainage, and hygiene. Good drainage is essential.

Look Beyond Chemicals:

- Follow recommended management practices for fungal diseases to minimise sources of pathogens that can be spread by fungus gnats.
- Avoid using potting media high in organic matter such as peat, which favours fungus gnats.
- Avoid excessive watering—most nurseries over water.
- Keep growing surfaces, below benches and walkways free of water, algae, weeds, plant waste, and spilled potting mix.
- Speedily remove unsold remnants of previous infested crops.
- Improve media porosity to reduce water holding capacity.
- Improve drainage throughout the nursery and ensure that drains are well graded and free flowing.

- Fine gravel or vermiculite as a mulch on the media surface may deter egg laying.
- Improve ventilation of greenhouses and spacing of plants to maximise air movement and minimise unnecessary surface water.
- Avoid over-fertilising to discourage growth of algae on mats, benches, and nursery surrounds.
- Disinfest growing surfaces and paths to remove algae.
- Cover unused potting media to minimise gnat contamination or spread.
- Inspect incoming plants and media before purchase or on arrival for signs of infestation.
- Pasteurise all recycled mix to minimise the spread of fungal pathogens.
- Quarantine incoming stock as per Nursery Industry Accreditation Scheme Best Practice Guidelines (Atkinson, 1997) to enable monitoring for fungus gnat adults and larvae before moving stock to production areas.

REGULAR SCOUTING AND MONITORING IS CRITICAL

1) Yellow sticky traps in all sensitive production and propagation areas will rapidly attract fungus gnat adults. Sticky traps are a tool to provide an early warning of gnat presence. Use a minimum of one trap per 100 m^2 placed about 10 cm above the crop canopy near susceptible crops, doorways, and vents. Traps placed horizontally above media or infested plants catch most gnats but suffer from soil splash. Traps should be inspected at least weekly and changed every 2 to 4 weeks. Numbers of less than 20 flies per trap per week may not present an economic problem but this threshold will vary with the sensitivity and value of the crop and if pathogens are present.
2) Learn to identify fungus gnats on sticky traps. A 10× hand lens is sufficient.
3) Infested pots, trays, media, or root masses placed in a clear plastic bag or bottle for a few days will trap emerging adults to give a definitive idea of the size of a population.

Potato Baits. Monitor larval populations by pressing skinless, 2.5 cm diameter by 1.25 cm thick potato discs into potting media. Leave the disc, with top level with soil surface, for at least 4 h before quickly lifting and counting larvae on and under the disc. Make sure the disc surface in contact with the potting media is always moist.

BARRIERS

Insect-proof screens fitted to glasshouses and polyhouses can prevent fungus gnats from entering. This may be an option for protecting particularly sensitive crops or propagation areas. Barriers will only be effective if incoming plants and media are free of gnats. Vents will need to be enlarged to compensate for the decrease in ventilation caused by the screening. Double doorways may need to be installed.

BIOLOGICAL CONTROLS

Biological controls (*Hypoapsis* mites and entomopathogenic nematodes) are commercially available in Australia for use against fungus gnats and are successfully used by many nurseries, including an increasing number of plug, seedling, and potted colour growers for whom fungus gnats are a particularly damaging pest. Liaise with the suppliers to ensure the maximum benefit from purchased biological controls. Most biological control agents will not tolerate insecticide applications and may be adversely affected by residues of previous sprays. The Integrated Pest Management in Ornamentals Information Guide (Goodwin et. al., 2000) contains information on chemical compatibility with fungus gnat predators and advice on how to use biological controls.

Predatory Mites. Hypoapsis [*Hypoaspis miles* (syn. *Stratiolaelaps miles*)] is a soil-dwelling predatory mite that feeds on fungus gnats, thrips pupae, springtails, and other small insects that inhabit the soil. Adult Hypoapsis mites are 0.5 to 1 mm long and light brown. The mites live in the top 1 to 2 cm of soil or media and move rapidly in search of eggs and young larvae. Mites will consume from 1 to 5 fungus gnat larvae per day. They can survive up to 4 to 5 months with food and for 7 weeks without live prey, feeding on organic debris and nematodes. They do not harm plants or humans. Like all biological controls these mites are most effective if applied before the pest population reaches epidemic proportions. The predators are sold in containers containing a composted medium for transport and are easily applied.

Nematodes. Entomopathogenic (insect-eating) nematodes are microscopic worm-like creatures that actively seek out their hosts in moist soil or media, enter the insect body, killing the insect, and reproducing and feeding on its remains. They can be very effective biological controls of insect pests that inhabit "hard to reach" habitats. One species, *Steinernema feltiae,* is commercially available for use against fungus gnat larvae. Nematodes prefer slightly moister and cooler conditions than the predatory mites. They have proved effective against gnats when used as the sole biological and in combination with the mites for year-round control in warmer, dryer climes. Nematodes are shipped in packs containing millions of nematodes in an inert medium, which are added to water and sprayed or applied through drippers onto the infested media in the nursery.

Parasitic Wasps. A naturally occurring parasitic wasp (*Synacra* sp.) has been found attacking fungus gnats in some low pesticide nurseries on the east coast. It is probably widespread as it also occurs in North America and Scandinavia. The wasps are dark brown and ant-like, and appear to have two abdominal segments. They are about the same size as adult fungus gnats and crawl over the surface of the media searching for larvae to parasitise, emerging from the dead pupae. They may be detected on yellow cards used to monitor pest populations. This wasp is not commercially available but will contribute to control where not killed by insecticides.

Bacillus thuringiensis (Bti). Various formulations of this bacterium are marketed commercially (e.g., for caterpillar control). A strain effective against fungus gnats, mushroom flies, and mosquitoes (*B. thuringiensis* var. *israelensis*) is marketed overseas but is not yet registered for use against fungus gnats in Australia.

CHEMICALS

Insecticidal drenches can be effective against fungus gnat larvae but must be applied correctly—the media must be thoroughly drenched to reach all larvae in a pot. There is evidence that some fungus gnat populations are resistant to organophosphate insecticides such as diazinon. As well, repeated application of diazinon may damage many ornamentals. A slow-release formulation of chlorpyrifos is registered for use against fungus gnats. Methiocarb is registered and can provide good adult knockdown. Several of the chemicals used against fungus gnat larvae currently face EPA review and may be restricted. Fungus gnat adults can be managed in confined areas with aerial or space sprays of pyrethroids and other low-toxicity chemicals registered for use against gnat adults. Check InfoPest, Peskem, and other sources of current registrations for information on products suitable for use against larvae and adults.

CONCLUSION

Fungus gnats are frequently overlooked as a nursery pest but can cause significant crop damage. As their name suggests, they are often associated with fungi, so both need to be managed correctly using a combination of control tactics. These include choosing the right media, good site drainage, irrigation design, and hygiene, and the use of commercially available biological control agents.

LITERATURE CITED

Atkinson, I.C. (ed.). 1997. NIASA Best Practice guidelines for the nursery industry accreditation scheme, Australia. 2nd Ed. Nursery Ind. Assoc. Austral.

Frodsham, A., K. Bodman, M. Steiner, and **S. Goodwin.** 2000. Fungus gnats - common and damaging! The Nursery Papers #13, 2000. Nursery Industry Assoc. Austral. <www.ngia.com.au>

Goodwin, S., M. Steiner, R. Parker, L. Tesoriero, G. Connellan, E. Keskula, B. Cowper, A. Medhurst, and **C. Rodriguez.** 2000. Integrated pest management in ornamentals: Information guide. AgiLink Series. NSW Agriculture, Department of Primary Industries, Queensland, Agriculture Victoria, Nursery Industry Assoc. Austral., Hort. Res. Dev. Corp.