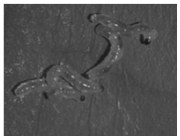
2018 Pest Management Symposium

February 22, 2018
Watsonville, CA

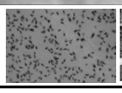


Biology And Insecticide Management For Fungus Gnats

Raymond A. Cloyd
Professor, Extension Specialist in Horticultural Entomology/Plant Protection
Kansas State University, Manhattan, KS
Phone: 785-532-4750 **Email: rcloyd@ksu.edu**

Overview: What To Expect

- **Introduction:**
  - **Biology and Damage**
  - **Why Fungus Gnats Are A Problem**
- **Fungus Gnat Management:**
  - **Scouting**
  - **Cultural**
  - **Physical**
  - **Insecticides**
  - **Biological**
- **Questions and discussion**



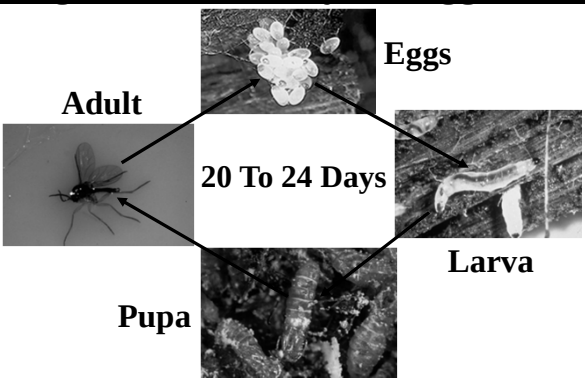
Fungus Gnats

*** Larvae feed on plant roots causing plant stunting and wilting. Also, capable of transmitting certain soil-borne plant pathogens.**

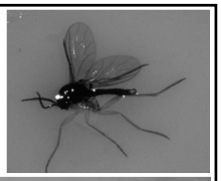
*** Larvae may reside throughout the growing medium profile.**

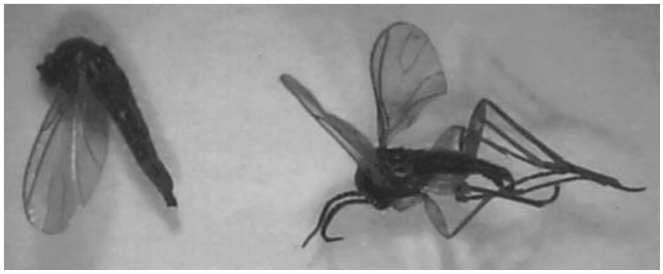
*** Adults are primarily a "nuisance;" however, they can transmit diseases.**

Fungus Gnat Life Cycle: Egg To Adult



Fungus Gnat Adults





Fungus Gnats Are Primarily A Concern To Greenhouse Producers During Propagation

Why Are Fungus Gnats A Problem In Greenhouse Production Systems?

1. Larvae cause direct injury to plants while feeding on plant roots.

2. Larvae may directly transmit soil-borne plant pathogens (e.g. *Pythium* spp.).

3. Wounds created by larvae during feeding provide entry sites for soil-borne plant pathogens (e.g. *Pythium* spp.).

4. Adults flying around may be considered a nuisance.

Fungus Gnat Larvae Feed On The Root Hairs And Small Roots Thus Inhibiting The Ability Of Plants To Obtain Water And Nutrients

Fungus Gnat Larvae Tunneling Into Geranium Cutting

Fungus Gnat Larval Feeding Damage

Fungus Gnat Larvae Inside Poinsettia Cutting

A Transvaal/Gerbera Daisy Crop Infested With Fungus Gnat Larvae

Fungus Gnat Management

- **Monitoring: yellow sticky cards (adults) and potato wedges (larvae).**
- **Cultural: avoid-overwatering and prevent the build-up of algae.**
- **Insecticides: pyrethroids, neonicotinoids, pyrrole, insect growth regulators, and microbials [e.g., *Bacillus thuringiensis* subsp. *israelensis* (Gnatrol)].**
- **Biological: predatory mites (*Stratiolaelaps scimitus* and *Hypoapis aculeifer*), rove beetle (*Dalotia coriaria*), and an entomopathogenic nematode (*Steinernema feltiae*).**

Where Do Fungus Gnats Come From?

- **Bagged growing medium.**
- **Un-sealed garbage containers.**
- **Growing medium with plants.**
- **"Old" growing medium.**
- **Moist or gravel areas underneath benches (especially those in which weeds are growing).**
- **"Compost" areas outside of greenhouses.**

Potential Source Of Fungus Gnats Is Contaminated Bagged Growing Medium

HORTICULTURAL ENTOMOLOGY

Fungus Gnats, *Bradysia* spp. (Diptera: Sciaridae), and Other Arthropods in Commercial Bagged Soilless Growing Media and Rooted Plant Plugs

RAYMOND A. CLOYD[1] AND EDMOND R. ZABORSKI[2]

Department of Natural Resources and Environmental Sciences, University of Illinois at Urbana-Champaign, 384 National Soybean Research Laboratory, 1101 W. Peabody Dr., Urbana, IL 61801

J. Econ. Entomol. 97(2): 503–510 (2004)

ABSTRACT Fungus gnats, *Bradysia* spp., in greenhouses cause economic losses to horticultural producers by damaging young root systems during plant propagation, by spreading soilborne diseases, and by reducing the marketability of the crop. In a greenhouse cage study, our observations suggested that bagged soilless growing media or rooted plant plugs from wholesale distributors may be sources for the introduction of fungus gnats into commercial greenhouse facilities. To evaluate these possibilities, carefully collected samples of bagged soilless growing media stored in the greenhouse, as well as bagged soilless growing media and rooted plant plugs delivered from midwestern wholesale distributors, were incubated under controlled conditions in the laboratory. Fungus gnats emerged from soilless media stored in the greenhouse, soilless media delivered from wholesale distributors, and from rooted plant plugs delivered from wholesale distributors. These results demonstrate that pasteurization of even bagged soilless media may be essential to effectively managing greenhouse populations of fungus gnats. However, pasteurization is not an option for responding to contamination of rooted plant plugs. Preliminary evidence is provided that application of entomopathogenic nematodes may offer potential as a method for managing fungus gnats in plant plugs, so long as treatment is early. Other arthropods found contaminating soilless media and rooted plant plugs included the western flower thrips, *Frankliniella occidentalis* (Pergande), Collembola, Acari, Formicidae, Staphylinidae, Psychodidae, and other Diptera.

Fungus Gnat Adults In Garbage Container: November 9 Through November 14, 2010

346 On One Yellow Sticky Card (185 + 161)

Scouting For Fungus Gnats In Greenhouses

Fungus gnat adults:

*** Place yellow sticky cards near the growing medium surface. Position horizontally on the edge of containers or flats.**

Fungus gnat larvae:

*** Insert 1/4-inch potato disks on the surface of growing medium. Leave for 48-hours, then turn potato disks over and look for fungus gnat larvae.**

Placement Of Yellow Sticky Card To Capture Fungus Gnat Adults

Fungus Gnat Adults On Yellow Sticky Card

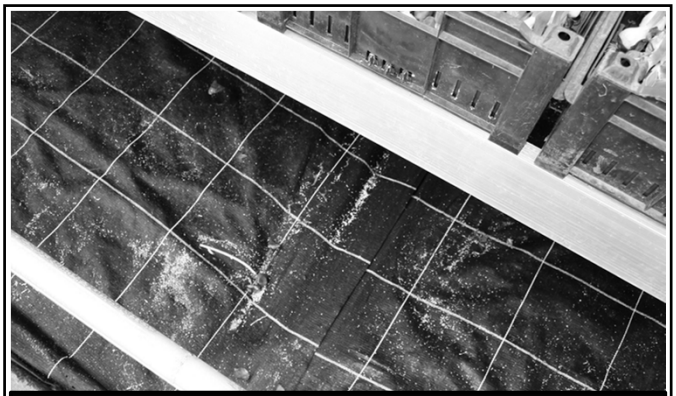
Fungus Gnat Adult Shore Fly Adult

Potato Disk Used To Assess Presence Of Fungus Gnat Larvae

Scout Underneath Benches To Assess Population Dynamics Of Fungus Gnat Adults (Based On Larvae Or Pupae In Soil)

Cultural and Sanitation Practices That Will Help Minimize Problems With Fungus Gnats

- **Moisture Management: Only provide enough water that plants need. Excess moisture may lead to algae growth. Repair all leaks, and make sure water does not accumulate in low areas.**
- **Sanitation: Remove weeds, "old" growing medium, and growing medium debris. Weeds underneath benches provide a conducive habitat for fungus gnats. "Old" growing medium and growing medium debris provide sites for fungus gnat adult females to lay eggs.**



Weed Barrier Placed Underneath Benches

Insecticides: Adults

*** Bifenthrin (Attain/Talstar)**

*** Cyfluthrin (Decathlon)**

*** Fluvalinate (Mavrik)**

*** Potassium salts of fatty acids (M-Pede)**

Insecticides: Larvae

*** *Bacillus thuringiensis* subsp. *israelensis* (Gnatrol)**

*** Chlorfenapyr (Pylon)**

*** Chlorpyrifos (DuraGuard)**

*** Cyromazine (Citation): insect growth regulator**

*** Diflubenzuron (Adept): insect growth regulator**

*** Pyriproxyfen (Distance): insect growth regulator**

Pest Management Science *Pest Manag Sci* 62:171–177 (2006)
DOI: 10.1002/ps.1143

Effect of *Bacillus thuringiensis* subsp. *israelensis* and neonicotinoid insecticides on the fungus gnat *Bradysia* sp nr. *coprophila* (Lintner) (Diptera: Sciaridae)

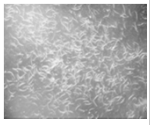
Raymond A Cloyd[1]* and Amy Dickinson[2]

[1]Department of Natural Resources and Environmental Sciences, University of Illinois, 384 National Soybean Research Laboratory, 1101 West Peabody Drive, Urbana, IL 61801, USA
[2]Department of Natural Resources and Environmental Sciences, University of Illinois, Urbana, IL 61801, USA

Abstract: The soil bacterium *Bacillus thuringiensis* Berliner subsp. *israelensis* (*Bti*), the neonicotinoid insecticides dinotefuran, imidacloprid, thiamethoxam and clothianidin and the insect growth regulator pyriproxyfen were evaluated to determine their efficacy against the larval stages of the fungus gnat *Bradysia* sp nr. *coprophila* (Lintner) in the laboratory. Treatments were applied as a drench to the growing medium in polypropylene deli containers. The *Bti* treatments had no effect on either instar tested, whereas all the other compounds negatively affected both the second and third instars. This study demonstrates that the soil bacterium *B. thuringiensis* var. *israelensis* may not be active on these larval stages, whereas the neonicotinoid insecticides and the insect growth regulator pyriproxyfen are effective on these stages. The fact that *Bti* is not effective on the second and third instars of the fungus gnat means that greenhouse producers using this insecticide must make applications before fungus gnat populations build up and before overlapping generations develop.

Biological Control Agents: Fungus Gnats

Entomopathogenic Nematode



- ***Steinernema feltiae***

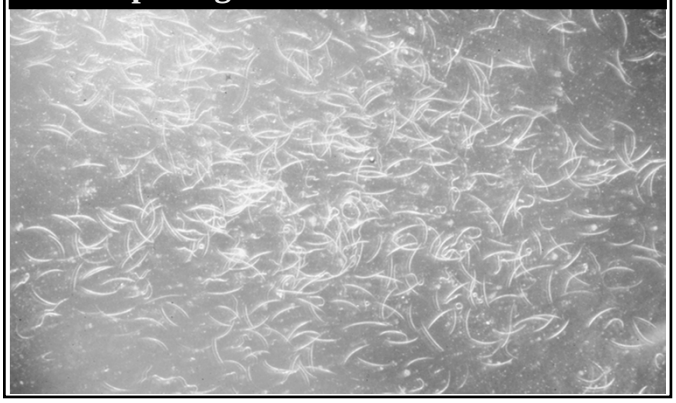
Predatory Mite

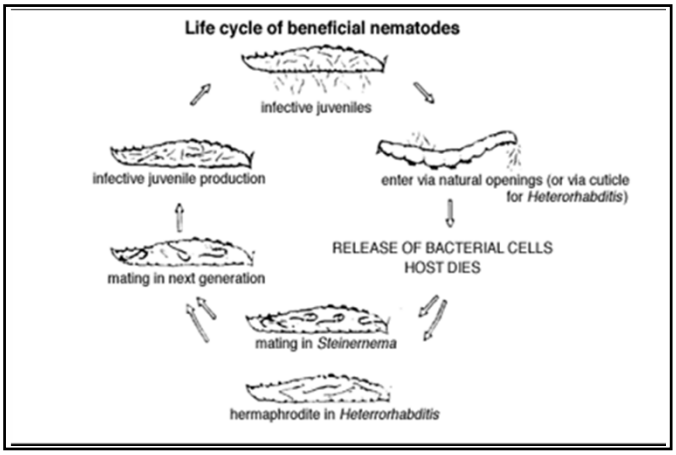
- ***Stratiolaelaps scimitus* (formerly *"Hypoaspis miles"*)**

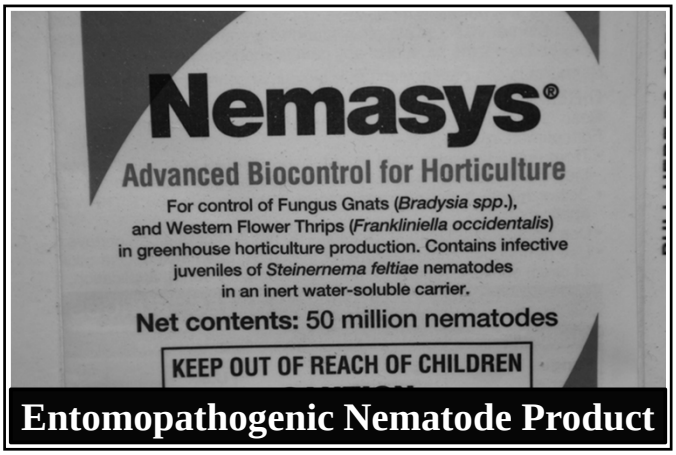
Predatory Beetle

- **Rove beetle, *Dalotia coriaria***

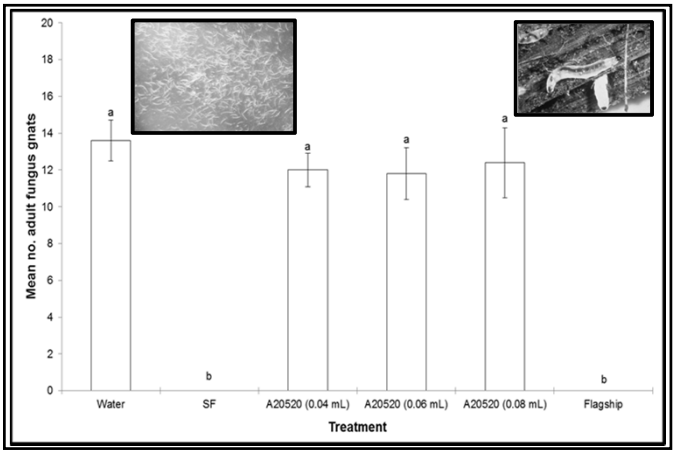
Entomopathogenic Or Beneficial Nematodes



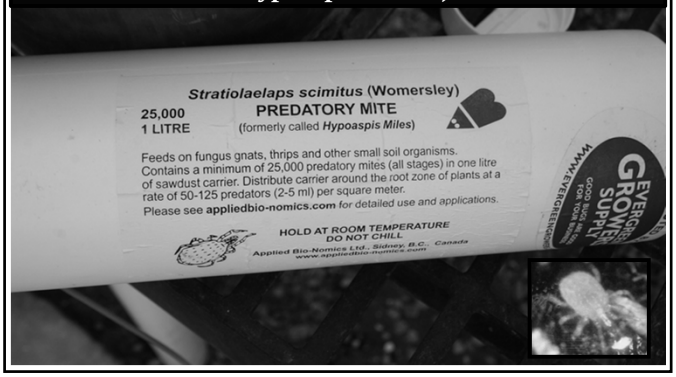




Entomopathogenic Nematode Product



Product Containing *Stratiolaelaps scimitus* (formerly *"Hypoaspis miles"*)



Rove Beetle (Coleoptera: Staphylinidae) Predation on *Bradysia* sp. nr. *coprophila* (Diptera: Sciaridae)[1]

E.A. Echegaray, R.A. Cloyd[2], and J.R. Nechols

Department of Entomology, Kansas State University, Manhattan, Kansas 66506 USA

J. Entomol. Sci. 50(3): 225–237 (July 2015)

Abstract Rove beetles (Coleoptera: Staphylinidae) are important predators of arthropods in soil habitats. However, minimal information is available on their effectiveness, including *Dalotia* (formerly *Atheta*) *coriaria* (Kraatz), which is a reported biological control agent of fungus gnats (*Bradysia* spp.) in greenhouses. In this study, predation by *D. coriaria* on *Bradysia* sp. nr. *coprophila*, was investigated in small containers (473 ml) in the laboratory using different numbers and ratios of predators and prey. In tests with 1–5 rove beetle adults and 10–40 fungus gnat larvae, predation was greatest at each prey density when four rove beetle adults were released, and lowest at three of four prey densities when five adult rove beetles were released. Per capita prey consumption was greatest when only one rove beetle was present, and predation efficiency decreased as predator numbers increased. This inverse relationship was strongest at the highest prey density (40 fungus gnat larvae). Thus, while using four rove beetle adults in conjunction with 10–40 fungus gnat larvae increased overall effectiveness (number of prey consumed), increasing the number of predators negatively affected predation efficiency. When predator and prey numbers were increased, the level of predation also increased, but only at the highest predator–prey ratio (1:5). At lower predator–prey ratios (1:10 and 1:20), adjusting numbers of predators and prey had no effect on predation. Based on our results, when used appropriately, *D. coriaria* may be a viable augmentative biological control agent of fungus gnats in greenhouse production systems.

Publication: Effects of Growing Medium Type and Moisture Level on Predation by Adult Rove Beetle, *Dalotia coriaria* (Coleoptera: Staphylinidae), on Fungus Gnat, *Bradysia* sp. nr. *coprophila* (Diptera: Sciaridae), Larvae under Laboratory and Greenhouse Conditions. 2017. HortScience 52(5): 736-741

HortScience 52(5):736–741. 2017. doi: 10.21273/HORTSCI11842-17

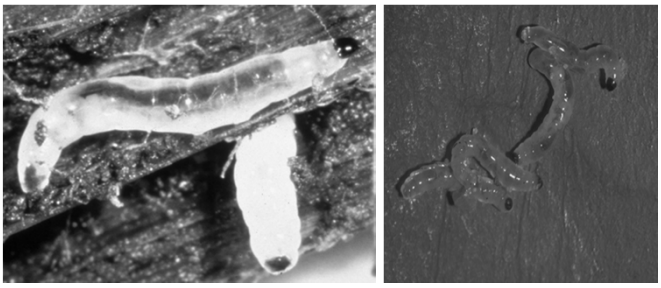
Effects of Growing Medium Type and Moisture Level on Predation by Adult Rove Beetle, *Dalotia coriaria* (Coleoptera: Staphylinidae), on Fungus Gnat, *Bradysia* sp. nr. *coprophila* (Diptera: Sciaridae), Larvae under Laboratory and Greenhouse Conditions

Nathan J. Herrick and Raymond A. Cloyd[1]

Department of Entomology, Kansas State University, 123 Waters Hall, Manhattan, KS 66506

Additional index words. biological control, cultural practices, plant protection, growing medium, moisture content

Abstract. **The fungus gnat, *Bradysia* sp. nr. *coprophila* (Lintner) (Diptera: Sciaridae), is an insect pest of greenhouse production systems. The rove beetle, *Dalotia coriaria* [Kraatz] (Coleoptera: Staphylinidae), is a commercially available predator of certain greenhouse insect pests that reside in growing media, including fungus gnats. There is minimal information discussing how growing medium type and moisture level (watering treatment) impact the interactions between pests and natural enemies. Therefore, we conducted laboratory and greenhouse experiments to investigate the influence of two growing media (Sunshine® LC1 Professional Growing Mix and Fafard® 3B Mix Professional Formula) and two moisture levels ("constantly saturated" and "initially saturated") on predation by adult *D. coriaria* on *B.* sp. nr. *coprophila* larvae after releasing one or two rove beetle adults. In the laboratory experiment, moisture content or the amount of water retained by the growing medium did not significantly influence the recovery of adult fungus gnats for any of the rove beetle treatments. However, there was a significant difference in the recovery of fungus gnat adults between the two growing media. Two fungus gnat adults emerged from the Sunshine® LC1 Professional Growing Mix (0.9 ± 0.2 adults) than the Fafard® 3B Mix Professional Formula (6.0 ± 0.9 adults). Significantly fewer adult fungus gnats were recovered in the treatments where one rove beetle adult was released (2.7 ± 0.7 adults) and two rove beetle adults were released (2.3 ± 0.5 adults) compared with the control without rove beetles (5.4 ± 1.4 adults). However, there was no significant difference between the number of rove beetle adults released. In contrast to the laboratory experiment, moisture content in the greenhouse experiment significantly influenced the recovery of adult fungus gnats. More adult fungus gnats were recovered from the "constantly saturated" treatment (9.9 ± 1.4 adults) than the "initially saturated" treatment (3.8 ± 1.0 adults). Similar to the laboratory experiment, there was a significant difference in the recovery of fungus gnat adults between the two growing media. Fewer fungus gnats emerged from the Sunshine® LC1 Professional Growing Mix (3.2 ± 0.8 adults) than the Fafard® 3B Mix Professional Formula (10.4 ± 1.4 adults). However, the treatments with rove beetle adults [one rove beetle (6.6 ± 1.8 adults) or two rove beetles (5.3 ± 1.5 adults)] were not significantly different from the control without rove beetles (8.6 ± 1.5 adults), suggesting that the growing media and moisture levels were acting directly on fungus gnat survival. The results of our study demonstrate that survival of fungus gnat larvae that reside in the growing medium and the success of rove beetle adults used to regulate these pests can be influenced by growing media and the moisture content within growing media.**



If You Want To Implement A Biological Control Program I Recommend Targeting Fungus Gnats. Why? There Are A Number Of Effective Biological Control Agents Or Natural Enemies Including An Entomopathogenic Nematode, Predatory Mite, And Predatory Beetle


What About Repelling ("Push") Fungus Gnat Adults Away From Growing Media?

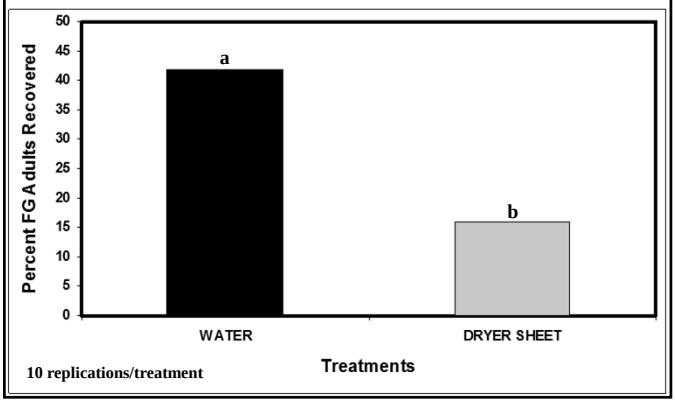

Bounce® Original Brand Fabric Softener Dryer Sheets

Contain biogradable cationic softeners and perfume

Experimental Arenas: Central Compartment and Sample Compartments

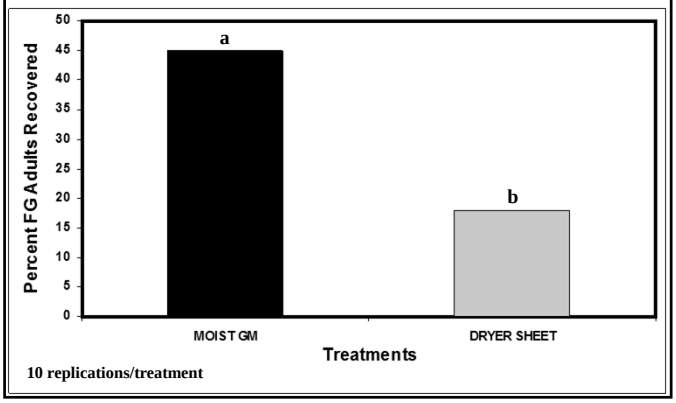
Experimental Set-Up

Results



10 replications/treatment

Results



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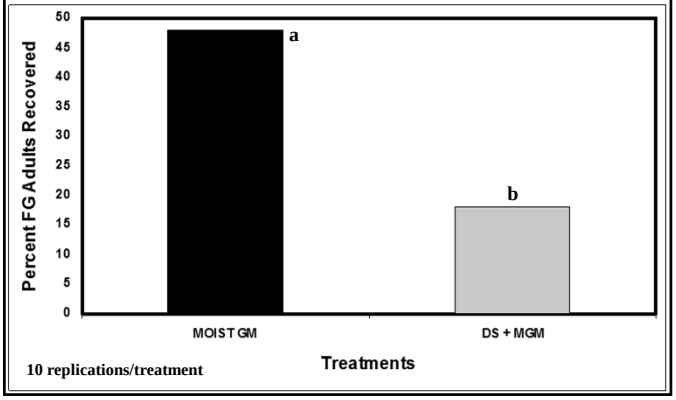
Results



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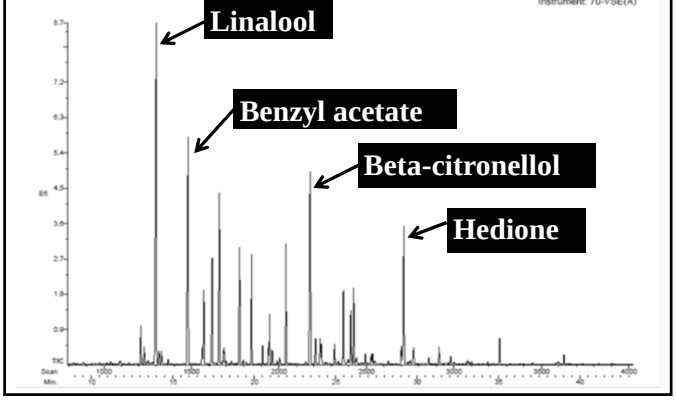


HortScience 45(12):1830–1833. 2010.

Bounce® Fabric Softener Dryer Sheets Repel Fungus Gnat, *Bradysia* sp. nr. *coprophila* (Diptera: Sciaridae), Adults

Raymond A. Cloyd[1]
Kansas State University, Department of Entomology, 123 Waters Hall, Manhattan, KS 66506-4004

Karen A. Marley and Richard A. Larson
University of Illinois, Department of Natural Resources and Environmental Sciences, Urbana, IL 61801

Bari Arieli
Kansas State University, Department of Entomology, Manhattan, KS 66505

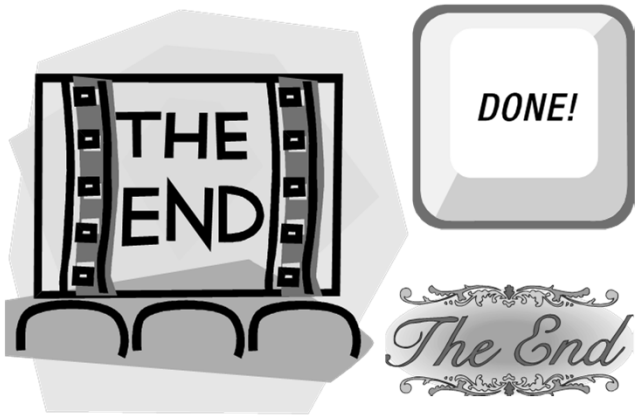
Additional index words. growing medium, linalool, pest management, repellency, steam distillation

Abstract. This study was conducted to assess the repellency of Bounce® original brand fabric softener dryer sheets against fungus gnat, *Bradysia* sp. nr. *coprophila* (Diptera: Sciaridae), adults. For all five experiments conducted under laboratory conditions, fungus gnat adults collected in the sample compartments that included Bounce® original brand fabric softener dryer sheets ranged between 12% and 18% compared with the mean proportion of fungus gnat adults recovered from sample compartments that excluded dryer sheets, ranging in mean proportion from 33% to 48%. Chemical analysis using a steam distillation procedure to isolate volatile constituents found linalool as one of the major volatiles detected in the Bounce® original brand fabric softener dryer sheets. Additional constituents isolated were benzyl acetate, beta-citronellol, and hedione. Based on the results from our study, under laboratory conditions, Bounce® fabric softener dryer sheets do in fact repel *B.* sp. nr. *coprophila* adults.

Future Management Of Fungus Gnats: Insert Bounce Fabric Softener Dryer Sheets Into Containers?

Extension Publication

Cloyd, R. A. 2010. Fungus Gnats: Management In Greenhouses And Nurseries. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. MF-2926. Kansas State University, Manhattan, KS. 4 pages.



Thank You For Your Attention!

I Hope You All Learned Something!