Young Plant Research Center

PERSISTENCE AND EFFICACY OF PRODUCTS FOR FUNGUS GNAT (*Bradysia spp.*) CONTROL IN LINER PRODUCTION OF VEGETATIVE CUTTINGS

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EXECUTIVE SUMMARY

Fungus gnats (*Bradysia* spp.) are major insect pests of greenhouse crops, particularly during plant propagation. Female fungus gnat adults lay eggs in growing media, and the emerging larvae feed on root tissue. Fungus gnats may create significant economic losses. However, there are a variety of insecticides and biological control agents available to greenhouse growers that can be used to control fungus gnats.

A number of commercially available pest control materials or products registered for application as growing medium drenches (Nemasys®, Citation®, Distance® and two concentrations of Safari™) were compared to assess their ability to control fungus gnats in liner trays. In particular, we were interested in the duration of control or residual activity of the pest control materials.

To test these products, cuttings of *Phlox drummondii* were propagated in 1/5 (10-cell) portions of 50-cell liner trays filled with a peat/perlite growing medium (PRO-MIX BX). Fungus gnat adults were collected from other greenhouses at the University of New Hampshire with an aspirator and introduced into the greenhouse containing the liner trays. The pest control materials were applied to the growing medium using the recommended label rates. The initial and residual efficacy of products was evaluated by removing liners from the greenhouse 1, 7, 14 and 28 days after the application, and then monitoring subsequent adult fungus gnat emergence with yellow sticky cards.

All the treated trays had significantly lower fungus gnat adult counts compared with the control trays throughout the 28-day period, with greatly reduced fungus gnat numbers one and seven days after application. Citation® and the high and low concentrations of Safari™ demonstrated the best control after 14 and 28 days. There were no significant differences between the high and low (12 and 24 oz/100 gal) concentrations of Safari™ in terms of the number of fungus gnat adults that emerged.

INTRODUCTION

Fungus gnats (*Bradysia* spp.) are important insect pests of greenhouse-grown crops. Female fungus gnat adults lay clusters of eggs in the crevices of growing medium. Eggs hatch into translucent larvae, which feed on fungus and root tissue. Larvae undergo four instars before developing into a pupae stage. Adult fungus gnats emerge from the pupae in the growing medium, mate, and then females locate suitable sites for egg laying. *Bradysia spp.* have many overlapping generations throughout the year with a single lifecycle typically taking about four weeks at 70 to 80°F (Lyon, 2000).

There are several reasons why fungus gnats are a major insect pest. Aside from the direct damage from larval feeding, weakened plants are at greater risk of infection by soilborne diseases such as *Pythium* root rot. Adults can vector pathogens including *Botrytis* between plants, and flying insects detract from the aesthetics of container-grown plants (Cloyd and Zaborski, 2004). Extensive fungus gnat populations, both larvae and adults, may result in economic losses. There are a variety of insecticides and biological control agents available to greenhouse growers for control of fungus gnats.

The objective of this study was to evaluate the efficacy of four materials labeled for controlling fungus gnats in liner production of vegetative cuttings. Our goal was to determine the effectiveness of each of the pest control materials immediately after application, as well as up to 28-days from a single application.

The results reported in this study expand on previous research conducted at the University of New Hampshire with poinsettias grown in 6-inch containers, in which excellent control of fungus gnats was obtained with Safari™, and very good control was obtained with Nemasys®, Citation®, and Distance®. Nemasys® is a product that contains the entomopathogenic nematode, *Steinernema feltiae*; both Citation® and Distance® are insect growth regulators, and Safari™ is a neonicotinoid-based systemic insecticide. The experimental design was modified for liner propagation of ornamental transplants.

MATERIALS AND METHODS

A selection of commercially available pest control materials labeled for growing medium drench applications were evaluated (Table 1). Nemasys®, Citation®, Distance® and two concentrations of Safari™ were compared along with an untreated control.

Table 1. Pest control material treatments applied as drenches to the growing medium in the study

Treatment	Active Ingredient	Drench Rate
Control	None	No Drench
Nemasys®	*Steinernema feltiae*	1 packet/35 gal
Citation®	Cyromazine	2.6 oz/100gal
Distance®	Pyriproxyfen	2 fl oz/100 gal
Safari™ (“LOW” rate)	Dinotefuran	12 oz/100 gal
Safari™ (“HIGH” rate)	Dinotefuran	24 oz/100 gal

50-cell liner trays were cut into 5 x 2-cell partial trays and filled with PRO-MIX BX peat/perlite growing medium. Cuttings (total 2,880) of annual phlox (*Phlox drummondii*), air-freighted from TicoPlant, Costa Rica, were propagated in 288 partial trays in a glass greenhouse with concrete

floors, which was disinfected prior to initiating the study. After the phlox cuttings were stuck on February 2, 2006 approximately 320 fungus gnat adults (age unknown and mixture of females and males) were collected with an aspirator from infested greenhouses at University of New Hampshire and released over a 3 week period. Approximately 140 fungus gnat adults were released into the greenhouse on Feb. 9, 2006; 80 on Feb. 16, 2006; and 100 on Feb. 21, 2006. The phlox plants were pinched to a height of 2 inches and watered daily to encourage egg laying on the exposed growing medium surface. Air temperatures averaged 23±1.7°C (73.4±3.1°F, mean ± one standard deviation), soil temperature averaged 22.9±3.8°C (73.1±6.9°F), PAR light averaged 2.4 moles/m^2/d and a fog system maintained relative humidity at an average 74.4±10.5%.

The prolific growth of the annual phlox plants was pinched back to a height of 2 inches every 2-3 weeks to make the media surface accessible to female fungus gnats. (Photo: Steven Conaway)

Drenches were applied to growing medium in the partial trays on Feb. 23, 2006. We delayed drench applied until 3 weeks after the cuttings were stuck. By three weeks, fungus gnat populations had begun to increase before applying the pest control materials, and liners had been removed from mist. The treatments were applied to 48 partial trays at a volume of 9 mL/cell (450 mL/50-cell liner tray, =15.2 oz/tray), which were then randomly placed on a greenhouse bench. Twenty-four hours after applying the treatments, the first 12 replicates (partial trays) of each treatment were removed from the greenhouse.

A cutaway view of a bagged partial tray. Each 5 x2 section of cells was placed on a saucer filled with water and covered with a yellow sticky card mounted on clothespins. (Photo: Steven Conaway)

After removing the trays from the greenhouse, plants were cut off at the growing medium surface and each partial tray was placed in a saucer containing 200 mL (7 oz) of water. A 2.5 x 2.5 cm (1 x 1-in) yellow sticky card was positioned just above the growing medium surface of each partial tray on 2 clothespins to collect adults emerging from the growing medium. The partial trays were placed inside paper grocery bags, labeled, and stapled shut.

To evaluate both initial and residual efficacy of each pest control material, treatments were processed at four time intervals: 1, 7, 14, and 28 days (Feb. 24, March 2, 9 and 23, 2006) after the pest control material drenches had been applied. All the bags were incubated for 7 weeks at 13^{o}C (55^{o}F) for 3 weeks followed by 20^{o}C (68^{o}F) for 4 weeks, and the moisture in the saucer was re-supplied after 3 weeks.

After the 7-week incubation period, the yellow sticky cards were removed from the bags. Fungus gnat adult counts for each replicate were recorded and analyzed statistically. Fungus gnat adult counts were subject to a one-way analysis of variance (ANOVA) with pesticide treatment as the main effect using the Statistical Analysis System (SAS) program. All data were square-root transformed prior to analysis. Significant differences among the treatments were determined using a Tukey's HSD mean comparison test, at P=0.05.

RESULTS AND DISCUSSION

The number of fungus gnats emerging from untreated control trays increased on day 14 and 28 compared with day 1 and 7 (Figure 1). Therefore, the pest counts for control trays was not constant over the period of the experiment.

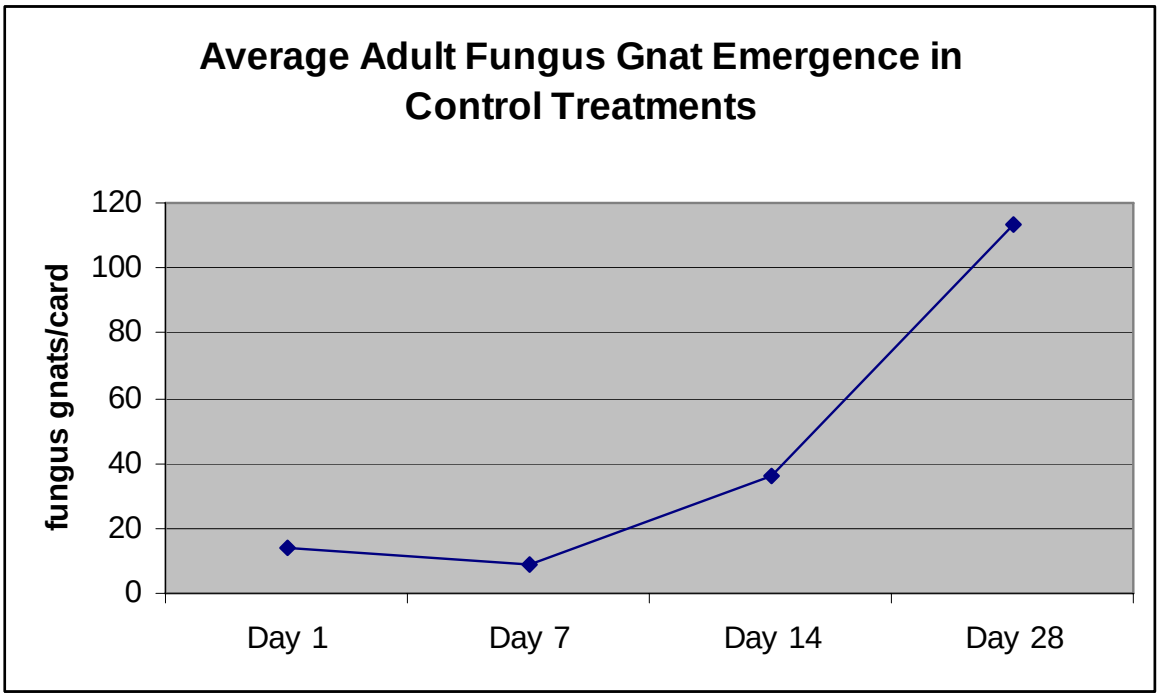

Figure 1. Mean fungus gnat adult emergence per partial (1/5) tray for the control treatments 1, 7, 14 and 28 days after the pest control materials had been applied.

The results indicate significant differences between the treatments and control. All of the pest control material treatments had significantly lower fungus gnat adult counts than the controls across all four time intervals (Fig. 2).

All pest control materials exhibited similar control 7 days after application. Fungus gnat levels in trays treated with Nemasys®, Citation® and Distance® were not significantly different from the Safari™-treated trays 1 and 7 days following application of the treatments.

The Safari™ low label rate (12 oz/100 gal) was just as effective as the high label rate (24 oz/100 gal) over the 4-week period. This is important to growers in that less material is needed in order to control fungus gnats, which equates to less costs associated with purchasing additional product.

Citation® and Distance®, which are both insect growth regulators, differed in residual efficacy. Distance® was significantly less effective than Citation® and Safari™ (both rates) 14 and 28 days after application.

The Nemasys® label recommends re-applying at 14-21 day intervals. In this study,only a single application of Nemasys® was applied, and yet Nemasys® provided residual activity similar to Distance®. Because Nemasys® is a biological control agent, its residual activity is likely to be influenced by environmental conditions such as growing medium temperature and moisture content.

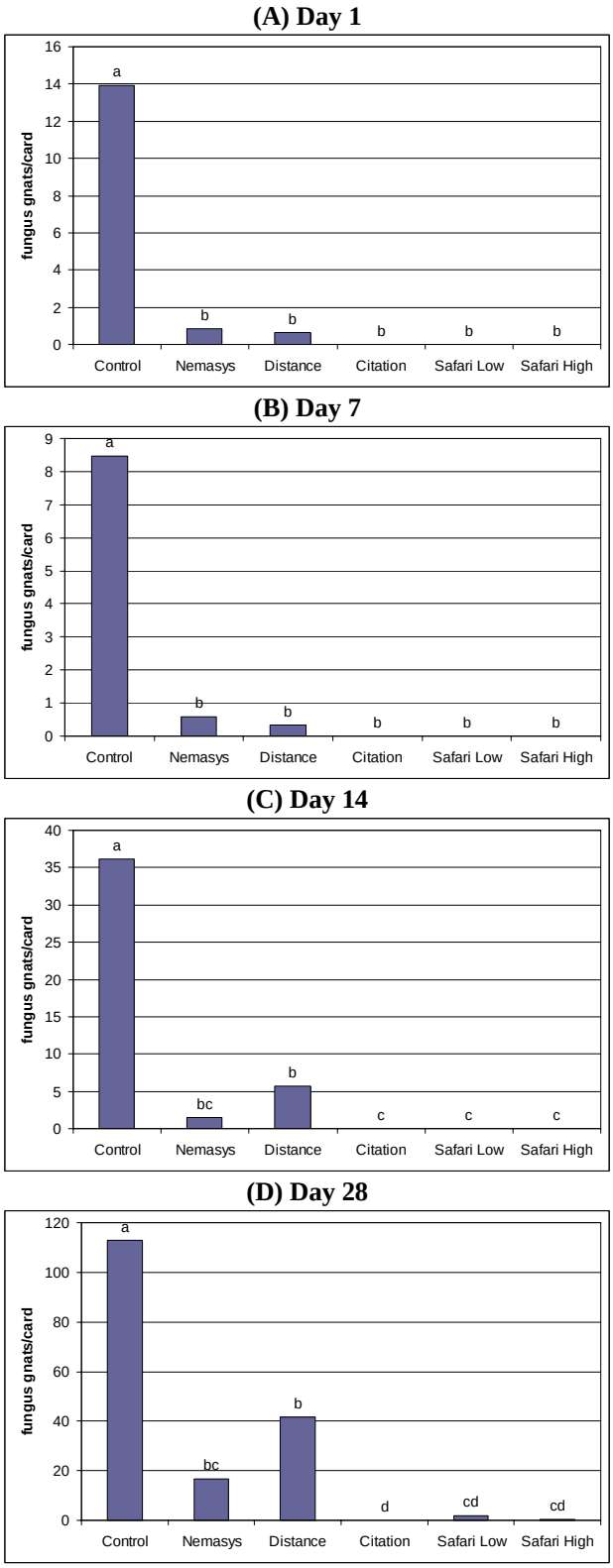

Figure 2. Mean fungus gnat adult counts per partial tray (1/5 of a 50-cell liner tray). Results from treatments bagged and incubated 1, 7, 14 and 28 days after growing medium drench applications. Units on the Y-axis represent number of fungus gnat adults captured on the yellow sticky cards. Each bar represents the average of 12 partial trays. Bars sharing the same letter are not significantly different.

Future evaluations trials may be improved by implementing measures that reduce variability in the experimental procedures. Pest pressure could be maintained at a more constant level during the greenhouse phase by keeping foliage cover constant and introducing fungus gnat adults at a consistent number per week. Incubated fungus gnats developed slower than expected, probably due to low storage temperatures. From Feb. 24 until the bags were moved to a warmer location on April 3, incubation temperatures averaged 13°C (55°F) and dropped as low as 12°C (53°F). As a result, the storage time was extended to 7 weeks and the bags were moved to a different storage room at 20°C (68°F). Fungus gnat development is dependent on moisture content and temperature. Bags should be stored in an environment under consistent temperature and relative humidity conditions, and moisture content should be assessed weekly to ensure that the growing medium in the containers is consistently moist.

LITERATURE CITED

Cloyd, R.A. and E.R. Zaborski. 2004. *Fungus Gnats,* Bradysia *spp. (Diptera: Sciaridae) and other Arthropods in Commercial Bagged Soilless Growing Media and Rooted Plant Plugs*. Journal of Economic Entomology. 97(2): 503-510.

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We thank the UNH Agricultural Experiment Station and our Young Plant Research Center research partners: Blackmore Co., Center Greenhouses, D.S. Cole Growers, Ellegaard, Four Star Greenhouses, Glass Corner Greenhouses, Greencare Fertilizers, Kube-Pak Corp., Lucas Greenhouses, Pleasant View Gardens, Premier Horticulture Quality Analytical Laboratories, Sun Gro Horticulture and Welby Gardens. Thanks to TicoPlant and InnovaPlant for providing Phlox cuttings. Erika Williams assisted with data collection. David Goudreault and Russell Norton assisted with plant care and applied pesticides.