Young Plant Research Center

EVALUATION OF INSECTICIDES FOR FUNGUS GNAT MANAGEMENT
POINSETTIA TRIAL OCTOBER 2005

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Fungus gnats (*Bradysia* spp.) are major insect pests of greenhouse crops, and can cause economic losses across a wide range of crops during stock plant, propagation, and finished plant production. Female fungus gnat adults lay eggs in growing media, and the emerging larvae feed on the roots and crown.

Fungus gnat management is an ongoing focus of our research team. The objective of the study reported here was to evaluate the efficacy of different insecticides applied as media drenches. The notable feature of this study was that we tested insecticides at several geographic locations simultaneously. We used poinsettia as a model test crop because it was grown in all the collaborating greenhouses.

Research methods

Six-inch poinsettias were grown in eight greenhouse locations that included seven commercial growers in CO, MI, NH, NJ, and the University of New Hampshire (UNH). Ten containers received each insecticide treatment in each location. There were a total of eight insecticides evaluated (Table 1) and a control that did not receive an insecticide treatment.

In the commercial greenhouses, the experimental plants, those receiving the treatments, were grown and managed alongside commercial crops. Insecticide sprays or media-applied fungicides were permitted, but no insecticide drenches were applied other than the experimental treatments. At the UNH, no insecticides or fungicides were applied other than the experimental treatments.

Only one media drench application was made in the commercial greenhouses. For those insecticides labeled for multiple applications, two applications were made for several treatments at the UNH (see Figure 1). Because the study was part of our Young Plant Research Center program, we were interested in fungus gnat control across a wide range of floricultural crops, rather than just poinsettia. We therefore allowed some treatments that were not labeled for poinsettia: there were two applications of Distance at UNH, although Distance should only be applied once to poinsettia, and Adept was used even though this insect growth regulator is not registered for poinsettia. In addition, DuraGuard, which is normally applied as a spray to the growing medium surface for fungus gnat control, was applied as a full-volume drench.

Insecticide applications were made on Oct. 18, 2005. For those treatments at the UNH that received two applications, there was an additional drench application two weeks earlier on Oct. 4, 2005.

Twenty-four hours after the Oct. 18 application, each plant was cut off at the surface of the growing medium line using clippers, and the containers with growing media were placed in separate bags for 28 days (see insert). A yellow sticky card was placed on the surface of the growing medium. Any adult fungus gnats emerging from the growing medium were caught on the yellow sticky card and counted.

Results and Discussion

Counts in the untreated control-containers varied greatly between each location (second column in Table 2), from a high of 121 fungus gnat adults emerging per –(remove extra space)container to a mean of less than 1 fungus gnat adult per container. This may be due to the variability in pest pressure between greenhouses.

Because each adult fungus gnat female can lay up to 300 eggs, populations can rapidly increase so it is essential to keep fungus gnat numbers low before planting and early in the crop production cycle. Some operations in the study were able to "empty out" their greenhouses before the poinsettia crop was started, which effectively eliminated any carryover –pests.

Fungus gnats may be initially present on rooted cuttings or in growing media. Because fungus gnat life stages occur both above (adults) and in growing medium (larvae) both sprays and drenches of insecticides are typically required. However, the use of spray applications in dealing with fungus gnats differed among the locations. Crop conditions varied among the locations, and fungus gnat development is favored by overwatering, high humidity and low light levels, which impact drying of the growing medium. In addition, growing media that retain high moisture, and greenhouses that have soil rather than concrete floors, tend to favor fungus gnat development. There are several *Bradysia* species of insects that we collectively call "fungus gnats", and populations may have varied from one location to another.

The bottom of Table 2 shows the fungus gnat adult numbers per container as a percent of the control, which is based on the six locations that had more than 20 fungus gnat adults emerging per control container.

Duraguard, Adept, and Azatin provided moderate control. For most locations, fungus gnat adult counts were less than 50% when compared with the untreated containers (Table 2). However, in several locations, the number of fungus gnat adults was not significantly different from the untreated (control) for all three insecticides. Note that Azatin may be more effective when applied multiple times.

The insect growth regulators Citation and Distance provided sufficient control of fungus gnats, as did Marathon and the entomopathogenic nematode product, Nemasys.

Safari was consistently the most effective product, and provided better control than Marathon. Both Safari and Marathon are neonicotinoid-based insecticides. Overall, fewer than 5 fungus gnat adults emerged from the Safari-treated containers in all greenhouses.

Figure 1 shows the complete range of treatments at the UNH, including the treatments where insecticides were applied twice. Two applications of Citation, Nemasys, and Distance were all effective and similar to the control provided from one application of Safari. However, it should be noted that the label specifies that only one application of Distance be applied to poinsettia, because phytotoxicity has been observed when using this insecticide on poinsettia. Label information for some of the products also included precautionary statements regarding applications to other crops such as begonia and hibiscus. Although Safari was effective in controlling fungus gnats, it should not be rotated with Marathon because Safari and Marathon have similar modes of action. In addition, Safari should only be applied as a drench once per cropping cycle in order to avoid resistance.

Results from the nematode product Nemasys (active ingredient *Steinernema feltiae*) were encouraging. In a separate study (organic production of poinsettia) in 2005 with poinsettia in which Nemasys was the only insecticide used, we obtained acceptable control of fungus gnats (although four applications were needed throughout the cropping cycle). There are several products commercially available that contain the nematode, *Steinernema feltiae*.

Fungus gnats are pests that can be effectively controlled using commercially-available insecticides in addition to implementing practices such as sanitation and avoiding excess soil moisture. When testing any new

insecticide in your rotation program, always read the label and manufacturer's instructions. Test on a small sample of plants (around 10 to 20) before applying to the entire crop. We were pleased with the quality of information collected by our grower collaborators, and a similar protocol might be helpful at your location. Finally, avoid using insecticides with the same mode of action (such as Marathon and Safari) in succession. Always use at least two insecticides with different modes of action in between using any neonicotinoid-based insecticide.

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Table 1. Insecticide treatments applied in the study as media drenches for fungus gnat control

	Pesticide Trade Names	Active Ingredient	Mode of Action	Re-entry Interval	Other notes	Concentration Used in this Trial	Vol. Per 6" Pot	Cost Per Container	Container Size	Cost/100 pots
1	**Safari™ 20 SG**	Dinotefuran	Acetylcholine esterase inhibitor; binds to acetylcholine receptor disrupting nerve transmission, EPA 4	12 Hrs.	Safari, which is a neonicotinoid-based insecticide has the same mode of action as Marathon, Flagship, Celero, and TriStar.	24 oz/100 gal	4 fluid ounces per pot	$362.25	3 lb.	$5.66
2	**Marathon® 60 WP**	Imidacloprid	Acetylcholine esterase inhibitor; binds to acetylcholine receptor disrupting nerve transmission, EPA 4	12 Hrs.	Can also be applied by ebb and flood, and there is a granular formulation (Marathon 1%G)	1 packet (20 grams) per 31.25 gal	4 fluid ounces per pot	$314.34	5 (20 gram) packets	$6.29
3	**Adept®**	Diflubenzuron	Chitin synthesis inhibitor, EPA 15	12 Hrs.	Not for use on poinsettia. Included in study because Adept can be used on most other floricultural crops. Do not reapply drenches more than once every 4-8 weeks, or more than 4 times per crop.	1 bag in 200 gal	6 fluid ounces per pot	$121.04	1 lb.	$0.18
4	**Distance®**	Pyriproxyfen	Juvenile hormone mimic, EPA 7	12 Hrs.	Phytotoxicity may be observed on poinsettia, especially when in bract. Apply to poinsettia only once per crop cycle, and not after bract formation.	2 fl.oz/100 gal	3 oz per pot	$254.38	1 qt	$0.37
5	**Citation®**	Cyromazine	Chitin synthesis inhibitor, EPA 17	12 Hrs.	Repeat applications can be made at 7-14 days to minimize reinfestation.	2.66 oz (1 packet)/100 gal	4 fluid ounces per pot	$295.26	6 (2.66 oz) packets	$1.54
6	**Azatin® XL**	Azadirachtin	Ecdysone antagonist, EPA 18	4 Hrs.	Can be repeated at 7 day intervals. Ornazin® and other azadirachtin products are available.	8 oz/100 gal	4 fluid ounces per pot	$181.23	1 qt	$1.42
7	**DuraGuard™ ME**	Chlorpyrifos	Acetylcholine esterase inhibitor; binds to acetylcholine receptor disrupting nerve transmission, EPA 1	24 Hrs.	Microencapsulated formulation. Up to 30 days of residual activity reported by manufacturer.	0.5 fl.oz/gal	6 fluid ounces per pot	$192.24	1 gallon	$3.52
8	**Nemasys®**	*Steinernema feltiae*	Entomopathogenic nematode. Enters fungus gnat larvae and releases bacteria that kills the pest.	0 Hrs.	This is a biological organism. Therefore, care must be taken regarding storage and application. May need to reapply after 14-21 days depending on the fungus gnat population.	1 pack in 35 gal water	4 fluid ounces per pot	$176.00	5 pks/50 million Nem.	$3.14

Notes on Table 1: Adept is not labeled for use on poinsettia crops, but was included in this study because it may be used on most floricultural crops. Use caution with media drenches of Distance because phytotoxicity has been observed. Apply before bract color, and only one drench application should be made per poinsettia crop. Prices were based on Griffin Greenhouse and Nursery Supplies 2005.

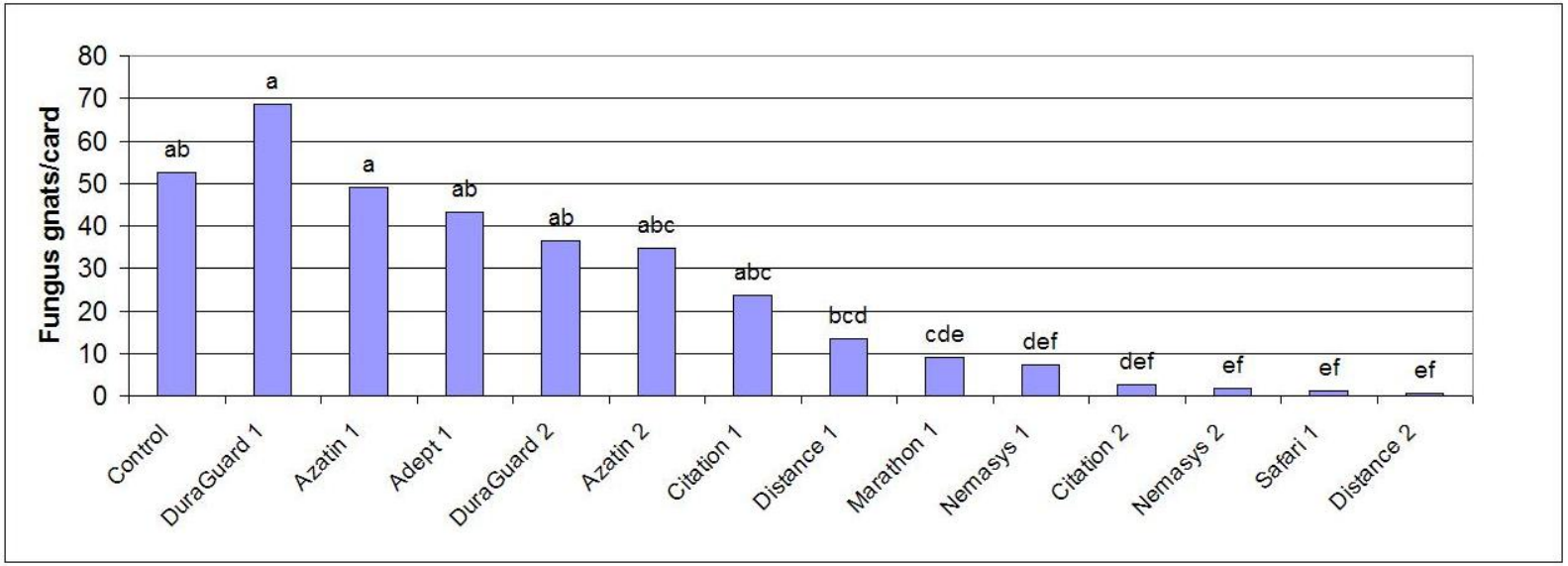
Table 2. Summary of single media drench applications of insecticides (on Oct. 18 2005). Average count of fungus gnat adults per sticky card (10 containers per treatment per location).

LOCATION	Control	DuraGuard	Adept	Azatin	Citation	Distance	Marathon	Nemasys	Safari
1	121 a	79 ab	54 b			46 b	44 b	14 c	3.1c
UNH	53 ab	69 a	43 ab	49 ab	24 bc	13 cd	9 cd	7 cd	1.2 d
2	46 a	31 abc	29 abc	30 abc	11 cd	17 bcd	18 bcd	18 bcd	4.8 d
3	32 a	19 abc	21 ab	14 abcd	11 bcd	10 bcd	10 bcd	6 cd	4 d
5	24 a	25 a	15 ab	3.8 bc	11 abc	8 abc			1.2 c
4	22 a	7 b	13 ab	11 ab	8 b	5 bc	3 bc	5 bc	0.3 c
6	0.3 a	0.3 a	0.5 a	0.2 a	0.8 a	0.4 a	0.1 a	12 a	0 a
7	0.2 abc	0.8 ab		0 bc	0.3 abc	0 c	0 bc	0.4 abc	0.1 bc
Overall percent for sites 1-5 and UNH	**100%**	**76%**	**63%**	**53%**	**37%**	**31%**	**27%**	**22%**	**4%**

Notes on Table 2:

- Notes: Values within a row (column?) that share the same letter designation are not statistically different (Tukey's HSD test at *P*=0.05).
- For locations 6 and 7, fungus gnat adult counts were low for all containers, including the control.
- For locations 1, 5, and 7, not all insecticides were applied.
- The bottom row represents the average (mean?) percent fungus gnat adult control for locations 1 through 5 and the UNH.

Figure 1. Summary of insecticide results from University of New Hampshire with 1 or 2 media drench applications ("1" on Oct. 18 or "2" on Oct. 4 and Oct. 18).



Note: Bars that share a common letter are not significantly different from each other (Tukey's HSD at *P*=0.05).

Insert: Grower protocol
Below is our method for determining fungus gnat adult counts, which may be used to monitor fungus gnats or evaluate insecticides. Photos by Kate Santos, UNH.

Growers received a kit that included beakers and gloves for applying the insecticides, labels, mailing envelops, bags, and instructions. Insecticide treatments were applied on Oct. 18 at the 8 locations.

One day after the insecticide treatments had been applied, the above ground portion of the plant was removed and discarded.

A yellow sticky card was placed on top of two clothespins, on the growing medium surface. The container was placed on a tray filled with water inside a paper bag, which was stapled closed and maintained at 70ºF for 28 days. Any fungus gnat adults that emerged from the growing medium over the 28-day period were captured on the yellow sticky card.

After 28 days, the yellow sticky cards were removed, placed in a plastic bag, and shipped to the University of New Hampshire (this photo shows technician Luke Hydock) and the number of fungus gnat adults was counted.