

EVALUATION OF 'ORGANIC' TREATMENTS FOR RED IMPORTED FIRE ANT MOUNDS

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Over 70 insecticide products are registered for the treatment of individual mounds of the red imported fire ant, *Solenopsis geminata* Buren. Few of these, however, are considered to be 'organic' (of natural origin). Because of the sensitivity of some people to synthetic insecticides (perceived to be more toxic than 'natural' products), these trials were conducted to evaluate several commercially available products considered to be 'organic'. Orthene® Turf, Tree and Ornamental Spray (75% acephate dust, an organophosphate insecticide) was included in this trial as a non-'organic' "standard".

Materials and methods

Trial 1. Plots, 40 ft. wide and variable in length (Table 1), containing 10 active fire ant mounds each, were established in ornamental turf in Brazos County, 12 May 1993. Plots were arrayed by length and blocked into four sets of eight plots each. Treatments listed below were randomly assigned to each block and applied to individually flagged mounds according to directions, 14 May. Temperatures (top of mound, 5 cm and 10 cm below the surface) of an untreated fire ant mound were monitored during the application of the Insecto™ Formula 7 treatment.

<u>Treatment</u>	<u>Rate</u>
1. Organics Plus™ (0.2% pyrethrins + 1.1% piperonyl butoxide + 90% diatomaceous earth)	4 tbsp./1 gal./mound
2. Insecto™ Formula 7 (pine oil + sugar + linseed oil + mint oil + ammonium + coloring + water)	3 oz./3 gal./mound
3. Bonide® Rotenone 5 Insecticide (5% rotenone + 10% other cube resins)	1 rounded tbsp./2 gals. applied in 4 ft. diam. around mound
4. Natural Guard™ Nicotine Sulfate (10% nicotine (alkaloid))	1 tbsp./1 gal./mound
5. GardenVille® Diatomaceous Earth	4 tbsp./gal./mound
6. Orthene® Turf, Tree & Ornamental Spray (75% acephate dust)	tbsp./gal./mound
7. water drench	1 gal./mound
8. untreated check	dry

Two hours after treatment, one plot from each treatment was inspected for fire ant activity. At 3, 7, 14 and 30 days following treatment, plots were evaluated using the minimal disturbance method. New mounds occurring in each plot were also noted. Notes were also taken on any phytotoxicity which occurred as a result of the treatment. Post-treatment fire ant activity was analyzed based on the number of treated mounds and the total number of mounds per treatment plot using analysis of variance (ANOVA) and the Tukey's Studentized Range Test ($P \leq 0.05$) (PC SAS).

Trial 2. Because of concerns that mound temperatures were too high at the time of application of Insecto™ Formula 7 in Trial 1, a second trial was initiated on 26 May. This trial compared the treatment to the 1 gal. water drench. This trial was established, monitored and analyzed using methods similar to those described above for Trial 1, except that evaluations were made 4, 7, 16 and 30 days following application of treatments.

Results and Discussion

The experimental design employed in these trials was developed to provide two types of efficacy data: 1) the effect of a treatment as measured by ant activity on four uniform sets (plots) of 10 marked red imported fire ant mounds; and 2) the ability of individual mound treatments to reduce the total number of ant mounds in treated areas. By arraying plot length to produce blocks within which treatments are randomly assigned, the mean plot length for each treatment becomes uniform (Table 1). In this way, the probability of fire ant colonies migrating in or out of any given set of treatment plots is equal. Furthermore, the presence of a number of 'new' (unmarked) mounds which appeared between treatment plots were considered to be relocated fire ant colonies, called 'satellite' mounds. These were separately documented and included in evaluations.

Trial 1. Treatments were applied, 14 May, 1993. Due to recent rains, soil moisture was high and mound building activity was evident. The weather was clear and warm. By 3:52 p.m. when Insecto™ Formula 7 was applied, ambient temperatures had risen to 98 degrees F. Temperatures within untreated mounds ranged from 90 to 97 degrees F at 5 cm and 87 to 89 degrees F at 10 cm below the surface. High mound temperatures at the time of treatment prompted the second trial because of anecdotal reports from the manufacturer that the product was less effective when applied during periods of high temperatures.

Two hours following completion of treatments (5:30 pm), one plot from each treatment except for Orthene® Turf, Tree and Ornamental Spray was inspected for ant activity in the ten mounds treated. The number mounds with ant activity of ten was as follows: 2 - Organics Plus™; 10 - Insecto™ Formula 7; 9 - Bonide® Rotenone 5 Insecticide; 10 - Natural Guard™ Nicotine Sulfate; 9 - GardenVille® Diatomaceous Earth; 10 - water drench; and 9 - untreated check. The Organics Plus™ treatment was the only 'organic' treatment which caused a reduction in ant activity.

On the 17 May evaluation, weather was partly cloudy, with temperatures in the mid 70's (degrees F) and soil was moist. On 21 May, evaluations were made from 9:30 am to 11:00 am and 1:30 pm to 3:00 pm. Temperatures ranged from 75 to 80 degrees F, and weather was partly cloudy. On 27 May, evaluations were made from 9:00 to 11:00 am. Temperatures were in the low 70's and weather was cloudy. Soil was very moist and virtually all active ant mounds were found to contain brood which was readily visible near the top of the mound. No phytotoxicity was observed.

Fire ant activity in mounds following treatments is presented in Table 2. Organics Plus™ and Orthene® Turf, Tree and Ornamental Spray treatments resulted in statistically similar reductions of ant activity. These treatments produced a rapid, 80 to 85 percent (calculated from a pre-treatments level of 10 mounds), elimination of activity within 3 days of treatment. Reduction of ant activity in treated mounds continued to increase, reaching 95 to 98 percent at 14 and 30 days following treatment, respectively. Plots treated with Orthene® and the untreated control had fewer 'satellite' mounds recorded following treatment than other treatments. Satellite mounds were more frequently recorded in the Organics Plus®, Insecto™ Formula 7, diatomaceous earth and water drench treatments than the others (Table 3).

Insecto™ Formula 7 (lot 30404 4/4/93) drenches resulted in a slow decline in ant activity. Three days after treatment, 53 percent of the treated mounds contained no active ants. Reduction was similar at 7 days (60 percent); however, this level of suppression was not significantly different from that obtained with the 1 gal. water drench treatment (Table 2). On day 14 following treatment, ant activity in mounds treated with Formula 7 had declined to 98 percent from pre-treatment levels. An average of three 'new' (unmarked) mounds were detected in each treatment plot (Table 3). Thus, the reduction in the total number of fire ant active mounds per plot was 68 percent ($[(0.25+3.00/10)-1] \times 100$). By the end of the trial (30 days following treatment), ant activity in mounds treated with Insecto™ Formula 7 was reduced by 95 percent and the plots contained 80 percent fewer active ant mounds.

Suppression of fire ant activity using Insecto™ Formula 7 was significantly different from untreated control plots throughout the trial, and from mounds drenched with 1 gal. water 3, 14 and 30 days after treatment (Tables 2 and 3). During application of Formula 7 some treated mounds collapsed and some of the solution ran away from the treatment sites. Brood (larvae and pupae) were not observed to float to the top of the mound during treatment as occurred during the water drench applications. Treatments using 3 gal. water per mound were noted to be labor intensive and time consuming as compared to 1 gal. drench treatments.

Insecto™ Formula 7 is not currently registered as a fire ant insecticide by the Environmental Protection Agency (EPA). Data from these trials are intended to provide documentation of product performance. Effects of Formula 7 treatments were found to be statistically similar to those obtained using 1 gal. Bonide® Rotenone 5 Insecticide mound drench treatments (Tables 2 and 3). Rotenone is an EPA registered insecticide approved for treating fire ant mounds in ornamental turf. Rotenone treatments resulted in fewer 'satellite' mounds (Table 3).

Natural Guard™ Nicotine Sulfate and Gardenville® Diatomaceous Earth treatments produced no

significant reductions of red imported fire ant mound numbers throughout this trial. The nicotine sulfate product is currently an EPA registered insecticide for use as a fire ant mound drench in turf areas. Gardenville® Diatomaceous Earth is not an EPA registered insecticide for fire ant control. This treatment was included because 1) many people consider diatomaceous earth to be 'organic' and it is said to be effective for the control a wide range of arthropods; 2) diatomaceous earth is one component of the Organics Plus™ treatment (although the diatomaceous earth formulated in Organics Plus contains only amorphous silica dioxide). Results of this trial indicate that the diatomaceous earth when used alone did not significantly reduce ant activity in treated mounds.

Trial 2. Insecto™ Formula 7 (3 gals per mound) and water treatments (1 gal per mound) were applied from 8:35 to 10:45 am, 26 May. Temperature ranged from: 71 to 78 degrees F, on top of an untreated mound; 71 to 79 F at 5 cm; and, from 70 to 75 F, 10 cm below the surface. Results of this trial were similar to those observed in Trial 1. The effects of the Insecto™ Formula 7 treatment was slow, with a maximum of 100 percent elimination of ant activity in treated mounds at 16 days following application (Table 4). However, considerable 'satellite' mound formation occurred during this trial in both Formula 7 and water drenched treatment plots. Wet spring conditions may have aggravated colony relocation, and as a result, a significant difference in the total number of ant active mounds per plot occurred between treatments at the 16 day post-treatment evaluation date. At that time, reduction of mounds in the Formula 7 plots reached 73 percent (calculated from a pre-treatments level of 10 mounds). As in trial 1, inclusion of a water drench treatment using 3 gals per mound would have resulted in a better evaluation of the effects of Insecto® Formula 7 than the 1 gal. water drench treatment used as a control in this trial.

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Table 1. Length of plots (feet and inches and total feet) containing 10 active Red Imported Fire Ant mounds each before treatment, Brazos Co., Texas 1993 (Trial 1).

Treatment	Block				Total length
	I	II	III	IV	
Organics Plus™	21' 1"	25' 9"	28' 4"	35' 6"	110.66
Insecto™ Formula 7	24' 0"	20' 0"	27' 6"	46' 8"	123.17
Bonide® Rotenone 5 Insecticide	23' 9"	26' 4"	27' 0"	56' 2"	133.25
Natural Guard™ Nicotine sulfate	26' 0"	34' 2"	34' 8"	38' 2"	133.01
Gardenville® Diatom- aceous Earth	20' 9"	24' 5"	32' 8"	37' 2"	115.01
Orthene® Turf, Tree and Ornamental Spray	20' 1"	24' 7"	29' 10"	46' 2"	122.65
water drench	21' 6"	26' 2"	27' 6"	38' 1"	113.25
untreated check	17' 4"	17' 10"	22' 5"	45' 5"	103.00

Table 2. Number of treated mounds of ten containing active Red Imported Fire Ant colonies following treatment using 'organic' insecticide products, Brazos Co., Texas 1993 (Trial 1).

	Dates Post-treatment ^a			
	17 May 3 day	21 May 7 day	27 May 14 day	11 June 30 day
Organics Plus™	2.00b (80)	2.00d (80)	0.25b (98)	0.50b (95)
Insecto™ Formula 7	4.75b (53)	4.00bcd (60)	0.25b (98)	0.50b (95)
Bonide® Rotenone 5 Insecticide	4.50b (55)	3.25cd (68)	3.25b (68)	1.50b (85)
Natural Guard™ Nicotine sulfate	8.50a (15)	6.50abc (35)	7.75a (23)	6.50a (35)
Gardenville® Diatomaceous Earth	8.00a (20)	8.25ab (17)	8.25a (18)	6.75a (33)
Orthene® Turf and Ornamental Spray	1.50b (85)	1.25d (88)	0.25b (98)	0.25b (98)
water drench	9.00a (10)	7.75ab (23)	8.00a (20)	6.25a (38)
untreated control	9.50a (5)	10.0a (0)	9.50a (5)	8.25a (18)
MSE	1.809	3.400	2.149	1.208
R-square	0.0001	0.0001	0.0001	0.0001
d.f.	15.47	8.76	21.95	27.27
Studentized Range	4.743	4.743	4.743	4.743
Min. Sig. Diff.	3.1904	4.3735	3.4767	2.6071

^a Mean no. fire ant active mounds/10 treated per plot. Means followed by the same letter are not significantly different according to ANOVA and the Tukey's Studentized Range Test (≤ 0.05). Percent reduction of ant activity in mounds in parentheses.

Table 3. Number of fire ant active treated mounds of ten plus new active fire ant mounds occurring in treatment plots following treatment using 'organic' insecticide products, Brazos Co., Texas 1993 (Trial 1).

	Dates Post-treatment ^a				
	17 May <u>3 day</u>	21 May <u>7 day</u>	27 May <u>14 day</u>	11 June <u>30 day</u>	
Organics Plus™	3.25b (1.25)	3.25bc (1.25)	2.00b (1.75)	1.50b (1.00)	
Insecto™ Formula 7	6.00ab (1.50)	4.75bc (0.75)	3.25b (3.00)	2.00b (1.50)	
Bonide® Rotenone 5 Insecticide	6.00ab (1.50)	3.25bc (0.00)	4.25b (1.00)	3.25b (1.75)	
Natural Guard™ Nicotine sulfate	9.00a (0.50)	6.75ab (0.25)	9.75a (2.00)	7.50a (1.00)	
Gardenville® Diatomaceous Earth	8.75a (0.75)	9.50a (1.25)	10.75a (2.50)	8.00a (1.25)	
Orthene® Turf and Ornamental Spray	2.50b (1.00)	1.75c (0.50)	0.75b (0.50)	0.25b (0.00)	
water drench	10.25a (1.25)	9.00a (1.25)	9.50a (1.50)	7.50a (1.25)	
untreated control	10.00a (0.50)	10.25a (0.25)	10.25a (0.75)	8.50a (0.25)	
MSE	3.851 0.0001	3.310	3.494 0.0001	2.923 0.0001	0.0001
R-square	0.7753 7.24	0.8313 10.35	0.8710 14.18	0.8414 11.14	
d.f.	21	21	21	21	
Studentized Range	4.743	4.743	4.743	4.743	
Min. Sig. Diff.	4.6544	4.3147	4.4333	4.0546	

^a Mean total no. active mounds per plot/average. Means followed by the same letter are not significantly different according to ANOVA and the Tukey's Studentized Range Test (≤ 0.05). Mean no. 'satellite' mounds in parentheses.

Table 4. Number of mounds containing red imported fire ant activity following treatment using Insecto™ Formula 7 (3 gals. per mound) or water drench (1 gal. per mound), Brazos Co., Texas applied 26 May 1993 (Trial 2).

		Dates Post-treatment ^a			
		<u>4 day</u>	<u>7 day</u>	<u>16 day</u>	<u>30 day</u>
Insecto™ Formula 7		2.75b (73)	1.50b (85)	0.00b (100)	0.75b (93)
water drench		9.00a (10)	9.00a (10)	8.75a (13)	4.75a (53)
MSE		2.4583	0.8333	0.7917	4.333
		0.0587	0.0077	0.0046	0.2992
R-square		0.9151	0.9787	0.9850	0.7263
		8.080	34.50	49.11	1.99
d.f.		3	3	3	3
Studentized Range		4.549	4.549	4.549	4.539
Min. Sig. Diff.		3.5665	2.0765	2.0239	4.7352
		Dates Post-treatment ^b			
		<u>4 day</u>	<u>7 day</u>	<u>16 day</u>	<u>30 day</u>
Insecto™ Formula 7		8.75a (6.0)	7.75a (6.25)	2.75b (2.75)	2.00a (2.00)
water drench		12.50a (3.50)	11.25a (2.25)	9.50a (0.75)	6.75a (2.00)
MSE		3.7917	6.1667	4.7917	8.4583
		0.1678	0.2172	0.0832	0.3027
R-square		0.8219	0.7849	0.8918	0.7238
		3.46	2.74	6.18	1.97
d.f.		3	3	3	3
Studentized Range		4.549	4.549	4.549	4.549
Min. Sig. Diff.		4.4294	5.6487	4.9793	6.6156

^a Mean no. fire ant active mounds/10 treated per plot. Means followed by the same letter are not significantly different according to ANOVA and the Tukey's Studentized Range Test (≤ 0.05). Percent reduction of ant activity in mounds in parentheses.

^b Mean total no. active mounds per plot/average. Means followed by the same letter are not significantly different according to ANOVA and the Tukey's Studentized Range Test (\leq

0.05). Mean no. 'satellite' mounds in parentheses.