Effectiveness of Pyrethrin and Pyrethroid-containing Formulations of Diatomaceous Earth for the Control of Individual Fire Ant Colonies

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The San Antonio-based company Global Organic Resources produced insecticide formulations used for the control of red imported fire ants (*Solenopsis invicta* Buren) that contain the active ingredients pyrethrin and diatomaceous earth. This trial was initiated to confirm the efficacy of these formulations when applied as individual mound treatment (IMT) drenches. Furthermore, supply problems occasionally limit the availability of pyrethrin, causing the company to seek an alternative active ingredient. The pyrethroids allethrin and permethrin are being considered as substitutes and were included in the test to supply efficacy data for their registration.

Objective: Test the effectiveness of different percentages of pyrethrin, pyrethroids and piperonyl butoxide (PBO), plus diatomaceous earth for the control of individual fire ant colonies.

Materials and Methods

The test was established near one end of the runway at Coulter Field, the municipal airport serving Bryan, Texas. Calculations showed that the test area had an active mound density of over 600 mounds per acre on a sandy loam soil. A strip of land 30 feet long and of indeterminate length was marked off and mowed. Several days were then allowed for mound rebuilding. Beginning at one end of the strip and moving down it, wire surveyor's flags of one color were placed just to the east side of consecutive, active fire ant mounds until 10 mounds were marked. This set of 10 active mounds constituted a plot. Flag colors were then switched for the next set of 10 and so on, alternating flag colors, until a sufficient number of plots were established.

Larger plot marker flags were placed along one edge of the strip at the midpoint between the last flag of one plot and the first flag of the adjoining plot. The distances between plot markers were then measured and recorded, thus giving a defined length to each plot. The plot lengths were then arrayed from longest to shortest (lowest to highest mound density) and divided into four equal groups (replications). Treatments were first randomly assigned within replications, then re-arranged within replications so that the total length (or area) of the four replications comprising a treatment were as equal as possible between all treatments. In other words, every treatment had an approximately equal total amount of plot area. This method helps equalize the chances of a colony relocating within its original plot and helps equalize re-invasion pressure since treatment perimeter lengths, as well as area, are similar (Barr and Best, 2002).

The test was established on 9 May 2000. An unforseen rain event occurred that evening, the result of which was the appearance of a great number of new mounds (an average of nearly four per plot) in the already-marked plots. To avoid having to re-establish the entire test, the plots were re-surveyed before treatment on the morning of 10 May. Unmarked mounds were "blue-flagged" so they were not treated or included in subsequent evaluations.

At the time of treatment the soil was wet, though drying out rapidly, air temperature 75-85°F, skies were partly cloudy and there was a light wind. Brood was evident near the top of most mounds, making for good individual mound treatment conditions. All test products were mixed at

a rate of four tablespoons per gallon of water and applied at a rate of one gallon per mound. A gallon of water only was applied to control mounds. Treatments are listed in **Table 1.**

Table 1. Treatments included. Coulter Field, Bryan, TX, 2000.

Treatment	pyrethrin/pyrethroid	Silica dioxide (from diatomaceous earth)	Piperonyl butoxide
Organic Plus®	0.02%	97.9%	1.1%
Organic Solutions®	0.01%	83.3%	1.0%
Organic Solutions "O"	0.05%	82.9%	0.0%
pyrethrins 0.02	0.02%	82.9%	1.0%
permethrin	0.025%	83.3%	1.0%
allethrin	0.02%	82.9%	1.0%
water-drench control	-	-	-

All treatments were applied according to manufacturer's directions. Using a watering can with the breaker removed, pouring began a foot or two from the mound center and spiraled inward. The water stream was then directed onto the mound structure so that it collapsed and all freshly worked soil was washed down.

Evaluations were conducted at 1, 7, 14, and 30 days post-treatment. Evaluations were conducted using the minimal disturbance technique. The plots were re-surveyed to detect the formation of satellite/new mounds on the one and 30-day evaluations dates. Data were analyzed using SAS ANOVA with means separated using Tukey's studentized range (HSD) test, $P < 0.05$.

Results and Discussion

As can be seen in **Table 2**, all insecticide-treated plots had significantly ($P < 0.05$) fewer active, treated mounds versus plots with water-drenched mounds for the duration of the test. There were no statistical differences in the number of new/satellite mounds between any of the treatments. All treated plots had significantly fewer total (treated + new) active mounds than the water-drenched control at 14 days post-treatment. At 30 days post treatment, there were no statistical differences in total active mounds between any treatments, due mainly to natural abandonment of water-drenched mounds.

The number of naturally abandoned mounds was unusually high in this test as was the number of new mounds found in the plots. We believe that this phenomenon was due largely to ant behavior characteristic at this site and the weather conditions. A number of tests have been conducted over the years in areas near this test site. Active fire ant mounds are present at very high densities, on the order of 600 mounds per acre under ideal conditions, but they tend to form and be abandoned frequently, usually in response to weather. A number of rain events occurred in the area over the course of the test, each of which appeared to result in natural mound formation and abandonment.

Therefore, it is felt that all product formulations gave near-100% control of treated fire ant

colonies with little indication of colony movement or shattering.

Table 2. Results of red imported fire ant mound evaluations - 10 mounds treated, 4 replications. Bryan, TX, treated May 9, 2000.

	Mean number of active mounds							
Treatment	Day 1	Day 1 new	Day 1 total	Day 7	Day 14	Day 30	Day 30 new	Day 30 total
untreated	9.25 a	3.50 a	12.75 a	6.75 a	4.25 a	3.25 a	6.50 a	9.75 a
Organic Plus	1.00 b	2.00 a	3.00 b	0.00 b	0.00 b	0.25 b	5.75 a	6.00 a
Organic Resources	0.75 b	1.75 a	2.50 b	0.50 b	0.50 b	0.25 b	4.50 a	4.75 a
Organic Resources "O"	0.00 b	2.50 a	2.50 b	0.00 b	0.00 b	0.50 b	8.50 a	9.00 a
pyrethrin 0.2%	1.75 b	2.50 a	4.25 b	0.75 b	0.25 b	0.00 b	4.75 a	4.75 a
permethrin	0.25 b	1.25 a	1.50 b	0.25 b	0.00 b	0.00 b	7.25 a	7.25 a
allethrin	1.00 b	1.50 a	2.50 b	0.50 b	0.25 b	0.00 b	5.50 a	5.50 a
F	36.18	1.86 a	15.23	13.74	6.49	6.83	1.68	2.21
P	0.0001	0.1254	0.0001	0.0001	0.0004	0.0003	0.1656	0.0728
R^2	0.9476	0.4819	0.8839	0.8729	0.7644	0.7735	0.4571	0.5249
MSD	2.0711	2.8427	3.8971	2.5238	2.4096	1.7906	6.1362	6.6805

Means in the same column followed by different letters are significantly different ($P < 0.05$). Data analyzed using PC SAS analysis of variance procedures. Means separated using Tukey's Studentized Range (HSD) Test. df = 18

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