RED IMPORTED FIRE ANT
APPLIED RESEARCH/RESULT DEMONSTRATIONS
1992-1993

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SURVEY OF RED IMPORTED FIRE ANT MOUND DENSITIES IN MANAGED NATIVE PRAIRIES - THE ATTWATER PRAIRIE CHICKEN NATIONAL WILDLIFE REFUGE: FINAL REPORT

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The Attwater's prairie chicken, *Tympanuchus cupido attwateri*, is a subspecies, like the Greater prairie-chicken, of the Heath hen. The Attwater Prairie-Chicken National Wildlife Refuge was established in 1972 to preserve and restore critical habitat for this endangered subspecies. Approximately 8,000 acres are currently managed by the U.S. Fish and Wildlife Service. Native grasses and forbes of the prairie are critical components of prairie-chicken habitat.

The five-month mating season of the Attwater's prairie-chicken begins in late December when males congregate on courtship or "booming" grounds. Booming grounds vary in shape and size (usually 0.1 to 10 acres or less) and have short plant cover. Females are attracted to the booming grounds by the spirited fighting and booming of the males. Mating usually occurs there, and nests are normally located within one-half mile. Hens prefer to nest in medium to heavy grass cover and lay an average of 12 eggs which incubate for 26 days. Chicks are escorted from dense cover soon after hatching and can fly when they are two weeks old. The nesting occurs in April and is completed by mid-May.

The refuge is intensively managed for the preservation of the Attwater's prairie-chicken, one of the few National Wildlife Refuges designated specifically for an endangered species. Management techniques to improve habitat include controlled grazing, prescribed burning, strip row cropping, mowing, pest plant control and predator control. Snakes, opossums, raccoons, coyotes, armadillos and especially skunks prey upon the eggs and young birds.

The red imported fire ant, *Solenopsis invicta* Buren, has been documented to prey on hatching eggs of several ground-nesting birds including waterfowl and quail. However, no ant-related mortality of the Attwater's prairie-chicken has been documented. This survey was initiated to monitor fire ant mound nesting density in the managed native prairie to determine if management practices produced any changes in mound density over time.

Materials and Methods

The Reichardt Prairie, a section of managed native prairie approximately 4,000 by 10,000 ft. (918 acres) and containing no internal fencing, was subdivided into four managed areas or plots under a rotational cultural management regime of prescribed burning, shredding and controlled grazing as described below:

Plot 1) 106 acres (this area contains a booming area)
- Not burned since 1979
- Burned 24 Jan. 1992
- Strips of this plot were shredded 14 to 18 September 1992

Plot 2) 137 acres
- Not burned since 1983/84
- Burned 24 Jan. 1992

Plot 3) 234 acres (this area serves as good nesting/brood habitat)
- Burned in 1990
- Shredded early August 1991
- Shredded, 11 to 14 August 1992

Plot 4) 175 acres (this area serves as a primary nesting habitat)
- Burned in February 1991
- Shredded early August 1991
- Strips of this plot were shredded 14 to 18 September 1992

Notes: All areas serve as nesting/brood habitat following a burn.

No transects were burned during 1993. All were under continuous grazing throughout the year.

On March 16, 1991 within each plot, four permanent subplot sites were established using metal fence posts and were arranged in transect lines initiating from road intersections that separate managed areas within the prairie. The number of active red imported fire ant mounds within an 80 ft. radius (0.46 acre or 0.19 hectare) of these fence posts were counted using the minimal disturbance method. This process was repeated on 12 March 1992 and 16 March 1993. Average density of fire ant mounds and the effect of cultural management practices were evaluated over the three year period. Data were analyzed across years for each managed area (plot) individually and together using analysis of variance (ANOVA) and Duncan's Multiple Range Test ($P \leq 0.05$).

Results and Discussion

Population densities of fire ants throughout this study were found to be within the range normally associated with areas inhabited by the single queen or monogynous form of the red imported fire ant (40 to 150 mounds per acre)(Table 1). These densities are dramatically lower than those associated with the multiple queen or polygynous form of this species (200 or more mounds per acre). Although mound numbers declined after 1991, no significant differences in mound density occurred in the analysis of combined data from the four managed areas over this 3 year study. These results indicate that this population of fire ants is rather stable (Table 2).

On 9 March 1991 fire ant mound numbers were found to be remarkably consistent between plots except in the recently burned Plot 4. There, mound density averaged 89 mounds per acre, 45 percent greater than in plots with forage cover and the higher density encountered through this 3 year study (Table 1). Apparently, the lack of cover allowed more mounds to be detected in these subplots.

The 12 March 1992 evaluation revealed that fire ant mound numbers had remained constant or declined from the previous year, even though plots 1 and 2 had recently been burned (Table 1). Mound numbers in Plots 3 and 4, burned in 1990 and 1991 and now supporting dense vegetation, were significantly lower than in 1991 (Table 2). Whether this decline resulted from the burn, weather conditions or ant mound monitoring ability can not be conclusively determined from these data. No significant changes in mound numbers occurred from 1992 through the last monitoring date, 16 March 1993 (Table 2). The only managed area (plot) in which a significant increase in mound numbers occurred over the three years was in Plot 2. The only management practice implemented there was a prescribed burning in January 1992.

Results of this fire ant population monitoring effort suggest that prescribed burning and the other cultural practices implemented do not eliminate fire ant colonies. During a short period following a burn, fire ant mounds may be more noticeable and more accurately sampled because of lack of cover vegetation. Shredding practices produced no noticeable differences in mound numbers.

Table 1. Number of red imported fire ants per 0.46 acre subplots within culturally managed areas of the Reichardt Prairie, Attwater Prairie Chicken National Wildlife Refuge, Colorado County, Texas, 1991 through 1993.

	No. fire ant mounds per 80 ft. radius circular					
	----------Subplot-----------					
Plot/management practices	1	2	3	4	Mean[a]	
6 March 1991:						
1. not burned since 1979	19	24	22	23	22.0b	(48[b])
2. not burned since 1983/84	24	23	21	21	22.2b	(48)
3. burned in 1990	24	24	30	18	24.0b	(52)
4. burned in February 1991	34	50	40	40	41.0a	(89)
12 March 1992:						
1. not burned since 1979[c]	23	20	22	19	21.0ab	(46)
2. not burned since 1983/84[c]	32	23	16	29	25.0a	(54)
3. burned in 1990[d]	14	9	13	11	11.8bc	(26)
4. burned in February 1991[d]	9	17	14	15	13.8bc	(30)
16 March 1993:						
1. not burned since 1979[e]	14	24	27	19	21.0b	(46)
2. not burned since 1983/84	28	32	29	38	31.8a	(70)
3. burned in 1990[f]	17	17	9	12	13.8bc	(31)
4. burned in February 1991[e]	14	13	11	14	13.0c	(28)

[a] Means in columns for each monitoring date followed by the same letter are not significantly different using analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT)($P \leq 0.05$): 6 March 1991, $F = 19.328$, $P = 0.0001$; 12 March 1992, $F = 7.450$, $P = 0.0300$; 16 March 1993, $F = 14.788$, $P = 0.0003$.

[b] Number of mounds per acre

[c] Burned 24 Jan. 1992

[d] Shredded early August 1991

[e] Strips of this plot were shredded 14-18 September 1992

[f] Shredded, 11 to 14 August 1992

Table 2. Mean number of red imported fire ants per managed area (plot), Attwater Prairie Chicken National Wildlife Refuge, Colorado County, Texas 1991-1993.

	-------------No. red imported fire ants per 0.46 acre[a]--------------- Managed area (plot)				
Year	1	2	3	4	Mean
1991	22.0a	22.3b	24.0b[b]	41.0b[c]	27.3a
1992	21.0a[d]	25.0ab[d]	11.8a	13.8a	18.0a
1993	21.0a	31.8a	13.8a	13.0a	19.5a
F	0.105	4.57	10.67	75.26	1.372
P	0.9017	0.0622	0.0106	0.0001	0.3345

[a] Means in columns followed by the same letter are not significantly different using analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT)($P \leq 0.05$).
[b] Burned Feb. 1990
[c] Burned Feb. 1991
[d] Burned Jan. 1992

RED IMPORTED FIRE ANT INVASION OF FALLOW RICE FIELDS

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The red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae) is an introduced species in the southeastern United States. It has spread through Texas since the 1950's and despite eradication attempts, has become widely established in the eastern half of the state. Fire ant population densities appear to become somewhat stable in undisturbed areas such as the Attwater Prairie Chicken National Wildlife Refuge in Colorado County, where fire ant mound numbers averaged 49 per acre (ranging from 40 to 90) over a 3 year period (1991-1993). In land disturbed by flooding, agriculture, construction or insecticide use, ants re-invade quickly, often to higher colony densities than they were before disturbance. This census of fire ant mound densities in fallow rice fields was undertaken to provide documentation of fire ant re-invasion of disturbed habitats.

Methods and Materials

Rice production in Texas is characterized by fields being permanently flooded through the summer months and then being drained for harvest during August through November. Fallow rice fields, which had been planted to rice and flooded during the summer 0.5, 1.5 and 2.5 years prior to surveying were selected (These fields were planted to rice in 1992, 1991 or 1990, respectively). Four sets each of fallow rice fields were surveyed in February 1993. Within each field, six 0.5 acre circular areas, selected as to avoid field margins and levees, were monitored for the presence of active fire ant mounds and the presence of reproductive larvae and pupae. Resulting mound numbers were analyzed using regression analysis and the Student's *t* test ($P \leq 0.05$).

Results and Discussion

No red imported fire ant mounds were found in fields planted to rice the previous summer (Table 1). In 1.5 year fallow rice fields (1991), ant mounds averaged 45 per acre (ranging from 12 to 92) and in fields planted to rice 2.5 years earlier (1990), an average of 74 mounds per acre (ranging from 28 to 202) was detected. A significant linear regression ($F = 97.695$; $P = 0.0001$; d.f = 70) was found between the appearance of mounds over time: Y = 18.52X + -17.319, where Y = ant mound density and X = time (years, rounded off). The number of plots in which reproductive brood was detected also increased over time, with 8 plots in 1991 planted rice fields (1.5 years) and 18 plots in 1990 planted rice fields (2.5 years).

Results of this fire ant mound census provide documentation of fire ants re-invading an area cleared of ants by flooding in rice culture. Ant mound densities in this disturbed habitat were shown to increase at a rate of 37 mounds per acre per year. Over a three-year period densities increased to 74 mounds per acre, exceeding densities in a stable habitat at a nearby wildlife refuge by 25 mounds per acre (34 percent).

Table 1. Number of red imported fire ants per 0.5 acre circle area in fallow rice fields, Colorado County, Texas 1993.

	No. fire ant mounds per 0.5 acre circular plot				
	Field				
Sample site	A	B	C	D	A-D
Planted to rice in 1992					
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
Mean	0	0	0	0	0
Planted to rice in 1991					
1	28*	6*	46*	22	
2	40*	18	34	9	
3	25*	26*	26*	25	
4	12	24*	16	54	
5	10	25	13	19	
6	7	8	20	18	
Mean ± S.D.	20.3 ± 12.8	17.8 ± 8.9	27.5 ± 11.4	24.5 ± 15.4	22.5* ± 12.1
Planted to rice in 1990					
1	41*	15	27	32*	
2	24*	48*	52*	44*	
3	14	33*	29	48*	
4	22	42*	52*	30*	
5	20	41*	101*	23*	
6	38*	26*	65*	22*	
Mean ± S.D.	26.5 ± 10.7	34.2 ± 12.1	54.3 ± 27.1	33.2 ± 10.7	37.0* ± 18.8

* Indicates means are significantly different according to the Student's *t* test ($P \leq 0.05$; d.f. = 46; $t = -3.1681$).

CULTURAL AND CHEMICAL RED IMPORTED FIRE ANT SUPPRESSION PROGRAM EVALUATION

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The red imported fire ant, *Solenopsis invicta* Buren, is considered to be a serious pest of hay and cattle production in Texas. Tall, hardened mounds have been reported to break machinery, particularly sickle bar-type cutters, or force producers to raise their cutting height, thereby loosing yield. This trial was conducted to provide documentation of the effect of insecticide applications (broadcast applications of Amdro® Fire Ant Granules (hydramethylnon) and cultural practices (dragging heavy metal bar to knock down mounds and level dirt), alone and in combination on the number and height of fire ant mounds in a grazed pasture.

Materials and Methods

On 13 May 1993, a grazed pasture in Colorado County was divided into 6 areas. Sizes of these areas and treatments assigned to each area are listed below:

Treatment	Dimensions (ft.)	Acres
1. untreated control	130 x 512	1.53
2. Amdro® (1.5 lbs./acre) applied twice per year	130 x 512	1.53
3. Amdro® (1.5 lbs./acre) applied twice per year and dragged after initial application	130 x 512	1.53
4. Mounds dragged only	130 x 512	1.53
5. Amdro® (1.5 lbs./acre) applied one per year	207 x 520	2.52
6. Amdro® (1.5 lbs./acre) applied one per year and dragged after initial	207 x 520	2.52

Amdro® was applied using a Cyclone® Model 1C1 seeder. Mounds were dragged, 10 June 1993, using a 16 ft. offset disc set at a depth of 1 inch. Plots (treatments 3, 4 and 6) were cultivated using a tractor-pulled toothed harrow behind which a metal rail was dragged to break apart clumps of soil.

Prior to initial treatment and periodically thereafter, red imported fire ant mounds were evaluated in three 0.25-acre circular subplots within each plot. Mound numbers, presence or absence of an ant colony and mound heights were recorded for each plot except in treatments 5 & 6 where only the number of active ant mounds were recorded. These data were used to calculate mound density, average mound height and active ant mounds.

This test is ongoing. A second application of Amdro® was applied on 12 November 1993. These plots will be monitored in the spring and fall of 1994.

Results and Discussion

Height distribution and numbers of red imported fire ant mounds within treatment plots are depicted in Fig. 1. Prior to treatment and dragging, mounds averaged 6.3 to 8.1 inches in height (Table 2). The combination of a broadcast application of Amdro® Fire Ant Granules followed by dragging dramatically reduced active ant mound numbers (from 20 to 4, or 80 percent) and height from (8.1 to 3.8 inches) by 30 June. Dragging alone reduced mound height from 6.3 to 4.3 inches, but did not dramatically reduce active ant mound numbers by 30 June. In fact, by 12 November, ant mounds in this treatment plot had greatly increased in numbers (from 106 pre-treatment to 230 mounds). In Amdro® treated plots, the number of active ant mounds was reduced by 30 June (from 53 to 20 mounds), but had recovered by 12 November (to 108 mounds). Mound height in these subplots was unaffected.

In this trial, the height of all (active and inactive) mounds within subplots was measured. Not all mounds within untreated or treated areas were found to be occupied (Note: in the untreated plot 38 of 68 and 44 of 88 mounds were unoccupied on 30 June and 12 November, respectively (Table 2)). Insecticide applications applied to suppress fire ants in an attempt to reduce average mound height did not succeed within the five month period monitored. Insecticide treatment would not be expected to affect the height of a mound not occupied by ants. The "old" mounds in this field were completely overgrown with bermudagrass and other weeds, making them very resistant to weathering.

Table 1. Red imported fire ants mounds (total and active) per 0.25 acre subplot areas in an unimproved pasture, Colorado Co. Texas 1993.

	Untreated Leveled	Amdro®x2	Amdro®x2 Leveled	Untreated	Amdro®x1	Amdro®x1
May 13, 1993:						
Total	8.3b	10.3b	24.0a	35.3a		
Active	8.3b	9.0b	18.0b	35.0a	40,8,5,9	-,-,-
June 30, 1993:						
Total	23.0ab	1.7c	23.7a	22.0ab		
Active	6.7bc	1.0c	10.0b	21.0a	2,4,2	1,2,0
Nov. 12, 1993:						
Total	29.3bc	12.7c	49.0ab	74.0a		
Active	14.7bc	8.7c	36.3b	73.3a	43,16,10	12,13,7

* Means in lines followed by the same letter(s) are not significantly different using ANOVA and Duncan's Multiple Range Test ($P \leq 0.05$)(F = 25.5, 12.1, 106.2, 24.5, 10.4 and 18.9, respectively).

Table 2. Effect of dragging a pasture and/or use of insecticide on red imported fire ant mound height and number, Colorado County, 1993.

	Untreated Leveled	Amdro®x2	Amdro®x2 Leveled	Untreated
	Fire ant mound height (inches) ± S.D. (number)			
May 13:				
Active	6.3 ± 1.9 (106)	6.5 ± 2.0 (53)	8.1 ± 2.1 (20)	7.6 ± 3.0 (25)
Total	6.3 ± 1.9 (106)	6.5 ± 2.0 (55)	8.1 ± 2.1 (20)	7.6 ± 3.0 (25)
June 30:				
Active	4.3 ± 1.5 (62)	6.7 ± 2.8 (20)	3.8 ± 0.5 (4)	10.0 ± 3.7 (30)
Total	4.3 ± 1.5 (65)	6.7 ± 1.9 (70)	3.8 ± 0.4 (5)	9.0 ± 3.4 (68)
Nov. 12:				
Active	4.1 ± 1.7 (230)	6.4 ± 2.0 (108)	3.6 ± 1.4 (26)	8.7 ± 3.6 (44)
Total	4.1 ± 1.7 (230)	6.0 ± 2.0 (145)	3.8 ± 1.4 (37)	8.0 ± 3.2 (88)

Fig. 1. Red Imported Fire Ant Mound Occurrence by Height (inches), Colorado Co., TX. 1993
('-' denotes inactive mound, X = active mound)

13 May 1993

Height	UNTREATED	AMDROx2 LEVELED	AMDROx2	UNTREATED LEVELED
15		X-		
14				
13	X		X	
12	XX	X-		X
11	XX	-		
10	XX	XX	XX	XXXXX
9	XX	XXXXX	XXXXX-	XXXXXX
8	XXXX	XXXXXXX	XXXXXXX	XXXXXXXXXXXXXXXXXX
7	XXXX	XXXXXX	XXXXX-	XXXXXXXXXXXXXXXX
6		XXXXX-	XXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXX
5	XXX	X	XXXXXXXXXX	XXXXXXXXXXXXXXXXXX
4	XXX		XXX	XXXXXXXXXXXXXXXXXX
3	X		XXX	XXX
2	X			

30 June 1993

Height	UNTREATED	AMDROx2 LEVELED	AMDROx2	UNTREATED LEVELED
16	X-			
15	XX			
14	X			
13	XXXXXXXX---			
12	X--			
11	XX---		X--	
10	XX--		X--	
9	XX-------		---	
8	XX----		XX------------	X
7	XXX--		XXXXXX--------	XXXX
6	X---------		XXX---------	XXXXXXXXXX
5	XX--		XXX---------	XXXXXXXXXXXX
4	XX---	XX--	XX------	XXXXXXXXXXXXXX--
3	X	X	X	XXXXXXXXXXXXXXX-
2				XXXXXX

Fig. 1, cont. Red Imported Fire Ant Occurrence by Mound Height (inches), Colorado Co., TX. 1993
('-' denotes inactive mound, X = active mound)

12 November 1993

Height				
18	X			
17				
16				
15	X			
14	XX-			
13	XX		X	
12	XXXX--			
11	XXX--			
10	XXXXXXX-------		XXXXX-	
9	XXX--		XXXXXXXXX--	**x**
8	XX--		XXXXXXXXXXXXXXXXX	**xxxx**
7	XXX---------		XXXXXXXXXXXXXXXX----	**xxxxxx**
6	XXXXXXX--------	XX--	XXXXXXXXXXXXXXXXXXXXXXXX------	**xxxxxxxxxx**
5	XXXX-----	XXXXXX--	XXXXXXXXXXXXXXXXX-------	**xxxxxxxxxxxxxxxxxxx**
4	XXX----	XXXXXX-----	XXXXXXXXXXXXXX---------------	**xxxxxxxxxxxxxxxxxxxxxxxxxx**
3	X--	XXXX-	XX	**xxxxxxxxxxxxxxxxxxxxxxxxxxxx**
2	X	XXXXXXXXX-	XX-	**xxxxxxxxxxxxxxxxxxx**
1			X	**xx**
	UNTREATED	AMDROx2 LEVELED	AMDROx2	UNTREATED LEVELED (**x** = 2 mounds)

IMPACT OF LOGIC® FIRE ANT BAIT (FENOXYCARB) ON RED IMPORTED FIRE ANT MOUND NUMBERS, HEIGHT AND DIAMETER

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Potential economic loss caused by the presence of tall, hardened mounds produced by the red imported fire ant, *Solenopsis invicta* Buren, in pastures is related to mound height, diameter and numbers. Mound height and hardness is due primarily to soil type and character. The impact of a broadcast application of Logic® Fire Ant Bait on fire ant mounds in an unimproved, ungrazed pasture was examined in the trial reported here.

Materials and Methods

Four 1.0 acre square plots (208 ft. sides) were established in an unimproved pasture on the Lionberger Farm in Austin County, Texas, 24 July 1992. Within each plot, the number, height and diameter of all mounds (occupied and unoccupied) attributed to red imported fire ant activity were measured in 1/2 acre circular plots (83 ft. diameter circle), recording total mound numbers by half-circle (1/4 acre) increments within each plot.

Logic® (fenoxycarb) Fire Ant Bait was applied using an ATV-mounted electric-driven Herd® Seeder at a rate of 1.5 lbs. formulated product per 1.0 acre on two plots. The remaining two plots were left untreated.

Plots were evaluated again on 4 June 1993 using methods described above. However, mound totals were recorded for entire 1/2 acre circular plots rather than by 1/4 acre plot halves. Results of pre- and post-treatment monitoring efforts were analyzed using the Student's *t* test at $P \leq 0.05$.

Results

Mound numbers: Before treatment, no significant differences occurred between ant mound numbers in treatment and untreated control plots (Table 1). In untreated plots, fire ant infested mounds numbered 29 per acre, increasing to 37 (Table 2) by the following year (11 months). The number of mounds (occupied plus unoccupied) in untreated plots averaged 60 per acre. Unoccupied mound numbers were similar to infested mound numbers (25 in 1992 and 29 in 1993), indicating that only about one half of the visible mounds in the field were infested with fire ants. In plots treated with Logic® Fire Ant Bait, ant occupied mounds were reduced by 79% (29 in 1992 to 6 in 1993). The number of detectable unoccupied mounds was also reduced 57% (from 37 to 16).

Mound height: This unimproved pasture had mixed soil types from sandy to clay-type soils. Ant occupied and unoccupied mounds in untreated plots averaged 3.02 inches high in 1992 (pre-treatment) to 5.40 inches (post-treatment)(Tables 1 & 2). Height of fire ant mounds is known to change through the season and from year to year depending on environmental conditions.

Generally, height of ant occupied and unoccupied mounds was found to be similar. In only a few plot comparisons was ant occupied mound height found to be significantly higher than the height of unoccupied mounds. This situation is to be expected since ant mound building activity continues to increase mound height by bringing new soil to the surface as galleries in the mound are being excavated. Only in plot #2, following the application of Logic®, was the height of unoccupied mounds found to be significantly higher than infested ant mounds (Table 2). In the other Logic®-treated plot, there was a numerically similar trend.

Before treatment, mound height in Logic® plots was found to be significantly higher than in untreated plots (3.84 versus 3.19 inches, respectively)(Table 1). One year (11 months) following treatment, mound height in Logic® treated plots had been significantly reduced relative to those in the untreated plots (4.17 versus 5.86 inches, respectively) (Table 2).

Mound width: Width of all mounds averaged 15.67 inches. No significant differences in width were documented between occupied and unoccupied mounds (Tables 1 & 2).

In untreated plots, mound width increased from 1992 to 1993. Mound width changes over time as a result of the same conditions that influence mound height. Before treatment, in Logic® treated plots, mound diameter was found to be wider than mounds in untreated plots (16.48 to 16.41 versus 14.34 to 14.16 inches, respectively)(Table 1). One year (11 months) following treatment, however, ant mound width in Logic® treated plots was significantly less than that of untreated mounds (13.33 versus 15.67 inches, respectively)(Table 2).

Discussion

Potential impact of reduced mound height on harvesting equipment: Tall, hardened fire ant mounds interfere in hay harvesting operations by damaging equipment. Sickle bar-type cutters are known to break or become inoperable after hitting the hardened mounds. Disc-type (Kountz) cutters are designed and marketed to withstand impact from hitting mounds. However, when conditions are wet, even disc-type cutters are reported to be unsuccessful in cutting through the taller mounds. As a consequence, operators must occasionally resort to raising cutting height to avoid equipment damage and delays caused by broken or clogged machinery. Raising cutting height results directly in a reduction of hay yield for that cutting.

Methods to reduce fire ant mound numbers and average mound height, such as the annual application of an approved fire ant bait product, can reduce the probability of equipment damage or the need to raise cutting height. NOTE: Logic® Fire Ant Bait is not currently approved for use in hay pastures.

The sum height (mound number x mean occupied and unoccupied) of fire ant mounds in plots one year (11 months) following the application of Logic® to this unimproved, ungrazed pasture was 91.1 inches. In untreated plots the sum of mound height was 356.4 inches. The use of Logic® had reduced this sum by 74.4 percent.

Potential impact of reduced mound width: Although actual yield losses caused by mounding activities of the red imported fire ant have not been documented, the theoretical impact of loss of forage production can begin to be estimated. During this trial, when ant mound width was measured, little forage production occurred on the freshly worked ant mounds. At other times of the year, ant mounds tend to support more forage production, perhaps as a result of aerated soil and increased nutrient levels. However, the total area denuded by ant mounding activities could, at least temporarily, reduce forage production.

The average radius of untreated mounds on this trial was 7.835 inches or 192.85 sq. inches. The total area of forage production lost in this pasture by fire ant mounding activities was 192.85 x 66 = 1,2728.34 sq. inches, or 0.002029 acres (= 1,2728.34 sq. in./6,272,640.0 sq. in/acre), representing a potential 0.2 percent reduction in hay yield.

The sum width (mound number x mean occupied and unoccupied) of fire ant mounds in plots one year (11 months) following the application of Logic® to this unimproved, ungrazed pasture was 293.3 inches. In untreated plots the sum of mound width was 1,016.3 inches. The use of Logic® had reduced this sum by 71 percent. Note: The density of mounds in this trial was relatively low compared to most pastures.

Economic implications: The direct economic loss due to the presence of fire ant mounds in a hay production system is related to a combination of cutting height, the total area on which forage production is not occurring due to ant mounding activities and the value of the forage crop. The current cost of a single application of Logic® (material, equipment plus labor) is estimated to be roughly $10.00 per acre. Only where the potential economic loss due to a fire ant infestation exceeds the cost of treatment is the use of this ant suppression method justified in agricultural production.

Indirect impacts of a fire ant infestation in a hay production system include: 1) potential medical problems of field workers when encountering this medically important insect; 2) United States Department of Agriculture Quarantine regulations prohibiting the shipment of fire ant infested hay to uninfested areas; 3) aesthetic effects of ant mounding activities in a pasture. These factors are much more difficult to measure economically, but may be important in determining a producer's treatment decision.

Table 1. Red imported fire ant mound numbers, height and diameter in an unimproved pasture, Austin County, Texas.

Treatment	Number	Height (in.)	Diameter (in.)
		Pre-treatment 24 July 1992	
untreated control			
total			
occupied	29/acre (7,8,7,7)	3.19 ± 1.32**	14.34 ± 3.05
unoccupied	25/acre (7,8,4,6)	2.82 ± 1.42	14.16 ± 3.10
plot 1			
occupied	15/0.5 acre (7,8)	3.10 ± 1.42	
unoccupied	15/0.5 acre (7,8)	2.37 ± 1.45	
plot 3			
occupied	14/0.5 acre (7,7)	3.29 ± 1.25	
unoccupied	10/0.5 acre (4,6)	3.50 ± 1.13	
Logic® Fire Ant Bait			
total			
occupied	29/acre (8,6,9,6)	3.84 ± 1.52*,**	16.48 ± 4.18
unoccupied	37/acre (6,8,13,10)	3.26 ± 1.08*	16.41 ± 4.08
plot 2			
occupied	14/0.5 acre (8,6)	4.18 ± 1.68*	
unoccupied	14/0.5 acre (6,8)	2.89 ± 1.02*	
plot 4			
occupied	15/0.5 acre (9,6)	3.80 ± 1.59	
unoccupied	23/0.5 acre (13,10)	3.37 ± 0.96	
Occupied + unoccupied:			
untreated control	54/acre	3.02 ± 1.37*	
Logic® Fire Ant Bait	66/acre	3.51 ± 1.31*	
total	120/2.0 acres	3.37 ± 1.40	

* Indicates significant difference between mean couplets using the Student's *t* test ($P \le 0.05$).
** Indicates significant difference between means so marked using the Student's *t* test ($P \le 0.05$).

Table 2. Red imported fire ant mound numbers, height and diameter 11 months following a broadcast application of Logic® (fenoxycarb) Fire Ant Bait in an unimproved pasture, Austin County, Texas.

Treatment	Number/acre	Height (in.)	Diameter (in.)
	Post-treatment, 4 June 1993		
untreated control			
total			
occupied	37/acre	5.86 ± 2.02*,**	15.89 ± 4.15
unoccupied	29/acre	4.81 ± 1.62*	16.27 ± 4.56
plot 1			
occupied	22/0.5 acre	5.77 ± 2.41	
unoccupied	16/0.5 acre	4.59 ± 2.15	
plot 3			
occupied	15/0.5 acre	6.00 ± 1.31*	
unoccupied	13/0.5 acre	4.77 ± 1.48*	
Logic® Fire Ant Bait			
total			
occupied	6/acre	4.17 ± 1.60*,**	13.33 ± 3.72
unoccupied	16/acre	4.13 ± 1.63*	13.19 ± 2.34
plot 2			
occupied	0/0.5 acre	0.00 ± 0.00*	
unoccupied	10/0.5 acre	3.90 ± 0.88*	
plot 4			
occupied	6/0.5 acre	4.17 ± 1.60	
unoccupied	6/0.5 acre	4.50 ± 2.51	
Occupied + unoccupied:			
untreated control	66/acre	5.40 ± 1.92	
Logic® Fire Ant Bait	22/acre	4.14 ± 1.92	13.33 ± 3.72*
untreated (pre- + post-)	186/3.00 acres		15.67 ± 3.99*

* Indicates significant difference between mean couplets using the Student's *t* test ($P \leq 0.05$).
** Indicates significant difference between means so marked using the Student's *t* test ($P \leq 0.05$).

EVALUATION OF EXPERIMENTAL LOGIC® (FENOXYCARB) FORMULATIONS WITH REDUCED AMOUNTS OF THE ACTIVE INGREDIENT

Charles L. Barr, Extension Associate
Bastiaan M. Drees, Professor and Extension Entomologist
Mark Smith, County Extension Agent - Agriculture

Bait-formulated products containing fenoxycarb (Logic® and Award®) for suppressing the red imported fire ant, *Solenopsis invicta* Buren, are registered for use as broadcast and individual mound treatments. When applied as a broadcast application, 1.0 to 1.5 lbs. of the formulated materials per acre are to be applied using special broadcast application equipment. These products are currently formulated as baits containing 1.0 percent active fenoxycarb. The trials reported here were evaluations of lower rates (0.50 and 0.25 percent) fenoxycarb formulations.

Materials and Methods

Trial 1. This trial was initiated, 29 July 1991, on the J.B. Evans Turf Farm in Algoa, Texas. The site was an abandoned turf farm and adjacent abandoned field. The fields were overgrown St. Augustinegrass and had been recently mowed. There was a considerable amount of litter on the surface of the turf area.

The experimental design consisted of three replications (blocks), with four treatment plots each. Treatments were randomized within each block. Each treatment plot consisted of a square, 150 feet on a side, or 0.51 acres. Counts of active fire ant mounds were made within a 0.25 acre circular subplot inside each half-acre plot, using a string 58 feet long anchored in the plot center. Ant mounds were considered active if ants ran up to the mound surface within 5 to 10 seconds of light disturbance with a shovel handle (minimal disturbance method). Counts were made either before noon or after 5:00 pm. to maximize ant response. In addition, on 3 Sept. treatment plots were monitored to determine if the fenoxycarb treatments had affected the ant mounds. Four plots, one from each treatment, were evaluated by opening each mound and looking for the presence of worker brood (larvae and pupae).

The following treatments were included: 1) untreated control; 2) fenoxycarb bait 1% (Logic® Fire Ant Bait); 3) fenoxycarb bait 0.5%; and 4) fenoxycarb bait 0.25%. All baits were applied, 30-31 July, at a rate of 1.5 lbs per acre using a Cyclone® Model 1C1 hand seeder operated from the tailgate of a moving truck. Plots were monitored for ant mound activity 8 weeks, 3, 7, 12 and 18 months following application of treatments. Resulting ant mound counts per plot were analyzed using analysis of variance (ANOVA) and means were separated using Tukey's Studentized Range test ($P \leq 0.05$).

Trial 2. This trial was located on the back side of the earthen dam impounding Lake Somerville. The area is federally owned and managed by the U.S. Army Corps of Engineers. Access is tightly restricted to maintenance and monitoring personnel only. The area is gently sloping with small water diversion terraces through the middle. Vegetation is primarily native grass. Mowing is done, at most, three times per year. Mowing had just been completed at the onset of the trial. The total area available for the test was approximately 400 feet wide and 4,000 feet long.

Plots were established, 22 Aug. 1991 in adjoining columns, two plots wide and 8 long. Due to a severe decrease in ant mound numbers, a second block of four adjoining plots was laid out at the opposite end of the dam where mound numbers were more consistent. The 20 plots allowed for four replications (blocks) of the four treatments to be assigned randomly within each block. Two additional sets of two plots were established for untreated control and 1 percent fenoxycarb treatments. The plots were identical in size to those in Trial 1 and treatments, applied 26 Aug. 1991 (4:00 to 8:00 pm), were also identical. Fire ant mound density was monitored as in Trial 1. Active ant mounds were monitored in each plot 8 weeks, 3, 12 and 18 months following treatment.

Results were analyzed as those of Trial 1, and results from both trials were analyzed as one. Finally, a linear regression analysis was conducted on the percent reduction in active ant mounds (calculated from pre-treatment levels) at 7 and 12 months after treatment, using results from both trials.

Results and Discussion

Trial 1. The 1 percent fenoxycarb bait (Logic®) application was made the evening of 30 July. The remaining treatments were applied 31 July before 11:45 a.m. According to the owner, a brief, heavy thunderstorm occurred at approximately 4:30 p.m. Since the bait formulation, composed of defatted corn grit, is effectively dissolved by moisture, the low rate bait particles had less than 5 hours to be collected by foraging ants. This concern prompted the establishment of the second trial. On 3 Sept., no worker brood was noted in the fenoxycarb treatment plots while large numbers were present in the untreated control plot mounds. This finding indicated that the rain that fell shortly following treatment did not affect the ants' retrieval of the product.

All treatments significantly reduced the number of active fire ant mounds beginning 3 months after treatment (Table 1). Curiously, the 1 percent fenoxycarb formulation was slower to suppress ants than the other two formulations, and did not produce a significant level of suppression after 18 months. Statistically, the 0.5 and 0.25 percent formulations performed equally well in this trial. Maximum suppression of active ant mounds from fenoxycarb bait occurred 7 months following treatment (85 to 98 percent reduction relative to untreated plots on that date).

Trial 2. One plot (replicate I, below) at Somerville maintained unusually high ant mound numbers. This area apparently contained a source of water such as a seep since Johnsongrass grew heavily there. Analysis using this plot was attempted, but the decision was made to substitute data from one of the other two 1.0 percent fenoxycarb bait treated plots (Plot VI) for analysis of data from the evaluation of the three formulations.

	I	II	III	IV	V	VI
pre-count	108	49	58	41	10	7
2 weeks	77	31	37	32	15	8
6 weeks	37	17	14	30	14	7
3 months	42	8	13	9	11	6
7 months	55	0	1	3	10	8
1 year	3	0	2	2	4	2
18 months	35	2	23	26	12	11

In this trial, significant reductions from fenoxycarb bait treatments did not occur until 7 months after application (Table 1), when percent suppression ranged from 77.0 to 91.4 relative to untreated plots on that date. Significant levels of suppression lasted for one year. By 18 months after treatment, active mound numbers had increased. All treatments performed equally well, statistically.

Analysis of data from both trials, again, documents that the fenoxycarb formulations performed equally well from seven months to a year after treatments (Table 2). The 1.0 percent fenoxycarb bait (Logic®) suppressed active ant mounds more quickly (by 3 months).

Linear regression analysis suggests that there may be an influence of initial mound density on the level of active ant mound suppression resulting from a 1% fenoxycarb bait (Logic®) application, particularly after 1 year of treatment (Table 3). In particular, efficacy seems to be lower when applied to plots with low densities of fire ant mounds. Omitting Plot I data from Trial 2 greatly changes the equation for the line, particularly at seven months after treatment. Although the results of this analysis are preliminary, additional data points from other trials may render results definitive. Implications of the pre-treatment ant mound density effect on product performance justify, to some extent, excluding data from Trial 1 plot I data in the analysis presented here. Furthermore, these results support the technique of arraying pre-treatment ant mound counts in plots from low to high density and assigning blocks according to these density increments. This method has been used on all subsequent studies.

Table 1. Numbers of active red imported fire ant mounds before and after treatment with a broadcast application of 1.5 lbs. per acre fenoxycarb (Logic®) bait formulations, 1991.

Trial 1. J.B. Evans Turf Farm Site, Alvin (Galveston Co., Texas), 30-31 July 1991

	Mean number of active fire ant mounds, 3 replications*					
Treatment	Pre-count	8 wks.	3 mos.	7 mos.	1 yr.	18 mos.
untreated control	41.33a	30.67a	25.33a.	35.33a	11.67a	34.00a
1% fenoxycarb (Logic®)	33.67a	8.67a	5.00ab	0.67b	3.67a	22.67ab
0.5% fenoxycarb bait	30.67a	12.67a	3.00b	5.33b	2.00a	15.33b
0.25% fenoxycarb bait	35.00a	18.33a	1.67b	1.00b	3.67a	12.67b
MSE	273.500	79.833	61.667	39.500	15.250	48.250
F	0.22	3.45	6.09	21.02	3.72	5.66
P	0.8789	0.0716	0.0104	0.0004	0.0609	0.0223
MSD	43.244	23.364	20.451	16.434	10.211	18.163

* Means followed by the same letter are not significantly different using analysis of variance (PROC ANOVA) and the Tukey's Studentized Range Test ($P \leq 0.05$; d.f. = 8; Range = 4.529)(PC SAS)

Trial 2. Sommerville Dam Site (Burleson County, Texas), 26 Aug. 1991

	Mean number of active mounds, 4 replications**						
Treatment	Pre-	2 wks.	6 wks.	3 mo.	7 mo.	1 yr.	18 mos.
untreated control	24.00b	22.75c	18.00a	21.25a	34.75a	22.25a	33.00a
1.00% fenoxycarb	38.75ab	27.00bc	17.00a	9.00a	3.00b	1.50b	15.50a
0.50% fenoxycarb	64.75a	46.50ab	22.25a	18.75a	4.25b	1.75b	12.50a
0.25% fenoxycarb	62.50a	51.50a	20.75a	19.25a	8.00b	2.75b	18.75a
MSE	217.708	99.229	87.625	72.688	187.167	84.605	169.563
F	7.05	8.11	0.27	1.65	4.80	4.86	1.94
P	0.0055	0.0032	0.8471	0.2294	0.0202	0.0194	0.1766
MSD	30.975	20.912	19.651	17.898	28.717	19.31	27.336

** Means followed by the same letter are not significantly different using analysis of variance (PROC ANOVA) and the Tukey's Studentized Range Test ($P \leq 0.05$; d.f. = 12; Range = 4.199)(PC SAS)

Table 2. Numbers of active red imported fire ant mounds before and after treatment with a broadcast application of 1.5 lbs. per acre fenoxycarb (Logic®) bait formulations, Trials 1 and 2, Galveston and Burleson Counties, Texas, 1991-1993.

	Mean number of active mounds, 7 replications*				
Treatment	Pre-count	3 mos.**	7 mos.	1 year	18 mos.
untreated control	31.43a	23.00a	35.00a	17.71a	33.43a
1.0% fenoxycarb bait	36.57a	7.29b	4.00b	2.43b	18.57ab
0.5% fenoxycarb bait	50.14a	11.43ab	3.29b	1.86b	13.71b
0.25% fenoxycarb bait	50.71a	12.29ab	5.00b	3.14b	16.14b
MSE	330.6380	82.4678	115.1408	57.2318	112.0589
F	2.29	4.29	10.95	5.45	3.71
P	.0907	.0097	.0001	.0031	.0100
MSD	26.897	13.433	15.872	11.190	15.658

* Means followed by the same letter are not significantly different using analysis of variance (PROC GLM) and the Tukey's Studentized Range Test ($P \leq 0.05$; d.f. = 23; Range = 3.914)(PC SAS). Sites were not significantly different unless noted.

** Sites statistically different for this post-treatment date:

site	$F = 5.75$
	$P = .0250$
treatment	$F = 3.81$
	$P = .0237$

Table 3. Linear regression analysis of percent reduction of red imported fire ant mounds from the application of 1 percent fenoxycarb bait (Logic®) at seven and twelve months after treatment versus the initial ant mound density, Burleson and Galveston Counties, Texas, 1991-1993.

Model: $Y = MX + B$

where Y=percent reduction; X=initial density; M=slope; and B=Y intercept

At seven months, all plots: $Y = 0.638X + 36.293$
$F = 1.743$ $P = 0.2283$

At seven months, Plot I omitted: $Y = 2.358X - 13.903$
$F = 60.411$ $P = 0.0002$

At 1 year, all plots: $Y = 0.317X + 74.113$
$F = 7.560$ $P = 0.0285$

At 1 year, Plot I omitted: $Y = 0.661X + 64.096$
$F = 24.300$ $P = 0.0026$

SKIP-SWATH APPLICATION OF AMDRO® AND LOGIC® BROADCAST BAITS FOR THE SUPPRESSION OF THE RED IMPORTED FIRE ANT

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Charles L. Barr, Extension Associate, and
Michael E. Heimer, County Extension Agent - Agriculture

Abstract

Logic® Fire Ant Bait applied at 0.75 lbs./acre in alternate 35 foot swaths provided similar initial and long-term ant mound suppression to a full rate, full coverage application. Amdro® Fire Ant Granules applied at 0.75 lbs./acre in alternate swaths yielded approximately half the initial mound suppression as a full rate, full coverage application followed by faster reinfestation. A hopper box blend of 0.75 lbs./acre each Amdro and Logic gave quicker initial suppression similar to full rate, full coverage Amdro and long-term suppression similar to an application of Logic only.

Previous studies have indicated that Logic® Fire Ant Bait (fenoxycarb) is effective at active ingredient concentrations of 1% (regular formulation), 0.5% and 0.25% (Drees, et. al., unpublished). Furthermore, spot applications (3 tablespoons) of Logic to active mounds or along a transect affect fire ant mounds up to 20 feet away in areas of multiple queen infestations (Drees, et. al., 1993). Logic is an insect growth regulator (IGR) and relatively slow to act, taking up to six months to achieve full ant suppression, but reinfestation is very slow and suppression often lasts for over a year. Amdro® Fire Ant Granules (hydramethylnon) is a direct toxicant to worker, larval and reproductive fire ants. Broadcast applications of Amdro usually attain maximum suppression within five to eight weeks. However, reinfestation begins thereafter.

The objectives of this trial were: 1) To evaluate the effectiveness of Amdro and Logic for fire ant suppression when applied at half the label rate (full rate over half the treatment area or skip swath); and 2) To attempt to gain the fast suppression of Amdro plus the long residual effectiveness of Logic with a single application of a hopper mix of half rates of both chemicals.

Materials and Methods

This test was located on the earthen dam impounding Lake Conroe, in Montgomery County, Texas. The area is managed by the San Jacinto River Authority and access is strictly limited to authorized personnel. The site is gently sloping, well drained, and with a few scattered clumps of trees. Vegetation is dominated by bahia grass closest to the dam graduating to Johnsongrass. Due largely to heavy spring rains and flooding, ant densities were somewhat clumped, concentrating on the higher patches of ground within the test plots.

This trial consisted of one-acre square blocks, 210 feet on a side. Plots were established with corners flagged and the centers marked with 3-foot wooden stakes and 6 by 8 inch metal plates nailed into the ground. Minimum of a 30-foot buffer was left between adjacent plots. Before treatment (June 11 and June 15, 1992) fire ant-active mounds were counted within an 83-foot radius circle (approx. 0.5 acre) in the center of each plot. Mounds were considered to contain an active fire ant colony if ants came to the surface in numbers within 15 seconds after disturbance with a pointed stick. Treatments were assigned by first ranking the plots from highest to lowest in active mound numbers. The highest six were blocked into the first replication, the next highest six the second replication, and so on to make four replications. Treatments were numbered from one through six and, using a random number table, were randomly assigned to plots within each block.

The treatments were as follows:

1) Untreated Control
2) Logic, solid coverage (1.5 lbs total)
3) Logic, skip swath coverage (0.75 lbs. total)
4) Amdro, solid coverage (1.5 lbs. total)
5) Amdro, skip swath coverage (0.75 lbs. total)
6) Logic/Amdro (1:1 by weight) hopper mix, solid coverage (1.5 lbs. total)

Application of all treatments was delayed by the threat of thunderstorms until June 24 from approximately 4:30 p.m. to 8:30 p.m. The bait was broadcast using a tractor-mounted Herd® Model 77 seeder. Swath width was 35 feet. Six swaths were required to cover the solid coverage plots and four swaths were applied to the alternate swath plots, two on the outer edges and two roughly straddling the center.

Subsequent evaluations were made on 13 July, 13 August, 25 September, 1992; 13 January and 7 June 1993; and 5 January 1994 using the minimal disturbance technique. Data were analyzed using analysis of variance (ANOVA) and separated using Tukey's studentized range test (PC SAS) at $P \leq 0.05$.

Results and Discussion

The broadcast treatment of Amdro® Fire Ant Granules required complete area coverage at full label rate to provide significant initial and long-term suppression (Table 1, Fig. 1). Application of Logic® Fire Ant Bait provided statistically similar suppression at both full rate, full coverage and when applied at the same rate to every other pass across the plot (skip-swath or strip application)(Table 1). The slow-acting nature of Logic is the probable cause of the effects of the treatment extending into the 35 ft. strips left untreated within each skip swath treated plot. Results suggest that the treatment costs of Logic may be reduced considerably. The Amdro plus Logic combination appeared to offer the best characteristics of both products: fast suppression and long-term suppression (Fig. 1, Table 1). Effects of all treatments except for the skip-swath Amdro® application suppressed ant mound numbers relative to the untreated control plots for 12 mouths. At that time, the Logic®/Amdro® treatment provided numerically greater suppression than other treatments. By 18 month of application, no significant differences between treatments remained.

A primary deterrent to large scale application of fire ant bait products in cattle production systems is cost. Product and application costs are usually in the $10 per acre range (Drees and Vinson, 1992), making their use unfeasible in most production systems. Applying less product and applying it with less labor are both ways in which costs can be reduced. The use of a mixture of Amdro plus Logic can be a good method of achieving rapid suppression characteristic of Amdro and the long-term effectiveness of Logic.

Literature Cited

Drees, B. M., C. L. Barr, and S. B. Vinson. 1993. Effects of spot treatments of Logic® (fenoxycarb) on polygynous red imported fire ants: an indication of resource sharing? Southwestern Entomologist. 17:4 313-317.

Drees, B. M. and S. B. Vinson. 1992. Fire ants and their management. TAEX B-1536. Texas A&M University System, College Station, Texas.

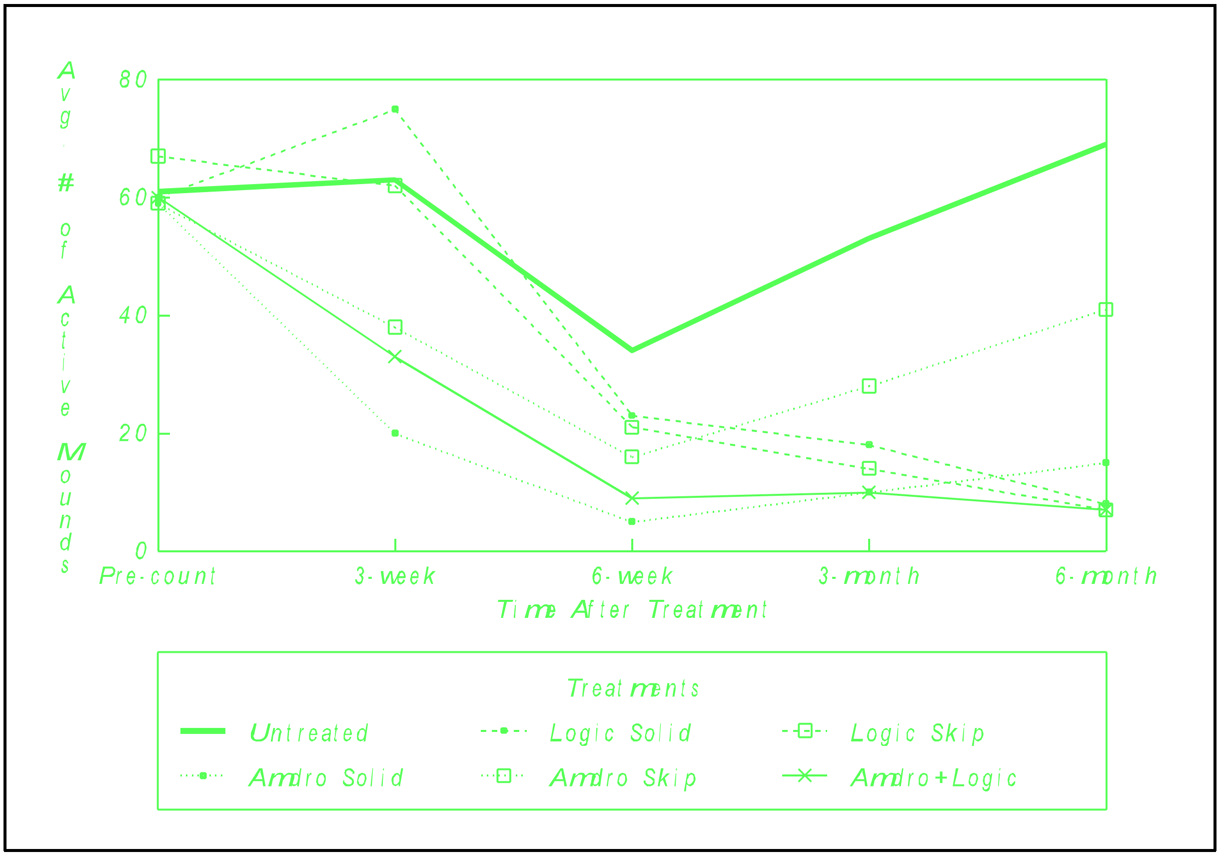
Table 1. Fire ant active mound numbers per 0.5 acre subplot within one acre treatment plots before and after June 24, 1992 treatments, Conroe, Texas.

	Mean no. fire ant active mounds/0.5 acre*			
Treatment	Pre-count	3-weeks	6-weeks	3-months
untreated control	61.25a	62.50ab	34.00a	52.50a
Logic® solid	60.25a	75.25a	22.50ab	17.50b
Logic® skip-swath	66.50a	61.75ab	21.25ab	13.75b
Amdro® solid	59.00a	20.25b	5.00b	9.50b
Amdro® skip-swath	59.00a	38.25ab	15.50ab	27.75ab
Amdro® + Logic®	59.75a	33.25ab	9.25b	10.25b
F	7.57	2.15	5.19	4.56
R-square	0.8016	0.5336	0.7345	0.7085
P > *F*	0.0004	0.0964	0.0031	0.0056

Treatment	6-months	12-months	18-months
untreated control	69.00a	66.75a	100.75a
Logic® solid	8.25c	14.75bc	70.50a
Logic® skip-swath	6.75c	14.75bc	55.00a
Amdro® solid	14.75c	22.25bc	87.75a
Amdro® skip-swath	41.25b	37.75ab	77.25a
Amdro® + Logic®	6.50c	6.75c	53.25a
F	13.44	8.74	0.99
R-square	0.8776	0.8233	0.4780
P > *F*	0.0001	0.0002	0.3466

* Means followed by different letters are significantly different using analysis of variance and Tukey's studentized range test (PC SAS)

Figure 1. Fire ant active mound numbers per 0.5 acre subplot within one acre treatment plots before and after June 24, 1992 treatments, Conroe, Texas.



EVALUATION OF PAGEANT® AND AMDRO® FOR THE SUPPRESSION OF RED IMPORTED FIRE ANTS ON MANAGED TURFGRASS

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Bastiaan M. Drees, Professor and Extension Entomologist

The red imported fire ant, *Solenopsis invicta* Buren, is a major pest of managed turfgrass areas. In addition to decreasing the aesthetic value of these areas, fire ants pose the threat of injury, particularly in areas of heavy foot traffic such as around golf course greens and tee boxes. Bait products generally provide 6 to 18 months of fire ant suppression, but take 3 - 5 weeks before results are noticeable. Surface applied, contact insecticides such as chlorpyrifos-based products, provide suppression of ant activity within days, but provide only 1 - 3 months of control. This trial was conducted to test the speed and effectiveness of a bait application followed by a surface toxicant application in order to achieve rapid and long-term ant suppression.

Materials and methods

This trial was established on the Wedgewood Country Club golf course in Conroe, Texas. Due to the spotty nature of the fire ant infestation, plots were widely scattered around the course. One treatment replication and all the control plots were located on a tee-box, another treatment replication around a green and the third on a maintenance area used to grow replacement turf. Treatment plots were all 75 x 75 feet square. Control plots were of variable size so as to contain an appropriate number of active ant mounds. Plot corners were marked with nails and marking tape so that they could be mowed over without damage to either the marks or machinery.

Plots were established, pre-counts taken and a broadcast application of Amdro® made (1.5 lbs per acre), 29 October 1992. That night, the area received approximately an inch of rain which potentially rendered the Amdro application less effective. A decision was made at this point to continue the test without re-application of Amdro to confirm whether the treatment was rendered ineffective by the rain. On 5 November, Pageant® DF Insecticide (active ingredient, 50% chlorpyrifos) was applied by means of a utility cart-mounted hydraulic sprayer. The Pageant was applied at the labeled rate of 2 pounds per acre in 49 gallons of water.

Evaluations were conducted at 1, 2, 5 weeks and 3 months after the application of Pageant. The entire area each plot was surveyed for ant active mounds using the minimal disturbance technique.

Results and discussion

Table 1 indicates that the Amdro provided a 70% reduction in mound numbers at 6 weeks post-treatment. This level of suppression is somewhat less than the 90-95% reduction in 2-3 weeks that is common. Considering that the bait was subjected to a heavy rain within 12 hours of application, it seems likely that the queens were fed preferentially and died as expected. Worker mortality was reduced, however, due to the short time of availability of the toxicant.
The Amdro treatment produced a significant decrease over the untreated plots at 2 weeks post-treatment. This difference disappeared at 5 weeks then reappeared at 3 months. This variation is probably due to the changeable weather at that time of year affecting the evaluation conditions.

Statistical analysis (**Table 1**) shows that Pageant and the combination of Amdro followed by Pageant resulted in significantly faster suppression compared to the Amdro alone. These two treatments did not differ significantly in their levels of suppression over the course of the test. The Pageant treatments resulted in a 70-90% reduction in mound numbers that held constant over the three month course of the test.

Previous tests with chlorpyrifos-based pesticides have shown that a suppression period of 6-10 weeks can be expected followed by a rapid resurgence in mound numbers. At the end of the test, the Pageant-treated plots had not begun to experience a rise in mound numbers, though the Amdro-treated plot counts did show that a slow increase in mound numbers was in progress.

Acknowledgements

The authors are grateful for the cooperation and equipment provided by the grounds keepers and management of Wedgewood Country Club.

Table 1. Mean number of fire ant active mounds, Montgomery Co., Texas, 1992.*

Treatment	pre-count	1 week	2 weeks	5 weeks	3 months
Untreated**	23.7a	29.7a	24.7a	24.3a	21.7a
Amdro®	18.7ab	20.0a	15.3b	5.3ab	7.0b
Pageant®	10.7b	3.3b	2.7c	2.7b	2.3b
Pagt.+Amd.	17.7ab	2.7b	5.0c	2.0b	1.3b
MSE	11.25	21.64	7.47	47.81	22.97
F	10.15	15.89	25.27	4.57	7.36
P	0.0021	0.0021	0.0006	0.0458	0.0153
R-square	0.8943	0.9298	0.9546	0.7920	0.8598
Min.Sig.Dif.	9.4804	13.148	7.7263	19.543	13.547

* Means followed by the same letter are not significantly different according to ANOVA and the Tukey's Studentized Range Test (*P* # 0.05).

** Untreated plot values are converted to a standard 75 by 75 foot plot: (actual count x 5,625 ft^2/plot ft^2).

EVALUATION OF ORTHENE® FIRE ANT KILLER (75% ACEPHATE) AS A DUST APPLICATION FOR THE CONTROL OF RED IMPORTED FIRE ANTS

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Charles L. Cole, Professor and Extension Entomologist

Acephate, formulated as a 75 percent wettable powder (Orthene® Fire Ant Killer and Orthene® Turf, Tree and Ornamental Spray) is a widely-used individual mound treatment for control of the red imported fire ant, *Solenopsis invicta* Buren. Application as a dust treatment, using one to two teaspoons of product per mound, provides elimination of ant activity in treated mounds within days. Its fast-acting and low-labor properties make it an attractive method for controlling ant colonies in urban environments.

The penetration of the acephate dust into a fire ant mound is poorly understood. Possible routes of ant exposure to acephate applied as a dry powder include:

1) fumigation or vapor action
2) direct contact by:
    a) ants tracking the material into interior mound surfaces
    b) dust sifting into the mound's galleries

The odor produced by acephate formulations results from the mercaptans (thiols), sulfur-containing organic chemicals. These compounds are not known to be toxic (or repellent) to ants. However, the active ingredient, acephate (an organophosphate cholinesterase inhibitor), is known to be highly toxic to ants even at very low exposure rates. Thus, the idea that this product is distributed through fire ant mounds by worker ants "tracking" the toxicant from the treated surface through the rest of the mound, or by contact with the fine dust "sifting" through the highly structured soil particles comprising the mounds surface are likely possible routes into the mound. How the product reaches the queen ants and whether the dust treatment kills queen ants were questions addressed by a series of trials reported here.

This report documents trials conducted with Orthene® Fire Ant Killer (75 percent wettable powder) applied to individual red imported fire ant mounds or ants under laboratory conditions:

I. **Field trial 1.** Montgomery County 1990 (Drees et al. 1991).
II. **Field trial 2.** Brazos County 1991 (Drees and Barr 1992).
III. **Laboratory trial 1.** Possible effects of acephate vapor on confined ants, 1990.
IV. **Laboratory trial 2.** Dye-labeled acephate "antarium" experiments, 1992.
V. **Field trial 3.** Dye-labeled acephate field experiments, Brazos County, 1992.
VI. **Laboratory trial 3.** Queen confinement/isolation experiments, 1992.
VII. **Field trial 4.** Queen confinement mound experiments, Brazos County, 1992-1993.

I. Field trial 1. Montgomery County 1990 (Drees et al. 1991).

This trial was established on 11 June 1990 to evaluate several individual fire ant mound treatments, particularly the bait formulated products, Amdro® and Logic®. Orthene® Fire Ant Killer, applied as a dry wettable powder application (2 teaspoons per mound) was included. In this trial, all mounds within plot areas were marked and treated. This method allowed for documentation both of the reduction of treated ant mounds and the reduction of ant mounds in the areas. This method is capable of detecting "satellite" mound formation when the number of treated mounds is reduced after treatment but the number of mounds within the treated plot areas is not.

In summary, active fire ant mounds treated with dry acephate wettable powder were totally eliminated within one week. Only 2 "new" mounds were found within the 0.25 acre plot on the July 9 and August 1 evaluations, indicating that satellite mound formation as a result of treatment likely did not occur within this 8 week trial.

Materials and Methods

On June 11, 1990, 8 circular plots, 60 feet in radius, were surveyed for fire ant mound activity. All mounds were marked with Kerr® canning jar lids and numbered sequentially. Mound activity was determined by light disturbance of the mound. The rating scale below was used to document the level of ant activity within each mound:

0 = fewer than 10 ants, very slow reaction to disturbance
1 = 10 to 100 ants, slow reaction to disturbance
2 = 100 to 1000 ants, and/or vigorous reaction to disturbance
3 = more than 1000 ants, very vigorous reaction to disturbance

The following day, all marked mounds within each plot were treated as indicated below:

Plot	Active ingredient	Formulation	Rate	No mounds treated
1	untreated	none	none	34
2	**acephate**	**Orthene® Fire Ant Killer**	**3 tsp/mound**	**47**
3	fenoxycarb	Logic®	3 Tbsp/mound	32
4	"	Amdro® "89"	"	50
4	hydramethylnon	Amdro "90"	5 Tbsp/mound	51
5	hydramethylnon	Amdro "A"	5 Tbsp/mound	37
6	"	Amdro "B"	"	39
7	"	Amdro "C"	"	36

Post-treatment evaluations were made after one-week (20 June 1990), two-week (27 June), four-week (9 July), and eight-weeks (1 August). Evaluations were made in the evening after ant activity had resumed.

Analysis of data were performed in two ways: 1) the mean mound ratings were calculated for the first sequentially numbered 30 mounds within each plot and separated using ANOVA and the least significant difference (LSD) test at $P \leq 0.05$; 2) the number of active mounds within each quadrant of each plot (1/16 acre) were determined for each evaluation date and these values were used to determine the mean number of active mounds per unit area per evaluation. These data were statistically analyzed as above.

Results and Discussion

Extreme heat and high humidity were persistent for the duration of the experiment. Daily heat indexes were 105-110○F. Soil moisture conditions were very poor (dry) until after the first evaluation. Some rainfall occurred during this period resulting in the increased activity noted in the ratings, particularly in the control plot.

Fire ant foragers were attracted to the bait formulations almost immediately upon application. No residual granules were noted the following week. At that time, large numbers of dead ants in "bone piles" were noted near the Amdro-treated mounds. No such accumulations were seen in the Orthene, Logic, or control plots.

All formulations of Amdro and Orthene performed similarly, eliminating all ant activity within the first week of treatment (Table 1 and 2). In plot 7, treated with Amdro C, activity in a few treated mounds resumed 4 and 8 weeks following treatment, and several new mounds were detected in the plot. These mounds were a result of either control failure, or migration into the plot from untreated areas. This determination can not be made with the available data. Logic-treated colonies declined more slowly, requiring 4 weeks before statistically-equivalent suppression to other treatments was achieved and 8 weeks before elimination of mound activity was realized.

Table 1. Mean red imported fire ant mound rating[a/] prior to and following treatment of 30 individual marked mounds within 0.25-acre circular plots, Montgomery County, Texas 1990.

	---------------------Mean mound rating[a/]----------------------				
Treatment	11 June Pre-count	20 June 1-week	27 June 2-week	9 July 4-week	1 Aug. 8-week
Untreated	1.57ab.	1.23a..	1.63a..	1.13a.	0.83a.
Orthene®	**1.50abc**	**0.00..c**	**0.00..c**	**0.00.b**	**0.00.b**
Logic®	1.47abc	0.73.b.	0.80.b.	0.03.b	0.00.b
Amdro® 89	1.33abc	0.00..c	0.00..c	0.00.b	0.00.b
Amdro 90	1.20..c	0.00..c	0.00..c	0.00.b	0.00.b
Amdro A	1.27abc	0.00..c	0.00..c	0.00.b	0.00.b
Amdro B	1.30abc	0.00..c	0.00..c	0.00.b	0.00.b
Amdro C	1.57a..	0.00..c	0.00..c	0.17.b	0.13.b
LSD 5%	0.303	0.359	0.287	0.322	0.230

[a/] Means followed by the same letter(s) are not significantly different according to ANOVA and the least significant difference (LSD) test ($P \leq 0.05$).

Table 2. Mean number of active red imported fire ants per 0.13-acre quadrant of a 0.25-acre circular plot, Montgomery County, Texas, 1990.

	---------------------Mean mound rating[a/]----------------------				
Treatment	11 June Pre-count	20 June 1-week	27 June 2-week	9 July 4-week	1 Aug. 8-week
Untreated	8.50a	8.00a.	7.25a.	7.00a.	5.25a.
Orthene®	**11.50a**	**0.00.b**	**0.00.b**	**0.00.b**	**0.00.b**
Logic®	8.00a	5.50a.	4.75a.	0.25.b	0.00.b
Amdro® 89	12.50a	0.00.b	0.00.b	0.00.b	0.00.b
Amdro 90	12.75a	0.00.b	0.00.b	0.00.b	0.00.b
Amdro A	9.25a	0.00.b	0.00.b	0.50.b	0.00.b
Amdro B	9.75a	0.00.b	0.00.b	0.50.b	0.00.b
Amdro C	9.00a	0.00.b	0.00.b	1.50.b	0.50.b
LSD 5%	5.613	3.161	2.999	3.383	2.668

[a/] Means followed by the same letter(s) are not significantly different according to ANOVA and the least significant difference (LSD) test ($P \leq 0.05$).

II. Field trial 2. Brazos County 1991 (Drees and Barr 1992).

This trial was initiated on 12 June 1991, to evaluate several individual fire ant mound treatments. Methods were changed from the previous year, using plots of variable size to containing 5 active fire ant mounds each. This technique allowed for a replication in plots in a complete randomized block design. The plots were replicated four times for each treatment. Again the number of marked and treated mounds as well as the number of mounds in treated areas were monitored. Orthene® Fire Ant Killer was applied at a rate of 2 teaspoons dry formulation per mound.

This trial documented a 90 to 100 percent reduction in active ant mounds over this 8 week trial. Re-infestation/satellite mound formation averaged 2.0 mounds per plot by the end of the test, compared to 3.0 mounds per plot for the untreated plots. This rate of re-infestation is most likely because of the relatively small sizes of plots established in this trial.

In addition to the small-plot test, another test using one-acre circles was established adjacent to the first. All mounds within the circles were marked. Four clusters of five mounds each within the plot were marked with coded canning jar lids and evaluated on the dates listed above. Orthene® Fire Ant Killer treatments resulted in 100% control and no satellite mound formation within the entire one-acre circle for the duration of the test.

Materials and Methods

On 12 June, 1990 on mowed turf areas adjacent to the airport runway of Coulter Field, Brazos County, Texas, circular plots were established to encompass 5 active red imported fire ant mounds. Four replications were established for each of seven treatments:

Treatment	Rate
sulfuramid	5 tbsp./mound
Amdro® (hydramethylnon)	5 tbsp./mound
Amdro® lot-91	5 tbsp./mound
Orthene® Fire Ant Killer (acephate)	**2 tsp./mound**
Logic® (fenoxycarb)	3 tbsp./mound
Spectracide® (granular diazinon)	0.5 cup + 1 gal. water/mound

The location of the colonies within each plot was mapped, marked with numbered Kerr® canning jar lids and rated for degree of activity. Activity was determined by observing the defensive movement of the ants following mound disturbance. This was done by slightly probing the mound with a thin metal wire and estimating the number of ants that came to the surface on a rating scale from 0 to 3: 0 = 0 ants; 1 = 1-100 ants; 2 = 100 - 1000 ants; and 3 > 1000 ants. Colonies were rated prior to treatment and 2 days, 1, 2, 4 and 8 weeks post treatment.

Results and Discussion

All individual mound treatments except for Logic® produced statistically similar reductions in ant activity ratings (Table 1). The 2-day post-treatment decline in ant activity in Amdro and sulfuramid treated mounds was surprisingly rapid for bait-formulated materials. Significant reduction in ant activity in Logic-treated mounds relative to untreated mounds did not occur until 8 weeks following treatment. Numerically, mounds treated with Spectracide and drenched with water resulted in the greatest reduction of ant activity.

Evaluation of treatment efficacy using the number of occupied ("active") mounds per plot (not the rating scale) for analysis provides similar results (Table 2). However, this analysis indicates that there is a numerical trend for the 1990 lot of Amdro to reduce mound activity more slowly that did the 1991 lot. Furthermore, the Spectracide treatment produced reductions significantly more quickly than did the 1990 lot of Amdro.

The turf area on which this test was conducted was mowed routinely by city services and was not watered. Drainage was excellent and resulted in a rather dry terrain even after heavy rains. The density of fire ant mounds on this site was rather low for this area, averaging 115 mounds per acre (ranging from 147 to 97) with an average mound diameter of 25.1 cm. Low mound density and dry conditions resulted in little migration of colonies and little detectable re-infestation of treated plots. The average plot size, containing 5 fire ant mounds, was 0.044 acre (24.8 ft. radius).

Table 1. Efficacy of individual mound treatments for the red imported fire ant, Coulter Field, Bryan, Texas 1991.

	Mean level of fire ant activity*					
	Pre-treat.	Post-treatment				
	12 June	14 June	19 June	26 June	11 July	8 Aug.
	0 day	2 day	1 week	2 weeks	4 weeks	8 weeks
untreated	2.4a	2.2a	2.1a	1.3a	1.2a	1.1a
Orthene®	**2.3a**	**0.2b**	**0.2b**	**0.0b**	**0.1b**	**0.0b**
Spectracide®	2.3a	0.2b	0.0b	0.0b	0.0b	0.0b
Logic®	2.3a	2.0a	2.1a	0.9a	1.1a	0.4b
Amdro® 91	2.2a	0.5b	0.2b	0.2b	0.1b	0.2b
Amdro® 90	2.3a	0.6b	0.3b	0.5b	0.1b	0.1b
sulfuramid	2.2a	0.4b	0.0b	0.5b	0.0b	0.3b
F	0.3411	36.769	56.763	8.670	7.969	3.680
P	0.9059	0.0000	0.0000	0.0002	0.0003	0.0146

* Mean values followed by the same letters are not significantly different according to ANOVA and the Duncan's Multiple Range Test ($P \leq 0.05$).

Table 2. Efficacy of individual mound treatments for the red imported fire ant, Coulter Field, Bryan, Texas 1991.

	Mean number of active ant mounds per plot*					
	Pre-treat.	Post-treatment				
	12 June	14 June	19 June	26 June	11 July	8 Aug.
	0 day	2 day	1 week	2 weeks	4 weeks	8 weeks
untreated	5.0a	5.0a	4.8a	3.3a	3.3a	2.5a
Orthene®	**5.0a**	**1.0bc**	**0.5bc**	**0.0b**	**0.5b**	**0.0b**
Spectracide®	5.0a	0.5c	0.0c	0.0b	0.0b	0.0b
Logic®	5.0a	5.0a	4.8a	2.5a	2.8a	1.0b
Amdro® 91	5.0a	2.0bc	0.5bc	0.5b	0.3b	0.5b
Amdro® 90	5.0a	2.3b	1.3b	0.3b	0.3b	0.3b
sulfuramid	5.0a	2.0bc	0.0c	0.3b	0.0b	0.5b
F	---	14.653	69.909	8.2290	9.660	4.213
P	---	0.0000	0.0000	0.0002	0.0001	0.0080

* Mean values followed by the same letters are not significantly different according to ANOVA and the Duncan's Multiple Range Test ($P \leq 0.05$).

III. Laboratory trial 1. Possible effects of acephate vapor on confined ants, 1990.

In October, 1990 tests were undertaken in an attempt to determine if the "vapor" from Orthene® was toxic to fire ants. Although inconclusive, results indicate that acephate is highly toxic to fire ants in very low concentrations.

Materials and Methods

Tall Petri dishes were coated with Fluon® to prevent ant escape. A piece of filter paper was placed in the bottom each dish. Small, clear plastic containers, approximately 1 inch deep and 1-1/2 inches in diameter were dipped in Fluon to prevent ant access to the interior and contact with the treatment. Ten ants were added to each tall petri dish. A small piece of plastic with two drops of honey-water was provided to the ants to help prevent desiccation. One eighth teaspoon of Orthene® Fire Ant Killer was placed into each of six of the small containers. Empty ones were placed in the remaining six Petri dishes. The dishes were covered with lids, in which two holes had been melted to allow some air circulation. After 5 and 24 hours, ant mortality was evaluated. Results were analyzed using the Student's t test ($P \leq 0.05$).

Results and Discussion

Results (Table 1) indicate that either acephate "vapor" or very low concentrations of airborne wettable powder is toxic to red imported fire ants. After 24 hours, there was slight mortality in the untreated dishes, and 100% mortality in all Orthene treatments. Mercaptan, the odor-causing chemical in 75 percent acephate is not known to be toxic to ants. It is possible then, that the airborne dust moved out from the weighing dishes into the tall petri dish and that low concentrations of the dust caused ant death.

Table 1. Effect of acephate applied in containers within tall Petri dishes to prevent fire ant contact, on fire ant workers.

	Average number of live ants/10 per dish			
	5 hours post-treatment		24 hours post-treatment	
Dish	Orthene®	untreated	Orthene®	untreated
mean	8.0	9.2	0.0	4.5
S.D.	± 1.4	± 0.8	± 0.0	± 2.6
t	-1.7838		-4.2584	
P	0.0524		0.0008	
d.f. = 10				

IV. Laboratory trial 2. Dye-labeled acephate "antarium" experiments, 1992.

In order to visually trace movement of the acephate, a series of experiments was conducted using a fluorescent dye-labeled acephate wettable powder formulation supplied by the manufacturer. These studies determined that the fluorescence of the dye-formulation was eliminated when in contact with organic matter in soil or media. Because of this, the true "soil profile" of the dry wettable powder formulation could not be documented. Furthermore, ant activity in the "antarium" continued in some trials deep in the soil for many days following application of the dry-formulated treatment.

Materials and Methods

A 10 gallon glass aquarium was partially reconstructed so that it stood on end with the top open. Two plexiglass panels were cemented inside to form two compartments measuring 12 inches wide, 24 inches tall, and 2 inches deep. Wood frames were cemented around the top edge and 1/2 inch wide electrical heating strips were clipped to the frames. The heating strips were maintained at 140○F by means of a rheostat. Previous tests indicate that fire ants will not cross a surface of this temperature or higher.

Several methods of getting the ants and the soil into the narrow compartment openings were tried with varying degrees of difficulty. However, all resulted in approximately 18 inches of soil and a colony of 10-20,000 ants in both compartments. Opaque covers, a heating pad, and various arrangements of lights were used to encourage the ants to build galleries against the glass so their movement could be more easily seen. The ants were maintained with frozen crickets and honey water for several days while they built a mound structure within the compartments.

Both regular Orthene® Fire Ant Killer and dye-labeled Orthene® Fire Ant Killer were applied at a rate of 2 teaspoons per compartment. The material was gently sprinkled through the opening so that the entire soil surface was covered. Treatment combinations varied over the course of the tests.

Visualization was accomplished by ceiling light in the test room. A twin-tube fluorescent ultra-violet light was then shone on the antarium so that the dye fluoresced vividly. (Previous tests indicated that the aquarium glass allowed the UV light to penetrate, though it did alter the fluorescent color from bright pink to orange.) A tripod mounted camera (35mm Pentax ME with close up lenses) was used to photograph both the whole "antarium" and small areas of interest within the mound structure. Due to the extremely low light conditions, shutter speeds of 2 to 8 seconds were required for proper exposure. Photographs were made immediately after Orthene application and periodically thereafter for up to 24 hours. After test completion, the soil was washed out and all surfaces washed with Alconox® detergent to remove any traces of Orthene. The antarium was then dried and reused. A total of six trials were conducted with varying degrees of success in viewing the dye-treated acephate dust.

Results and Discussion

At best, the dye acephate wettable powder formulation penetrated to a depth of 5 inches in very small, isolated spots - most likely by being carried on the backs of ants that were on the surface at the time of application. Dye penetration was uniform to a depth of 1-1/2 inches. Excessive soil moisture seemed to inhibit dye penetration. Complete ant death occurred within 48 hours in all trials with sufficient soil moisture. However, dry soil was used in one test and ants survived for 10 days at a depth of over 6 inches. When drenched, the ants died within one day.

These inconsistent results suggested that moisture was having an effect on the dye and possibly the acephate formulation itself. To test the interaction of the dye, water and soil, glass jars were filled with various media including water, soil similar to that used in the tests, coarse sand, fine sand, gravel, and a heavily organic artificial potting media. Four teaspoons of dye-marked Orthene were placed in each jar. Water was added so that it covered the media and the entire mixture was shaken thoroughly and allowed to settle. Water was found not to have an effect on dye fluorescence. However, the presence of organic matter in the media greatly reduced or eliminated fluorescence.

To try to eliminate the organic matter, the antarium was filled with coarse sand. The ants died within 24 hours, probably due to desiccation or contamination of the sand. The antarium was then filled with a mixture of coarse and fine grade vermiculite. The ants built galleries normally and Orthene® Fire Ant Killer (non-dye formulation) was applied. Surface ant activity was stopped but ant activity continued at a depth below 6-8 inches and persisted for over one month. At this time, the compartment was drenched with water and the ants died within 48 hours indicating that the Orthene was still active.

Ant behavior in this "antarium" was probably not natural. In dry wettable acephate powder treatment trials, the ants moved deep in the soil column and remained active for extended periods of time following treatment. In the natural environment, fire ant colonies are known to "thermo-regulate", moving to locations within the mound with optimum moisture and temperature conditions. In cool early morning hours, for instance, most of the members of a fire ant colony are located just underneath the surface of the eastern slope of the mound being warmed by sunlight. If the surface of the mound had been treated, this movement to the surface could result in the ants' contact with the toxicant.

V. Field trial 3. Dye-labeled acephate field experiments, Brazos County, 1992.

This trial was conducted in an attempt to document the distribution of fluorescent dye formulated acephate wettable powder after dry application to fire ant mounds under field conditions. Ant activity in 4 of six mounds treated was eliminated 3 days after treatment. However, no penetration of acephate into the mound profile was documented due to the deactivation of the fluorescence upon contact with organic matter into the soil.

Materials and Methods

On 10 April 1992, 6 active fire ant mounds were marked with flags. The mounds were located next to curbs to facilitate observation. U-shaped wooden frames were constructed to hold 2 pieces of plexiglass, 6 inches high x 16 inches long. The plexiglass panes were clipped together, inserted in the frames then the entire apparatus was placed in a marked mound so that the plexiglass cut through the middle of the mound. The ants were allowed to rebuild the mound structure around the plexiglass for several days.

On 13 April, the mounds were treated with 2 teaspoons of dye-labeled Orthene each. On April 15, 8:30 p.m., UV lights were set up by the treated mounds so that the dye fluoresced. The clips were carefully removed from the panes of plexiglass and the outer one gently pulled away carrying that half of the mound with it. The goal was to obtain an unobstructed view of the mound galleries through the remaining piece of plexiglass.

Results and Discussion

Unfortunately, the plexiglass blocked the UV light and prevented fluorescence. Previous tests had indicated that plexiglass allowed UV light to penetrate, but the plastic used for these panes was apparently of a different type. As a result, the pane was gently removed to expose the galleries and mound profile.

The dye was vividly fluorescent on the surface of treated mound No. 1, but no fluorescence appeared below the surface or within the mound structure. Photographs were taken and then the mound was excavated to depth of 9 inches where a few live worker ants were observed. In treated mound No. 2, similar results were observed though more active worker ants appeared around the edges of the mound. Observations from treated mound no. 3-5 were similar, although no active fire ants were present. On one small surface section of treated mound No. 3, fluorescent dye appeared mixed with the soil to a depth of 1/4 inch. Apparently worker ants had continued to deposit new soil on top of the mound after treatment. This finding supports the observation that Orthene® Fire Ant Killer is not repellent to fire ants. Various combinations of UV and incandescent lighting were used to obtain suitable photographs. The treated mound no.6 had not been rebuilt after insertion of the frame and was not examined. The finding that organic matter decomposed the fluorescent dye ended further field investigation.

VI. Laboratory trial 3. Queen confinement/isolation experiments, 1992.

In order to evaluate whether Orthene® Fire Ant Killer applied as a dry wettable powder application to individual red imported fire ant mounds actually kills fire ant queens, a method was developed to isolate and confine queen ants within ant colonies.

Materials and Methods

Two methods of queen ant confinement were developed and evaluated in the laboratory: The first used a 20 ml. glass scintillation vial with a mesh-covered hole in the lid. The mesh size allowed worker ant access to the queen, but prevented queen escape. The second method used a capsule constructed of a very fine brass mesh which confined the queen and prevented worker access.

In the first experiment, one queen was confined to a scintillation vial container within each of 5 small laboratory fire ant colonies containing worker ants and brood (larvae and pupae). After 24 hours, the vials were emptied of all brood and worker ants. The queen was then re-inserted and moved into a new small colony box adjacent to the original box with a cardboard bridge to allow ant movement between the two colony boxes. Migration of the ant colonies (workers and brood) to the colony box housing the confined queen was observed for 7 days. Confined queens, along with some worker ants were then introduced into their original laboratory colonies. Queen survival was monitored for three weeks.

The two types of confinement containers were compared in a trial whereby individual queen ants were placed into each type and then introduced into unrelated laboratory colonies. The test was replicated five times. Queen survival was monitored for two weeks.

Results and Discussion

Queen ants confined to scintillation vials survived through the duration of this trial. Within 48 hours of separating queen ants from the remainder of the colony, two of the colonies had migrated to the boxes housing their queens. By 7 days, four of the five colonies had moved all brood into the boxes containing the queens. This experiment supported the idea that a colony, with a known number of confined queens, could be "planted" in the field.

Confined queen ants were reintroduced into their original field-collected colony. The five confined queens survived for 2 days, 4 for 8 days, and 2 for three weeks. This test supported the idea that an introduced queen could be accepted into a colony for at least a short period.

In the comparison of the two types of confinement containers, all queens in the mesh capsules lived at least three days. The queens in the glass vials were alive after two weeks and appeared able to live normally and indefinitely. These results indicated that field trials with these containers were feasible.

VII. Field trial 4. Queen confinement mound experiments, Brazos County, 1992-1993.

In order to evaluate whether Orthene® Fire Ant Killer applied as a dry wettable powder application to individual red imported fire ant mounds actually kills fire ant queens, methods developed to isolate and confine queen ants within ant colonies were used in the field to evaluate the effect of treatment.

Materials and Methods

<u>Trial 1</u>. The first test involved inserting both types of queen containers (20 ml. glass scintillation vial with a mesh-covered hole in the lid and fine brass mesh capsule) into active fire ant mounds. Due to a limited number of containers, only one mound was used per treatment. The control mound received 1 vial and 2 screens, the others: 1 vial + 4 screens and 2 vials + four screens. On 10 April 1992, the queen containment containers were inserted and the ants allowed to rebuild the mound for 48 hours. Two mounds were then treated with 2 teaspoons of Orthene® Fire Ant Killer each, 12 April. The third was left as an untreated control to confirm queen survival. The mounds were dug open after 48 hours (14 April) and the queen containers examined.

<u>Trial 2</u>. This experiment involved separating several laboratory ant colonies into "colonoids" that were allowed to live for several weeks in separate containers to stabilize. The colonies were then carefully examined and all queens placed into vial-type containers that allowed worker access, but prevented queen escape. The containers used in this trial were 7 ml. plastic vials in which the bottom had been filled with plaster to reduce volume and provide a moisture reservoir. The screw-on plastic cap had several holes melted into the top using a medium-sized paper clip wire to create the melted holes of appropriate size.

The eight "colonoids" were then taken to an area with little grass and few nearby fire ant colonies. The ground was loosened, and the queen container placed at approximately ground level in November 1992. The containers were then covered with approximately an inch of loose soil and the workers placed on top of the pile. Frequent rains and cold weather prevented any further action with the mounds until weeks later. Once mound-building activity was noted, four of the mounds were treated with 2 teaspoons of Orthene® Fire Ant Killer on January 25, 1993. Two days later (January 27, 1993), the queen containers were removed from all mounds and examined for living queens.

Results and Discussion

<u>Trial 1</u>. Results were inconsistent. All queens in the vials in treated mounds were dead, but some were missing. All queens in the treated mesh capsules were dead, but some were missing and others appeared to have been broken apart by workers before treatment. Queen survival in the untreated mound was also inconsistent with some queens in the mesh capsules appearing to have been killed by workers. The mesh capsules did not appear to exclude workers adequately, though

why is unknown, and their use was discontinued.

<u>Trail 2</u>. Results were, again, inconsistent. Surprisingly, all the mounds had worker ant activity, and all but one contained either a live queen or their bodies. Of the four treated colonies, 2 contained live queens, one dead, and one missing. Of the untreated colonies, three of the four had at least one live queen in a container. The fourth contained a queen that appeared to have been dead for some time.

Because of cool weather during the time this trial was conducted, ants did not build up the field established mounds well and the soil on the tops of the mounds was crusted over. This crust may have prevented "sifting" of the acephate wettable powder into the mound as would be more likely on recently "worked" mounds. In this trial, queen ants were enclosed in vials that protected the queen from exposure to all sources of toxicant transmission but contact with other ants. If the treatment acts solely as a tracking powder, queen ants would be affected using this method. Conversely, should the treatment provide coverage within the colony through sifting, the queens so protected would be spared.

Conclusions

The objectives of these studies were not resolved conclusively. Field trials document excellent elimination of live ants in treated mounds with little or no "satellite" mound formation in treated areas. This is probably the best indirect data indicating that entire colonies, including queen ants are killed by the dust treatments. Experiments using fluorescent dye formulated acephate 75 percent wettable powder failed to demonstrate whether the dust treatment was a tracking powder or whether ant mortality resulted from a sifting action into the mound substrate. Failure resulted from the loss of fluorescence when the labeled Orthene® Fire Ant Killer contacted moist organic matter. In some of these trials, ants remained active below the treated surface for extended periods of time in the laboratory "antarium".

Attempts to cage queens were successful and this method allowed the establishment and maintenance of queens and colonies in the field. However, due to low numbers of replications of this labor-intensive procedure, results from Orthene® Fire Ant Killer treatments to caged-queen-colonies in the field were not consistent. Evidently, the dust treatment does not act solely as a tracking powder. This treatment more than likely acts to some extent as a sifting powder, as well. Since the Orthene® Fire Ant Killer is apparently not repellent to fire ants, ants contacting surfaces (soil or other ants) treated with even low concentrations of the insecticide are eliminated.

Literature Cited

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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 invicta* 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.

Treatment	Rate
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]-1x100). 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.

Acknowledgments

The authors are grateful to Harry Howell and Bill Summerlin for assistance in applying treatments for Trial 1.

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).

	Block				
Treatment	I	II	III	IV	Total length
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® Diatomaceous 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	21 May	27 May	11 June
	3 day	7 day	14 day	30 day
Organics Plus™	2.00b	2.00d	0.25b	0.50b
	(80)	(80)	(98)	(95)
Insecto™ Formula 7	4.75b	4.00bcd	0.25b	0.50b
	(53)	(60)	(98)	(95)
Bonide® Rotenone 5 Insecticide	4.50b	3.25cd	3.25b	1.50b
	(55)	(68)	(68)	(85)
Natural Guard™ Nicotine sulfate	8.50a	6.50abc	7.75a	6.50a
	(15)	(35)	(23)	(35)
Gardenville® Diatomaceous Earth	8.00a	8.25ab	8.25a	6.75a
	(20)	(17)	(18)	(33)
Orthene® Turf and Ornamental Spray	1.50b	1.25d	0.25b	0.25b
	(85)	(88)	(98)	(98)
water drench	9.00a	7.75ab	8.00a	6.25a
	(10)	(23)	(20)	(38)
untreated control	9.50a	10.0a	9.50a	8.25a
	(5)	(0)	(5)	(18)
MSE	1.809	3.400	2.149	1.208
P	0.0001	0.0001	0.0001	0.0001
R-square	0.8805	0.8066	0.9126	0.9285
F	15.47	8.76	21.95	27.27
d.f.	21	21	21	21
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 ($P \leq 0.05$). 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 3 day	21 May 7 day	27 May 14 day	11 June 30 day
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	3.310	3.494	2.923
P	0.0001	0.0001	0.0001	0.0001
R-square	0.7753	0.8313	0.8710	0.8414
F	7.24	10.35	14.18	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 ($P \leq 0.05$). 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]			
	4 day	7 day	16 day	30 day
Insecto™ Formula 7	2.75b	1.50b	0.00b	0.75b
	(73)	(85)	(100)	(93)
water drench	9.00a	9.00a	8.75a	4.75a
	(10)	(10)	(13)	(53)
MSE	2.4583	0.8333	0.7917	4.333
P	0.0587	0.0077	0.0046	0.2992
R-square	0.9151	0.9787	0.9850	0.7263
F	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]			
	4 day	7 day	16 day	30 day
Insecto™ Formula 7	8.75a	7.75a	2.75b	2.00a
	(6.0)	(6.25)	(2.75)	(2.00)
water drench	12.50a	11.25a	9.50a	6.75a
	(3.50)	(2.25)	(0.75)	(2.00)
MSE	3.7917	6.1667	4.7917	8.4583
P	0.1678	0.2172	0.0832	0.3027
R-square	0.8219	0.7849	0.8918	0.7238
F	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 ($P \leq 0.05$). 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 ($P \leq 0.05$). Mean no. 'satellite' mounds in parentheses.

EVALUATION OF DRY-FORMULATED, DRY-APPLIED INDIVIDUAL FIRE ANT MOUND TREATMENTS

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Treatment of red imported fire ant (*Solenopsis invicta* Buren) mounds is a labor intensive process when 1 to 3 gallons of water are required to drench each mound. Products containing acephate (Orthene® Tree, Turf and Ornamental Spray and Orthene® Fire Ant Killer) have gained in popularity because of ease of application, low price and relatively quick results. Recently, chlorpyrifos containing products (Greenlight® Fire Ant Killer II and Greenlight® Double Dursban®) have been marketed with instructions not to apply water after placement of the bran granules on and around the mound. Most other chlorpyrifos products for fire ant mound treatments require one or more gallons of water to drench the insecticide into the mound. Finally, the manufacturer of Amdro® Fire Ant Granules, a bait-formulated insecticide, was interested in the effectiveness of this product applied at 2 Tbsp. rather than 5 Tbsp. around each mound. If effective, this reduced rate would dramatically reduce the cost of individual mound treatments with Amdro®. This trial was conducted to determine the relative effectiveness of dry application of dry-formulated products to individual red imported fire ant mounds.

Materials and Methods

This trial was conducted on the Texas A&M University Riverside Campus, Brazos County, Texas. On 10 May 1993, a 40-foot wide X 700-foot long strip was established and marked with flags. All active fire ant mounds were located within the strip and marked with flags in groups of ten. The 10-mound plots were measured and sorted into four blocks (replicates) of five treatments by increasing order of plot length. Treatments were then randomly assigned to one plot within each block (Table 1). In this way, each treatment was assigned to a long plot, short plot and two intermediate length plots. Treatments were as follows:

Treatment:	Rate
1. Amdro® (1% hydramethylnon)	2 Tbsp./mound
2. Amdro® (1% hydramethylnon)	5 Tbsp./mound
3. Orthene® Turf, Tree and Ornamental Spray (75% WP acephate)	2 tsp./mound
4. Green Light® Fire Ant Killer II (1% G chlorpyrifos)	4 Tbsp./mound
5. Untreated control	

All treatments were applied on the afternoon of 11 May 1993 according to directions. Evaluations were conducted 3, 6, 15 and 31 days (14, 17, 26 May and 11 June, respectively) after treatment using the minimal disturbance technique. The plots were also surveyed for the presence of new/satellite mounds 6, 15 and 31 days after treatment.

Results and Discussion

The experimental design employed in this trial provides two types of efficacy data: 1) the effect of a treatment 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 and total area of plots for each treatment becomes fairly uniform (Table 1). In this way, the probability of fire ant colonies migrating in or out of any given set of treatment plots is roughly equal. Furthermore, differences in the number of 'new' (unmarked) mounds appearing between treatment plots can be inferred to be relocated fire ant colonies, called 'satellite' mounds.

On 17 May, 1993, plots were monitored from 12:00 noon to 1:00 pm. Weather was sunny and temperatures were in the middle 80○F range. Mounds required vigorous disturbance before ants appeared within 15-30 seconds. No rain had occurred since the treatments had been applied. On 26 May, observations were made from 1:30 to 2:30 pm. Weather was cloudy and temperatures were in the middle 70○F range. Mounds required minimal disturbance and ants emerged within 5-10 seconds. These conditions may account for higher numbers of active mounds in some Amdro® treatment plots than in documented on 17 May.

All treatments significantly reduced ant activity in treated mounds by three days after application except the low (2 Tbsp./mound) rate of Amdro® (Table 2). By the sixth day, all treatments were performing equally well, statistically, although Amdro® treatments provided a numerically slower rate of suppression. The maximum levels of suppression achieved by Amdro® treatments occurred 31 days after application. Both rates tested provided similar results.

Statistically, Orthene® Turf, Tree and Ornamental Spray (acephate) and Greenlight® Fire Ant Killer (chlorpyrifos) treatments were similar (Table 2). Orthene® provided a numerically quicker suppression of ant activity in treated mounds. 'Satellite' mound formation was greater following these treatments. On 26 May, 100 percent elimination of ant activity in acephate and chlorpyrifos treated mounds was documented. However, an average of 2.0 and 1.8 "new" mounds appeared in the acephate and chlorpyrifos ant mound treatment plots, respectively. Thus, the actual level of suppression of active ant mounds (percent reduction relative to the pre-treatment active ant mound level of 10) in these treatment plots was 80 percent and 82 percent for acephate and chlorpyrifos ant mound treatment plots, respectively. Satellite mound formation in these treatment plots resulted in performance levels statistically equivalent to Amdro® treatments.

Homeowners frequently report disillusionment with fire ant control, often stating that individual mound treatment merely cause ant colonies to move and build new mounds. The experimental design used in this trial addresses their concern, providing both types of data describing the results of these individual mound treatments. In this trial, all treatments were effective. However, the analysis of reduced treated ant mound numbers and treatment-related reduced ant mound numbers per unit area (plot) produced statistically different results.

Table 1. Treatment plot length (feet and inches) and dimensions, Brazos Co., Texas 1993.

Treatment	Block 1	Block 2	Block 3	Block 4	Total area
Amdro® (2 Tbsp./mound)	25' 4"	25' 9"	38' 0"	52' 8"	5,425.2 sq. ft.
Amdro® (5 Tbsp./mound)	21' 0"	31' 2"	43'10"	55' 0"	6,040.4
Orthene® Turf, Tree and Ornamental Spray (2 tsp./mound)	25' 3"	27' 2"	36' 3"	44' 0"	5,306.4
Green Light® Fire Ant Killer II (4 Tbsp./mound)	19' 9"	25' 6"	33' 3"	45' 9"	4,970.0
Untreated control	21'11"	28' 6"	39'11"	45' 4"	5,425.2
Total block area (sq. ft.):	3,519	4,383	6,098	7,880	

Table 2. Number of active red imported fire ant mounds following application of dry individual mound treatments, Brazos County, Texas, 11 May 1993.

	Mean no. active fire ant mounds/10* (Percent reduction in parentheses)			
	3 days 14 May	6 days 17 May	15 Days 26 May	31 days 11 June
Amdro® (2 Tbsp.)	6.5ab (35)	3.5b (65)	3.5b (65)	0.8b (92)
Amdro® (5 Tbsp.)	4.0b (60)	2.8b (72)	3.3b (67)	0.5b (95)
Orthene® TT&O (2 tsp.)	2.0b (80)	0.5b (95)	0.0c (100)	0.3b (98)
Greenlight® Fire Ant Killer II (4 Tbsp.)	3.3b (67)	0.3b (97)	0.0c (100)	0.0b (100)
Untreated control	9.5a (5)	9.3a (7)	9.0a (l0)	5.3a (47)
MSE	4.6667	3.5750	1.7333	1.2250
F	5.14	8.83	18.44	10.01
P	0.0067	0.0006	0.0001	0.0003
R-square	0.749	0.837	0.915	0.854
Min. Sig. Dif.	4.8690	4.2616	2.9674	2.4946
(d.f. = 12; Studentized Range = 4.508)				

	Mean no. active fire ant mounds/plot* (Mean no. 'satellite' mounds/plot in parentheses)			
	3 days 14 May	6 days 17 May	15 Days 26 May	31 days 11 June
Amdro® (2 Tbsp.)	6.5ab (---)	3.5b (0.0)	4.5b (1.0)	0.8b (0.8)
Amdro® (5 Tbsp.)	4.0b (---)	3.8b (1.0)	4.5b (1.0)	1.5b (1.3)
Orthene® TT&O (2 tsp.)	2.0b (---)	1.5b (1.0)	2.0b (2.0)	1.0b (0.8)
Greenlight® Fire Ant Killer II (4 Tbsp.)	3.3b (---)	2.0b (1.8)	1.8b (1.8)	0.3b (0.3)
Untreated control	9.5a (---)	9.3a (0.0)	9.5a (0.5)	6.0a (0.8)
MSE	4.6667	4.4917	3.8667	1.9833
F	5.14	5.09	6.30	7.00
P	0.0067	0.0070	0.0029	0.0018
R-square	0.749	0.748	0.786	0.803
Min. Sig. Dif.	4.8690	4.7768	4.4320	3.1742
(d.f.=12; Studentized Range = 4.508)				

* Means followed by similar letters are not significantly different according to analysis of variance (ANOVA) and Tukey's Studentized Range Test at $P \leq 0.05$).

EVALUATION OF PYRETHROID POTTING MEDIUM TREATMENTS FOR THE SUPPRESSION OF RED IMPORTED FIRE ANTS

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The red imported fire ant, *Solenopsis invicta* Buren, is an introduced species. Quarantine regulations, developed by the United States Department of Agriculture (USDA) and enforced by the Texas Department of Agriculture (TDA), are in effect for this species. These regulations prohibit the shipment of nursery stock outside of quarantined counties to uninfested counties unless certified as free of fire ants. Treatments for fire ant elimination from potting media have changed over time. Chlordane products used in the early 1980's have been banned. Chlorpyrifos-based treatments used during the late 1980's provided only a short interval of ant suppression. More recently, pyrethroid insecticides (Talstar® 0.2G and Talstar® T&O Insecticide containing bifenthrin) have been registered for use to suppress fire ants in potting media. This trial was conducted to evaluate the effectiveness of Talstar® 0.2G and other candidate pyrethroid insecticide formulations for long-term suppression of fire ants in treated media.

Materials and Methods

On 9 October 1990 one flat of four-inch square plastic pots was treated as described below:

Treatment:	Rate:
1) Pounce® 1.5G (permethrin)	0.5 tsp./gallon
2) Pounce® 1.5G (permethrin)	1.0 tsp./gallon
3) Ammo® 0.75G (cypermethrin)	1.0 tsp./gallon
4) Talstar® 0.2G (bifenthrin)	1.0 tsp./gallon
5) Untreated control	---

All treatments were applied to the custom-blended potting media obtained from Powell Plant Farm in Troup, Texas, immediately after mixing.

Evaluations were conducted using bioassay with fire ants. Six pots from each flat were randomly selected and each placed in a plastic bag. The bags were secured around the rim of the pots with a rubber bands to force the ants into the media. Approximately one-half teaspoon of worker ants, brood, and at least one queen was added to each pot. The top of the bag was then quickly sealed to prevent ant escape. The pots were then placed in Fluon®-treated plastic boxes to further guard against escape. After 24 hours, the bags were cut open and ant activity evaluated by estimating the percent mortality and making other descriptive observations. In addition, from 14 to 26 April, 1992, a 2 week exposure of ants to treated media was monitored, and between 18 and 20 January 1993 a 3 day period of exposure was monitored. Following all assays, the pots were frozen to kill any remaining ants and discarded. The flats were stored uncovered in a cool, dry environment between evaluations.

Results and Discussion

All treatments yielded roughly the same rate of kill and knockdown immediately after treatment (Table 1, Appendix). After 16 months, the effectiveness of Talstar® 0.2G was virtually unchanged. Both Pounce® 1.5G rates resulted in good, but not total kill. The Ammo® 0.75G was still causing 50% kill, but knockdown was incomplete. After two weeks exposure to the media (26 April 1992), Talstar® 0.2G treated media had 100 percent kill; 1 tsp. Pounce® 1.5G - 80 percent; and 0.5 tsp. Pounce® 1.5G - 40 percent. The Ammo® 0.75G and control pots had been frozen due to high ant activity and escapes. It was obvious, at this point, that only the Talstar® 0.2G was providing acceptable levels of control.

After 27 months, Talstar® 0.2G continued to provide 90-95 percent kill and 100 percent knockdown. Though its effectiveness was somewhat slower, it was still an effective treatment. Both Pounce® 1.5G and Ammo® 0.75G treatments provided only partial kill (Pounce® 1.5G 0.5 tsp./gal. - 50%; Pounce® 1.5G 1.0 tsp./gal. - 80-90%; and Ammo® 0.75G - 75-80%) even after 3 days exposure to the treated media (20 January 1993) indicating that some insecticidal properties remained, but that effectiveness had degraded considerably.

Table 1. Red imported fire ant mortality after 24-hrs. exposure to potting medica treated 9 October 1990.

	Percent mortality		
Treatment and rate	24 hours 10 Oct. 1990	16 months 14 Apr. 1992	27 months 18 Jan. 1993
Pounce® 1.5G (permethrin) 0.5 tsp./gallon	99%	99%	55%
Pounce® 1.5G (permethrin) 1.0 tsp./gallon	99%	99%	50%
Ammo® 0.75G (cypermethrin) 1.0 tsp./gallon	99%	50-75%	50% kill (90% knockdown)
Talstar® 0.2G (bifenthrin) 1.0 tsp./gallon	100%	99%	90% kill (100% knockdown)
Untreated control	0%	0%	0%

Appendix. General Observations

October 10, 1990 - 24 hours post-treatment
Pounce 1.5G, 0.5 tsp./gal. - Most knocked down or dead, a few affected but not knocked down.
Pounce 1.5G, 1.0 tsp./gal. - Most dead, a few appeared unaffected.
Ammo 0.75 G, 1.0 tsp./gal. - A few unaffected ants were found in every pot, though most were dead or knocked down. Large numbers of incapacitated ants were found between the bag and pot in three pots, indicating possible repellency. Not noted in any other treatment.
Talstar 0.2G, 3.5 tsp./gal. - All ants appeared dead or knocked down.
Untreated - Ants active, media heavily worked

April 14, 1992 - 16 months post-treatment
Pounce 1.5G, 0.5 tsp./gal. - 99% kill, a few unaffected
Pounce 1.5G, 1.0 tsp./gal. - 99% kill, a few unaffected
Ammo o.75 G, 1.0 tsp./gal. - 50-75% kill, other ants slowed, but not knocked down.
Talstar 0.2G, 3.5 tsp./gal. - 99% kill, all affected.
Untreated - Ants active, media heavily worked.

April 26, 1992 - (2 week exposure to media)
Pounce 1.5G, 0.5 tsp./gal. - 4 of 6 pots with live ants
Pounce 1.5G, 1.0 tsp./gal. - 1 of 6 with live ants
Ammo 0.75 G, 1.0 tsp./gal. - not evaluated
Talstar 0.2G, 3.5 tsp./gal. - 0 of 6 with live ants
Untreated - not evaluated

January 18, 1993 - 27 months post-treatment
Pounce 1.5G, 0.5 tsp./gal. - 55% kill, many ants between bag and pot, lethargic
Pounce 1.5G, 1.0 tsp./gal. - 50% kill, many ants between bag and pot appearing more strongly affected than 0.5 tsp. rate.
Ammo 0.75 G, 1.0 tsp./gal. - greater than 50% kill, 90% knockdown, some unaffected
Talstar 0.2G, 3.5 tsp./gal. - 90% kill, remainder knocked down
Untreated - Ants active, media heavily worked.

January 20, 1993 - (3 day exposure to media)
Pounce 1.5G, 0.5 tsp./gal. - 50% alive
Pounce 1.5G, 1.0 tsp./gal. - 80-90% kill
Ammo 0.75 G, 1.0 tsp./gal. - 75-80% kill, (better kill than 0.5 tsp. Pounce, less than 1 tsp. rate
Talstar 0.2G, 3.5 tsp./gal. - 95% kill, 100% knockdown
Untreated - not evaluated - Ants active, media heavily worked