RED IMPORTED FIRE ANT MANAGEMENT
APPLIED RESEARCH/RESULT DEMONSTRATIONS
1994-1995

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EVALUATION OF AMDRO® (HYDRAMETHYLNON) FORMULATIONS FOR SUPPRESSION OF RED IMPORTED FIRE ANTS

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Amdro® Granular Insecticide (hydramethylnon) is an effective bait-formulated insecticide registered for use in landscapes and pastureland. New formulations of hydramethylnon have been developed, one incorporating the queen pheromone and another using a corn cob grit carrier. These new formulations were evaluated, along with a simultaneous application of Amdro plus fertilizer.

Materials and Methods

This trial was conducted in a pasture on the Look Ranch near Hempstead in Waller County, Texas. Thirty two plots, 0.5 acre squares were established, each containing a 0.2 acre circular sampling subplot area. Prior to treatment, the number of active mounds was documented for each subplot. Plots were arrayed from highest to lowest mound density and divided into four blocks (replicates). Treatments were assigned randomly within each block and included:

Treatment	Rate
1. Amdro® cob formulation	5-6144 Batch 5-150 1 CW, applied 52.6 lb. per plot
2. Amdro®, experimental	Lot# AC9902-94A, "Experimental Amdro", 1.5 lbs./acre
3. Amdro® + pheromone "med"	Lot# AC9677-60, 0.5% Hyd + 0.01% pher., 1.5 lbs./acre
4. Amdro® + pheromone "high"	Lot# AC9677-61, .73% Hyd + 0.01% pher., 1.5 lbs./acre
5. Amdro® standard	24567-08, 429101E, 1.5 lbs./acre
6. Urea + Amdro®	50 lbs. of 38%N urea + 1.5 lbs. Amdro/acre applied simultaneously
7. Urea	50 lbs. of 38%N urea
8. untreated control	---

Treatments were applied 8 and 9 August, 1995 using broadcast application equipment: the fertilizer in treatment 6 was applied with a PTO-driven fertilizer spreader. Treatments 2 through 4 were applied using a hand-held Cyclone 1C1 seeder, and Amdro in treatments 5 and 6 and the Amdro cob formulation in treatment 1 were applied using a Herd GT77 electric powered spreader.

Periodically following treatment, subplots were monitored for active ant mounds. Active mounds were rated on a scale from 1 to 5 (1 = 5 - 25 ants; 2 = 25-50 ants; 3 = 50 - 100 ants; 4 = "normal mound"; 5 = unusually large, active mound). Results were evaluated using analysis of variance (ANOVA) and means were separated using Tukey's Studentized Range Test ($P \leq 0.05$).

Results and Discussion

No significant differences were found between the performance of any of the experimental Amdro® formulations and the untreated control based on number of active mounds per 0.2 acre subplot area except during week 4 after treatment (**Table 1**). At that time, the experimental Amdro formulation performed numerically better than other treatments, but the addition of queen pheromone did not increase performance. Means from the cob formulation of Amdro and urea applied alone were not significantly different from the untreated control. Application of Amdro® simultaneous with fertilizer performed statistically as well as when applied alone.

Results of mound rating efforts documented treatment differences only on weeks 2 and 4 after application (**Table 2**). All Amdro®-based treatments performed similarly and had ratings significantly lower than those of untreated control plot mounds. Dry weather during the course of this trial suppressed ant activity in all plots. By 8 weeks after treatment, ant activity (in terms of number of active mounds per unit area) had returned to pre-count levels or higher (Table 1). The overall performance of Amdro in this trial was rather disappointing, with a maximum suppression of 74 percent 4 weeks after treatment.

Table 1. Number of active red imported fire ant mounds before and after treatment using Amdro® (hydramethylnon) formulations, Look Ranch, Waller County, Texas, treated 8 and 9 August 1995.

	Mean no. active fire ant mounds/0.2 acre subplot[a]					
Treatment	Pre-count	48 hrs	1 wk	2 wks	4 wks	8wks
Exp. Amdro®	30.5	19.8	10.8	13.8	5.0c	35.0
Amdro + Pher. "Med."	27.5	21.5	11.0	11.0	6.8bc	31.0
Amdro + Pher. "High"	27.5	21.5	13.0	12.3	9.3abc	38.0
Amdro standard	27.8	23.0	17.3	14.0	6.5bc	35.0
Urea+Amdro	28.0	NA	11.8	11.3	8.5bc	66.0
Urea	29.8	NA	18.5	15.5	14.0abc	76.0
Amdro cob formulation	30.8	N/A	17.5	15.3	16.5ab	81.0
untreated control	29.3	26.0	19.0	24.3	19.0a	65.0

[a] Means followed by different letters are significantly different (*P*<0.05) using PC SAS, ANOVA and Tukey's Studentized Range test. Statistical analysis for 48 hr., 1 and 2 week evaluations did not include Amdro cob formulation and the two urea treatments.

Table 2. Ratings of active red imported fire ant mounds following treatment using Amdro® (hydramethylnon) formulations, Look Ranch, Waller County, Texas, treated 8 and 9 August 1995.

	Mean rating of active fire ant mounds/0.2 acre subplot[a]				
Treatment	48 hrs.	1 wk	2 wks	4 wks	8 wks
Exp. Amdro®	4.00	3.96	3.05b	2.80b	3.77
Amdro + pher. "Med."	3.70	3.89	3.09b	2.56b	3.81
Amdro + pher. "High"	3.71	3.54	2.73b	2.51b	3.68
Amdro standard	4.10	2.57	2.05b	2.31b	3.06
untreated control	3.96	4.12	3.34a	3.34a	3.65

[a] Means (total rating/total number of active mounds) followed by different letters are significantly different (P<0.05) using PC SAS, ANOVA and Tukey's Studentized Range test. Statistical analysis for 48 hr., 1 and 2 week evaluations did not include Amdro cob formulation and the two urea treatments. Ratings: 1 = 5 - 25 ants; 2 = 25-50 ants; 3 = 50 - 100 ants; 4 = "normal mound"; 5 = unusually large, active mound. NOTE: all ratings are subjective and may have varied with temperature and time of day on each evaluation date.

EVALUATION OF PYRETHRINS PLUS SILICA DIOXIDE TREATMENTS FOR RED IMPORTED FIRE ANT CONTROL

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Organic Plus™ Fire Ant Killer and Organic Solutions™ Multipurpose Fire Ant Killer (origionally evaluated using Permaguard™ D-21) are dust formulations containing pyrethrins (0.2%, 0.1%), piperonyl butoxide (1.1%, 1.0%) and diatomaceous earth (97.9%) or silica dioxide (83.3). Pyrethrins are extracted from pyrethrum daisies, piperonyl butoxide is a synthetic synergist and silicone dioxide is the chemical composing the bodies of fossilized diatoms found in diatomaceous earth. These products are registered by the Environmental Protection Agency for treatment of the red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae). We conducted a series of trials to evaluate these products and others considered to be 'organic'(Bonide® Rotenone 5 Insecticide, Insecto™ Formula 7, Natural Guard™ Nicotine Sulfate, Gardenville® Diatomaceous Earth), comparing efficacy to standard treatments including acephate (Valent™ Orthene® Turf, Tree & Ornamental Spray, Orthene® Systemic Insect Control), chlorpyrifos (Ortho-Klor® Soil Insect and Termite Killer) or diazinon (Rigo's Best Diazinon® 2E), water only treatment and untreated controls.

Materials and methods

Trial 1. Plots, 40 ft. wide and variable in length, 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 of four blocks and applied to individually flagged mounds according to directions, 14 May.

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)	1 tbsp./gal./mound
7. water drench	1 gal./mound
8. untreated check	dry

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. At 3, 7, 14 and 30 days following treatment, plots were evaluated using the minimal disturbance method. Mounds were considered "active" (harbor an active ant colony) if a dozen or more ants emerged from the lightly disturbed mound and displayed defensive behavior, a method similar to that used by Frankem, 1983. 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). Percent control was calculated from a pre-treatments level of 10 mounds.

Trial 2. Six treatments were evaluated to reduce the number of red imported fire ant mounds in treated areas. Treatments included:

1) PermaGuard™, D-20 (0.2 % pyrethrins, 1% piperonyl butoxide plus diatomaceous earth) - 4 tbsp./gal./mound

NOTE: Quanta Lab (9330 Corporate Dr. #703, Selma, TX 78154-1257; 210/651-5799; FAX: 210/651-9271) analysis of this material documented 0.1% pyrethrins plus 0.9% piperonyl butoxide (Report #950S1004, 26 April 1995).

2) PermaGuard™ D-21 (0.1 % pyrethrins, 1% piperonyl butoxide plus diatomaceous earth)- 4 tbsp./gal./mound

NOTE: Quanta Lab analysis of this material documented 0.1% pyrethrins plus 0.6% piperonyl butoxide (Report #950S1003, 26 April 1995).

3) Ortho-Klor® Soil Insect and Termite Killer (12.8% chlorpyrifos) - 2 tbsp./gal/mound

4) Orthene® Systemic Insect Control (9.4% acephate liquid) - 2 tbsp./gal/mound

5) Untreated control - 1 gal. water per mound

6) Permaguard D-20 applied with a Ortho® Dial'n Spray Hose-End Sprayer driven by a Shurflo® Diaphragm Pump powered by a 12 volt battery that delivers 40 psi. calibrated to deliver 2 lbs. Permaguard® in 50 gal. water per acre after spraying each mound within the treated area using an inward spiral spray pattern until the mound structure collapsed.

Four sets of replicated plots of equal width and variable length, containing ten (10) red imported fire ant mounds were established for each treatment (40 mounds treated per treatment). Treatment blocks were assigned by arraying plot length from longest to shortest and treatments were randomly assigned within each block. Each mound was marked with a plot flag and received one of the six treatments. Periodically (3, 7, 14 and 31 days; on 6, 10, 17 Feb. and 6 March, respectively) following treatment, treated mounds and plots were inspected for ant activity using the minimal disturbance method. Results were analyzed using Analysis Of Variance (ANOVA) and means separated using Tukey's Studentized Range Test ($P \leq 0.05$).

Trial 3. Products evaluated in this trial are labeled to treat fire ant infested areas in sites listed using the methods listed below:

Treatment	Method and rate appearing on product label
1) Organic Solutions™ Multipurpose Fire Ant Killer (0.1% pyrethrins; 1.0% piperonyl butoxide, silicon dioxide 83.3%)	**As a dust:** For best results, dust the perimeter of the mound first. With a stick, disturb the mound, then dust mound in a circular motion working toward the center until the entire mound is thoroughly dusted. **Mound drench or "Water Method":** Use 0.6 oz. (4 Tablespoons) to one gallon of water. For best results, saturate the perimeter of the mound first working toward the center of the mound in a circular motion (you may want the mixture to puddle). An ant mound 12-14 inches in diameter requires about one gallon of the mix. **Hose-end sprayer:** Use 16 oz. (1 lb.) per 1000 square feet of area. Use of a hose-end sprayer for lawns, add a small amount of water to the jar and add the amount needed for the measured area, stir to make a slurry, then add the remaining water to the top of the jar. Empty entire contents of the jar on the premeasured area.
2) Valent™ Orthene® Turf, Tree & Ornamental Spray (acephate 75%)	2 teaspoons/mound
3) Rigo's Best Diazinon® 2E (diazinon 25.0%)	1 fl. oz. in 3 gals. of water/125 sq. ft. Spot spray ant hills

Twenty four plots were established in a shredded wayside area 22 to 44 feet wide and varying in length as to contain ten red imported fire ant mounds each. Fire ants in this location were assumed to be of the multiple queen (polygyne) form. Each mound was marked with a colored plot flag. Plots were arrayed from longest to shortest and divided into four blocks or replicates. Each of six treatments listed below were randomly assigned, one to each block.

Treatments	Rate
1) untreated control	---
2) Organic Solutions™ Multipurpose Fire Ant Killer:	
mound drench	4 tbsp./gal./mound
dust treatment	2 tbsp./mound
broadcast spray	4 tbsp./gal./thorough coverage of mounds & plot (1.77 oz./0.89 gal./mound + 14 oz./7.0 gal./1,000 sq. ft.)
3) diazinon 2E broadcast	8 fl. oz./24 gal./1,000 sq. ft.
4) acephate 75% WP	2 tsp./mound

All treatments were applied, August 17, 1995. Recent light rains had occurred and soil was moist. However, temperatures were in the 90 to 100 degree F range throughout much of this trial period. Casey Cornwell, a technical representative from Organic Solutions was present to apply the broadcast treatment of the Multipurpose Fire Ant Killer using a hydraulic sprayer provided by Organic Solutions. Volume of solution and amount of product used was measured by timing treatments and determining flow rate. To treat individual ant mounds in broadcast treatment plots, 1.77 oz. Organic Solutions was used per mound (10 mounds treated) in 0.89 gal. water. Then the plots were oversprayed using 14.0 oz Organic Solutions per 1,000 sq. ft. in 7.0 gal. water. Diazinon was applied with a hose-end sprayer powered by a battery powered Shurflo RV Automatic Demand Pump, drawing diluted insecticide from a 40 gallon plastic container. Additional mounds detected during treatment were treated and marked with contrasting color flags so that they would not be included in subsequent monitoring efforts.

Periodically (4, 7, 14, 27 days) following treatment, marked mounds were inspected for ant activity using the minimal disturbance method. After the last evaluation, the plots were mowed to a height of 4 inches. Two days thereafter (Sept. 15), all active fire ant mounds were counted within each plot. Results were analyzed using analysis of variance (ANOVA) and means were separated using Tukey's Studentized Range test ($P \leq 0.05$).

Results and Discussion

The "strip plot" or "railroad track" method. 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. This method is considered to be an improvement over previous methods used (Franke 1983) because it addresses the issue of colony relocation following treatment.

Trial 1. Of the 'organic' treatments tested, Organics Plus™ Fire Ant Killer caused the most rapid reduction in ant activity. The number of active mounds of ten treated was: Organics Plus™ - 2; Insecto™ Formula 7 - 10; Bonide® Rotenone 5 Insecticide - 9; Natural Guard™ Nicotine Sulfate - 10; GardenVille® Diatomaceous Earth - 9; water drench - 10; and untreated check - 9. 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, elimination of ant activity in treated mounds within 3 days of treatment. Percent control continued to increase, reaching 95 to 98 percent at 14 and 30 days following treatment, respectively. Insecto™ Formula 7 drenches resulted in a slow decline in ant activity. Natural Guard™ Nicotine Sulfate and Gardenville® Diatomaceous Earth treatments produced no significant reductions of red imported fire ant mound numbers throughout this trial. Gardenville® Diatomaceous Earth is not an EPA registered insecticide for fire ant control. Plots treated with Orthene® and the untreated control had fewer 'satellite' mounds recorded following treatment than other treatments. No phytotoxicity was observed.

Trial 2. The average plot size was 750 sq. ft. On the day of treatment, the temperature ranged from 64.5 to 68.2 degrees F and relative humidity from 50 to 43 percent. Individual mound drenches of flagged mounds required about 2.4 man-minutes per mound ($0.17 per mound at minimum wage of $4.25 per hour). Per mound cost for treatments was $0.48/mound for Orthene® Systemic Insect Control and $0.55/mound for Ortho-Klor® Soil Insect & Termite Killer.

Ten ounces of Permaguard® were mixed per gallon of water and used to fill the sprayer. The Ortho® Dial'n Spray Hose-End Sprayer, set at 8 oz rate, emitted 1.62 gal water/minute and sprayed out 13.5 fl oz dissolved insecticide per minute. Permaguard™ was dispensed at 0.0176 oz per minute. The amount of spray used on the hose-end treated plots is listed below:

Plot no./length	Spray time/plot	Spray time/10 mounds	Total amount
6 15 ft	19 sec. (4.3 fl. oz.)	80 sec. (18 fl. oz)	= 1.74 oz. Permaguard® D-20
7 46 ft	59 sec. (13.3)	69 sec. (15.5)	= 2.25 oz.
23 24 ft	31 sec. (7.0)	56 sec. (12.6)	= 1.53 oz.
24 18.5 ft	24 sec. (5.4)	85 sec. (5.4)	= 1.91 oz.

Four tablespoons of Permaguard™ D-20 weighs 22.2 grams or 0.78 oz. Plots receiving individual mound drenches for 10 mounds received 7.8 oz. product.

The Permaguard® formulations performed differently, with D-20 (0.2% pyrethrins, 1% piperonyl butoxide plus diatomaceous earth) providing significantly better elimination of ant activity than D-21 (0.1% pyrethrins) 3 days following application (**Table 3**). Permaguard™ D-20, applied as an individual mound treatment eliminated ant activity in treated mounds more quickly than did Orthene® Systemic Insect Control (9.4% acephate), and performed statistically similar to Ortho-Klor® Soil Insect and Termite Killer (12.8% chlorpyrifos) throughout the trial. From 1 to 4 weeks following application, all individual mound treatments significantly reduced ant activity in treated mounds relative to ant activity in untreated control (water drench only) mounds and performed statistically the same, providing 75 to 100 percent suppression of ant activity in treated mounds.

The surface application of Permaguard™ D-20 significantly reduced the number of ant mounds 1 to 4 weeks following treatment relative to the untreated control (water drench only) plots by 50 to 53 percent. Apparently, the "spiral pattern spray" to individual mounds failed to deliver sufficient product to eliminate ant activity in treated mounds to the extent that 1 gallon individual mound treatments achieved. However, less material was applied to the plots using the surface treatment (1.9 oz. versus 7.8 oz for individual mound treated plots). (Note: The individual mound treatment rate of PermaGuard™ would have resulted in the application of 28.3 lbs. per acre for 581 ant mound infestation in this study area. Obviously, in areas with fewer mounds per acre would require less material.)

None of the treatments applied appeared to greatly aggravate colony movement (**Table 4**), although more "new" colonies appeared in the plots treated with the surface application of PermaGuard™ D-20. However, new mounds appeared in the plots during the course of this 4 week long trial. By the fourth week, only the Ortho-Klor® Soil Insecticide and Termite Killer (chlorpyrifos 12.8%) treated plots contained significantly fewer mounds than did the untreated control plots, having 65 percent fewer mounds. The other treatments performed statistically similar to Ortho-Klor® Soil Insecticide and Termite Killer, achieving percent reductions of active fire ant mounds ranging from 58 to 13 percent.

This trial was conducted in February, and was characterized by mild and wet climate conditions. Field plots were mowed 1 and 27 Feb. Conceivably, colony migration into mowed plots from adjacent high grass areas may have increased because of the mowings or because of natural ant behavior during this period of the year. Further testing with these treatments will provide additional confidence in the results generated from this trial.

Trial 3. All treatments significantly reduced the number of red imported fire ant mounds treated within 4 days except the dry dust treatment of Organic Plus Multipurpose Fire Ant Killer (**Table 5**). This treatment remained less effective than the rest even though periodic rain showers occurred during the monitoring period (Aug. 19, 23, Sept. 13) that were sufficiently heavy to dissolve most of the powdered insecticide into the soil. Thereafter, all except the dust treatment performed, providing 95 to 100 percent elimination of active ant mounds treated. The dust treatment did significantly reduce the number of active ant mounds 36 to 54 percent relative to the number in untreated plots, but not to the same degree as did the rest of the treatments.

New mounds occurring in treatment plots 29 days after treatment resulted either from 1) treated colonies moving away from treatment spots and forming a new "satellite" colony; 2) treated colonies moving away from treatment spots and forming more than one new ant mound, a process referred to as "shattering"; or 3) migration of colonies into the treatment plots from untreated adjacent areas. Organic Solutions Multipurpose Fire Ant Killer treatment plots were found to harbor as many or more new unmarked mounds at that time than those found in untreated plots (**Table 5**). Only the acephate and diazinon treated plots contained significantly fewer total ant mounds at the end of the trial than untreated plots, providing 69 and 98 percent suppression of mound numbers, respectively.

Acknowledgements

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Literature Cited

Franke, O. F. 1983. Efficacy tests of single-mound treatments for control of red imported fire ant, *Solenopsis invicta* Buren. Southwest Entomologist 8:42-45.

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, Trial 1, treated May 1993.

	Dates Post-treatment[1]			
	17 May 3 day	21 May 7 day	27 May 14 day	11 June 30 day
	No. active fire ant mounds/10 (Percent control in parentheses)			
Organics Plus™	2.00b (80)	2.00d (80)	0.25b (98)	0.50b (95)
Insecto™ Formula 7	4.75b (53)	4.00bcd (60)	0.25b (98)	0.50b (95)
Bonide® Rotenone 5 Insecticide	4.50b (55)	3.25cd (68)	3.25b (68)	1.50b (85)
Natural Guard™ Nicotine sulfate	8.50a (15)	6.50abc (35)	7.75a (23)	6.50a (35)
Gardenville® Diatomaceous Earth	8.00a (20)	8.25ab (17)	8.25a (18)	6.75a (33)
Orthene® Turf and Ornamental Spray	1.50b (85)	1.25d (88)	0.25b (98)	0.25b (98)
water drench	9.00a (10)	7.75ab (23)	8.00a (20)	6.25a (38)
untreated control	9.50a (5)	10.0a (0)	9.50a (5)	8.25a (18)
F	15.47	8.76	21.95	27.27
P	0.0001	0.0001	0.0001	0.0001
MSE	1.809	3.400	2.149	1.208
Min. Sig. Diff.	3.1904	4.3735	3.4767	2.6071
R-square	0.8805	0.8066	0.9126	0.9285
d.f. = 21; Studentized Range = 4.743				

[1] 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. Mean number active ant mounds following application of individual red imported fire mound treatments, Brazos Co., Texas, Trial 2, treated 3 Feb. 1995.

	Mean no. active mounds/10[a]			
Treatment	3 days	1 week	2 week	4 weeks
untreated control 1 gal. water/mound	10.00 a...	10.00 a..	8.75 a..	9.25 a..
Permaguard™ D-21 (0.1% pyrethrins, 1% PBO) 4 tbsp./gal./mound	6.00 .b..	2.50 .bc	1.25 ..c	2.00 .bc
Permaguard™ D-20 (0.2% pyrethrins, 1% PBO) 4 tbsp./gal./mound	1.50 ..cd	0.25 ..c	0.25 ..c	1.00 ..c
Permaguard™ D-20 surface treatment[b] 2 lbs./50 gal./acre	9.75 a...	4.75 .b.	4.75 .b.	5.00 .b.
Orthene® Systemic Insect Control (9.4% acephate EC) 2 tbsp./gal./mound	4.00 .bc .	1.00 ..c	1.00 ..c	1.25 ..c
Ortho-Klor® Soil Insect and Termite Killer (12.8% chlorpyrifos) 2 tbsp./gal./mound	0.00 ...d	0.00 ..c	0.00 ..c	0.00 ..c
F	22.32	30.40	17.80	13.12
P	0.0001	0.0001	0.0001	0.0001
MSE	1.952	1.200	1.7111	2.333
Min. Sig. diff.	3.2104	2.5166	3.0052	3.5093
d.f. = 15; Critical value = 4.595				

[a] Means followed by the same letter are not significantly different using analysis of variance (ANOVA) and the Tukey's Studentized Range Test ($P \leq 0.05$).
[b] Permaguard™ D-20 applied with a Ortho® Dial'n Spray Hose-End Sprayer driven by a Shurflo® Diaphragm Pump powered by a 12 volt battery that delivers 40 psi. to spray plot surface after spraying each mound within the treated area using an inward spiral spray pattern until the mound structure collapsed.

Table 4. Mean number of new mounds appearing per plot and total number of active ant mounds per plot following treatment of individual red imported fire ant mounds, Brazos Co., Texas, 1995.

	Mean no. active mounds/plot[a]		**No. "satellite" mounds/plot[a]**	
Treatment	2 weeks	4 weeks	2 weeks	4 weeks
untreated control	10.25 a..	11.50 a.	1.50 a	2.25 a
Permaguard™ D-21	2.75 .bc	7.25 ab	1.50 a	5.25 a
Permaguard™ D-20	1.00 ..c	4.25 ab	1.25 a	3.25 a
Permaguard™ D-20 surface treatment	7.50 ab.	8.75 ab	2.75 a	3.75 a
Orthene® Systemic Insect Control	2.25 .bc	5.00 ab	1.25 a	3.75 a
Ortho-Klor® Soil Insect and Termite Killer	0.50 ..c	3.50 .b	0.50 a	3.50 a
F	6.35	5.23	0.69	2.14
P	0.0011	0.0029	0.6934	0.0972
MSE	6.275	6.964	2.919	11.986
Min. Sig. diff.	5.755	6.0626	3.9254	7.9537
d.f. = 15; Critical value = 4.595				

[a] Means followed by the same letter are not significantly different using analysis of variance (ANOVA) and the Tukey's Studentized Range Test ($P \leq 0.05$).

Table 5. Mean number of active red imported fire ant mounds per plot, with 10 mounds treated per plot in four replicated variable sized plots, Trial 3, treated 17 Aug. 1995, Burleson Co., Texas.

Treatment and rate	Mean no. fire ant mounds per plot/10 initially treated				Total mounds per plot (new)	
	Aug 21 Day 4	Aug 24 Day 7	Aug 31 Day 14	Sept 13 Day 27	Sept 15	
untreated check	9.8a*	9.3a	8.8a	7.5a	(8.8)	16.3a
Organic Solutions®						
dust treatment						
(2 tbsp./mound)	9.5a	5.5b	4.0b	4.8b	(16.8)	21.5a
mound drench						
(4 tbsp./gal./mound)	0.8b	0.5c	0.5c	0.3c	(13.0)	13.3a
broadcast spray						
(4 tbsp./gal./thorough coverage of plot)	0.0b	0.3c	0.3c	0.3c	(11.8)	12.0ab
acephate 75% WP						
(2 tsp./mound)	0.3b	0.0c	0.3c	0.0c	(5.0)	5.0bc
diazinon 2E broadcast						
(8 fl. oz./24 gal./ 1,000 sq. ft.)	0.3b	0.0c	0.0c	0.0c	(0.3)	0.3c
F	111.54	74.88	30.51	29.70		11.82
P	0.0001	0.0001	0.0001	0.0001		0.0001
MSD	1.6602	1.6424	2.3322	2.1761		10.259
d.f. = 8						

* Means in columns followed by the same letter are not significantly different using analysis of variance (ANOVA) and means were separated using Tukey's Studentized Range test ($P \leq 0.05$).

ORTHO® ANT-STOP® ORTHENE FIRE ANT KILLER (ACEPHATE 75% WP) FORMULATIONS AND CYFLUTHRIN (TEMPO®) EVALUATED AS DUST APPLICATIONS FOR RED IMPORTED FIRE ANT MOUNDS

Bastiaan M. Drees, Professor and Extension Entomologist and
Charles L. Barr, Extension Associate

The application of dust formulations to individual mounds of the red imported fire ant, *Solenopsis invicta*, is a widely accepted method because of the low cost and low labor required for treatment. The per mound treatment cost is estimated to be about $0.15 for Ortho® Ant-Stop® Orthene® Fire Ant Killer (Solaris) or Orthene® Turf, Tree and Ornamental Spray (Valent U.S.A.), both 75% wettable powder formulations of acephate. Use of water as a diluent or applied after treatment is not required or suggested as is the common practice for most individual fire ant mound treatments. This trial was conducted to evaluate new formulations of 75% acephate. In addition, a formulation of the pyrethroid cyfluthrin, Tempo® 0.1% Dust (Bayer Agric. Div.) was evaluated.

Materials and Methods

Trial 1. This trial was conducted behind the dam at Lake Somerville, in Burleson Co., Texas. Twenty plots, 30 ft. wide, were established so that each plot contained ten fire ant mounds, thus varying in length. Each mound was marked with a field flag. Plot lengths were arrayed from longest to shortest and divided into 4 blocks or replicates. Treatments were then assigned randomly to one plot within each block. Treatments were applied 16 May 1995. Three formulations of Orthene® Fire Ant Killer (75% acephate SP) and Tempo® 0.1% Dust (cyfluthrin) were evaluated and compared to an untreated check (three treatments, total). Treatments were applied as topical dusts to red imported fire ant mounds according to manufacturers' instructions. Amounts of material used varied with mound size for Tempo® 0.1% Dust:

Product	Mound diameter (inches)	Dosage/Mound
Ortho® Ant-Stop® Orthene® Fire Ant Killer	all	2 tsp.
Tempo® 0.1% Dust	6	1 tsp.
	12	1 tbsp.
	18	2 tbsp.

Periodically (7, 14 and 30 days) following treatment, treated mounds were inspected for ant mounding activity using the minimal disturbance method. On the last evaluation date, plots were also inspected for additional ant mounds, representing immigrant colonies and/or "satellite" mounds formed by survivors of initially-treated mounds. Results were analyzed using Analysis Of Variance (ANOVA) and means separated using Tukey's Studentized Range Test ($P \leq 0.05$). Trial 2. Twenty plots, variable in length and ranging from 22 to 45 ft. in width and containing ten active red imported fire ants (polygyne form) each were established, September 26, 1995, along a road side bordering Royalty Pecans, Burleson County, Texas. Plots were arrayed by plot length and divided in to four blocks (replicates). Treatments were randomly assigned to each block. Treatments and rates included:

1. untreated control
2. Ortho® Ant Stop® Orthene® Fire Ant Killer (75% dust) - 2 teaspoons/mound
3. SF18881 Orthene (75% dust)(NB5608561) - 2 teaspoons/mound
4. SF18898 Orthene (75% dust)(NB5608561) - 2 teaspoons/mound
5. Velocity® (15% acephate granular) - 2 tablespoons/mound

Additional mounds found in treatment plots at time of application were treated with the product assigned to that plot and mounds were marked with blue flags and no longer considered for evaluation.

Ant mounds were considered active is 12 or more ants emerged from the top of the mound displaying defensive behavior after minimal disturbance. All active mounds were marked with plot flags. Periodically after treatment (3, 7, 14 and 30 days), treated mounds were evaluated for activity. Results were analyzed using analysis of variance (ANOVA) and means were separated using Tukey's Studentized Range Test ($P \leq 0.05$).

Results and Discussion

Trial 1. The experimental formulations of acephate 75% WP were developed to overcome the objectionable mercaptan based odor of the current formulations. These new formulations appeared to contain perfuming masking agents: SF-18881, NB# 5608530 smelled somewhat like almonds and SF-18898, NB# 5608530 smelled something like carpet freshener. Although in casual contact these formulations smelled similar to cleaning products, the odors could become overpowering during instances of higher exposure that occasionally happen during application.

All acephate 75% WP formulations tested performed statistically similar during the course of this trial (**Table 1**), although numerically more "new" mounds were documented in the plots treated with the experimental formulations 4 weeks after treatment. Ant mounds in cyfulthrin (Tempo® 0.1% Dust) treated plots declined more slowly over time, and these plots contained numerically higher numbers of "new" mounds at the end of the trial. Although active ant mound numbers slowly declined in untreated plots over the course of time, most likely because of hot weather and little rain, total mound numbers within each set of treatment plots at the end of the trial indicate that only those treated with Ortho® Ant-Stop® Orthene® Fire Ant Killer contained fewer mounds than did untreated plots, providing 96.7 percent suppression of mound numbers.

Trial 2. Statistically, all acephate formulations tested performed similarly, providing 100 percent elimination of ant activity in treated mounds within 1 week (**Table 2**). Numerically, SF 18898 did not perform as well as other treatments. Satellite mound formation was not significantly different between treatments at the end of the monitoring period.

Velocity is sold in 12 oz. shaker cans with instructions to use 2 tablespoons per mound. Two cans treated 35 mounds (17.5 mounds per can). The Spread Rite G applicator provided by the manufacturer of Velocity was used to treat mounds in two plots (#6 &19) using the disc with a 1/4 inch hole in the cap and counting up to 8 while sprinkling granules on and around the mounds. We found this device to be quick and easy to use.

Table 1. Number of active red imported fire ant mounds of ten following 16 may 1995 application of dust treatments using Ortho® Ant-Stop® Orthene® Fire Ant Killer (acephate 75% WP), two additional acephate 75% WP formulations (SF-18881, NB# 568530 and SF-18898, NB# 5608530) or Tempo® 0.1% Dust (cyfluthrin), Trial 1, Burleson Co., Texas.

Treatment	3 days	1 week	2 weeks	4 weeks	Satellite	Total
Untreated	9.25 a	7.75 a	7.75 a	5.25 a	2.50 a	7.75 a
Orthene®	0.00 c	0.00 c	0.25 c	0.25 b	0.00 a	0.25 b
SF-18881	0.25 c	0.00 c	0.00 c	1.25 b	1.25 a	2.50 ab
SF-18898 2	0.75 c	0.50 c	0.00 c	0.50 b	1.75 a	2.25 ab
Tempo®	5.75 b	4.75 b	2.50 b	1.00 b	4.25 a	5.25 ab
F	21.54	52.30	65.33	4.71	1.37	2.47
P	0.0001	0.0001	0.0001	0.0094	0.3023	0.0811
MSE	1.8500	0.5417	0.3917	2.0583	4.9583	8.5000
Min. sig diff.	3.0656	1.6588	1.4106	3.2337	5.0188	6.5712

Critical value = 4.508
d.f. = 12

Table 2. Number of active red imported fire ant mounds of ten following application of individual mound treatments, Burleson Co., Texas, treated 26 September 1995.

	Mean no. active fire ant mounds/10*			30 days		
Treatment	3 day	7 day	14 day	30 day	satellite	sum
Orthene®	0.00b	0.00b	0.00b	0.00b	1.50	1.75b
SF 18881	0.25b	0.00b	0.00b	0.00b	1.00	1.00b
SF 18898	0.50b	0.00b	0.00b	0.25b	3.00	3.25b
Velocity®	0.00b	0.00b	0.00b	0.00b	2.50	2.50b
untreated control	9.50a	9.50a	7.50a	7.50a	3.25	10.75a
F	183.5	619.29	58.6	73.05	1.07	12.48
P	0.0001	0.0001	0.0001	0.0001	0.4360	0.0001
MSE	0.2167	0.0667	0.4333	0.3417	3.8830	3.0250
MSD	1.0491	0.5819	1.4836	1.3174	4.4414	3.9200
df=12						
crit.=4.508						

* Means in columns followed by the same letter are not significantly different using analysis of variance (ANOVA) and means were separated using Tukey's Studentized Range Test ($P \leq 0.05$).

EVALUATION OF CHLORPYRIFOS SURFACE APPLICATIONS TO A PECAN ORCHARD FLOOR FOR SUPPRESSION OF THE RED IMPORTED FIRE ANT

Bastiaan M. Drees, Professor and Extension Entomologist,
Charles L. Barr, Extension Associate and
David E. Rue, County Extension Agent, Burleson County

Chlorpyrifos (Lorsban® 50 WP and Lorsban® 15G) is registered for treatment of pecan orchard floors for suppressing the red imported fire ant, *Solenopsis invicta* Buren. Previous work (Drees et al. 1989; Barr et al. 1991) has demonstrated that orchard floor chlorpyrifos treatments suppress ant foraging and mound building activities for a period exceeding the treatment-to-harvest interval for the use of this insecticide. These treatments could be useful to reduce ant activity during the harvest period and to protect equipment such as drip and sprinkler irrigators. Since the primary affect of surface chlorpyrifos applications is to suppress ant foraging and other surface activity, little reduction in ant mound numbers is expected unless treatments are routinely applied.

This trial was conducted to evaluate a new formulation of chlorpyrifos, a wettable gel (75 WG), one that contains no organic solvents, and to determine whether the suppressive affect on foraging red imported fire ants produced by this formulation was similar to the conventional formulation, Lorsban® 4E.

Materials and Methods

This trial was conducted at Royalty Pecans in Burleson County, Texas, which has trees planted on a 45 ft. spacing. The test site was shredded twice before treatment plots were established. Twenty plots, 90 by 90 ft. or 5,400 sq. ft. (0.1239 acre) were established, 9 June 1995, and the number of active red imported fire ant mounds were counted in each plot using the minimal disturbance method. Plots were arrayed from highest to lowest active ant mound numbers and divided into four blocks or replicates. Treatments were randomly assigned to a plot within each block. Treatments were confined to plots 60 by 90 ft. in size (5,400 sq. ft. or 0.1239 acre) due to limited test material. Treatments were applied, 13 June 1995, using a Continental Belton Sprayer with a 50 gal. tank and a 12 ft. boom fitted with eight FanSpray 8003 nozzles mounted two feet above the ground, using 20 gal. solution per acre applied at 40 psi and traveling at 2 mph. Treatments included:

1. Lorsban® Wettable Gel 0.5 lb a.i./acre = 160 g in 5 gals. water/plot
   (Lorsban® 75WG; EF-1315; 75% w/w chlorpyrifos; lot #PM1241; 500 gms. sample)
2. Lorsban® Wettable Gel 1.0 lb a.i./acre = 340 g in 5 gals. water/plot
3. Lorsban® 4E 0.5 lb a.i./acre = 58.1 mls. in 5 gals. water/plot
   (Lorsban® 4E (44.9% chlorpyrifos); EPA Est. 62719-1N1; JB15161601
4. Lorsban® 4E 1.0 lb a.i./acre = 116.1 mls. in 5 gals. water/plot
5. Untreated control

Before and periodically following application (0, 7, 14, 21 and 28 days), the number of foraging fire ants attracted to twelve 1 by 1 inch olive oil-soaked index cards were counted within an hour after placement. Cards were placed in three transects across each plot (4 cards in a line down the center, and 4 each on two lines on either side of the middle transect) when temperatures were mild. At three weeks after treatment, number of active ant mounds within each plot were again counted, although only a subsample of the plot (20 by 90 ft. swath) was surveyed. Results were analyzed using analysis of variance (ANOVA) and means separated using Tukey's Studentized Range Test ($P \leq 0.05$).

Results and Discussion

No statistical differences in ant mound numbers (**Table 1**) or foraging ant response to olive-oil cards (**Table 2**) was found between sets of treatment plots prior to treatment. Initially, all chlorpyrifos treatments significantly suppressed ant foraging activity. The higher rates of Lorsban® 4E and Lorsban® 75 WG suppressed activity to a greater degree for the first 2 weeks following application. The low (0.5 lb. a.i./acre) rate of Lorsban® 4E began to lose effectiveness at two weeks after treatment. By the third week, ant numbers attracted to oil-soaked cards were similar between the untreated plots and all chlorpyrifos treatments except the high concentration (1.0 lb. a.i./acre) of the 75 WG formulation.

Active ant mound numbers in treated plots were numerically suppressed in chlorpyrifos-treated plots, but were not eliminated. At three weeks after treatment, significant suppression of ant mounds resulted from Lorsban® WG applied at 1.0 lb. a.i./acre (**Table 2**). Overall, the Lorsban® 75 WG applied at 1.0 lb. a.i./acre suppressed foraging to the greatest degree over the 4 week monitoring period, while Lorsban® 4E applied at 0.5 lb. a.i./acre was the least effective. The "new" 75 WG formulation performed as well or better than the conventional 4E formulation. During treatment, however, we noted that the Lorsban® 75 WG formulation is not quite as easy to use as the 4E formulation. We found the wettable gel difficult to measure accurately since it was hard to "pour" or scoop and tended to "pack down". It was also so light as to be easily blown by the wind. The dry gel was also very difficult to place directly into the spray tank. It required vigorous stirring and agitation to break up the buoyant clumps. This problem was alleviated by first mixing the gel with a small quantity of water to form a slurry in a separate container, then pouring and rinsing the slurry into the spray tank.

Literature cited

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Acknowledgment

The authors are grateful to Andy Sherrod of Royalty Pecans for providing the site for this trial and assisting by shredding the orchard floor prior to this trial's establishment.

Table 1. Number of active red imported fire ant per plot prior to 13 June 1995 treatment (90 by 90 ft. plots) and three weeks following treatment (a 20 by 90 ft. subsample within the 60 by 90 ft. of plots actually treated), Royalty Pecan, Burleson Co., Texas.

Treatment	Number of active mounds/total[a]	
and rate	Pre-count*	3 weeks**
Untreated control	104.75 a	15.75 a
Lorsban® 4E 0.5 lb. a.i./acre	106.25 a	8.25 ab
Lorsban® 1.0 lb. a.i./acre	102.75 a	5.50 ab
Lorsban® WG 0.5 lb. a.i./acre	101.25 a	7.25 ab
Lorsban® WG 1.0 lb. a.i./acre	103.00 a	5.25 b
F	10.81	2.50 (treatment = 3.42)
P	0.0002	0.0779
MSE	30.250	21.567
MSD	12.396	10.467
d.f. = 12		
Crit. Val. = 4.508		

[a] Means followed by different letters are significantly different using analysis of variance (ANOVA) and means separated using Tukey's Studentized Range Test ($P \leq 0.05$).

Table 2. Number of foraging red imported fire ant workers attracted to twelve 1 by 1 inch olive oil-soaked cards within an hour, placed in treatment plots on a pecan orchard floor, Royalty Pecans, Burleson County, Texas, treated 13 June 1995.

Treatment and rate	Mean no. ants per 12 oil-soaked cards[a] Pre-count	1 week	2 weeks	3 weeks	4 weeks
Untreated control	114.25 a	283.25 a	136.00 a	180.75 a	427.50 a
Lorsban® 4E 0.5 lb. a.i./acre	86.00 a	25.25 b	65.25 ab	116.25 ab	256.25 ab
Lorsban® 1.0 lb. a.i./acre	83.00 a	0.25 b	12.50 b	69.50 ab	119.00 b
Lorsban® WG 0.5 lb. a.i./acre	101.75 a	12.50 b	56.25 b	85.75 ab	199.00 b
Lorsban® WG 1.0 lb. a.i./acre	84.00 a	0.00 b	5.00 b	36.00 b	116.25 b
F	0.28	9.93	6.23	2.80	5.60
P	0.9485	0.0004	0.0030	0.0567	0.0047
MSE	2237.458	3652.758	1061.641	2701.558	6813.775
MSD	106.61	136.22	73.439	117.15	186.05
d.f. = 12					
Crit Val. = 4.508					

[a] Means followed by different letters are significantly different using analysis of variance (ANOVA) and means separated using Tukey's Studentized Range Test ($P \leq 0.05$).

EVALUATION OF BIFENTHRIN AND LINDANE FORMULATIONS AND APPLICATION METHODS AS INDIVIDUAL RED IMPORTED FIRE ANT MOUND TREATMENTS

Bastiaan M. Drees, Professor and Extension Entomologist, and
Charles L. Barr, Extension Associate

This trial was conducted to evaluate several formulations of bifenthrin, a pyrethroid insecticides, and lindane, a chlorinated aryl hydrocarbon insecticide. The bifenthrin product, Talstar®, is currently registered for fire ant suppression in nursery crops as a granular media treatment. Liquid bifenthrin and lindane formulations are not currently registered as fire ant mound drenches.

Materials and Methods

Forty plots, 30 ft. wide and varying in length, were established along an abandoned airport runway on the Texas A&M Riverside Campus, Brazos. Co., Texas. All mounds were marked with plot flags. Plots were recently mowed and flora consisted of pasture grasses. Soil was sandy loam. Plots were consecutively numbered and arrayed by length and separated into four treatment blocks (replications). Treatments were randomly assigned within blocks, with each block receiving one of each of the treatments listed below:

Formulation	Application method	Rate	Mounds/plot
bifenthrin			
Talstar® Flowable	mound drench	0.972 fl. oz.(27.6 ml.)/gal.	10
SPG95-01 (bifenthrin EC)	mound drench	0.648 fl. oz.(18.4 ml.)/gal.	10
SPG95-02 (bifenthrin ME)	mound drench	25.6 fl. oz./gal.	5
SPG95-02	mound drench	4.0 fl. oz./gal.	5
SPG95-02	mound drench	2.0 fl. oz./gal.	5
SPG95-03 (Biflex® EC)	mound drench	0.37 fl. oz. (10.5 ml.)/gal.	10
lindane			
Gamma-Mean® L.O. (4 lbs. a.i./gal.)	mound injection	9.1 ml./gal.	10
chlorpyrifos (standard)			
Dursban® 2E (2 lbs. a.i./gal.)	mound drench	0.25 fl. oz./gal.	10
untreated control			
water	mound drench	1.0 gal.	10
water	mound injection	1.0 gal.	10

Treatments were applied, 16 November 1995, using either 2 gallon capacity sprinkler cans or an injector device. Each mount treated received 1 gallon of solution.

Prior to and periodically following treatment (20, 27 Nov.,1 Dec., 4 Jan.1996, or 4, 11, 15,and 49 days after treatment, respectively), fire ant mounds were evaluated within treated plots using the minimal disturbance method, whereby mounds were slightly disturbed using a stick and considered active if 12 or more worker ants came to the surface as a general defensive response to disturbance. New mounds appearing in treatment plots were marked and counted, 20 Nov. 1995 and 4 Jan. 1996. Results were analyzed using Analysis of Variance (ANOVA) and means were separated using Tukey's Studentized Range Test ($P \leq 0.05$).

Results and Discussion

Originally, 10 mounds were scheduled for treatment with each formulation. However, due to the shortage of bifenthrin ME (SPG95-02), only five mounds were treated within each plot. The remaining mounds were marked and not further considered for monitoring and analysis.

All treatments significantly reduced the number of active red imported fire ant mounds per treatment plot (**Table 1**). Gamma-Mean® injection produced a slower response than was achieved with other treatments. Statistically, Dursban and Gamma-Mean treatments performed the same from 7 to 49 days following treatment. All bifenthrin treatments performed similarly and produced the most dramatic suppression of mound activity. No differences in new or "satellite" (Sat.) mounds occurred between chemical treatments. Of notable interest in this trial was the effect of the water injection in causing colonies to move. Plots receiving this treatment were found to have significantly fewer active treated mounds following treatment, but the total number of mounds per plot remained similar to the water drench treated plots until seven weeks after application.

Table 1. Mean number of active red imported fire ant mounds following individual mound treatments, Brazos Co., Texas, treated16 Nov., 1995.

	Mean number* of active mounds* (*of 10 or 5)/plot			
TREATMENT	4-days	11-days	15-days	49 days
Dursban® 2E	0.00 d	0.25 c	0.25 cd	0.25 c
Gamma-Mean® L.O.	2.25 c	1.00 c	2.00 c	1.00 c
Talstar® T&O	0.25 cd	0.00 c	0.00 d	0.00 d
Biflex® EC (-03)	0.00 d	0.00 c	0.00 d	0.00 d
bifenthrin EC (-01)	0.00 d	0.00 c	0.00 d	0.00 d
bifenthrin ME (-02) High	0.00 d	0.00 c	0.00 d	0.00 d
bifenthrin ME (-02) Med	0.00 d	0.00 c	0.00 d	0.00 d
bifenthrin ME (-02) Low	0.00 d	0.00 c	0.00 d	0.00 d
water drench	9.00 a	8.25 a	9.00 a	7.50 a
water inject	6.50 b	3.25 b	5.25 b	4.00 b
F-value	41.73	55.43	51.92	54.26
P	0.0001	0.0001	0.0001	0.0001
MSE	0.7815	0.3843	0.5556	0.3509
MSD	2.1501	1.5077	1.8129	1.4408
critical value =4.864				
df = 27				

	Mean number* of active mounds/plot			
	--------------4 Days-----------		------------49 days-------------	
	Sat. only	Tot. active	Sat. only	Tot. active
Dursban® 2E	4.50 a	4.50 c	2.00 a	2.00 bc
Gamman-Mean® Inject	4.00 a	6.25 bc	0.75 a	1.75 bc
Talstar® T&O	3.50 a	3.50 c	1.75 a	1.75 bc
Biflex® EC (-03)	3.00 a	3.00 c	1.75 a	1.75 bc
bifenthrin EC (-01)	4.25 a	4.25 c	0.75 a	0.75 c
bifenthrin ME (-02) High	3.75 a	3.75 c	1.25 a	1.25 bc
bifenthrin ME (-02) Med	2.50 a	2.50 c	1.50 a	1.50 bc
bifenthrin ME (-02) Low	5.25 a	5.25 c	3.25 a	3.25 bc
water drench	5.25 a	14.25 ab	1.75 a	9.25 a
water inject	8.25 a	14.75 a	1.00 a	5.00 b
F-value	0.94	5.66	1.27	8.19
P	0.5200	0.0001	0.2918	0.0001
MSE	8.8102	10.9815	1.9843	2.4731
MSD	7.2193	8.06	3.4261	3.825
critical value = 4.864				
df = 27				

* Means in columns followed by the same letter are not significantly different using Analysis of Variance (ANOVA) and means were separated using Tukey's Studentized Range Test ($P \leq 0.05$).

EVALUATION OF D-LIMONINE AS AN INDIVIDUAL RED IMPORTED FIRE ANT MOUND TREATMENT

Charles L. Barr, Extension Associate and
Bastiaan M. Drees, Associate Professor and Extension Specialist

D-limonine, a terpene extracted from citrus peel oils, is known to have insecticidal properties causing spontaneous activity of sensory and motor nerves, resulting in twitching, lack of coordination, convulsions and knockdown paralysis of target insect pests. Several insecticide products containing D-limonine are currently registered by the Environmental Protection Agency for control of insects such as fleas. However, none is currently registered for control of red imported fire ants. This trial was conducted to determine if a D-limonine formulation developed by the Environmental Pesticides Group is effective when applied as an individual fire ant mound drench.

Materials and Methods

On August 4, 1992 a 40-foot wide strip was marked on the earthen dam impounding Lake Somerville, Burleson County, Texas. The area within the strip was carefully surveyed and each active mound marked with a surveying flag. A plot marker flag was placed after locating 10 active mounds. Therefore, each plot was of an equal width (40 feet) and contained 10 mounds, but varied in length. This design allowed for similar re-infestation pressure on all plots. The plots were then divided into 3 blocks (replications) of 6 plots each and treatments were then randomly assigned within the blocks. Mound density was approximately 380 mounds per acre. Mound activity was determined by lightly disturbing the mound with a pointed wooden tool handle. A mound was considered active if ants came to the surface in some numbers within 15 seconds of disturbance.

On August 5, 1992, the treatments were applied beginning at 9:00 a.m. and ending at 4:00 p.m. The material was mixed in a large drum then dispensed into 2-gallon garden sprinkler cans. The breaker nozzle was removed from the end of the can spout to give a solid stream that penetrated the mound structure better. The method of application was similar for all plots. The following treatments were applied:

1) 5% D-limonine + 2% Mazclean; 1.5 gallons per mound
2) 4% D-limonine + 1% Mazclean; 1.5 gallons per mound
3) 3% D-limonine + 1% Mazclean; 1.5 gallons per mound
4) Emulsifier only: 4% Mazclean; 1.5 gallons per mound
5) Standard treatment: 2 teaspoons Orthene®/gallon water; 1 gallon per mound
6) Untreated control: 1.5 gallons water per mound

Post-treatment evaluations were made beginning at 9:00 a.m. on 6, 7 and 12 August, and 11 September (1, 2, 7 and 37 days post-treatment, respectively). The 7 day evaluation of the treated mounds was accompanied by a survey of the entire plot area to locate any satellite mounds or re-infestation from outside the plot. Also noted was the number of application sites showing phytotoxicity and the relative severity of the damage. Damage was rated on a scale of 1 to 3, with 1 being yellowing of the leaves and 3 being considerable browning and necrosis. Results were analyzed using Analysis of Variance (ANOVA) and Least Significant Difference (LSD) test ($P \leq 0.05$).

Results and Discussion

Due to varying temperature, moisture, sunlight, and the application of the large volumes of water to the mounds themselves, ant activity in mounds varied greatly. The activity of the treated mounds had to be compared to those that served as untreated controls. Generally, a mound was considered "active" if, upon disturbance, enough ants rose to the surface within 15-30 seconds to create what is considered to be a functional, nuisance mound. Rarely was 100% kill encountered in any of the six treatments, nor were some of those mounds rated as active as vigorous and healthy as they had been prior to treatment.

One day after application, the 5% D-limonine treatment had produced numerically the best control, while all active ingredient treatments produced significantly different reductions of treated active ant mounds compared to the Mazclean and water drench treatments (Table 1). By 2 days after application, the number of active mounds increased in all the D-limonine plots, although these treatments performed statistically the same. Orthene® Fire Ant Killer performed best, numerically, but statistically the same as 5% D-limonine. Mazclean, the emulsifier for the D-limonine solutions, showed a significant level of active ant mound suppression over the water-drenched plots. By the 7-day evaluation, the most noticeable change was the unexpected reduction in activity of the Mazclean-treated plots, similar to active mound suppression resulting from D-limonine treatments. Other treatments remained both statistically and numerically similar to 2 day post treatment results. The re-infestation survey showed considerable new mound formation in some plots, although there was no statistically significant difference between them. This data indicates that treatments did not cause mound movement that would have resulted in the appearance of "new" (satellite) mounds, or that ant colonies migrating into treated plots from adjacent areas.

Results of the phytotoxicity survey provides some reason for concern. Of the 90 mounds treated with the D-limonine formulations, 80% of them showed some phytotoxicity to the surrounding vegetation:

Treatment	Mean no. affected mounds/Average rating
D-limonine 5% + 2% Mazclean/1.5 gal.	9.33 / 2.43
D-limonine 4% + 1% Mazclean/1.5 gal.	8.67 / 1.35
D-limonine 3% + 1% Mazclean/1.5 gal.	6.00 / 1.61
Emulsifier only: Mazclean 4%/1.5 gal.	0.67 / 1.00
standard treatment: Orthene® 2 tsp./gal.	0.00 / 0.00
untreated control: 1.5 gal. water	0.00 / 0.00

The severity of the damage varied with the formulation, the 5% D-limonine treatment being considerably worse, having an average of 2.43 on a 3-point scale and causing considerable yellowing with some browning and death of foliage. The primary vegetation at this site is bahia grass, a rugged "invader" used for hay and erosion control, as well as numerous other native species. It is unlikely that this level of damage would be considered acceptable on ornamental turf.

Table 1. Mean number of ten active red imported fire ant mounds following individual mound drenches with D-limonine, Burleson Co., Texas, treated 5 August 1992.

	Mean no. of active fire ant mounds/10 per treatment*			
Treatment and rate	1 day	2 days	7 days	37 days
D-limonine 5% + 2% Mazclean/1.5 gal.	1.3 a	2.0 cde	0.7 c	0.7 b
D-limonine 4% + 1% Mazclean/1.5 gal.	2.7 a	3.3 cd	3.3 b	0.7 b
D-limonine 3% + 1% Mazclean/1.5 gal.	3.3 a	3.7 bc	2.7 bc	0.7 b
Emulsifier only Mazclean 4%/1.5 gal.	9.0 b	6.0 b	1.7 bc	2.0 b
standard treatment Orthene® 2 tsp./gal.	2.7 a	0.3 e	0.7 c	1.0 b
untreated control 1.5 gal. water	9.7 b	9.3 a	8.0 a.	9.0 a
F-ratio	18.254	16.287	17.410	15.619
P	0.0001	0.0002	0.0001	0.0002

* Means in columns followed by the same letter are not significantly different using Analysis of Variance (ANOVA) and Least Significant Difference (LSD) test ($P \leq 0.05$).

EVALUATION OF ACROLEIN AS AN INDIVIDUAL RED IMPORTED FIRE ANT MOUND TREATMENT

Charles L. Barr, Extension Associate and
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Acrolein (92%, a three carbon aldehyde that breaks down sulfuryl molecules) is currently marketed as Magnacide® H Herbicide by Baker Performance Chemicals, Incorporated (3920 Essex Lane, Houston, Texas 77027). It is a highly toxic (signal word DANGER), Restricted Use, liquid under pressure used in the control of submersed and floating weeds and algae in irrigation canals. Acrolein is also marketed as a rodenticide. The product cost is estimated at $0.15 per 20 mls. It is highly volatile and water soluble and upon release, produces a toxic fumigating vapor.

With the impending loss of methyl bromide (currently registered for control of red imported fire ants and the Texas leaf cutting ant) in the year 2000, Baker Performance Chemicals, Inc. is investigating the possibility of acrolein as a replacement. Soil injected pesticides are exempt from food tolerances that pertain to pesticides applied above ground.

Materials and Methods

Acrolein was applied under the supervision of and using tractor mounted special equipment supplied by the manufacturer. Acrolein was propelled using nitrogen gas and the dose was metered using a timer activated by a trigger on the injector rod. The acrolein injector rod had lateral openings on the injector tip and all treatments were applied inside of the mound below the soil line.

Trial 1. Rate response. Six treatments were evaluated to reduce the number of red imported fire ant mounds in treated areas. Treatments included:

1) untreated control
2) 16 mls. applied with a single insertion into a mound
3) 32 mls. applied with a double insertion into a mound
4) 48 mls. applied with a triple insertion into a mound
5) 25 mls. applied with a single insertion into a mound
6) 75 mls. applied with a triple insertion into a mound

Three replicated plots of equal width and variable length, containing ten (10) red imported fire ant mounds with diameters for 8 or more inches were established for each treatment (30 mounds treated per treatment). Treatment were assigned to the three blocks in the order listed above. Each mound was marked with a plot flag and received one of the six treatments. Prior to treatment, mounds were selected by size and ant activity. Time required to treat each plot was recorded.

Time required to treat each 10 mound set within a plot are listed below. Nozzle problems occurred in block 2 (second replicate) which caused some time delay. Each block was treated by a different individual. Treatments were applied between 9:54 am and 1:20 pm. Temperature ranged from 66 to 67.9○F, and relative humidity was 38 to 36.9 percent. Soil temperature was not recorded. Plots had been mowed 23 March, 5 days prior to plot establishment and treatment.

<u>Treatment</u>	<u>Treatment time</u>
1) untreated control	---
2) 16 mls. applied with a single insertion into a mound	1:30, 2:10, 1:20
3) 32 mls. applied with a double insertion into a mound	1:48, 3:20, 2:49
4) 48 mls. applied with a triple insertion into a mound	2:24, 6:05, 4:40
5) 25 mls. applied with a single insertion into a mound	1:35, 2:06, 2:36
6) 75 mls. applied with a triple insertion into a mound	3:45; 4:30, 4:47

Periodically (0, 2 and 10 days; on 28, 30 March and 7 April), mound activity was monitored. Following treatment, ant activity in monitored mounds was rated on a 0 to 5 scale, with 0 being "no activity" and 5 being highly active mounds. In addition, mounds in one set (replicate) of plots were opened using a shovel and presence of brood was noted. The presence of "satellite" mounds, defined as small freshly-produced ant mounds within a foot of the treated mound, were noted.

<u>Trial 2</u>. Based on the results of the rate test in the spring of 1995, two additional trials of acrolein were conducted to determine efficacy versus standard chemicals. The first site was a roadside in Burleson County, Texas near the Brazos River. Soil was a friable, deep, silty bottomland soil that, at the time of testing, was moist. A strip, 30 feet wide and indeterminate length was mowed with the grass clippings blown off the mowed area to aid mound location. Groups of 10 active mounds were marked using wire surveyor's flags. The length of each plot was then measured, the lengths arrayed from highest to lowest and blocked into groups of four. Treatments were then assigned randomly within each block. Treatments were as follows: 1) Untreated control; 2) Acrolein, 4 injections of 16 ml each; 3) acephate 75 percent dust (Orthene Turf, Tree and Ornamental Spray), 2 tsp. per mound; and 4) injectable chlorpyrifos (Whitmire PT270), multiple injections based on mound diameter.

<u>Trial 3</u>. The second site was located at the TAMU Riverside Campus approximately 200 yards from the Brazos River. Soil conditions were similar except the soil appeared to contain a greater percentage of clay than the other site. Site preparation and test layout were similar. Treatments were as follows: 1) Untreated control; 2) Acrolein, 4 injections of 16 ml each; and 3) Acrolein, 1 injection of 64 ml.

Treatments were made on 5 October 1995 before noon. Weather was clear, with a strong breeze, temperature between 75 and 80 degrees Fahrenheit. The acrolein was applied by Dave Blodgett of

Baker Performance Chemicals using specialized application equipment. Acrolein-treated mounds were stepped on after application to help seal in the material. Other chemicals were applied according to label directions. Any additional mounds that were spotted during the treatment process were flagged and treated, but not included in post-treatment evaluations.

Evaluations were conducted before and periodically after treatment by lightly disturbing the mound and surrounding area and observing any ant activity. A mound was considered active if 20 or more ants rose to the surface within 30 seconds of disturbance (time varied depending on temperature and sun exposure). Acrolein was observed to cause satellite mounding in the previous test. As a result, a mound was considered active if there was any mound building activity around the immediate perimeter of the original mound as well as the mound site itself.

Results and Discussion

Trial 1. After 48 hrs. of treatment, during which time heavy rains had occurred, the effects of treatments appeared to be dose related (**Table 1**). From the 48 hour post-treatment evaluation, treatments 5 and 6 provided 67 to 90 percent elimination of ant activity in treated mounds. Optimum treatment for minimum 8 inch diameter mounds appears to lie in between these treatments. It was observed that increasing number of mound insertions enhanced distribution and performance of the fumigant within the mound. Therefore, four insertions of 16 mls. dose (64 mls. acrolein @ $0.48/mound) appears to be a likely candidate for an optimum dose.

The 8 day post-treatment evaluation (7 April 1995) produced results similar to the 48 hour evaluation (**Table 1**). The grass on and around mounds that received the high treatment rate of acrolein was chlorotic and necrotic. Ant activity began to resume in treated soil, indicating that any residual effects of the treatment had dissipated. Mounds in block 1 that had been rated using the Mound Indexing Method 2 days after treatment were found to be largely inactive. It is likely that heavy rains that occurred between these two ratings filled the loosened soil and caused surviving ants in these mounds to move away.

Trial 2. This trail compared acrolein to two chemicals and an untreated control. Acephate was included as a standard since it is considered the cheapest ($0.13 - $0.30 per mound), most easily used, and one of the most effective individual mound treatments available. The drawbacks to acephate dust include a very bad smell and its toxicity. It was hoped that acrolein would compare favorably with acephate's cost per mound and effectiveness. The second "standard" treatment was PT270 injectable chlorpyrifos, chosen because of the similar application method and target market, pest control operators (PCO's). The drawbacks of this product are high cost, at least $1.00 per mound, and the long residual activity of chlorpyrifos.

All treatments significantly reduced the number of active red imported fire ant mounds within 24 hours after treatment and throughout the 4 week monitoring period (**Table 2**). However, acrolein injections, using four injections of 16 mls. each, did not provide as great a reduction in active mound numbers as did the acephate or chlorpyrifos standard treatments. New mounds occurring within treatment plots 4 weeks after treatment were not significantly different between treatments. Results indicate that acrolein provides significant control ($P < 0.05$) of fire ant mounds versus an untreated mounds over the one month duration of the test. Acrolein provided an average control level of around 50%. However, it is significantly less effective than both acephate and chlorpyrifos, >95% control for both products.

Trial 3. This trial was conducted to support the results of Trial 1, but with equipment that worked properly and in much warmer, sunnier weather. It was noted during Trial 2 that four insertions of the applicator wand seemed to take a long time - long enough to be undesirable to a PCO employee. Therefore, the same amount of acrolein was injected using four sites versus one site in an effort to reduce application time. Unlike results of Trial 2, however, the acrolein ant mound treatment using four injections of 16 mls. each did not significantly reduce numbers of active ant mounds except 1 week after treatment as compared to untreated control plot data (**Table 2**). The single injection of 64 mls. performed better. A possible explanation is that, in weather that was sunny, windy and about 20 degrees warmer, the single, large injection of acrolein evaporated and/or dissipated more slowly than multiple injections exposing more ants for a longer time.

As mentioned, acrolein was noted to form new, "satellite" mounds along the edges of treated mound sites. This phenomenon was noted so frequently in both Trials 2 and 3 that if a satellite mound overlapped the original mound site, the mound was considered active. While satellite mound formation is one concern, mound "shattering" is another. Shattering occurs when treatment causes an ant colony to not only move, but split into more than one smaller colony. After the one month mound evaluation, the treatment plots were surveyed for additional mounds. Neither test showed a significantly higher number of new mounds between any treatments or the control. Therefore, it appears that while acrolein can cause surviving members of a colony to relocate, it does not cause shattering.

The application of acrolein was considerably improved over that of the Trial 1 with the modification of the injector wand. We experienced no irritation and virtually no odor from the acrolein during treatments. However, it was a near certainty that some gas would be released during set-up and, particularly, take-down of the injector apparatus. Though not a major concern if adequate safety precautions are taken, it could still be unpleasant and, possibly, unsafe.

In Trials 2 & 3, there was no rain from three days before the treatment date until the final evaluation, when approximately 1.25 inches fell the night before. Consequently, soil conditions were dry for the one and two week evaluations. Also, temperatures ranged from the 40's to the lower 90's over the course of the test. These factors help explain why the number of active mounds in a few plots appear to fluctuate. Ant activity varies greatly with the weather and even the time of day. Mounds that are "borderline" in their activity may appear "active" when conditions are favorable for the ants to be near the top of the mound, but "inactive" when the weather is hot, dry, and/or sunny, keeping the ants deeper in the mound regardless of the amount of disturbance. Several acrolein-treated mounds fit this description. Therefore, treatments should be compared only on the same evaluation date, not across time.

Conclusions

1) Acrolein's effectiveness is, at best, about 70%, averaging about 50%. This is generally considered unacceptably low, particularly by the PCO industry when "call-backs" by clients are expensive to the operator.

2) Acrolein is highly toxic with a very real potential for worker injury. The product's toxicity and potential danger to the public would exclude its use from urban and suburban areas - the primary market for PCO's.

3) Acrolein's cost, though low to moderate on a per-mound basis, is still greater than that of an acephate dust treatment and it is not as effective. Since the product's toxicity limits its use to non-urban areas, it must then compete with bait products for use on large areas. Baits cost roughly $10-12 per acre including labor and provide greater than 90% control, regardless of the number of mounds.

4) Acrolein is a herbicide. Consequently, it kills any vegetation around a treatment site. This is aesthetically unacceptable in an ornamental turf situation and could potentially cause costly damage if it were used around shrubs, trees, or other ornamental plants.

5) The equipment used to apply acrolein is rather elaborate and expensive, requiring a vehicle of some type to transport and use. Acephate dust application requires a teaspoon and a pair of gloves. The injectable chlorpyrifos was easily carried by one person and most other individual mound treatments require only a bucket and a water source.

While acrolein appears to have found a superior niche in rodent control and as an aquatic herbicide, there are fire ant control products on the market that are more effective, cheaper, safer, and easier to use.

Table 1. Activity of acrolein injections on red imported fire ant mounds, Burleson Co., Texas 28 March 1995.

Treatment	and rate (mls.)	Cost	No. inactive mounds/30	Avg. rating	No. satellites
			---------------------- 48-hr. post treatment----------------------		
1	0	$0.00	0	4.10	0
2	16	$0.12	11	1.73	5
3	25	$0.19	11	1.69	8
4	32 (16x2)	$0.24	15	0.94	13
5	48 (16x3)	$0.36	20	0.90	8
6	75 (25x3)	$0.57	27	0.13	6
			---------------------- 8 days post treatment----------------------		
1	0	$0.00	0	4.00	2
2	16	$0.12	15	1.16	6
3	25	$0.19	20	0.83	9
4	32 (16x2)	$0.24	21	0.60	5
5	48 (16x3)	$0.36	19	0.93	6
6	75 (25x3)	$0.57	29	0.03	4

Table 2. Number of active red imported fire ant mounds before and after treatment with acrolein and standard insecticides., Burleson County, Texas, 1995.

Trial 1 Mean number of active fire ant mounds of 10*

						------------------4 wks--------------------				
Treatment	24 hrs	3 days	1 wk	2 wks		Mounds		"Saltellites"		Total
untreated control	10.0a	10.0a	9.5a	10.0a		8.75a		4.0a		12.75a
acrolein	4.8b	6.0b	4.0b	5.5b		3.25b		5.0a		8.25b
acephate	2.3c	0.0c	0.0c	0.0c		0.00c		2.8a		2.75c
chlorpyrifos	0.3c	0.3c	0.3c	0.5c		0.00c		4.0a		4.00c
F value 37.99	204.3	124.0	77.37		61.50		0.90		11.61	
Prob.	<0.01	<0.01	<0.01	<0.01		0.0001		0.5332		0.0009
MSE	0.951	0.229	0.333	0.528		0.5556		3.6736		3.6736
MSD	2.153	1.057	1.275	1.604		1.6453		4.231		4.231
df = 9										
crit. value = 4.415										

Trial 2

						------------------4 wks--------------------				
Treatment	24 hrs	3 days	1 wk	2 wks		Mounds		"Satellites"		Total
untreated check 10.0a	10.0a	8.8a	8.5a		8.75a		3.00a		11.75a	
acrolein										
4 x 16 mls.	8.5ab	7.0a	4.3b	3.5ab		6.25ab 2.25a			8.50a	
1 X 64 mls.	6.0b	2.8b	1.3c	3.5b		4.00b		4.00a		8.00a
F value 2.89	8.03	16.00	7.54		7.13		2.36		3.15	
Prob.	0.115	0.012	0.002	0.014		0.0166		0.1625		0.0977
MSE	2.333	2.750	1.444	1.778		4.3390		3.0833		5.4722
MSD	3.314	3.598	2.607	2.893		2.5311		3.8095		5.0751
df = 6										
crit. value = 4.339										

* Means followed in columns by the same letters are not significantly different using analysis of variance (ANOVA) and Tukey's Studentized Range Test ($P \leq 0.05$).

EVALUATION OF AN ALIPHATIC PETROLEUM HYDROCARBON, WORKS WELL, AS AN INDIVIDUAL RED IMPORTED FIRE ANT MOUND TREATMENT

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Works Well, a product consisting largely of short-chain, aliphatic petroleum hydrocarbons (APH), was evaluated as a potential liquid fumigant treatment for individual mounds of the red imported fire ant, *Solenopsis invicta* Buren. Historically, 1,1,1 trichloroethane, sold as MC-96, was available as a quick kill liquid fumigant product. However, this pesticide was discontinued due to the ozone depletion properties of the active ingredient. Few products remain that can provide a quick knockdown of ant activity in treated colonies.

Materials and Methods

The trial was initiated, 6 February 1995 behind the earthen dam of Somerville Lake, Burleson County, Texas. The area is controlled by the U.S. Army Corps of Engineers and access is limited to authorized personnel. The soil is well drained sandy clay with covering vegetation of native bunch grasses and, at the time of treatment, patches of clover. The area was mowed the previous fall, but there was little regrowth of grasses at test initiation. Three treatments were evaluated: 1) Untreated control; 2) Works Well (APH) at a rate of 4 fl. oz. per mound (2 oz. in a punched hole, 2 oz. sprinkled on mound; 4 oz. or 114 ml., total); and 3) Orthene® Fire Ant Killer (75% acephate) at a rate of 2 tsp. per mound, was applied on top of each mound.

A strip, 30 feet wide and indeterminate length was marked with surveyor's flags. Beginning at one end of the strip, the ground was surveyed and all active fire ant mounds marked with a surveyor's flag until 10 were marked. This process was repeated using alternating colors of flags until 12 sets of 10 mounds were marked. Each set of 10 mounds was considered a plot. Numbered flags (1-12) were placed at the plot edges and the lengths of the plots recorded. The plot lengths were ordered from longest to shortest and grouped into 4 sets of 3 plots each. Treatments were randomly assigned to specific plots within sets by drawing slips of paper from a container.

Works Well was measured into a graduated cylinder. Using a piece of aluminum tubing provided by the manufacturer, a hole was punched into the center of each mound until firm resistance was met. Approximately half the Works Well was poured down the hole, with the remainder sprinkled across the mound surface. This procedure was used on 3 of the 4 plots. No hole was punched in the 10 mounds of the remaining plot as the procedure was rather awkward and appeared unnecessary given the rapid absorption of the product into the soil.

Evaluations were conducted before and periodically after treatment (0, 48 hrs., 8, 15, 28, and 32 days; 6, 8, 14, 21 Feb., 6, 10 April, respectively) using the minimal disturbance technique. Mounds were lightly struck with a sharpened tool handle and if 15-20 ants came to the surface in a defensive reaction within 30 seconds, a mound was considered active. The plots were mowed immediately after the one month evaluation to aid in the spotting of satellite mounds. Five days were allowed between mowing and the final evaluation to allow for mound rebuilding. Since mound building can be considered a sign of a "healthy", active mound, the marked mounds were evaluated for this characteristic as well as ant activity when the plots were surveyed for satellite mounds. Results were analyzed using PC SAS analysis of variance (ANOVA) procedure and means were separated using Tukey's Studentized Range Test ($P \leq 0.05$). Since Works Well is still in the developmental stages of product development and E.P.A. registration, notes and observations were made regarding aspects of product use.

Results and Discussion

The four plots containing the 40 mounds treated with Works Well occupied an area of 4185 sq. ft. (0.096 acre) or an average of 417 mounds/acre (Range: 264 - 691 mounds/acre). The total amount of material applied was 160 oz., the equivalent of 13.0 gallons/acre. (Range: 8.25 - 21.6 gallons/acre). The 4 plots containing the 40 Orthene-treated mounds occupied an area of 4,020 sq. ft. (0.092 acre) or an average of 435 mounds per acre (Range: 309 - 807 mounds/acre). The total amount of material applied was 0.313 lbs., the equivalent of 3.40 lbs./acre (Range: 2.41 - 6.30 lbs./acre).

Works Well provided a significant reduction ($P \leq 0.05$) in active mound numbers versus untreated control plots throughout the trial (**Table 1**). Works Well provided significantly quicker elimination of ant activity in treated mounds than did Orthene® Fire Ant Killer within 48 hours of application, but performed similarly 8 days and 1 month after treatment. Curiously, Works Well-treated mounds had significantly more ant activity than did Orthene treated mounds 15 days after treatment. It should be noted that Works Well-treated mounds determined to be "active" were observed to have sustained substantial levels of ant mortality. Large numbers of worker ants were placed in "bone piles" by surviving members of the colony. However, a sufficient number of ants remained so that the level of activity met the "active" criteria.

Numbers of new mounds occurring within treatment plots, referred to as "satellite" mounds, were not significantly different between treatments, although Works Well treated plots harbored numerically fewer (**Table 2**). Both Works Well and Orthene had significantly fewer total active ant mounds (treated + satellite) per plot than the untreated control. Ant activity, as judged by mound building, was significantly suppressed by both Works Well and Orthene versus the untreated mounds. Orthene treated plots, however, had numerically less ant activity, having no mound building on any treated mound.

Treatment times differed for the two products evaluated. Orthene® Fire Ant Killer was applied to 40 previously marked fire ant mounds in 9 minutes, or 13.5 seconds per mound. Conversely, 23 minutes were required to treat 30 mounds with Works Well, or 46 seconds per mound. Most of this time was spent squeezing the chemical out of the plastic bottle provided. It was also inconvenient and time consuming trying to manage three objects (chemical container, graduated cylinder, and rod) while applying Works Well to mounds in these field plots. The petroleum distillate seemed to penetrate the mound structure quite easily with virtually no soil disturbance. Therefore, the decision was made not to punch the hole in the top of each treated mound in the fourth replicate plot (Plot 12), which was treated by slowly pouring approximately half the volume (2 fl. oz.) on one spot on top of the mound and sprinkling the rest across the mound surface as before. This procedure required 6 minutes to treat 10 mounds, or 36 seconds per mound. A savings of 10 seconds per mound. Again, the bulk of this time was spent squeezing the chemical out of the containers.

Two containers were provided by the Works Well developer. The half-gallon plastic bottle was easy to hold and ejected 3 streams of fluid, making it much faster to fill the measuring container (10-15 seconds per fill). The plastic was flexible which allowed better "pumping". However, this container was unstable in the field when placed on irregular vegetation. This was unhandy when using the rod method of application, but was not a factor when holding only two objects. Also, the 3-stream spout would make it difficult to concentrate the chemical on the mound center if not using a measuring container, but makes for faster coverage of a mound's surface. The half-gallon metal container was easy to hold and was very stable when placed on the ground. However, it's single-stream spout and relatively rigid construction made it prohibitively time-consuming to squeeze out the required amount of material (25-35 seconds per fill). Consequently, the plastic bottle was used for all treatments. It must also be noted that a half-gallon container will only treat 17 mounds at the rate used.

A few extra seconds of treatment time may seem irrelevant, but when multiplied by the number of mounds treated it can become substantial. For instance, at the minimum wage of $4.25 per hour, Orthene costs $1.59 per 100 mounds in labor. Works Well, using the "punch method" costs, $5.43 per 100, but only $4.24 per 100 using the "pour method". By comparison though, one-gallon mound drenches cost about $17.00 per 100, not including the time and logistics involved in getting 100 gallons of water to the treatment site. All these times are based on treating mounds that have been previously located and flagged. In contrast, Orthene® Fire Ant Killer, applied as a dust, is extremely easy to use and requires only a teaspoon and protective gloves to apply. The time involved in accurately measuring out the material is inconsequential. Orthene is also very inexpensive. Using the purchase price for material used in this test and a rate of 2 tsp. per mound, it costs about $0.30 per mound ($0.28 + $0.016). This product can also be applied at a rate of 1 tsp. per mound for smaller mounds. Orthene® dust products are some of the least expensive, easiest to use, and most efficacious currently available individual mound treatments, although broadcast bait products are even less expensive on a per acre basis in areas with many ant mounds and eliminate ant activity more slowly. Therefore, in order for Works Well to be cost competitive with Orthene® dust products, it would need to be priced at about $0.26 per mound in material cost using the $0.04/mound in labor (pour method). At a treatment rate of 4 fl. oz. per mound, the cost would be $8.32 per gallon.

The "percent control" attained by Works Well ranged from 60 to 78 percent and most of the colonies considered active were markedly reduced in ant numbers. Complete coverage of the mound surface was necessary for complete elimination of ant activity. Four ounces was excessive for a mound 6 inches in diameter and not sufficient for mounds exceeding 10 inches in diameter. Apparently, fumigant properties alone are not sufficient to eliminate ant activity in treated mounds. We suspect that product performance will vary under different environmental conditions and soil types. In this trial, weather conditions were ideal for control at the time of treatment. The weather was warm, but not hot, and sunny and the soil was moist. Conditions such as these bring the majority of a colony's ants to just under the surface of the mound along with the queen and brood. Heat causes ants, particularly the queen and brood, to avoid the mound surface, reducing the likelihood of exposure to liquid Works Well. The stated boiling point of Works Well is 95EF. Air temperature in Texas often reaches that level and soil temperatures reach well over 100 degrees for much of the day during the summer. A significant portion of the material would very likely "flash" upon contact with the mound surface and the remainder could evaporate very quickly.

One of Works Well's strengths, as stated, is its potentially low cost. The increased material volume per mound that would be needed under these circumstances would rapidly increase the cost to the consumer. Repeat applications may overcome the problem of incomplete elimination of ant activity in treated mounds, but it would also increase the cost. The top complaints about fire ant control products are their high cost and that they "just move the mounds over". Works Well could suffer the same fate if frequent repeat applications should be required. Finally, even though Works Well is highly volatile (or at least the majority of its components are), it is a petroleum distillate. Products of this type frequently raise environmental safety questions, and concerns over soil and groundwater pollution will need to be addressed by the developer.

Table 1. Red imported fire ant mound activity reduction following individual mound treatments (6 February 1995) using Works Well (alipahtic petroleum hydrocarbon, 4 oz./mound) and Orthene® Fire Ant Killer (acephate 75%SP, 2 tsp./mound), Burleson Co., Texas.

	Mean no. active mounds/10*			
Treatment	48 hours	8 days	15 days	1 month
Untreated control	10.00 a.	10.00 a.	10.00 a..	10.00 a.
Works Well	2.25 .b	3.00 b.	4.00 .b.	2.50 .b
Orthene® Fire Ant Killer	8.75 a.	2.50 b.	0.25 ..c	0.00 .b
F	28.38	9.44	24.91	30.60
P.	0.0004	0.0082	0.0006	0.0003
MSE	1.0278	3.0000	1.5833	1.4444
Min. sig. dif.	2.1996	3.758	2.7301	2.6076
Critical value	4.339	4.339	4.339	4.339
d.f.	6	6	6	6

* Means followed by different letters are significantly different using the PC SAS ANOVA procedure and Tukey's Studentized Range Test ($P \leq 0.05$).

Table 2. Red imported fire ant mounds in plots 32 days following individual mound treatments (6 February 1995) to ten mounds per plot using Works Well (aliphatic petroleum hydrocarbon, 4 oz./mound) and Orthene® Fire Ant Killer (acephate 75%SP, 2 tsp./mound), Burleson Co., Texas.

	Total active ant mounds/4 replicated plots*			
Treatment	No. active treated mounds	"Satellite" mounds	Total no. mounds	No. with active "mound building"
Untreated	40 a..	27 a	67 a.	34 a..
Works Well	18 .b.	16 a	34 .b	6 .b.
Orthene®	1 ..c	22 a	23 .b	0 .b
F	42.64	1.60	6.86	39.00
P	0.0001	0.2893	0.0181	0.0002
MSE	0.9167	14.4722	10.6389	0.8889
MSD	2.0773	8.254	7.0769	2.0456
Crit val.	4.339	4.339	4.339	4.339
d.f.	6	6	6	6

* Totals (active ant mound numbers from 4 replicated plots) followed by different letters are significantly different ($P \leq 0.05$) and means separated using PC SAS Tukey's Studentized Range Test.

EXCLUSION OF ANTS USING HOLES OF VARIOUS DIAMETERS

Bastiaan M. Drees, Professor and Extension Entomologist

In the design of ant bait stations or utility housings, knowledge of the minimum widths of cracks or holes that ants of different species can crawl through can be useful to make these objects "ant proof" or ant-selective. This trial was conducted to describe minimum hole sizes that will allow passage of worker ants of the red imported fire ant, *Solenopsis invicta* Buren, or the red harvester ant, *Pogonomyrmex badius* (Latreille).

Materials and Methods

Plastic vials (16 mm by 53 mm) with screw-on plastic caps were used for this trial. Seven or more holes were drilled into the caps, 0.6, 0.7, 0.8, 0.9, 1.6, 2.1, 2.3, 2.6, 2.8 and 3.3 mm in diameter. Ten or more worker ants, either the red imported fire and or the red harvester ant, were placed in vials on 11 March 1994. Vials were then placed in sealed jars. On 29 March, the head widths of ants which had escaped from the vials into the jars were measured.

Results and Discussion

Red imported fire ants were unable to escape from vials with 0.6 mm holes drilled into the caps. Head measurements of fire ant workers escaping from the vial with 0.7 mm holes were 0.5 to 0.6 mm wide (0.6, 0.6, 0.6, 0.5, 0.6, 0.5, 0.5, 0.5, 0.6, 0.5, 0.5).

Red harvester ants were unable to escape from vials with holes drilled into the caps that were 2.1 mm or less. Red harvester ant head widths of those escaping from vials with 2.3 mm holes drilled into the caps were 2.2 and 2.3. Ants remaining in the vials measured 2,2 to 2.4. All harvester ant escaped from the vial with 2.6 mm holes. Their head widths measured 2.1 to 2.5 mm (2.3, 2.1, 2.2, 2.5, 2.1, 2.0, 2.3, 2.3).

These results demonstrate that hole size into bait stations can be used to exclude certain larger ant species, preserving them from the potentially toxic effects of the ant bait. For instance, Amdro® Fire Ant Granules (hydramethylnon) is registered for the control of both the red harvester ant and the red imported fire ant. In areas where red harvester ants are desirable, such as in areas where these ants serve as the sole food source for the horned-toad lizard, ant-selective bait stations could make this product species-selective.

Results also demonstrate the difficulty in designing structures to exclude the red imported fire ant. These ants have been shown to have an affinity for electricity. In order to make housings of these or other utilities "fire ant proof", the design and construction must prevent holes or cracks that are 0.6 mm or more in width.

FIRE ANT-RELATED ECONOMIC LOSSES VERSUS OPERATION SIZE IN CATTLE PRODUCTION: RESULTS OF THE TEXAS CATTLE PRODUCER'S SURVEY

Charles Barr, Extension Associate and
Bastiaan M. Drees, Professor and Extension Entomologist

In 1994, the Texas Agricultural Extension Service with cooperation from the Texas and Southwestern Cattle Raiser's Association (TSCRA), mailed a detailed survey on fire ant-related economic losses to TSCRA members in 72 fire ant-infested counties. The impetus of the survey was to document these losses in order to develop Integrated Pest Management programs for the red imported fire ant. Survey results indicated that fire ant related losses were both widespread and costly, though with substantial variations, even between ranches in the same county. Because of these variations, it is imprudent to make a "one-size-fits-all" management plan. Rather, an operation-by-operation cost analysis is called for in which losses are balanced against treatment costs so that fire ant management can be justified economically.

Nevertheless, survey comments, among other sources, indicate that there is still widespread interest in large-scale fire ant treatment programs. In urban and suburban settings, there is rarely an economic component involved in making treatment decision, other than out-of-pocket costs. In agricultural situations, however, the cost of treating large areas must be balanced by the economic benefits of reducing fire ant damage. Consequently, the need exists for some way to estimate or predict losses without going through detailed cost analyses of every property involved.

Choosing a Predictor

To develop an accurate method of estimation, it is necessary to have an accurate independent variable, or predictor, on which to base the estimates. A ranch must have two things to be called a ranch - cattle and land on which to raise them. Though there are ant-related losses associated directly with cattle, the number of head varies on almost a weekly basis for many operations and is dependent on constantly fluctuating weather and economic factors. Acreage, however, has many advantages for this purpose. Despite land sales, leases and changes in production status, the amount of land on which cattle and hay are raised is relatively constant. Most fire ant-related costs are at least indirectly associated with the amount of land in production. Acreage in agricultural production is publicly accessible information, whether in the form of county tax records or state and national census figures. Finally, acreage in production was provided by nearly all respondents to the Cattle Producer's Survey from which the economic information was extracted.

Frequency of Fire Ant Damage

There are two components to predicting fire ant-related losses - frequency and the loss per-respondent amount. This report will deal primarily with loss amount since it is a much more complicated subject. However, any loss on a per operation basis **must** be tempered by the fact that not every operation suffers every type of loss. In fact, most operations suffer just a few types of loss on a regular basis.

Of the 4,521 surveys mailed to TSCRA members, 1,540 were returned, or 34%. Of these, 1,090 (70.8%) included some dollar figure for economic loss due to fire ants. Perhaps more importantly, this means that nearly 30% of respondents within the fire ant-infested portion of the state reported no fire ant damage. It was necessary to group the detailed areas of loss into categories for meaningful analysis in this report. Surprisingly, only 309 respondents (28.3% of those reporting losses) reported a loss in every broad category. Further examination revealed that only *65 respondents* (5.9%) reported a loss in every area of the survey excluding personal injury, losses to other animals, and hunting. Losses in hay production were not included in this figure since they were analyzed separately.

It is important to note that all dollar figures reported here are on a per respondent basis *only for those responding in each category*. "Zero" responses are not included since it is inappropriate to predict losses where losses do not occur.

Analysis Method Development

With 1,090 surveys to analyze, the total number of economic responses in the included categories came to almost 13,000. Therefore, it was necessary to examine these data in both graph form and through the use of statistics in order to comprehend them. This brought about its own set of problems. Reported acreage ranged from 1 to 70,000 acres and loss values ranged from $10 to nearly $70,000 per year. To further complicate matters, response numbers were heavily weighted towards the lower end of the acreage range. Over one-third of respondents had operations of less than 300 acres with over two-thirds less than 1,000 acres. This meant that graphs over the entire range of values crowded the great majority of responses into one little corner, obscuring important details.

To help resolve this situation, the data set was narrowed using the following criteria. To be included in this analysis a survey must have: included a dollar value in one of the chosen categories, included a positive acreage figure, and fallen within two standard deviations of the mean for total losses and acreage. Despite this seemingly stringent set of conditions, 957 respondents were included in the data set with acreages ranging up to 11,000 and losses to about $7,300 annually.

Figure 1 shows a scatterplot of the data for total losses vs acreage with a line drawn for a simple linear regression. Note that the regression line is highly significant with almost no probability of it being the result of chance. Also notice that with an R^2 of 0.02 it is a very, very poor fit, meaning that it does a poor job of describing the data. Since the whole object of this analysis is predictive, accurately describing the data is paramount. After many attempts at various regression analysis methods, it was found that a moving average, the second line in Figure 1, gave the best and most easily understood representation of the data.

A moving average is simply taking a point and averaging the values of a set number of points on either side of it, a "window", then plotting that value against the original point. The "window" then moves to the next data point and the process is repeated. The advantage of a moving average is that it smooths out "noisy" data by diluting unusually high and low values with more common values closer to the mean. It is also a simple mathematical procedure that is easy to understand compared to regression methods. Its main disadvantage is that it inherently "lowers the peaks and raises the valleys." Those peaks and valleys that remain also tend to shift slightly along the X-axis as the window width is adjusted. Therefore, actual values found from a graph of a moving average must be used with caution. What a moving average does is give a better graphical representation of the data.

Graphing Loss Categories

Figure 2 shows the major loss categories across the entire acreage range. Note that the lines are virtually flat after about 2,000 acres. This is due to relatively few respondents above that acreage and the wildly scattered degree of losses they suffered. **Figure 3** includes only those respondents with less than 2,000 acres of land. As mentioned earlier, the dollar amounts associated with the various categories are less important than the shape of the lines.

Pesticide use, the very bottom line, is almost flat across its entire length. Analysis of the individual pesticide use data explains this phenomenon. The majority of fire ant pesticides are used around the home. Whether a ranch is one acre or 1,000 acres, there is usually just one homesite and it only takes so much pesticide to treat that relatively small area.

Note how cattle injury and death rises at a steeper slope than the other lines. Since the number of cattle in an operation is perhaps most closely tied to the number of acres than any other category, its proportional rise is to be expected. The leveling out of the line as acreage increases is probably due to two factors. The first is that there are more large ranches in the western and southern parts of the state where there are fewer fire ant problems. The second is probably one of perceptions. A rancher with a few dozen cattle is more likely to notice fire ant-related losses than a rancher with several hundred. These losses are no more or less real, they are just more likely to be noticed and reported.

The next item of interest is the intriguing "bump" in the material and equipment damage total on the very low end of the acreage scale. **Figure 4** includes only these categories. Note that the range of values on the Y-axis is less than half that of Figures 2 and 3 so the line appears much more jagged despite the increase in size of the moving average "window" from 200 to 300 data points. At this resolution, the "bump" around 200 acres is readily apparent for both electrical damage and shredder damage. There is no such bump for hay and feed losses.

It was first thought that this might be a mathematical anomaly due to a few extreme damage reports and/or greatly varying numbers of respondents between the four categories. However, electrical damage was reported by 637 respondents (63%), the highest incidence of any category in the entire survey except pesticide use. Shredder damage was reported by only 304 respondents (27.9%), the lowest of the four categories. Ruined feed and hay had 359 and 416 responses respectively. Examination of the data also shows that most of the extreme responses were in feed and hay. Consequently, it can only be assumed that the "bump" is a real phenomenon. But why?

The answer lies in the nature of the ranches, and ranchers, of this size range. Two-hundred acres in any part of Texas is not a full-time ranch, particularly with today's cattle prices. Therefore, it can be safely assumed that the operators of these ranches must also have off-farm jobs or other sources of income. Under most circumstances, that 200 acres will, in fact, provide very little income - to the point that the ranch becomes a "weekend place" rather than a serious money making enterprise. However, it is large enough to require a significant amount of attention. This size operation has its own set of fire ant-related problems versus larger and smaller ranches.

This point can be illustrated by an all-too-real example. Suppose the owner arrives at his ranch for the weekend and finds that fire ants have hit him in all four of the categories shown in Figure 4. He removes the infested feed bags and hay bales from the storage shed, dumps them outside, and lets the ants have them - end of story. He has no desire to spend his weekend without water since the ants have shorted out his well switch, nor does he have the desire to mess with fixing it and get himself electrocuted. So, he calls an electrician and pays $50 an hour plus parts. While waiting for the electrician, he climbs on his tractor to shred an overgrown pasture. After a time, he hits the inevitable fire ant mound, strips a gearbox and bends a blade which tears the housing. Not having the time, equipment, desire, or, possibly, expertise to fix it himself, he loads the broken shredder onto a trailer and hauls it into town where he pays $40 an hour shop time plus parts and picks it up the next weekend. Someone who lived on his ranch and operated it as more of a business would have the tools, the welder, and the expertise, and would make time during the week to fix everything to avoid paying those labor costs that cut so deeply into the pocketbook.

Prediction Equations

As useful as the above mentioned graphs are for "seeing" what is going on, they still do not serve very well as a predictor. What is still needed is an equation, or equations, into which one can plug acreage and get an estimated dollar loss. After many attempts, the best way found to do this was by manually fitting linear regression lines across acreage ranges so that their endpoints matched as closely as possible. The result is shown in **Table 1** with **Figure 5** illustrating the equations graphically for comparison to the moving regression line. Due to the difficulty of fitting these lines, only the relationship between total losses and acreage was determined. Note that Figure 5 only goes up to 2,000 acres and that the line past 950 acres is not

Table 1. Loss prediction equations.

Acreage range	Equation
1 - 100	loss = $7.71(ac) + $337
100 - 950	loss = $0.84(ac) + $1,009
>950	loss = $0.02(ac) + $1,790[1]

[1] Not significant at $p<0.05$

statistically significant. This is due to relatively few responses and the high degree of loss variability among these respondents. A simple average calculated for these responses was almost identical to the regression line over this range.

An Area-wide Economic Treatment Justification Example

What the statistically significant linear regression equations provide is a way of estimating total losses for groups of ranches. This is best illustrated through a hypothetical example as shown in **Table 2**. The important thing to note is that the number of acres to be treated stays the same: 10,000. How these acres are divided is what makes the area-wide treatment program economically feasible or not. Clearly, Scenario 2 is the only practical one economically. Why the huge difference?

Table 2. Hypothetical area-wide treatment scenarios.

	Scenario 1	Scenario 2
Total Acreage	10,000	10,000
Average Ranch Size	500	80
Number of Ranches	20	125
Estimated loss/ranch/yr[1]	1,429	983.80
Cost per acre to treat	$10	$10
Total treatment cost	$100,000	$100,000
Total Losses/yr	$28,580	$122,975
Net Gain/Loss	-$71,420	+$22,975

[1] Calculated using regression equations.

As demonstrated earlier, most factors contributing to fire ant damage have little or no proportional relationship to acreage. The relationship is either non-proportional or incremental. For instance, almost every ranch needs at least one water well and its electrical equipment is susceptible to fire ant damage. In fact, a ranch may only need one water well up to a certain size. Beyond that, it may need two. The same holds true for electrical breaker boxes, feed barns, shredders, or anything else. The point is that every ranch needs at least one of these things and that "one thing" is susceptible to damage. Therefore, it is not so much the size of the ranch as it is the very existence of the ranch. The economic feasibility, indeed profit, in Scenario 2 comes from the fact that there are 125 ranches instead of 20 ranches on that 10,000 acres.

But what about the 20 ranchers in Scenario 1? Must they just live with over $1,400 in losses each year? No. Those items causing the most loss to virtually every rancher are located on very small amounts of land. It is quite likely that the owners of those 500-acre ranches are suffering almost all their losses on less than 100 acres. If they were each to treat only 100 acres, their total treatment costs would drop from $100,000 to $20,000, they would realize a profit of over $8,000 between them, and solve the majority of their problems.

Conclusions

● Individual ranchers are strongly encouraged to do their own cost/benefit analysis regarding fire ant losses before initiating any type of treatment program.

● The frequency of fire ant-related damage must be given equal weight to per-operation losses when making loss estimates for multiple ranches.

● All dollar amounts listed in this report must be treated as estimates. There is tremendous variability depending on numerous factors including geography, topography, weather, climate, and ranch management practices.

● Generally speaking, it is not feasible for ranchers with over 200 acres to treat their entire property.

● Any group or governmental organization planning a large-scale fire ant treatment program should look at the character of the agricultural industry in that area, not just total acreage to be treated, in order to economically justify treatment.

● Areas with high concentrations of small ranches, such as are found around many cities in Texas, are more likely to benefit economically from large-scale fire ant treatments.

Figure 1. Total economic loss versus acreage.

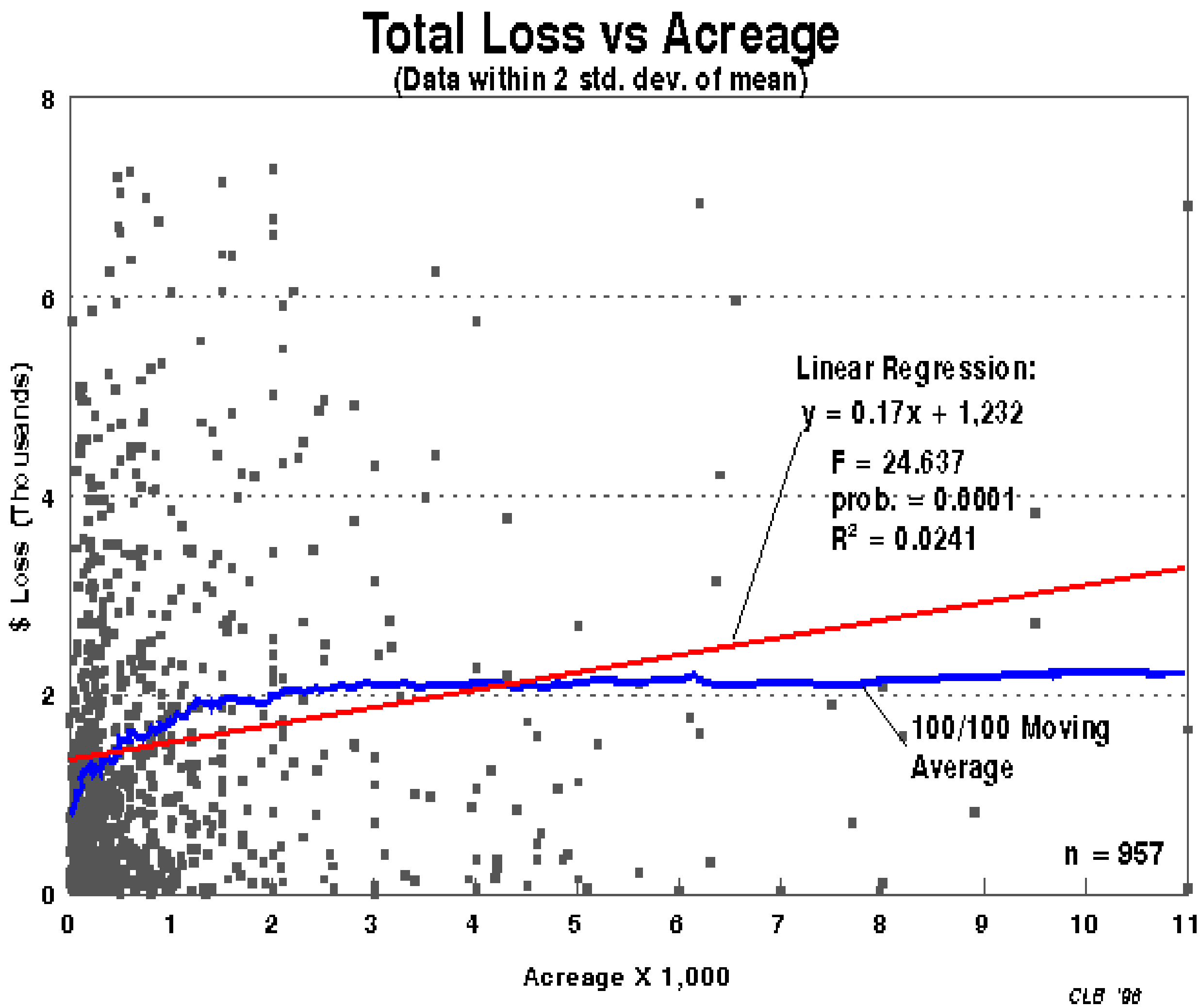

Figure 2. Moving average (100/100) for all loss categories and all acreages.

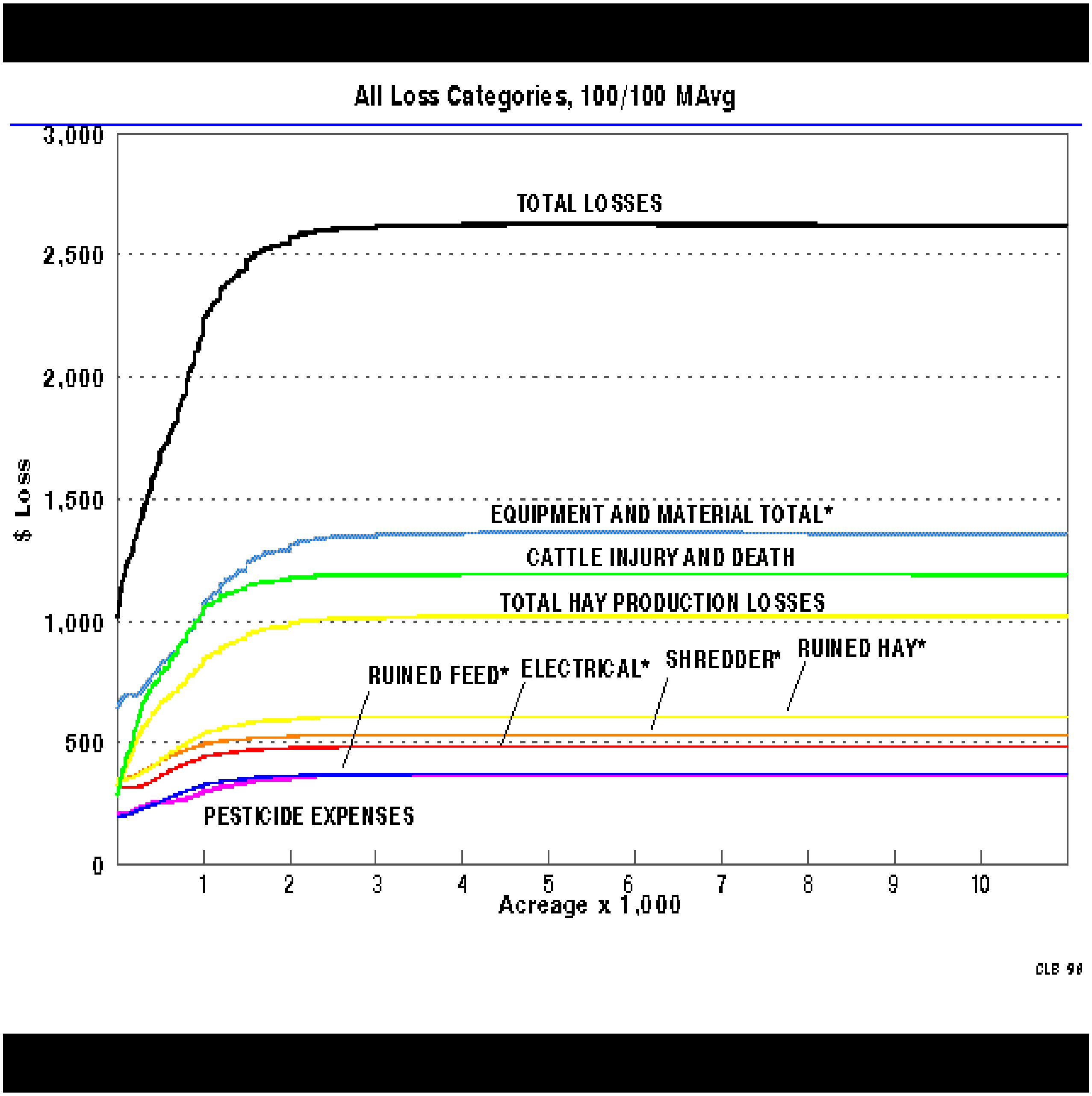

Figure 3. Moving average (100/100) for all loss categories, ≤ 2,000 acres.

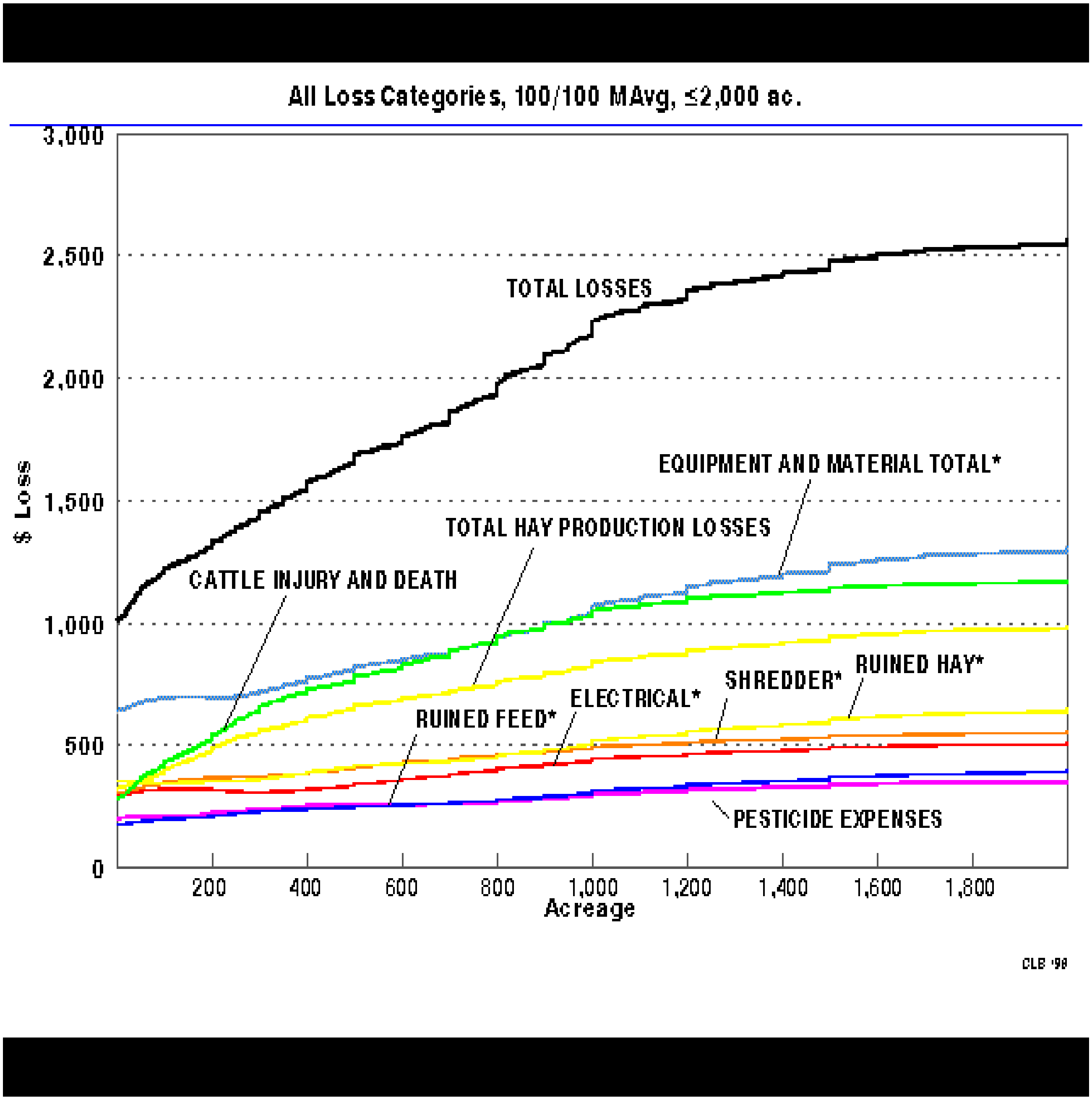

Figure 4. Material and equipment damage, 150/150 moving average, ≤ 2,000 acres.

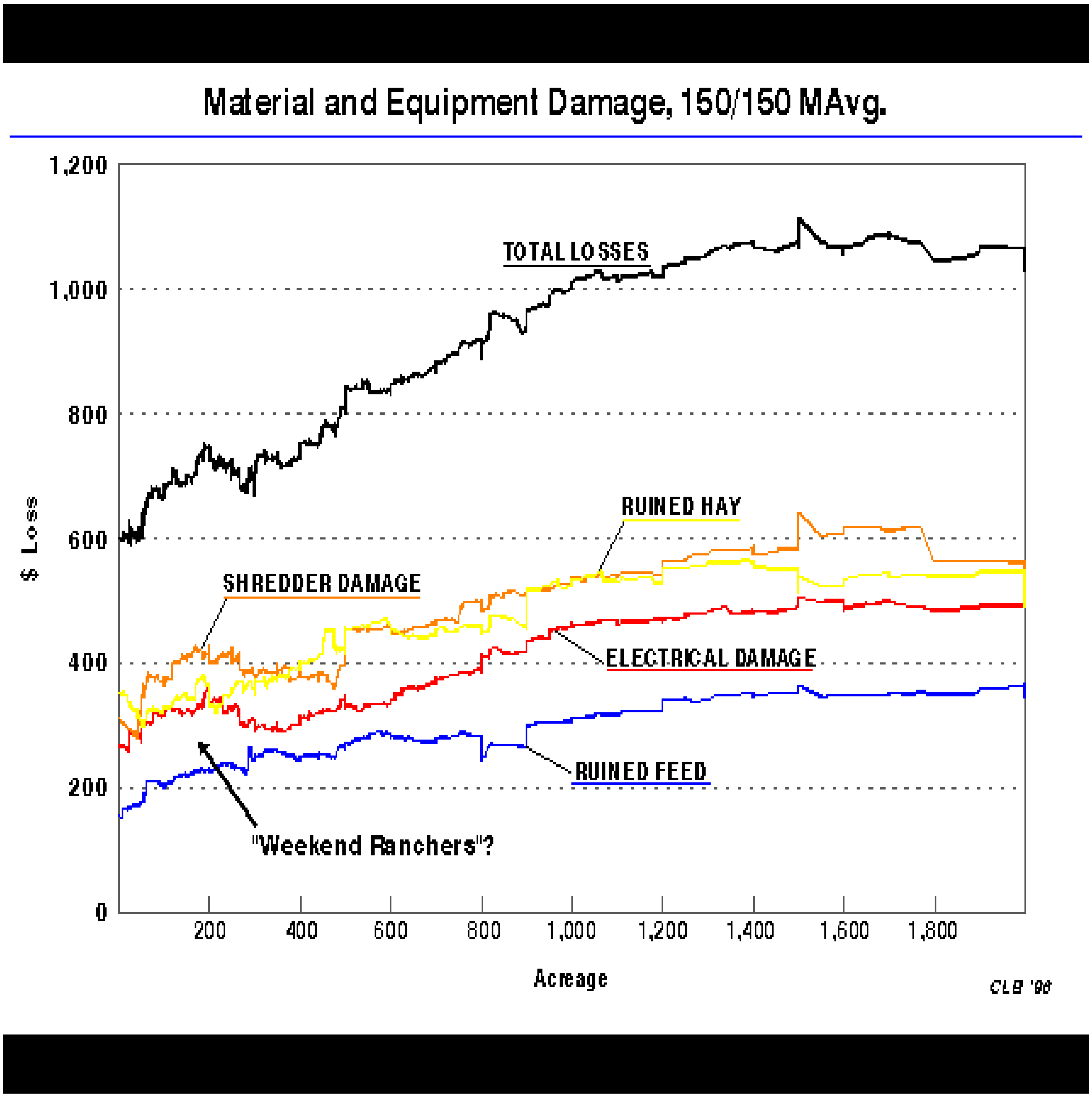

Figure 5. Prediction equations and confidence intervals, ≤ 2,000 acres