RED IMPORTED FIRE ANT MANAGEMENT
APPLIED RESEARCH/RESULT DEMONSTRATIONS
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RAPID LABORATORY EVALUATION OF SELECTED "HOME REMEDIES" FOR CONTROL OF THE RED IMPORTED FIRE ANT

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A tremendous number of "home remedies" have been developed by people to control the red imported fire ant (RIFA), Solenopsis invicta Buren. Many of these methods have attained almost mythical properties as stories of their effectiveness have spread. Some of the "remedies" are based on sound biological principles, while others are based on some apparent logic without a sound biological basis. Still other "remedies" are based on apparent perceived "control" where in actuality displacement (colony movement) has occurred. This demonstration was conducted to quickly screen a number of reported home remedies using laboratory colonies.

Materials and Methods

RIFA colonies were collected in soil from the field in 5 gallon buckets which had inner surfaces liberally dusted with talcum powder (the ants are unable to climb up talcum powder-dusted vertical surfaces). In the laboratory, ants were extracted by dripping water into the buckets very slowly, allowing the ants and brood (larval and pupal stages of ant development) to move up and finally float. They were moved into plastic sweater boxes which were coated on the inner surfaces with Floun® which acts in a similar manner as talcum powder. Large petri dishes were prepared with a Castone® (plaster-like) bottom and 4 holes (5mm diameter) melted into the tops and covered with a paper towel. These dishes were placed in the sweater boxes to serve as brood chambers and the queens, brood and nurse ants readily moved into these structures. Colonies were maintained on a standardized laboratory diet (daily meals of 2 mealworms, honey-water, distilled water and artificial diet made of hamburger meat and other substances).

The following is a list of compounds and their supposed, or in some cases, documented, method of action that were tested in this screening experiment:

Method	**Mode of Action**
Chalk	Apparently abrades and dehydrates
Diatomaceous earth	Abrades and dehydrates
Gypsum	Apparently abrades or clogs
Plaster of paris	Apparently abrades and clogs
Tide® detergent	Unknown; perhaps removes wax layer of exoskeleton resulting in dehydration
Grits	Supposedly eaten by ants where it imbides and "explodes"
Flour	Possibly similar to grits
Orange peels	Insecticidal action of limonene in peels

Colonies were treated by adding a large quantity of the treatment material in individual colony boxes. There was enough material of each type to basically cover the bottom of the colony boxes. The ants had to pass through it at some point to get to water and food. These tests were intended only as a screening process. Because of space limitations, no replications of treatments were included. Treated colonies were maintained for 6 weeks. The estimated number of ants and the presence of brood was documented weekly.

Results and Discussion

Results of this screen are presented in **Table 1.** Few treatments provided reduction of worker numbers or brood. Numerous dead ants were observed in association with some treatments (diatomaceous earth, flour) with no apparent affect on the colony as a whole. The plaster of Paris treated colony declined by the fifth week both in worker numbers and brood. By week 6 the colony had expired. Similarly, Tide® detergent caused colony death by week 6.

This method of evaluation has the advantage of rapidly determining if a given method produces ant mortality. In the field, ants in a treated mound often disappear, but determination of whether the ant elimination resulted from direct mortality or colony emigration is more difficult. Conversely, this technique does not provide data on repellent or irritant properties of substances tested because of colony confinement. In addition, this method allows for the evaluation of materials in the laboratory which may not be desirable when applied to the environment. Many petroleum products, acids and strongly alkaline materials are considered potential pollutants of soil and groundwater. Results of this screen do not constitute a recommendation for their use by the Texas Agricultural Extension Service or the Texas Agricultural Experiment Station.

Table 1. Colony status (+ = presence of brood, ++ = relatively more brood number = approximate number of ants X 1000) following treatment with various "home remedies" for control of the red imported fire ant (6 September through 16 October, 1989).

	WEEK					
Treatment	**1**	**2**	**3**	**4**	**5**	**6**
Untreated	++,15+	++,15	++,15+	++,15+	++,15	++,15
Chalk	++,15+	++,15+	++,15	++,15+	++,15	++,<15
Diatomaceous earth	++,20	++,20	++,20	++,20	++,20	++,20
Gypsum	++,30	++,30	++,25	+,25	+,25+	+,25+
Plaster of Paris	++,15	++,15	++,15	++,10	-,<1	dead
Tide® detergent	++,30	++,30	++,25	+,20	Queen Death	
Grits	++,20	++,20	++,20	++,20	++,20	++,<20
Flour	+,20	+,20	+,15	++,20	++,20	++,20
Orange peel slices	++,20+	++,20+	++,20	++,20	++,20	++,20

LABORATORY EVALUATION OF ANT BAIT STATIONS FOR CONTROL OF THE RED IMPORTED FIRE ANT

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Currently, there are no bait -formulated insecticide products specifically registered for control of indoor colonies of the red imported fire ant, Solenopsis invicta Buren. Other materials, such as arsenic-based baits, registered for control of ants, have not been found to be effective for eliminating the large (10,000 and or more) fire ant laboratory colonies. Three bait products currently on the market contain active ingredients found in outdoor ant baits (hydramethylnon in Combat® and Maxforce®) or that are being developed for outdoor use (sulfuramid in RaidMax®). However, they are formulated differently than their registered outdoor products. Indoor products contain peanut butter, sugar or wax moth caterpillar based bait in solid form within a plastic bait station. Outdoor products are formulated in soybean oil on de-fated de-hydrogenated corn cob grit. This trial was conducted to determine if these newer bait products are effective for eliminating indoor laboratory fire ant colonies.

Materials and Methods

On October 17, 1990 twelve laboratory fire ant colonies maintained on a consistent laboratory dietary regime were selected for study. One bait station of each type was placed in each of three colonies and replicated four times. Products tested and their formulations are as follows:

1. Combat® Ant Control System - 0.9% hydramethylnon in what appears to be a sugar cake bait; $1.89/3 = $0.63 each.

2. Raid Max® Ant Bait - 0.5% N-ethyl perfluorooctanesulfonamide (sulfuramid) in what appears to be a peanut butter bait; $3.19/4 = $0.79 each.

3. Maxforce® Pharoah Ant Killer - 0.9% hydramethylnon in what appears to be a ground insect bait; 6 for $12.00 = $2.00 each (sold only through Private Pest Control Operators or their suppliers).

Estimated number of ants per colony, presence of brood (larvae and pupae) and presence of queen ants were determined weekly. Resulting ant number estimates were subjected to analysis using ANOVA and the Least Significant Difference (LSD) test at P 0.05.

Results and Discussion

Results listed in **Table 1** show that Maxforce® and Combat® decreased red imported fire ant colony size relative to the untreated colonies within 1 week of exposure. Raid Max® was slower to reduce ant numbers, requiring 3 weeks for a significant reduction to occur. Unexplained declining numbers of ants in untreated colonies reduced differences between treatments. However, Maxforce® treated colonies continued to decline through the four week monitoring period. Colonies were never eliminated. However, numbers of ants declined dramatically and brood production was eliminated. Queen ants, however, were not observed to be eliminated in these multiple queen colonies. Although colony decline in this test was slow, more bait stations per colony, as suggested in an actual indoor ant problem situation, may have improved the rate and degree of decline.

Table 1. Effects of ant bait stations on laboratory colonies of the red imported fire ant (one station per colony).

No. of ants x 1000/percent colonies with brood[a]/

	Maxforce ®	Combat ®	Raid Max®	Control	LSD
Pre-count	13ab/100	11.25/100	15.00/100	20.00/100	7.054
1 week	12.50b/75	11.25/100	14.37ab/75	20.00a/100	7.429
2 week	9.25b/75	8.13b/100	11.25ab/75	20.00a/100	8.844
3 week	5.88b/75	5.63b/75	8.00b/100	17.50a/100	6.536
4 weeks	0.50b/0	4.25ab/10	5.75ab/25	10.00a/50	5.801

[a]/Means with similar letters are not significantly different according to ANOVA and the Least Significant Difference (LSD) test (p 0.05).

EVALUATION OF THE LINDANE SEED TREATMENT, GAMMASAN®, TO PREVENT PREDATION BY THE RED IMPORTED FIRE ANT ON SORGHUM SEED

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The red imported fire ant (RIFA), Solenopsis invicta (Buren), can be a major pest of newly-planted sorghum (Drees and Vinson, in press). Seed predation can occasionally lead to loss of a planting. Gammasan® is a lindane-based hopper seed treatment produced by Chipman Chemicals. Efficacy and seed protection studies against RIFA using Gammasan® were conducted under laboratory conditions.

Materials and Methods

Treatment: Label directions recommend adding one packet of Gammasan® Seed Treatment (2.7 oz.) to 25 lbs. of seed in the hopper, mixing thoroughly, adding an additional 25 lbs. and re-mixing. To duplicate this recommendation using a small lot of seeds, .766 g. of Gammasan® was added to 1/4 lb. of sorghum seed and mixed in a plastic bag. An additional 1/4 lb. of seed was added and re-mixed.

Efficacy trials: Equal numbers of Gammasan-treated and untreated germinated sorghum seeds were placed on moist filter paper, allowing them to imbibe overnight. They were placed in tall, Fluon®-treated Petri plates lined on the bottom with filter paper so as to not lose any chemical. Ten ants were placed in the plates. Mortality, defined as ants unable to walk normally, was recorded every 15 minutes for a duration of 60 - 120 minutes. There were 5 replications within each of four trials conducted: 1) 5 seeds germinated overnight and transferred to petri dish, 120 min.; 2) 3 seeds germinated overnight and transferred to dish, 60 min.; 3) 3 seeds germinated overnight in dish, 60 min.; and, 4) 3 seeds germinated overnight and transferred to dish, 90 min. Mortality over time was subjected to regression analysis and time elapsed (minutes) to achieve 10, 50 and 90 percent mortality was conducted for each trial.

Seed Production Trials: Gammasan®-treated and untreated sorghum seeds were soaked overnight on moist filter pater until the hypocotyl emerged. Five seeds of each type were then placed on fry filter pater in separate Petri dishes within laboratory RIFA colony trays. Petri dishes were covered with lids perforated with small (5 mm. diameter) holes to discourage seed removal by the ants and retard seed drying. This test was replicated using four colonies. The number of damaged seeds was recorded after 24 hours. The number of damaged treated and untreated seeds per colony were subjected to a Student's t test (P 0.05).

Results and Discussion

Efficacy trials: Gammasan® was strongly toxic to RIFA, initially acting within 30 minutes (24.3 to 34.37 min.) To achieve 10 percent mortality. Ninety percent mortality occurred from 49.8 to 118.1 minutes following exposure **(Table 1).** Control mortality was negligible (not over 2%) and is not shown here. It was observed that if the ants in plates with treated seed had not died within the two hour time period, they would survive overnight or for as long as the control ants lived. Seed production trials: RIFA damaged significantly more untreated than Gammasan®-treated seeds in the 4 trials conducted: 4.25±0.9574 vs 0.0 ± 0.0 (t = 8.8780; D.F. = 6; P 0.0001). None of the treated seeds were harmed or displaced whereas the untreated seeds sustained 85% damage and several were removed form the dishes within 18 hours. All seeds were under intense feeding pressure from the fresh, aggressive colonies that averaged over 30,000 ants each. There was also some ant toxicity noted in the Gammasan®-treated seed dishes.

Table 1. Statistical results of four trails to document the rate of mortality for a lindane seed treatment (Gammasan®) under laboratory conditions.

				Calculated percent mortality		
Trail	**Regression Coef.**			**10%**	**50%**	**90%**
duration	**dead**	**constant**	**r squared***	**(minutes)**		
1 (120)	8.97	20.55	29.50	0.8685	65.38	101.23
2 (60)	3.18	21.12	0.7896	24.30	37.02	49.75
3 (60)	3.11	23.21	0.4889	26.31	38.74	51.17
4 (90)	10.46	23.90	0.6776	34.37	76.21	118.06

* P 0.05; D.F.= 21, 18, 18, and 28, respectively; T=13.601, 5.460, 4.150 and 7.671; and r =0.9319, 0.6235, 0.6992 and 0.8231

EFFECTS OF FORMULATIONS OF "RIDDANCE' FORMULATIONS (SPACE AGE TECHNOLOGY PRODUCTS, INC.) ON LABORATORY COLONIES OF THE RED IMPORTED FIRE ANT (HYMENOPTERA: FORMICIDAE)

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Formulations of products called "Riddance Diner" or "Riddance Powder," produced by Space Age Technology Products, Inc. (4536 West Lawrence Ave., Chicago, Illinois 60630; 312/725-0404) were tested to determine if any effects could be observed when fed to laboratory colonies or the red imported fire ant (RIFA), Solenopsis invicta Buren. These materials are distributed with a label produced on a copy machine claiming "Food service for reaches, termites, ants, and other vermin pests. Non-poisonous. The Pied Piper of roaches, termites, ants, and other vermin pests." The ingredients are unknown, but may be derivatives of latex paint.

Materials and Methods

Experiment 1 (20-22 June 1989): In order to simplify testing of the active ingredient, which is apparently similar in all formulations, a preference test was conducted. The formulations tested and their appearances are as follows: 1) powder: "Riddance Powder", a dark pink, fluffy powder with white chunks of varying size scattered throughout; 2) caulk: a dark brown, crumbly, wet paste; and 3) paint: a dark gray, thick latex with much sediment. One gram of each material, as it came form the container, was weighed out into small, glass scintillation vials. Two samples of paint were weighed, one was allowed to dry before testing. Vials containing the formulations were placed on their sides and arranged randomly within each of 4 standardized RIFA colonies. Observations were taken at 15 minutes, and 1, 2, 3, and 48 hours. Colony reactions were given a rating or + or - to indicate preference of each formulation and any observable "knock down" or worker mortality.

Experiment 2 (13-17 July 1989): A second series of 4 samples was weighed out into small foil cups. Only the powder, caulk, and wet paint were used. One cup of each sample was placed in the four standardized RIFA laboratory colonies and one set was left out to serve as a control. The samples were removed after 4 days of exposure and ants were also removed from the cups before the samples were then re-weighed. The water content of the samples was determined by weighing the control samples, calculating a percent water content, and multiplying the other weights accordingly.

Experiment 4 (11-13 July): Three tall Petri Dishes were coated with Fluon® to prevent ant escape. The bottom of one was covered with "Riddance Powder," the other with a large quantity of caulk, and the third was left as a control. A small cup containing honey water was placed in each dish to extend the ants' lives. Approximately 30 ants were pulled from an untreated colony and placed in each dish.

Results and Discussion

Experiment 1: RIFA tunneled extensively in the powder, removed some material, but no amount was observed to be taken into the colony dish. The caulk was found to be very attractive to the ants. Chunks were chewed and reduced in size, but no removal was noted. Dry paint was chewed off the sides of the vial, but ants did not remove the material from the vial. Ants almost immediately brought refuse (waste products) into vial containing the wet paint, presumably to soak up the liquid. The paint-soaked refuse was removed by ant once it had dried. No preference could be observed or inferred from this experiment. The ants were obviously attracted to the water in the moist compounds, but ingredient removal could not be differentiated from water removal since no control samples were left out of the colonies for later weighing. No dead or dying ants were seen following exposure to any of the formulations.

Experiment 2: Average active ingredient removal from a .250 g. sample was as follows:

	Powder	**Caulk**	**Paint**
	.1740	.0570	.0280
	.0979	.1541	.0204
	.2053	.0317	.0052
Average	.1591g	.0809g	.0536g

About twice as much powder was removed as the caulk and about three times as much as the paint. The powder was chosen for the efficacy experiment.

Experiment 3: The powder was tunneled, formed, and removed in all treatment colonies. There were no observable differences in colony size, health, or brood condition between the treatment and control colonies.

1,000 ant/brood condition				
Colony	**13 July**	**20 July**	**27 July**	**31 July**
Treatment 1	15/poor	15/poor	<15/poor	<15/poor
Treatment 2	20/poor	<20/poor	15/poor	15/poor
Treatment 3	15/poor	15/poor	15/poor	15+fair
Treatment 4	15/poor	<15/poor	15/poor	<20/poor
Control 1	10/poor	10+/poor	10/poor	10+/poor
Control 2	15/fair	15/fair	<15/fair	15/fair
Control 3	<15/poor	15/poor	<15/poor	15/poor
Control 4	15/poor	15/poor	<15/poor	<15/poor

Experiment 4: After two days, no death had occurred from the treatments.

Conclusions

The Space Age Technology products are, apparently, attractive to the ants. RIFA foragers were certainly attracted to the water-containing products and consistently removed some of the active ingredient. However, no transportation of the ingredient into the colony brood dish was noted at any point. There appeared to be no toxicity of the products to RIFA workers or any effects on brood quantity or condition.

EFFECT OF INSECTICIDES APPLIED TO PECAN TREE TRUNKS AND THE ORCHARD FLOOR FOR THE SUPPRESSION OF THE RED IMPORTED FIRE ANT (HYMENOPTERA: FORMICIDAE)

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ABSTRACT

The red imported fire ant (RIFA), Solenopsis invicta Buren, is a pest of several aspects of pecan production and a natural enemy of several pecan pests. Investments made in insecticide treatments for RIFA suppression must be economically justified. To begin development of economic justification, the impact of registered treatments to RIFA foraging and mound activity were demonstrated. Trunk sprays effectively suppressed foraging in trees for up to 16 weeks following treatment. Broadcast applications to the orchard floor suppressed mound activity, with chlorpyrifos (Lorsban® 4E) performing better than bendiocarb (Rotate® 2 1/2G) and isazofos (Triumph®). These treatments may be effectively implemented to suppress ant activity in tree canopies or the orchard floor to suppress ant activity during field operations.

Introduction

The impact of the red imported fire ant (RIFA), Solenopsis invicta Buren, in pecan *Carya illenoiensis* orchards has not been conclusively documented. Pestiferous aspects of this insect include 1) interference of production operations such as grafting, mowing and harvesting operations, 2) predation by the ants on natural enemies of certain pests such as vulnerable stages of the green lacewing (Chrysopa spp.), which naturally suppresses population of the pecan aphid complex (Tedders et al. 1989), and 3) damaging drip or sprinkler irrigation systems by chewing into pipes, clogging nozzles or burying system components. Beneficial aspects of the ants include predation on primary pecan pests such as pecan weevil (*Curculio caryae* (Horn) (Dutcher and Sheppard 1981), hickory shuckworm (*Cydia caryana* (Fitch)) and perhaps others.

RIFA management options in pecan orchards include cultural and chemical methods. Dragging heavy objects (such as railroad ties) can reduce mound height temporarily so that hardened mounds will not interfere with mowing or ground harvesting machinery operations. Insecticides registered for RIFA in pecan include 1) bendiocarb (Rotate® 2 1/2G) registered for non-producing citrus and pecan orchards, and 2) chlorpyrifos (Lorsban® 4E). Alternative methods, such as the use of very hot water may also be used (Drees and Vinson 1989), although the practicality of using these methods on a large scale is doubtful.

This series of applied research/result demonstration was conducted to document the effectiveness of available insecticidal methods of RIFA control in the pecan orchard. The goal was to demonstrate available methods of RIFA management. With this information, one could begin contemplating the economic justification of including these approaches into the pecan production system.

Material and Method

Two tests were conducted at Royal Pecans in Burleson County, Texas: 1) use of chlorpyrifos trunk sprays to eliminate RIFA foraging activity in the pecan tree canopy, and 2) ground application of bendiocarb, chlorpyrifos and an experimental compound, isazofos (Triumph®) to eliminate RIFA foraging and mound activity in an abandoned portion of the orchard.

Trunk sprays: Two sections of the orchard were selected for this test: 1) an unmanaged area of relatively small young trees, and 2) a fully managed area of mature, producing trees. All of the trees were of a size where their canopies were not touching, therefore leaving only the individual trunks as a means of access for the ants into the tree canopies. On 23 June 1989, chlorpyrifos (Dursban® 4E) was applied at a rate of 1 fl. oz. per gal.(peach tree borer rate) to the trunks with a hand pressure sprayer to a height of about 4 feet to runoff three 3 sets of three trees in the managed area and 6 sets of 3 trees in the unmanaged area. These sets of treated trees were positioned between an equal number tree sets designated as untreated (control) trees. Due to rain shortly after application, a second application made on 13 July.

Evaluation was conducted weekly by attaching a 1.0 x 0.5 inch olive-oil soaked index card to each middle tree of the three-tree sets. Treated trees were sampled both above and below the treatment area. Untreated trees were sampled with on strip 3 feet above ground level. The number of RIFA in contact with these cards was documented and analyzed using the Student's test (P 0.05).

Broadcast applications: This test was initiated on 22 September 1989. Five non-replicated square 1-acre plots were established. Treatments were applied 25 Sept.1989; 1)bendiocarb (Rotate® 2 1/2G), at a rate if 12.5 lbs./acre (0.31 lb. active ingredients (AI)/acre) was applied using a Herd seeder, 2.25 setting, 5 - 7 mph. double-treated pattern; 2) chlorpyrifos (Lorsban®4E), 1 qt./acre (1 lb. AI/acre) + 30 gal. water; 3) isazofos (Triumph® 4E, FL-840876), 1 qt./acre (1 lb. AI/acre) + 30 gal. water (H. Ray Smith, Senior Field Research & Development Representative, Ceiba-Geigy). Treatments 2 and 3 were applied using Yamaha PS-50 Spray Equipment with a 24 ft. boom and 20 inch nozzle spacing; and 4) untreated (check).

The number of active RIFA mounds were determined using the minimal disturbance technique (Frankie 1983) in 6 permanently-established contiguous 0.03-acre square subplot areas (36 x 36 ft.) within treatment plots before and weekly following treatment. In addition, the number of RIFA foraging on 0.5 x 0.5 inch olive-oil soaked index cards affixed to 6 tree trunks within treatment plots during an approximate 1 hour exposure period were documented. Results of monitoring procedures were analyzed using subplot analysis of variance with the Duncan's

Multiple Range test (P 0.05) (Ecosoft 1981). Percent reductions were calculated using Henderson's formula (Henderson and Tilton 1955).

Results and Discussion

Trunk sprays: Tables 1 and 2 list the resulting impact of trunk sprays RIFA canopy foraging activity. Olive-oil card monitoring efforts produce erratic results as indicated by the "check" (c) column in these tables. However, within both managed and unmanaged orchards, RIFA foraging in trees above the trunk-treatment zones areas was virtually eliminated for more tan 16 weeks (112 days). Thus, trunk treatment appears to be an effective method for maintaining ant-free trees. This method could be used to eliminate the nuisance of ant presence during grafting and pruning operation and/or to preserve aphid predators during portions of the growing season. If insecticide treatments required for aphid species (*Monelliopsis pecanis* Bissell - yellow pecan aphid and *Monilia Caprella* (Fitch) - blackmargined aphid) could be reduced or eliminated as a result of the suppression of RIFA, such trunk spray treatments could be justified economically within a pecan production system.

Broadcast applications: Broadcast applications of chlorpyrifos, bendiocarb and isazofos all produced significant reductions in the number of active RIFA mounds relative to the untreated plot within the course of this study (**Table 3**). Statistically, chlorpyrifos performed overall better than the other materials, providing maximum suppression 27-35 days following treatment. Isazofos performed in a similar trend. Bendiocarb produced significant levels of suppression erratically (5, 27, 35, and 56 days following treatment).

Though weather conditions varied tremendously over the test period, with minimum low of 33 degrees and a maximum high of 96, all evaluations were conducted with ground temperatures between 70 and 90 degrees to ensure mound and forager ant activity. All insecticides tested gave virtually 100% control of foraging ants within 2 days (**Table 4**). After this time, though, the elimination of RIFA foraging in trees became statistically less consistent. Some trees had no ants for up to six weeks while others had ants after two and these numbers remained consistent. A possible explanation of the spotty, yet consistent results of monitoring efforts using olive oil-soaked cards on the tree trunks is the presence of mound close to , or at the base of the tree. Because the liquid pesticides were applied with a long boom, it is probable that the area around the base of the trees was left untreated.

Surface application of contact insecticides appear to provide almost 100% control of foraging RIFA, but only for a short time. There was an observed lag between pronounced worker death and mound number decrease of over a week. One would assume that such great worker mortality caused the mounds to become devoid of ant activity slowly as food gathering activities on the treated surface was eliminated. Of equal notability was the persistence of reduced RIFA activity. In some trees within treated areas, foraging RIFA returned quickly, while other remained free of ants after 6 weeks. These results were supported by the results of chlorpyrifos trunk treatment test. Active mound numbers also remained remarkably consistent with little resurgence following treatment for 5 weeks.

These results document the feasibility of using broadcast orchard floor treatments to suppress ant activity prior to harvesting operations. Significant levels of suppression extend beyond the 28-day pre-harvest interval specified on the Lorsban 4E (chlorpyifos) label. Thus, an application made a month before the expected harvesting date should 1) provide RIFA suppression and 2) provide for the treatment may be particularly suitable when using ground harvesting equipment:

Model 420 Harvester	Savage Equipment, Inc. 400 Industrial Rd. Madill, OK 73446
Bag-A-Nut Harvester	Bag-A-Nut® 10601 Theresa Dr. Jacksonville, FL 32216
Nu-Harvester N-60	Nu Equipment Corporation 403 East Pecan Street San Saba, TX 76877
Model 8090 Pecan Harvester	Nut Hustler, Inc Star Rt. Box 18 Lampasas, TX 76550

However, the suppression of RIFA canopy foraging appears to be more effectively achieved using trunk treatments rather than with broadcast applications of sprays or granules to the orchard floor. Since the only direct effects of RIFA suppression using a broadcast application on pecan production appears to be worker safety and elimination of ants during period of specific field activity such as harvesting operations, the monetary benefit resulting from an investment in this pesticide application to control RIFA remains to be justified.

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Table 1. Results of Student's test form the mean number of foraging red imported fire ants in contact with olive-oil soaked 1.0 x0.5 inch index cards in chlorpyrifos (Dursban® 4E) treated (above and below treated area) and untreated pecan tree trunks before and weekly after treatment (28 June and repeated 13 July 1989). Royalty Pecan, Burleson County, Texas.

Date	Above (A)	Below (B)	t(A/B)	Check (C)	t(A/C)
Managed Areas					
23 June	28.7± 37.6	---	-	44.0±24.6	x
13 July	3.7±6.4	1.0±1.7	x		
(20)	"			5.8±40.5	-2.31
20 July	0±0	3.3±5.8	x		
(27)	"			113.3±51.1	-3.84
27 July	0±0	16.0±17.7	x		
(34)	"			51.7±37.6	-2.38
4 Aug.	0±0	0±0	x		
(42)	"			41.3±21.8	-3.29
10 Aug.	0±0	4.3±5.8	x		
(48)	"			19.3±21.2	x
18 Aug.	0±0	3.7±3.2	x		
(56)	"			26.0±22.6	x
24 Aug.	0±0	11.0±14.2	x		
(62)	"			18.3±16.5	x
1 Sept.	0±0	9.7±8.7	x		
(70)	"			22.3±18.0	-2.15
8 Sept.	0±0	13.7±11.8	x		
(77)	"			11.0±6.0	-3.18
15 Sept.	0±0	14.7±10.8	-2.36		
(84)	"			32.0±16.0	-3.46
22 Sept.	0±0	11.7±12.4	x		
(91)	"			13.0±3.6	-6.25
2 Oct.	0±0	7.7±2.1	-6.38		
(101)	"			6.3±5.7	x
6 Oct.	0.33±.58	9.0±5.3	-2.82		
(105)	"			11.3±5.0	-3.76
13 Oct.	0.67±1.15	5.7±5.1	x		
(112)	"			9.7±4.9	-3.08

x = means not significantly different (p 0.05)
(d. f. = 4)

Table 2. Result of Student's t test from the mean from the mean number of foraging red imported fire ants in contact with olive-oil soaked 1.0 x 0.5 inch index cards in chlorpyrifos (Dursban® 4E)treated (above and below treated area) and untreated pecan tree trunks before and weekly after treatment (28 June and repeated 13 July 1989). Royalty Pecan, Burleson County, Texas.

Date	**Above (A)**	**Below (B)**	**t(A/B)**	**Check (C)**	**t(A/C)**
Unmanaged Areas					
23 June	63.7±41.3	---	-	32.3±30.7	x
13 July	18.8±28.6	35.2±33.7	x		
(20)	"			46.8±47.0	x
20 July	0±0	10.0±13.3	-1.85		
(27)	"			15.0±10.3	-3.56
27 July	0±0	18.3±24.3	-1.85		
(34)	"			10.8±3.5	-7.61
4 August	0±0	4.7±8.6	x		
(42)	"			8.7±8.8	-2.40
10 August	0±0	3.3±4.5	-1.83		
(48)	"			4.2±5.2	-1.95
18 August	0.83±1.3	6.0±4.8	-2.51		
(56)	"			11.3±16.8	x
24 August	2.2±4.0	7.0±3.46	-2.23		
(62)	"			4.5±17.4	x
1 Sept.	0.17±41	6.2±10.6	x		
(70)	"			10.0±10.4	-2.30
8 Sept.	3.0±6.4	7.0±5.2	x		
(77)	"			4.7±4.4	x
15 Sept.	0.30±.52	11.3±8.9	-3.00		
(84)	"			7.7±9.4	-1.92
22 Sept.	0.67±1.0	12.7±7.7	-3.79		
(91)	"			2.5±4.5	x
2 October	0±0	2.8±4.9	x		
(101)	"			0.30±.80	x
6 October	4.5±6.3	4.0±3.4	x		
(105)	"			1.3±1.9	x
13 October	0.83±1.3	2.5±2.25	x		
(112)	"			1.0±1.3	x

x = means not significantly different (p 0.05)
(D. F. = 10)

Table 3. Active red imported fire ant mounds per 0.03-acre subplot (replicated 6 times) within 1 acre non-replicated 25 September treatment plots in an abandoned pecan orchard floor. Royalty Pecans, Burleson County, Texas. 1989.

No. active fire ant mounds per 0.03-acre subplot[1]/ and percent reduction[2]/ in parenthesis

	Sept.		**Oct.**				**Nov.**		
Date	**22**	**27**	**6**	**13**	**19**	**27**	**3**	**10**	**17**
Post-treatment Date	**0**	**5**	**14**	**21**	**27**	**35**	**42**	**49**	**56**
Treatment and rate									
chlorpyrifos	10.8a	6.0b	2.0c	2.0c	1.8d	1.7d	6.3c	5.5b	5.2c
(Lorsban 4E)		(44)	(79)	(85)	(83)	(86)	(50)	(52)	(59)
1 lb a.i./A									
isazofos	12.7	8.8ab	5.3b	6.2b	4.7c	4.0c	11.3ab	6.0b	7.7c
(Triumph®)		(30)	(53)	(61)	(61)	(73)	(0)	(56)	(48)
1 lb a.i./A									
bendiocarb	8.8a	7.7b	8.7a	11.5a	8.7b	8.2b	12.0ab	10.7a	10.7b
(Rotate® 2 1/2g)		(11)	(0)	(0)	(0)	(19)	(0)	(0)	(0)
0.3 lb a.i./a									
untreated	11.5a	11.3a	10.3a	14.5a	11.0a	13.2a	13.5a	12.3a	13.5a

1/ Means in columns followed by different letters are significantly different using the Duncan's Multiple Range Test (P# 0.005).

2/ Calculated using Henderson's Formula (Henderson and Tilton 1955).

Table 4. Mean number of red imported fire ants per 0.5 square inch olive oil soaked index card after 1 hour exposure on 6 trees (replicated 6 times) with 1- acre non-replicated 25 September treatment plots in an abandoned pecan orchard floor. Royalty Pecans, Burleson County, Texas. 1989.

No. foraging ant per oil-soaked card[1]/ and percent reduction [2]/ in parenthesis

	Sept.		**Oct.**				**Nov.**		
Date	**22**	**27**	**6**	**13**	**19**	**27**	**3**	**10**	**17**
Post-Treatment Date	**0**	**5**	**14**	**21**	**27**	**35**	**42**	**49**	**56**
Treatment and rate									
chlorpyrifos	15.3a	0.0b	7.8a	6.8a	4.2a	1.3b	11.5ab	4.7ab	15.8ab
(Lorsban® 4E)		(100)	(0)	(4)	(59)	(72)	(17)	(52)	(0)
1 lb a.i./A									
isazofos	6.2a	0.0b	3.2a	9.5a	9.8a	4.0b	0.5b	2.7b	4.3b
(Triumph®)		(100)	(0)	(0)	(0)	(0)	(91)	(32)	(21)
1 lb a.i./A									
bendiocarb	17.2a	0.7b	5.0a	10.8a	6.5a	13.3b	8.0ab	9.2ab	22.8a
(Rotate® 2 1/2g)		(91)	(34)	(0)	(41)	(0)	(49)	(17)	(0)
0.3 lb a.i./a									
untreated	22.2a	10.0a	9.7a	10.3a	15.0a	6.8a	20.2a	14.3a	19.5ab

[1]/ Means in columns followed by different letters are significantly different using the Duncan's Multiple Range Test (p #0.05).

[2]/ Calculated using Henderson's Formula (Henderson and Tilton 1955).

EVALUATIONS OF AMDRO® (HYDRAMETHYLNON) FORMULATIONS AND LOGIC® (FENOXYCARB) FOR RED IMPORTED FIRE ANT CONTROL

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Use of bait-formulated insecticides is one method of red imported fire ant (RIFA) *(Solenopsis invicta* Buren) suppression. Products like Amdro® (hydramethylnon), Logic® (fenoxycarb) and Affirm® (abemectrin) are applied either as treatments around individual mounds or as broadcast applications. Successful control is attained when several conditions are met: ants are actively foraging (when soil temperatures exceed 65 to 70EF), 2) fresh product is used, and 3) the ground is dry at the time of application and for the 24-hour period following application.

Bait particles are formulated as soybean oil coated corn grits. The oil contains the active ingredient. Attractiveness of the bait is reduced if 1) too much active ingredient or other repellent chemicals are added to the soybean oil and/or 2) the soybean oil becomes rancid (oxidizes) over time or after exposure to air. If the bait is unattractive, control failure will occur. Furthermore, if the active ingredients decompose (through time- or temperature-mediated chemical decomposition or photo degradation), the material will also become less effective for control.

This research was conducted to examine several aspects of bait attractiveness and efficacy of controlling RIFA, particularly when applied as individual mound treatments. Products and formulation tested included Amdro (fresh product produced in 1990), old Amdro (Amdro A, B, and C), and for comparison, Logic® (fenoxycarb) "insect growth regulator," and Orthene® Fire Ant Killer or 75W (acephate).

Materials and Methods

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

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

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

Plot	Active Ingredient	Formulation	Rate /mound	No. Mounds treated
1	hydramethylnon	Amdro “A”	5 Tbsp	37
2	“	Amdro “89"	“	50
3	“	Amdro “B”	“	39
4	acephate	Orthene 75W	3 Tsp.	47
5	fenoxycarb	Logic	3 Tbsp.	32
6	hydramethylnon	Amdro “90"	5 Tbsp	51
7	“	Amdro “C”	“	36
8	untreated	none	none	34

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

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

Bait preference test: In the laboratory RIFA colonies were maintained in 5 gallon plastic buckets and fed a standardized diet regime, several trails were conducted to determine the attractiveness of several formulations of Amdro:

1) Amdro 90 versus Amdro A versus Amdro B versus Amdro C: Six colonies received pre-weighed 0.5 to 0.56g samples of each formulation in weighing dishes. After an exposure period of 50 minutes, the samples were weighed again and the amount of bait removed was determined. These values were used to calculate the mean weight of bait removed per formulation, and date were analyzed using ANOVA and the LSD test ($\underline{P} \leq 0.05$).

2) Amdro Lot 90 versus Lot 89: This trail was conducted similarly to trial 1 except for a 55 minute exposure time and analysis using the Students $\underline{t}$ test ($\underline{P}$ # 0.05).

3) Logic Lot 90 versus Lot 89: This trail, using “fresh” Logic from a just-opened bag produce in 1990 versus Logic form and opened bag stored in the laboratory since 1989, was conducted similarly to trial 2 except for a 1 hour and 40 minute exposure time.

4) Fresh Amdro versus Amdro exposed to air in a tray for 1 week versus Amdro exposed for 3 weeks: Quantities of Amdro were removed from fresh (1990) Amdro container stored in a laboratory freezer 3 weeks and 1 week before the trial was conducted and placed on a laboratory shelf in a tray to “age” the bait by exposing it to air. The trial was conducted and analyzed as trial 1 with an exposure period of 1 hour and 35 minutes.

Logic lot field test: To determine if properly stored Logic Fire Ant Bait lost effectiveness after storage in a opened, but tightly sealed 3 lb. plastic container, a trial was established on Milberger Turf Farm in Wharton County. On June 22, 1990, three, one acre treatment blocks established on a non-productive section of the farm. Prior to and following (5 Oct.) treatment, fire ant mounds were monitored for activity using the minimal disturbance technique. Ant mounds in each block were counted using a 105 foot string, pivoting in the center of the one-acre block. Active mounds were counted for each quarter of the circle. Treatments and rates were as follows: 1) 1989 batch Logic at 1 ½ lbs per acre; 2) 1990 batch Logic at 1 ½ lbs per acre and 3) untreated control. The Logic was applied by means of a wheeled, broadcast fertilizer spreader. Results were analyzed using ANOVA and the Least Significant Difference (LSD) test (P # 0.05).

Results and Discussion

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

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

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

Bait preference tests: Results of these trials are discussed separately below. Overall, there was a trend towards older bait being less attractive to foraging worker ants than fresh material. Differences were small and nonsignificant in trials comparing the attractiveness of fresh product to bait lots from unopened year-old containers or opened and re-sealed containers stored under laboratory conditions for a year. However, exposure of the fresh bait to air prior to exposure to ants resulted in significant decreases in attractiveness within a week.

1) Amdro 90 versus Amdro A versus Amdro B versus Amdro C: Statistically, all formulations tested were found to be equally attractive. Numerically, Amdro C seemed to be consumed more rapidly than others, although in field tests, this formulation performed numerically poorer than other treatments.

Treatment	**Average Percent Consumed**	**Mean bait weight removed[a]/**
Amdro 90	65.16%	0.3396 a
Amdro A	49.84%	0.2581 a
Amdro B	57.64%	0.3017 a
Amdro C	70.98%	0.3691 a

[a]/ Means are not significantly different according to ANOVA and least significant difference (LSD = 0.152) test (P #0.05).

2) Amdro Lot 90 versus Lot 89: Although statistically similar, numerically more fresh bait was removed within the exposure period.

Treatment	**Average percent consumed**	**Mean bait weight removed[a]/**
Amdro 90	43.13%	0.22±0.15 (SD)
Amdro 89	41.90%	0.21±0.17

[a]/ Means are not statistically different according to the Students t test (t = 0.1007; d f = P# 0.05).

3) Logic Lot 90 versus Lot 89: As in trail 2, no statistical differences were documented, but the trend for older bait to be less attractive was consistent in this trial. Variability of quantity of bait consumed between colonies prevented statistical differences from being documented.

Treatment	Average percent consumed	Mean bait weight removed [a]/
Logic 90	44.64%	0.23±0.17 (SD)
Logic 89	29.79%	0.15±0.09

[a]/ Means are not statistically different according to the Students t test (t = 1.0231; d f = P# 0.17).

4) Fresh Amdro versus Amdro exposed to air in a tray for 1 week versus Amdro exposed for 3 weeks: Air-exposed or oxidized, rancid bait was less attractive to foraging worker ants than fresh bait.

Treatment	Average percent consumed	Mean bait weight removed [a]/
fresh	71.54%	0.3733 a.
1 week	49.51%	0.2394 .b
3 week	43.30%	0.2223 .b

[a]/ Means followed by the same letter are not significantly different according to ANOVA and least significant difference (LSD=0.082) test (P #0.05).

Logic lot field test: No differences in performance were detected between lots of Logic:

No. active fire ant mounds per quadrant			
Treatment	Pre-count (22 Sept.)	Post-count (5 Oct.)	Percent reduction
89 Logic	10.0a	2.8b	92
90 Logic	4.8b	0.5b	90
Untreated	5.5b	8.5a	

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

	Mean mound rating[a]/				
	11 June	**20 June**	**27 June**	**9 July**	**1 Aug.**
Treatment	**Pre-count**	**1-week**	**2-week**	**4-week**	**8-week**
Amdro A	1.2667 abc	0.0000 ..c	0.0000 ..c	0.0000 .b	0.0000 .b
Amdro 89	1.3333 abc	0.0000 ..c	0.0000 ..c	0.0000 .b	0.0000 .b
Amdro B	1.3000 abc	0.0000 ..c	0.0000 ..c	0.0000 .b	0.0000 .b
Orthene	1.5000 abc	0.0000 ..c	0.0000 ..c	0.0000 .b	0.0000 .b
Logic	1.4667 abc	0.7333 .b.	0.8000 .b.	0.0333 .b	0.0000 .b
Amdro 90	1.2000 ..c	0.0000 ..c	0.0000 ..c	0.0000 .b	0.0000 .b
Amdro C	1.5667 a..	0.0000 ..c	0.0000 ..c	0.1667 .b	0.1333 .b
Untreated	1.5667 ab.	1.2333 a..	1.6333 a..	1.1333 a.	0.8333 a.
LSD 5%	0.303	0.359	0.287	0.322	0.230

[a]/ Mound rating are: 0 = fewer than 10 ants, very slow reaction to disturbance, 1=10 to 100 ants, slow reaction to disturbance, 2 = 100 to 1000ants, and/or vigorous reaction to disturbance, and 3 = more than 1000 ants, very vigorous response to disturbance. Means followed by the same letter(s) are not significantly different according to ANOVA and the least significant difference (LSD) test (P # 0.05).

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

	Mean mound rating[a]/				
	11 June	**20 June**	**27 June**	**9 July**	**1 Aug.**
Treatment	**Pre-count**	**1-week**	**2 week**	**4-week**	**8-week**
Amdro A	9.2500 a	0.0000 .b	0.0000 .b	0.5000 .b	0.0000 .b
Amdro 89	12.5000 a	0.0000 .b	0.0000 .b	0.0000 .b	0.0000 .b
Amdro B	9.7500 a	0.0000 .b	0.0000 .b	0.5000 .b	0.0000 .b
Orthene	11.5000 a	0.0000 .b	0.0000 .b	0.0000 .b	0.0000 .b
Logic	8.0000 a	5.5000 a.	4.7500 a.	0.2500 .b	0.0000 .b
Amdro 90	12.7500 a	0.0000 .b	0.0000 .b	0.0000 .b	0.0000 .b
Amdro C	9.0000 a	0.0000 .b	0.0000 .b	1.5.000 .b	0.5000 .b
Untreated	8.5000 a	8.0000 a.	7.2500 a.	7.0000 a.	5.2500 a.
LSD 5%	5.613	3.161	2.999	3.383	2.668

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

EVALUATION OF ISAZOPHOS (TRIUMPH®) FORMULATIONS FOR RED IMPORTED FIRE ANT SUPPRESSION ON A COMMERCIAL TURF FARM

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Triumph® 4E (isazophos) is a contact insecticide registered for use on turf for the control of turf pests such as white grubs, mole crickets, chinch bugs, sod webworms and armyworms. It is currently not registered for control of the red imported fire ant (RIFA), *Solenopsis invicta* Buren, although several previous test have documented that this product does not affect this pest.

This trial was conducted to provide further documentation of the efficacy of Triumph 4E and a new formulation, Triumph 1G, against the RIFA. In addition, plots were established to determine if post-treatment irrigation improved the performance of these products.

Materials and Methods

The Walton Turf Farm in Harris County was selected for this trial . On June 8, 1990, Ten one acre square plots were established. The plots were roughly in aline two wide and five deep. The rows were separated by a 20 foot buffer and plots within rows were separated by a buffer of from 10 to 5 feet. The following treatment were applied to each row of five plots:

1) Triumph 1G at 1 lb AI and 2 lb AI applied with a granular fertilizer spreader.

2) Triumph 4E at 1 lb AI and 2 lb AI applied with an all-terrain vehicle mounted spray apparatus delivering 20 gallons/acre.

3) An untreated check plot was left in each row.

The western-most row of plots received a thorough soaking via a rolling stationary irrigation system within 24 hours of treatment application. The eastern row of plots did not receive water until five days later (June 13), after the first follow up evaluation.

An initial count of active RIFA mound was made prior to treatment by using a center stake with a 105 ft. string attached to circumscribe a uniform area within each square acre (approx. 0.8-acre). The number of active mounds were recorded form within each (0.2 acre) quadrant of this circular area. A mound was considered active if ant swarmed to the surface with in a few seconds of disturbance. Since the area was quite dry and hot, the time and disturbance required for ant emergence varied greatly. Disturbance techniques included kicking, poking with a sharp stick, and deeper digging with a shovel. The latter method was employed in all subsequent evaluations (1 week - 13 June, 3 week - 26 June, 4 week - 10 July, and 8 week - 2 August).

The mean number of active mounds within the 0.2 acre quadrants was calculated and data were statistically analyzed using ANOVA and the Least Significant Difference (LSD) test (P # 0.05).

Results and Discussion

The results (**Table 1**) of the first evaluation were most intriguing. There was far less decrease in active mound numbers or ant observed in the non-irrigated plots relative to pretreatment levels. However, mound numbers decreased significantly in all irrigated Triumph-treated plots (Triumph 1G 1 lb a.i. = 100%, 1G 2 lbs a.i. = 77%, 4E 1 lb a.i. = 69%, 4E 2 lbs = 72% reduction according to Henderson's formula). Although the results of analysis indicate a significant reduction in non-irrigated Triumph-treated plots relative to the non-irrigated untreated plot after 1 week, this resulted from 1) an increase in the active mound numbers detected in the untreated plot relative to pretreatment numbers, and 2) numerical decreases occurred only in the Triumph 1G 2 lbs a.i. and Triumph 4E 2 lbs a.i. treated plots relative to pretreatment levels.

One striking feature was the difference in mound appearance between the treated a and untreated plots in the irrigated test. Because of the very dry conditions, all the mound encountered initially were very low and indistinct with almost no granular, moundish appearance so distinctive of RIFA colonies. After the irrigation though, in the untreated irrigation plot, mound were very loose, distinct, and built up. In the treatment plots, however, the surviving mounds were still indistinct with the soil virtually undisturbed. Ants in the untreated mounds were extremely active while the treated mounds had to be poked and/or dug vigorously to obtain any ant response.

At 3 weeks post-treatment, all Triumph-treated plots had been irrigated and all were found to have significantly fewer active RIFA mounds than untreated plots. This condition persisted through the remainder of the evaluation period (**Table 1**). Actual reductions of active mound numbers following a single application of a surface toxicant is usually not expected since the toxicant does not usually penetrate sufficiently deep into the soil to reach the queen(s) and brood. However, the mounds in this site were small and disturbed with frequent mowing and watering. Furthermore, irrigation was applied to thoroughly soak the sod for a 12 hour period. This practice produced saturated conditions, forcing the ant colonies to move up, into contact with treated soil surfaces. Mortality of ll ant stages in colonies resulted.

Statistically, the formulation tested produced similar reductions of mound activity. Numerically, however, the Triumph 4E treatments were not as effective as were the granular formulation treatments (**Table 1**, weeks 4 and 8). Increases of rates from 1 to 2 lbs a.i. did not improve control. Reinfestation of RIFA colonies into the treated plots did not occur within the monitoring period.

Acknowledgments

The authors are grateful to the Vernon Walton for allowing this trial to be conducted on his farm. Funding for this project was provided, in part, by Ciba-Geigy Corporation and by Expanded Research Area funds by the Texas Agricultural Experiment Station.

Table 1. Mean number of active red imported fire ant mounds per 0.2 acre subplot, Harris County, Texas, 1990.

	Number active mounds per 0.2-acre[a]/				
	8 June	**13 June**	**26 June**	**10 July**	**2 Aug.**
Treatment	**Pre-count**	**1-week**	**3-week**	**4-week**	**8-week**
Irrigated					
Untreated	5.50 abcde	9.75 a	3.25 ab	9.0.0 a	13.25 a
1lb AI, 1G	5.00 bcdefg	0.00 e	0.00 c	0.25 c	0.50 b
2lb AI, 1G	5.50abcdef	2.25 bcde	0.50 bc	0.25 c	0.50 b
1lb AI, EC	6.75 ab	3.75 bcd	1.00 bc	1.00 c	3.75 b
2lb AI, EC	3.75 cdefgh	0.25 de	0.00 c	0.00 c	1.50 b
Non-irrigated					
Untreated	5.75 abc	10.00a	5.50 a	4.50 b	12.25 a
1lb AI, 1G	2.25 h	4.00bc	0.00 c	0.00 c	0.25 b
2lb AI, 1G	7.75 a	2.25 bcde	0.50 bc	0.00 c	0.00 b
1lb AI, EC	3.75 cdefgh	9.75 b	1.00 bc	1.00 c	2.75 b
2lb AI, EC	5.75 abcd	3.25 bcde	0.00 c	0.25 c	0.75 b
LSD 5%	2.191	3.099	2.619	2.163	4.028

[a]/ Means followed by different letters are not significantly different according to ANOVA and the Least Significant Difference (LSD) test (P # 0.05).

COST COMPARISON FOR PRODUCTS FOR THE CONTROL OF RED IMPORTED FIRE ANTS IN COMMERCIAL TURF PRODUCTION

Bastiaan M. Drees, Professor and Extension Entomologist

Suggested (retail) prices (August 1990):

Product	Unit price	Rate/acre	Cost/acre	
Bait-formulated insecticides:				
Logic® (fenoxycarb) retail (25 lb bag) government program	6.20/lb	1-1.5 lbs	6.20-9.30 5.25-7.88	
Amdro® (hydramethylnon) retail (25 lb bag) government program	5.75/lb 4.20/lb	1.0 lb	5.75 4.20	
Contact insecticides:			**Liquid**	**Granules**
Dursban® 4E (chlorpyrifos) foraging fire ants, only	88.00/gal	0.25 gal	22.00	
Dursban® 50W (2 lb cans) 6-week certification period	11.35/lb	16 lbs	181.60	
Ford's Dursban 10G* (50 lbs) 4-week certification period 10-week certification period	2.51/lb	40 lbs 60 lbs		100.40 150.60
Oftanol® 2 (isofenphos) 2.5 gal @ $156.00 Oftanol 5% 40 lbs	62.40/gal 1.75/lb	1 gal 40 lbs	62.40	70.00
Triumph ® 4E (isazophos)** Triumph 1G**	179.00/gal 1.45/lb	0.25 gal 100 lbs	44.75	145.00

* Only approved treatment for the USDA Fire Ant Quarantine Treatment Program
** Not specifically registered for fire ant control in turf

Sources for prices:
Maag Agrochemicals, Inc., Porter Williams/Marty Gibson (8/31/90)
Control Solutions, Houston, Joe Blake, referred to by Jeannie, Ford's Chemical & Service, Inc. (8/31/90)
DowElanco, Houston, John Roach (08/31/90)
Ciba-Geigy, College Station, Ray Smith
Van-Waters & Rogers, Houston, Kitty Wooten (08/31/91)
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EFFECTS OF SPOT TREATMENTS OF LOGIC® (FENOXYCARB) ON POLYGYNOUS RED IMPORTED FIRE ANTS: AN INDICATION OF RESOURCE SHARING?

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Food exchange between adjacent nests of the red imported fire ant, *Solenopsis invicta* Buren was elucidated by Summerlin el al. (1975) using dye-impregnated soybean oil. Bhatkar and Vinson, (1987, 1987a, 1989) demonstrated foraging pattern differences between monogyn and polygyn red imported fire ants by marking foraging ants with a non-toxic paint, finding that worker ants moved freely between mounds of the polygynous form.

Logic® Fire Ants Bait contains the active ingredient, fenoxycarb, which acts as an insect growth regulator. Ingestion of fenoxycarb by the brood redirects larval development toward production of winged reproductive castes, only. Queen ant ovaries are also affected (Glancey 1987) and egg production is severely reduced or eliminated. In the absence of worker ants are not replaced. This process can take up to several months. During this period, affected colonies can be detected because of the absence of worker brood and prevalence of reproductive brood (large larvae and pupae with wing pads).

Individual spot Logic applications were used to determine whether or not, and to what extent, neighboring red imported fire ant mounds were affected by the treatment.

Materials and Methods

Native pasture at the edge of an abandoned pecan orchard in Burleson County was used to establish test plots. Logic® Fire Ant Bait (fenoxycarb) applied either to 1) the top of individual fire ant mounds or 2) placed randomly in the pasture at a rate of 3 tablespoons per spot on 21 September 1990. Treatment spots and mounds were established along transect lines and were separated by a minimum of 70 ft. Treatments were replicated six times and marked with plot flags. An additional set of six spots were marked to serve as an untreated check. These plots were randomly selected from an area adjacent to the treatment plots but at least 150 feet away form any flag. The entire area appeared uniform in terrain, soil type, and vegetation. Adequate moisture was present throughout the test period with temperatures varying greatly, but staying well above 70EF.

Five weeks following treatment, all active mounds within a 30 ft. radius were mapped and inspected for presence of worker and reproductive brood. The total number of fire ant mounds and mounds affected by the Logic treatment, as indicated by the lack of worker brood and the presence of reproductive brood, was determined within 0-5, 5-10, 10-15, 15-20, 20-25 and 25-30 ft. radius form the location of the spot application for each treatment. These values were converted to percent affected mounds and these values were correlated to the distance form treatment location.

Results

Average mound density was 24.78 mounds per plot or 381 mound per acre, indicating the prevalence of the polygynous form of the red imported fire ant. Significant negative correlations (P # 0.01) between the number of Logic-affected mound and the distance form the spot application (**Table 1**). Linear regression equations [Y, percent affected mounds = (Y intercept) + (slope) X, distance from treatment spot] were:

Treated central mound: Y = 93.7 + -3.66X (r = -0.8993)
Random treatment: Y= 105.10 + -4.13X (r = -0.8706)

Relationships between treatment location and affected mounds were very similar, regardless of placement of bait on mounds or randomly within an infested area (Fig. 1). A calculated range, for the distance from the spot application to where 50 percent of the mounds were affected by the treatment was 11.9 to 13.4 ft. for bait placed on the mound versus randomly, respectively. The maximum treatment spot to affected mound distance was 23 ft.

Discussion

Clearly, more than a single fire ant mound was affected by the spot applications of Logic ®. In areas infested by the polygyn form, these mounds may represent a single colony comprised of numerous mounds. Results of this study, however, cannot be used to conclusively argue that food exchange occurred between individuals form adjacent mounds. Conceivably, foraging workers form adjacent mound or colonies shared a single resource (a spot application of bait) over time, although fire ant baits readily decompose in the environment. Regardless, results support the finding of previous studies (Summerlin et al. 1975, Bhatkar, A.P. and S. B. Vinson, 1987, and 1989).

Other aspects of these results may have implications research methodology and fire ant management. The distance between bait treatment location and affected mounds reported here would conceivable differ with varying densities of fire ants within the study area and the dose. However, during evaluations of individual mound or broadcast bait applications, the researcher must be aware of the possibility of the exchange and/or sharing of the toxicant-laden bait between neighboring colonies. In establishing broadcast application plots, buffer zones of at least 60 ft. between treatments my be necessary to completely eliminate the possibility of treatments affecting adjacent plots.

In fire ant management, the food exchange and/or resource sharing of a toxicant bait can be beneficial in a number of ways. The knowledge that bait application in restricted small spaces, such as home lawns can affect mounds in neighboring areas for roughly 20 feet form the edge of the treatment can be beneficial and help justify the urban use of slow-acting pesticides such as Logic.

Furthermore, documented resource sharing between mounds could help justify the use of bait station for fire ant management. And finally, resource sharing among the polygyn form would make them more capable of transmitting natural enemy agents, particularly pathogens, form mound to mound and perhaps between colonies.

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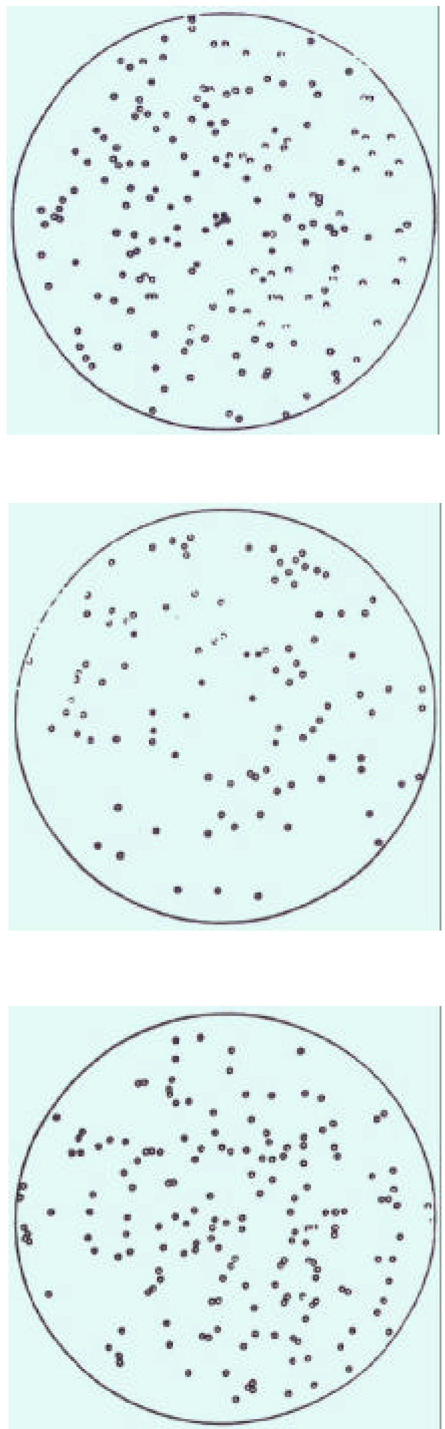
Table 1. Number of red imported fire ant mounds affected by a spot treatment of Logic® (fenoxycarb) Fire Ant Bait five weeks following application (21 Sept.), Burleson County, Texas, 1990.

No. of Mounds with reproductive brood only/total mounds (percent in parentheses)

Radius	**Treated mound**	**Random treatment**	**Untreated**
0-5	5/6 (83)	1/1 (100)	0/11 (0.0)
6-10	10/14 (71)	6/6 (100)	0/17 (0.0)
11-15	4/26 (15)	3/24 (12.5)	0/41 (0.0)
16-20	2/45 (4)	0/18 (0.0)	0/36 (0.0)
21-25	1/38 (3)	1/23 (4.3)	0/34 (0.0)
25-30	0/44 (0)	0/31 (0.0)	0/31 (0.0)
r	-0.90*		-0.87*

* Indicates significant correlation df = 11, Corr. Coef. = 0.708, P=0.01

Fig. 1. Composite plot maps from 6 replicates of 3 treatments: 1) spot applications of Logic® to central locations, and 3) untreated. Open circles represent active unaffected red imported fire ant mounds while black dots indicate affected mounds containing reproductive brood, only. Burleson County, Texas, 1991.



FIRE ANT PREDATION ON WATERFOWL

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The National Audubon Society and the Texas General Land Office have concerns over the invasion of the red imported fire ant, *Solenopsis invicta* Buren., into the waterbird colonies along the Texas coast natural and man made "spoil" islands.

The red imported fire ant has been documented to feed on hatching eggs (Johnson 1961, 1962, Mount 1981, Mount et al. 1981). However, the impact of this ant behavior on egg clutch survival and nest density in fire ant-infested areas has remained undocumented. In the absence of this information, suppression programs using available control technology are not ecologically and economically justified. Programs using current technology provide only temporary suppression and require repeated applications. Discontinuation of treatments results in re-invasion of the ants to levels that may exceed those prior to initial treatment.

A pilot program was conducted to document the impact of the red imported fire ant suppression program, based on the use of the environmentally acceptable management tactics over time on 1) fire ant activity, 2) waterfowl survival during and after hatching.

Materials and Methods

Heavily infested islands at Rollover Pass in east Galveston Bay were selected for this pilot program. These islands are colonized by more than a dozen ground and shrub nesting water birds form March through August, including the great egret, great blue heron, olivaceous cormorant, snowy egret, Louisiana (tricolor) heron, roseate spoonbill, laughing gull, gull-billed tern and Forester's tern.

Treatment regimes were based on a preliminary fire ant survey and the geography of the four Rollover Pass islands. Island 1 and the eastern half of Island 4 were treated on 27 February and 29 September 1989 using the product, Logic® (fenoxycarb), an insect growth regulator, to maintain low levels of fire ant activity Island 3 and the west half of Island 4 were left untreated and had high levels of fire ant activity.

Fire ant mound densities were estimated on 27 February 1989, but thereafter, relative foraging ant activity between treated and infested areas was monitored using olive oil-soaked index cards. Ten one-inch-square cards were positioned in a transect line across each island or island portion. The number of ants associated with each card was estimated after 0.5 to 24 hours of exposure.

During periodic visits, 6 or more randomly-selected, egg-containing waterfowl nests were marked in treated and untreated areas. Numbers of marked nests containing chicks were determined during subsequent visits. Percent mortality was calculated form these sets of marked nests and observations were made to determine cause of death.

Results and Discussion (Note: Results presented here are preliminary, representing only two years of data)

A preliminary survey documented an estimated 180 mounds per acre on Islands 1, 3 and 4. Island 2 was found to harbor primarily a native ant species, *Monomorium minutum* Buckley, the little black ant. The effects of the 27 February 1989 Logic® treatments were not evident during the 1989 breeding season (**Table 1**).

Survey of nesting waterfowl on 23-24 May 1989 provided no indication of the impact of ants on hatching survival, although some hatchling chick were observed being attacked by red imported fire ants. During June 1989, hurricane Allison flooded the Rollover Pass Islands with a 5 ft. flood and 27 inches of rain. These adverse weather conditions eliminated bird nesting activities and all developing waterfowl. Hurricane Chantal produced 6 inches of rain on the islands on 1 August. Thus, no waterfowl developed on these islands in 1989.

On 21 April 1990, waterfowl nesting was already in progress preventing a spring broadcast application of ant bait. The 29 September 1989 Logic application to the eastern half of Island 4 had resulted in a 91.6 percent reduction in foraging activity. Heavy rains and floods occurred in May. On 1 June 1990, high tides had been occurring causing flooding conditions, and many laughing gull and tri-color heron nest had been submerged.

Although flood-related mortality of hatchling waterfowl was documented in April and May 1990, ant-related mortality on the infested portion of Island 4 was not documented until after June 1. Mortality increased to 100 percent of marked nests through the remainder of the monitoring period (**Table 2**).

Preliminary Conclusions

- Red imported fire ants can successfully be suppressed on rookery island of the Texas coast using an annual fall broadcast application of Logic® insect growth regulator.
- Fire ant-caused mortality of hatching waterfowl was not detected from April until the end of May and increased to 100 percent of monitored bird nests through the remainder of the nesting season. (July 20)
- Weather conditions play a major role in the ability of both birds and fire ants to successfully nest on these islands.

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Table 1. Number or red imported fire ant workers associated with olive oil-soaked index card, Rollover Pass Islands, Texas.

Average no. foraging red imported fire ants per card-

Olive-oil card station	**Treated Island 4E**	**Untreated Island 4W**
23-24 May 1989	31.8	27.6
29 September 1989	14.0	18.1
21 April 1990	2.7*	27.9*
1 June 1990	0.2	180.0
10 July 1990	4.0	19.5

* The September 1989 Logic® application in a 91.6 percent reduction of fire ant foraging activity.

Table 2. Percent mortality of hatching waterfowl on fire ant treated and infested (untreated) part of Roll over Pass Island 4, Galveston Bay, Texas, 1990.

Percent Mortality of hatchling waterfowl
(number of marked nest observations in parentheses)

Date	Treated	Untreated
April 21*-May 6	14.3 (7)	50.0 (6)
May 6 - June 1	0.0 (4)	50.0 (4)
June 1* - June 15	10.0 (10)	--
June 15*-June 24	N/O	100.0 (?)
June 24*-July 3	N/O	100.0 (5)
July 3*-July 10	N/O	100.0 (3)
July 10-July 20	N/O	100.0 (3)

* Dates when sets of nest containing waterfowl eggs were marked for subsequent observation of hatching success.
N/O = Non observed

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EVALUATION OF TRIUMPH® TREATED POTTING MEDIA FOR ELIMINATION OF RED IMPORTED FIRE ANTS

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The spread of the red imported fire ant, *Solenopsis invicta* Buren, through the United States has been thought to have occurred largely via the movement of nursery stock and sod between urban areas. The United States Department of Agriculture Fire Ant Quarantine mandates certain specific treatments of potting media before plants can be approved for shipment out of the quarantine zone. Additionally, the Texas Floral and Nursery Law mandates pest -free plants.

Historically, chlordane was an effective tool for enforcement of the quarantine law and provided two years residual control of fire ants in treated media. Since chlordane use was cancelled in the early 1980's, products containing chlorpyrifos (Dursban®) have been approved for this use. However, recently, there have been some cases in which live fire ants were found in media treated with chlorpyrifos. Currently, there is a search for other insecticide products with may provide residual control of this pest in potting media. This trial was conducted to evaluate the residual activity of two formulations of isazophos, Triumph® 4E and 1G.

Materials and Methods

This trial was conducted at Powell Plant in New Summerfield, Texas, on 23 August 1990. Variegated Asiatic jasmine *(Trachelospermum asiaticum* var. 'Varigata')from 2" square pots were transplanted to 6" plastic azalea pots containing treated and untreated potting media. The composition was as follows:

4 bales	peat moss (40 cu. ft.)
8 cu. ft.	Styrofoam
15 lbs.	Osmocote® 15-15-15
7 lbs.	Esmigram®
15 lbs	Lime
10 oz	Truban® granules
6 cu. ft.	bark

Total: 54 cu. ft. medium

The treatments were as follows:

1G - 500 pots at a rate of 24.4g (5.4374 lbs formulation) a.i/yd³ incorporated into the media
4E - 500 pots at a rate of 0.125 fl. oz./gal. water applied as a drench
CK - 500 pots untreated control

Residual effectiveness of treatments was determined by assaying 12 pots randomly selected from each treatment 4 days, 3, 6, and 12 week following application. During this period, plants were watered and fertilized routinely by nursery operators.

Pots were shipped to the laboratory at Texas A&M University where ants were introduced to treated media to assay product performance. Assays were performed as follows: 1 gallon plastic sandwich bags were placed over the top of the pots and secured tightly around the rim with rubber bands. The pots were then placed in Fluon-treated plastic shoe boxes to prevent escape. Approximately half of the seam in the top of the bag was cut away to allow introduction of ants.

Ants were obtained from freshly collected, active mounds. Due to differences in brood quantity and number of queens in field collected colonies, homogenous mini-colonies were assembled for assays. Since the colonies were from a multiple-queen area, no territoriality was observed between colonies. Into each pot was placed: approximately 8.0ml. worker ants, 2.0 ml. brood (larvae and pupae), and at least four queens added. Immediately after introduction of the “collonoid”, the top of the bag was sealed by twisting it closed with twist-tie. After 24 hours, pots were disturbed and observed for ant activity. An effort was also made to locate brood and queen ants.

Results and Discussion

Results of assays are presented below:

No. of active colonies out of 12 after 24 hours

Treatment	4 days	3 weeks	6 weeks	12 weeks
Triumph 1G	0	0	6	12
Triumph 4E	0	0	1	12
untreated control	12	12	12	12

For the first post-treatment assays, ant mortality was observed in as little as 15 minutes after exposure to treated media. No ants survived for 24 hrs. in treated media for the first three weeks. After six weeks of treatment, ants began to survive in treated media, particularly that treated with the granular formulation. Treatments and number of plots with ants surviving after 24 hrs. exposure per 3 pot replicate were as follows:

Triumph 4E	0.25 a
Triumph 1G	1.50 b
Untreated control	3.00 c

(LSD (P # 0.05) = 0.865)

At 12 weeks following treatment, a few live ants were observed in all pots receiving insecticide treatment after 24 hrs. exposure. However, morality continued to be observed. The assay method used in this study did not allow for an evaluation of "repellency" of low residual effects of treatments. Bulk density of the top ½ to 1 inch of potting media significantly increased over time.

EFFECT OF A PARASITIC NEMATODE (RHABDITIDA: STEINERNEMATIDAE) ON THE RED IMPORTED FIRE ANT (HYMENOPTERA: FORMICIDAE) APPLIED AS MOUND DRENCHE AND BROADCAST SPRAY TREATMENTS

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ABSTRACT Pathogenicity of infective juveniles (IJs) of selected *Steinernema* spp. on field populations of the red imported fire ant (RIFA), *Solenopsis invicta* Buren, was ascertained using mound drench and broadcast spray treatments. No statistical differences were found between treatment programs. Monitoring individually marked mounds in treated areas generally provided a higher percent reduction value in mound activity than resulted from monitoring mound per unit area (0.25-acre plot).

The red imported fire ant (RIFA), *Solenopsis invicta,* Buren, has a distribution spanning the southeastern United States and continues to spread westward through Texas. RIFA is a serious pest impacting the lives of people both in rural environments. Problems range from a nuisance pest to life threatening through their sting to people, domestic and wild animals (Lofgren 1986). Management has focused on the use of insecticides (Drees and Vinson 1989) and non-chemical solutions are few. The recent development of low-cost, large-scale production of Entomogenous nematodes of the genera *Steinernema=Neoaplectana and Heterorhabditis* (Bedding 1984) has enabled large-scale field testing with modest success against a number of turf- and soil-infesting insect pests (Kaya 1985, Poinar 1986). Several researchers have examined the susceptibility of various fire ant species to strains of *S. carpocapsae* in laboratory bioassays (Poole 1976, Laumond et al. 1979, Quattlebaum 1980). We decided to further examine the efficacy of Steinernematidae on field populations of RIFA using a program if individual mound drench and broadcast spray treatments, and the combination of these methods.

Materials and Methods

The James Northrup turf farm in Brazoria County, Texas, was selected as the site for this test. Historically, this farm had received only spot treatments for RIFA. Circular 0.5 acre (within 0.8 acre square plots) plots were established for each of 8 treatments, replicated 3 times in a randomized block design. All active RIFA mounds were marked prior to treatment and monitored. Mounds were determined to be active if numerous ants emerged from mounds when disturbed (Frankie, 1983). Treatments were as follows:

1. 1 gal. water per mound (19 April, 9 May)
2. 2.0×10^5 infective juveniles (IJ's) per mound (19 April, 9 May)
3. 1.6×10^6 dissected IJ's per mound (19 April, 9 May)
4. 8.0×10^5 IJ's per mound (19 April, 9 May)
5. 1.6×10^6 IJ's per mound (19 April, 9 May)
6. 5 tablespoons hydramethylnon (Amdro®) per mounds (19 April)
7. 2.0×10^5 IJ's per mound followed by 200 IJ's per $inch^2$ broadcast (19 April), with repeated mound drenches (9 May)
8. 1.6×10^6 IJ's per mound followed by 200 IJ's per $inch^2$ broadcast (19 April), with repeated mound drenches (9 May)

The mean number of active RIFA mounds per plot was determined for each treatment and subjected to analysis of variance using the Least Significant Difference Test (P # 0.05)(Microsoft, 1981) for each monitoring date. Percent reduction was calculated using Henderson's Formula (Henderson and Tilton 1955).

Results and Discussion

No significant differences between the number of active mound per plot were documented during this demonstration (Table1). High variability and low number of replications may have been contributing factors. Heavy rains during the course of the monitoring period resulted in excessive mound movement in some of the plots. Regardless, percent reduction was calculated using Henderson's formula (Henderson and Tilton 1955). There was a trend for all treatments to eventually reduce active RIFA mound numbers relative to untreated plots. On the 25 April and 3 June evaluation dates, percent reductions calculated from data generated by monitoring individually treated and marked mounds were consistently higher than those calculated using number of active mounds per unit area (0.25-acre plot). Establishment of satellite mounds or excessive mound movement following nematode drenches has been observed in earlier tests (Miller, Drees, Vinson, and Georgis, in press).

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Table 1. Number of active red imported fire ant mounds per 0.25 acre plot and percent reduction in mound activity (Henderson and Tilton 1955) following individual mound treatments of water (drenches), hydramethylnon (Amdro®) bait or infectious juvenile (IJ) *Steinernema* spp. parasitic nematodes or mound drenches (19 April 1988 and May) or nematode mound drenches plus a broadcast application of nematodes (19 April) in a Brazos County, Texas commercial turf farm.

No. active fire ant mounds of initially marked set[1/]
(No. active mounds per 0.25 acre plot in parentheses) and percent reduction

Treatment and dose	19 Apr.	25 Apr.		9 May		3 June	
water drench	8.3a	6.3a	(7.3a)	3.7a	(9.7a)	6.3a	(9.7a)
2.0 x 10^5 IJ's drench	14.3a	7.0a 36%	(10.0a) 21%	5.7a 11%	(10.3a) 38%	3.3a 70%	(7.7a) 54%
1.6 x 10^6 desiccated IJ's drench	9.7a	2.7a 63%	(4.0a) 53%	5.0a 0%	(8.3a) 27%	3.7a 50%	(6.0a) 47%
8.0 x 10^5 IJ's drench	12.7a	3.3a 66%	(5.0a) 55%	4.7a 17%	(6.7a) 55%	3.3a 66%	(5.7a)0 62%
1.6 x 10^6 IJ's drench	12.7a	3.3a 69%	(5.7a) 49%	5.3a 6%	(11.0a) 26%	3.7a 61%	(9.0) 39%
hydramethylnon 4 tbsp/mound	15.7a	6.3a 47%	(9.0a) 35%	3.7a 47%	(6.7a) 64%	2.3a 81%	(6.7a) 64%
2.0 x 10^5 IJ's drench + broadcast (200 IJ's per square inch)	10.0a	8.7a 0%	(10.0a) 0%	6.7a 0%	(10.3a) 12%	5.0a 33%	(7.7a) 34%
1.6 x 10^6 IJ's drench + broadcast (200 IJ's per square inch)	12.0a	3.0a 67%	(5.7a) 46%	4.0a 25%	(6.3a) 55%	4.7a 48%	(8.0a) 43%
LSD (P # 0.05)	14.83	8.233	(9.939)	6.968	(9.959)	4.641	(8.374)

[2/] Means followed by the same letter are not statistically different using the Least Significant Difference analysis of variance (P # 0.05).

LABORATORY AND FIELD EVALUATION OF SODIUM ARSENATE BAIT STATIONS FOR RED IMPORTED FIRE ANT CONTROL

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Sodium arsenate (Fatsco® Ant Poison) and related compounds such as arsenic trioxide (Grant's Kills Ants®) have been formulated as containerized bait stations for use indoors to eliminate house-infesting ants. Some of these products have been marketed for the control of the red imported fire ant (RIFA), *Solenopsis invicta* (Buren). These tests were conducted to evaluate the effectiveness of these bait stations for eliminating laboratory and field RIFA colonies.

Materials and Methods

Laboratory trial: Eight field-collected standardized RIFA colonies were established and maintained under laboratory conditions and feeding schedule. On 29 March, 1989, four of these colonies were exposed to cotton balls (20mm diameter) saturated in the 3 percent sodium arsenic Fatsco Ant Poison solution. One sodium arsenate saturated cotton ball was placed in each 55mm diameter ant cup provided by Fatsco as a tamper proof bait station. Four other cotton balls were saturated with distilled water and placed in bait station to serve as controls. The ant colonies were exposed simultaneously. The number of worker ants, number of queens (dealate females) and the presence and type of brood (reproductive or worker) was determined prior to and following exposure of the colonies to the bait stations. The number of ants per colony for each post-treatment evaluation was subjected to analysis of variance using the Least Significant Difference test (P # 0.05).

On 13 April, 1989, this trial was repeated. However, the cotton balls in the bait stations were re-treated (with 2 droppers full of solution) every 2 to 3 days until 1 May, 1989, using a total of two 2 fl oz bottles of Fatsco or 1 fl oz per colony during the test period. Data and analysis was performed as described above.

Field trial: On 5 July, 1989, 30 RIFA mounds were located, marked with plot flags and numbered consecutively in 0.25 of a 0.25-acre circular plot (0.063-acre) established at the A&M Riverside Campus. A Fatsco Ant Poison cup, containing a cotton ball, was placed near each mound. In an adjoining 0.063-acre quarter circle and left as a control. On 6 July, 5 ml of Fatsco Ant Poison were added to each cup. The cups were recharged tree more times, approximately every four days with additional 5 ml doses. Each mound received a cumulative dose of 20 ml of Fatsco Ant Poison during the three week treatment period.

Mound evaluations were conducted weekly with each mound receiving a "+" or "-" indicating whether ants came to the surface with light mound disturbance. Evaluations were conducted at approximately 10:00 a.m. The final evaluation was conducted by digging the mound, observing brood presence and giving the mound an index value (Banks, 1986). New mounds in the two plots were also documented to determine charges in mound density. For analysis, the 30 sequentially-numbered mound sets in the treated and untreated plots were subdivided into 6 subsets of 5 mounds. The number of active RIFA mound within each subset was determined for each evaluation date, used to calculate plot means and subjected to analysis using the Students t test (P # 0.05). This procedure was also used to analyze resulting mound index values.

Results and Discussion

Laboratory trial: Prior to exposure to Fatsco ant bait (29 March, 1989), the eight laboratory colonies used for these trials were similar in vigor and reproductive status:

		No. workers		**Reproductive**	**Worker**
Treatment	**Colony**	**(1000's)**	**No. Queens**	**brood**	**brood**
Fatsco Ant Poison	18	40	1	-	+
(Sodium arsenate)	27	40	45	-	+
	26	40	25	-	+
	16	40	25	-	+
Untreated	20	50	60	-	+
	24	40	40	-	+
	19	40	15	-	+
	23	40	15	-	+

One week following treatment (6 April), there was no difference in the estimated number of RIFA per colony or reproductive status. However, there was a notable difference in the amount of food consumed by the ant colonies exposed to the Fatsco Formulation. Consumption estimated to be 50% less.

By April 17, the first evaluation of the 13 April to 1 May treatment regime, colonies that had received the Fatsco Ant poison had slightly fewer ants. However, consistent differences in estimated ant numbers did not occur until 8 May (**Table 1**). From that point, Fatsco-treated colonies declined through the course of the treatment period, but was never entirely eliminated.

Larvae in treated colonies were reduced both in number and in size, as only very small darker cream-colored larvae were detected. No loss in the number of queen ants was noted. On the 13 June evaluation, over 1 month following the last Fatsco Ant Poison treatment was determined to suppress colony size and development, but was not determined to effectively eliminate colonies during a reasonable treatment schedule.

<u>Field trial</u>: Results of the field trial were similar to those produced in the laboratory. The number of active mounds during the monitoring period were numerically decreased, but statistically they were decreased only on 4 and 25 August (**<u>Table 2</u>**), representing 16 and 41 percent reduction in active mounds respectively. Overall mound rating by the end of the monitoring period were suppressed due to hot, dry conditions. However, on 30 August, mean (± S.D.) mound index values were significantly suppressed in the plot containing 30 treated mounds: 10.3 ± 8.4 vs. 14.1 ± 8.4 (N = 28 vs 27; D.F. =53; t = -1.7055, P = 0.0470), a reduction of 27 percent index value. Eight new mounds were detected in the untreated (control) plot, while only occurred in the treatment plot, resulting in a total mound density of 464 vs 560 mounds per acre in the treated vs untreated plots.

The Fatsco Ant Poison was Found to be difficult to dispense safely with the cups provided. In liquid form, the sodium arsenate formulation can spill easily either when dispensing the solution or after the material has been placed in the cups. A safer application method should be developed to avoid accidental contamination to the user and the environment. Once the material had dried in the cup, then cotton ball was hardened and adhered tightly to the green vessel. Instructions for disposal of contaminated materials were not provided.

Results of these trials are similar to those obtained form test using arsenic trioxide bail stations. In that test, conducted 26 September 1988, three standard laboratory colonies were exposed to the bait stations and evaluated relative to 3 untreated colonies. The test was monitored until 17 October, 21 days following initial exposure. No elimination of worker brood or queen ants was documented, and no reduction in colony vigor was observed.

The arsenic (or arsenate) compounds tested for RIFA control failed to eliminate colonies. Apparently, the number of ants associated with a RIFA colony decreased the ability of these slow acting stomach poisons to reach and affect the queen ants. Although some worker ants may have been eliminated, sufficient numbers of worker (nurse) ants survived to care for the queen(s) and (diminished) brood.

Boric acid baits, registered for indoor ant control, are not know to effectively eliminate RIFA colonies. However, another bait, Raid® Max Ant Bait, containing sulfonamide (N-ethyl perfluorochlansulfonamide, 0.5%) and registered for control of ants indoors (black carpenter ants, Argentine ants, cornfield ants and pharaoh ants), has eliminated RIFA colonies in a similar (non-replicated) laboratory test. Amdro® (hydramethylnon) is also known to be an other hydramethylnon formulations (Combat® and Maxforce® bait stations) are registered for the control of other ant species indoors. These products may show promise for indoor RIFA control using a bait-station approach. However, in the absence of an effective bait registered for indoor RIFA control , current management tactics are restricted to surface treatments (emulsifiable concentrate, liquid, wettable powder, dust or granule formulations) to eliminate foraging working ants or fumigants (aerosols formulations) and injectable (dust, aerosols, sprays) materials to treat colonies detected inside wall voids or other structures (Drees and Vinson 1989, Owens 1983).

Banks, W.A. 1986. Control of imported fire ants with new insect growth regulator and fluorocarbon baits. Proc. 1986 Imported Fire Ant Conference (M. E. Mispagel, ed.). Univ. Ga, Athens, GA pp. 76-82.

Drees, B. M. and S. B. Vinson. 1989. Fire ants and their control. B-1536. Texas Agriculture Extension Service. Texas A&M University System, College Station, Texas. 12 pp.

Owens, J. M. 1983. House infesting ants. L-2061. Texas A&M University System, College Station, Texas. 4pp.

Table 1. Estimated of red imported fire ants and presence of worker brood per colony during a Fatsco Ant Poison (3% sodium arsenate) treatment period conducted from 13 April through 1 May, 1989, during which colonies received a total of 1 fl oz solution dispensed over 2 to 3 day intervals relative to untreated colonies.

	----April----		**--------------May--------------**				**June**
Treatment	**17**	**24**	**1**	**8**	**15**	**22**	**13**
	No. ants (thousands)/colony						
sodium arsenate	30*	22	22	18*	14*	11*	8*
untreated	45	22	22	34	30	31	23
	Worker brood						
Sodium arsenate	++++	few+	few+	++++	-+++	++++	-+++
untreated	++++	++++	++++	++++	++++	++++	++++

* Means significantly different (P#0.05) according to the Student, s t test.

Table 2. Active red imported fire ant mounds in 6 sets of 5 mounds following a 5 to 26 July 1989 treatment program in which mounds received weekly 5 ml doses (20 ml total) of sodium arsenate (Fatsco Ant Poison), relative to sets of untreated mounds, Brazos County, Texas.

Treatment	**4 Aug.**	**10 Aug.**	**21 Aug.**	**25 Aug.**	**30 Aug.**
	Active fire ant mounds/5				
untreated	5.0±0.0*	4.0±1.3	4.2±1.0	3.7±1.0*	3.8±0.9
sodium arsenate	4.2±0.8*	3.2±1.7	3.0±1.7	2.2±1.7*	3.1±1.7
t	-2.7116	-09552	-1.4725	-1.8495	-0.8617
P	0.0109*	0.1810	0.0858	0.0486*	0.2045
D.F. = 10					

* indicates significant difference in means in columns using the Student's t test (P # 0.05).

ACCEPTABILITY OF PLANT OILS TO THE RED IMPORTED FIRE ANT (HYMENOPTERA: FORMICIDAE

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Bait-formulated insecticides for the red imported fire ant (RIFA), *Solenopsis invicta*, normally are composed of de-fatted hydrogenated corn grit coated with soybean oil, which contains the active ingredient. Oil-soaked cards are also used to evaluate foraging intensity in field situations. These tests were conducted to evaluate if the soybean oil available at local grocery stores was as attractive as other plant-derived or vegetable oils.

Materials and Methods

A. TRIAL 1: To determine the acceptability of seven oils (**Table 1**) by RIFA, oils were presented to standardized laboratory colonies. Micro-Hematocrit tubes (capillary tubes) containing 40 mm. of each of the oil samples were presented to the ant colonies. The volume of oil consumed from each sample was calculated by measuring the length of the oil in the capillary tubes before and following by measuring the length of the oil in the capillary tubes before and following exposure and applying the formula: volume of a cylinder = length x pi x radius^2 (Note: inside diameter of Micro-Hematocrit tubes = 1.10 mm). Different methods of presenting the capillary tubes to the ants were used 1) tubes were imbedded in dissecting tray wax; 2) tubes were supported on microscopes slides and held in place using double-sided tape; and 3) tubes were inserted through holes made in Parafilm® stretched across a large petri dish. In all cases, the capillary tubes were tilted slightly (at approximately 11 degrees) to the horizontal with the lower end approximately 1 mm above the surface accessible to the foraging worker ants. The volume of oil consumed in each of the three trials testing delivery methods was analyzed as one test (3 replications) using the Least Significant Difference analysis of variance test (P # 0.05).

Table 1. Oil types offered to laboratory red imported fire ant colonies.

Oil type
1) NuMade® Natural Vegetable (Soybean) Oil
2) Mazola® Corn Oil
3) Hollywood® Safflower Oil
4) Olio Sasso® Olive Oil
5) Pompeian® Olive Oil
6) Numade® Sunflower Oil
7) Planters® Peanut Oil

B. TRIAL 2: Soybean, olive and pecan oil were offered to RIFA colonies in capillary tubes and the amount of material removed was recorded after 3 to 4 hours exposure. Four colonies (replications) were involved in each of two evaluations. Resulting oil consumed values were analyzed as above.

Results and Discussion

A. Results are presented in **Table 2**. The capillary tubes imbedded in dissecting tray wax did not result in a high level of oil consumption due to one or more factors: 1) smaller colony size or vigor which did not consume much oil, or 2) the ants spent more time consuming wax for nesting material, being distracted from feeding on the oils. The method in which capillary tubes were mounted on microscope slides with double-sided tape was the preferred, since the ants consumed the largest was the preferred, since the ants consumed the largest volume of oils when tubes were presented in this manner.

In this test, RIFA consumed various amounts of the oils tested (**Table 2**), preferring the Pompeian olive oil, numerically followed by sunflower oils. The remaining oils were not consumed to a great extent, but proved equally attractive statistically. RIFA consumed the least corn oil. Traditionally, soybean oil has been considered most attractive to RIFA., and has been used to a great extent in formulating insecticidal baits for this pest (Amdro® or Hydramethylnon, ProDrone, Logic® or fenoxycarb and Affirm® or avermectrin). Results show that RIFA favor certain types of oils over others.

Tables 2. Volume of various oils removed by red imported fire ant workers in laboratory colonies during a 3.75hr. exposure period.

Capillary tube holding method:	**Imbedded in wax**	**Supported on microscope slides tape**	**Stuck through Parafilm®**	
Colony:	**S**	**H**	**C**	
Sample no.	**Volume consumed (micro liters)**			**Mean**
1	1.9	2.8	4.7	3.1b
2	0.0	0.0	2.8	0.9b
3	1.0	5.7	3.8	6.0b
4	0.0	5.7	11.4	5.7b
5	0.0	29.4	38.0	22.5a
6	0.0	24.7	2.8	9.2ab
7	0.0	5.7	3.8	3.1b
1-7	0.41	10.57a	9.61ab	LSD 5% =14.7
	LSD 5% = 9.638			

Note: Means followed by different letters in last column or across bottom of table are significantly different from on another using the Least Significant Difference (LSD) analysis of variance (P#0.05).

B. Soybean, olive and pecan oil were statistically equally attractive in these two evaluation, although ants consumed a greater volume of olive oil:

--Micro liters of oil consumed-

Exposure time	**Soybean**	**Olive**	**Pecan**	**LSD (5%)**
3 hours	12.5a	21.3a	17.8a	9.18
4 hours	23.5a	33.8a	22.6a	16.82

Pecan oil may a suitable substitute for soybean oil in the formulation of bait-formulated insecticides provided that the oils are cost equivalent. These results also support the observation that RIFA will forage in cracked pecans on the orchard floor, presumably to feed on the pecan oil.

EFFICACY OF PECAN ORCHARD FLOOR TREATMENT FOR THE SUPPRESSION OF THE RED IMPORTED FIRE ANT

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Bastiaan M. Drees, Professor and Extension Entomologist

Few insecticide products are registered for suppression of red imported fire ants, *Solenopsis invicta* Buren, in pecan orchards. Chlorpyrifos-containing products, Lorsban® 4E, 50wp and Lorsban® 15G, are currently registered at a rate of 1 pound active ingredient per acre in bearing pecan orchards. This demonstration was conducted to provide documentation of the effectiveness of using Lorsban 50WP and 4E for fire ant suppression.

Materials and Methods

This demonstration was conducted in the 33 acre Komensky Orchard containing primarily the pecan variety 'Choctaw'. No mechanical harvesting machinery was used in this operation. Thus, the crop was allowed to remain on the orchard floor for up to a week prior to harvest. Tree spacing is 35 feet. On 29 September 1990, plots were established and three treatments were applied: 1) 3 lb. Lorsban® 50WP/30 gal./acre; 2) 3 lbs. Lorsban® 50WP + 1 pint Lorsban® 4E/30 gals./acre; 3) Untreated Check plot.

On 17 and 30 October, red imported fire ant activity was monitored using ten 1 in. x _ in. olive oil-soaked index cards placed on the ground along the transect lines through treatment plots for approximately 1 hour. The number of ants associated with each card was estimated.

By October 30, 1990, we had been informed that a portion of this orchard had been treated with Logic® (fenoxycarb) in 1989. Since Logic has been reported to have effects lasting for up to two years, oil-soaked cards were placed in transect lines in an area of the orchard that had been treated with Logic® in 1989 and Lorsban in 1990, and one which had never been treated. Results were analyzed using the Student's t test (P # 0.05).

Results and Discussion

Red imported fire ant activity, as indicated by the average (mean) number of ants attracted to oil-soaked cards, in Lorsban® treated plots was significantly reduced 18 days following application:

Untreated Check :	74.0 ± 27.4 S.D.
3lbs. Lorsban WP:	0.3 ± 9.5
3 lbs. Lorsban WP + 1 pint Lorsban 4E:	0.0

Results from the 30 October (31 days after Lorsban application) fire ant monitoring efforts document suppression of ant numbers in the area of the orchard treated with Logic in 1989. Added suppression of ant foraging was noted in Lorsban-treated plots:

		N	**t**	**P#**	**d.f.**
Untreated control:	45.00 ± 15.81	10	-2.13	0.02	18
Logic (1989):	25.4 ± 24.4	10			
Logic (1989):	25.4 ± 24.4	10	-3.00	0.00	18
Lorsban (19901) + Logic (1989):	2.0 ± 3.16	10			

EVALUATION OF CHLORPYRIFOS TRUNK TREATMENTS ON THE RED IMPORTED FIRE ANT, APHIDS AND NATURAL ENEMIES IN PECAN TREE CANOPIES

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The red imported fire ant, *Solenopsis invicta* Buren, is suspected of aggravating aphid (yellow pecan aphid, *Monelliopsis pecanis* Bissell; blackmargined aphid, *Monellia carvella* (Fitch) outbreaks in pecans by preying on beneficial insects such as the green lacewing *(Chrysoperia* spp.), (Tedders et al. 1989). A trunk spray of chlorpyrifos has been shown to be an effective, long lasting barrier to keep ants out of tree canopies (Drees, Ree and Barr, 1990). This study was undertaken to determine whether elimination of fire ant foraging from the tree canopy using a trunk spray would have an impact on aphid population densities and/or populations of natural enemies of aphids.

Material and Methods

On 5 July 1990, four plots were established in a non-bearing section of a pecan orchard (Royalty Pecans) in Burleson County, TX. Plots were established that were five tree rows wide and seven tree rows deep on a tree spacing of 36 feet (38,880 sq. ft. or 0.89 acre). All of the trees in two of the blocks were treated with a trunk from the ground to a height of 4 feet. The remaining blocks were left untreated.

Aphid and natural enemy population densities were monitored by selecting ten compound leaves on each of six marked trees was monitored by stapling a one-inch square olive oil-soaked index card to the trunk at eye level (above the treatment line) and estimating the number of worker ants associated with each card after approximately one hour of exposure. Post-treatment monitoring efforts were conducted on 31 July, 11 and 20 August. For each monitoring date, the number of aphids per leaf, percent leaves containing natural enemy life stages (green lacewing larvae, eggs, adults, etc.) per 10-leaf sample and the number of fire ant worker ants attracted to oil-soaked cards were analyzed for treated and untreated plots using the Student's t test (P # 0.05).

Results and Discussion

For the two months following trunk treatments, fire ant foraging into pecan tree canopies was significantly reduced:

Mean no. ants per oil-soaked card

Date	Treated trunks	Untreated trunks	t	P#	d.f.
31 July	1.33 ± 3.37 S.D.	9.91 ± 6.96 S.D.	3.85	0.00	22
31 August	0.0	11.17 ± 10.07	3.84	0.00	22

Aphids numbers in all plots declined dramatically in August (**Table 1**). Initially, untreated plot trees contained more aphids. However, within 26 days after treatment, treated trees contained more aphids per leaf as well as significantly more percent leaves with natural enemy life stages. By 11 August, treated trees averaged fewer aphids per leaf than did untreated plot trees. No statistical differences between trunk treated and untreated plots were detected thereafter.

Additional data will be required before confidence can be raised for the use of trunk treatments to effect aphid population densities or to document a case where the treatment of tree trunks to eliminate ant foraging prevents an insecticide application for a potentially damaging population of aphids.

Table 1. Aphid and natural enemy density estimates in pecan orchard plots after receiving (treated) or not receiving (untreated) chlorpyrifos trunk sprays, 5 July 1990. Royalty Pecans, Burleson County, Texas.

	Mean no. aphids per leaf		Percent Leaves with natural enemies	
Date	**Treated**	**Untreated**	**Treated**	**Untreated**
5 July	16.6 ± 25.7*	27.6 ± 33.7*	11.7 ± 14.0**	26.7 ± 20.2**
31 July	26.5 ± 25.5*	11.2 ± 13.0*	40.8 ± 16.8**	24.2 ± 16.2**
11 August	0.4 ± 0.8*	2.5 ± 5.1*	7.5 ± 8.7	10.0 ± 10.4
20 August	0.4 ± 1.9	0.6 ± 1.8	9.1 ± 12.4	13.3 ± 13.7

* Significantly different (P #0.05) according to the Student's t test (5 July, t = 2.83, d.f. = 283; 31 July, t = -5.73, d.f. = 233; 11 Aug., t = 4.57, d.f. = 238

** Significantly different (P #0.05) according to the Student's t test (5 July, t = 2.11; 31 July, t = -2.48; d.f. = 22).

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