**1997-1999 - RESULT DEMONSTRATION HANDBOOK**
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## Acknowledgments

The authors would like to thank the following companies and individuals who have supported the work of the TAEX Fire Ant Applied Research Program through direct grants, gifts and/or donations of products.

Alternative Control Systems Corporation, Columbia, SC

American Cyanamid Company, Parsippany NJ

Aventis (Rhone-Poulenc), Lyon, France

Dow AgroSciences LLC, Indianapolis, IN

DSC Inc., Dallas, TX

Fire Ant Control Company, Waco, TX

FMC, Chicago, IL

Garden-Ville Fertilizer Co., San Antonio, TX

Dr. Warren Hardwick

Novartis Crop Protection, Inc., Greensboro, NC

The Scott's Company (Ortho), Columbus, OH

TXI, Dallas, TX

Valent USA Corporation, Walnut Creek, CA

Wellmark International, Bensenville, IL

## Disclaimer

Neither the Extension service nor the Texas Fire Ant Research and Management Plan endorses or discourages the use of any of the products mentioned in this text.

Because of rapid changes in product development, regulatory and market conditions and ongoing scientific research, product names and availability may change. Product names and formulations used here were those from the product label itself or those suggested by the manufacturer at the time the tests were conducted.

**Logic® Plus Fertilizer Blends and Alternative Coverage Application Test**
**Granger Lake, Williamson Co., Texas - 1997-98**

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David Herd, Herd Seeder Co., Inc.
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Some ranchers in Texas have been known to mix Logic® fire ant bait with dry fertilizer to reduce the need for buying a specialized bait spreader and eliminate an additional pass over a field specifically for fire ant control. Though this practice certainly reduces immediate costs for the rancher, there is evidence that mixing soybean oil-formulated fire ant bait with fertilizer quickly reduces the attractiveness of the bait to fire ants resulting in less or no control. This test was designed to simulate actual field use of fertilizer and Logic® (1.0% fenoxycarb) application rates and equipment as closely as possible. Therefore, plot size was set at three acres to increase application realism, but at the cost of replications, which may have yielded better statistical data.

**Materials and Methods**
Seven three-acre rectangular plots (450 ft. x 300 ft.) were established along the earthen dam of Granger Lake, Williamson Co., TX on 15 October 1997. Turn rows of 50 ft. width were left between all plots to minimize overlapping of broadcast treatments and "bleeding" of Logic effects between plots. Each plot was randomly assigned one of the following seven treatments:

| Treatment name | Fertilizer | Logic® /acre rate | Equipment | Coverage, swath |
|---|---|---|---|---|
| untreated control | - | - | - | - |
| Logic | none | 1.5 lb. | Herd seeder | full, 35 ft. center |
| Logic Skip | none | 1.5 lb. | Herd seeder | skip, 50 ft. center |
| Logic Low Rate Skip | none | 1.0 lb. | Herd seeder | skip, 50 ft. center |
| Logic + Fertilizer Mix | dry granular | 1.5 lb. | PTO fert. cart | full, 60 ft. center |
| Logic + Fertilizer Tandem | dry granular | 1.5 lb. | Herd seeder on fert. cart | 50 ft. center (full fert., skip Logic) |
| Logic + Liquid Fert. Tandem | liquid | 1.5 lb. | Herd seeder, 40 ft. boom cart | 40 ft. center (full fert., semi-skip Logic) |

Treatments were applied on 21 October 1997 from approximately 10:30 a.m. - 3:00 p.m. Weather conditions were warm, partly cloudy, calm and dry in the morning, turning cooler, windy and mostly cloudy in the afternoon. A brief rain occurred around 1:00, but was barely enough to wet the ground. Dry fertilizer was applied using a Terra, twin fan, PTO powered, pull-behind cart with a swath width of approximately 60 feet. Liquid fertilizer was applied using a ground-powered, pull behind cart with a 40-foot boom. Logic was applied using a Herd GT-77 electric seeder with a fixed gate, modified and mounted on the fertilizer cart by Mr. David Herd of Herd Seeder Co.

Inc. Treatments applied as “tandem” were accomplished using the Herd Seeder and fertilizer spreader simultaneously, but with no intentional blending or mixing of the two materials.

Evaluations were conducted by counting all the active mounds in 30 ft. wide transects running 300 ft. across the plots (0.21 ac.). Four, randomly placed transect counts were made for each plot on 21 November 1997 and 4 February 1998. Because of the slow-acting nature of Logic, the first evaluation was considered a pre-count. Active mound numbers in an adjoining test of a faster-acting fire ant product actually increased during this time period due to rainfall and more moderate temperatures.

Two statistical tests were conducted to better analyze data. Duncan’s multiple range test was used to better separate the subtle differences that appeared in the data. Tukey’s studentized range test was used to reduce Type I error. Only Tukey’s was performed on the five-month data.

**Results**

Mean no. active mounds (in 4 random 0.21 ac. transects) per plot

| **Treatment** | **Pre-count** | **15 weeks** | **change vs pre** | **5 months** |
|---|---|---|---|---|
| Untreated | 19.75 abc/ab | 20.25 a/a | 2.5% | 14.25 a (Tukey) |
| Full Logic | 15.50 bc/ab | 7.25 b/b | - 53.2% | 5.25 b |
| Logic Skip | 22.00 ab/ab | 8.75 b/ab | - 60.2% | 6.75 b |
| Logic Low-rate Skip | 13.25 c/b | 9.00 b/ab | - 32.1% | 8.50 ab |
| Logic+Fert Mixed | 22.00 ab/ab | 14.00 ab/ab | - 36.4% | 8.25 ab |
| Logic+Fert Tandem | 25.25 a/a | 18.25 a/ab | - 27.8% | 15.50 a |
| Logic+Liquid Fert | 14.50 c/b | 16.00 ab/ab | 10.3% | 8.75 ab |
| ~~F~~ | ~~3.84~~ | ~~3.50~~ | ~~-~~ | ~~5.77~~ |
| *P* | 0.0096 | 0.0147 | - | 0.0011 |
| $R^2$ | 0.5235 | 0.5002 | - | 0.6223 |

Data analyzed using PC SAS ANOVA procedures. Means in the same column with different letters are significantly different ($P<0.05$) using Duncan’s multiple range test/Tukey’s studentized range test.

**Discussion**

Given the mild, wet weather that the test site received after treatments were applied, it was unlikely that Logic treatments reached their level of maximum suppression by early February. However, there appear to be some strong trends emerging. The number of active mounds in the untreated plot stayed very constant, despite the use of randomly placed transects for evaluations. Full coverage, full rate Logic and skip swath, full-rate Logic resulted in a greater than 50% reduction in mound numbers that were significantly ($P < 0.05$) lower than mound numbers in the untreated plot. These results are consistent with those from past trials on this and other sites with similar treatments. It would be expected that active mound counts would continue to decline into the 80-95% control range.

The low-rate skip-swath and two dry fertilizer treatments had numerically lower rates of control than the conventional and skip swath applications without fertilizer, but the differences were not statistically significant ($P < 0.05$). Results may be indicative of not enough viable product reaching all the colonies to affect them. The reasons could be several-fold. Laboratory preference tests performed in conjunction with this test and on other, similarly-formulated products suggest that fertilizer quickly reduces the attractiveness of soybean oil formulated baits. Though this would account for the lower performance of the bait mixed with fertilizer, it would not account for the low-rate skip-swath or the tandem application. These two treatments were applied later in the day after a cold front passed through the area. Since both baits were applied on 50 ft. centers, as was the conventional skip swath, it could be assumed that the cooler weather reduced ant foraging on what might have been a threshold level of Logic, resulting in an insufficient dose to some colonies.

The Logic applied in tandem with liquid fertilizer actually saw a 10% increase in mound numbers, possibly indicating that bait granules in contact with liquid fertilizer quickly lose their attractiveness to ants or that liquid fertilizer deters ant foraging for some time.

Results of the test are somewhat inconclusive given the fact that it was not replicated, due to the large size of the plots, and given the season and weather conditions. However, the loss of statistical rigor was at least partially offset by accurate representation of field use conditions. Application of fire ant control baits to pastures, particularly those being hayed, is encouraged in the fall for maximum mound suppression the following spring. These results reinforced the recommendation that soybean oil formulated fire ant bait NOT be mixed or over-sprayed with fertilizer, but that skip swath application of Logic at 0.75 lb/acre is a viable means of cutting costs in half while maintaining similar rates of control.

**A Long-term Study of the Effects of Granular and Bait Formulations of Fipronil on the Suppression of Fire Ant Colonies Granger Lake Dam, Williamson Co., Texas - 1997-2000**

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Fipronil is an insecticide effective in extremely low concentrations. Some reports also show residual activity for over a year against red imported fire ants (*Solenopsis invicta* Buren) when applied as a broadcast granular toxicant. This test was designed to evaluate fipronil's effectiveness and residual activity both as a bait and as a granular material applied at three different rates.

**Materials and Methods**

The test was located on the earthen dam impounding Granger Lake, Williamson Co., Texas. The area is controlled by the U.S. Army Corps of Engineers and public access is strictly limited. The site is mowed two or three times per year and is not grazed or hayed. Soil is primarily a heavy, black clay with high shrink-swell properties.

Plots consisted of 150 x 235 foot rectangles (0.81 acres) with a 0.25 acre circular sampling area (59 foot radius) at the center. Pre-counts were made on 24 October 1997 using the minimal disturbance technique in which mounds were disturbed with a pointed tool handle until ants emerged in a defensive manner. Plot counts were arrayed from lowest to highest, divided into four equal replications and treatments assigned within replications so that the total number of mounds for each treatment (all four replications) was as equal as possible. Treatments included:

| Treatment | Lbs a.i./acre | Lbs. material/acre | Application method |
|---|---|---|---|
| untreated | — | — | --- |
| fipronil, 0.1% granules | 0.0125 | 12.5 | broadcast |
| fipronil, 0.1% granules | 0.01875 | 18.5 | broadcast |
| fipronil, 0.1% granules | 0.0250 | 25.0 | broadcast |
| fipronil, 0.0015% bait | 0.0000225 | 1.5 | broadcast |
| hydramethylnon 0.7% bait | 0.0105 | 1.5 | broadcast |
| 50% chlorpyrifos | 8.0 | 16.0 | boom sprayer |

Treatments were applied 31 October and 3 November 1997. Due to a shortage of granular material, only three replications of the 0.025 rate of fipronil were applied. Evaluations were conducted on 25 November 1997, 28 January, 14 April 1998, 7 January 1999 and 12 January 2000. For the first three evaluations, the first five mounds encountered when sampling were dug with a shovel and rated on a scale of 1-5 for the relative number of ants present with a multiplying factor of 5 if worker brood was observed. The remainder of the plot was evaluated using the minimal disturbance technique to count active mounds. Due to unfavorable weather conditions, meaningful brood ratings could only be made during the 25 November evaluation.

**Results**

*Mound Evaluations*

Mean number of active ant mounds per 0.25 acre plot (4 replications)

| Treatment | Pre-count | 1 month | 3 months | 5 months | 14 months | 27 months |
|---|---|---|---|---|---|---|
| **untreated** | 16.00 a | 32.00 a | 17.50 a | 8.25 a | 18.50 a | 21.50 a |
| chlorpyrifos | 16.50 a | 3.75 c | 0.75 b | 0.50 b | 12.25 b | 19.00 a |
| hydramethylnon | 15.75 a | 13.50 bc | 1.50 b | 0.50 b | 12.00 b | 16.50 a |
| fipronil 0.0125 G | 16.00 a | 20.50 ab | 0.50 b | 0.00 b | 1.75 d | 5.75 b |
| fipronil 0.01875 G | 16.00 a | 22.00 ab | 1.50 b | 0.50 b | 0.00 d | 4.00 b |
| fipronil 0.0250 G* | 16.00 a | 21.33 ab | 0.67 b | 1.00 b | 1.33 d | 4.00 b |
| fipronil bait | 15.75 a | 15.50 b | 0.50 b | 1.25 b | 7.00 c | 6.00 b |
| F | 8.09 | 3.03 | 16.66 | 7.04 | 14.02 | 6.72 |
| *P* | 0.0001 | 0.0236 | 0.0001 | 0.0003 | 0.0001 | 0.0004 |
| $R^2$ | 0.8107 | 0.6159 | 0.8981 | 0.7885 | 0.8813 | 0.8076 |

* Only 3 replications were applied due to insufficient product
Data analyzed using SAS GLM procedure (due to unequal sample size) with means separated using Duncan's Multiple Range Test. Means in the same column followed by different letters are significantly different (*P* <0.05)

*Brood Rating (25 November 1997 only)*

Ratings of first five active mounds found in plots

| | untreated | ------------------fipronil------------------ 0.0125 | 0.0188 | 0.025 | bait | Amdro | Dursban |
|---|---|---|---|---|---|---|---|
| Total rating | 291 | 197 | 125 | 114 | 53 | 217 | 47 |
| Number mounds* | 20 | 20 | 20 | 19 | 6 | 20 | 15 |
| Mean rating | 14.55 a | 9.85 ab | 6.25 bc | 10.74 ab | 5.17 bc | 10.85 ab | 3.13 c |

* some plots with fewer than 5 active mounds
Data analyzed using SAS General Linear Model procedure (due to unequal sample size) with means separated using Duncan's Multiple Range Test. Means followed by different letters are significantly different (*P* <0.05).

**Discussion**

Active mound numbers actually increased from the date of treatment to the one month evaluation, except in chlorpyrifos-treated plots, due to rain and cooler temperatures. However, significant ($P$<0.05) differences were found between treatments. Chlorpyrifos, applied as Dursban 50WP, 8 lbs./acre active ingredient (the USDA quarantine mandated rate), resulted in 88% control compared to untreated plots within one month. The fipronil and Amdro baits had reduced active mound numbers by about 50% at this time.

By the three month evaluation, all treatments had significantly fewer active mounds than untreated plots. There were no statistical differences between any of the treatments. This pattern continued to the five month evaluation. Note that the number of active mounds found in untreated plots at the five-month evaluation dropped by about half compared to pre-count levels, due to an unusually warm, dry spring that preceded what became a record-breaking drought during the summer of 1998.

At 13 months post-treatment, the granular fipronil-treated plots averaged fewer than two mounds per plot with the 0.01875 lb/ac treatment showing 100% control. The 27 month post-treatment evaluation showed that both the Amdro and Dursban-treated plots were back to pre-treatment infestation levels. All the fipronil-treated plots, however, had significantly ($P$<0.05) fewer active mounds than untreated plots. These plots maintained 75-81% control versus untreated, Dursban-treated and Amdro-treated plots.

Mound condition at the time of the final evaluation indicated that large, healthy colonies were able to exist within the treated areas, so any further evaluations would only monitor natural re-infestation. Therefore, the test was discontinued, even with the fipronil treatments showing such a high level of control. Control of this magnitude and duration, particularly from a granular, contact insecticide, far exceeds any product performance tested in recent years.

## Small-Plot Spinosad Bait Efficacy Trial
## Coulter Field, Brazos County, Texas - 1998

Charles L. Barr,
Extension Program Specialist - Fire Ant Project

Spinosad is a compound derived from a bacterial fermentation process and found to be highly effective against insects at extremely low concentrations. The following test was conducted to determine the compound's efficacy when formulated and applied as a 0.015% broadcast bait for the elimination of red imported fire ant (*Solenopsis invicta* Buren) mounds in non-agricultural land.

### Materials and Methods

The test site was located at Coulter Field, the municipal airport serving Bryan, Texas. The site is located on shallow sandy soil over claypan with a vegetative cover of native grasses. The area is routinely mowed two or three times per year by the City of Bryan and has not been grazed or hayed in many years.

Plots consisted of 105 x 105 ft. squares with 40 ft. radius circular sampling areas (0.11 acre) at their centers. All active mounds were counted within the circle. Mound activity was determined using the minimal disturbance technique in which the mound was lightly disturbed with a pointed tool handle. The mound was considered active if a sufficient number of ants rose to the surface in a defensive manner within approximately 15 seconds of disturbance. Plots were set up and pre-counts made on 19 May 1998.

Pre-count numbers were arrayed from lowest to highest then divided into four equal groups (replications) of four plots each. Treatments were assigned within replications so that the total number of mounds for each treatment was as equal as possible. In this way, a full set of treatments were applied to plots of low through high mound density while keeping the total number of treated mounds approximately equal for each product. Products were applied the evening of 20 May 1998 with a bait blower apparatus to the entire square plot. Treatments included:

| Treatment | Rate |
|---|---|
| Untreated | — |
| Amdro® (0.73% hydramethylnon) | 1.5 lbs. per acre |
| spinosad (0.015%) | 1.5 lbs. per acre |
| spinosad (0.015%) | 3.0 lbs. per acre |

Evaluations were conducted May 20, 5 June, 25 June and 9 October 1998 using the minimal disturbance technique. Results were analyzed using PC SAS analysis of variance procedures with means separated using Tukey's studentized range test ($P<0.05$) except where noted.

**Results**

Mean number of active mounds per 0.11 acre plot (4 replications)

| Treatment | pre-count | 9 days | 16 days | 35 days | 20 weeks* |
|---|---|---|---|---|---|
| Untreated | 14.75 a | 11.75 a | 10.50 a | 13.50 a | 10.50 a** |
| spinosad 1.5 lb/ac | 11.75 a | 3.00 b | 1.50 b | 3.00 b | 17.50 a |
| spinosad 3.0 lb/ac | 12.00 a | 3.50 b | 1.00 b | 2.50 b | 11.50 a |
| hydramethylnon | 12.75 a | 2.25 b | 1.25 b | 0.00 b | 7.50 a |
| $F$ | 3.92 | 4.66 | 13.89 | 53.63 | 0.93 |
| $P$ | 0.0311 | 0.0199 | 0.004 | 0.0001 | 0.5460 |
| $R^2$ | 0.7234 | 0.7566 | 0.9025 | 0.9242 | 0.4215 |

Means followed by different letters are significantly different when analyzed by PC SAS analysis of variance procedures (PROC ANOVA). Means were separated using Tukey's studentized range test, $P < 0.05$.
*analysis using general linear model procedures (PROC GLM) due to missing data points.
** only two data points

**Discussion**

As shown by the results, both rates of spinosad resulted in a rapid decrease in mound numbers that persisted through 35 days post-treatment. Mound reductions are similar to that of hydramethylnon (Amdro®) and all were significantly lower ($P$<0.05) than active mound counts in untreated plots. Though not significantly different ($P$<0.05), the spinosad treatments had more active mounds than Amdro at five months post-treatment. Further testing under better weather conditions is needed to determine if this shortened period of control is a characteristic of spinosad bait or a numerical anomaly of this test site and/or the extreme weather conditions.

The test was initiated in May after about three weeks without rain. Record-breaking 100EF temperatures persisted throughout the summer and significant rainfall was not received until mid-September. During this period, the ants ceased mound building and would not reliably rise to the surface, even in occupied mounds. Consequently, evaluations did not resume until the ants began mound building in early October when rain was received and the weather cooled .

To further complicate the test, the site was mowed by Extension personnel in late September. A week or so later, and without our knowledge, the City of Bryan mowed the site again, destroying all the plot markers in this and an adjacent test. Consequently, counts for the final evaluation were made from re-located plot centers and may not be completely accurate, though counts show definite re-infestation of the area. Two untreated plots could not be accurately re-located. Statistical analysis reflects this by using only two untreated plot numbers and the general linear model procedure that accounts for missing data points. In conclusion, the 0.015% spinosad bait gave rapid (9 day) elimination of ant activity in fire ant mounds, comparable to that produced by Amdro, currently the fastest-acting broadcast bait available. Though activity was similar, the amount of active ingredient applied to an acre for spinosad is less than 1/45th that of the active ingredient of Amdro.

**Efficacy Testing of Clinch™ Broadcast Bait for the Control of Red Imported Fire Ants in Pecan Orchards Burleson Co., Texas - 1998**

Charles L. Barr, Extension Program Specialist
Rody L. Best, Extension Assistant

Red imported fire ants (*Solenopsis invicta* Buren) have been reported as a pest in pecan orchards damaging irrigation equipment, consuming certain varieties of fallen pecans, interfering with harvesting equipment, endangering workers (particularly when shaking trees for harvest) and possibly reducing the number of beneficial insects. Clinch™ (0.011% abamectin), produced by Novartis Crop Protection, is a conventionally formulated broadcast bait product currently labeled for use on non-crop and a few agricultural sites. This test was conducted to demonstrate the efficacy of Clinch in reducing fire ant mound numbers in pecan orchards to provide data for future label expansions.

**Materials and Methods**

The test site was located in Burleson Co., Texas in a non-bearing section of a large pecan orchard. Trees were spaced at 45 feet, so they were used as convenient plot boundary markers. Treatments were made on plots consisting of a square of three inter-tree spaces on a side (135 feet, 0.42 acres). The sampling area was the central 45 x 45 foot square delineated by a tree at each corner. An untreated buffer of one inter-tree space (45 feet) was left around all sides of every plot.

Pre-counts were made on 26 October 1998 using the minimal disturbance technique. Mound numbers were arrayed from highest to lowest and divided into four equal groups (replications). Treatments were assigned within groups so that the total number of mounds for each treatment (sum of four replications) was as equal as possible. Baits were applied in the afternoon and evening of 26 October using a Herd GT-77 seeder mounted on a John Deere ‘Gator utility vehicle. Ch The weather was mild and dry and the ants were actively foraging. Chlorpyrifos was applied using a 12V boom sprayer towed behind a pick-up truck.

Treatments included:

| Treatment | Rate | Application |
|---|---|---|
| untreated control | – | – |
| Clinch® (0.011% abamectin) | 1.5 lbs/acre | broadcast bait |
| Logic® (1.0% fenoxycarb) | 1.5 lbs/acre | broadcast bait |
| Lorsban® 4E (44.9% chlorpyrifos) | 4 pts/acre | orchard floor spray, 20 gal./ac. solution |

Post-treatment counts were conducted on 3 and 16 November and 1 December 1998. Data were analyzed using PC SAS analysis of variance procedures with means separated by Duncan’s multiple range test ($P < 0.05$).

**Results and Discussion**

Mean number of active mounds per 0.046 acre sampling area (4 replications)

| Treatment | Pre-count | 1 week | 3 weeks | 5 weeks |
|---|---|---|---|---|
| Untreated | 16.00 a | 12.50 a | 7.75 a | 4.75 a |
| Clinch® (0.011% abamectin | 16.50 a | 6.25 ab | 4.25 a | 1.25 b |
| Logic® (1.0% fenoxycarb) | 17.00 a | 14.75 a | 7.25 a | 3.75 ab |
| Lorsban® 4E (44.9% chlorpyrifos) | 17.25 a | 3.00 b | 3.00 a | 1.75 ab |
| *F* | 9.90 | 4.28 | 2.72 | 2.21 |
| Probability | 0.0015 | 0.0257 | 0.0860 | 0.1372 |
| $R^2$ | 0.8684 | 0.7405 | 0.6446 | 0.5956 |

Means in the same column followed by different letters are significantly different using Duncan's multiple range test ($P < 0.05$) for mean separations.

Considerable rain and cooler temperatures were experienced after treatment which caused colonies to relocate and overall mound numbers to drop. Weather conditions also resulted in increased variability within treatments as shown by dropping $R^2$ values over the course of the test and lack of significant differences between treatments at three weeks. As expected, the Lorsban 4E treatment significantly ($P < 0.05$) reduced active mound numbers versus untreated and Logic-treated plots within a week. Clinch showed 50% control at this time, though the reduction was not significantly different. By five weeks post-treatment, Clinch showed a significant ($P < 0.05$) reduction in mound numbers versus untreated controls with about a 75% reduction in active mounds. Results provide support that Clinch, applied as a broadcast bait at 1.5 lbs./acre, significantly reduces active fire ant mound numbers within five weeks of application. The test was not monitored long enough to record maximum control from Logic treatments.

**Rate Test of Spinosad-based Broadcast Bait for the Suppression of Red Imported Fire Ants in Large Plots Brazos, Co., Texas - 1997-1998**

Charles L. Barr, Extension Program Specialist
Rody L. Best, Extension Assistant

Spinosad, manufactured by Dow AgroSciences, is a bacterially-derived metabolyte that is effective in very low concentrations and has been shown to control a wide variety of insects. This test was designed to test the efficacy of 0.015% spinosad formulated as a conventional, soybean oil-based broadcast bait at varying application rates on large plots in an unimproved pasture. To utilize the available space and common treatments, other broadcast bait treatments were included in this trial. Those results are reported separately (see Evaluation of Skip Swath and Hopper Blend Applications of Extinguish™ for Red Imported Fire Ant Control).

## Materials and Methods

The test site was located approximately eight miles east of Bryan, Texas in Brazos County. Applications were made to an ungrazed pasture consisting of heavy clay soil. The area was just emerging from a record-breaking drought during the summer of 1998. Though the pasture was very rough due to large, visible fire ant mounds, most of the mounds were unoccupied by ant colonies. Those that were, usually contained rather small colonies nesting on only a portion of the mound structure.

Square plots, 210 x 210 feet (approx. one acre) were laid out in an irregular pattern following fence lines and the shape of the pasture. Plots were established with adjoining boundaries. A 0.25 acre circular sampling area was established in the center of each plot using 3/8" reinforcing rod as a permanent center marker which allowed for a treated buffer of at least 45 feet between a sampling area and the nearest plot border.

Active mound numbers were determined on 9 October 1998 using the minimal disturbance technique. Plots with a suitable number of mounds were arrayed from highest to lowest and divided into four equal groups (replications). Treatments were assigned within replications so that the total number of mounds for each treatment (total of four replications) were as equal as possible. Treatments were applied 13-14 October using a Red Ball® seeder mounted on a John Deere 4x6 'Gator utility vehicle. Weather during application was mild and sunny and ants were actively foraging.

Post treatment evaluations were made on 28 October, 11 November and 14 December 1998 and 1 April 1999. Evaluations were made using the minimal disturbance technique. In late March we were notified that the site had been sold to the poultry farm adjacent to the property and was to be used for litter disposal. Within two weeks of the final evaluation, the land was plowed and the site had to be abandoned.

Treatments for this portion of the test included:

| Treatment | Rate | Application |
|---|---|---|
| untreated control | – | – |
| spinosad (0.015%) | 1.5 lbs/acre | full broadcast coverage |
| spinosad (0.015%) | 3.0 lbs/acre | full broadcast coverage |
| spinosad (0.015%) | 5.0 lbs/acre | full broadcast coverage |
| Amdro® (0.75 hydramethylnon) | 1.5 lbs/acre | full broadcast coverage |

**Results**

Mean number of active mounds in 0.25 ac. circle, 4 replications

| Treatment | pre-count | 2 weeks | 4 weeks | 8 weeks | 24 weeks |
|---|---|---|---|---|---|
| untreated | 15.75 a | 26.75 a | 24.50 a | 27.25 a | 19.25 a |
| spinosad 1.5 | 16.00 a | 12.25 b | 10.25 b | 10.00 b | 5.75 b |
| spinosad 3.0 | 15.75 a | 9.25 b | 6.50 b | 6.50 b | 4.00 b |
| spinosad 5.0 | 15.75 a | 4.50 b | 5.00 b | 4.25 b | 2.75 b |
| Amdro® full | 15.75 a | 6.75 b | 6.75 b | 5.75 b | 2.25 b |
| F | 18.05 | 10.09 | 12.15 | 18.36 | 7.32 |
| probability | 0.0001 | 0.0003 | 0.0001 | 0.0001 | 0.0015 |
| $R^2$ | 0.9133 | 0.8548 | 0.8764 | 0.9146 | 0.8103 |
| Min. sig. diff. | 5.8844 | 11.823 | 10.416 | 9.3449 | 10.159 |

Means in the same column followed by different letters are significantly different ($P < 0.05$) using PC SAS ANOVA and Tukey's studentized range test for mean separations.

**Discussion**

All treatments significantly ($P < 0.05$) reduced active mound numbers by two weeks post treatment versus untreated controls. This suppression continued through 24 weeks post-treatment. There were no statistical differences between bait treatments. The spinosad bait, applied at 1.5, 3.0 and 5.0 lbs./acre showed a consistent numerical rate response, however, with the 5.0 lbs/acre rate performing better than the other two. The 5.0 lbs/acre rate of spinosad also showed slightly greater control than Amdro for most of the test. For practical purposes, maximum control was achieved within two weeks of application. This was somewhat faster than is normally expected of a broadcast bait and is probably the result of the small, summer-weakened colonies retrieving a high percentage of the bait and it being shared among fewer worker ants than normal. Unfortunately, because the test site was sold and plowed only six months after application, no conclusions can be drawn regarding the duration of control of any of the treatments.

**Evaluation of Skip-Swath and Hopper Blend Applications of Extinguish™ for Red Imported Fire Ant Control**

Charles L. Barr, Extension Program Specialist - Fire Ant Project
Rody L. Best - Extension Assistant - Fire Ant Project

Previous research with broadcast fire ant baits has shown that a 50:50 hopper blend of Amdro® (0.73% hydramethylnon) plus Logic® (1.0% fenoxycarb), an insect growth regulator (IGR), produces both rapid control of fire ants characteristic of Amdro and long-lasting control characteristic of Logic. In similar tests, it was also found that skip swath applications of Logic, broadcasting bait in 30 foot swaths on 60 foot centers (0.75 lb./ac. total), gave almost identical control to full rate, full coverage applications (1.5 lbs./ac.). Skip swath applications of Amdro yielded about half the control as full coverage applications, however.

This field trial was conducted in conjunction with the large plot spinosad rate test in a pasture east of Bryan, Texas (see Rate Test of Spinosad-based Broadcast Bait for the Suppression of Red Imported Fire Ants in Large Plots). Amdro, as well a set of untreated plot, was included as a standard in the spinosad test. To take advantage of the available space, it was decided to include hopper blend and skip swath treatments of Extinguish™ (0.5% s-methoprene), a newly released IGR-based fire ant bait, that has the distinct advantage of almost unrestricted use sites on the label. Previous research on Extinguish showed it to be as effective, but also as slow to work, as Logic, so it was tested as a 50:50 Amdro hopper blend to speed its action. Because of the potential use of Extinguish in agriculture, it was hoped that skip swath applications would perform well so that treatment costs could be cut in half, making it more possible to economically justify its use in pastures and other crops.

## Materials and Methods

The test site was located approximately eight miles east of Bryan, Texas in Brazos County. Applications were made to an ungrazed pasture consisting of heavy clay soil. The area was just emerging from a record-breaking drought during the summer of 1998. Though the pasture was very rough due to large, visible fire ant mounds, most of the mounds were unoccupied by ant colonies. Those that were, usually contained rather small colonies nesting on only a portion of the mound structure.

Square plots, 210 x 210 feet (approx. one acre) were laid out in an irregular pattern following fence lines and the shape of the pasture. Plots were established with adjoining boundaries. A 0.25 acre sampling area was established in the center of each plot using 3/8" reinforcing rod as a permanent center marker which allowed for a treated buffer of at least 45 feet between a sampling area and the nearest plot border.

Active ant mound numbers were determined on 9 October 1998 using the minimal disturbance technique. Plots with a suitable number of mounds were arrayed from highest to lowest and divided into four equal groups (replications). Treatments were assigned within replications so that the total number of mounds for each treatment (total of four replications) were as equal as possible. Treatments were applied 13-14 October using a Red Ball® seeder mounted on a John Deere 4x6 'Gator utility vehicle. Weather during application was mild and sunny and ants were actively foraging.

Treatments for this portion of the test included:

| Treatment | Rate | Application |
|---|---|---|
| untreated control | – | – |
| Amdro® (0.75 hydramethylnon) | 1.5 lbs/acre | full broadcast coverage |
| Extinguish™ (0.5% s-methoprene) | 1.5 lbs/acre | full broadcast coverage |
| Amdro+Extinguish 1:1 blend | 1.5 lbs/acre total | full broadcast coverage |
| Extinguish skip swath | 0.75 lb/acre total | 25 ft. skip swath |

Post treatment evaluations were made on 28 October, 11 November and 14 December 1998 and 1 April 1999. Evaluations were made using the minimal disturbance technique. In late March we were notified that the site had been sold to the poultry farm adjacent to the property and was to be used for litter disposal. Within two weeks of the final evaluation, the land was plowed and the site had to be abandoned.

**Results**

Mean number of active mounds in 0.25 ac. circle, 4 replications

| Treatment | pre-count | 2 weeks | 4 weeks | 8 weeks | 24 weeks |
|---|---|---|---|---|---|
| untreated | 15.75 a | 26.75 ab | 24.50 a | 27.25 a | 19.25 a |
| Amdro full | 15.75 a | 6.75 b | 6.75 bc | 5.75 b | 2.25 b |
| Extinguish full | 18.25 a | 32.50 a | 20.75 abc | 17.50 ab | 4.00 ab |
| Extinguish+Amdro | 18.25 a | 4.50 b | 4.50 c | 3.25 b | 1.75 b |
| Extinguish skip | 17.75 a | 37.50 a | 22.00 ab | 25.50 a | 12.25 ab |
| *F* | 35.16 | 6.48 | 6.93 | 6.74 | 3.55 |
| Prob. | 0.0001 | 0.0026 | 0.0019 | 0.0022 | 0.0263 |
| $R^2$ | 0.9535 | 0.7907 | 0.8017 | 0.7971 | 0.6746 |
| Min. sig. diff. | 6.5838 | 24.376 | 16.311 | 18.139 | 10.159 |

Means in the same column followed by different letters are significantly different ($P < 0.05$) using PC SAS ANOVA and Tukey's studentized range test for mean separations.

**Discussion**

Both the Amdro and Extinguish+Amdro had significantly ($P<0.05$) fewer active fire ant mounds at only two weeks post-treatment versus the untreated plots through the remainder of the test. Numerically, the Extinguish+Amdro treatment was the superior treatment for the entire test, including the spinosad treatments not included in this analysis. The unusually fast activity is probably due to the small, summer weakened colonies. There was a slight decrease in the number of active mounds at 24 weeks post-treatment. It is suspected that this is due to the activity of the Extinguish and/or larger colonies where the queens were killed by Amdro, but it took several months for the remaining workers to die.

It took until the 24 week evaluation for the full rate Extinguish to show even a numerical reduction in active mound numbers. Because of high variability within plots and shortened monitoring period, it never achieved a statistically significant ($P<0.05$) difference versus untreated plots, but numerically, the full rate of Extinguish was similar to the Amdro and Extinguish+Amdro treatments by the end of the test.

The Extinguish skip swath treatment only showed a 36% reduction in active mound numbers versus untreated plots by the end of the test. It is possible that these numbers could have decreased further, but it is unlikely given that worker brood was seen in most of the active mounds at the final evaluation.

To fully appreciate the implications of these results, one must compare them to the Amdro hopper blend and skip swath application results of Logic. Logic + Amdro produced similar, rapid control. However, Logic as a skip swath application has shown almost identical control to full rate, full coverage applications where Extinguish did not. Both Extinguish (s-methoprene) and Logic (fenoxycarb) are insect growth regulators, but are very different compounds in terms of their environmental stability. Fenoxycarb is relatively stable in the environment and it can persist in laboratory ant colonies (in the workers' crops) for months. Methoprene, on the other hand, is a relatively unstable compound. Therefore, it is possible that skip swath activity is the result of active ingredient transport within worker ants, rather than or in addition to, forging of ants into treated areas. An unstable compound would either not persist within workers once consumed or in the environment waiting to be picked up.

Other slow-acting fire ant baits with the active ingredients pyriproxyfen and abamectin are now on the market. Results from this test suggest that combining them with Amdro may speed their activity, as it does Logic and Extinguish. However, these same results suggest that these other compounds must be evaluated individually, particularly in regard to skip swath and/or reduced rate applications.

**Efficacy of Hydramethylnon Formulated on a Lightweight Aggregate Carrier for the Control of Red Imported Fire Ants Coulter Field, Brazos Co., Texas - 1998**

Charles L. Barr, Extension Program Specialist

The TXI Corporation, one of the largest suppliers of aggregates in the world, produces what is called a lightweight aggregate - a dark brown to black, hard, porous, rock-like material that can be ground and screened to any size from near-dust to over half and inch. Previous tests used lightweight aggregate as a carrier for chlorpyrifos, a contact insecticide. Results showed the formulation to be very effective in controlling individual colonies of red imported fire ants (*Solenopsis invicta* Buren) with less dust, and therefore applicator hazard, than a commercial formulation using a vermiculite-type formulation. This test was conducted to determine the suitability of lightweight aggregate as a carrier for broadcast application of a conventionally formulated (soybean oil based) bait using 0.7% hydramethylnon (Amdro®) as the active ingredient.

**Materials and Methods**

This test was included in another test (see Bifenthrin Individual Mound Treatment and Broadcast Treatment Comparison Test for additional details) to make more efficient use of space and effort. Results for the lightweight aggregate treatment were analyzed separately for this report. The test was located at Coulter Field, a municipal airport serving Bryan/College Station, Brazos Co., Texas. The site was gently sloping with shallow, sandy loam soils over a claypan. The test area was covered by native grasses and forbs which had been mowed, but never grazed, for many years. Vegetation ranged from lush to sparse over the course of the test and the site.

Plots consisted of 100 x 100 foot squares (0.23 ac). The sampling area for all plots was a central circle, 40 feet in radius (0.115 ac.). The product was extremely oily and would not flow through a broadcast spreader. Therefore, applications were made using a hand-held shaker can. Treatments were replicated four times and included: 0.73% hydramethylnon formulated on lightweight aggregate, broadcast Amdro® (0.73% hydramethylnon) and untreated control.

Treatments were applied 30 April 1998. Evaluations were conducted on 8, 15 and 29 May using the minimal disturbance technique to determine activity of mounds. By June 1 the area had received no rain in over a month and was experiencing 100-degree days. Mound building/rebuilding ceased making it nearly impossible to locate ant colonies. The drought continued into September with the area receiving no rain whatsoever. The site was mowed by Extension personnel in early September in anticipation of an evaluation within the next few weeks. By the time rain and cooler weather were received, the site had been re-mowed by City of Bryan personnel, destroying all plot markers and the test was abandoned.

**Results**

Mean number of active mounds per 0.11 acre sampling area (4 replications)

| Treatment | pre-count | 10 day | 14 day | 30 day |
|---|---|---|---|---|
| Untreated | 13.75 a | 16.50 a | 14.75 a | 11.75 a |
| Aggregate + hydramethylnon | 13.75 a | 16.25 a | 12.25 a | 10.00 a |
| Amdro | 13.75 a | 7.75 a | 6.75 a | 2.25 a |
| *F* | 9.44 | 3.46 | 1.82 | 3.43 |
| Probability | 0.0082 | 0.0813 | 0.2426 | 0.0828 |
| $R^2$ | 0.8872 | 0.7426 | 0.6031 | 0.7407 |
| Min. sig. diff. | 3.2341 | 9.6279 | 11.411 | 9.5461 |

Means in the same column followed by different letters are significantly different ($P$<0.05) using PC SAS analysis of variance and Tukey's studentized range test to separate means.

**Discussion**

Results indicate that 0.73% hydramethylnon formulated on TXI lightweight aggregate had little effect on fire ant mound numbers. Despite not showing any statistical differences due to high variability, the conventionally formulated Amdro bait produced an average 80% reduction in mound numbers versus untreated control plots. The reason for the failure of the aggregate to control is probably twofold. First, the material was very oily and caked, making it impossible to spread using regular broadcasting equipment. It was also considerably more dense than conventional bait resulting in there being very little volume of material to spread. Consequently, spreading was non-uniform and, even had it been uniform, very sparse on a granule per unit area basis. The second reason, supported by informal laboratory tests, is that fire ants were simply not attracted to lightweight aggregate granules saturated with soybean oil. Why they are not attracted is unknown.

Despite disappointing results in this test, TXI lightweight aggregate still appears to hold promise as a carrier for contact-type insecticides that are "dry" when formulated.

Acknowledgment

The author would like to thank the American Cyanamid Co. for their cooperation in formulating the TXI lightweight aggregate with 0.73% hydramethylnon in soybean oil.

**Efficacy of Two Formulations of Logic® Fire Ant Bait**
**Brazos Co., Texas - 1997-98**

Charles L. Barr, Extension Program Specialist
Bastiaan M. Drees, Professor and Fire Ant Project Coordinator

Logic® fire ant bait is a conventionally formulated bait defatted corn cob grit as a physical carrier. The active ingredient (1.0% fenoxycarb) is mixed with soybean oil which acts as both the chemical's carrier and as the ant attractant. This test was conducted to test an new formulation of oil. Because the baits were numbered, it is not know whether the oil was a modified soybean oil or another type of oil entirely. The experimental bait had a more buttery smell, but otherwise, was identical in appearance and flow characteristics as the "old" formulation.

**Materials and Methods**
The test was conducted in an ungrazed pasture in western Brazos Co., Texas. Plots consisted of 0.25 acre squares (105 x 105 feet) with a 40 foot radius sampling area (0.115 ac) in the center. Plots were established and pre-counts made during the week of 13 October 1997. Treatments were applied 17 October using a Cyclone 1C1 hand-held seeder. Weather was partly cloudy, 75-85EF with moderately moist soil and actively foraging ants.

Evaluations, both pre and post-treatment were made using the minimal disturbance technique to determine mound activity. A mound was considered active if a sufficient number of ants, compared to untreated mounds, rose to the surface within 15-20 seconds of disturbance. Evaluations were conducted at 18 and 35 days, and 13, 23, 34 and 60 weeks post-treatment.

**Results**

Mean number of active mounds per 0.115 acre subplot (4 replications)

| Treatment | pre-count | 18 day | 35 day | 13 week | 23 week | 34 week |
|---|---|---|---|---|---|---|
| Untreated | 17.75 a | 14.50 a | 13.00 a | 20.25 a | 17.75 a | 24.25 a |
| "Old" Logic | 16.50 a | 16.50 a | 10.75 a | 20.50 a | 20.00 a | 3.75 b |
| "New" Logic | 16.25 a | 16.25 a | 17.50 a | 24.00 a | 22.25 a | 13.00 ab |
| *F* | 7.61 | 1.38 | 2.37 | 0.70 | 0.25 | 3.29 |
| Probability | 0.0141 | 0.3486 | 0.1614 | 0.6411 | 0.9242 | 0.0898 |
| $R^2$ | 0.8638 | 0.5353 | 0.6641 | 0.3699 | 0.1734 | 0.7326 |
| Min. sig. diff. | 4.2322 | 7.1499 | 8.6856 | 11.092 | 16.542 | 16.158 |

Means in the same column followed by different letters are significantly different ($P$<0.05) using PC SAS analysis of variance and Tukey's studentized range test to separate means.

**Discussion**

There were no significant differences ($P<0.05$) between “old” formulation and “new” formulation fenoxycarb products for the duration of the test and no meaningful numerical differences until the final post-treatment count. At that time, both formulations reduced mound numbers versus untreated controls. “Old Logic” reduced active mound numbers statistically, versus untreated, and numerically versus the “new” formulation, 3.75 mounds/plot versus 13.00 mounds/plot. Field notes indicated that some of the mounds considered active in the “new” Logic were weak and probably not reproductively active.

The most interesting facet of the test is the length of time it took for fenoxycarb to suppress active mounds to any extent, versus untreated areas. No suppression whatsoever was noted through 23 weeks post-treatment. Treatments were applied in mid-October and did not achieve suppression until some time after late March and early June the following spring. Such extended colony decline periods have been noted in several other tests using insect growth regulator (IGR) baits applied in the fall. The recommendation of “treat in the fall for fewer fire ants in the spring” must be carefully considered when using IGR baits. Since IGR’s do not kill adult ants, colony decline is the result of natural mortality. During a mild, moist winter, as was had during 1997-98, little worker mortality occurred. Colony elimination was not seen until hot, dry weather began in May. Therefore, a late spring through late summer-early fall application of IGR baits may be more suitable for the rapid colony suppression desired by most people.

**Comparison of Two Commercial Bait Formulations of the Active Ingredient Pyriproxyfen for Red Imported Fire Ant Control Coulter Field, Brazos Co., Texas - 1999-2000**

Charles L. Barr, Extension Program Specialist
Rody L. Best, Extension Assistant

In 1999, two formulations of the active ingredient pyriproxyfen, an insect growth regulator (IGR), became widely available as red imported fire ant (*Solenopsis invicta* Buren) bait. Both are conventionally-formulated baits (soybean oil carrier/attractant on defatted corn cob grit) that differ only in their content of active ingredient, label application rate and oil percentage. The Valent Corporation introduced the product Distance®, which contains **0.5%** pyriproxyfen and is applied at a rate of 1 - 1 ½ lbs. per acre (43,560 $ft^2$) when broadcast, as are most other fire ant bait products. Distance is marketed primarily to the pest control industry, but there are no label restrictions on use by the general public. The second product is Spectracide® Fire Ant Bait (referred to here as "Spectracide", for brevity) manufactured by the Spectrum Group, Division of United Industries Corporation. It is part of the popular Spectracide line of pesticides marketed through many retail outlets to the general public. This product contains only **0.05%** pyriproxyfen (listed as "pyridine" on the label) and is applied at one pound per 4,400 $ft^2$, or about 10 times as much per acre as Distance.

Though 0.5% pyriproxyfen has been tested for a number of years as a broadcast fire ant bait with good results, no field efficacy data from Texas trials could be found for the reduced percentage contained in Spectracide. Given that the product rapidly attained a prominent place on many retail store shelves, there was considerable concern over two factors regarding its use. The first is that the reduced rate had not been tested, to our knowledge, so the question of "does it work" could not be answered. The second is that the one pound per 4,400 square foot rate is inconsistent with all the other conventionally-formulated bait products on the market which could easily result in under-application by consumers.

Therefore, this test was undertaken to compare the efficacy of Spectracide to that of Distance at full label rate for both products. Additionally, a reduced rate of 3 lbs Spectracide/acre was tested. This rate was chosen using the reasoning that most baits, even though labeled at 1 - 1 ½ lbs/acre, are over-applied by homeowners because of failure to calibrate and/or equipment limitations.

## Materials and Methods

The test site was located at Coulter Field, Brazos Co., Texas. Soil at the site was a sandy loam with moderately dense native grass vegetation. The plots were mowed using a Toro 72" commercial mower immediately before test initiation and prior to each evaluation, if necessary. Plots consisted of 75' x 75' squares (1/8 acre) with 15 foot untreated buffers. Plot size was designed to replicate a typical urban/suburban yard. Entire plots were both treated and evaluated. All evaluations were conducted using the minimal disturbance technique to assess fire ant mound activity. Pre-counts were conducted 13 May 1999. Mound numbers were arrayed from highest to lowest, divided into three equal groups (replications) and treatments assigned so that the total number of mounds for each treatment was as equal as possible. Baits were applied the morning of 14 May 1999 using a Cyclone Model 1C1 hand-held seeder. Weather was 80-85EF, partly cloudy with a moderate breeze. The soil was moist with easily visible mounds and actively foraging ants. Treatments included: Spectracide fire ant Bait at 10 lbs/acre and 3 lbs/acre, Distance at 1.5 lbs/acre and an untreated control. All treatments were replicated three times. Post-treatment evaluations were conducted on 21 May, 7 June, and 13 July 1999 and 11 January 2000.

**Results**

Mean number of active mounds per 1/8 acre plot (3 replications)

| Treatment | pre-count | 1 week | 3 weeks | 8 weeks | 35 weeks |
|---|---|---|---|---|---|
| Untreated | 32.7 a | 21.3 ab | 15.3 a | 12.0 a | 8.3 a |
| Distance | 30.7 a | 23.3 a | 10.0 ab | 2.7 b | 1.3 b |
| Spect, high | 30.7 a | 15.7 ab | 3.0 bc | 0.3 b | 1.0 b |
| Spect, low | 30.7 a | 12.7 b | 2.3 c | 1.0 b | 1.3 b |
| F | 9.92 | 9.72 | 11.44 | 9.58 | 9.64 |
| *P* | 0.0073 | 0.0077 | 0.0050 | 0.0079 | 0.0078 |
| $R^2$ | 0.8921 | 0.8901 | 0.9051 | 0.8887 | 0.8893 |

Data analyzed using SAS analysis of variance procedure with means separated using Tukey's studentized range test. Means in the same column followed by different letters are significantly different ($P$ <0.05)

**Discussion**

Results of this trial indicate that Spectracide Fire Ant Bait significantly ($P$ <0.05) reduced active fire ant mound numbers, compared to untreated plots, within eight weeks at both rates. All the baits had statistically similar performance at and after eight weeks. Both Spectracide rates performed similarly and substantially faster than Distance at one and three weeks post-treatment. Pyriproxyfen-based baits have eliminated mounds faster than other IGR-based baits (such as fenoxycarb and s-methoprene) in other tests we and others have conducted over the years. Pyriproxyfen is an insect growth regulator (IGR) with no known adult ant toxicity, therefore, there is no apparent reason for the faster mound elimination seen with Spectracide compared to Distance or with Distance compared to other IGR's.

The Spectracide product was extremely oily which made it somewhat difficult to apply. The bait tended to cake and not flow smoothly in the spreader. This could be a problem for homeowners since the typical homeowner-type spreader has very poor agitation and bait flow under even the best conditions. Other than this minor problem, Spectracide Fire Ant Bait was very effective even when applied at less than one-third the label rate.

**Efficacy of Works Well for the Control of Individual Fire Ant Colonies**
**Lake Conroe Dam, Montgomery County, Texas**
**June 1997**

Charles L. Barr, Extension Program Specialist - Fire Ant Project
Bastiaan M. Drees, Coordinator - Fire Ant Project

Works Well®, a mixture of short-chain aliphatic and aromatic hydrocarbons was evaluated by TAEX in 1995. The product provided 60-80% control of individually treated red imported fire ant (*Solenopsis invicta* Buren) mounds over the course of the one month test. The number of active mounds were statistically similar to those of a standard treatment, Orthene® (75% acephate), and significantly lower than those in untreated control plots. Contact with Works Well results in immediate ant death, however, with only 2 - 6 oz. applied per mound, control is thought to be achieved through vapor toxicity. Additional laboratory tests were performed on Works Well to help determine it's action against fire ants. Results indicated that ants require exposure times of 15 to 20 minutes at high vapor concentrations to cause mortality.

Results were forwarded by the manufacturer to the Environmental Protection Agency (EPA) as part of the registration process. The EPA responded with three specific experimental protocols to address efficacy concerns: 1) the effect of high ambient temperatures, 2) the effect of sandy versus clay soil type and, 3) the effects of disturbance at time of treatment. The result of negotiations with the manufacturer was a protocol for a single test designed to "address" all three concerns. The test was conducted in relatively hot, dry conditions on a site with sandy soil and mounds were probed before treatment. It must be emphasized that, since all three factors differed from the first test, the treatment conditions and results **can not be directly compared**.

## Materials and Methods

The test was located in an area below the earthen dam of Lake Conroe, Montgomery County, Texas. The soil on the test site was a deep, moderately coarse sand or loamy sand. The test site was mowed to a height of 3.5 inches during the last week of May 1997. The test was established on 3 June 1997 in the following manner. Two strips, 40 feet wide and approximately 200 feet long each, were measured and marked using six-foot long pieces of 3/8-inch diameter reinforcing rod at all corners. The strips were surveyed for active mounds and mound activity assessed using the minimal disturbance technique. Beginning at one end of a strip, 10 active mounds were marked with red surveyor's flags. The next 10 mounds were marked with orange flags and so on, alternating colors, until 12 sets of 10 mounds (plots) had been marked. The length of each plot was then measured, arrayed lowest to highest and divided into four blocks of three plots each (replications). Treatments were assigned within blocks so that the total lengths for each treatment were approximately the same.

Treatments included the following:
1) Untreated Control,
2) Works Well - amount applied according to mound size,
3) Spectracide® Dursban®, 6% chlorpyrifos, 2 oz. concentrate in one gallon water per mound.

Treatments were applied 5 June 1997, beginning at approximately 10:30 a.m. The weather was partly cloudy and humid, with a slight breeze. Temperature at the end of the test was approximately 85 degrees F and the soil was dry to slightly moist.

Dr. Warren Hardwick, manufacturer of Works Well, was present for the test and applied all the Works Well treatments personally. Dr. Hardwick located the site of greatest ant activity in each mound and probed to a depth where resistance was met using a pointed metal rod approximately 3/8-inch in diameter. The material was applied directly from a half-gallon metal can with a single-hole squirt cap. He applied the desired amount of Works Well into the hole then sprayed a band of fluid around the perimeter of the mound and on top of the mound. The time of each application was recorded on a stopwatch. After all mounds were treated, the remaining fluid in each can was measured in a graduated cylinder and subtracted from the stated full volume. In this way, the amount applied per mound could be calculated later.

Standard chlorpyrifos drenches were applied during the same time period by Dr. Bastiaan M. Drees using a plastic sprinkler can with a breaker nozzle. Before applications began, the plots were re-surveyed for any moved or missed mounds. These mounds were marked with blue flags and treated with the appropriate chemical after marked-mound treatments.

The first evaluations was conducted on 6 June at 9:00 a.m.. Weather conditions were similar to those of the treatment date. Each marked mound was disturbed with a pointed tool handle until ants rose to the surface in a defensive action (“active”) or failed to appear after 10 - 20 seconds (“inactive”). Dr. Hardwick was present for all evaluations and agreed with the evaluator’s assessment of mound activity at the time. The number of active mounds was recorded for each plot. During the first evaluation, active mounds in Works Well and standard-treated plots were marked with large, yellow flags for later re-treatment. The plots were surveyed and any active unmarked mounds were also marked with large, yellow flags.

The second evaluation was conducted on 9 June 1997 at 8:00 a.m. The weather was overcast, with sprinkling rain, temperature 70-75 degrees. Evaluations were conducted in a similar manner. Active Works Well-treated mounds were re-treated by Dr. Hardwick at this time and the application times recorded. Active, unmarked mounds were also treated. No chlorpyrifos-treated mounds were active, so only unmarked ones were treated.

The one-week post-treatment evaluation was conducted 12 June 1997, beginning at 9:00 a.m. The weather was partly cloudy, temperature 75 - 80 degrees F and the soil was slightly moist. Minimal disturbance evaluations were conducted on all originally flagged mounds and given “active” or “non-active” ratings. The plots were also surveyed for satellite mound formation. Flags were removed from previously marked satellite mounds if they showed no activity.

The final, two-week evaluation was conducted on 19 June 1997. Dr. Drees evaluated the marked mounds using the Lofgren and Williams (1982) method of mound activity rating. The plots were also surveyed for satellite mound formation. Conditions at the time of evaluation ( beginning 9:00 a.m.) were partly cloudy, 80 - 85 degrees F, with high humidity and calm winds. The soil was moist. Dr. Hardwick was present for all evaluations.

**Results**

Mean no. active mounds*

| | 1-day | | | 4-day | | |
|---|---|---|---|---|---|---|
| **Treatment** | **Marked** | **Sat** | **Tot** | **Marked** | **Sat** | **Tot** |
| Control | 10.00 a | 1.00 a | 11.00 a | 9.50 a | 0.75 a | 10.25 a |
| Works Well | 8.25 b | 2.50 a | 10.75 a | 4.75 b | 2.25 a | 7.00 a |
| chlorpyrifos | 0.25 c | 0.75 a | 1.00 b | 0.00 c | 1.25 a | 1.25 b |
| F-value | 104.24 | 1.08 | 17.97 | 32.56 | 0.72 | 5.96 |
| Prob. | 0.0001 | 0.4552 | 0.0015 | 0.0003 | 0.6328 | 0.0253 |
| Min. Sig. Diff. | 1.4004 | 3.3336 | 3.7403 | 2.3153 | 2.8944 | 5.3019 |
| Crit value | 4.339 | 4.339 | 4.339 | 4.339 | 4.339 | 4.339 |
| df | 6 | 6 | 6 | 6 | 6 | 6 |

Mean no. active mounds

| | 7-day | | | 14-day | | |
|---|---|---|---|---|---|---|
| **Treatment** | **Marked** | **Sat** | **Tot** | **Marked** | **Sat** | **Tot** |
| Control | 8.25 a | 1.75 a | 10.00 a | 7.75 a | 1.75 a | 9.50 a |
| Works Well | 2.25 b | 1.00 a | 3.25 a | 0.00 b | 1.00 a | 1.00 b |
| chlorpyrifos | 0.00 c | 1.50 a | 1.50 b | 0.00 b | 1.25 a | 1.25 b |
| F-value | 30.69 | 2.12 | 15.95 | 61.29 | 1.45 | 24.18 |
| Prob. | 0.0003 | 0.1932 | 0.0021 | 0.0001 | 0.3296 | 0.0007 |
| Min. Sig. Diff. | 2.1392 | 2.3153 | 3.2543 | 1.5761 | 1.9472 | 2.7299 |
| Crit value | 4.339 | 4.339 | 4.339 | 4.339 | 4.339 | 4.339 |
| df | 6 | 6 | 6 | 6 | 6 | 6 |

Means in the same column followed by different letters are significantly different ($P<0.05$) using PC SAS analysis of variance procedures and Tukey's studentized range test for mean separations.

* Marked = 10/plot; Sat = "new" mounds occurring in plot; Tot = marked + sat.

**Mound Activity Rating Results**
As requested by both the manufacturer and the EPA, the final evaluation of Works Well also included a mound activity rating as defined by Lofgren and Williams (1982).

| Treatment | Mean Rating |
|---|---|
| Control | 10.65 a |
| Works Well | 0.00 b |
| Standard | 0.00 b |
| | |
| F-value | 25.83 |
| Prob. | 0.0001 |
| Min. Sig. Diff. | 2.5964 |
| Crit. Value | 3.358 |
| df | 114 |

**Works Well Application Volume**
The application volume for the initial application of Works Well was 80.63 ml ± 26.80 ml (2.84 oz. ± 0.94 oz.) per mound. The marked mound density of Works Well plots was 335 mounds per acre. If "blue flagged" mounds are included, the density rises to 469 mounds per acre. Therefore, the application rate per acre was 7.433 gallons/acre ± 2.46 gal.. If all mounds had been treated with the calculated rate, the total volume per acre would rise to 8.794 gal./ac. ± 3.444 gal..

Re-treatments on the 19 still-active mounds were made with considerably more volume: 153.16 ml/md ± 41.06 ml (5.39 oz. ± 1.45 oz.). Had this rate been used for the initial treatment of marked mounds the per acre rate would have been 14.11 gal./ac. ± 3.79 gal.. For all mounds, the rate would have risen to nearly 20 gallons per acre.

**Discussion**
Application of Works Well to individual mounds resulted in significant ($P < 0.05$) elimination of ant activity as compared to those mounds receiving no treatment at all evaluation dates. However, Works Well treated mounds were significantly more active than those receiving a standard chlorpyrifos drench treatment at one, four and seven days post-treatment. In one EPA report to the manufacturer, a requirement for 90% control was mentioned. The following table lists "Percent Control" for each post-treatment evaluation date in this test.

| | Percent Control (% inactive mounds of 40 treated) | | | |
|---|---|---|---|---|
| Treatment | 1 day | 4 days* | 7 days | 14 days |
| Control | 0.0 | 5.0 | 17.5 | 22.5 |
| Works Well | 22.5 | 52.5 | 77.5 | 100.0 |
| Standard | 97.5 | 100.0 | 100.0 | 100.0 |

* all active mounds retreated

When both treated and “satellite” mounds within plots were combined, Works Well plots did not differ significantly from untreated control plots. Field notes indicate that an unusually high number of satellite, or new, mounds appeared in one of the high-density Works Well plots immediately after the initial treatment. Mound activity ratings at day 14 showed complete control of all treated mounds by both Works Well and the standard.

Compared to those from the first test, these results were somewhat disappointing. It is suspected that the combination of higher temperatures and/or sandy, porous soil was responsible for the lack of rapid control. Lab tests from the previous test indicate that fire ants must be either directly contacted or exposed to high concentrations of Works Well vapor for at least 15 minutes for mortality to occur. Given the low flash point (135EF) and high volatility of Works Well, it is suspected that the material either volatilized too quickly, did not reach effective vapor concentrations within the mound, or a combination of both, to cause complete elimination of ant activity. Further testing would be necessary to determine which of these factors was the cause.

**Field Trial of Some Commercially Available and Home Remedy Products for the Control of Red Imported Fire Ant Colonies Brazos Co., Texas - 1997**

Charles L. Barr, Extension Program Specialist
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The Texas Agricultural Extension Service, Fire Ant Applied Research Program (FAARP) receives many inquiries from companies and individuals touting their products for fire ant control. Due to the associated costs, many of these products are not evaluated with replicated, statistically valid tests. Nevertheless, they appear on store shelves and are the subject of consumer inquiries. Similarly, there are many "home remedy"fire ant control measures. To help answer the questions that arise over some of these products, an abbreviated version of a standard individual mound treatment (IMT) test was conducted. The testing of these products was **non-replicated** and, therefore, *not* statistically analyzable. The test did, however, provide data for screening some of these products for possible future testing in a more formal manner and provided enough information to give some idea of a product's effectiveness.

**Materials and Methods**

The test site was located in western Brazos County, Texas in an ungrazed pasture with heavy clay soil. Active fire ant mound density averaged about 150 mounds per acre. Mounds were physically large, but, due to a hot, dry summer, the colonies occupying them were relatively small. The test method used a modified version of the "railroad track" design of individual mound treatment testing used for most FAARP trials.

A strip, 30 feet wide and of indeterminate length was marked near a fence line. Beginning at one end of the strip, the first 10 mounds encountered were marked with wire flags of a single color. The next 10 mounds marked with a different color flag and so on using different or alternating flag colors. Each set of 10 mounds was considered a plot. Because there was no replication of plots, treatments, as listed above, were assigned randomly. A set of untreated control plots were also established as part of another, concurrently run test.

Products were applied during the morning hours of 18 September 1997. Though the soil was dry, ant brood was noted near the tops of mounds throughout the application period. All drench products were applied using two-gallon plastic watering cans with diffusers removed to better penetrate the mound structure.

Evaluations were conducted at 4, 7, 14, 28 and 35 days post-treatment using the minimal disturbance technique. At 14 and 35 days post-treatment, plots were surveyed for new or "satellite" mound formation within their borders. Mounds were disturbed with a pointed tool handle until a sufficient number of ants rose to the surface in a defensive manner. The number of ants required to consider a mound "active" was determined by the evaluator in comparison to untreated mounds under the prevailing moisture, sunlight and temperature conditions.

The test products included:

<u>Synthetic insecticides</u>

*Spectracide® Dursban® Indoor and Outdoor Insect Control ( chlorpyrifos, 6.0%)*:

This product was used as a standard at a rate of 1 fluid oz. in 1 gallon of water per mound, applied as a drench.

*Enchem's ™ Rapid Kill Fire Ant Mound Drench Concentrate [(s)-cyano (3-phenoxyphenyl) methyl-(s)-4-chloro-alpha-(1-methylethyl) benzeneacetate, 0.22%)* or s-fenvalerate:

Applied as a drench at 1.5 fluid ounces in 1 gallon water per mound.

<u>"Organic" insecticides</u>

*Insecto Formula 7 (pine oils, 20%)*:

Applied as a drench at 1 fluid ounce in 1 gallon water at 3 gallons solution per mound.

*True Stop™ Fire Ant Insecticide ( rotenone, 0.21%; cube root extract, 0.41%)*:

Applied as a drench at 2/3 cup product in 1 gallon water per mound.

*Safer's Insecticidal Soap*

Applied as a drench at 3 liquid ounces in 1 gallon water per mound.

*Garden-ville Fire Ant Liquid Compost Fire Ant Control (70% liquid compost, 30% orange oil)*:

Applied as a drench at 6 liquid ounces in 1 gallon water per mound.

*Garlic Barrier Insect Repellent (100% garlic water)*:

Applied as a drench at 3 fluid ounces in 1 gallon water per mound.

*Hot Pepper Wax™ Animal Repellent (capsaicin and other capsaicinoids, 0.00018%)*:

Applied as a drench at 3 fluid ounces in 1 gallon water per mound.

*UBIX No. 0071/XP0078 Fire Ant Control (ingredients unknown)*:

Applied as a drench 3 fluid ounces in 1 gallon water per mound.

<u>"Home Remedies"</u>

*50 Grain Pure White Distilled Vinegar (acetic acid)*:

Applied as a drench 6 fluid ounces in 1 gallon water per mound.

*Imperial Pure Cane Sugar®*:

Applied as a drench ½ teaspoon granules in 1 gallon water per mound.

**Results**

This test was conducted in association with a fully replicated trial of another experimental product (see Evaluation of Ant Express™ for the Control of Individual Red Imported Fire Ant Colonies). Consequently four plots each of both untreated control mounds and Spectracide Dursban-treated mounds were available for comparison. Reported results are the *mean* of all four plots for each of these treatments (10 mounds x 4 replications). Other treatment values are for 10 treated mounds. Results are shown in **Table 1.**

**Table 1.** Number of active mounds, ranked in order of 4 day level of control.

| Treatment (Trade name) | Number of active mounds of 10 treated or as noted* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 4 day | 7 day | 14 day | 14 day sats. | 14 day total | 28 day | 35 day | 35 day sats. | 35 day total |
| Enchem's™ Rapid Kill | 0.00 | 0.00 | 0.00 | 2.00 | 2.00 | 2.00 | 2.00 | 3.00 | 5.00 |
| Dursban® | 0.25 | 0.25 | 0.50 | 0.50 | 1.00 | 0.00 | 0.00 | 1.50 | 1.50 |
| Garden-ville | 1.00 | 1.00 | 3.00 | 0.00 | 3.00 | 2.00 | 3.00 | 0.00 | 3.00 |
| Insecto Formula 7 | 2.00 | 2.00 | 2.00 | 1.00 | 3.00 | 4.00 | 4.00 | 0.00 | 4.00 |
| Hot Pepper Wax | 6.00 | 4.00 | 5.00 | 0.00 | 5.00 | 7.00 | 8.00 | 5.00 | 13.00 |
| Safer's Soap | 6.00 | 5.00 | 5.00 | 4.00 | 9.00 | 3.00 | 5.00 | 7.00 | 12.00 |
| Garlic barrier | 8.00 | 6.00 | 8.00 | 0.00 | 8.00 | 5.00 | 2.00 | 3.00 | 5.00 |
| True Stop | 9.00 | 7.00 | 6.00 | 3.00 | 9.00 | 5.00 | 4.00 | 4.00 | 8.00 |
| sugar | 9.00 | 8.00 | 10.00 | 1.00 | 11.00 | 7.00 | 6.00 | 8.00 | 14.00 |
| UBIX | 10.00 | 5.00 | 6.00 | 0.00 | 6.00 | 7.00 | 7.00 | 5.00 | 12.00 |
| untreated | 10.00 | 8.25 | 9.00 | 0.00 | 9.00 | 7.75 | 8.00 | 1.25 | 9.25 |
| vinegar | 10.00 | 9.00 | 7.00 | 2.00 | 9.00 | 5.00 | 7.00 | 4.00 | 11.00 |

* Marked = 10/plot; Sat = "new" mounds occurring in plot; Tot = marked + sat.

**Discussion**

The Rapid Kill and Dursban products gave 80-100% control of treated mounds over the course of the test while Garden-Ville and Insecto Formula 7 products gave 60-90% control over the same period. The exact number of "active" mounds varied somewhat due to weather and evaluator interpretation of activity. The garlic and pepper repellent products, as well as the Safer's, gave some measure of treated mound control, but also showed indications of satellite mound formation, indicating repellence, rather than mortality. True Stop showed very little control until the final evaluation where it reached 60%, but had four satellite mounds in the plot. The sugar and vinegar home remedies and the UBIX product showed little control versus untreated plots.

## Evaluation of Hot Water Injections for the Control of Individual Red Imported Fire Ant Colonies Brazos Co., Texas - 1997

Charles L. Barr, Extension Associate
Bastiaan M. Drees, Professor and Fire Ant Project Coordinator
Bill Summerlin, Technician

This test was undertaken to determine the effectiveness of commercially-applied hot water injections for the control of red imported fire ant colonies. Funding was provided by the Fire Ant Control Company of Waco, Texas, who also supplied the equipment and experienced personnel to make the injections. Recently, a number of devices have been developed to inject either steam or hot water into fire ant mounds. These devices are currently being sold, rented and leased for such purposes and are being used by some pest control operators to eliminate fire ant mounds, control weeds, and for various other tasks.

The advantage hot water has over other forms of fire ant control is its rapid ant kill and the fact that only tap water is used in the injections, thus making the method appear to be more "environmentally friendly" than other methods that utilize chemicals. Conversely, some "organic" authorities do not consider very hot water to be an organic treatment because it sterilizes the soil and kills beneficial microorganisms. Since there is no residual activity from hot water treatments, all ants and queens must be killed immediately to effectively eliminate the colony from an area. Worker ants that are not killed outright die or move within a few days or weeks, but surviving queens will likely continue the colony.

### Elimination of Ant Activity in Individual Mounds

*Materials and Methods*

The test was located in western Brazos County, Texas in an ungrazed pasture. The pasture had fire ant infestations in the 200-300 mounds per acre range and were considered to be the multiple queen form of ant colonies. Plots were established by marking several 30-foot wide strips 20 feet apart and of indeterminate length. Within each strip, beginning at one end, 10 active fire ant mounds were marked with wire surveyor's flags of a single color. The next set of 10 mounds was then marked with another color and so on, alternating colors, until sufficient plots of 10 mounds each had been marked in the rows. Flags were placed along one edge of the plots at the midpoint between sets of mound-marking flags, thereby delineating the boundaries of each plot.

Plot lengths were measured and recorded. Lengths were then arrayed from highest to lowest and divided into 4 sets (replications) of 5 plots each. Within each replication, treatments were assigned randomly to plots. The total lengths of the 4 plots of each treatment were then summed. Treatments were then re-assigned within replications as needed so that the total plot length of all treatments were as equal as possible. In this way, bias was reduced in plot assignment and the area available for ant re-invasion was roughly equal for all treatments.

Treatments were made on the morning of 1 October 1997. Skies were clear and the temperature reached a high in the upper 80's that afternoon. Soil was moist and ant activity was distributed at all levels of randomly examined mounds. Treatments included:

| Treatment | Material/method |
|---|---|
| hot water | Hot water injection apparatus, amount varied by mound |
| Sevin XLR® (41.2% carbaryl) | 1.5 qt/100 gallons, 1 gallon/mound drench |
| untreated | Untreated |
| water drench | 1 gallon water only drench/mound |
| water injection | 4 gallons water only injection/mound |

Three sets of control plots were included to help determine if it was the heat or the injected water that most disrupted colony activity. Evaluations were made at 1, 5, 8, 15, and 30 days post-treatment. Evaluations were conducted by lightly disturbing the treated mound structures with a pointed tool handle. A mound was considered active if a number of ants rose to the surface in a defensive manner within 15 seconds of disturbance. All plots were surveyed at the end of the test for satellite mound formation. Results were analyzed using PC SAS ANOVA procedures and Tukey's studentized range test for mean separations ($P$<0.05).

*Statistical Analysis*

Mean no. active mounds

| Treatment | 1-day | 5-day | 8-day | 15-day | 30-day | 30 sat | 30 tot |
|---|---|---|---|---|---|---|---|
| untreated | 9.50 a | 9.25 a | 9.75 a | 8.50 ab | 8.50 a | 1.25 a | 9.75 a |
| hot Water | 8.25 ab | 5.00 b | 3.50 b | 3.50 c | 4.25 b | 1.25 a | 5.50 ab |
| water drench | 8.75 ab | 8.50 a | 8.75 a | 9.25 a | 8.50 a | 2.00 a | 10.50 a |
| water inject. | 6.75 b | 6.50 ab | 7.50 a | 6.25 b | 6.50 ab | 3.00 a | 9.50 a |
| Sevin® XLR | 0.25 c | 0.00 c | 0.00 c | 0.50 d | 0.75 c | 1.75 a | 2.50 b |
| *F* | 27.77 | 17.63 | 32.79 | 28.43 | 18.50 | 0.99 | 5.64 |
| Prob. | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.4847 | 0.0046 |
| Min. sig. diff. | 2.45 | 3.0655 | 2.4431 | 2.3368 | 2.6268 | 3.6862 | 5.2293 |

Means followed by different letters in the same column are significantly different ($P$<0.05) using PC SAS analysis of variance and Tukey's studentized range test for mean separations.

**Phytotoxicity Evaluations**

Ant mounds treated with hot water injections were evaluated for phytotoxicity at 5 and 8 days post-treatment. A rating scale was used to describe damage to vegetation surrounding mounds:
1 = yellowing of some leaves, plant expected to recover completely,
2 = browning of some leaves, plant damaged but expected to recover,
3 = browning of most plant structures, plant seriously damaged or killed

| | Average rating | |
|---|---|---|
| Plot no. | 5-day | 8-day |
| 1 | 2.5 | 2.5 |
| 2 | 2.5 | 2.5 |
| 3 | 2.0 | 2.5 |
| 4 | 2.5 | 3.0 |

**Evaluation of Queen Mortality**

In an area adjacent to the individual mound treatment test, 20 mounds were flagged for evaluation of the effectiveness of hot water injections in immediately killing fire ant queens and winged female reproductive ants (alates). Ten mounds were treated with hot water injections while the remaining ten were untreated. Evaluations were conducted by digging up approximately 0.25 $ft^3$ of soil out of the center of each mound and spreading it out on a tarp. Three to five people then examined the debris and counted any live queens or female winged reproductives. Evaluations of the hot water-treated mounds was made one-half to one hour after treatment.

| | No. of live queens/live female alates | |
|---|---|---|
| Mound no. | Treated | Untreated |
| 1 | 0/0 | 3/0 |
| 2 | 0/0 | 0/1 |
| 3 | 0/0 | 0/1 |
| 4 | 0/0 | 0/0 |
| 5 | 0/0 | 0/2 |
| 6 | 0/0 | 0/0 |
| 7 | 0/0 | 0/0 |
| 8 | 0/0 | 4/1 |
| 9 | 0/0 | 0/2 |
| 10 | 0/0 | 0/4 |
| mean | 0.0/0.0 | 0.7/1.1 |

**Discussion and Summary**

Results of the individual mound treatment test showed that the hot water injections eliminated ant activity in significantly ($P$<0.05) more treated mounds versus mounds treated with a water drench or left untreated at 5, 8, 15 and 30 days post-treatment. Hot water injections resulted in significantly fewer active mounds versus cold water injections of similar volume at 8 and 15 days post-treatment. The standard treatment, a one gallon/mound drench with 1.5 qt./100 gal. carbaryl, resulted in significantly fewer active mounds versus all other treatments at all evaluation dates.

New or satellite mound counts, conducted at 30 days post-treatment, showed no significant differences between treatments, though cold water injection plots had more new/satellite mounds. Carbaryl (Sevin) had significantly ($P<0.05$) fewer active mounds than the untreated, water-drenched or cold water-injected treatments when the total number of mounds (flagged + satellite) were analyzed at 30 days. Sevin and hot water-injection treatment plots contained statistically similar numbers of total active mounds, but the hot water injection-treated plots averaged more than double the number of active mounds than the Sevin-treated plots, 5.5 versus 2.5, respectively.

Phytotoxicity of hot water-injected mounds was fairly severe. Virtually all treated mounds had severely browned vegetation surrounding them, much of it appearing dead. Some mounds did appear to have vegetation with new growth appearing after 30 days.

Excavation of treated and untreated mounds revealed no live queens or female alates in treated mounds. However, in some treated mounds, ants were active around mound perimeters where there was no contact with hot water.

Results indicated that hot water injections immediately kill a large number of worker ants and any queens that are contacted by hot water. However, "control of treated ant mounds" averaged only about 60% over the course of the test. Observations showed that the ants would frequently abandon the main mound structure after injection, but rebuild a smaller mound immediately adjacent to the larger, original one. Observations taken at the 30 day evaluation show that, of the 17 mounds considered active, 9 contained brood and resembled a "normal" colony of reasonable size. The remaining 8 had either sufficient activity to be considered active or were of the small type located to the side of the original mound.

Re-invasion of plots was minimal and there were no significant differences, and small numerical ones, between treatments. The lack of new or satellite mounds indicates that both hot water injections and carbaryl treatments did, in fact, kill colonies, rather than re-locate them. Colony re-location, rather than mortality, is one of the main complaints consumers have about all fire ant control treatments.

The seemingly low rate of control by hot water injections is probably the result of two factors. The first and most important, is that these were multiple queen (polygyne) colonies. To achieve elimination of an ant colonies, *all* the queens would have to be killed within, perhaps, 10 minutes, the time needed to inject the hot water and for it to cool to a non-lethal temperature. Should a queen be deep in the soil or off to the side of the treated area, she would not be exposed to lethal temperatures.

The second factor is the large size of the mounds in this test site and the clay soil. Both of these conditions make the penetration of lethal-temperature water to all areas of the mound slower and more difficult. Though these conditions are found across much of Texas, they are rarely found in managed turf situations. Regular mowing simply does not allow such large mounds to build up. it is likely that control rates for smaller mounds, particularly in lighter soils, would be considerably better.

Finally, the cost of treating mounds must be taken into account. The cost of individual mound treatments range from a few cents to well over one dollar per mound. Bait products, costing $10-15 per acre, control roughly 90% of the mounds that are present in that acre. For instance if there are 100 mounds per acre (a moderate infestation), the cost is only $0.10 - 0.15 per mound. Sevin XLR is one of the least expensive individual mound treatment products available. At 1.5 quarts of Sevin XLR per 100 gallons, the cost is about $0.20 per mound, including labor at minimum wage, and mound control is greater than 90%.

The cost of materials for hot water injections are negligible - tap water and the fuel to heat it - but the initial investment in the equipment and, especially, the time it takes to treat mounds, is considerable. In this test, an average of about four gallons of water was applied to each mound, though the actual amount varied greatly. Consequently, it took an average of about three minutes to treat a single mound - a rate of only 20 mounds per hour.

In conclusion, hot water injections have a place in overall fire ant management, particularly in areas where very fast results and/or chemical-free treatments are desired. However, the economics of this method, particularly from a pest control operator perspective, must be seriously considered before adopting such a treatment method.

# Evaluation of Ant Express™ for the Control of Individual Red Imported Fire Ant Colonies Brazos Co., Texas - 1997

Charles L. Barr, Fire Ant Project Facilitator
Bill Summerlin, Technician
Bastiaan M. Drees, Professor and Fire Ant Project Coordinator

The product Ant Express™ was evaluated for effectiveness in eliminating activity in red imported fire ant (*Solenopsis invicta* Buren) mounds. The product is a light brown, viscous liquid with a paraffin-like odor. It is mixed at a rate of 6 oz. per gallon of water with vigorous agitation and applied at a rate of one gallon of solution per mound. The product is described by the manufacturer as a "drilling mud" for oilfield use and degrades in the environment.

## Materials and Methods

The test site was located in western Brazos County, Texas in an ungrazed pasture. Plots were laid out in a strip 35 feet wide and indeterminate length. Ten active fire ant mounds were marked with wire flags of one color (referred to as a plot). Another set of 10 mounds was then marked with another color flag and so on, alternating flag colors, until sufficient plots were marked down the length of the 35-foot strip. The length of each plot was measured and the lengths arrayed from highest to lowest and divided into 4 groups (replications) of 3 plots each (treatments). Within each replication, one plot was assigned to a treatment so that the total length of all plots for a treatment was as equal as possible. This method helps eliminate plot selection bias and equalizes perimeter length subject to ant re-invasion.

Treatments were applied on 18 September 1997 beginning in the morning. The weather was warm and sunny, temperature in the upper 70's to mid 80's and the clay soil was dry. The following treatments were applied:

| Treatment | Rate |
|---|---|
| Ant Express™ | 6 oz. in 1 gal. water per mound |
| chlorpyrifos | 1 oz. in 1 gal. water per mound |
| Untreated | 1 gal. water per mound |

Ant Express was prepared by mixing 60 oz. product with approximately 10 gallons of water in a plastic container. The product was added while vigorously stirring the water. Stirring continued for several minutes and the product appeared to dissipate completely. The standard treatment, chlorpyrifos, treatments were mixed in 2 gal. batches. All treatments were applied with plastic sprinkler cans without breaker nozzles so that the water stream broke through the mound surface. Additional solution was poured around the perimeter of each mound.

Due to the very dry weather and soil conditions, the test was repeated in an identical manner in a nearby area after several inches of rain fell. It was hoped that increased soil moisture and cooler weather would bring the ants closer to the surface and give Ant Express, in particular, better conditions in which to work. Sevin XLR® (41.2%, 4 lb/gal. carbaryl) was used as the standard (1.5 qt./100 gal. water). These treatments were applied 1 October 1997 and

Evaluations were conducted at 1, 3, 7, 14, 28 and 35 days. Evaluations were made by lightly disturbing the surface of the mound with a pointed tool handle or small shovel. A mound was considered active if a number of ants rose to the surface in a defensive manner within about 15 seconds of disturbance. At several points during the tests, plots were examined for the presence of new or "satellite" (unmarked, untreated) mounds. Results were analyzed using PC SAS ANOVA procedures and means separated by Tukey's studentized range test ($P<0.05$).

## Results and Discussion

**Test 1** Mean no. active mounds per plot

| Treatment | 1-day | 7-day | 14-day | 14 sat | 14 tot | 28-day | 35-day | 35 sat | 35 tot |
|---|---|---|---|---|---|---|---|---|---|
| untreated | 10.0 a | 8.3 a | 9.0 a | 0.5 a | 9.0 a | 7.8 a | 8.0 a | 1.3 a | 9.3 a |
| Ant Express | 8.3 a | 4.3 b | 4.8 b | 1.3 a | 6.0 a | 4.0 b | 4.3 b | 2.0 a | 6.3 b |
| chlorpyrifos | 1.0 b | 0.3 c | 0.5 c | 0.0 a | 1.0 b | 0.0 c | 0.0 c | 1.5 a | 1.5 c |
| *F* | 18.28 | 13.22 | 37.10 | 1.19 | 7.43 | 16.97 | 85.80 | 2.73 | 30.08 |
| Prob. | 0.0014 | 0.0034 | 0.0002 | 0.4121 | 0.0149 | 0.0018 | 0.0001 | 0.1265 | 0.0004 |
| Min sig. diff. | 3.13 | 3.23 | 1.95 | 3.00 | 4.34 | 2.78 | 1.20 | 1.08 | 2.01 |

Means followed by different letters in the same column are significantly different ($P<0.05$) using PC SAS analysis of variance procedures and Tukey's studentized range test.

**Test 2** Mean no. active mounds per plot

| Treatment | 1-day | 7-day | 14-day | 28-day | 35-day | 35 sats | 35 tot |
|---|---|---|---|---|---|---|---|
| untreated | 8.8 a | 8.5 a | 8.8 a | 9.3 a | 8.5 a | 2.0 a | 10.5 a |
| Ant Express | 8.5 a | 7.5 a | 6.8 a | 7.0 b | 5.5 a | 0.5 a | 6.0 ab |
| carbaryl | 0.3 b | 0.0 b | 0.0 b | 0.0 c | 0.0 b | 1.8 a | 1.8 b |
| *F* | 66.57 | 39.00 | 16.24 | 43.61 | 8.22 | 0.65 | 5.09 |
| Prob. | 0.0001 | 0.0002 | 0.0020 | 0.0001 | 0.0117 | 0.6711 | 0.0362 |
| Min. sig diff. | 1.66 | 2.05 | 3.13 | 2.01 | 4.15 | 3.41 | 5.38 |

Means followed by different letters in the same column are significantly different ($P<0.05$) using PC SAS analysis of variance procedures and Tukey's studentized range test.

As shown by the results of the first test, Ant Express significantly ($P<0.05$) reduced active mound numbers versus water-drenched (untreated) mounds, at all evaluation points except one day, post-treatment. However, chlorpyrifos eliminated significantly more mounds than Ant Express at all evaluation dates. At most, Ant Express eliminated activity in 60% (day 28) of treated mounds, versus 100% (day 28 and 35) for chlorpyrifos.

In the second test, Ant Express was only significantly different from water-drenched (untreated) mounds at 28 days post-treatment. Ant Express reached maximum control at 35 days, where ant activity was eliminated in 45% of treated mounds. Carbaryl (Sevin) achieved 100% elimination of ant activity in treated mounds after the one day evaluation and continued to have significantly fewer active mounds than both Ant Express and water-drenched mounds at all evaluation points.

There were no significant differences in satellite mound formation between any treatments in either test. Lack of significant satellite mound formation indicated that chemical treatments likely eliminated colonies from treated mounds, rather than relocated them.

Overall, Ant Express appeared to eliminate activity in only about 50% of treated mounds regardless of temperature and soil moisture conditions. It must be kept in mind that these fire ant colonies were in rather large mound structures that are common in pasture situations in clay soils. Mounds of this size are unlikely to be found in sandy soils or in managed ornamental turf situations in any soil type. It is possible that Ant Express would be more efficacious under circumstances where colonies and mounds are smaller, but such a conclusion could only be drawn from further experimentation.

**Evaluation of Different Rates and Formulations of Bifenthrin for the Control of Individual Red Imported Fire Ant Colonies**
**Brazos Co., Texas - 1997**

Charles L. Barr, Extension Associate
Bill Summerlin, Technician
Bastiaan M. Drees, Professor and Fire Ant Project Coordinator

Two formulations of the pyrethroid compound bifenthrin (Talstar® Flowable and SPG97-003) were applied to mounds of the red imported fire ant *(Solenopsis invicta* Buren) to test their effectiveness and speed in eliminating ant activity. Each formulation was applied at three different rates. Spectracide® 5% diazinon granule, was used as a standard treatment for comparison.

## Materials and Methods

The test was located in western Brazos County, Texas in an ungrazed pasture with an infestation in the 200-300 mounds per acre range. Plots were established by marking two 30-foot wide strips 20 feet apart and of indeterminate length. Within each strip, beginning at one end, 10 active fire ant mounds were marked with wire surveyor's flags of a single color. The next set of 10 mounds was then marked with another color and so on, alternating colors, until 32 plots of 10 mounds each had been marked in the two rows. Flags were placed along one edge of the plots at the midpoint between sets of mound-marking flags, thereby delineating the boundaries of each plot.

Plot lengths were measured and recorded. Lengths were then arrayed from highest to lowest and divided into 4 sets (replications) of 8 plots each. Within each replication, treatments were assigned randomly to plots. The total lengths of the 4 plots of each treatment were then summed. Treatments were then re-assigned within replications as needed so that the total plot length of all treatments were as equal as possible. In this way, bias was reduced in plot assignment and the area available for ant re-invasion was roughly equal for all treatments.

Treatments were applied 26 September 1997, beginning at 8:30 a.m. The weather was clear with temperatures reaching a high of about 85EF in the afternoon and the soil was fairly moist allowing for visibly "worked" soil on active mounds. The following treatments were applied:

| Treatment | Conct. | Amount | Application Method |
|---|---|---|---|
| Bifenthrin | | | |
| SPG97-003 (gran.) | 0.05% | 1 cup/mound | + 1 gal. water drench |
| SPG97-003 (gran.) | 0.05% | ½ cup/mound | + 1 gal. water drench |
| SPG97-003 (gran.) | 0.05% | 1/4 cup/mound | + 1 gal. water drench |
| Talstar Flowable | 7.9% | 0.592 ml/mound, 12.5 ppm | 1 gal. solution |
| Talstar Flowable | 7.9% | 1.184 ml/mound, 25 ppm | 1 gal. solution |
| Talstar Flowable | 7.9% | 2.368 ml/mound, 50 ppm | 1 gal. solution |
| Diazinon (gran.) | 5% | 1/3 cup/mound | + 1 gal. water drench |
| Control | | none | 1 gal. water drench |

Talstar Flowable was mixed in batches of 10 gallons each and applied by means of sprinkler cans with the breaker heads removed so that the water stream would break through the mound crust. Irrigation of granular treatments and untreated control mounds were made with the same sprinkler cans with the breaker heads attached to avoid washing away the granular material.

Evaluations were made at 3, 7, 13 and 34 days post-treatment. Plots were surveyed for satellite mound formation at 34 days. Evaluations were conducted by lightly disturbing the mound with a sharpened tool handle or small shovel. A mound was considered active if a number of ants rose to the surface in a defensive manner within 15 seconds of disturbance. Results were analyzed using PC SAS ANOVA and Tukey's studentized range test for mean separations ($P$<0.05).

**Results**

Mean number of active mounds per plot of 10 treated or as indicated

| Treatment | 3-day | 7-day | 13-day | 34-day | 34 sats* | 34 tot* |
|---|---|---|---|---|---|---|
| Control | 9.25 a | 9.00 a | 8.50 a | 8.50 a | 3.00 a | 11.5 c |
| SPG 1 cup | 0.00 c | 0.25 b | 0.00 b | 0.00 b | 2.50 a | 2.50 b |
| SPG 0.5 cup | 1.00 c | 0.00 b | 0.00 b | 0.75 b | 2.75 a | 3.50 b |
| SPG 0.25 cup | 3.00 b | 1.50 b | 0.75 b | 0.75 b | 2.25 a | 3.00 b |
| TF 12.5 ppm | 0.00 c | 0.25 b | 0.00 b | 0.00 b | 1.25 a | 1.25 b |
| TF 25 ppm | 0.00 c | 0.00 b | 0.00 b | 0.00 b | 1.00 a | 1.00 b |
| TF 50 ppm | 0.00 c | 0.00 b | 0.00 b | 0.00 b | 1.50 a | 1.50 b |
| Diazinon | 0.50 c | 0.00 b | 0.00 b | 0.00 b | 0.50 a | 0.50 b |
| F | 42.87 | 41.33 | 25.91 | 32.83 | 2.69 | 19.59 |
| *P* | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0270 | 0.0001 |
| Min. sig. diff. | 1.9644 | 1.9365 | 2.338 | 2.054 | 2.5699 | 3.2074 |

Means followed by different letters in the same column are significantly different ($P$<0.05) using PC SAS ANOVA and Tukey's studentized range test.

* sats = satellite or unmarked mounds found within plot; tot = active marked + sat mounds

**Discussion**

Both bifenthrin formulations significantly ($P$<0.05) reduced active mound numbers versus water-drenched control mounds at all rates on all evaluation dates. The 1/4 cup rate of SPG97-003 had significantly more active mounds than the other treatments at day 3. Otherwise, all bifenthrin and diazinon treatments were statistically similar at all evaluation dates. There were no significant differences in satellite/new mound formation at 34 days post-treatment and control plots had significantly more total mounds than all treatments on that date.

All Talstar Flowable treatments produced 100% control within 3 days of treatment and throughout the test. The one active mound found on day 7 was borderline in activity and may have been the result of an abortive colonization attempt after nearly a week of rains.

The bifenthrin granular formulation, SPG97-003, showed a numerical, if not statistical rate response. The 1/4-cup rate yielded only 70% control at 3 days. The number of active mounds continued to decline, but, unlike the other granular and flowable rates, never reached 100% control. The ½-cup rate was also slower to work than the 1-cup rate, but did reach 100% elimination of ant activity in treated colonies at 7 days post-treatment. Surprisingly, the 1-cup rate had one active mound appearing at 7 days. This mound was observed to have a fairly large number of ants crawling among a pile of moist granular material. The mound returned to having no ant activity by 13 days.

From an ease-of-use standpoint, the Talstar Flowable needed the usual safety precautions when mixing any chemical, but produced rapid, thorough control. The granular material was easier to handle, but 1 cup of material per mound, even on these rather large mound structures, seemed excessive. A 1/4-cup seemed inadequate for some of the larger mounds and produced less than satisfying results. The ½-cup rate seemed to be a reasonable amount and produced good, though not outstanding, control. Though the application of the granular material itself was quick and easy, watering the granules in was just as time-consuming as using the Flowable drench, with slightly poorer results. One of the main problems with general use of granular materials is failure to irrigate after application, resulting in colony relocation and consumer dissatisfaction.

## Efficacy of Spinosad Bait for the Control of Individual Fire Ant Colonies
## Brazos Co., Texas - 1997

Charles L. Barr,
Extension Program Specialist - Fire Ant Project

Spinosad is a compound derived from the soil actinomycete *Saccaropolyspora spinosa* that affects insect nervous systems at very low doses. This test was conducted to determine the effectiveness of different application rates of a spinosad-based bait for the control of individual colonies of red imported fire ants (*Solenopsis invicta* Buren). The test, sponsored by Dow AgroSciences LLC, was intended to be non-replicated with results combined from similar tests across the country to form a statistically viable study.

**Materials and Methods**

The test site was located in western Brazos County, Texas in an ungrazed pasture with heavy clay soil. Active fire ant mound density averaged about 150 mounds per acre. Mounds were physically large, but due to a hot, dry summer, the colonies occupying them were relatively small. The test method used a modified version of the "railroad track" design.

A strip, 30 feet wide and of indeterminate length was marked near a fence line. Beginning at one end of the strip, the first 10 mounds encountered were marked with wire flags of a single color. The next 10 mounds marked with a different color flag and so on using different or alternating flag colors. Each set of 10 mounds was considered a plot. Because there was no replication of plots, treatments, as listed above, were assigned randomly. A set of untreated control plots were also established as part of another, concurrently run test.

The bait treatments were applied during the afternoon hours of 18 September 1997. Though the soil was dry, ant brood was noted near the tops of mounds throughout the application period and ants were actively foraging.

Treatments included application of 0.015% spinosad on soybean oil coated defatted corn cob grit bait granules at two, four and six tablespoons per active mound. Ten mounds of each rate were treated with bait scattered within a three-foot radius of the mound.

Evaluations were conducted at 4, 7, 14, 28 and 35 days post-treatment using the minimal disturbance technique. At 14 and 35 days post-treatment, the plots were evaluated for "satellite" mound formation within their borders. Mounds were disturbed with a pointed tool handle until a sufficient number of ants rose to the surface in a defensive manner. The exact number of ants required to consider a mound "active" was determined by the evaluator in comparison to untreated mounds under the prevailing moisture, sunlight and temperature conditions.

**Results**

Number of active mounds of 10 treated or as indicated

| Treatment | 4 day | 7 day | 14 day | 14 day sats. | 14 day total | 28 day | 35 day | 35 day sats. | 35 day total |
|---|---|---|---|---|---|---|---|---|---|
| untreated (mean) | 10.0 | 8.25 | 9.0 | 0.0 | 9.0 | 7.75 | 8.0 | 1.25 | 9.25 |
| 2 TB | 7 | 7 | 3 | 1 | 4 | 1 | 3 | 1 | 4 |
| 4 TB | 4 | 3 | 1 | 0 | 1 | 3 | 0 | 2 | 2 |
| 6 TB | 3 | 7 | 6 | 3 | 9 | 5 | 4 | 4 | 8 |

* sats = satellite or unmarked mounds found within plot; tot = active marked + sat mounds

**Discussion**

Results indicate that the four tablespoon per mound rate was the most effective treatment. The apparent oddity is that the higher rate was, in fact, the worst performer. Acceptance could not have been a factor since the treatments were all of the same formulation (from the same container, in fact).

The answer may lie in the activity of spinosad. Tests on other insects show that spinosad has a very narrow threshold between ineffective and lethal doses. The two tablespoon rate may not have provided enough active ingredient to some colonies to have an effective dose reach the queens, the ultimate target for colony elimination. One necessary trait of fire ant baits is that the active ingredient must act slowly enough to allow its circulation throughout the colony undetected. Unhealthy workers are removed from the colony to prevent the spread of whatever is making them sick. The six tablespoon rate may have supplied too much active ingredient, which sickened too many workers, too quickly and caused the colony to switch off that food source, thus protecting the queens and the colony’s existence.

Over the course of the year 2000, Pennington Seed and Central Garden and Pet, with licenses from Dow AgroSciences, will release a series of spinosad-based bait products. Labels for the products have directions to apply four tablespoons of material to each active fire ant mound, six tablespoons to mounds larger than 15 inches in diameter.

## Elimination of Red Imported Fire Ants from Square Bales of Hay

Michael Heimer, County Extension Agent, Montgomery County, Texas

The red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae), is an exotic pest in forage and hay production in Texas and other southeastern infested states. Movement of the pest into non-infested counties is regulated through enforcement of United States Department of Agriculture (USDA) fire ant quarantine by the Texas Department of Agriculture (TDA). Currently, the only approved method of having a TDA inspector certify bales of hay as “fire ant free” and approved for shipping from an infested (quarantined) to and non-infested area is to remove square or round bales from the field immediately after baling and storing them off the ground. No chemical treatment programs have been designed or evaluated to: 1) treat infested bales in the field; 2) treat hay fields or pastures to eliminate the likelihood that bales of hay will become infested; or 3) preventively treat areas on which bales of hay will be stored on the ground.

In addition to the regulatory aspects of fire ant infested bales of hay, other concerns include: 1) square bales are handled by hand and can expose field workers to fire ant stings when they handle infested bales; 2) fire ant infested bales placed in pens with young or weakened livestock can result in a stinging incident or reduced feeding. Although fire ant colonies are not thought to be incorporated into a hay bale during the baling process, colonies readily move into the bales as preferred nesting sites, particularly after heavy rains saturate the soil and cause ants to seek dry nesting sites.

No insecticide is registered specifically for treating bales of hay to eliminate red imported fire ants. However, Amdro® Pro (hydramethylnon) as a bait-formulated product registered for use in hay fields and livestock pastures. It is registered for use as: 1) an individual mound treatment (5 tbsp. around each mound) which eliminates treated colonies in about one week; and 2) as a broadcast application (1 to 1.5 lbs./mound) which provides 80 to 90 percent elimination of ant mound numbers 2 to 6 weeks following treatment until re-invasion occurs.

This trial was conducted to document an attempt to eliminate red imported fire ant colonies from square bales using Amdro® as individual mound treatment method applied around, not directly onto bales.

### Materials and Methods

Forty square bales were obtained and placed in a native pasture infested with red imported fire ants near Dobbin, Texas in Montgomery County, June 8, 1999. Each bale was placed on top of an ant mound which had been disturbed to assure that the ants were present. On June 16, the area in which the bales had been placed was divided into 8 plots, each containing five ant infested square bales. Alternatively, bales in each plot were either treated using 5 tbsp. Amdro® applied around each bale and marked with field tape, or left untreated and unmarked. The approximate size of each plot was estimated and the plots were inspected for additional active fire ant mounds. Periodically following treatment (June 22, 29), ant activity in each bale was evaluated as either active (+) or inactive (-) by rolling the bales over and observing ant activity. At the end of the observation period the plots were again inspected for additional active fire ant mounds. Livestock had been removed from this pasture for the duration of the trial.

**Results and Discussion**

Six days after treatment, 95 percent control was achieved in removing ant activity from infested square bales (1 versus 19, June 22, 1999). Thereafter, rain events occurred regularly, with a "soaking" rain (4 inches) occurring prior to the 29 June pro-treatment evaluation, at which time the number of infested bales increased dramatically (50 percent). These results indicate that this treatment may be useful to temporarily suppress ants in infested bales. Under different environmental conditions (i.e., no rain), results may have documented ant control for a longer period of time.

**Table 1.** Impact of treating around square bales with Amdro® (hydramethylnon) to eliminate red imported fire ant infestations, Montgomery Co., Texas, 1999.

| | | Number of fire ant infested bales/5 (other mounds in plots) | |
|---|---|---|---|
| Date | Days | Treated* | Untreated |
| June 16 | 0 | 5 (1), 5(3), 5 (3) , 5 (2) = 20 | 5 (1), 5 (2), 5(2), 5 (3) = 20 |
| June 22 | 6 | 1, 0, 0, 0 = 1 | 4, 5, 5, 5 = 19 |
| June 29 | 13 | 2, 2, 3, 3 = 10 | 4, 5, 5, 5 = 19 |
| July 12 | 27 | 2 (1), 3 (1), 3 (1), 4 (0) = 12 | 3(2), 5(0), 5(0), 5(2) = 18 |

*5 tbsp. Amdro® (hydramethylnon) applied around each bale (803701E, 816902E, applied 9:30 a.m. to 11:00 a.m.)

Acknowledgment

The author wishes to thank Bastiaan M. Drees, Texas Fire Ant Project Coordinator for guidance and assistance in completing this result demonstration.

## Evaluation of Garden-Ville Soil Conditioner as a Potential Mound Drench Treatment for Red Imported Fire Ants

Bastiaan M. Drees,
Professor and Extension Entomologist, Texas Fire Ant Project Coordinator

Garden-Ville Soil Conditioner (Garden-Ville Fertilizer Company, 7561 E. Evans Rd., San Antonio, TX 78266; 210/651-6115) contains compost tea, black strap molasses and humic acid fermented together to create a liquid compost. Then, cold pressed orange oil is added to enhance the soil conditioning effects. This formulation is considered to be an "organic" product containing naturally occurring ingredients. In sandy soils, the product is applied at a rate of 4 oz. per gallon of water. In heavy dark soils, 6 oz per gallon of water are used. This formulation has been observed to kill red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae) colonies. In 1997, a similar formulation was marketed in some parts of Texas as the product, Fire Ant Control. The product's label is transcribed below:

> Garden-Ville Fertilizer Company
> Organic Specialists Since 1957
> Liquid Compost
> Fire Ant Control
> All Natural, Earth Friendly
>
> DIRECTIONS FOR USE:
> Keep out of reach of children. Store at room temperature.
>
> SHAKE WELL before using. Mix 4 to 6 oz. per gallon of water. Break a small hole through the crust in the center of the ant mound and pour mix in until the whole underground ant cavity is flooded, then quickly drench the ants on top and the surrounding area. Because of the numerous queens in mounds and large numbers of worker ants out foraging, large mounds may need the second treatment. The killing process is a slow but sure, smothering, dissolving, biological action.
>
> Garden-Ville FIRE ANT CONTROL will control most all chewing and sucking insects. Use lower rates for soft bodied insects and the higher rate for hard skinned insects. Works best when insect is totally covered with the mix. This product is also a good soil conditioner. Note; 2 tablespoons = 1 oz. liquid.
>
> INGREDIENTS: Liquid compost 70 percent, Orange oil 30 percent.
>
> 32 fl. oz. or 1 US quart
> DISTRIBUTED BY GARDEN-VILLE FERTILIZER CO.
> 7561 E. EVANS RD. SAN ANTONIO, TX. 78266 (210) 651-6115

These products are not currently registered as insecticides by the Environmental Protection Agency. This trial was conducted to develop efficacy (effectiveness) data documenting the product's performance when as applied as directed. It was evaluated against sets of red imported fire ant mounds that received either one gallon of water, only (untreated control), or Organic Plus® Pyrethrins/Diatomaceous Earth Insecticide (CAUTION) containing pyrethrins (0.2%), diatomaceous earth (90%) and piperonyl butoxide (1.1%) produced by Organic Resources, Inc. at a rate of 4 Tbsp./gal./mound. The trial was monitored for 27 days.

**Materials and Methods**

This trial was conducted on the campus of Texas A&M University Campus (between Buildings 107 and 108; Research Park Freeway and Discovery Rd.). Twelve plots, variable in size but each containing 10 marked imported fire ant mounds, were established, Nov. 12, 1999. Plots were arrayed by area, blocked by size category (large plots block, two medium sized plots blocks and small plots block) into four replicates and individual ant mound treatments were assigned randomly within each block:

| Plot | | Dimensions | Area (square yards = paces) | Assigned treatment |
|---|---|---|---|---|
| Rep1 | 7 | 60.5x16.5 | 998.3 | check |
| | 11 | 13x67 | 871 | Garden-Ville |
| | 8 | 51.5x14.5 | 746.8 | Organic Plus |
| Rep2 | 3 | 17.5x38 | 665 | Organic Plus |
| | 4 | 44x15 | 660 | Garden-Ville |
| | 1 | 27x23 | 621 | check |
| Rep3 | 10 | 36x15.5 | 558 | Organic Plus |
| | 9 | 13.5x41 | 553.5 | Garden-Ville |
| | 12 | 17.5x29 | 507.5 | check |
| Rep4 | 2 | 20.5x20 | 410 | Garden-Ville |
| | 6 | 14.5x28 | 406 | Organic Plus |
| | 5 | 16.5x17.5 | 288.8 | check |

Total area: check - 2,416.15 sq. yds.; Garden-Ville - 2,494.5; Organic Plus - 2,375.8

Red imported fire ant mounds were marked with field flags to establish and treat plots, and were marked with paint so that flags could be removed after treatment to allow for mowing operations to continue. This is a sprinkler-irrigated turfgrass area, allowing ant mounds to form despite dry summer and fall weather conditions. Although much of campus is treated with fenoxycarb bait (Award®) in the spring and late summer, this area was evidently not treated as was evident by imported fire ant mounds being numerous in this localized area and colonies were found to contain worker larvae (brood).

Treatments included: 1) Garden-Ville Soil Conditioner - 1 gal diluted product per mounds; 2) Organic Plus Pyrethrins/Diatomaceous Earth Insecticide - 4 Tblsp./ gal water/mound; and 3) untreated check - 1 gal water/mound.

Plots were be monitored 1, 2, 8, 16 and 27 days (Nov. 14, 15, 21, 29, Dec. 30, 1999) following treatment for activity in marked mounds, and ant mounds were counted in entire plot areas 16 and 27 days following treatment. Results were analyzed using Analysis of Variance (ANOVA) at $P \leq 0.05$ for both active ant mound assessment data, with means separated using Tukey's Studentized Range test by Dr. Charles L. Barr, Extension Program Specialist, Fire Ant Project.

**Results and Discussion**

This trial was conducted rather late in the year since extreme hot, dry conditions during the summer months prevented red imported fire ant mounds from being plentiful near the surface. In this trial, most of the plots were located in an area receiving sprinkler irrigation. However, in some of these irrigated plots, possibly because of the watering regime, thick turfgrass in these sites or merely because of the time of year, the fire ant colonies were easily disturbed and moved to new locations. In some plots receiving the water drench, only, treatments, many of the drenched mounds became inactive (Table 1). In those plots receiving less water, fewer colonies moved from originally treated locations. Before the Nov. 29 (16 day) post-treatment evaluation, the site received heavy rains resulting in mounds being freshly built up and readily visible by the next evaluation date. Consequently, the untreated check (water drench only) plots were found to contained many “new” ant mounds; significantly more so than did plots receiving chemical treatments. These were, presumably, many of the same colonies originally drenched with water which had moved to new locations to construct mounds. The total number of mounds in these plots actually increased to an average of 13.1. Regardless, in this trial percent control values for chemically treated plots were calculated relative to the number of active mounds in the water-drench only plots for each post-evaluation date (within the columns in Table 1).

Both chemical ant mound drench treatments performed similarly in this trial, significantly reducing the number of red imported fire ants in treated plots for the duration of the 27 day monitoring period. The maximum level of control achieved by the Garden-Ville Soil Conditioner drench was 92.3 percent, two days after application. Thereafter, the number of active treated ant mounds per plot gradually increased, but 76.4 percent were still inactive after 27 days of treatment. The Organic Plus ant mound drench eliminated ant activity in treated mounds more slowly, reaching maximum suppression of ant activity in treated mounds (90.9 percent control) by the end of the trial. Neither treatment caused more colonies to occur in treated plots than were found in the water only (untreated control) treated plots.

In conclusion, Garden-Ville Soil Conditioner, applied as an individual red imported fire ant drench significantly reduced ant activity in treated mounds relative to a water drenched only treatment (untreated check), and performed the statistically same as a “standard” insecticide product currently registered by the Environmental Protection Agency.

**Acknowledgment**

The author is grateful for permission to conduct this trial on the Texas A&M University Campus with approval from the Landscape Maintenance Department, Tom Drew, Superintendent. This trial was conducted with funding support provided by Malcolm Beck for Garden-Ville.

**Table 1.** Number of active red imported fire ant mounds of ten (four replications) prior to and periodically following treatment, Nov. 13, 1999, using selected insecticidal products, Brazos Co., Texas.

**Average no. active fire ant mounds/10 treated mounds**
(Percent control relative to check plots in parentheses)

| **Treatment** | 1 day | 2 day | 8 day | 16 day | 16 day sats.* | 16 day total* | 27 day | 27 day sats.* | 27 day total* |
|---|---|---|---|---|---|---|---|---|---|
| Untreated | 7.3 a | 6.5 a | 5.0 a | 6.3 a | 6.8 a | 13.1 a | 5.5 a | 2.3 a | 7.8 a |
| Garden-Ville | 1.0 b (86.3%) | 0.5 b (92.3%) | 0.5 b (90.0%) | 1.0 a (84.1%) | 4.5 b | 5.5 b (58.0%) | 1.3 b (76.4%) | 2.3 a | 3.6 b (53.8%) |
| Organic Plus | 2.3 b (68.5%) | 1.8 b (72.3%) | 0.5 b (90.0%) | 0.8 a (87.3%) | 3.8 b | 4.6 b (64.9%) | 0.5 b (90.9%) | 0.8 a | 1.3 b (83.3%) |
| *F* | 28.4 | 24.46 | 13.50 | 11.87 | 6.88 | 16.19 | 9.79 | 3.37 | 7.37 |
| *P* | 0.0009 | 0.0013 | 0.0066 | 0.0087 | 0.0280 | 0.0038 | 0.0129 | 0.1042 | 0.0242 |
| Mean sig. diff. | 2.6816 | 2.7774 | 3.0682 | 3.911 | 0.5822 | 5.0103 | 3.4703 | 2.0454 | 5.2772 |

Means in columns followed by the same letter are not significantly different using Analysis of Variance (ANOVA) and Tukey's Studentized Range test at $P \leq 0.05$ (SAS).

* sats = satellite or unmarked mounds found within plot; tot = active marked + sat mounds

**A Cost/Efficacy Comparison of Individual Mound Treatments (IMT)**
**Versus Broadcast Baits**
**Brazos Co., Texas - 1997-98**

Charles L. Barr, Extension Program Specialist
Bill Summerlin, Technician
Bastiaan M. Drees, Fire Ant Project Coordinator

## Introduction

There are two basic types of pesticide treatments used for the control of red imported fire ants (*Solenopsis invicta* Buren): individual mound treatments (IMT) and broadcast baits. There are literally dozens of IMT products available employing a variety of application methods. In recent months there has also been a dramatic increase in the number of conventionally-formulated broadcast bait products available, as well. Though most are labeled for use as IMT's, the distinguishing characteristic of these products is that they can be scattered over an area (broadcast) at very low rates without the need to locate and treat individual fire ant colonies. Conventionally-formulated baits consist of three components: a defatted corn cob grit granule, soybean oil that acts as both carrier and attractant and the active ingredient. These products are almost identical in appearance, application method and application rate, varying mainly in their speed of action and duration of control.

The purpose of this test was to compare the cost and effectiveness of several individual mound treatment products, representing the major application methods, and the two major classes of conventionally-formulated broadcast baits, toxicants and insect growth regulators (IGR's). The test was designed to simulate homeowner-type applications on yard-sized plots to get a more accurate representation of the time and labor involved in application.

## Materials and Methods

The test was located in an ungrazed pasture in western Brazos Co., Texas. Soil in the pasture was a dark, heavy clay which resulted in large, grass-covered fire ant mounds of a height and density that made driving, and even walking, difficult. Vegetation consisted of unimproved sod and bunch grasses. Fire ants were believed to be of the polygyne (multiple-queen) type based on colony densities that averaged 150 mounds per acre. Prior to test initiation in October 1997, the area had endured four months of virtually no rainfall with daytime highs above 95EF. The first rains of fall began in late September, about two weeks before test initiation. Consequently, though fire ant mounds were physically large, the colonies were rather small in population and tended to occupy only a part of the mound structure.

Test plots consisted of 0.25 acre squares (105 x 105 feet) with a central circular sampling area. Initial active mound counts were first taken in a circular sampling area 30 feet in diameter using the minimal disturbance technique where mounds were disturbed with a pointed tool handle. If a sufficient number of ants rose to the surface in a defensive manner, the mound was considered active. Active mound numbers were then arrayed from highest to lowest and divided into four equal sets (replications). Treatments were assigned semi-randomly within replications so that the total number of mounds for each treatment (all four replications) were as equal as possible.

Since the evaluation area would also be used as the IMT treatment area, it was found that some of the plots did not have a sufficient initial number of active mounds for a good test. There was also considerable variability within the low and high density replications. Rather than lay out and evaluate more plots or re-evaluate existing ones and re-assign treatments, it was decided to use a larger, 40-foot radius circle (0.115 ac) for sampling and treating, with pre-count numbers to be determined at the time of treatment.

In plots designated to receive IMT treatments, two workers surveyed the central 40-foot radius circle of each plot and marked all active mounds with wire flags. Active mounds were counted, but not marked, in plots designated to receive no or broadcast bait treatments. Circles were determined by placing a stake in the center of the plot and following a 40-foot long tape around the entire area marking all encountered active mounds. Treatments were done on 17 October 1997. Weather was partly cloudy, 75-85EF with moderately moist soil. The following treatments were applied:

| Treatment | Application rate | Application Method |
|---|---|---|
| chlorpyrifos, 6.6% liquid | 1 fl. oz./md. | IMT, 1 gal. pre-mix drench |
| diazinon, 5G | 1/3 cup/md. | IMT, + 1 gal. water drench |
| diazinon, 5G | 1/3 cup/md. | IMT, dry granules only |
| acephate, 75S | 2 tsp./md | IMT, dry dust on mound |
| hydramethylnon (Amdro®) | 5 TB/md. | IMT, dry granules |
| hydramethylnon | 1.5 lb./acre | broadcast |
| fenoxycarb (Logic®/Award®) | 1.5 lb./acre | broadcast |
| untreated | – | -- |

Plots were treated one at a time by two workers and times were kept on all phases of the treatment process. Drenches were applied with two-gallon plastic watering cans and dry treatments with kitchen measuring spoons to simulate likely homeowner use of the products. Broadcast baits were applied using a Cyclone 1C1 hand-held spreader by a third worker late in the day. Since the 40-foot radius circles had no perimeter markings and time was running short, it was decided to treat the entire 0.25 acre plots of all broadcast bait treatments.

Evaluations of active mounds were conducted within the 40-ft radius circular sampling area using the minimal disturbance technique at 18 and 35 days, and 13, 23, 34 and 60 weeks post-treatment. Since the time it takes to apply IMT's varied with mound density, application times were standardized to the mean mound density of the area, 150 mounds per acre. Mound location times were averaged for all applicable plots. Labor rates were calculated at $6.00 per hour per worker. Product prices were obtained from local Bryan/College Station, Texas retailers on 9 June 1998.

**Results**

**Table 1.** Mean number of active mounds (4 replications) per 0.115 ac circular sampling area.

| **Treatment** | **Pre-count** | **18 day** | **5 week** | **13 week** | **23 week** | **34 week** | **60 week** |
|---|---|---|---|---|---|---|---|
| Untreated | 17.75 ab | 14.50 ab | 13.00 a | 20.25 ab | 17.75 ab | 24.25 a | 41.50 a |
| Dursban, drench | 16.75 ab | 4.75 c | 4.25 bc | 12.00 ab | 10.50 b | 16.75 ab | 35.00 ab |
| Diaz. w/water | 17.00 ab | 3.50 c | 4.00 c | 11.50 b | 11.75 b | 17.00 ab | 32.75 ab |
| Diaz.-dry | 15.75 ab | 7.25 bc | 5.75 bc | 13.00 ab | 14.25 ab | 17.25 ab | 31.00 abc |
| Orthene | 20.00 a | 2.25 c | 3.00 c | 14.00 ab | 11.75 b | 24.00 a | 35.50 ab |
| Amdro-IMT | 13.5 b | 6.00 c | 3.00 c | 12.25 ab | 10.75 b | 9.75 bc | 25.75 bcd |
| Amdro-brdcst.. | 17.25 ab | 4.75 c | 2.25 c | 2.50 c | 2.50 c | 4.25 c | 18.50 d |
| Logic-brdcst. | 16.50 ab | 16.50 a | 10.75 ab | 20.50 a | 20.00 a | 3.75 c | 19.75 cd |
| *F* | 16.64 | 7.29 | 6.52 | 7.45 | 7.99 | 16.61 | 7.40 |
| Prob. | 0.0001 | 0.0001 | 0.0002 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| $R^2$ | 0.8880 | 0.7764 | 0.7563 | 0.7802 | 0.7919 | 0.8878 | 0.7790 |
| Min. sig. diff. | 4.8101 | 7.9908 | 6.6532 | 8.8554 | 7.7141 | 8.2849 | 11.987 |

Means followed by different letters in the same column are significantly different ($P<0.05$) using PC SAS ANOVA and Tukey's studentized range test.

**Table 2** - Summary of fire ant treatment costs. All figures are in dollars ($). Standardized to 150 mounds per acre with two trained applicators working at $6.00 per hour each. Product prices are retail.

| | Product | | Labor | | Locate | Total |
|---|---|---|---|---|---|---|
| Product and method | mound | acre | mound | acre | mounds | per acre |
| Dursban pre-mix drench | 0.31 | 46.50 | 0.106 | 16.00 | 17.39 | **79.89** |
| Diazinon granules + irrigation | 0.20 | 30.00 | 0.076 | 11.50 | 17.39 | **58.89** |
| Diazinon granules w/o irrigation | 0.20 | 30.00 | 0.04 | 6.00 | 17.39 | **53.39** |
| Orthene dry dust | 0.25 | 37.50 | 0.04 | 6.00 | 17.39 | **60.89** |
| Amdro, indiv. mound treatment | 0.62 | 93.00 | 0.05 | 8.00 | 17.39 | **118.39** |
| Amdro, broadcast | N/A | 14.00 | N/A | 1.20* | N/A | **15.20** |
| Logic, broadcast | N/A | 16.50 | N/A | 1.20* | N/A | **17.70** |

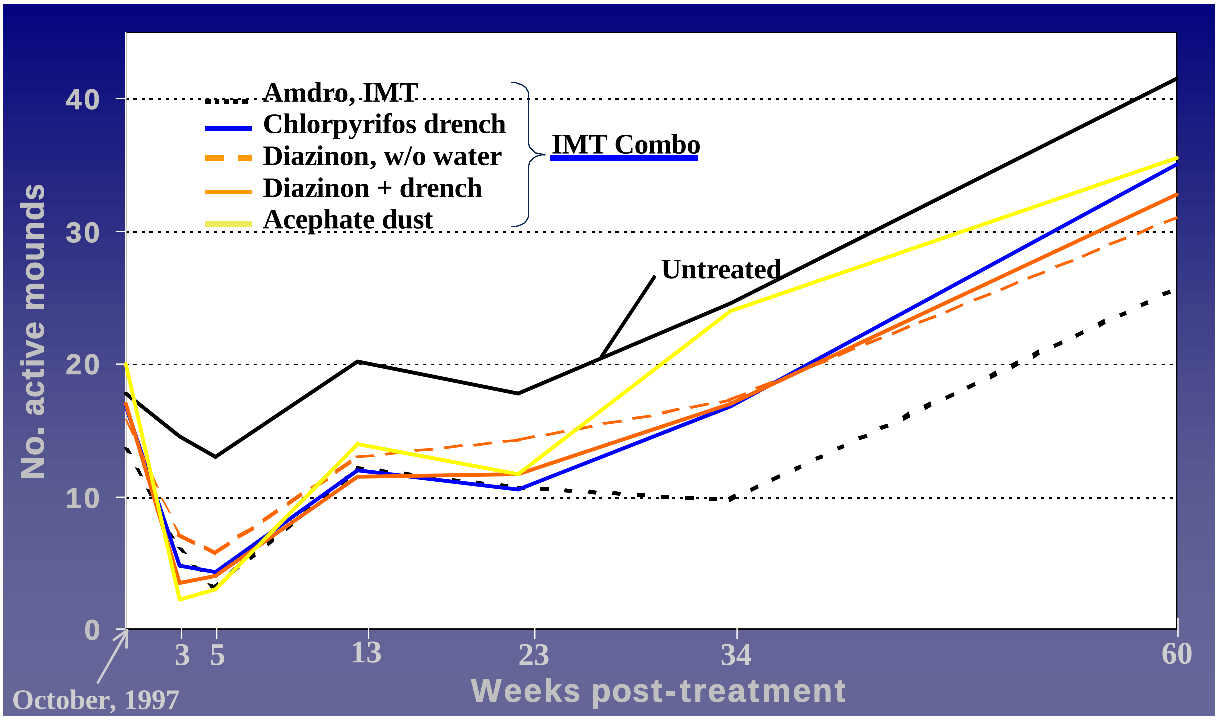
* One applicator only

## Discussion

*Efficacy*

**Figure 1** (from **Table 1** data) illustrates that all IMT's performed almost identically in terms of active mound elimination from three through 23 weeks post-treatment. No statistical differences ($P < 0.05$) appeared among the IMT's until 34 weeks post treatment where Amdro-IMT held populations down significantly better.

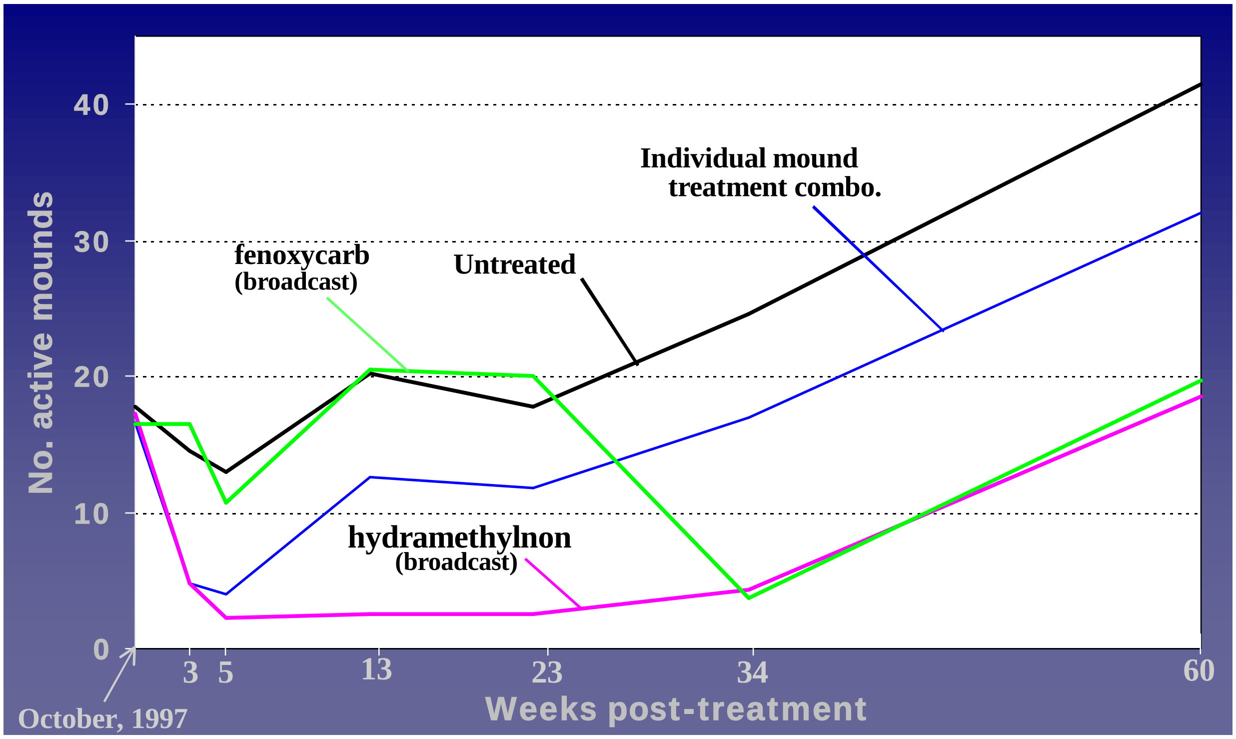
**Figure 1.** Summary of individual mound treatment efficacy.




Based on their similar performance, the IMT's values were consolidated in **Figure 2** for clarity. Note how hydramethylnon applied as a broadcast bait performs similarly to the IMT's through five weeks post treatment. This speed of mound suppression (65% reduction in 18 days) is unusually fast for a broadcast bait. It is speculated that the small, summer-weakened colonies were foraging very actively at the time of treatment in order to rebuild. Consequently, the ants retrieved a high proportion of bait particles, thereby concentrating the toxic effects of hydramethylnon in relatively few worker ants.

The effects of broadcast Logic/Award (fenoxycarb) were quite the opposite. It took over seven *months* for this IGR treatment to reach maximum mound suppression after this fall application. Field observations indicated that worker brood disappeared as expected, but workers died at a very slow rate. This low natural mortality was probably due to the cool, wet winter and spring experienced in 1997-98. Shortly after the 23 week evaluation, rainfall in the area virtually stopped and temperatures were unseasonably high - the likely cause of the steep drop in active mound numbers in fenoxycarb-treated plots.

**Figure 2.** Summary of mound treatment combination versus broadcast bait treatments.




One of the most notable points in **Figure 2** occurs between five and 13 weeks post-treatment. During this interval, IMT active mound numbers return to near pre-treatment levels, while hydramethylnon-treated plots stay near maximum suppression. This trend continues through 34 weeks post-treatment. At this point, it is best to discuss a potential flaw in the experiment. As mentioned earlier, entire 0.25 acre square plots were treated with broadcast baits due to circumstances at the time of treatment, whereas only the central 0.115 acre circle of IMT plots were treated. It is possible that the IMT plots had a higher rate of re-infestation than broadcast-treated plots due to the treated buffer around broadcast plot sampling circles.

However, there are a number of reasons to suspect that the difference in plot sizes may be only a minor factor in the rapid increase in active mound numbers in IMT-treated plots. With 105-foot square plots and an 80-foot diameter sampling area, the circle is within 13 feet of the plot edge on four sides, hardly a major barrier to re-infestation though the buffer is larger in corners.

Most importantly though, the slope of the fenoxycarb-treated plot line, the IMT combination line and the fenoxycarb-treated plot line are virtually identical during the 5-23 week period, indicating that fluctuations were likely the result of weather, season or other non-treatment factors. An overall increase in active mound numbers in all plots did not occur until spring (23 weeks) when colony founding, movement and resulting re-invasion would be most expected. The exception being fenoxycarb-treated plots, which finally began to show steep colony reductions.

Furthermore, the hydramethylnon-treated plots showed virtually no increase in mound numbers, while the fenoxycarb-treated plots showed a steep increase in the 5-13 week period. These plots are directly comparable since entire plots were treated for both. Had the ants been re-invading across the area, the hydramethylnon-treated plots should have shown a similar increase since the product's effects would have been long past.

Consequently, it seems reasonable to assume that the rapid rebound of active mound numbers in IMT-treated plots was the result of either colonies not being seen and treated, or not being eliminated by the treatments, rather than differences in plot size and/or substantial re-invasion. The graph clearly shows that the IMT treatments did eliminate some colonies since their numbers were about half of what they were in untreated and fenoxycarb-treated plots at 13 weeks. Interestingly, the IMT combination line remains about halfway between the untreated and hydramethylnon-treated plot lines from 5-weeks to the end of the test.

*Product and Labor Costs*

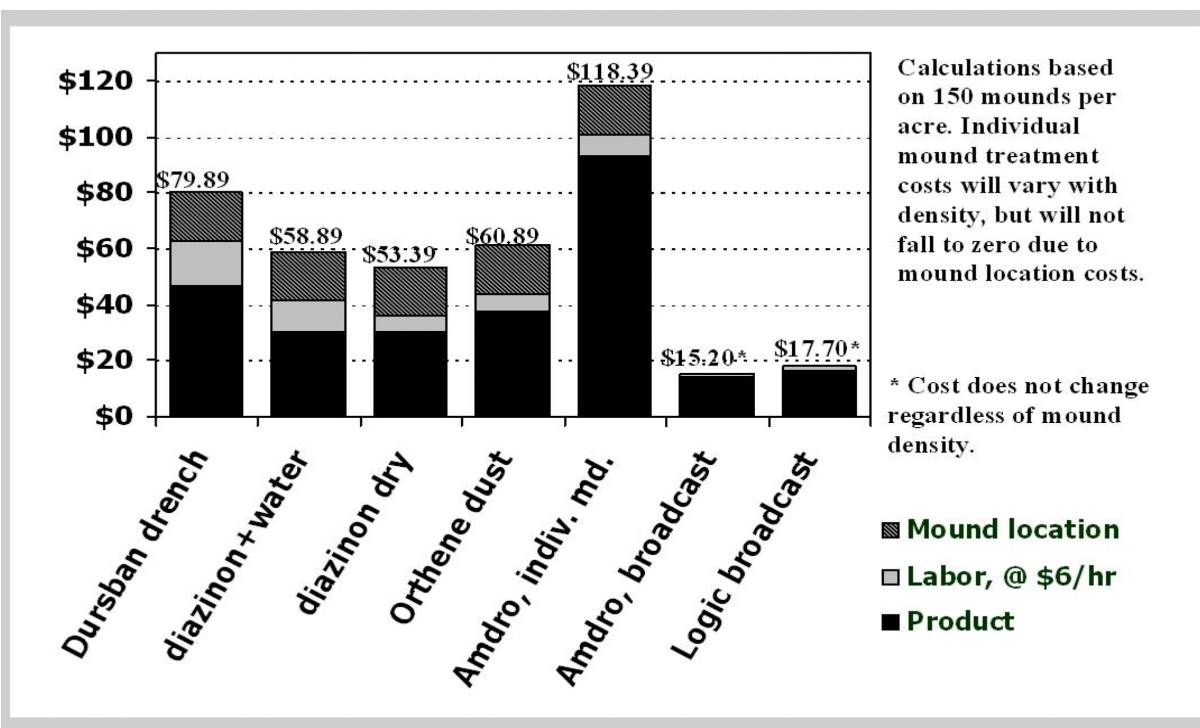
As can be seen from the data in **Table 2** and from **Figure 3**, the labor and product costs of IMT's are several times higher than those of broadcast baits at a standardized mound density of 150 mounds per acre. Costs of IMT's would drop more-or-less proportionately with increasing or decreasing mound density, but would never drop to zero because of the time it takes to survey for active mounds, even if there are few or none present. In this test, just locating mounds cost an average of $17.39 per acre. Broadcast bait applications do not require the location of mounds, of course, so there are no costs associated with that step.

Also note the differences in proportion of total cost for the IMT's. Amdro® (hydramethylnon), used as an IMT, cost about $0.62 per mound, whereas the other IMT products cost $0.20 - $0.31 per mound. On the other hand, the labor involved in mixing chlorpyrifos then carrying it to mounds and drenching them cost nearly $0.11 per mound ($16/acre) where the other methods cost from $0.04 - $0.076 per mound ($6.00 - $11.50/ac).

**Figure 3.** Summary of product and labor costs.

**Conclusion**

The broadcast toxicant bait Amdro (0.73% hydramethylnon) gave the most effective, least



expensive *and* longest-lasting suppression of any of the treatments in this fall-applied test. Experience with Amdro over a number of years of testing has shown that this type of performance is not atypical of broadcast Amdro, though control was somewhat faster than would be expected for a spring or early summer treatment. Treatment with the IGR bait, Logic (1.0% fenoxycarb), demonstrated the main pitfall of all IGR bait products, extremely slow suppression with a fall application. Spring and summer applications usually provide maximum suppression within three months, versus over six in this test. The level of maximum control between fast and slow-acting broadcast baits, as demonstrated here, is usually very similar, but the initiation and duration of that maximum control may very tremendously with seasonal and climatic factors.

There were virtually no differences in effectiveness between IMT products or methods. In practical terms, if a fire ant mound is properly treated with an effective product (as all of these were) one can expect the colony to be eliminated. Therefore, IMT effectiveness across an area seems to depend largely on how well mounds can be located. Mounds in this test were in vegetation that was much taller than would be found in ornamental turf situations, making them harder to find, but mounds tended to be built up due to lack of mowing, making them more visible. Managed turf is usually quite dense and mounds are kept low and small by frequent mowing, which makes them hard to spot in that situation. It is also the very small mounds that are most likely to be stepped in and cause injury. So, regardless of the site, it is very difficult, if not impossible, to locate every fire ant colony in an area of any size with high colony density.

The differences in product and labor costs between IMTs and broadcast baits are striking. Because of the need to survey an area for any IMT program, it requires less labor to treat with a broadcast bait in *any* situation, regardless of mound density. Locating mounds requires a slow, deliberate walk over an area even if no colonies are found, while broadcasting baits requires a brisk walk or a vehicle can be used. When labor must be paid for, even including product costs, IMTs are more expensive than broadcast baits in virtually every situation. In terms of *product cost only*, IMTs can be less expensive than broadcast baits in situations with very low colony densities. At $0.25 per mound for an IMT, 60 mounds in an acre could be treated for about the same cost as 1.5 lbs. of broadcast bait, $15.00, not including any labor value.

When all factors are considered, individual mound treatments are only appropriate when any of the following are primary factors: a) very fast control, less than a week or two; b) there is little or no cost for labor, c) colony density is very low and, d) preservation of other ant species is a concern. In almost every other situation, broadcast baits will provide easier, less expensive and longer lasting control of fire ants.

**Bifenthrin Individual Mound Treatment and Broadcast Treatment Comparison Test**
**Coulter Field, Brazos Co., Texas - 1998**

Charles L. Barr - Extension Program Specialist

There are three general methods of controlling red imported fire ants (*Solenopsis invicta* Buren) on large areas: individual mound treatments, broadcast baits and surface-applied contact insecticides. Each method has its advantages and disadvantages. Individual mound treatments (IMT's) provide fast control, but mounds must be located and treated individually, which can be expensive and time consuming in large areas with high mound densities. It is also very difficult, if not impossible, to locate every colony, particularly those without visible mounds. Broadcast baits are, supposedly, picked up by every colony in an area, though results usually show 80-95% control, and are rather inexpensive compared to the other methods. However, baits work very slowly, taking anywhere from 2 weeks to over 6 months to reach full suppression, depending on product used, season of application and weather conditions. Surface-applied contact insecticides provide fast suppression of virtually all ant foraging activity in an area for some weeks, depending on product, but eliminate colonies only with repeated applications. They are more expensive per acre than broadcast baits, but much less labor intensive than IMT's in most instances.

The purpose of this test was to compare individual mound treatments and broadcast (surface) applications of a granular, a flowable liquid and an experimental liquid formulation of bifenthrin, a synthetic pyrethroid, to each other and a standard treatment (chlorpyrifos). A broadcast Amdro® (hydramethylnon) treatment was included so that the bifenthrin formulations could be compared to a fast-acting broadcast bait for speed and duration of ant suppression. Also added to the test was a broadcast application of hydramethylnon formulated on "lightweight aggregate", a rock-like granule that has a farther spreader "throw" than the defatted corn cob grit used for most conventional fire ant baits.

**Materials and Methods**

The test was located at Coulter Field, a municipal airport serving Bryan/College Station, Brazos Co., Texas. The site was gently sloping with shallow, sandy loam soils over a claypan. The test area was covered by native grasses and forbs which had been mowed, but never grazed, for many years. Vegetation ranged from lush to sparse over the course of the test and the site.

Plots consisted of 100 x 100 foot squares (0.23 ac). The sampling area for all plots was a central circle, 40 feet in radius (0.115 ac.). This circle also served as the treatment area for all IMT's. Because of the difficulty in broadcasting or spraying products accurately in a circle, all broadcast and surface treatments were applied over the entire plot.

Evaluations were conducted in two ways. The first were simple active mound counts using the minimal disturbance technique. The second was to determine ant foraging presence through the use of bait stations. Some difficulty was encountered with this second technique. The original protocol called for the use of glass scintillation vials containing bits of bait. This technique produced a very inconsistent all-or-nothing response by the ants, even when vials were within a few feet of each other in the same plot. The method used for most of the test was to place three 1.5-inch diameter plastic weigh boats about three feet apart in a line in the center of the plot. Two pieces of Tender Vittles® cat food were placed in each boat. Boats were placed in all test plots in sequential order, which took approximately 30 minutes. After waiting another 30 minutes and using the same order as for placement, the estimated number of ants in each boat was recorded for later analysis and the boats picked up.

A total of 53 plots were evaluated for mound numbers on 27 April 1998. Those plots with very low or very high numbers were not used. Plots were arrayed by mound number from lowest to highest, then divided into four equal groups (replications) of 11 plots each. Treatments were assigned within replications so that the total number of mounds for each treatment (total of all four replications) was as equal as possible. Treatments included:

| Product | Application | Rate |
|---|---|---|
| 1. Talstar® Flowable (7.9% bifenthrin) | Surface spray | 26.06 ml/1000 $ft^2$ |
| 2. Talstar® Flowable (7.9% bifenthrin) | IMT drench | 1 tsp/gal. water/md |
| 3. SPG97-001 (experimental bifenthrin) | Surface spray | 86.9 ml/1000 $ft^2$ |
| 4. SPG97-001 (experimental bifenthrin) | IMT drench | 2 tsp/gal. water/md |
| 5. Talstar granular (0.2% bifenthrin) | Broadcast | 2.30 lb/1000 $ft^2$ |
| 6. Talstar® granular (0.2% bifenthrin) | IMT + 1 gal water | 1/4 cup/md |
| 7. Dursban® 4E (chlorpyrifos) | Surface spray | 217 ml/28 gal water/ac. |
| 8. Dursban® 4E (chlorpyrifos) | IMT drench | 1 oz./gal water/md |
| 9. Amdro® (0.73% hydramethylnon) | Broadcast | 1.5 lb/ac |
| 10. Agg. granule + 0.73% hydramethylnon) | Broadcast | 1.5 lb/ac |
| 11. untreated control | untreated | -- |

Treatments were applied 28-30 April 1998. IMT treatments were applied using appropriate measuring devices and two-gallon plastic watering cans. All mounds within the central 40-foot radius circle were treated. Granular and bait products were applied with a Cyclone® 1C1 hand spreader. Due to heavy rain late in the afternoon of 27 April, the ground was too soft to use a full size tractor with a boom sprayer for broadcast toxicant application. Instead, a 14 gallon, 12V, 6-foot boom sprayer was towed behind a John Deere STX 38 lawn tractor.

Evaluations were conducted as follows: 6 May (foraging), 8 May (mound), 15 May (mound and foraging), 29 May (mound) and 1 June (foraging).

**Results**

**Table 1.** Mean number of foraging workers or active mounds for four replications

| Product | Pre-count | 1 week[1] foraging | 10 day mound | 2 week mound | 2 week[2] foraging | 4 week mound | 4 week[2] foraging |
|---|---|---|---|---|---|---|---|
| Talstar® Flow - Brd | 13.75 a | 0.50 ab | 9.75 abcd | 8.00 abc | 9.00 b | 4.50 ab | 41.25 b |
| Talstar® Flow - IMT | 13.75 a | 0.75 ab | 2.75 d | 1.50 c | 19.00 b | 1.25 b | 75.00 ab |
| SPG97-001 - Brd | 14.00 a | 0.50 ab | 8.75 abcd | 11.25 abc | 75.00 ab | 8.00 ab | 58.25 ab |
| SPG97-001 - IMT | 13.75 a | 1.00 a | 2.5 d | 2.00 c | 26.25 b | 0.75 b | 67.50 ab |
| Talstar® gran - Brd | 13.75 a | 0.00 b | 12.00 abc | 8.50 abc | 5.25 b | 5.50 ab | 23.50 b |
| Talstar gran - IMT | 13.75 a | 1.00 a | 3.25 d | 2.50 bc | 26.75 b | 1.00 b | 92.50 ab |
| Dursban® - Brd | 13.75 a | 0.50 ab | 7.50 cd | 4.25 bc | 31.25 ab | 5.00 ab | 46.75 b |
| Dursban® - IMT | 13.75 a | 1.00 a | 3.75 cd | 3.25 bc | 19.25 b | 0.75 b | 47.00 b |
| Amdro® - Brd | 13.75 a | 0.50 ab | 7.75 bcd | 6.75 abc | 12.50 b | 2.25 b | 19.25 b |
| Agg. granule - Brd | 13.75 a | 1.00 a | 16.25 ab | 12.25 ab | 73.25 ab | 10.00 a | 85.00 ab |
| untreated | 13.75 a | 1.00 a | 16.50 a | 14.75 a | 102.5 a | 11.75 a | 132.50 a |
| *F* | 19.77 | 2.80 | 7.22 | 4.35 | 4.24 | 6.05 | 4.22 |
| probability | 0.0001 | 0.0097 | 0.0001 | 0.0004 | 0.0005 | 0.0001 | 0.0005 |
| $R^2$ | 0.8954 | 0.5484 | 0.7579 | 0.6532 | 0.6476 | 0.7237 | 0.6465 |
| Min. sig. diff. | 3.2184 | 0.9129 | 8.5659 | 9.8066 | 71.454 | 7.492 | 75.269 |

df = 30, critical value of Studentized range = 4.917

[1] Due erratic results, vials were given a "+" or "-" rating based on ant presence in the vials. Ratings were converted and analyzed as 1.00 and 0.00 respectively.

[2] Mean of three weigh boats per plot and four plots per treatment. Bait was removed entirely from some weigh boats, so no ants were present by the time of evaluation. These stations were given an arbitrary number of 50 ants.

Results analyzed using PC SAS analysis of variance procedures ($P < 0.05$). Means separated using Tukey's studentized range test.

**Discussion**

Results from the test were somewhat disappointing, due largely to no rain and high temperatures beginning immediately after test initiation and lasting through mid-September. Bifenthrin applications suppressed surface foraging to varying degrees at two weeks post-treatment. The Talstar Flowable spray and Talstar granular broadcast provided the best suppression, to 5-10% that of the untreated plots, but no treatment kept 100% of the ants from all 12 bait stations used for each treatment. By week four, foraging ant numbers were on the rise, though the numerical trends seen at two weeks continued. A number of treatments had significantly ($P$<0.05) fewer foraging ants that the untreated control, but there was no clear trend as to which products consistently gave better suppression.

Mound activity elimination showed similar results. Plots treated with IMT's showed rapid reductions in active mound numbers. Control levels of about 80% versus untreated plots were seen in two weeks, increasing to over 90% in four weeks. Based on field observations, it is believed that the active mounds found in these plots were simply not seen and treated, rather than there being any type of product failure, so the actual control rate for *treated* mounds probably approached 100% for all IMT treatments. All IMT treatments showed significantly ($P<0.05$) fewer active mounds than untreated control plots at both two and four weeks post-treatment. There were only slight numerical differences between IMT treatments.

Surface contact insecticide applications showed greater numerical reductions of active mounds than any of the IMT's, though this is not borne out statistically. Active mound number reductions in broadcast toxicant-treated versus untreated plots ranged from 25% - 50% at two and four weeks. Though there were few, or overlapping, statistical separations between products, the numbered compound fared worse than either Talstar granular or flowable, which had the highest active mound control of the broadcast toxicants.

Amdro showed a 50% reduction in active mounds in two weeks, with about an 80% reduction in a month. Though it never reached the mound elimination levels of the toxicant IMT's, it exceeded those of the broadcast-applied toxicants by four weeks post-treatment. Significant statistical differences were few or overlapping with no clear trend. The lightweight aggregate formulation of hydramethylnon resulted in little reduction in active mounds or foraging ant numbers. The product was very oily and difficult to apply.

Extreme weather conditions played a major role in the conduct of this test. There was a light shower two weeks after test initiation (mid-May) which was the last precipitation received at the test site until mid-September. Temperatures were very high with a record-breaking string of 100EF+ days in June, July and August (total of 51 with 42 consecutive). Consequently, ant mound building activity ceased by mid-June, making it impossible to visually locate colonies. Furthermore, foraging levels increased from Week 2 to Week 4 despite the heat and drought, indicating that the toxicant compounds had "broken" and were allowing ants to move on the ground surface. The result of these factors is that there was no attempt to evaluate the test until rains were received and temperatures cooled in the fall. By that time, City of Bryan mowing crews had destroyed the plot markers, making accurate relocation impossible, so the test was discontinued.

In conclusion, it appears that toxicant IMT's eliminate more mounds from an area than broadcast toxicants and do it much more quickly than Amdro, the fastest acting broadcast bait available, under the conditions of this particular test. There were few differences in effectiveness between IMT products. Labor requirements, on the other hand, were quite different between IMT's and either broadcast baits or toxicants. It took three workers approximately eight hours to locate and treat all 16 IMT plots. It took one worker less than three hours to treat all 12 spray-applied toxicant plots using a very small, slow spray rig. It took less than five minutes per plot to treat with the broadcast baits.

The author would like to thank the following people for their considerable effort in making the pre-counts and applying all the individual mound treatments and granular bifenthrin:

*Pam Traylor, EA-IPM, Harris County; Nathan Riggs, EA-IPM, Bexar County; Scott Russell, EA-IPM, Dallas/Tarrant County; and Lisa Lennon, EA-IPM, Travis/Williamson County.*

**Multiple Treatments of Amdro®, Bifenthrin and Orthene® for the Long-Term Suppression of Fire Ant Populations in Small Plots Coulter Field, Brazos Co., Texas - 1999-2000**

Charles L. Barr, Extension Program Specialist
Rody L. Best, Extension Assistant

The products Amdro® (0.73% hydramethylnon), a bait; Talstar® (0.2% bifenthrin), a granular pyrethroid and; Orthene® (75% acephate), an organophosphate dust, are all labeled for the control of red imported fire ants (*Solenopsis invicta* Buren) on ornamental turf. Amdro is labeled for use as an individual mound treatment, but is most effectively and economically used as a broadcast bait under most circumstances. Talstar is applied as either a broadcast spray or granular material, providing long-lasting suppression of both fire ant colonies and foraging workers through contact activity. It is favored by many pest control operators because of its fast action and immunity to rainfall, unlike Amdro. Orthene is most commonly used as a dry dust for individual mound treatments (IMTs) by consumers. It is both very easy to use and economical on a per colony basis. Therefore, each product has both strengths and weaknesses in controlling fire ants.

The purpose of this test was two-fold. The first was to test the short-term effectiveness of the products alone and in several combinations. The Two-Step program promoted by the Texas Agricultural Extension Service suggests applying a broadcast bait to an area, waiting a few days, then treating individual "nuisance mounds" to eliminate them quickly. Amdro and Orthene are two of the more common, effective and economical products suggested for use in this program.

The second purpose was to test the long-term suppression of the individual products and the products in combination. Talstar, bifenthrin, gives a very fast kill to ants coming in contact with it and also has a residual on the order of several months. Amdro and Orthene are broken down within a matter of days. The particular "Talstar" formulation used in this test was a 1.2% bifenthrin granular experimental compound. The ultimate goal of the test was to utilize the benefits of the Two-Step program, using Amdro and Orthene, and try to extend the time of suppression by using bifenthrin to suppress colony re-invasion. This program was referred to as the Three-Step since it involved applying a bait, followed in 24 hours by individual mound treatments, followed in six weeks by a long-residual toxicant.

**Materials and Methods**

The test was located at Coulter Field, the Bryan, Texas municipal airport. Soil was a sandy loam over claypan. The area is known to have high ant colony densities during the wet spring and early summer, rapidly decreasing densities as the weather becomes hot and dry, then substantial colony rebuilding and relocation once favorable weather conditions arrive in the fall. The site was chosen to test the residual activity of bifenthrin under this high re-invasion pressure.

Plots consisted of 75 ft. X 75 ft. (approx. 1/8 acre) squares with minimum 15 ft. untreated buffers on all sides to enhance and equalize re-invasion pressure. Plots were established on 7 May 1999 and pre-counts made on 13 May. Plots were arrayed from highest to lowest based on active mound counts and divided into three equal groups (replications). Only three replications were used due to limited bifenthrin test material.

The test included the following treatments:
1. untreated control
2. (A+O) Amdro broadcast, followed in 24 hours with Orthene individual mound treatment (IMT)
3) (O+B) Orthene IMT, followed in 24 hours with bifenthrin broadcast granules
4) (A+O+B) Amdro broadcast bait, followed in 24 hours with Orthene IMT, followed by bifenthrin broadcast granules in 6 weeks
5) (A+B) Amdro IMT, followed by bifenthrin broadcast granules in 6 weeks
6) Amdro broadcast bait only

Initial individual mound treatments and broadcast Amdro treatments were made the afternoon of 13 May. The second step of the Two-Step treatments (individual mound treatments) were made 14 May. For the 24 hour IMT treatments, all active mounds in the appropriate plots were treated, regardless of size of vigor, and the number treated was recorded. Six-week treatments with Talstar were made 24 June 1999.

All evaluations used the minimal disturbance technique. Evaluations were conducted 21 May, 7 June, 13 July 1999 and 11 January 2000. The test was discontinued after the final post-count.

**Results**

Mean number of active mounds (3 replications)

| **Treatment*** | **pre-count** | **1 week** | **3 weeks** | **8 weeks** | **35 weeks** |
|---|---|---|---|---|---|
| untreated | 32.7 a | 21.3 a | 15.3 a | 12.0 a | 8.3 a |
| A+O | 33.0 a | 4.3 b | 0.00 b | 1.0 b | 4.0 ab |
| O+B | 32.7 a | 5.7 b | 2.7 b | 0.7 b | 1.0 b |
| A+O+B | 33.0 a | 1.7 b | 1.0 b | 0.3 b | 1.0 b |
| A+B | 31.7 a | 1.7 b | 2.7 b | 0.3 b | 0.3 b |
| Amdro only | 32.7 a | 5.3 b | 2.7 b | 0.3 b | 4.0 ab |
| *F* | 4.43 | 13.47 | 43.25 | 11.81 | 4.53 |
| Prob. | 0.0173 | 0.0002 | 0.0001 | 0.0004 | 0.0160 |
| $R^2$ | 0.7560 | 0.9041 | 0.9680 | 0.8921 | 0.7604 |
| Min. sig. diff. | 10.429 | 8.4605 | 3.5748 | 5.8503 | 5.9186 |

* Abbreviations correspond to treatment regimes outlined in Materials and Methods

Means in the same column followed by different letters are significantly different ($P < 0.05$) using SAS analysis of variance procedures and Tukey's studentized range test for mean separation.

**Discussion**
All treatments resulted in substantial and significant ($P < 0.05$) reductions in active mound numbers within one week of treatment. This level of suppression remained relatively constant through eight weeks post-treatment even though the number of active untreated mounds decreased by 63% versus pre-treatment levels. By 35 weeks post-treatment, the mean number of untreated mounds were a mere 27% of pre-count levels. All three treatments that received bifenthrin granules broadcast over the entire plot had significantly ($P < 0.05$) fewer active mounds than untreated control plots. The Amdro only and Amdro + Orthene IMT plots had about 50% fewer active mounds than in the untreated plots, but were statistically similar.

Weather played an important role over the course of this test. May and June of 1999 were quite moist after a fairly dry spring, resulting in the high colony densities seen in this area (260 colonies per acre). The site received rain the evening after the initial treatments, resulting in numerous new mounds the following day, compared to pre-counts. Regardless of pre-count, all active mounds in the appropriate plots were treated. It was also noticed that many of the smaller colonies, though still considered active, were already starting to show the effects of Amdro after only 24 hours. It is felt that these colonies would have died off in another day or two without additional treatment, but the protocol was followed and they were treated at 24 hours.

Rainfall virtually stopped in mid-July, making it impossible to accurately count mounds. Despite a few rains during the late fall, mounds did not reappear to any extent until a 2.5-inch rain in January 2000. Despite the rain and moderate weather, the number of mounds in untreated plots was still 30% lower than the previous counts in July, an unusual occurrence in our moderate winters.

The final evaluation suggests that a broadcast application of bifenthrin does numerically reduce colony re-invasion in the long-term. Given the weather conditions, it is difficult to say whether prevention occurred when there was still moisture available in mid-summer or when rainfall was finally received in the late fall and winter, though. Despite there being statistical differences between bifenthrin treatments and the control, there were none between any treatment regimes. The general lack of mounds may have reduced all differences considerably, but the numerical differences between all treatments and controls were slight. It is questionable whether the additional cost of a third, or even the 24-hour individual mound treatments following broadcast Amdro, would have been justified by the additional colony reductions under these conditions.

**Evaluation of Fool-a-bug® V-m Protector as an Exclusion Device Against the Red Imported Fire Ant and the German Cockroach**

Rody L. Best, Extension Assistant, and
Bastiaan M. Drees, Fire Ant Project Coordinator, and
Charles L. Barr, Extension Program Specialist

A dish which can, by design, exclude foraging insects and prevent recruitment would have many valuable uses. This trial was conducted in the laboratory to determine the effectiveness of the Fool-A-Bug®V-M Protector (manufactured by Alternative Control Systems Corporation, 4046 B Fernandina Road, Columbia, SC 29212-3367) **(Fig. 1)** as a foraging deterrent against the red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae), and the German cockroach, *Blatella germanica* (Hymenoptera: Formicidae).

**Fig.1. A Fool-A-Bug®V-M Protector Device.**

**Materials and Methods**

Eight Fool-A-Bug V-M pet dishes were placed in pairs into four specially built stands (**Fig. 2)**. Stands were constructed from wood and consisted of a base, two tiers, and a top. One dish was placed on a tier as it would naturally sit (raised), utilizing the flange design of the dish. This treatment will be referred to as the "Fool-A-Bug®Protector" treatment in this report. Care was taken to prevent the sides of the dish from touching the sides of the stand. The other dish was placed into a pre-cut hole on the other tier which allowed the dish to rest on the outside lip (level), which simulated a dish without the flange. This treatment will be referred to as the "level dish" in this report. The tiers were alternated so that two stands had the level dish on the first tier and the Fool-A-Bug®Protector dish on the second tier, and the other two stands had the Fool-A-Bug®Protector dish on the first tier, and level dish on the second tier. This configuration eliminated dish position on the stand as a variable.

**Fig. 2 Experimental platform for evaluating Fool-A-Bug® V-M Protector under laboratory conditions.**

## I. Red Imported Fire Ant

On 23 November 1998, four red imported fire ant colonies were collected from Royalty Pecan Orchard on Highway 21 in Burleson County and placed into five gallon buckets. The sides of the buckets were coated in talcum powder to prevent escape. The buckets were brought back to the lab and the ants were allowed several days to rebuild. Each colony was provided water and a small amount of crushed cat food.

### A. Exclusion Experiment:

On 1 December 1998, one tablespoon of talcum powder was placed into the bottom of each dish. The four stands were lowered into the five gallon buckets and placed on the top of the red imported fire ant mounds. The ants that managed to gain entry into the dish became trapped in the talcum powder at the bottom of the dish. At intervals of six hours, 1 and 3 days, the approximate number of red imported fire ants trapped in the dishes was recorded. At 7 days, dead ants were sifted out of the talcum powder and counted. The stands were removed from the buckets, and the dishes were thoroughly cleaned.

### B. Recruitment Experiment:

On 11 January 1999, the experiment was repeated with modification to determine the recruitment ability of the red imported fire ant into the dish. One fourth of a tablespoon of crushed IAMS© cat food was placed into the bottom of each dish. The four stands were lowered into the five gallon buckets and placed on the top of the red imported fire ant mounds. At intervals of one hour, four hours, and six hours, the approximate number of red imported fire ants occupying the dishes was recorded, as well as an approximate amount of food that had been removed.

**II. German Cockroach**

On 26 January 1999, the sides of four five gallon buckets were thinly coated with Vaseline. Twenty German cockroaches were placed in each bucket and given water in a baby food jar with a wick and 4 kernels of Purina brand dog food.

**A. Exclusion Experiment:**
Tanglefoot® Pest Barrier was applied to the inside of the eight Fool-A-Bug V-M Protector dishes. Tanglefoot® is a sticky solution composed of Castor oil, Natural gum resins, and vegetable wax. The dishes were placed in the four stands as described in the red imported fire ant experiment, and lowered into the four five gallon buckets. At intervals of six hours, 1, 3, and 7 days, the approximate number of German cockroaches trapped in the dishes was recorded.

**B. Food Attractant Experiment:**
On 8 February 1999, the exclusion experiment was repeated with modification to determine the effect of a food attractant on the German cockroach to gain access into the dish. One fourth of a tablespoon of crushed IAMS© cat food was placed into the bottom of each dish. The four stands were lowered into the five gallon buckets with the 20 German cockroaches. At intervals of six hours, 1, 3, and 7 days the number of German cockroaches occupying the dishes was recorded, as well as an approximate amount of food that had been removed.

Resulting insect numbers per dish were analyzed using the Student's t test (*P*#0.05) and paired comparison using PROC MEANS (*P*#0.05) for each trial and post-initiation interval.

**Results and Discussion**

**I. Red Imported Fire Ant**

**A. Exclusion Experiment:**
The Fool-A-Bug®Protector appeared to reduce the number of fire ants that managed to gain entry (**Table 1**). While there was no statistically significance difference between treatments (P#0.05), there was a trend and an overall 28% numerical reduction in fire ants collected at the end of day 7 in the Fool-A-Bug®Protector versus the level dishes. However, foraging workers were able to get into the Fool-A-Bug V-M Protector dish, whether level or raised; therefore, the Fool-A-Bug®Protector was unsuccessful in completely excluding the red imported fire ant. Variability in foraging pressure between laboratory ant colonies seemed to influence effectiveness, with greater differences between treatments observed in devices placed in buckets with smaller, less active ant colonies.

**B. Recruitment Experiment:**
If fire ants were able to get into the Fool-A-Bug V-M Protector dish as the Exclusion Experiment showed, could they recruit other ants to a food source? Results demonstrate that the Fool-A-Bug®Protector was successful in significantly reducing the number of ants

recruited to the Fool-A-Bug®Protector versus the level dishes (**Table 2**). Observations showed that ants were able to remove the food in the level dishes much faster, even establishing feeding trails along the walls of the dishes. A much slower rate of removal of food from the raised, properly placed Fool-A-Bug®Protectors was observed. In fact, only one feeding trail was observed. However, the data collected from this experiment also showed that the Fool-A-Bug®Protector was unsuccessful in completely preventing recruitment, suggesting that this device can play a role as a part of an Integrated Pest Management (IPM) Program to aid in reducing fire ant access to items placed in the bowl. However, this trial was conducted for a maximum of 6 hours, and should be repeated to confirm these results over a longer period of time.

## II. German Cockroach

### A. Exclusion Experiment:

As in the Fire Ant Exclusion Experiment, German cockroaches were able to enter the Fool-A-Bug®Protector and whether level or raised; the Fool-A-Bug®Protector was unsuccessful in completely excluding the German cockroach. Unlike the fire ant exclusion experiment however, the Fool-A-Bug®Protector was not found to numerically reduce the number of cockroaches getting into the Fool-A-Bug®Protector versus the level dish **(Table 3)**.

### B. Food Attractant Experiment:

Cockroaches were observed in both level dishes and Fool-A-Bug®Protectors at different times and, although the removal of food was difficult to monitor due to their small consumption rates, no visible difference was observed. Results from this experiment failed to document that the Fool-A-Bug®V-M Protector completely prevented the German cockroach from being attracted to food place in the dish **(Table 4)**.

**Table 1. Fire Ant Exclusion Experiment-** Mean number of red imported fire ants, *Solenopsis invicta* Buren, counted in Fool-A-Bug®Protectors versus level dishes following exposure of the device to laboratory colonies (4 replicates).

| **Dish** | **6 hours** | **1 day** | **3 days** | **7days** |
|---|---|---|---|---|
| level dish | 13.50 | 35.00 | 64.25 | 346.25 |
| Fool-A-Bug®Protector | 10.25 | 20.75 | 46.00 | 249.50 |
| Probability* | 0.6351 | 0.3698 | 0.5702 | 0.6207 |
| t-statistic | 0.2319 | 0.0694 | 0.0621 | 0.0990 |
| DF= 6.0 | | | | |

*No significant differences between means using the Students *T* test (P#0.05) and paired comparison using PROC MEANS (P#0.05).

**Table 2. Fire Ant Recruitment Experiment-** Mean number of red imported fire ants, *Solenopsis invicta* Buren, counted in Fool-A-Bug®Protectors versus level dishes following exposure of the device to laboratory colonies (4 replicates).

| Dish | 1 hour | 4 hours | 6 hours |
|---|---|---|---|
| level dish | 62.50 | 58.75* | 35.00* |
| Fool-A-Bug®Protector | 11.25 | 15.25* | 11.00* |
| Probability | 0.0053 | 0.0155 | 0.0413 |
| t-statistic | 0.0075 | 0.0667 | 0.1088 |
| DF = 6.0 | | | |

*Significantly different means in columns using the Student's *T* test and PROC MEANS by paired comparison (p#0.05).

**Table 3. German Cockroach Exclusion Experiment-** Mean number of German cockroaches, *Blatella germanica*, counted in Fool-A-Bug®Protectors versus level dishes following exposure of the device to laboratory colonies (4 replicates).

| Dish | 6 hours | 1 day | 3 days | 7days |
|---|---|---|---|---|
| level | 0.00 | 0.25 | 0.25 | 0.25 |
| Fool-A-Bug®Protector | 0.00 | 0.75 | 0.75 | 0.75 |
| Probability | 0.00 | 0.3903 | 0.3903 | 0.3903 |
| t-statistic* | ------ | 0.3910 | 0.3910 | 0.3910 |
| DF= | 0.00 | 6.0 | 6.0 | 6.0 |

*No significant differences between means using the Students *T* test (P#0.05) and paired comparison using PROC MEANS (P#0.05).

**Table 4. German Cockroach Food Attractant Experiment-** Mean number of German cockroaches, *Blatella germanica*, counted in Fool-A-Bug®Protectors versus level dishes following exposure of the device to laboratory colonies (4 replicates).

| Dish | 6 hours | 1 day | 3 days | 7days |
|---|---|---|---|---|
| level dish | 0.00 | 0.50 | 1.00 | 0.75 |
| Fool-A-Bug®Protector | 0.25 | 0.00 | 0.75 | 0.75 |
| Probability | 0.3559 | 0.1340 | 0.7049 | 1.000 |
| t-statistic* | 0.3910 | 0.1817 | 0.7608 | 1.000 |
| DF= 6.0 | | | | |

*No significant differences between means using the Students *T* test (P#0.05) and paired comparison using PROC MEANS (P#0.05).

## Second Evaluation of The Fool-a-bug® V-m Protector as an Exclusion Device Against Foraging Red Imported Fire Ants and German Cockroaches

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A device which can exclude foraging insects and prevent recruitment could prove valuable for free standing vending machines and/or free standing food service equipment, such as food preparation tables. This was the second trial conducted in the laboratory to determine the effectiveness of the Fool-A-Bug®V-M Protector **(Fig. 1)** (manufactured by Alternative Control Systems Corporation, 4046 B Fernandina Road, Columbia, SC 29212-3367) as a foraging deterrent against the red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae) **(Fig. 2)**, and the German cockroach, *Blatella germanica* (Hymenoptera: Formicidae) **(Fig 3)**.

**Fig. 1. A Fool-A-Bug®V-M Protector Device.**

**Fig. 2. *Solenopsis invicta* Buren (Hymenoptera: Formicidae)**

**Fig. 3. *Blatella germanica* (Hymenoptera: Formicidae)**

**Materials and Methods**

Eight Fool-A-Bug V-M dishes were washed with mild soap and warm water and then dried. They were then placed onto a 3/4 inch thick piece of plywood that measured approximately 5 inches by 5 inches. Four of the devices were placed on the plywood as they would naturally sit (raised) **(Fig. 4.)**. This treatment will be referred to as the "Experimental device" in this report. The other four devices were placed into holes in the plywood which allowed them to rest on the outside lip (level) **(Fig. 5.)**. This treatment will be referred to as the "Control device" in this report.

**Fig. 4. Experimental device**

**Fig. 5. Control device**

The plywood and device were placed in pairs (one Experimental device and one Control device) into a plastic rectangular box ("Rubbermaid Underbed Box" 9.8 Gal, approximate dimensions- 23 in. long by 17 in wide by 6 inches deep), which will be referred to as the "test arena" in this report. The devices were placed in the test arenas so that they were at least 6 inches away from any wall of the arena. The sides of the test arena were coated with a 1:1 mixture of Parade™ Vaseline and Squibb® Mineral Oil to prevent insect escape. The insect colonies were housed in separate containers. Fire ants were kept in a plastic box which measured approximately 16 in. long by 11 in wide by 4 inches deep. The sides of the box were coated with Fluon® to prevent ant escape. German cockroaches were kept in five gallon buckets sealed with a lid with a vent. These will be referred to as the "colony boxes" in this report.

The experiments were conducted in a tile-lined, windowless, room. Lighting consisted of a single, incandescent, 60 watt bulb located on the ceiling. An electric fan was placed at the lowest possible speed and directed across the top of the experimental area.

Upon initiation of the experiment, both insect species (fire ant and German cockroach) were allowed access to the arena for 4 hours before placing the V-M Protector® inside the arena. This allowed the insects time to become familiar with the arena.

**I. Red Imported Fire Ant**

On 5 April 1999, four red imported fire ant colonies were collected from Royalty Pecan Orchard in Burleson County and placed into five gallon buckets. The sides of the buckets were coated in talcum powder to prevent escape. The buckets were brought back to the lab and the ants were allowed several days to rebuild. Each colony was provided water and crickets for food.

On 7 April 1999, water was slowly dripped into the colonies in the five gallon buckets over a period of approximately 8 hours. As the water level rose over the mound, the ants rose to the surface and formed a loose cluster of floating ants and brood. The ants were scooped from the five gallon buckets and placed in colony boxes. The ants were supplied water through a test tube plugged with cotton, and provided frozen crickets for food. A petri dish with holes in the lid was provided as shelter.

On 4 May 1999, 1/4 tablespoon of Jif® Crunchy Peanut Butter was placed into the bottom of eight 7.5 ml polyurethane vials. The inner walls of the vials were coated with Fluon® to prevent ant escape. The vials were then placed into 5/8 inch holes in a 3 ½ inch wooden furniture leg that was provided by the Alternative Control Systems Corporation. The leg was placed in the bottom of the Fool-A-Bug V-M devices, and held upright using a small ½ inch square piece of double sided sticky paper attached to the bottom of the wooden leg. The Fool-A-Bug V-M devices were placed on the plywood and then placed in the test arena **(Fig. 6)**.

**Fig. 6. Fire Ant Experimental dish**

The foraging bridge which connected the colony box to the test arena consisted of an aluminum strip, approximately 26 inches long by 2 inches wide, wrapped in clear packaging tape. It was bent into a slight "U" shape and attached to the colony box and test arena using tape. Water was provided in baby food jars with a rope for a wick and placed in the test arena. **(Fig. 7.)**

**Fig. 7. Red Imported Fire Ant Experiment**

The ants that managed to gain entry into the devices and climb up the wooden leg were then trapped in the bottom of the vials. At intervals of six hours, 1, 3, 7, 8, 9, and 10 days, the number of red imported fire ants trapped in the vials was recorded as well as the approximate number of ants visible on and in the Fool-A-Bug V-M device. The dishes were then removed from the colony boxes and thoroughly cleaned with mild soap and water and then dried.

Resulting insect numbers per dish were analyzed using the PC SAS and PROC MEANS by paired comparison (p#0.05).

## II. German Cockroach

On 18 May 1999, the insides of four five gallon buckets were thinly coated with a 1:1 mixture of Parade™ Vaseline and Squibb® Mineral Oil to prevent cockroach escape. Three sheets of wadded up paper towel was placed in the bottom of the five gallon buckets and in the test arena to provide shelter. A foraging bridge was constructed from Tygon® tubing with an inside diameter approximately ½ inch. A ½ inch hole was drilled into the base of the five gallon bucket and the test arena. The Tygon® tubing was attached to the holes in the five gallon bucket with silicone and then attached to the test arena.

Eight Victor® Roach Magnet boxes **(Fig. 8)** were obtained from Alternative Control Systems Corporation. The Roach Magnet consisted of a cardboard box, approximately 3 inches long by 2 ½ inches wide by 1 inch high. There were several openings, one in the front, another on the top in the far corner, and a large opening on one side (approximately 3 inches long by 1 inch high). A sticky glue was located on the bottom of the inside of the box, and a small piece of Balsa wood (approximately ½ inch by ½ inch) soaked in attractant was located on the inside ceiling of the box. The cardboard box was cut apart so that only the bottom of the box (where the sticky glue was located) remained. This measured approximately 2 inches by 2 inches. The Balsa wood attractant was torn from the inside ceiling of the box and placed in the middle of the sticky glue. The trap and attractant were placed in the bottom of the eight Fool-A-Bug V-M devices. **(Fig. 9)**


**Fig. 8. Victor® Roach Magnet**

**Fig. 9. Top View of the German cockroach trap and attractant**

The Fool-A-Bug V-M devices were placed on the 3/4 inch thick plywood and then placed in the test arena. Water was provided in baby food jars with a rope for a wick and placed in the test arena. Twenty-five German cockroaches were placed in each colony box labeled. At intervals of six hours, 1, 3, and 7 days, the of German cockroaches trapped on the Roach Magnet was recorded **(Fig 10)**.

**Fig. 10. German Cockroach Experiment**

Resulting insect numbers per dish were analyzed using the PC SAS and PROC MEANS by paired comparison (p#0.05).

## Results and Discussion

### I. Red Imported Fire Ant

As shown in Table 1 and Table 2, on Day 3 and Day 7 of the experiment, there was a statistically significant difference between treatments. There was also an average numerical difference of 84% in the number of fire ants observed in the vials of Experimental Device versus Control Device, and an average numerical reduction of 33% of the number of fire ants observed in and around the Experimental Device versus Control Device. Results indicate that the Fool-A-Bug® Protector significantly reduced the number of foraging red imported fire ants that gained access to a food source placed within the device versus a food source in devices with the flange touching the floor. However, these devices did not completely exclude the ants.

### II. German Cockroach

As in the Fire Ant Experiment, the Fool-A-Bug® Protector was found to numerically reduce the number of cockroaches gaining entry into the Experimental Device versus the Control Device **(Table 3)**. While there were no statistically significance differences between treatments (P#0.05), there was an average numerical reduction of 82%. Results indicate that the Fool-A-Bug® Protector reduced the number of foraging German cockroaches that gained entry into the device. Two of the devices completely excluded the German cockroaches.

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**Table 1. Fire Ant Experiment ("In Vial")-** Mean number of red imported fire ants, *Solenopsis invicta* Buren, counted in vials of Experimental Device versus Control Device following exposure of the device to laboratory colonies (4 replicates).

| **Fool-A-Bug® Protector Device** | **6 hours** | **1 Day** | **3 Days** | **7 Days** | **8 Days** | **9 Days** | **10 Days** |
|---|---|---|---|---|---|---|---|
| Control Device | 1.50 | 11.00 | 19.50 * | 22.00 * | 17.00 | 17.25 | 16.25 |
| Experimental Device | 0.00 | 1.25 | 1.00* | 2.25* | 3.75 | 5.00 | 3.50 |
| Probability* | 0.3559 | 0.0742 | 0.0002 | 0.0015 | 0.0900 | 0.1811 | 0.0814 |
| t-statistic | 1.0000 | 2.1589 | 8.3433 | 5.4997 | 2.0191 | 1.5129 | 2.0920 |
| DF= 6.0 | | | | | | | |

*Significantly different means in columns using the Student's *T* test and PROC TTEST (P# 0.05).

**Table 2. Fire Ant Experiment ("In and Around Device")-** Mean number of red imported fire ants, *Solenopsis invicta* Buren, counted in and around Experimental Device versus Control Device following exposure of the device to laboratory colonies (4 replicates).

| **Fool-A-Bug® Protector Device** | **6 hours** | **1 Day** | **3 Days** | **7 Days** | **8 Days** | **9 Days** | **10 Days** |
|---|---|---|---|---|---|---|---|
| Control Device | 3.75 | 16.25 | 15.75* | 14.00 | 10.50 | 7.00 | 11.75 |
| Experimental Device | 2.25 | 5.00 | 1.50* | 6.75 | 5.75 | 12.25 | 15.75 |
| Probability | 0.5717 | 0.1088 | 0.0060 | 0.2466 | 0.2584 | 0.5367 | 0.7357 |
| t-statistic | 0.5980 | 1.8821 | 4.1461 | 1.2837 | 1.2483 | -0.6551 | -0.3536 |
| DF= 6.0 | | | | | | | |

*Significantly different means in columns using the Student's *T* test and PROC TTEST (P# 0.05).

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**Table 3. German Cockroach Experiment-** Mean number of German Cockroaches, *Blatella germanica*, counted in Victor® Roach Magnet traps in Experimental Device versus Control Device following exposure of the device to laboratory colonies (4 replicates).

| **Fool-A-Bug® Protector Device** | **6 hours** | **1 Day** | **3 Days** | **7 Days** |
|---|---|---|---|---|
| Control Device | 0.00 | 2.75 | 5.00 | 5.00 |
| Experimental Device | 0.00 | 0.00 | 1.25 | 1.50 |
| Probability* | ------ | 0.1572 | 0.1734 | 0.2057 |
| t-statistic | ------ | 1.6160 | 1.5444 | 1.4190 |
| DF= 6.0 | | | | |

*No significant differences between means using the PROC TTEST (P# 0.05).

**Evaluation of Piperonyl Butoxide (PBO) as a Potential Insect Growth Regulator for Red Imported Fire Ants**

Charles L. Barr, Extension Associate and
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Piperonyl butoxide (PBO) is frequently used as a synergist in combination with other pesticides, particularly pyrethrins. Recent studies by Satoh and Plapp (1992) indicate that PBO may also act as a juvenoid type of insect growth regulator (IGR). These trials were conducted to determine if PBO had an effect on the development of the red imported fire ant, *Solenopsis invicta* Buren. Fenoxycarb, the active ingredient in Logic® and Award® fire ant baits, acts as a juvenoid IGR. Colonies treated with fenoxycarb in soybean oil fail to produce worker ant larvae and pupae and larvae present at the time of treatment develop only into larger reproductive larvae and pupae. These effects are observable within several weeks of treatment.

The first trials were conducted to determine the most acceptable concentration of PBO in soybean oil to fire ants. Thereafter, trails were conducted to determine if PBO produced insecticidal or IGR effects in laboratory colonies of fire ants.

## Materials and Methods

### I. Preference Trials

Trial 1. Three red imported fire ant colonies were field collected, extracted from the soil, and placed in Fluon®-coated plastic boxes. On 12 January 1994 a set of capillary tubes were filled with varying concentrations of PBO in soybean oil and placed together in the ant colonies. Concentrations exposed to the ants were:

1) Technical (100%) in soybean oil
2) 10,000 ppm (1%) in soybean oil
3) 100 ppm (0.01%) in soybean oil
4) 1 ppm in soybean oil
5) 0.01 ppm in soybean oil
6) 0 ppm, soybean oil alone

The capillary tubes were filled with the solutions to approximately 35 mm of the tubes' length. Exact distances (corresponding to volume) were recorded for each tube. The tubes were then exposed to ant colonies until one tube in each colony was emptied by the ants' feeding activities. The entire set of tubes was then removed and frozen (to kill any ants) before the amount of PBO-soybean oil solution was measured (in mm) and recorded to determine solution consumed. The entire test was repeated (Run 2).

Trial 2. Results from the first set of trials were used to formulate a narrower range of PBO concentrations in soybean oil (PBO was acceptable to ants at concentrations between 1 and 100 percent). The procedure described above was repeated, 13 January, 1994 using the following concentrations:

1) 50% PBO in soybean oil
2) 25% PBO in soybean oil
3) 10% PBO in soybean oil
4) 1% PBO in soybean oil

**II. Efficacy Trials**

Twelve freshly collected fire ant colonies were separated into a treatment and a control group based on the approximate number of workers and quantity of brood present. The colonies of the two groups were paired according to colony size so that each group had an approximately equal number of large and small colonies.

Trial 3. On 7 February 1994, a capillary tube with a known volume of solution was placed in each of the six treatment colonies. In order to deliver as much PBO as possible to the colonies, 25 percent PBO was chosen. A capillary tube of soybean oil alone was placed in the control colonies.

Ants were not apparently attracted to the 25 percent solution of PBO within an hour. The capillary tubes were removed and replaced with ones containing a known volume of 10% PBO. These tubes were removed later in the day and the volume of oil or solution consumed was recorded for all tubes. Results indicated very erratic acceptance of the PBO solution. The procedure was repeated with a 1 percent solution of PBO with tube removal at the end of the day. Consumption was again erratic.

On 8 February 1994 the above procedure was repeated using a 0.1 percent PBO solution. This concentration appeared to be acceptable to all colonies and the procedure was repeated again that day when the tubes were emptied and again on 11 February. In an effort to introduce as much PBO as possible into the colonies, two tubes were used on 11 February and three on 13 February.

The colonies were then examined weekly. Estimated numbers of worker ants and presence of worker brood (ant larvae and pupae) was recorded for each colony through 17 March 1994.

Trial 4. Because of poor results of Trial 3, another trial was conducted to attempt to deliver more PBO to treatment colonies. Colonies from Trial 3 were cleaned of debris and moved to new boxes as necessary. The procedure used in Trial 3 was repeated except that the PBO concentration was increased to 5 percent and was delivered in a disposable 1 ml pipette plugged with cotton to slow leakage. Colonies were observed periodically through 21 April. Worker ant numbers were estimated and presence of worker brood (larvae and pupae) was noted for each colony.

## Results and Discussion

### I. Preference Trials

Trial 1. No clear correlation occurred between amount of piperonyl butoxide concentrations in soybean oil and amount of solution consumed by foraging red imported fire ant activity. The debris piled up by foraging worker ants around the end of the tubes containing technical material indicates that the material was not repellent, but not attractive, at least not compared to the other food sources available (**Table 1**). The 1 percent solution was as "attractive" as any other formulation or oil alone.

Trial 2. Based on the results of Trial 1, the concentrations of this test were arrayed between 1 and 100 percent. The debris piling phenomenon was observed again on several tubes making the results difficult to interpret. The technical material was clearly not attractive as was the 50% concentration (**Table 2**). The lower concentrations yielded highly variable results, but the 25% solution appeared to be attractive enough to use in the delivery of PBO to the Efficacy Test colonies.

### II. Efficacy Trials

Trial 3. As indicated by the data in **Tables 3 and 4**, ants or brood (worker ant larvae and pupae) were not eliminated by the addition of piperonyl to soybean oil. Contrarily, most colonies were observed to increase brood production and some in worker numbers at some point during the duration of this trial. These observations indicate that either PBO is ineffective as an juvenoid insect growth regulator or not enough active ingredient was administered to colonies to cause an effect.

Trial 4. In this trial, the capillary tube method that delivered at most 6.2 mg PBO over a week was abandoned in favor of disposable pipettes containing 0.4 ml of 5 percent PBO that could deliver a maximum of 14 mg PBO within 24 hours. Though large amounts of debris were piled around the mouths of the tubes and some leaked out onto their mounting surface, all material was gone within 24 hours. In the larger colonies, ants were seen feeding on the puddles of material that leaked out.

As indicated in **Table 5**, the piperonyl butoxide administered to fire ant colonies in soybean oil again had no visible effect on either brood production or worker mortality as compared to the control. All colonies experienced some decline in brood and worker numbers over the course of the course of the trial.

### Conclusion

The results obtained from these trials failed to document piperonyl butoxide formulated as a bait in soybean oil as an effective insect growth regulator for the red imported fire ant.

## Literature cited

Satoh, G.T. and F.W. Plapp, Jr. 1992. Use of juvenoid insect growth regulators for management of cotton aphid and sweet potato whitefly populations. Proc. Beltwide Cotton Conf. 2:751-757.

**Table 1.** Amount (mm) of piperonyl butoxide (PBO) in soybean oil removed from capillary tubes by red imported fire ant workers in laboratory colonies, Trial 1, 12 January 1994.

| | Consumption of PBO:soybean oil (mm) | | | |
|---|---|---|---|---|
| PBO Concentration | Colony 1 | Colony 2 | Colony 3 | Total/Avg. |
| **Run #1** | | | | |
| Technical | 38* | 3 | 34* | 75 / 15.0 |
| 1.0% | 19 | 32 | 32 | 83 / 27.7 |
| 0.01% | 23 | 20 | 12 | 55 / 18.3 |
| 1.0 ppm | 30 | 11 | 28 | 69 / 23.0 |
| 0.01 ppm | 30 | 18 | 34 | 82 / 27.3 |
| soybean oil | 32 | 19 | 15 | 66 / 22.0 |
| **Run #2** | | | | |
| Technical | 35* | 37* | 34* | 76 / * |
| 1.0% | 15 | 18 | 32* | 65 / 21.7 |
| 0.01% | 24 | 20 | 27 | 71 / 23.7 |
| 1 ppm | 17 | 17 | 32* | 66 / 22.0 |
| 0.01 ppm | 25 | 26 | 8 | 59 / 19.7 |
| soybean oil | 18 | 13 | 17 | 48 / 16.0 |

* Indicates that ants piled debris around the end of capillary tubes causing the oil solution to soak out of the tube. Consumption cannot be confirmed, so these values should be treated as much less than indicated.

**Table 2.** Amount (mm) of piperonyl butoxide (PBO) in soybean oil removed from capillary tubes by red imported fire ant workers in laboratory colonies, Trial 2, 13 January 1994.

| | Consumption of PBO:soybean oil (mm) | | | |
|---|---|---|---|---|
| PBO Concentration | Colony 1 | Colony 2 | Colony 3 | Total/Avg. |
| Technical | 0 | 3 | 2 | 5 / 1.7 |
| 50% | 2 | 3 | 10 | 15 / 5.0 |
| 25% | 11 | 32* | 34* | 77 / * |
| 10% | 20 | 35* | 33* | 88 / * |
| 1% | 22 | 31* | 32* | 86 / * |

* Indicates that ants piled debris around the end of capillary tubes causing the oil solution to soak out of the tube. Consumption cannot be confirmed, so these values should be treated as much less than indicated.

**Table 3.** Amount of soybean oil or piperonyl butoxide in soybean oil consumed by untreated control (CK) or PBO treated (TRT) colonies during efficacy Trial 3, February 1994.

Consumption of soybean oil (mm)
Date of exposure and PBO concentration used

| | 2/7 | 2/7 | 2/8 | 2/9 | 2/9 | 2/11 | 2/11 | 2/13 | |
|---|---|---|---|---|---|---|---|---|---|
| Colony | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | Total PBO |
| CK1 | 60 | 43 | 70 | 70 | 70 | 70 | 140 | 210 | 0 |
| CK2 | 27 | 62 | 59 | 63 | 70 | 70 | 140 | 210 | 0 |
| CK3 | 50 | 35 | 70 | 70 | 70 | 70 | 140 | 210 | 0 |
| CK4 | 13 | 68 | 70 | 68 | 70 | 70 | 140 | 210 | 0 |
| CK5 | 44 | 60 | 18 | 65 | 70 | 70 | 140 | 210 | 0 |
| CK6 | 30 | 48 | 70 | 38 | 70 | 70 | 140 | 210 | 0 |

| | 10% | 1.0% | 1.0% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | Total PBO (mg**) |
|---|---|---|---|---|---|---|---|---|---|
| TRT1 | 70* | 35* | 70* | 10 | 70 | 70 | 140 | 210 | 6.2 / .37 |
| TRT2 | 70* | 10* | 70* | 70* | 70 | 70 | 140 | 210 | 6.0 / .36 |
| TRT3 | 70* | 25* | 70* | 65 | 70 | 70 | 140 | 210 | 6.2 / .36 |
| TRT4 | 0* | 4 | 68* | 65 | 70 | 70 | 140 | 210 | 0.9 / .43 |
| TRT5 | 2* | 5 | 20* | 58* | 70* | 70* | 140 | 210 | 0.7 / .29 |
| TRT6 | 0* | 5 | 40* | 25* | 70* | 70* | 140 | 210 | 0.7 / .29 |

* Indicates debris piled around end of capillary tube. The amount of debris and amount of oil soaked out of the tube varied widely.

** The first number indicates amount of PBO removed from tube from all factors. The second number indicates amount of PBO "guaranteed consumed", e.g. not including the amounts from those tubes with debris piles. (The weight of PBO was approximated using 1 ml = 1 gram X specific gravity factor of 0.7 for soy bean oil and PBO. Capillary tube volume = p(.575mm)$^2$(mm).

**Table 4.** Vigor and brood status of red imported fire ant laboratory colonies fed either soybean oil (CK) or piperonyl butoxide concentrations in soybean oil (TRT), February through March 1994.

| Treatment | No. workers x 1,000, brood quantity* | | | | | |
|---|---|---|---|---|---|---|
| Colony | 2/7 | 2/16 | 2/23 | 3/2 | 3/9 | 3/17 |
| CK1 | 50, 4SB | 50, 5SB | 50, 5SB | 50, 5SB | 50, 5SB+ | 50, 5SB |
| CK2 | 45, 4SB | 45, 4SB | 45, 4SB | 45, 4SB+ | 40, 4SB+ | 40, 4SB+ |
| CK3 | 40, 3SB | 45, 4SB | 40, 4SB | 40, 4SB+ | 40, 4SB+ | 40, 4SB+ |
| CK4 | 25, 1LB+ | 25, 1LB+ | 25, 1LB+ | 25, 1LB+ | 20, 1LB+ | 20, 1LB |
| CK5 | 20, 1LB | 20, 1LB | 25, 1LB++ | 20, 1LB+ | 20, 1LB | 20, 1LB |
| CK6 | 20, .5LB | 20, 1LB+ | 20, 1LB+ | 15, 1LB | 15, 1LB | 15, 1LB |
| Avg. | 33.3 | 34.1 | 34.2 | 32.5 | 30.8 | 30.8 |
| | | | | | | |
| TRT1 | 60, 2LB | 60, 2LB+ | 50, 2+2 | 50, 2+2 | 45, 2+2 | 40, 2+2 |
| TRT2 | 40, 3SB | 40, 4SB | 40, 4SB | 40, 4SB | 40, 4SB | 40, 4SB+ |
| TRT3 | 40, 2LB | 40, 2LB | 40, 2LB | 35, 2LB | 35, 2LB | 30, 2LB |
| TRT4 | 25, 1LB | 25, 1LB | 30, 1+1 | 30, 1+1 | 30, 1+1 | 35, 1+1 |
| TRT5 | 20, 1LB | 20, .75LB | 20, .75LB | 20, 1LB+ | 20, 1LB | 20, 1LB |
| TRT6 | 15, .5LB | 20, 1LB | 20, 1LB+ | 20, 1LB+ | 20, 1LB | 20, 1LB |
| Avg. | 33.3 | 34.1 | 33.3 | 32.5 | 31.7 | |

* Worker numbers are estimated on the basis of 20,000 in a "full" large petri plate and 10,000 in a "full" small petri plate. Brood quantity was evaluated on the basis of the amount in an average petri plate. LB indicates a "full" large petri plate, SB a "full" small petri plate. The number indicates the number of plates. The addition of + or ++ indicates an unusually large amount of brood. #+# indicates number of petri plates of both sizes with brood.

**Table 5.** Vigor and brood status of red imported fire ant laboratory colonies fed either soybean oil (CK) or piperonyl butoxide concentrations in soybean oil (TRT), March through April 1994.

| Treatment | # workers x 1,000, brood quantity* | | | | |
|---|---|---|---|---|---|
| Colony | 3/24 | 3/31 | 4/7 | 4/14 | 4/21 |
| CK1 | 50, 5SB | 45, 5SB | 40, 4SB | 30, 3SB | 25, 1SB |
| CK2 | 40, 4SB | 40, 4SB | 40, 4SB | 35, 4SB0 | 30, 2SB |
| CK3 | 40, 4SB | 40, 4SB | 40, 4SB | 35, 4SB | 30, 2SB |
| CK4 | 20, 1LB | 20, 1LB | 20, 1LB | 20, 1LB | 15, 1LB |
| CK5 | 20, 1LB | 20, 1LB | 20, 1LB | 20, 1LB | 15, 1LB |
| CK6 | 15, 1LB | 20, 1LB | 20, 1LB | 10, .5LB | 10, .5LB |
| Avg. | 30.8 | 30.8 | 30.0 | 25.0 | 20.8 |
| | | | | | |
| TRT1 | 40, 2LB | 30, 2LB | 30, 2LB | 30, 2LB | 30, 1LB |
| TRT2 | 45, 4SB | 40, 4SB | 40, 4SB | 40, 4SB | 40, 4SB |
| TRT3 | 30, 2LB | 25, 2LB | 25, 1.5LB | 25, 1LB | 25, 1LB |
| TRT4 | 25, 1LB | 25, 1LB | 20, 1LB | 20, 1LB | 20, 1LB |
| TRT5 | 20, 1LB | 20, 1LB | 20, 1LB | 20, 1LB | 20, 1LB |
| TRT6 | 20, 1LB | 20, 1LB | 20, 1LB | 20, 1LB | 20, 1LB |
| Avg. | 30.0 | 26.7 | 25.8 | 25.8 | 25.8 |

* Worker numbers are estimated on the basis of 20,000 in a "full" large petri plate and 10,000 in a "full" small petri plate. Brood quantity was evaluated on the basis of the amount in an average petri plate. LB indicates a "full" large petri plate, SB a "full" small petri plate. The number indicates the number of plates. The addition of + or ++ indicates an unusually large amount of brood. #+# indicates number of petri plates of both sizes with brood.