Fipronil Application Trial - Hallettsville Municipal Airport 2002:
1) Two-Step Application of Granular and Bait Formulations of Fipronil
2) Control of Fire Ant Colonies Along Paved Surfaces with Broadcast Fipronil and Individual Mound Treatments
3) Effectiveness of Broadcast and Individual Mound Treatments in Yard-sized Plots Including Hardscape Borders

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

The active ingredient fipronil has recently come to the market for red imported fire ant (*Solenopsis invicta* Buren) control in three granular and one bait formulated products. Effectiveness for all the products has been good with the granular products showing unmatched residual control.

One of the products' few weaknesses has been that control is relatively slow - usually about a month for full suppression. This is a common trait for all the broadcast bait products with which the fipronil-based products are in direct competition. One solution has been the development of the Two-Step Method in which a broadcast bait is first applied to an area, then a follow-up application of a fast-acting individual mound treatment is made some days later to quickly eliminate "nuisance" mounds.

There have also been scattered reports to the manufacturer indicating that the products may not control colonies as effectively when they are located next to or under paved surfaces. Given the cost of granular fipronil products, $175-$220 per acre, and their use by commercial operators in high visibility locations such as home yards and commercial turf, maximum control is essential.

Two protocols were supplied by the manufacturer, Aventis, to explore the effectiveness of; a) a modified two-step method using fipronil products, both bait and granular, as the first step, followed by a mound drench with Sevin SL, another product in their family and b) the effectiveness of the two-step against "pavement" mounds specifically. The site chosen for the test, the Hallettsville Airport in south Texas, proved unusually well suited to execute both these protocols. Not only were there abundant mounds, but a considerable number were located adjacent to the asphalt runway. The airport was also mowed frequently and, with the runway's 3,500 foot length, had sufficient space for many plots.

This fortuitous set of conditions allowed the combination of the two protocols into one test, thus providing a better set of controls and standards than either protocol had, as written, by itself. The most unique aspect of this test was that two sets of data were taken at each evaluation date - one recording the number of active "pavement" mounds and the other, the number of active mounds away from the pavement. This allowed the three separate comparisons that are reported as follows.

Objectives: Compare the effectiveness of granular and bait fipronil products as a two step treatment with a carbaryl drench for the elimination of fire ant colonies: 1) in the open, 2) in contact with pavement and 3) in both the open and against paved surfaces as would be found in most residential situations.

Materials and Methods

The test was located at the Hallettsville Municipal Airport, Lavaca County, Texas. Soils

were a clay loam with native vegetation that is mowed regularly. Plots were established using the runway lights, spaced every 200 feet, as plot edge markers. A few plots were located along paved taxiways and were marked on the pavement with paint. Treated areas began and ended 10 feet on either side of the runway lights and were 60.5 feet wide for a total plot area of 0.25 acres. All plots had one long edge situated against pavement.

Two distinct types of red imported fire ant mounds were observed. Away from the pavement, mounds were of a dark gray or brown color. Next to the asphalt pavement, however, the ants excavated a very light-colored sandy soil from beneath it. By definition, these light-colored mounds were evaluated as "pavement" mounds. For practical purposes, the evaluation area for these was a line along the pavement edge 160 feet long. A few mounds of the correct color were found a few inches away and were also included as "pavement" mounds. By and large, the pavement mounds were very small, often no more than a few inches in length and sometimes hidden by low vegetation, but the ants usually emerged very vigorously when given the slightest disturbance. To obtain a thorough count, evaluations were conducted by walking backwards and dragging a piece of steel re-bar or a tool handle along the pavement edge. A mound was considered active if ants could be seen running onto the surface of the light soil or onto the pavement itself.

Though pavement mounds made up a majority of active mounds in many plots, they were virtually absent in others. There were only 24 plots with enough pavement mounds to conduct a good test. Therefore, as prescribed in the original protocol, these were used for the two-step applications, untreated and standard treatments only. The remaining three broadcast-only treatments were placed in the plots with few pavement mounds, but a sufficient number of mounds located in the open.

Mounds located away from the pavement and of the darker color, referred to as "open" mounds here, were evaluated separately using the more typical minimal disturbance technique of light disturbance with a pointed tool handle. The sample area for these mounds consisted of a strip beginning and ending 10 feet inside the ends of the treated area and 20 feet wide beginning at the pavement edge for a total sampling area of 3,200 ft^2 (0.073 acres).

The number of active fire ant mounds were first counted on October 9, 2001. Plots were arrayed based on both "open" and "pavement" mound counts so that four replications were established of one low-density, two medium-density, and one high-density plot per treatment (Barr and Best, 2002). Treatments are described in **Table 1**.

Broadcast and S-IMT treatments were applied on October 19, 2001. Bait treatments were applied by hand using an Earth-Way® Ev-N-Spred rotary seeder. Granular products were applied by hand using a Warren's T-7II spreader. Drenches were applied by mixing the appropriate concentration of Sevin SL in a 55 gallon drum, dispensing into two gallon watering jugs and applying to the mound and surrounding area as described on the label. Drenches for the two-step treatments were applied to active mounds on October 29, 2001. Evaluations were conducted on October 24, November 5 and 19, December 3 and 20, January 18, 2002, April 18 and October 18. Data for each analysis were extracted and analyzed separately using SAS PROC ANOVA with means separated using both Duncan's multiple range test, for more separations, and Tukey's studentized range (HSD) test, for more conservative separations, $P < 0.05$, though both are not necessarily reported in the following tables.

Results and Discussion

1) Two-Step Application of Granular and Bait Formulations of Fipronil

These (**Table 2**) results represent product effectiveness against fire ant mounds formed in the open, away from pavement, buildings, trees, etc. that may allow ants to survive in protected spaces beneath these objects. The primary focus of this analysis is the increased speed of control provided by Sevin SL mound treatments versus broadcast treatments alone.

Results for evaluations of "open" mounds are shown in **Table 2**. At five days, the Sevin IMT drench only was the only treatment to significantly ($P < 0.05$) reduce active mound numbers versus the untreated control. This response is typical of contact insecticide individual mound treatments and it is why they often comprise the second step of the two-step method.

Mound drenches (the second step) were applied to plots with "+" treatments at 10 days post-broadcast, therefore the two week evaluation was important in determining how worthwhile the second step of a two-step treatment might be. It is very clear from the data that the Sevin drench resulted in significantly ($P < 0.05$), or nearly so, reductions in mound numbers versus the non-drenched treatments. An important note at this evaluation is that the Sevin IMT-only treatment is still significantly ($P < 0.05$) lower than the untreated plots, but is only showing about 49% control at a mere two weeks post-treatment. The likely reason for such a short duration of control is that the area received considerable rainfall during those two weeks which caused a substantial increase in the number of visible mounds - untreated plot numbers increased over 60%. The increase in mound numbers is therefore likely due to mounds not being visible or missed at the initial treatment, rather than any failure of the product to control mounds that were treated.

At four weeks, all the broadcast treatments had reached maximum suppression with control in the 85 - 95% range. Sevin IMT-only treatment numbers remained relatively steady as did the untreated control. Through two months, all treatments were significantly ($P < 0.05$) lower than untreated with some significant, though small numerical, differences between treatments at 6 weeks. By 3 months, it appeared that Amdro-treated plots were beginning to be reinvested, though differences disappear at the 4 month evaluation, probably due to tall grass and dry weather that made for poor mound building and difficulty in locating them.

At one year post-treatment, all treatments except for those treated with granular fipronil had been substantially reinfested. Both granular fipronil and the two-step with granular fipronil maintained significant ($P < 0.05$) control, greater than 95%, versus untreated. These results only add to those of a series of field trials in which granular fipronil maintained effective control for a year or better. (See Barr et al. 1997 and "Speed of Suppression of Different Carrier Formulations of Fipronil," p.35.)

Table 1. Treatments applied at Hallettsville Airport, October 2002.

Abbrev.	Product(s)	Active ingredient(s)	Rate	Application(s)
Gran	TopChoice	0.0143% fipronil	2 lbs/1000ft^2	broadcast
Gran+	TopChoice +	0.0143% fipronil,	2 lbs/1000ft^2	broadcast followed
Bait	(Firestar)	0.00015% fipronil	15 lbs/acre	broadcast
Bait+	(Firestar) +	0.00015% fipronil,	15 lbs/acre,	broadcast followed
Amdro	Amdro	0.073% hydramethylnon	1.5 lbs/acre	broadcast
Amdro+	Amdro + Sevin	0.073% hydramethylnon,	1.5 lbs/acre,	broadcast followed
Talstar	Talstar	0.2% bifenthrin	100 lbs/acre	broadcast

S-IMT	Sevin	43% carbaryl	label rate	IMT drench only
untreate	N/A	N/A	N/A	N/A

Shaded treatments not included in pavement mound data.

[1] Sevin SL label rate: 3/4 oz./gallon water, apply 1 qt./6" mound diameter

[2] The bait supplied was conventionally formulated with soy bean oil and corn grit. The commercial product Firestar is formulated on Tast-E-Bait granules, both contain 0.0015% fipronil.

Table 2. Results of "open" red imported fire ant mound evaluations - 3,200 ft^2 sample areas, 4 replications. Halletsville, TX. Treated October 19, 2001.

	Mean number of active mounds								
Treat	pre	5 day	2 week	4 week	6 week	2 month	3 month	4 month	12 month
untreat	14.75 a	17.50 ab	24.00 a	19.75 a	18.75 a	17.50 a	12.50 a	14.00 a	22.25 a
Gran	18.75 a	18.75 a	12.75 b	1.50 c	0.25 c	0.25 b	1.75 cd	0.50 b	0.75 b
Gran+[1]	17.25 a	18.25 ab	1.50 d	0.25 c	0.25 c	0.00 b	1.00 cd	0.50 b	1.00 b
Bait	24.50 a	19.00 a	8.50 bcd	1.50 c	0.50 c	1.00 b	2.75 bcd	0.75 b	10.50 ab
Bait+	15.75 a	14.25 ab	1.75 d	2.00 c	0.25 c	0.75 b	1.75 cd	0.75 b	18.00 a
Amdro	24.75 a	17.50 ab	11.00 bc	2.75 cb	2.00 cb	3.00 b	7.50 abc	2.75 b	12.75 ab
Amdro+	14.50 a	14.50 ab	1.25 d	1.00 c	0.75 c	2.50 b	3.50 bcd	1.00 b	16.25 a
Talstar	13.50 a	11.75 ab	2.50 cd	1.00 c	1.00 bc	0.00 b	0.50 d	0.00 b	11.50 ab
S-IMT	14.50 a	3.75 b	12.25 b	10.25 b	6.00 b	4.00 b	8.75 ab	3.00 b	18.25 a
F	3.46	2.74	11.92	11.97	23.60	18.28	7.37	21.26	6.13
P	0.0053	0.0189	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
R^2	0.6131	0.5566	0.8452	0.8459	0.9154	0.8933	0.7716	0.9069	0.7375
MSD	13.092	14.874	9.2089	7.8445	5.192	5.3481	6.7089	3.1774	12.543

Means in the same column with the same letter are not significantly different. Means separated by Tukey's studentized range (HSD) test, $P < 0.05$. df = 24.

[1] A "+" indicates second step Sevin drench of surviving mounds at 10 days post-treatment.

2) Control of Fire Ant Colonies Along Paved Surfaces with Broadcast Fipronil and Individual Mound Treatments

The primary focus of this analysis was to determine the effectiveness of the two-step method against mounds built next to a solid "hardscape" surface, in this case asphalt pavement. The assumption being made is that such a protective surface prevents some of an ant colony from being contacted by IMT drenches and/or coming into contact with an insecticide-treated soil

layer. The result of such an occurrence would be incomplete control.

As shown in **Table 3**, treatments with Talstar, Amdro and Sevin-only resulted in significant ($P < 0.05$) control of pavement mounds versus untreated at only 5 days post-treatment. Talstar, however, gave substantially better control numerically than the other two. By 2 weeks (after the Sevin SL mound drench) all treatment means were significantly ($P < 0.05$) less than untreated controls, except the Sevin SL drench-only (using Tukey's test). By 4 weeks post-treatment, granular fipronil and Talstar had no active pavement mounds in any plot, while the other treatments showed, at most about 75% control versus untreated. This trend continued through the 4 month evaluation with only a few colonies appearing in the granular fipronil plots and the Talstar plots remaining at zero. At 1 year, only a single active pavement mound was found in one granular fipronil plot. Talstar had reinfested to an average of 3.25, though still significantly ($P < 0.05$) less than untreated. The remaining treatments showed substantial reinfestation of 45% - 62% of untreated and 70+% of pre-treatment levels.

Table 3. Results of "pavement" red imported fire ant mound evaluations - 160 ft. linear sampling, 4 replications. Halletsville, TX. Treated October 19, 2001.

	Mean number of active mounds								
Treat.	pre	5 day	2 week	4 week	6 week	2 month	3 month	4 month	12 month
untreat	14.50 a/a	22.50 a/a	22.00 a/a	22.25 a/a	19.75 a/a	22.00 a/a	8.25 a/a	29.00 a/a	22.50 a/a
Gran+[1]	12.25 a/a	15.25 b/ab	0.50 c/b	0.0 c/b	0.25 b/b	1.25 bc/b	0.25 b/a	3.00 cd/bc	0.25 c/b
Bait+	13.50 a/a	13.25 b/ab	3.75 bc/b	6.00 bc/b	5.0 b/b	4.00 bc/b	4.25 ab/a	8.75 bc/bc	11.25 ab/ab
Amdro+	14.25 a/a	8.25 bc/bc	4.00 bc/b	6.50 bc/b	5.25 b/b	4.75 bc/b	2.00 ab/a	6.50 bcd/bc	10.25 bc/ab
Talstar	15.00 a/a	2.50 c/c	0.25 c/b	0.0 c/b	0.0 b/b	0.0 c/b	0.0 b/a	0.0 d/c	3.25 bc/b
S-IMT	14.25 a/a	10.00 b/bc	12.75 b/ab	11.75 b/ab	7.00 b/b	10.00 b/ab	3.0 ab/a	12.00 b/b	14.00 ab/ab
F	0.05	9.02	8.17	6.63	7.21	8.38	2.43	15.09	5.28
P	0.9978	0.0002	0.0004	0.0012	0.0007	0.0003	0.0749	0.0001	0.0037
R^2	0.0150	0.7147	0.6943	0.6481	0.6669	0.6994	0.4033	0.8073	0.5948
MSE	68.347	20.458	35.736	42.361	28.903	31.528	15.347	27.986	47.556

Means in the same column with the same letter are not significantly different. Means separated by Tukey's studentized range (HSD) test, $P < 0.05$. df = 15.

[1] A "+" indicates second step Sevin drench of surviving mounds at 10 days post-treatment.

Several conclusions can be drawn from these results. Talstar proved to be the fastest and, through the first months of the test, most effective treatment. Granular fipronil was somewhat slower to work, but provided almost as good control over the early months and greater residual control at one year. In fact, control at one year in these plots was 99%.

Finally, individual mound treatments can be used along with broadcast products to speed activity. Unfortunately, there were not enough pavement mounds in enough plots to accurately compare the broadcast treatments with and without a two-step mound drench without there being huge differences in pre-count levels. Therefore, speed of control of just the broadcast treatments alone cannot be fully compared to the two-step. However, the Sevin SL-only results give a good indication of how effective a mound drench is. In the critical early weeks of the test the IMT-only treatment never got better than about 65% control, and only around 50% at 5 days and 2 weeks when the treatment should have been most effective and useful.

3) Effectiveness of Broadcast and Individual Mound treatments in Yard-sized Plots Including Hardscape Borders

The two previous sections detailed the effects of a two-step application to mounds located away from pavement and a two step application on mounds directly adjacent to or under pavement. This section concentrates on treatment effectiveness on the two types of mounds taken together. The size of the plots, 0.25 acre, and the length of paved surface contact, about 180 feet, give an approximation of what would be encountered in a typical home lot if: street or sidewalk frontage = 80 feet; walkway (2 sides) = 60 feet; Driveway = 30 feet, for a total of 170 feet. Such a situation would also be found along street medians and in many commercial situations where only a strip of turf would be treated along high-traffic walkways.

Table 4 shows the results of treatments including both "away" and "pavement" mounds. As would be expected from an IMT, Sevin SL-only had the fastest reduction at five days, followed by Talstar broadcast granules. Both these treatments had significantly ($P < 0.05$) fewer active mounds than the untreated control. By week two, all treatments had significantly ($P < 0.05$) fewer active mounds, but the number of mounds in the S-IMT plots had almost doubled. The two-step plots, which received a Sevin SL drench at day 10, had numerically fewer mounds than their companion broadcast only treatments, though statistical differences were masked by high variability.

By 4 weeks, all treatments were again significantly ($P < 0.05$) less than untreated, but differences between treatments were not significant and most were numerically similar. The exception was S-IMT, which had almost triple the number of mounds as the next lowest treatment. At this point, Talstar reached an average of only one mound per plot and maintained this level or better through the four month evaluation.

By 6 weeks, the treatments appear to have reached maximum suppression. Differences between treatments from this point through the four month evaluation are fairly small and inconsistent. With only a few exceptions on a few dates, all maintain significantly ($P < 0.05$) fewer mounds than untreated control plots. By one year post-treatment, both granular treatments maintained a significantly ($P < 0.05$) lower number of active mounds than the untreated control and the two-step treatments. The two-step treatments of both Amdro and fipronil bait have numerically more mounds than their companion broadcast only treatments, though they do not separate statistically using Tukey's test. Talstar rebounded to only 67% control though still statistically less than untreated plot means. Sevin IMT-only plots averaged more mounds than at the beginning of the test (29 vs 32).

Table 4. Results of total number of active red imported fire ant mounds, "open" + "pavement", 4 replications. Halletsville, TX. Treated October 19, 2001.

	Mean number of active mounds per								
Treat	pre	5 day	2 week	4 week	6 week	2 month	3 month	4 month	12 month
untreat	29.50 a	40.00 a	46.00 a	42.00 a	38.50 a	39.50 a	20.75 a	43.00 a	44.75 a

Gran	28.50 a	32.50 abc	15.25 bc	4.00 bc	0.25 b	3.00 b	2.75 bc	1.25 c	1.00 c
Gran+[1]	29.50 a	33.50 ab	2.00 c	0.25 c	0.50 b	1.25 b	1.25 bc	3.50 c	1.25 c
Bait	29.00 a	28.00 abc	13.00 bc	4.50 bc	1.50 b	3.25 b	3.25 bc	5.75 bc	16.75 bc
Bait+	29.25 a	27.50 abc	5.50 c	8.00 bc	5.25 b	4.75 b	6.00 bc	9.50 bc	29.25 ab
Amdro	29.00 a	25.25 abc	13.50 bc	6.75 bc	4.50 b	4.75 b	10.25 abc	8.50 bc	15.75 bc
Amdro+	28.75 a	22.75 abc	5.25 c	7.50 bc	6.00 b	7.25 b	5.50 bc	7.50 bc	26.50 bc
Talstar	28.50 a	14.25 bc	2.75 c	1.00 c	1.00 b	0.00 b	0.50 c	0.00 c	14.75 bc
S-IMT	28.75 a	13.75 c	25.00 b	22.00 b	13.00 b	14.00 b	11.75 ab	15.00 b	32.25 ab
F	0.00	4.51	12.97	10.65	16.19	17.02	7.48	29.12	11.61
P	1.0000	0.0014	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
R^2	0.0012	0.5720	0.7936	0.7593	0.8275	0.8345	0.6891	0.8961	0.7748
MSD	25.559	19.383	4.758	19.477	14.403	14.148	11.22	11.488	20.106

Means in the same column with the same letter are not significantly different. Means separated by Tukey's studentized range (HSD) test, $P < 0.05$. df = 24.

[1] A "+" indicates second step Sevin drench of surviving mounds at 10 days post-treatment.

Overall, the performance of the bait products, including those with a second mound drench step added, were similar and fairly typical - around 90% control at maximum. However, reinfestation began by the two month evaluation, earlier than is expected for broadcast bait treatments.

Though mound treatments can speed colony elimination after a broadcast treatment, they should be limited to mounds that are in high-traffic or sensitive areas and when rapid control is needed. The time it took to treat all the plots, for both broadcast and IMTs was recorded for this trial. On average, it took one person about five minutes to broadcast any material over a 0.25 acre plot. It took an average of 40 "man-minutes" to re-treat the active mounds in those same plots with a drench. Control at two weeks was only 21% greater in the IMT plots versus those receiving just broadcast applications, though it would have been around 66% greater had they been re-treated at 1-3 days. Had the IMT re-treatment been postponed for a month there would have been few mounds to treat. Assuming the broadcast + IMT plots were equal to the broadcast only plots, a total of 61 mounds would have been found active in those 12 plots. At the 10 day treatment, our three workers treated 611 mounds - a tenfold difference.

In conclusion, granular fipronil yielded the best long-term performance of all the products and methods tested whether it was used on "pavement" or "open" mounds. Talstar provided the best short-term performance. Individual mound treatments proved difficult and time consuming to apply to these relatively small plots, gave only a short-term knockdown effect and were only marginally effective against pavement mounds when used alone. This tests illustrates the many variables that must be considered when implementing a control program on a site that includes both "hardscapes" and open areas and that has a severe infestation of fire ants.

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