

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

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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 95°F. 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:

<u>Treatment</u>	<u>Application rate</u>	<u>Application Method</u>
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-brdcast..	17.25 ab	4.75 c	2.25 c	2.50 c	2.50 c	4.25 c	18.50 d
Logic-brdcast.	16.50 ab	16.50 a	10.75 ab	20.50 a	20.00 a	3.75 c	19.75 cd
<i>F</i>	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 and method	Product		Labor		Locate	Total
	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

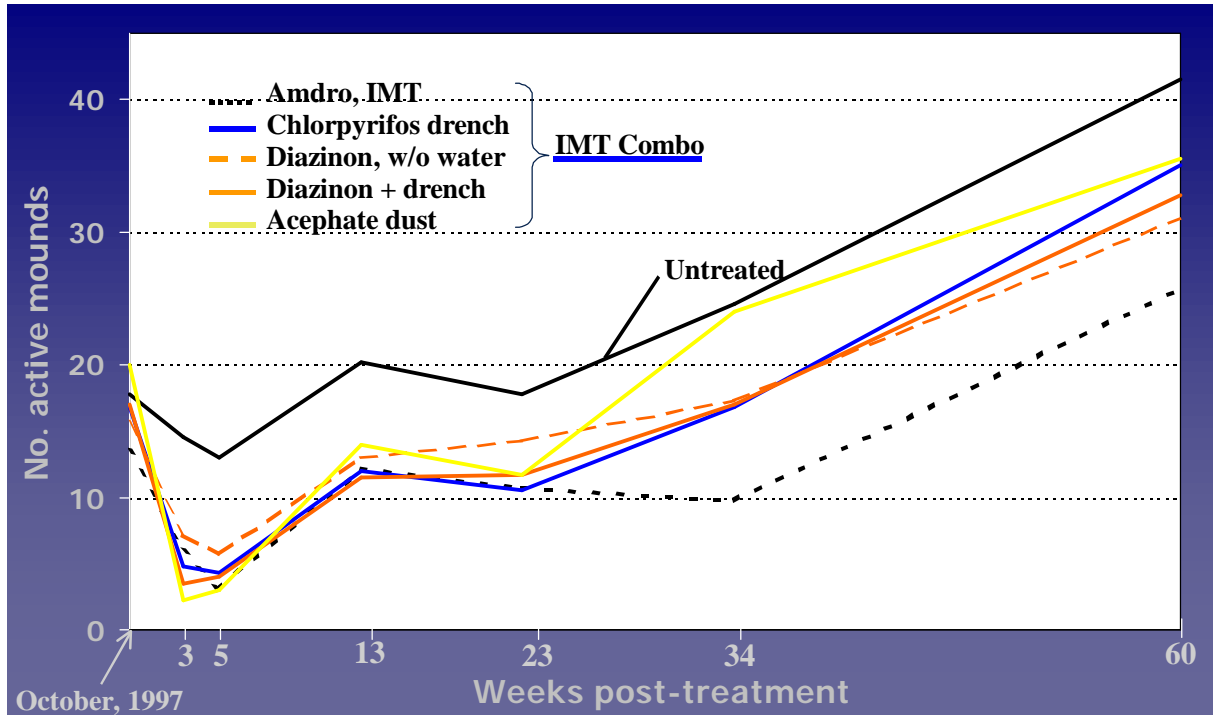
* One applicator only

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.

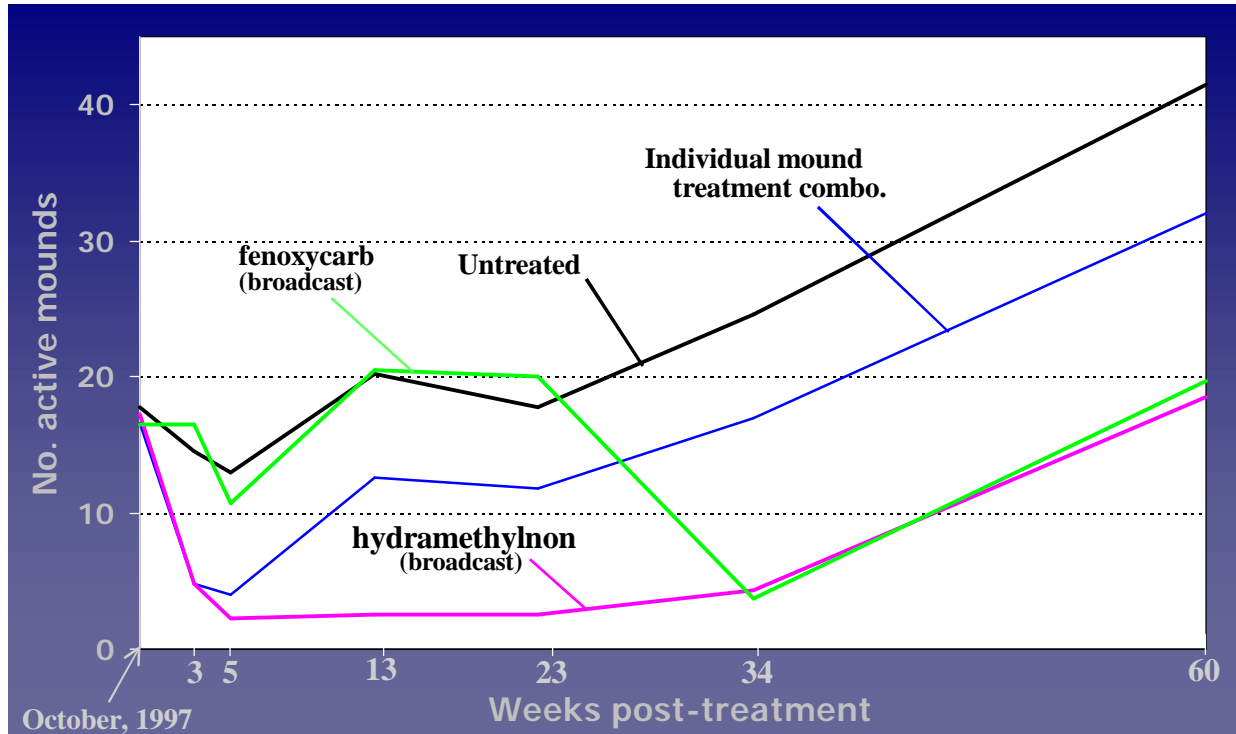
Figure 1. Summary of individual mound treatment efficacy.



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.

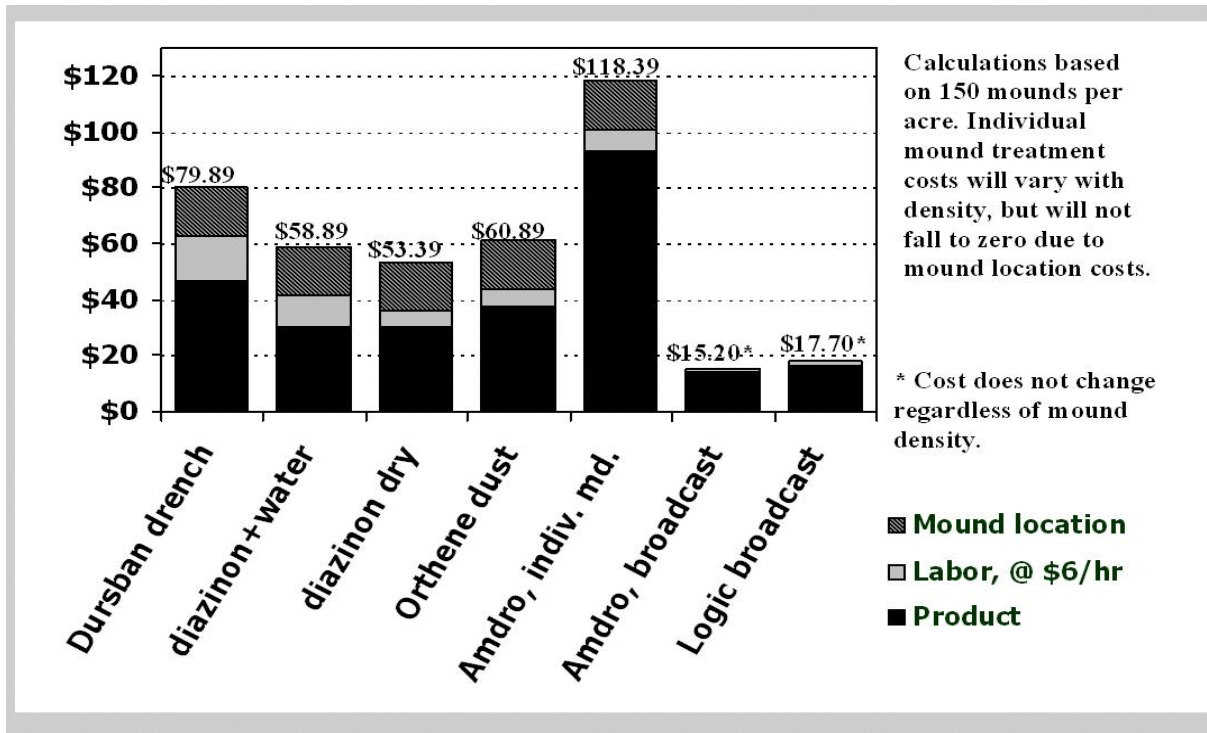
Product and Labor Costs

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 vary 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.