A Field Comparison of Five Broadcast Baits as Full Rate, Hopper Blend and Skip-Swath Applications

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A number of conventionally-formulated broadcast bait products have been introduced to the market in the last few years for the control of red imported fire ants (*Solenopsis invicta* Buren). The Texas Agricultural Extension Service's Fire Ant Applied Research Project has tested most of the active ingredients in field tests over the years, but had never conducted a large-scale, replicated test of the more readily available ones at the same time. Past research has also shown that a 50:50 hopper blend of hydramethylnon bait (Amdro®) plus an insect growth regulator (IGR)-based bait yields the fast speed of suppression of hydramethylnon plus the long duration of control characteristic of the IGR baits. Again, the combination has been tested with several of the products, but not all of them, and not in the same test. Similarly, the effectiveness of skip-swath application of baits has been shown to vary, depending on the bait (Barr and Best 1999; Drees and Barr 1997; Drees et al.1994 ; Drees et al 1993). This method of application has not been tested on all the available products or combinations, either. Skip-swath application, when fully effective, provides similar control to full-rate, full-coverage treatments using half the product and half the labor.

Objectives: 1) Compare the speed, maximum effectiveness and duration of control of five conventionally-formulated broadcast-applied baits when used according to label directions; 2) Compare the speed, maximum effectiveness and duration of control of four slow-acting baits when combined with hydramethylnon bait in a 50:50 hopper blend (1.5 lbs. total product per acre) and; 3) Compare the speed, maximum effectiveness and control duration of all five baits when applied in alternating 30-foot swaths.

Materials and Methods

The site selected for the test was the Palestine Municipal Airport in central East Texas. The airport consists of several hundred acres surrounding 5,000 and 4,000-foot runways set at right angles to each other in a cross-like configuration. The site also has numerous taxiways and other paved areas. Soil consisted of deep sand over most of the site, changing to reddish clay and gravel within 10-50 feet of pavement. The majority of visible fire ant mounds were located in this heavier soil.

Plots dimensions were 300 x 150 feet (1.03 acres). To equalize the better mound formation conditions, all plots had one 300-foot dimension located along a paved surface. Plots were established 10 June 1999. With a few small gaps at the runway ends and to avoid overlapping at corners, plots completely lined both sides of the full length of both runways, all taxiways and several other paved surfaces around hangers and roads.

Sampling was accomplished with two people linked together with a 20-foot piece of rope so they effectively surveyed a 30 foot swath. One edge ran along the pavement to take advantage of the more easily visible mounds and frequently-mowed vegetation. The sample swath began 20 ft. from the plot end markers to provide a treated buffer between sample swaths. Therefore, total

sample area was: 260 x 30 = 7800 sq. ft. or 0.18 acre (approx. 1/6th acre.) All mound evaluations were accomplished using the minimal disturbance technique.

Pre-counts were taken on 11 June 1999. Active mound numbers per sampling areas were arrayed from highest to lowest and divided into four equal groups (replications). Treatments were then assigned within replications so that the total number of active mounds (sum of four replications) was as equal as possible for each treatment. **Table 1** summarizes the treatments used in this test.

Table 1. Treatments applied. Palestine Airport, Anderson Co. Texas, 1999

Treatment	**Rate (/acre)**	**Application**
1) untreated	-	-
2) Amdro® (0.73% hydramethylnon)	1.5 lb	full coverage
3) Clinch™ (0.011% abamectin)	1.0 lb	full coverage
4) Distance® (0.5% pyriproxyfen)	1.5 lb	full coverage
5) Extinguish™ (0.5% s-methoprene)	1.5 lb	full coverage
6) Logic® (1.0% fenoxycarb)	1.5 lb	full coverage
7) Amdro + Clinch	0.75 + 0.75 lb.	full coverage
8) Amdro + Distance	0.75 + 0.75 lb.	full coverage
9) Amdro + Extinguish	0.75 + 0.75 lb.	full coverage
10) Amdro + Logic	0.75 + 0.75 lb.	full coverage
11) Amdro Skip Swath	1.5 lb. (0.75 actual)	30' skip swath
12) Clinch Skip Swath	1.5 lb. (0.75 actual)	30' skip swath
13) Clinch Reduced Skip	1.0 lb. (0.5 actual)	30' skip swath
14) Distance Skip Swath	1.5 lb. (0.75 actual)	30' skip swath
15) Extinguish Skip Swath	1.5 lb. (0.75 actual)	30' skip swath
16) Logic Skip Swath	1.5 lb. (0.75 actual)	30' skip swath

Two vehicles were used to apply the baits so that treatments could be accomplished within one 24-hour period on this very large test. A Herd Model GT-77 seeder on a John Deere 'Gator 4x6 utility vehicle was used to apply the hopper blend treatments. Because the speed of this vehicle could not be set to a high degree of accuracy, the total amount of bait needed for each plot was placed in the hopper and applied to the plot until used. All plots were fully covered with any remaining bait scattered in an even manner across the plot.

A Ford 3000 tractor with a Herd GT-77 seeder was used for the full-rate, full-coverage and skip-swath treatments. The flow rate of the different baits varied and accurate skip-swath application depends on accurate calibration. Therefore, all four plots of the full-rate, full-coverage treatment of one bait were applied first. The appropriate amount of bait was weighed out and applied until it was used. Gate opening adjustments were made during application so that

calibration was as accurate as possible and there was no re-coverage needed to use up the material. Then, without changing any application parameters (gate opening, speed, spreader height, etc.), all four skip-swath applications of the same bait were made to the appropriate plots. The proper amount of bait was weighed out, plus some extra to ensure consistent flow, and placed in the hopper before treating each plot. This step was not completely necessary given the calibration, but it was done to detect any problems such as the gate vibrating closed, blocked flow or other occurrences that might affect an accurate application. Any remaining bait (of which there was usually very little) was carried over to the next plot, but no re-coverage was made. This procedure was then repeated for the next bait, making any necessary calibration changes. Skip swaths were applied perpendicular to the pavement, across the width of the plots, so that the sampling swath would cross as many skips as possible (five) to better test the application technique.

The first treatment (full-rate, full-coverage Extinguish) was applied at dark on the evening of 14 June 1999. Because of heavy dew, applications were delayed until about 10:00 a.m. the morning of 15 June. Application of the hopper blends was completed by about 2:30 p.m. Treatments using the tractor were applied as described above in the following order: Extinguish skip-swath, Amdro (full then skip-swath), Distance (full, skip), Clinch (full, skip) and Logic (full, skip). Each set of four plots took about an hour to complete. The final plot of the Logic skip-swath treatment was completed at approximately 6:30 p.m.

Weather conditions throughout the day were partly to mostly cloudy, temperature 85 - 92°F with a slight breeze. Soil was moist from rains the previous week and ants were foraging very actively. Thunderstorms were seen in the area beginning in mid-afternoon, despite a rain-free forecast. Treatments could not be delayed because they were in progress and rain *was* forecast for the next several days. At approximately 7:15 p.m. a thunderstorm moved across the airport and appeared to stop and rain itself out. Rain was moderate to heavy until at least dark (about 8:30) when our personnel left. The airport weather monitoring system was just being brought on-line at this time, so no measured rainfall amounts could be obtained. It is estimated, however, that at least one and a half inches, possibly more, were received.

Post-treatment evaluations were conducted on 6 July (3 weeks post-treatment), 3 November 1999 (21 weeks), 2 March 2000 (37 weeks) and May 30, 2001 (1002 weeks).

Results and Discussion

Because of the heavy rain shortly after application, there was considerable concern as to whether at least some of the treatments had been ruined and whether it would be necessary to abandon the test. However, as shown in **Table 2**, results indicate that the full-rate, full-coverage treatments of all the baits yielded a speed and level of colony suppression that was as good or better than what is normally expected for those products.

The first important observation was that the test worked at all. It has been widely advised that there be at least 24 hours without rain after bait application to assure effectiveness. Here, the final Logic skip swath plot was treated less than an hour before a major rain event, with the other three plots applied at about 15 minute intervals before that. Even though conditions were not ideal, the effectiveness of this final treatment lends validity to all the others, despite the rain.

Three weeks post-treatment

At three weeks post-treatment, Amdro and all the hopper blends had significantly ($P<0.05$) fewer

active mounds than the untreated control plots and were at least numerically lower than all the slow-acting bait products and the skip swath treatments. These results support the idea that a 50:50 blend of Amdro (or possibly other fast-acting baits) applied at a total of 1.5 lbs./acre plus a slow-acting bait will substantially speed the activity of the slow-acting baits, their main drawback from a practical standpoint.

There were also large numerical differences between the four slow-acting baits at three weeks post-treatment. Both Distance and Clinch, full-rate, full-coverage treatments had substantially fewer active mounds than Logic and Extinguish-treated plots. This, too, is characteristic of these baits. Clinch, abamectin, is not a true IGR, but demonstrates IGR-like activity in that it does not kill a substantial number of adult ants, at least compared to a toxicant such as hydramethylnon. Distance, pyriproxyfen, on the other hand, is an IGR, yet still provides more rapid mound suppression because of some activity on later immature life stages.

Table 2. Mean number of active red imported fire ant mound counts - 0.18 acre plot, 4 replications. Palestine, TX, applied June 14-15, 1999.

	Mean number of active mounds				
Treatment	Pre-count	Week 3	Week 21	Week 37	Week
Untreated	26.00 a	19.75 a	27.50 a	20.00 a	13.00
Amdro® (A)	26.00 a	3.50 bcd	2.50 b	2.50 b	8.50 abc
Clinch™ (C)	25.75 a	11.00	4.00 b	4.50 b	6.75 abc
Distance® (D)	26.00 a	12.25	0.25 b	0.25 b	6.25 abc
Extinguish™ (E)	26.00 a	22.00 a	0.50 b	1.25 b	7.00 abc
Logic® (L)	26.25 a	18.75 a	0.75 b	2.50 b	7.25 abc
A + C	26.00 a	4.50 bcd	4.00 b	4.50 b	5.00 bc
A + D	26.00 a	1.25 cd	3.50 b	4.25 b	6.50 abc
A + E	26.00 a	4.50 bcd	3.75 b	2.00 b	13.75 ab
A + L	25.75 a	1.00 d	2.25 b	1.50 b	4.75 c
Amdro Skip	26.00 a	12.50 abc	14.50 ab	7.00 ab	14.25 a
Clinch Skip	26.25 a	18.00 a	14.00 ab	8.25 ab	9.00 abc
Clinch Skip	25.75 a	14.00 ab	11.25 b	10.25 ab	9.75 abc
Distance Skip	26.25 a	22.00 a	4.50 b	3.00 b	6.25 abc
Extinguish Skip	26.00 a	17.00 a	10.25 b	5.00 b	6.75 abc
Logic Skip	26.00 a	16.25 a	3.75 b	4.00 b	5.00 bc
F	0.01*	11.32	5.71	3.38	3.05
P	1.0000	0.0001	0.0001	0.0005	0.0012

R^2	0.9024	0.8191	0.6954	0.5751	0.5494
MSD	7.6751	11.28	14.454	13.193	8.9168

Means in the same column followed by different letters are significantly different ($P < 0.05$) using PC SAS analysis of variance procedures. Means separated using Tukey's studentized range (HSD) test. df = 45.

* F and *P* values are for treatment effects only. Replication $P = 0.0001$ due to stratification of mound densities.

Skip swath treatments of Amdro showed less than half the suppression of full-rate, full-coverage Amdro and were not significantly different from untreated plots. This treatment was included in the test as a negative control, so the result was expected. The slow-acting bait skip-swath applications showed minimal suppression at three weeks, again, as expected.

21 weeks post-treatment

By early November, 21 weeks post-treatment, all full-rate, full-coverage treatments appeared to have reached their maximum level of suppression, greater than 85% compared to the untreated control. Distance, in particular, had only a single active mound in four sampling plots with Extinguish and Logic having only two and three, respectively. The hopper blend treatments maintained good levels of control with four or fewer active mounds per plot, compared to an average of 27.5 for the untreated control.

The skip-swath IGR treatments also began to show mound suppression. Overall, active mound reductions were not quite as great as the full-rate, full-coverage treatments, but were significantly ($P<0.05$) less than the untreated control. Substantial numerical differences appeared between treatments, however, though no statistically significant differences were found. Amdro skip-swath, as mentioned, acted as a negative control and experienced little change in mound numbers from the previous evaluation. Logic skip-swath, which was included as a positive control for skip-swath, based on past research (Drees et al., 1993), performed as expected with >85% control. Distance skip-swath performed similarly. However, Extinguish and both rates of Clinch skip-swath yielded less than half the control of the other skip-swath treatments and, at most, 62% control versus the untreated plots. It is suspected that Clinch, because of its insecticidal properties, acted more like Amdro than an IGR and was not spread among colonies or ants that were not directly exposed, though the 1 lb./ac rate was significantly lower than the untreated control on this date.

37 weeks post-treatment

The winter of 1999-2000 was very mild and relatively dry with warm temperatures arriving by late February. There were virtually no changes over four months in any of the full-rate, full-coverage or hopper blend treatments. Untreated control plot active mound numbers declined by about 25%. The only notable changes were in the skip-swath treatments. Surprisingly, the number of active mounds in the Amdro skip-swath plots dropped by half. They also dropped by half in the Extinguish skip-swath plots. There was a non-significant decline of about 40% in the Clinch 1.5 lb/ac skip swath plots, as well. With the exception of both Clinch and the Amdro skip-swath treatments, all other treatments were statistically similar and had significantly ($P<0.05$) fewer active mounds than the untreated control plots. Not including the two Clinch skip-swath treatments and the uncharacteristically effective (though not statistically different) Amdro skip-swath, control rates ranged from Distance full-rate, full-coverage with only a single active mound, to Extinguish skip swath with a greatly-improved 80% control versus untreated control plot numbers.

The continued slow decline of Extinguish skip-swath active mound numbers indicated that the

treatment may still be as effective as full-rate, full-coverage treatments, though remarkably slow, when applied in this manner. The decline in Amdro skip-swath plots was surprising, given results of past tests and no plausible explanation can be offered at this time.

102 weeks post-treatment

Because of dry weather and a lack of mowing due to management changes at the airport, no meaningful evaluations could be made for well over a year. On May 30, 2001 a final evaluation was conducted under good mound-building conditions. Surprisingly, even at almost two years post-treatment, substantial differences in mound counts were evident in many treatments. Because the untreated control fell into "abc" category in the analysis, there were no treatments significantly ($P<0.05$) different from it, however, there were some numericail differences among treatments (see **Table 2**).

At two years post-treatment, there is some questions as to whether these differences, both statistical and numerical, are due to the activity of the treatments, the extreme weather conditions over the period or a combination of both. For instance, untreated mound numbers were exactly half of what they were at the pre-count. Amdro, which should have been substantially re-invaded by this point, had 67% fewer active mounds than in the pre-count and was still 35% lower than untreated at the 102 week evaluation. It is suspected that the interaction of the treatments and extremely hot, dry weather of the summer of 2000 caused these differences in re-invasion at two years. Another test was established at the Palestine Airport in June 2002 (see Commercially Available Broadcast Compounds for the Control of Red Imported Fire Ants), three years to the week after the first test. When adjusted for sample area size, pre-count active mound averages were actually higher in the second test: 145/acre vs 236/acre, indicating substantial reinvasion between June of 2001 and June 2002. This observation suggests that weather may have had a much more substantial impact than treatments.

Summary

At the time, this was the largest test, both in terms of number of plots and treatments and in acreage, we had ever conducted by a factor of two. It evaluated two important new methods for fire ant control: hopper blends and skip-swath treatments that have become increasingly important in fire ant management. A number of conclusions can be drawn from the results.

1) Despite a major rain event within a few hours of application, effectiveness of these products appeared to be undiminished. Though the 24-hour without rain recommendation is still a good one, users should be reminded that rain within a few hours of bait application does not necessarily mean a wasted treatment.

2) All five broadcast baits performed exceptionally well when applied at full rate, full coverage.

3) The slow speed of active mound suppression, characteristic of slow-acting baits, was improved to that of Amdro alone when applied as a 50:50 hopper blend with Amdro.

4) Maximum control with skip-swath applications appears to be similar to full rate, full-coverage treatments for Logic (fenoxycarb), Distance (pyriproxyfen) and, *eventually*, Extinguish (s-methoprene). Though control was not numerically quite as good as when these baits were applied at full-rate, full-coverage, it was disproportionately better considering that half the material and labor were used. Amdro and Clinch appear to have a more proportional response.

Literature Cited

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