Indoxacarb Bait Effects on Mound Activity and Foraging of Red Imported Fire Ants
Yoakum Airport, Fall 2002

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

Bait containing the active ingredient indoxacarb, manufactured by DuPont, was tested in the summer of 2002 and was found to eliminate activity in red imported fire ant (*Solenopsis invicta* Buren) colonies within a week (see Testing of the Experimental Compound Indoxacarb as a Broadcast Bait for the Control of Red Imported Fire Ants). Some faster-acting baits have been shown to have seasonal differences (see Spinosad Bait Rate and Formulation Study and Barr and Best, 1999) so a fall-applied test seemed warranted. It was also felt that a broadcast bait that eliminated ant activity so quickly might be able to compete favorably with contact insecticides for very fast suppression of foraging ants. Consequently, treated plots were not only evaluated for mound activity, but simultaneously monitored for foraging/recruitment using slices of wieners as an attractant.

Objectives: 1) Repeat broadcast test of indoxacarb bait in the fall. 2) Determine speed of foraging suppression of fire ants by broadcast indoxacarb bait.

Materials and methods

The test site was located at the municipal airport of Yoakum, Texas in Lavaca County, about 50 miles northwest of Victoria. The site was located in the southern part of Texas where warmer temperatures keep fire ants actively foraging for bait later in the season. The site was well-maintained with frequently mowed grass and there appeared to be a suitable concentration of fire ant mounds.

Pre-counts were made at the site on October 15, 2002. The runway lights were used as plot end markers with the width adjusted to equal plots of 0.25 acres in size - 200 feet x 55 feet. The sample area consisted of a strip beginning 10 feet either side of the runway lights (treated buffer) and from two feet outside the runway to 22 feet away from it. Mounds were not evaluated immediately next to the pavement because of difficulty defining and counting the small mounds that sometimes form next to paved surfaces. Therefore the sample area was 180 x 20 feet, 3,600 ft^2 or 0.0826 acres. Mounds were evaluated using the minimal disturbance technique and plots arranged into replications of similar densities as described in Barr and Best (2002).

Immediately following the pre-count, there was a period of rainy weather during which applying bait would have been risky. Treatments were finally applied on October 29. Treatments were replicated four times and included: indoxacarb bait at 0.025%, 0.05% and 0.1% v/v (labeled 86, 87 and 88 respectively), Amdro® Fire Ant Bait (0.73% hydramethylnon), Extinguish™ Fire Ant bait (0.5% s-methoprene) and an untreated control. All baits were applied at 1.5 lbs per acre using an EarthWay® EV-N–SPRED hand-held seeder. The first foraging evaluation was made immediately prior to treatment. Subsequent evaluations took place at 1, 2, 3, 7, 10, 14, 21, 27, 34, 42, 49, 72 and 99 days post-treatment to try to pinpoint mound and foraging suppression.

Foraging evaluations were completed in the following manner. Inexpensive wieners (hot dogs) were sliced into 1/8-inch thick rounds and skewered to the ground with wire surveyor's flags. Slices were placed so that they were touching soil and, if it was warm and sunny, shaded by small clumps of vegetation to enhance attractiveness. Flags were placed every 15 paces, beginning 15 paces from the runway light, so that the four hot dog slices were spaced evenly apart and equidistant from plot ends. Placing the hot dog slices (sub-samples) along the entire test, which ran the length of both sides of the 3,500 foot runway, could be accomplished in about 40 minutes with a similar time needed to evaluate them. Thus, exposure times for all slices were similar. Evaluations were made by observing the slices on the ground and estimating of the number of ants visible: 0, 10, 25, 50 or 100 ants. Though common to find no ants after treatment, it was rare to find only one or two ants on a slice and 100 meant that the slices were covered with ants. Slices were then slung out of the sample area. Data were analyzed using SAS PROC ANOVA with means separated with Tukey's studentized range (HSD) test, $P < 0.05$.

Results and Discussion

Results of the active mound evaluations are shown in **Table 1**. Much like in the earlier summer test, significant ($P < 0.05$) reductions in the number of active mounds for indoxacarb occurred in seven days post-treatment. However, maximum suppression occurred much more slowly (Day 27-72, depending on formulation) and it never reached quite the level of suppression found in the previous test. Compared to the standard treatments, on the other hand, indoxacarb was much faster. Amdro did not reach significant ($P < 0.05$) reduction versus untreated controls until Day 72 and Extinguish, an IGR, never achieved more than about 50% control, as would be expected. There were no significant and only slight numerical differences between the three indoxacarb formulations.

Results from the foraging sampling (**Table 2**) proved unexpected and quite dramatic. All three formulations of indoxacarb and the Amdro treatment reduced foraging significantly ($P < 0.05$) within 24 hours of application and they remained significantly lower over the duration of the test. Indoxacarb 88 reduced foraging significantly at 24 hours compared to Indox 86 and Amdro. The higher concentrations continued to suppress foraging more than Amdro, with some significant ($P < 0.05$) variations among the formulations, through Day 7, though numerical differences between indoxacarb and Amdro are substantial at some points.

On the other hand, Extinguish reduced foraging by a significant ($P < 0.05$) margin versus the untreated controls at only 10 and 14 days and never reduced it more than the faster-acting baits, either significantly or numerically. On all days, the number of foraging ants detected in Extinguish plots was, on average, at least double that found in the other treated plots and often, 10 times more in the first month or so of the test.

Based on these and results from the summer trial, it appears that indoxacarb bait works faster at eliminating mounds than Amdro in both summer and fall, though both slowed considerably in cooler fall conditions. Foraging suppression by indoxacarb is very, very fast - for practical purposes, within 48 hours - and much faster than colony elimination. It may be even faster in warmer conditions. To a lesser degree, the same holds true for Amdro. However, the insect growth regulator Extinguish had only a minimal effect on foraging and mound counts were only beginning to decline toward the end of the test.

Several other important observations were made during this test. Since treatments began in late October, cool temperatures were expected to disrupt foraging evaluations. The airport was furnished with a high quality digital thermometer so accurate readings could be easily obtained. **Table 3** shows air temperature, wind and sky conditions at each date along with the mean foraging levels for all 16 samples in the four untreated plots. Temperature vs foraging is shown graphically in Figure 1. As can be seen, there are no consistent differences in foraging with temperatures ranging from 75°F with sunny skies and calm air to 57°F with cloudy skies and a strong wind. Similarly, there are few seasonal differences as this period covers from October 29, 2002 to February 4, 2003. Such consistent foraging/recruitment at such low temperatures and during the winter was unexpected since the suggested “cut-off” temperature for bait applications is around 65°F.

Between the pre-count of active mounds and application, the area received over six inches of rainfall. The result was a huge increase in mound numbers, particularly in Plot #6, which was a control plot. A count of 83 gave this plot a per-acre mound density of 1,004. Conversely, within 2000 feet on the same side of the runway, there were unused plots with only one or two active mounds. Samples for *Thelohania* analysis were taken from these areas, but no relationship to mound density was found. Therefore, the reason for a thousand-fold difference in mound numbers remains a mystery.

The fast foraging suppression of indoxacarb suggests that it may be an effective alternative to contact insecticides. Not only does it control foraging within a day or two, but it also eliminates most colonies with a single, broadcast-applied application. Contact insecticides control foraging very quickly, but when the insecticidal layer “breaks,” colonies can reappear rapidly necessitating repeated application (Drees et al. 2002). Indoxacarb, like most baits, also uses considerably less chemical than do contact insecticide applications applied as a surface treatment or as a mound application. Further head-to-head tests of indoxacarb versus contact insecticides are planned for the near future.

Table 3. Comparison of weather conditions and ant foraging/recruitment. Yoakum Airport, 2002.

	Days post-treatment													
	0	1	2	3	7	10	14	21	27	34	42	49	72	99
°F	75	80	65	68	60	68	65	72	57	75	57	73	72	55
sky[1]	PC	clr	PC	PC	clr	clr	clr	clr	cldy	PC	PC	PC	PC	clr
wind[2]	10	5	15	5	10	15	15	10	>20	<5	10	15	10	10
ants[3]	96.9	94.4	92.2	95.3	100	87.5	100	100	90.6	100	77.8	87.5	78.1	80.3

[1] clr = clear, PC = partly cloudy/broken overcast, cldy = complete overcast

[2] estimated average steady wind in miles per hour using digital anemometer

[3] Mean of 16 untreated plot sub-samples, 4x4 reps.

Literature Cited

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Table 2. Results of red imported fire ant mound evaluations: 3,600 ft^2 sample areas, 4 replications. Yoakum Airport, 2002.

	Mean number of active mounds													
Treat.	Pre	Day 1	Day2	Day 3	Day 7	Day 10	Day 14	Day 21	Day 27	Day 34	Day 42	Day 49	Day 72	Day 99
untrteated	19.75 a	35.00 a	36.00 a	36.00 a	31.00 a	33.75 a	31.75 a	27.50 a	24.75 a	23.00 a	22.25 a	25.50 a	24.25 a	20.50 a
indox 86	19.50 a	27.00 a	25.25 a	18.00 a	11.25 b	10.50 b	4.75 b	3.50 b	1.75 b	1.50 b	2.00 b	0.75 b	1.50 b	2.50 b
indox 87	19.50 a	18.75 a	16.50 a	14.25 a	12.00 b	11.00 ab	8.25 ab	7.25 b	5.00 b	6.00 ab	2.25 b	3.00 b	0.75 b	3.25 b
indox 88	19.50 a	23.25 a	23.75 a	17.75 a	14.00 b	13.25 ab	7.00 b	3.50 b	3.25 b	5.50 ab	2.75 b	2.75 b	2.25 b	3.00 b
Amdro	19.50 a	23.25 a	20.25 a	17.25 a	16.50 ab	12.75 ab	10.50 ab	10.50 b	6.50 ab	5.75 ab	4.25 ab	3.75 ab	3.00 b	2.75 b
Exting.	19.50 a	21.00 a	22.25 a	21.25 a	20.00 ab	12.25 ab	19.25 ab	18.00 ab	16.25 ab	13.50 ab	10.75 ab	11.25 ab	11.75 ab	11.25 ab
F	0.00*	6.62	5.88	7.72	8.55	6.63	4.90	7.40	4.20	5.10	4.09	3.72	4.56	5.40
P	1.000	0.0009	0.0016	0.0004	0.0002	0.0009	0.0040	0.0005	0.0081	0.0033	0.0091	0.0137	0.0056	0.0025
R^2	n/a	0.7792	0.7581	0.8046	0.8201	0.7795	0.7234	0.7978	0.6914	0.7312	0.6856	0.6646	0.7085	0.7423
MSD	n/a	20.111	23.794	21.877	17.769	23.064	23.825	16.847	21.454	18.359	18.56	22.24	18.355	13.858

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 (treat, rep effects).

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

Table 3. Results of foraging/recruitment evaluation: 4 bait slices per plot, 4 replications. Yoakum Airport, 2002.

	Mean number of ants per bait slice													
Treat.	Pre	Day 1	Day2	Day 3	Day 7	Day 10	Day 14	Day 21	Day 27	Day 34	Day 42	Day 49	Day 72	Day 99
untreated	96.88 a	94.38 a	92.19 a	95.32 a	100.0 a	87.50 a	100.0 a	100.0 a	90.63 a	100.0 a	77.81 a	87.50 a	78.13 a	80.31 a
indox 86	90.63 a	58.44 b	4.06 b	3.75 bc	7.50 c	0.00 c	2.19 c	4.19 b	0.00 c	3.44 c	4.38 b	20.0 b	24.69 b	24.06 bc
indox 87	95.88 a	23.75 cd	4.38 b	6.25 bc	8.43 c	3.75 c	13.75 c	19.69 b	10.63 c	36.56 b	16.88 b	26.06 b	26.56 b	25.94 bc
indox 88	95.32 a	15.31 d	2.19 b	0.63 c	2.81 c	1.25 c	4.38 c	7.19 b	1.88 c	26.88 bc	12.19 b	19.50 b	19.38 b	10.63 c
Amdro	100.0 a	47.80 bc	22.81 b	28.75 b	35.00 b	5.00 c	10.00 c	20.0 b	12.50 c	14.69 bc	7.81 b	13.44 b	10.63 b	5.94 c
Exting.	85.94 a	96.88 a	92.19 a	79.38 a	100.0 a	54.38 b	62.19 b	82.81 a	55.31 b	94.38 a	63.13 a	78.75 a	61.56 a	52.19 ab
F	1.73	17.74	46.61	29.39	44.33	31.05	42.38	36.71	18.07	18.88	11.76	11.07	7.92	13.58
P	0.1030	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
R^2	0.1371	0.6198	0.8108	0.7299	0.8030	0.7406	0.7958	0.7715	0.6243	0.6345	0.5195	0.5045	0.4215	0.5553
MSD	20.44	29.923	21.16	25.119	22.74	21.738	20.09	22.36	28.29	31.13	30.915	33.329	33.64	29.215

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 = 5 (treatment effects only).