Fire ant management in urban landscapes with broadcast treatments

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The red imported fire ant (RIFA), *Solenopsis invicta* Buren, is one of the most destructive insect pests in the urban/suburban landscape. RIFA thrive in disturbed habitats and quickly invade these areas whether the disturbance is natural or manmade.

RIFA was introduced into the Mobile, AL area from South America in the 1920s and rapidly spread across the Southeastern U.S. It has now spread from coast to coast across the Southern States and infests over 133.5 million hectares (330 million acres). It continues to spread world wide and now infests parts of Mexico, Australia, New Zealand, Taiwan and China. The total annual cost due to damages and expenditures for control for RIFA within Texas alone was estimated at $1.2 billion for 1998 and the cost is increasing each year (Lard et al. 2001). This figure includes expenditures of $702 million for residential households, $42 million for schools, $47 million for golf courses, $45 million for commercial businesses and $64 million for cemeteries. These figures include the impact of unsightly mounds, damage to turf maintenance equipment, human health issues, damage to electrical equipment and the impact on recreation and tourism and on environmental quality.

Fire ant baits are normally effective as mound control because the workers collect the bait and distribute it within the entire colony to all stages including the queen (Drees et al. 2002). Baits containing indoxacarb have been shown to cause colony decline within 24-78 h, (Barr 2002). Fire ant control is generally aided by both passive and active contact with the chosen insecticide (Chen 2006). Currently marketed insecticides for the management of fire ants do not repel fire ants and therefore allow both passive and active contact as workers forage and construct colonies. Comparisons between long-lasting-slow-acting control methods and fast-acting-short-residual control products are needed to compare the efficacy of each product versus the time to begin control and the length of time of actual control. These types of studies provide efficacy data to make recommendations for homeowners and turf managers on golf course and sports field based on the type of control immediately desired to meet their environmental and sociological needs.

This experiment was initiated to compare the effectiveness of broadcast treatments of several fire ant control products in the urban landscape. The test compared a bait formulation of indoxacarb (Spectracide - Once 'N Done) with contact granular formulations of fipronil and bifenthrin (Over N' Out and Ortho Max Fire Ant Killer, respectively). Also, three alternate formulations of Over N' Out (fipronil) were compared with the commercial Over N' Out product.

Materials and Methods

This experiment was established on the grounds of a community college in the north Dallas, TX metroplex on 1 June 2006. Formulations and rates of application for the six treatments are given in Table 1. Plot sizes ranged from 240 to 2,860 m^2 [mean = 780 m^2 (8,400

ft^2)] and was delineated due to the number of active mounds. Each plot had at least 10 (up to 18) active mounds (mean = 13.75; mode = 13). To delineate the boundaries of a plot, all mounds were first flagged and the plot was terminated either ca 4.6 m past the last mound or at the nearest artificial barrier such as a sidewalk. The initial flagging of mounds was done within 2 d of a double irrigation cycle of 2 inches so that nearly all active colonies were visible. Plots were delineated with white turf marking paint on two sides and all plots were bordered on at least two sides by concrete curbs along parking lots or streets.

Table 1. Treatments and rate of application.

Fire Ant Control Product	Active ingredient	Formulation %	Application Rate[c] kg product/ha
Over N' Out (Sub 1: Sol E) [ab]	fipronil	0.0103 G	97.6
Over N' Out (Sub 1: Sol D) [a]	fipronil	0.0103 G	97.6
Over N' Out (Sub 2: Sol E) [a]	fipronil	0.0103 G	97.6
Over N' Out (Sub 2: Sol D) [a]	fipronil	0.0103 G	97.6
Ortho Max Fire Ant Killer	bifenthrin	0.2 G	112.2
Once & Done (Spectracide)	indoxacarb	0.016 B	24.4
Untreated Check			

[a] Substrate 1 = Biodac; Substrate 2 = Ecogran; Solvent E and D are proprietary formulations.
[b] Commercial standard for Over N' Out.
[c] To convert from kg/ha to lbs/1000 ft^2 divide kg/ha by 48.91.

Granular treatments were applied using walk-behind fertilizer spreaders of either a Scott's Pro Turf Professional Drop Spreader (The Scotts Co., Marysville, OH 43041) and a Spyker Cyclone Spreader Model # 34B7 (Spyker Spreaders, Urbana, IN 46990). Both spreaders were calibrated immediately before applications were made using blank granule formulations of each product. A belly bumper was used to apply the bait treatments. For all plots receiving a granular treatment, the perimeter of the plot was first ringed with one pass (ca. 1 m wide) application from the Scotts drop spreader, and the remainder of the plot was then treated with the Spyker Cyclone Spreader.

In this way, the area adjacent to the curb was carefully treated by dropping the granules directly on the interface of the curb with the turf. This approach was important since well over half of the RIFA mounds in these plots were established at the curb/turf interface. No irrigation was applied the evening after treatments, but all plots were irrigated with ca. 0.84 cm (0.33 inch) of water the following evening. Irrigation was applied weekly thereafter throughout the duration of the experiment; however, this area of the city was put on 'Stage 3' water rationing and only ca. 0.84 cm of water was applied weekly instead of the 1.3 cm (0.5 inch) or more that was required to maintain good turf cover.

A pre-count of the number of live mounds and an assay of the foraging activity was completed before treatments. Each live colony was marked ca. 30 cm from the mound by spraying a white X on the turf, so the colony could be easily found for the next assay. Mounds were recorded as active if RIFA workers expressed or emerged from the mound when it was probed with the wire of a red flag. Pretreatment foraging activity of the ants within each plot was assayed by placing five, 8-dram shell vial traps near the central area of the plot for ca. 30 to 50 min exposure. These vials were baited with ca. 1/10 (ca. 1.5-1.8 g) of hot dog (processed meat sausage) and placed no closer than ca. 1 m from the nearest active RIFA colony. After exposure, the labeled vials were collected, closed with a rubber stopper, and transported to the laboratory for counting. Only the three tubes with the largest number of ant were counted for each plot. Vials then were flooded with 95% ethanol, emptied into 10 cm diam Petri dishes, and the ant counts recorded as data. All vials with greater than 200 ants were recorded as only 200 for the sample. Plots were divided into 4 replicates based upon pretreatment counts of foraging ants and treatments were randomly assigned within each replication. This method assured that plots with the highest foraging activity were in Rep 1 with the next highest group comprising Rep 2, and so forth.

Foraging activity was assessed 1 to 2 d before treatments were applied and at 3, 7, 14, 21 and 42 d after treatment (DAT). Individual mound mortality was determined as the number of active colonies before and at 35 and 70 DAT by probing each mound with a wire flag. To assist with these mound assays, a 1.5 g piece of hot dog was also dropped on those mounds that did not express workers and observed 20-30 min later to confirm whether a mound was really dead or just quiescent. This secondary procedure was done since the test site became very dry as the test continued. If the colony was active, workers would forage for the hot dog pieces within this time period. The plots in this experiment will continue to be monitored up to one year post-treatment since several of the treatments are known to provide long term residual control.

Transformations (arcsin n + 0.01) were used on each data set to achieve normality and homoscedasticity before analysis (Steel et al. 1997) but untransformed means are presented. Analysis of variance (ANOVA) for a randomized complete block design was performed to test the differences between treatments, and means were compared at the 5% level of significance using Fisher's least-significant difference (LSD) multiple range test (SAS Institute 2003).

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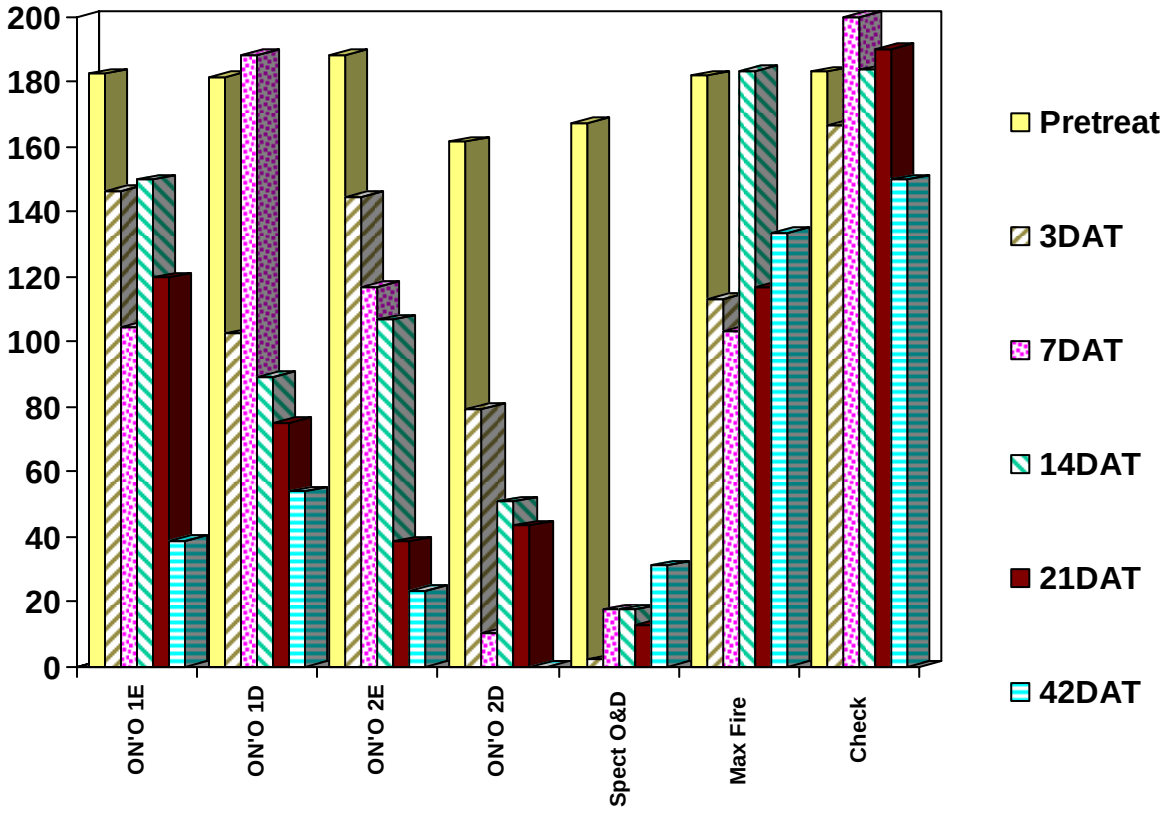
Results and Discussion

Foraging at Bait Tube Stations:

Among the six treatments, the Once & Done (Spectracide) formulation of indoxacarb provided immediate suppression and control of the foraging ants for the 42 d evaluation period (Fig. 1). Bait trap samples were reduced to an average of less than two ants per bait tube within 3 DAT and the trap samples remained ≤ 17.7 ants until 42 DAT when trap samples increased to 30.25 ants. All four formulations of the Over N' Out (formulation of fipronil) significantly reduced the numbers of ant foragers trapped; however, the best results were produced with the two formulations with Ecogran substrate (2) with little difference in the level of control due to the two solvents. The formulation with solvent D reduced the number of trapped ants to zero by 42 DAT. Plots treated with Ortho Max Fire Ant Killer (bifenthrin) never reduced to number of foragers below 100 trapped ants per bait station during the test period. Populations trapped in the untreated check plots remained ≥ 150 ants per bait tube throughout the test period.

Figure 1. Mean number of ants trapped in bait stations for each treatment at DAT[a].



Legend: ON'O 1E = Over N' Out (Sub 1: Sol E) (fipronil); ON'O 1D = Over N' Out (Sub 1: Sol D); ON'O 2E = Over N' Out (Sub 2: Sol E); ON'O 2D = Over N' Out (Sub 2: Sol D); Spect O&D = Once & Done (Spectracide) (indoxacarb); Max Fire = Ortho Max Fire Ant Killer (bifenthrin).

[a] Note: Plots in this experiment will continue to be monitored up to one year post-treatment since several of the treatments are known to provide long term residual control.

Reduction in Number of Active Colonies:

At the initiation of this study, there were an average of 13.75 active colonies per plot with a range of from 10 to 21 colonies depending on the colony density and size of the plot. In contrast to the continually high numbers of ant foragers in the Ortho Max Fire Ant Killer treated plots, this treatment, however, provided 56.9% reduction of active colonies at 35 DAT, but only a 10.6% reduction at 70 DAT. The four formulations of Over N' Out (fipronil) provided from 52.0 to 72.2% reduction of live colonies at 35 DAT, but decreased to only <22.8% by 70 DAT. The Once & Done (Spectracide) containing indoxacarb provided the highest colony reduction of 95.10% at 35 DAT, but fell to 37.1% by 70 DAT. During the test period, 37.6% and 7.9% of the colonies in the untreated check plots were lost at 35 and 70 DAT, respectively.

Table 2. Mean number of active fire ant colonies in plots at pretreatment and the percentage reduction at DAT for each treatment. [d]

Treatment	Colonies per plot	% reduction 35 DAT[a]	% reduction 70 DAT[a]
Over N' Out (Sub 1: Sol E) [bc]	12.5	72.2 b	13.1 bc
Over N' Out (Sub 1: Sol D) [b]	13.8	52.0 bc	2.0 c
Over N' Out (Sub 2: Sol E) [b]	13.8	64.3 bc	11.4 bc
Over N' Out (Sub 2: Sol D) [b]	13.8	53.3 bc	22.8 b
Ortho Max Fire Ant Killer	14.0	56.9 bc	10.6 bc
Once & Done (Spectracide)	15.0	95.1 a	37.1 a
Untreated Check	13.5	37.6 c	7.9 c

[a] Percentage reduction = (no. of active colonies at DAT / no of active colonies at start of test).
[b] Substrate 1 = Biodac; Substrate 2 = Ecogran; Solvent E and D are proprietary formulations.
[c] Commercial standard for Over N' Out.
[d] Note: Plots in this experiment will continue to be monitored up to one year post-treatment since several of the treatments are known to provide long term residual control.

Test Conditions and Impacts:

The slowness of control activity exhibited by treatments in this test can partially be attributed to the severe drought and watering restrictions experienced in the Dallas area and throughout the Southwest. Just after the test was established, this area of the metroplex was put under 'Stage 3' water rationing (watering only once a week), which significantly limited the amount of irrigation that could be applied throughout the test period. Also, essentially no rainfall was recorded during the test period. This lack of adequate soil moisture may have limited the release of toxicant from the granular formulations and either curtailed or delayed potential control of the RIFA.

Another factor, and a recommendation supported by previous experiments (JAR) by this experiment and likely also to be supported by future research, is to treat RIFA colonies along concrete curbs, sidewalks and other hard surfaces in a different manner than those that are surround entirely by turf areas. These colonies require special attention either by applying an increased application rate (double pass) of the graular insecticide treatments along the hard surfaces, applying an additional bait application in these areas or by applying a follow-up retreatment of the granules. In urban areas, such as this test area, quite often a high percentage (well over half) of the RIFA colonies are situated at the curb/turf interface and are much more difficult to bring under control, compared to colonies situated in an open turf area where the granular treatment completely surrounds the colony. Along these hard surface, unless one is careful to make full coverage applications to these interface area, many of the colonies will escape full exposure to the toxicants. **Another reason for increasing the application rate**

or modifying the application procedures along the hard surfaces is that these colonies are essentially only being treated on one/half of the mound perimeter and much of the RIFA foraging activity may continue across the hard surface with little on no exposure to the toxicant. This factor alone could explain why the ants in many of the colonies within these test plots were not killed by the contact insecticide treatments.

References Cited

Barr, C.L. 2002. Indoxacarb bait effect on mound activity and foraging of red imported fire ants, Yoakum Airport, Fall 2002. Result Demonstration Handbk., Texas Agric. Ext. Serv., College Station, TX. http://fireant.tamu.edu.

Chen, J. 2006. Digging behavior of *Solenopsis invicta* workers when exposed to contact insecticides. J. Econ. Entomol. 99(3): 634-640.

Drees, B.M., C.L. Barr, S.B. Vinson, D. Kostroun, B. Sparks, D. Pollet, D. Shanklin, K. Loftin, K. Vail, R.E. Gold, M.E. Merchant, N. Riggs, B. Hickman, P. Nester, K. Flanders, P.M. Horton, D. Oi, P.G. Koehler and R. Wright. 2006. Managing imported fire ants in urban area. Texas Coop. Ext., Texas A&M Univ. System. B-6043, 22 p.

Lard, C.F., V. Salin, D.B. Willis, S. Robison and K. Schroeder. 2001. The statewide economic impact of red imported fire ants in Texas: A part of the Texas fire ant initiative 1999-2001. Fire Ant Econ. Res. Rep. 01-08. Texas A&M Univ. College Station, TX. 76 p.

SAS Institute. 2003. SAS system for Windows, release 8.02. SAS Institute, Cary, NC.

Steel, R.G.D., Torrie, J.H. and Dickey, D.A., (eds). 1997. Principles and procedures of Statistics: a biometrical approach, 3rd ed. WCB/McGraw-hill, New York, NY.