Evaluation of ARINIX® Permethrin Impregnated Nylon Plastic Strips in Preventing Fire Ant Invasion in Electrical Pad-Mount Transformers

Molly Keck, Program Specialist-Urban IPM
Bastiaan M. Drees, Professor and Extension Entomologist
Colin Connally, Testing and Standards Specialist, CPS ENERGY

City Public Service (CPS) ENERGY is San Antonio's natural gas and electricity provider. CPS ENERGY is responsible for installation and maintenance of pad-mount electrical transformers used throughout San Antonio for underground electric distribution. Under ideal conditions, these box shaped transformers can last twenty years or more and most often require no maintenance. The transformers are oil filled to prevent the electric winding from overheating. When red imported fire ants, *Solenopsis invicta* Buren (Hymenoptera: Formicidae) invade pad-mount transformers, they build nests on the inside and outside of the transformer walls. The moisture from the nests causes corrosion of the walls. Once enough corrosion occurs, the oil begins leaking out, causing the transformer boxes to overheat and fail. This in turn causes a power outage and the transformer must be replaced. Fire ants also cause the soil underneath pad mounted transformers to become soft, forcing the transformer to tilt. This allows oil to leak, leading to the transformer's ultimate failure. CPS ENERGY estimates that once fire ants invade the transformers, their lifespan is reduced to approximately five years. In addition, an estimated 80% of all pad-mount transformer failures are due to fire ant damage. Each transformer has an approximate cost of $3,000-$4,000. CPS ENERGY spends a considerable amount of time and money to replace transformers damaged by fire ants. Because of the minimal maintenance of the transformers, CPS ENERGY is currently focusing on preventing fire ant invasion rather than curative measures.

NIX of America is a Japanese-based company that has developed permethrin impregnated nylon plastic, ARINIX®. The nylon formulation allows the pesticide to remain embedded in the plastic up to seven years under the correct conditions. In laboratory trials, ARINIX® it has been shown to help prevent fire ant access to an area when applied as a barrier.

A research project was initiated to determine if ARINIX® strips are a good control option for preventing fire ants from nesting inside and invading pad mount electrical transformers.

Materials and Methods

Two neighborhoods were utilized in this experiment, chosen by CPS ENERGY based on location, proximity to one other, and access to transformers (**Table 1**). At the start of this project, both neighborhoods were under construction and no fences had been built, making transformers easy to access. Both sites were located in Bexar County, TX.

Transformers were randomly assigned to one of two treatment groups: untreated controls and treated transformers. L-shaped ARINIX® strips of 60 inches long were installed in 35 transformers along the inner edge of the concrete pad the transformers sit upon. Strips were cut to fit within the transformers and held in place by a bolt already within the boxes (**Fig. 1**). All installation was performed by CPS ENERGY personnel.

This experiment was monitored for 16 months, in which transformers were checked approximately every three months (**Table 2**). One additional monitoring check was performed to

determine if recent rains had forced fire ants from yards into transformers. During monitoring, CPS ENERGY personnel opened transformers for inspection. Not all transformers were checked at each monitoring date. This was due to time constraints and inability to enter yards to check transformers (locks on gates, dogs in yards, etc.). Due to safety concerns, only CPS ENERGY personnel are allowed to touch transformers, and visual inspections were the only source of data collection. Visual inspections included the presence or absence of fire ant mounds inside transformers as well as other observations such as: fire ant foraging outside or inside, fire ant activity in yard, and mound building outside transformer boxes.

Data for selected dates and observations were analyzed using an Independent Samples T-test at $P \geq 0.05$ (SPSS 15.0).

Table 1. Neighborhoods and transformers used in experiment.

Neighborhood	Untreated Transformers	Treated Transformers	Total Transformers
Highland Farms Subdivision	13	14	29
Windfield Subdivision	12	15	27
Total Transformers	25	29	54

Table 2. Date and post treatment time of monitoring of transformers.

Number of Monitor Checks	Date	Months Post Treatment
1	1/19/2006	0 (installation)
2	4/6/2006	3
3	7/20/2006	6
4	10/3/2006	9
5	11/8/2006	10
6	2/21/2007	13
7	5/14/2007	16

Figure 1. Pad mounted electrical transformer box containing ARINIX permethrin impregnated nylon plastic strips.

Results and Discussion

Two observations were taken into account during analysis of ARINIX® in this experiment: 1) the presence of active fire ants inside transformers and 2) the presence of mounds inside transformers.

Pre-treatment, all transformers were negative for fire ant activity and the presence of mounds. Three, 6, and 9 months post-treatment, there were no fire ant activity observations made in transformers. However, at 9 months post-treatment, two untreated control transformers (10.5% of monitored boxes) did show that fire ants had built mounds, but no longer inhabited them (**Table 4**). As mentioned previously, in many cases, not all transformers were available to sample.

Ten months post-treatment (November 8, 2006), 8 monitored transformers (34.8%) had active fire ants and mounds. Thirteen months post-treatment, only 3 monitored transformers (12.5%) had active fire ants, and 7 monitored transformers (29.2%) had fire ant mounds. Sixteen months post-treatment, only 1 monitored transformer (4.2%) had active fire ants, and 5 (20.8%) had fire ant mounds present. (**Table 4**)

Table 3. Number and percent* of transformers in the ARINIX® treated group containing active fire ants and mounds.

Months Post Treatment	n	Fire Ant Activity		Mounds Present	
		Number	Percent*	Number	Percent*
0	29	0	0	0	0
3	29	0	0	0	0
6	29	0	0	0	0
9	24	0	0	0	0
10	28	0	0	0	0
13	27	0	0	0	0
16	29	0	0	0	0

n = number of transformers observed

* Percents of fire ant activity and mound presence in transformers determined by total number of transformer boxes checked at the time of inspection. Not all transformers were monitored at each monitoring date due to time constraints and inaccessibility of backyards.

Table 4. Number and percent* of transformers in the untreated control group containing active fire ants and mounds.

Months Post Treatment	n	Fire Ant Activity		Mounds Present	
		Number	Percent*	Number	Percent*
0	25	0	0	0	0
3	25	0	0	0	0
6	24	0	0	0	0
9	19	0	0	2	10.5%
10	23	8	34.8%	8	34.8%
13	24	3	12.5%	7	29.2%
16	24	1	4.2%	5	20.8%

n = number of transformers observed

* Percents of fire ant activity and mound presence in transformers determined by total number of transformer boxes checked at the time of inspection. Not all transformers were monitored at each monitoring date due to time constraints and inaccessibility of backyards.

Fire ant activity was significantly higher in untreated control transformers when compared to ARINIX® treated transformers at 10 months post-treatment. Although fire ants were found active in untreated controls at 10, 13, and 16 months post treatment, there was no significant difference between untreated controls and ARINIX® treated transformers. (**Table 5**)

The presence of mounds within transformers was significantly higher in untreated control when compared to ARINIX® treated transformers at 9, 10, 13, and 16 months post treatment. This is an important statistic to note due to the fact that mound building softening the soil below pad mounted transformers and moisture within in mound causing corrosion of transformers are the main concern for CPS ENERGY (**Table 6**).

Table 5. Percent of transformers with active fire ants.

	Months Post Treatment						
Treatment Group	**0**	**3**	**6**	**9**	**10**	**13**	**16**
Untreated Control	0	0	0	0	34.8%a	12.5%	4.2%
ARINIX®	0	0	0	0	0b	0	0

Means in a column followed by the same letter are not significantly different from one another at $P \geq 0.05$ using Independent Samples T- Test (SPSS 15.0).

Table 6. Percent of transformers with fire ant mounds.

	Months Post Treatment						
Treatment Group	**0**	**3**	**6**	**9**	**10**	**13**	**16**
Untreated Control	0	0	0	10.5%a	34.8%a	29.2%a	20.8%a
ARINIX®	0	0	0	0b	0b	0b	0b

Means in a column followed by the same letter are not significantly different from one another at $P \geq 0.05$ using Independent Samples T- Test (SPSS 15.0).

Many observations were made during the course of this experiment that were not tested statistically, but are worth noting. During installation of the ARINIX® strips, one transformer did have a very active fire ant mound. ARINIX® strips were placed within this box to determine if ARINIX® would force fire ants from the transformer box. This was not a variable in which statistical analysis could be performed, however. Three month post-treatment, the transformer that previously contained a very active fire ant mound was no longer active, and many dead fire ants were observed outside the nest and around ARINIX® strips. We were unable to determine if this mound was abandoned, or if it was abandoned or rendered inactive due to exposure to the pesticide.

Although ARINIX® treated transformer boxes never experienced active fire ants or mound building, fire ants were active near concrete pads and within the yard. Therefore, fire ants were present, but did not inhabit transformers. In untreated control groups when fire ants were observed directly outside transformers, they were also very often observed foraging inside. It was also a common occurrence that yards containing both active fire ant mounds and untreated control boxes also showed signs of fire ant invasion overtime (ie: the eventual presence of a mound).

Fire ant activity and mound activity within transformers was never consistent throughout this experiment. This may indicate that transformers are used during certain environmental conditions to provide shelter (ie: season, flooding, cold weather, etc.), and once the environment is suitable, they abandon the nest or were eliminated in part, by contact with the barrier strip. Previous efforts to assess insecticide treatments for imported fire ants in Bexar County transformers (Riggs 2005) documented highest levels of infestation during cooler months of the year. However, it is important that ARINIX® inhibited fire ants from building nests inside transformers because the process of mound building is the main source of failure for transformers. Based on the data and these early observations, ARINIX® appears to be a good preventive measure to keep fire ants out of pad-mounted electrical transformers. These transformer units will be monitored over the next few years to document long term effects and the length of time ARINIX® strips prevent fire ant mound building on vertical metal walls of these utility box housings.

Work Cited

Riggs, Nathan. 2005. 2004 Outcome Report – Final: Evaluation of Fire Ant Control Products in Electric Ground Transformer Boxes. Texas Cooperative Extension

Acknowledgements

The authors would like to thank Jim Center and all other CPS ENERGY crews who helped install strips and monitor transformers for fire ants and NIX of America for providing the materials needed for this experiment. In addition we would like to extend a special thanks to CPS ENERGY for allowing us to perform this experiment.

Appendix A – Riggs Evaluation of Fire Ant Control Products in Electrical Ground Transformer Boxes

2004 Outcome Report - Final
Evaluation of Fire Ant Control Products in Electric Ground Transformer Boxes
Nathan Riggs – Texas Cooperative Extension

Introduction

According to a 2001 survey by Texas A&M University, Red Imported Fire Ants represent a $1.2 billion liability to Texas in the form of damages to electric equipment, purchases and application of chemical treatments, medical expenses from stings, livestock losses and damages to personal property. While experts in the field of fire ant management all agree that eradicating fire ants from an area is not a realistic goal, treating them as their nests appear and initiating measures to prevent their entry into sensitive areas is a more feasible option. One of these sensitive areas is electrical equipment. In San Antonio and the majority of Bexar County, electrical service is provided by City Public Service and many neighborhoods are not exempt from the fire ant menace. In some parts of town, up to 80% of ground service transformers become infested with fire ant colonies over time. Approximately four or five boxes per month are replaced because the soil brought in by the fire ant colonies facilitates the development of rust and corrosion on the interior metals and causes the cooling oil reservoirs of the box to leak. At an average cost of $3500, replacing damaged ground transformer boxes can quickly become an expensive problem for City Public Service. This study served to examine two insecticide products available for treating fire ants in electrical utility housings and determine whether they could prevent fire ants from entering and infesting a newly-installed ground transformer box.

Materials and Methods

In order to reduce the costs associated with this study, City Public Service of San Antonio (CPS) utilized a large inventory of Elastrel™ Insecticide (active ingredient: 19.2% dichlorvos) produced by the Amvac Chemical Corporation, Los Angeles, CA., as one of the treatments. Elastrel™ product had been in CPS inventory but was not being used. The second product used was a version of the Diatect® Results Insecticide named Diatect® II (active ingredient: 0.2% pyrethrins, 1.0% PBO, 82% silicon dioxide), donated by the Diatect International Company, Heber City, UT).

Staff from Texas Cooperative Extension and City Public Service were involved in this study. CPS personnel received training from Extension on the insecticides being used and the proper methods to apply them. CPS personnel also conducted all treatments and were present to open the transformer boxes for evaluations. Due to 9-11 security

concerns, only CPS personnel were allowed to open the boxes for the evaluations that were conducted at two-month intervals.

The Neighborhoods

The neighborhoods were located in each of the CPS service districts (southside, eastside, and northside) in San Antonio. The Rustic Oaks neighborhood is located in the southside CPS district near the intersection of FM 1957 and Grosenbacher Rd. in southwest San Antonio. The soil type in the neighborhood was primarily composed of caliche-type clay and only four homes were built at the project beginning. The Arborstone neighborhood is located in the northside CPS district near the intersection of Judson and Lookout Roads in northeast San Antonio. The soil type in the neighborhood was heavy black clay and there were five homes under construction at the beginning of the project. The Canyon Golf Estates neighborhood in the northside CPS district is located one mile north of the intersection of Wilderness Oak Rd. and Canyon Golf Rd. in far northern Bexar County. The soil type in the neighborhood was black soil with heavy rock content and a total of two homes were under construction at the beginning of the study.

A total of 117 newly-installed ground transformer boxes in these neighborhoods were selected for this study. There were 39 boxes per neighborhood divided into three groups of 13 boxes. Each neighborhood was considered a replicate. There were 13 untreated, 13 Elastrel™ and 13 Diatect® boxes per neighborhood (replicate). Boxes were assigned in sequential order along the meter loop for the neighborhood. In each neighborhood, transformer boxes were installed at least four weeks prior to any home construction and no landscaping or sod installations were conducted until homes were built.

Treatments were applied as follows: Elastrel™ bottles were affixed by means of an adhesive pad to the back wall of the transformer, approximately six to eight inches from the bottom of the box. Diatect® insecticide was applied to all lower surfaces of the box, including the sills and exposed soil where the service wires penetrate. The total amount of Diatect® applied was approximately 56.75g (2 oz.) per box.

Evaluations were conducted at treatment application and at two month intervals for a total of six months of evaluations. Because of 9-11 concerns and CPS staff availability, evaluations were not conducted at the desired monthly intervals. Presence or absence of ants in a transformer box is the unit of evaluation for this study.

Results

Only one transformer box out of 117 in the beginning was infested with fire ants on treatment day. This transformer box was selected for an Elastrel™ treatment, so the ants were allowed to remain in the box to see if they would still be in the box at the next evaluation. One other box was found to be infested with carpenter ants (species unknown) but these were allowed to remain in that box as well. Both of these boxes were located in the Arborstone (eastern) neighborhood (See Table 1). No other boxes were found to be infested with fire ants on treatment day in any neighborhood. At the first 2-

month evaluation in June 2004, two Elastrel™-treated boxes in the Arborstone neighborhood were infested with fire ants, but none were found in any of the other treatments or replicates.

The four month evaluation in August 2004 revealed a fire ant-infested box in Arborstone in the Elastrel™ group that had been previously infested and an untreated box in Canyon Golf Estates that was infested with fire ants (See Table 3 for Canyon Golf Estates data).

At the six-month evaluation a dramatic increase in fire ant invasions was noticed in all neighborhoods. Seven of 39 boxes in Arborstone, three of 39 boxes in Rustic Oaks and two of 39 boxes in Canyon Golf Estates were infested (See Table 2 for Rustic Oaks data).

Discussion

Going into the study, many questions lingered as to whether this project was initiated at the correct time of year and the decision was made to begin in April and follow the results of the study. Many of the CPS staff commented that fall would have been a better time to begin the study because they notice more ant invasions at that time. Looking at the data in this trial, those observations may be true. Weather conditions were such that fire ants did not need to seek shelter in a transformer box until temperatures began to decline in early October. Prior to this study, CPS staff had been using commercial wasp spray as a means to mitigate active fire ant colonies in transformer boxes that were being inspected or serviced. As a result of this study, CPS staff has begun putting treatments into new transformers placed in locations where fire ants destroyed or damaged the previous occupant. CPS staff will continue to monitor the treated boxes to evaluate the length of activity of these products. As advertised, these products were expected to lose their effectiveness around six months post treatment. Results from this trial may indicate this to be true as more ants began appearing in boxes around six months post treatment, but because ant activity was not consistent throughout the trial, this cannot be proven statistically. It certainly appeared that the boxes treated with Elastrel™ were invaded more often than boxes treated with Diatect®, but there's no statistical proof of this either. Because of the obvious lack of ant invasions in this study, a statistical analysis was not performed.

Acknowledgements

The author wishes to thank CPS Standards Lab Director Colin Connally for his cooperation and leadership in coordinating CPS staff to assist with evaluations, locating the neighborhoods for this project and providing the Elastrel™ product. A big thanks goes to Mark Metzger and Diatect International for providing product for these box evaluations.

Table 1. Transformer Box Evaluation Results from the Arborstone Neighborhood.

				Treatment Date	Monitor Date		
Treatment Area	**Trt Grp**	**Rep**	**Transformer #**	**4/20/2004**	**6/25/2004**	**8/19/2004**	**10/20/2004**
Eastside	Elastrel™	1	70742	-	+	-	+
Eastside	Elastrel™	1	70727	-	-	-	-
Eastside	Elastrel™	1	70739	-	-	-	-
Eastside	Elastrel™	1	70736	-	-	-	-
Eastside	Elastrel™	1	70730	-	-	-	-(FHA)*
Eastside	Elastrel™	1	70733	- (CA)[a]	-	-	-
Eastside	Elastrel™	1	70766	-	+	+	-(FHA)
Eastside	Elastrel™	1	70757	-	-	-	-
Eastside	Elastrel™	1	70754	-	-	-	-
Eastside	Elastrel™	1	70751	-	-	-	-
Eastside	Elastrel™	1	70748	-	-	-	-
Eastside	Elastrel™	1	70745	+	-	-	-
Eastside	Elastrel™	1	70760	-	-	-	-
Eastside	Diatect®	1	70741	-	-	-	+
Eastside	Diatect®	1	70726	-	-	-	-
Eastside	Diatect®	1	70725	-	-	-	-
Eastside	Diatect®	1	70729	-	-	-	-
Eastside	Diatect®	1	70735	-	-	-	+
Eastside	Diatect®	1	70732	-	-	-	-
Eastside	Diatect®	1	70768	-	-	-	+
Eastside	Diatect®	1	70753	-	-	-	-
Eastside	Diatect®	1	70756	-	-	-	-
Eastside	Diatect®	1	70765	-	-	-	-
Eastside	Diatect®	1	70759	-	-	-	-
Eastside	Diatect®	1	70750	-	-	-	-
Eastside	Diatect®	1	70744	-	-	-	-
Eastside	Control	1	70737	-	-	-	-
Eastside	Control	1	70731	-	-	-	-
Eastside	Control	1	70734	-	-	-	-
Eastside	Control	1	70728	-	-	-	+
Eastside	Control	1	70740	-	-	-	-
Eastside	Control	1	70755	-	-	-	-
Eastside	Control	1	70767	-	-	-	-
Eastside	Control	1	70758	-	-	-	-
Eastside	Control	1	70764	-	-	-	-
Eastside	Control	1	70761	-	-	-	+
Eastside	Control	1	70749	-	-	-	-
Eastside	Control	1	70752	-	-	-	+
Eastside	Control	1	70743	-	-	-	-

* *Prenolepis impairis*

[a] *Camponotus* species

Table 2. Transformer Box Evaluation Results from the Rustic Oaks Neighborhood.

				Treatment Date	Monitor Date		
Treatment Area	**Trt Grp**	**Rep**	**Transformer #**	**4/19/2004**	**6/23/2004**	**8/20/2004**	**10/19/2004**
Southside	Elastrel™	2	72746(19565)	-	-	-	-
Southside	Elastrel™	2	72738	-	-	-	
Southside	Elastrel™	2	72742	-	-	-	-
Southside	Elastrel™	2	72724	-	-	-	-
Southside	Elastrel™	2	72726	-	-	-	-
Southside	Elastrel™	2	72729	-	-	-	-
Southside	Elastrel™	2	72736	-	-	-	-
Southside	Elastrel™	2	72753	-	- (AA)*	-	-
Southside	Elastrel™	2	72750	-	-	-	-
Southside	Elastrel™	2	72747	-	-	-	-
Southside	Elastrel™	2	72764	-	-	-	-
Southside	Elastrel™	2	72761	-	-	-	-
Southside	Elastrel™	2	72732	-	-	-	+
Southside	Diatect®	2	72743	-	-	-	-
Southside	Diatect®	2	72722	-	-	-	-
Southside	Diatect®	2	72741	-	-	-	-
Southside	Diatect®	2	72725	-	-	-	-
Southside	Diatect®	2	72728	-	-	-	-
Southside	Diatect®	2	72739	-	-	-	-
Southside	Diatect®	2	72754	-	-	-	-
Southside	Diatect®	2	72751	-	-	-	+
Southside	Diatect®	2	72748	-	-	-	-
Southside	Diatect®	2	72763	-	-	-	-
Southside	Diatect®	2	72760	-	-	-	-
Southside	Diatect®	2	72757	-	-	-	-
Southside	Diatect®	2	72734	-	-	-	-
Southside	Control	2	72765	-	-	-	-
Southside	Control	2	72762	-	-	-	-
Southside	Control	2	72759	-	-	-	-
Southside	Control	2	72756	-	-	-	+
Southside	Control	2	72733	-	-	-	-
Southside	Control	2	72730	-	-	-	-
Southside	Control	2	72737	-	-	-	-
Southside	Control	2	72755	-	-	-	-
Southside	Control	2	72752	-	-	-	-
Southside	Control	2	72749	-	-	-	-
Southside	Control	2	72723	-	-	-	-
Southside	Control	2	72740	-	-	-	-
Southside	Control	2	72727	-	-	-	-

* *Crematogaster* species

Table 3. Transformer Box Evaluation Results from the Canyon Golf Estates Neighborhood.

				Treatment Date	Monitor Date		
Treatment Area	**Trt Grp**	**Rep**	**Transformer #**	**4/22/2004**	**6/24/2004**	**8/18/2004**	**10/21/2004**
Northside	Elastrel™	3	71133	-	-	-	-
Northside	Elastrel™	3	71119	-	-	-	-
Northside	Elastrel™	3	71105	-	-	-	-
Northside	Elastrel™	3	71116	-	-	-	-
Northside	Elastrel™	3	71113	-	-	-	-
Northside	Elastrel™	3	71108	-	-	-	-(AA)*
Northside	Elastrel™	3	71110	-	-	-	-
Northside	Elastrel™	3	71122	-	-	-	-
Northside	Elastrel™	3	75536	-	-	-	-
Northside	Elastrel™	3	71125	-	-	-	-
Northside	Elastrel™	3	71128	-	-	-	-
Northside	Elastrel™	3	71102	-	-	-	-
Northside	Elastrel™	3	71130	-	-	-	-
Northside	Diatect®	3	75538	-	-	-	+
Northside	Diatect®	3	71109	-	-	-	-
Northside	Diatect®	3	71115	-	-	-	-
Northside	Diatect®	3	71112	-	-	-	-
Northside	Diatect®	3	71118	-	-	-	-
Northside	Diatect®	3	75535	-	-	-	-
Northside	Diatect®	3	71126	-	-	-	-
Northside	Diatect®	3	71121	-	-	-	-
Northside	Diatect®	3	71135	-	-	-	-
Northside	Diatect®	3	71132	-	-	-	-
Northside	Diatect®	3	71106	-	-	-	-
Northside	Diatect®	3	71103	-	-	-	-
Northside	Diatect®	3	71124	-	-	-	-
Northside	Control	3	71131	-	-	-	-
Northside	Control	3	71129	-	-	-	-
Northside	Control	3	75539	-	-	-	+
Northside	Control	3	75537	-	-	+	-(AA)
Northside	Control	3	71111	-	-	-	-
Northside	Control	3	71114	-	-	-	-
Northside	Control	3	71117	-	-	-	-
Northside	Control	3	71104	-	-	-	-
Northside	Control	3	71107	-	-	-	-
Northside	Control	3	71120	-	-	-	-
Northside	Control	3	71123	-	-	-	-
Northside	Control	3	71127	-	-	-	-
Northside	Control	3	71134	-	-	-	-

* *Crematogaster* species