

EVALUATION OF RED IMPORTED FIRE ANT MOUND TREATMENTS: ARINIX®, GARDSTAR®, QRD-400 AND A HOME REMEDY OF CITRUS OIL PLUS DISHWASHING LIQUID

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The red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae) is a major introduced ant pest of the eastern half of Texas and other southeastern states in the U.S. Individual ant mound treatments are an important component of many control programs, including being “Step 2” of the “Two-Step Method of Imported Fire Ant Control”. This trial was conducted to assess several new ant mound treatments in a field trial conducted in Brazos, Co., Texas.

Nix of America (Metro Plaza, 181 Metro Dr., Suite 590, San Jose, CA 95110; 408/971-3115; Fax: 408/971-3305; nikkonix@ix.netcom.com) has developed a process to formulate permethrin-impregnated nylon plastic parts. Previously, this company developed a 9% permethrin impregnated nylon-type part for Nissan automobiles (SG Tube 1725W) to repel spiders from internal combustion engines for an estimated 10 year period. It was developed as a barrier treatment for use in such locations as around bundles of cables in electric utility boxes or housings in order to prevent foraging imported fire ants from reaching sensitive components such as switching mechanisms. It was evaluated here as a direct fire ant mound treatment (**Fig. 1**) in order to determine if the ant colonies would be repelled by the presence of the permethrin impregnated nylon part. The GardStar® (permethrin) ant mound drench treatment was used as a “standard”. The wooden dowel rods hammered into mounds served as the “untreated control” as simple disturbance of ant mounds mound cause fire ant colonies to re-locate.



Fig. 1. Installing Arinix spiral wrap into red imported fire ant mound.

QRD-400 is a new botanical product derived from *Chenopodium ambrosioides* var. *ambrosioides* L., an indigenous plant to Central and South America, and appears to have insecticidal, acaricidal and fungicidal properties. This botanical insecticide is found to be a good alternative for managing soft-bodied insect pests of various greenhouse and outdoors crops such as green peach aphid, western flower thrips, citrus mealybug, two-spotted spider mite, greenhouse whitefly, and fungus gnats. Here it was used as a relatively high concentration ant mound drench.

The “home remedy” of liquid dishwashing soap plus citrus oil was included as a second effort to provide documentation of the effectiveness of this treatment. The formula was developed through a series of laboratory assays examining the toxic effects of each component and mixtures of components on worker ants.

Materials and Methods

On May 17, 2007, 20 plots, equal in width but varying in length were established containing 10 mounds each. Field flags were used to mark 200 red imported fire ant mounds along a service road and in a field on the Texas A&M University’s Riverside Campus. Plots were arrayed from longest to shortest and divided into four replicates or blocks. Treatments were randomly assigned within each replicate at random and adjusted to minimize pre-treatment plot length means or averages (see plot listing below). Weather conditions were sunny with a slight breeze. Treatments were applied from 3:00 p.m. until 5:40 p.m.:

Treatments:

1. GardStar® 40EC (40% permethrin) - 10 ml per mound
2. Dawn Ultra Original Scent (blue) + Medina Orange Oil - 3 oz. + 1.5 oz., respectively
3. QRD-400 (25% EC Concentrate, lot # ESR-07-134-1 14May07) - 1 fl. oz. per mound
4. Arinix® (SG Spiral tube NS-20, T – 1; 9.5% permethrin; 4 inches long, 3/4 inch diameter, 1/16 inch thick) - permethrin impregnated nylon spiral wraps over cut wooden dowel rod (described below)
5. Untreated control - dowel rod (3/4 inch diameter, 7 inches long, wooden dowel rods beveled on one end) hammered into each mound

Plots:

Number	Length in feet	Treatment
1	52'	GardStar
2	102'	GardStar
3	122'	Arinix
4	96'	Check
5	152'	QRD
6	183'	Check
7	78'	GardStar
8	101'	Orange +Soap

Plots, cont.:

Number	Length in feet	Treatment
9	96'	QRD
10	80'	Arinix
11	94'	Orange + Soap
12	43'	Arinix
13	40'	Arinix
14	40'	QRD
15	40'	GardStar
16	45'	QRD
17	37'	Orange + Soap
18	77'	Orange + Soap
19	45'	Check
20	31'	Check

Ant activity in marked mounds was monitored 4, 7, 15, 22, and 28 days after treatment (May 21, 24, June 1, 8, and 14, 2007) using the minimal disturbance method whereby mounds were disturbed gently and determined to contain active ant colonies if dozens of worker ants emerged shortly thereafter. On the final evaluation date, 33 days after treatment on June 19, all active ant mounds within treatment plots were counted in order to document “new” or “satellite” ant mounds that had appeared since treatments were applied. Data were analyzed using Analysis of Variance (ANOVA) at $P \leq 0.05$, and means were separated using two methods of separation: 1) Duncan’s Multiple Range Test, and 2) Tukey’s Honest Significant Difference, at $P \leq 0.05$ (SPSS for Windows, Version 14.0).

In addition, data were analyzed using Repeated Measures (Mixed Model) Analysis. In this analysis fixed and random effects are considered in the model. For the analysis, “time” and “treatment” were considered as fixed factors and “plot” considered as random and the interactions between “time” and “treatment” were also considered in the model. Significant differences when $P < 0.05$. SPSS 14.0 was also used for this analysis.

Results and Discussion

Ant activity in all treated mounds declined over the duration of the monitoring period of this trial possibly due to weather conditions prior to and following this trial period which included soaking rains followed by drying that could have caused ant colonies to move excessively in and out of these roadside plots (**Table 1**). Even “untreated control” (wooden dowel rods hammered into mounds) plot mounds declined by 90% by 22 and 28 days after treatment. Thus, there were no significant differences among treatments following 15 days of application. However, all treatments significantly reduced active mound numbers quickly (by 4 days after treatment and for 7 days following treatment) compared to “untreated control” active mound numbers. The “standard” treatment, GardStar® (permethrin) ant mound drench, eliminated all ant activity in treated mounds until June 14, 28 days after application. QRD-400 and the soap plus citrus oil “home

remedy” performed similarly but not numerically as good as GardStar mound drench. Arinix® spiral wraps significantly reduced active ant mounds relative to “untreated control” (dowel rod only) treatments within 7 days after treatment. It appears that colonies moved away from the spiral wrap rods, as indicated by the mean number of ant mounds in treated plots 33 days after treatment (June 19) which exceeded (non-significantly) that of the untreated control plots. However, findings support the concept that the permethrin impregnated nylon spirals can affect entire ant colonies and cause them to move away from the original mound location.

Mixed Model analysis (**Table 2**) also shows significant impacts caused by the treatments, and by sampling period as well as for the combination of treatment and week which indicates a relative reduction of colonies compared to those in the controls that remained similar throughout the sampling periods.

Acknowledgements

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Table 1. Number of active red imported fire ants in 10 mounds, replicated four times, following application of individual ant mound treatments, Riverside Campus, Texas A&M University campus, Brazos Co., TX.

Treated	4 DAT	7 DAT	15 DAT	22DAT	28DAT	33DAT
May 17	May 21	May 24	June 1	June 8	June 14	June 19 (total)
Treatments						
Untreated control	9.0 a	6.5 a ¹ a ²	1.8 a ¹ a ²	1.0	1.0	4.5
Arinix®	4.0 b	2.0 b b	1.5 a a	1.0	1.0	6.0
GardStar®	0.0 c	0.0 c c	0.0 b a	0.0	0.0	2.0
QRD-400	0.5 c	0.3 c bc	0.5 ab a	0.3	0.3	5.5
Orange oil plus soap	0.5 c	0.8 bc bc	0.5 ab a	0.5	0.5	2.3
df = 4	df = 4	df = 4	df = 4	df = 4	df = 4	df = 4
<i>F value</i>	48.583	34.519	3.385	2.087	2.087	1.249
<i>P value</i>	0.00	0.00	0.037	0.133	0.133	0.333
Mean sq.	58.300	28.825	2.200	0.383	0.800	13.550

¹ Means followed by the same letter are not significantly different using Analysis of Variance (ANOVA) at $P \leq 0.05$ and means separated using Duncan's New Multiple Range Test (SPSS for Windows, Version 14.0).

² Means followed by the same letter are not significantly different using Analysis of Variance (ANOVA) at $P \leq 0.05$ and means separated using Tukey's Honest Significance Difference (SPSS for Windows, Version 14.0).

Table 2. Mixed model analysis. Significant differences when $P < 0.05$ (Type III Tests of Fixed Effects (a)).

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	25.084	88.402	.000
Treat	4	25.084	45.993	.00000
Day	4	22.794	28.515	.00000
Treat *	16	22.794	15.749	.00000
Day				

a Dependent Variable: Total Active Mounds.