Evaluation of Altrevin®, Esteem®, Clinch®, and Extinguish® Plus Fire Ant Baits for the Management of the Red Imported Fire Ant in Pastures

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The red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae) has become an important economic problem in urban Texas, according to a 1998 study conducted by the Department of Agricultural Economics, Texas A&M University. Fire ant related costs in Dallas, Fort Worth, Austin, San Antonio, and Houston, fire ants have serious economic effects for these metro areas of Texas (Lard, Hall, and Salin 2000). Households experienced the largest costs among sectors examined with an average of $151 per household spent annually. These costs include repairs to property and equipment, first-aid, pesticides, baits, and professional services. A full damage assessment for Texas must include additional sectors, and the estimated costs of $581 million per year for the selected sectors underscore the impact of this pest. Treatment costs accounted for over 50% of the total cost. In Houston, the average medical treatment cost per household was $25.46. The duration of injury for children and adults was 6.6 days and 5.6 days, respectively. The fire ant limits outdoor activities and homeowners and agricultural producers incur added costs in managing fire ants.

Management of the fire ant on large mixed use land tracts using insecticide products is economically feasible when the economic impact of high fire ant population levels equals or exceeds the cost of control (Flanders and Drees 2004). Mixed use land tracts may include parks, camp grounds, convention centers, animal-care facilities, or a mixture of any of these. The use of these areas by large numbers of the general public can expose them to fire ants if no control measures are undertaken.

Fire ant bait products offer a means to treat large areas of managed turf to obtain a level of fire ant control and reduce the exposure of the general public to the fire ant. Fire ant bait formulations vary somewhat but most consist of de-fatted processed corn grit as a “carrier,” soaked with soybean oil as an attractant that contains the active ingredient. The broadcasting of fire ant bait products allows foraging fire ants from visible or hidden mounds access to the bait particles that they pick up and take back to their respective colonies. When foraging ants return to the colony the product is fed ant-to-ant, ant-to-larva, larva-to-ant and ant-to queen(s) so that all members of the colony are affected. This is also why most bait ingredients must be rather slow to kill ants. If ants die too fast, the active ingredient fails to reach the queen or multiple queens.

This study evaluated a new granular fire ant bait product being developed for use in fire ant infested pastures from BASF Corporation, Altrevin® (metaflumizone), from established fire ant control products from Valent U.S.A. - Esteem® Ant Bait (pyriproxyfen), Central Life Sciences - Extinguish® Plus (hydramethylnon + methoprene), and Syngenta Crop Protection - Inc., Clinch® (abamectin).

Material and Methods

This study was established in a grassy field at the Five Eagle Ranch, Caldwell, TX, in Burleson County (**Fig. 1**). Twenty, one acre plots were established on October 22, 2008. Pre-treatment assessments of the number of active red imported fire ant mounds were made within a 0.25 acre circle (59 ft radius) sampling area or sub-plot within each 1 acre plot. Plots were mapped using a handheld GPS unit (Trimble® Geo Explorer XT with submeter accuracy) before applying the fire ant bait products. Plots were arrayed in order from the plot containing the highest to the lowest number of fire ant mounds per sub-plot. Replications were established by dividing the array into four blocks and randomly assigning the six treatments **Table 1**) to plots within each block and then adjusting to assure that pre-treatment mean differences between treatments in all replications or blocks were minimal. All plots were monitored prior to and periodically following treatment throughout the entire result demonstration period.

All treatments were broadcast applied October 22, 2008, in the late afternoon, with a Herd GT-77 Sure Feed Broadcaster for Fire Ants (Herd Seeder Co., Inc., Logansport, IN **www.herdseeder.com**) mounted to either an ATV (Kawasaki Prairie 700) or John Deer Gator. The Herd GT-77 was calibrated to deliver 1.5 lb fire ant bait with a 20 ft swath. The Herd GT-77 was fitted with a Herd Seeder Co. #1 plate covering the agitator. After all the replications of each treatment were applied, the broadcaster hopper was swept clean before the next treatment. On December 8, 2008, another application, using 1.5 lb product/acre treatment of both Altrevin® and Clinch® was applied to their respective plots. Reapplication occurred because control in these treatments dropped below 90% within a 30-day period following initial application. At 0, 2, 4, 16 and 26 weeks after initiation of the study, the number of active fire ant mounds within the monitored sub-plot area of each plot was counted and recorded. To determine if a mound was active, a shovel was used to slightly disturb the mound. If no fire ants appeared after 15 seconds, the mound was considered inactive. Total active fire ant mounds in each plot were counted, and the data was recorded as the number of active fire ant mounds per 0.25 acre subplot.

Data Analysis: Data were analyzed first using the Linear Mixed Model (LMM) (Repeated Measures - Type III sum of squares and diagonal repeated covariance) procedure, in this analysis, the response variable was the number of fire ant mounds, “plot” was consider the random factor and “treatment” and “week” the fixed factors. This analysis allows for unsystematic variability of the data and provides greater power to detect effects. Since this procedure does not allow post-hoc analyses, independent ANOVAs where performed for individual sampling dates and using the Turkey’s post-hoc analyses to investigate what treatments differ from untreated control or check plots. The statistical package SPSS 16.0 (SPSS Inc. 2008) was used to perform these analyses (values significantly different when $P < 0.1$).

Results and Discussion

Low to moderate rainfall occurred during the testing period but periodic rains resulted in visible mounds on the ground surface throughout the trial. **Table 2** indicates that differences between treatments in all replications or blocks were minimal before treatments. Evaluations of active fire ant mounds at evaluation dates were disappointing (**Fig. 2**). Visual observations

indicated some effect (i.e., possible “brood shift” of larvae developing initially into from workers transforming to developing sexual reproductive larvae that are larger) at early evaluations. However, mound counts did not confirm this during later evaluation dates. We do not have an explanation for why significant decreases in active mounds numbers did not occur over time following applications (**Table 3**). Granular bait formulated insecticide products rely on the behavior of foraging worker ants in order to be effective. Many factors can affect retrieval of bait broadcast applied. Bait products contain a food attractant such as soybean oil which can become rancid and unattractive to foragers. Temperatures below 65 or greater than 95 degrees F discourage ant foraging. Regardless, even with fresh product and favorable temperature conditions, treatment failures have been reported on occasion with many bait products. Whatever combination of factors were present at the time of the treatments made during this trial, the results were overall disappointing. Thus, this trial should be replicated at another time and/or location. The site used in this study should be investigated to see if the ants dwelling there are simply not attracted to bait products**.**

When all treatment data is combined over the whole evaluation period, the Altrevin® (1.5 + 1.5 lb product/acre) and Extinguish® Plus (1.5 lb product/acre) treatments showed the greatest reductions in mound activity (**Figure 3**), though these reductions were approximately 30% (**Table 4**) which is not acceptable for a fire ant bait treatment.

Table 1. Red imported fire ant bait products evaluated on 1 acre plots, Five Eagle Ranch, Caldwell, TX in Burleson County, October 22, 2008

Treatment	**Rate (lb product/acre)**
Control	0
Altrevin ® (metaflumazone)	1.5 + 1.5
Esteem ® Ant Bait (pyriproxifen)	1.5
Extinguish® Plus (hydramethylnon plus methoprene)	1.5
Clinch ® (abamectin)	1.5 + 1.5

Table 2. LMM table for pre-treatment counts, (effect of treatments and interaction treatment-date on response variable). Pre Treatment values significantly different when $P < 0.1$.

Pre-treatment statistics

Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	15	299.301	.000
Treatment	4	15	0.76	.989
a. Dependent Variable: Mounds				

Table 3. ANOVA table, indicating mean number of mounds and ± standard error per treatment across the different sampling dates

	Week				
	0	2	4	16	26
Altrevin	17.5±1.65	12.75±2.32	13.75±3.98	11.5±3.47	12.5±3.81
Check	17.25±1.79	16±2.16	23.75±3.35	19.75±2.39	14.25±3.3
Clinch	17.25±1.54	14.5±1.32	17.75±1.18	16±1.47	13.25±1.79
Esteem	18.75±3.83	15.5±4.25	24.5±4.17	17.75±1.03	18.75±1.54
Extinguish Plus	17.5±1.7	12±1	13.25±2.01	13±0.91	10.25±1.65
P-value *	0.989	0.748	0.061	0.078	0.268
F	0.076	0.483	2.855	2.604	1.445
MSE	20.81	24.71	40	17.5	27.2
df	1,4	1,4	1,4	1,4	1,4

* Means (±SE) followed by an asterisk are significantly different compared to mean values observed on the Untreated check. Analysis of Variance (ANOVA) with means separated using the Tukey post-hoc analyses to investigate what treatments differ from Check plots. The statistical package SPSS 16.0 (SPSS Inc. 2008) was used to perform these analyses (values significantly different when $P < 0.1$).

Table 4. Overall LMM table for post-treatment counts, values significantly different when $P < 0.1$, and overall percent reduction in fire ant mound activity.

	Overall	%
		Reduction
Altrevin	12.62±1.56	32
Check	18.44±1.58	0
Clinch	15.37±0.78	17
Esteem	19.12±1.63	- 3
Extinguish Plus	12.12±0.72	34
P-value	0.046	
F	2.369	
MSE	28.11	
df	4,16	

Figure 1. Map of 5 Eagle Ranch, Caldwell, TX, experimental plots with respective treatments.

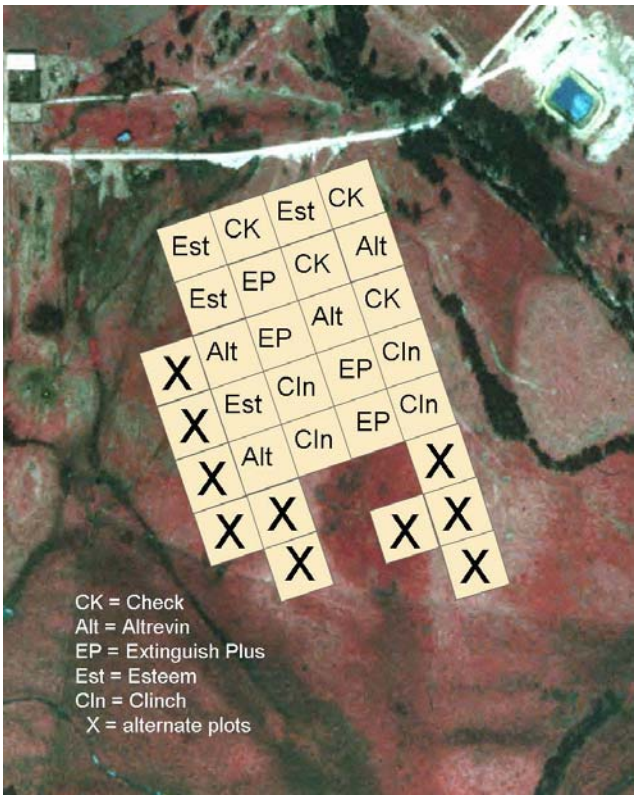
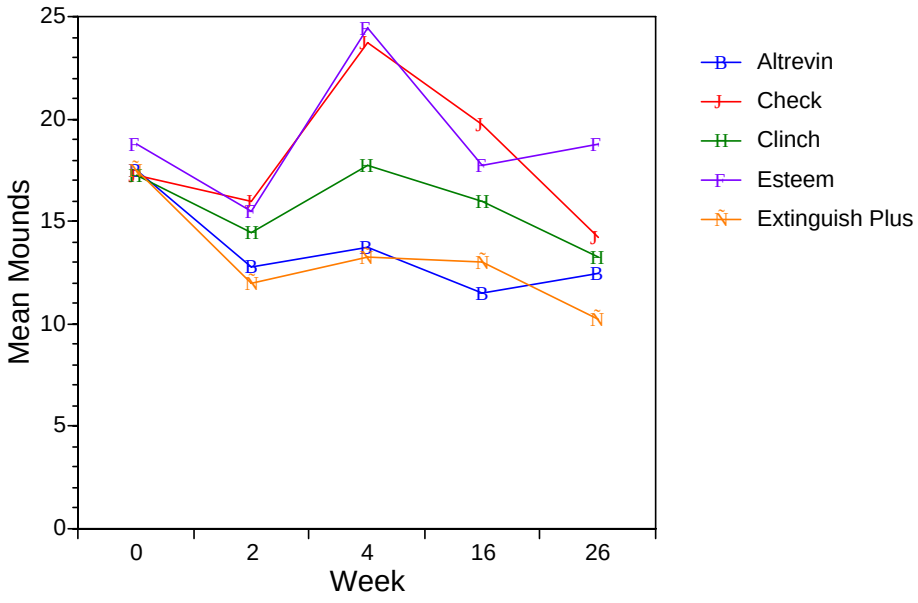


Figure 2. Mean active mounds per treatment throughout the sampling dates.



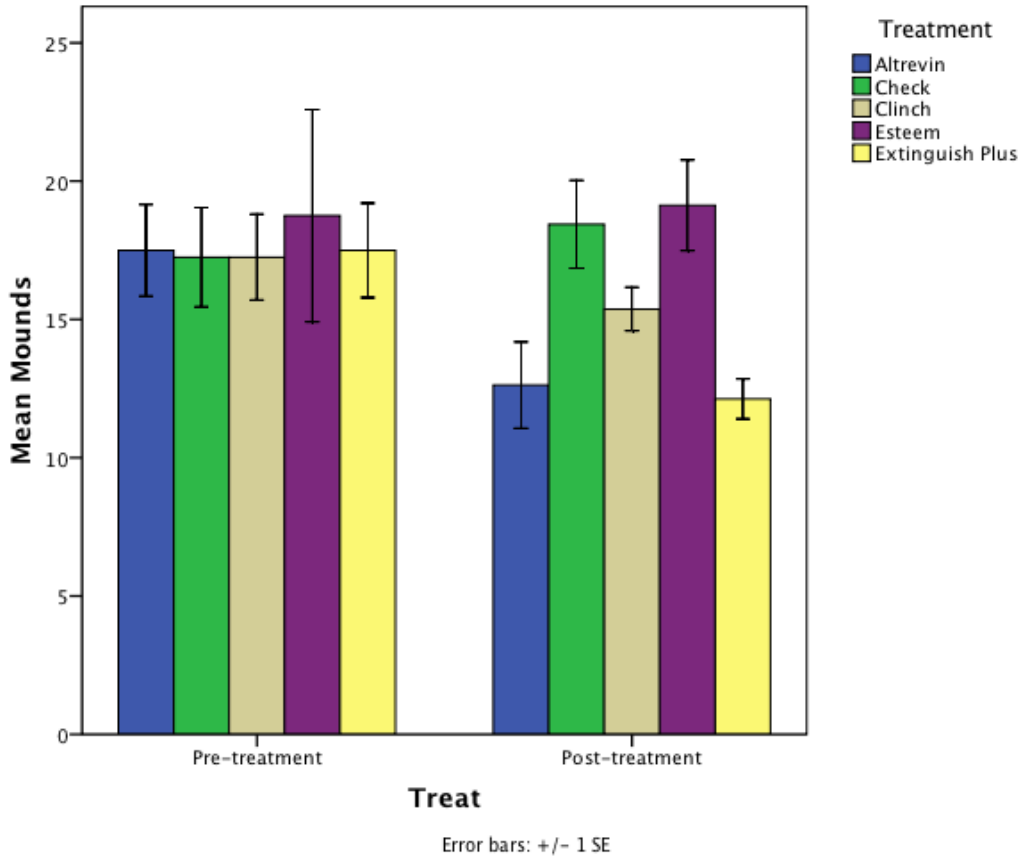


Figure 3. Overall mean active mounds and ± standard error per treatment.

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