

EVALUATION OF COMBAT® (HYDRAMETHYLNON) ANT BAIT AND TREATMENT PATTERNS

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Combat® and MaxForce® granular ant baits containing hydramethylnon on particles composed of ground up silkworm caterpillars differ from conventional Amdro® and Seige® formulations. Conventional ant bait formulations contain an active ingredient formulated in soybean oil used to coat defatted, processed corn grit particles. This difference can make the Combat/MaxForce formulations attractive to a different spectrum of ant and insect species and make broadcast application using conventional equipment (e.g. Cyclone®, Herd® or Ortho® Whirlybird®) seeders difficult. This trial was conducted to evaluate Combat granular ant bait as a treatment to suppress the red imported fire ant, *Solenopsis invicta* Buren, when applied as a broadcast application and various patterns of spot applications. Spot treatments of a conventional ant bait formulation of fenoxycarb, Award®, was used for comparison.

The product, Combat® Outdoor Ant Killing Granules (1% hydramethylnon) distributed by Combat Insect Control Systems, is labeled for controlling fire ants, Argentine ants, carpenter ants, pharaoh ants, pavement ants, honey ants, acrobat ants, odorous house ants and thief ants when applied as spot treatments of 1 oz quantities of granules every 20 feet around the perimeter of the home or structure, or 1 oz. around each ant hill. Additional solid formulations in plastic encased outdoor and indoor bait stations are sold as Combat® Outdoor Ant Killing Stations (registered for fire ant, Argentine ants, black carpenter ants, cornfield ants, little black ants, odorous house ants and pavement ants) and Combat® Superbait® (registered for pharaoh ants, fire ants, carpenter ants, Argentine ants, crazy ants, thief ants, odorous house ants, acrobat ants and pavement ants). MaxForce® Professional Insect Control® Ant Killer Granular Bait (1% hydramethylnon) and Ant Killer Bait Stations (for indoor and outdoor use) distributed by MaxForce are similarly registered for the professional pest control operator market. However, the granular bait is to be applied outdoors, only, by lightly sprinkling 4 to 8 oz MaxForce Ant Killer Granular Bait evenly in a band approximately 1 to 2 feet wide adjacent to the foundation of the average sized home (200 to 400 linear feet). It may also be applied at a broadcast rate of 1 oz. per 1,800 sq. ft. or to individual fire ant mounds at 2 Tbsp. (1 oz.) around each hill.

Materials and Methods

Forty plots, 100 by 100 ft., were established in a native pasture in Brazos Co., Texas. This field was heavily infested with suspected monogyne and polygyne red imported fire ant colonies. Each plot contained a 35 ft. radius circular treatment area (thus, 40 ft. buffer areas between treatment circles) in the center in which the number of active red imported fire ant mounds were monitored by measuring their distance (to the nearest 1 ft. increment) from the plot center. Prior to

treatment, plots were arrayed from highest to lowest number of mounds per circular subplot area. Five blocks (replications) of eight treatments each were established so that each treatment had a plot in each block. Treatment plots were assigned within each replicate block largely at random, but adjusted to reduce pre-treatment mean differences and variability between and among treatments. Eight treatments were initiated on 12 September 1996 as follows (Note: Combat® hydramethylnon granular bait treatment rates were calculated on applying 1.5 pounds per acre to the 70 by 70 ft. square or area-equivalent 39.5 ft radius circular plot, for a total of 76.61 grams maximum per plot):

1. Untreated control
2. Combat® hydramethylnon bait applied as a *broadcast* application, applying 76.61 g evenly across the 35 ft. radius circle. Applications were made with a Solo® backpack-style, engine-powered mist blower. Bait was placed in a coffee can attached to the end of the blower hose and the unit's Venturi-action feed tube used to vacuum the bait into the airstream.
3. Combat® hydramethylnon bait applied in a *grid pattern* of spot treatments, with 76.61 g placed in 11.7 g. spots every 20 ft around the 35 ft. radius perimeter, plus 5 spots every 20 ft. along a 16 ft. radius inner circle and a single spot in the center.
4. Combat® hydramethylnon bait applied as a *border* spot treatment, with 76.61 g placed in 11.7 g. spots every 20 ft around the 35 ft radius perimeter.
5. Combat® hydramethylnon bait applied as a *single center* spot, with 76.61 g scattered in an approximately 3 ft. radius spot in the plot center.
6. Combat® hydramethylnon bait applied as a *replenished* center spot, with 25.5 g applied three times at two-week intervals.
7. Award® fenoxycarb bait applied as a *single center* spot, with 76.61 g scattered in an approximately 3 ft. radius spot in the plot center.
8. Award® fenoxycarb bait as a *replenished* center spot, with 25.5 g applied at weekly intervals three times.

At time of treatment (9:30 am to 4:00 pm, 12 Sept. 1996), temperatures ranged from 70 to 80 degrees F. There was a light breeze and skies were partly cloudy with a persistent haze. Ants were observed picking up the bait within minutes of application throughout the day.

Plots were monitored for active ant mounds and mound locations from the plot center periodically (1 week, 2 weeks, 1 month and 2 months) after initiating treatments. Resulting active mound numbers per plot data were analyzed using analysis of variance (ANOVA) and means were separated using Tukey's studentized range test ($P \leq 0.05$). The distance of each active ant mound from the plot center was recorded for all plots. The plot circle was then divided into 35 concentric circles (rings) of 1 ft. radius each and the area of each ring calculated. The number of active ant mounds at each radius was divided by the area of the corresponding ring to give a mound per square foot density value. Densities were then analyzed and graphed using both linear regression and moving average techniques.

Results and Discussion

The mean number of active red imported fire ant mounds were significantly reduced in plots treated with the broadcast and grid pattern spot treatment of Combat® hydramethylnon bait applied at 1.5 lbs. per acre one week through one month following application relative to untreated plots (**Table 1**). The broadcast treatment producing the highest numerical level of suppression. Other spot treatment patterns of hydramethylnon bait produced less dramatic results, with maximum suppression achieved two weeks following initiation of treatment(s). Rains occurring between the 2 week and 1 month monitoring dates resulted in an increase in active ant mound numbers in all plots. Award® fenoxycarb bait applications did not produce consistent, significantly reduced mound numbers in treated plots within the time interval of these monitoring dates. These plots and the untreated control plots will continue to be monitored for 6 to 12 months.

Linear regression analysis of fire ant mound distance from the plot centers were somewhat problematic since sets of plots for two treatments (fenoxycarb center and replenished center spot treatments) had distributions of mounds that were higher toward the plot centers before treatments were initiated (**Figure 1**). However, other treatment plot mound distributions were roughly equal across plots, producing lines with no or almost no slope. At the point in time when the hydramethylnon treatment produced the maximum level of ant mound suppression (**Figure 2**), slopes and levels of most lines had changed, with hydramethylnon broadcast and grid treatments being suppressed from between 0.02 to 0.03 mounds per square foot (pre-count level) to 0.0 to 0.01 mounds per square foot. However, post-treatment lines had little slope, indicating ant mound distribution had remained fairly even across the plots.

In contrast, the slope for the hydramethylnon border treatment changed as expected, with more mounds occurring toward the center of the plot and fewer occurring around the perimeter of the circular plot (Fig. 2). Unfortunately, the line calculated for the hydramethylnon center spot treatment also had a negative slope. In this instance, the slope is possibly an artifact of converting data to standardize mound numbers to a per square foot value which over-compensates for mounds near the plot center. A few of the plots in the hydramethylnon center treatment contained mounds at or near the center of the plot and ant activity in these mounds was somehow not eliminated during the course of the trial.

One possible explanation for this lack of activity closest to a spot treatment is that hydramethylnon as formulated and applied at such a high rate acts as a rather fast-acting toxicant, perhaps so fast that ants soon recognize it as a toxicant and avoid recruiting additional workers to the product - a phenomenon recognized as a response by ant colonies to other fast-acting toxicants (e.g., chlorpyrifos treated seeds). This idea is supported by comparing the effects of the broadcast versus grid treatments (Table 1). In a broadcast treatment, scattered bait particles are collected by random foraging worker ants and may deliver the highest possible amount of this ingredient to a colony before its toxic effects are noticed. Spot treatments that rely on recruitment of worker ants bait for delivery to colonies may actually reduce total toxicant delivery due to learned avoidance.

In **Figures 3 through 10**, the average number of mounds per square ft. found within 3 ft. to either side of each 1 ft. increment from the plots' center are plotted. Using this method, the first three data points from the center have fewer than data from 6 concentric 1 ft. concentric rings from which means are otherwise calculated. This quirk of calculating and plotting moving average lines can result in higher variability (higher or lower) for plot center values. Otherwise, this method reduces variability and creates "smoother" lines from converted data. This method was used to depict the effects of each treatment plotted over time. Two month data were not included. **Figure 3** illustrates the rather stable nature of fire ant mound numbers and distribution in untreated control plots; **Figure 4** best depicts overall and uniform suppression of mound numbers following the broadcast application of Combat® hydramethylnon bait; and, **Figure 6** best depicts the suppression of active ant mound numbers within roughly 10 feet of the perimeter of the plots (although the rise in mound numbers at the center of the plot is unexplainable and/or an artifact of the data conversion and moving average plotting method).

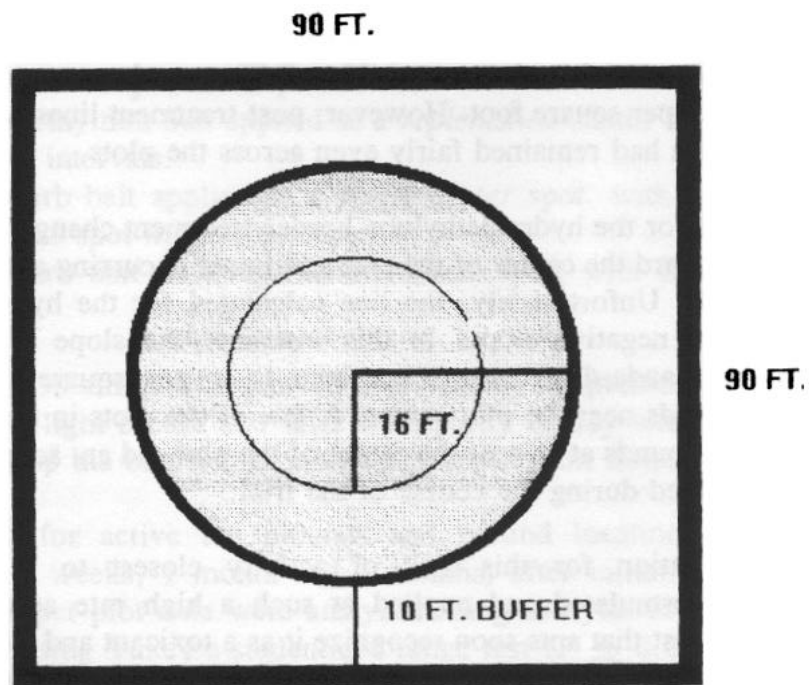


Table 1. Number of active red imported fire ant mounds before and following application of 1.5 lbs. per acre Combat® hydramethylnon or Award® fenoxycarb ant bait formulations in various patterns to 35 ft radius circular plots, initiated 12 September 1996, Brazos Co., Texas.

<u>Treatment</u>	Mean no. Ant mounds/35 ft. radius circular plot*				
	<u>Pre-treatment</u>	<u>1 week</u>	<u>2 weeks</u>	<u>1 mo.</u>	<u>2 mo.</u>
untreated control	18.4a	21.2a	22.6a	23.0a	26.8a
Combat® hydramethylnon					
<i>broadcast</i> application	19.2a	8.6c	6.0e	11.2c	11.8b
<i>grid pattern</i> of spots	19.0a	11.2bc	8.2de	13.4c	16.8ab
<i>border spot</i> treatment	18.6a	14.6abc	12.2cd	16.8abc	19.2ab
<i>single center spot</i>	18.8a	14.6abc	12.8bcd	15.8abc	23.8a
<i>replenished center spot</i>	19.2a	17.0ab	13.2bcd	22.6a	23.0ab
Award® fenoxycarb					
<i>single center spot</i>	18.8a	19.6a	16.8bc	24.0a	22.4ab
<i>replenished center spot</i>	18.4a	19.8a	18.2ab	22.2a	25.0a
<i>F</i>	22.45	7.70	14.02	6.22	3.07
<i>P</i>	0.0001	0.0001	0.0001	0.0001	0.0081
<i>MSD</i>	5.5228	8.1526	5.7445	8.8473	11.855
d.f. = 28					
Crit. val. = 4.625					

* Means of five replicate plots in columns followed by the same letter are not significantly different using analysis of variance (ANOVA) and means were separated using Tukey's studentized range test ($P \leq 0.05$).

Figure 1. Linear regression of pre-treatment red imported fire ant mound distribution across 35 ft. radius circular treatment plots, Brazos Co., Texas, September 1996.

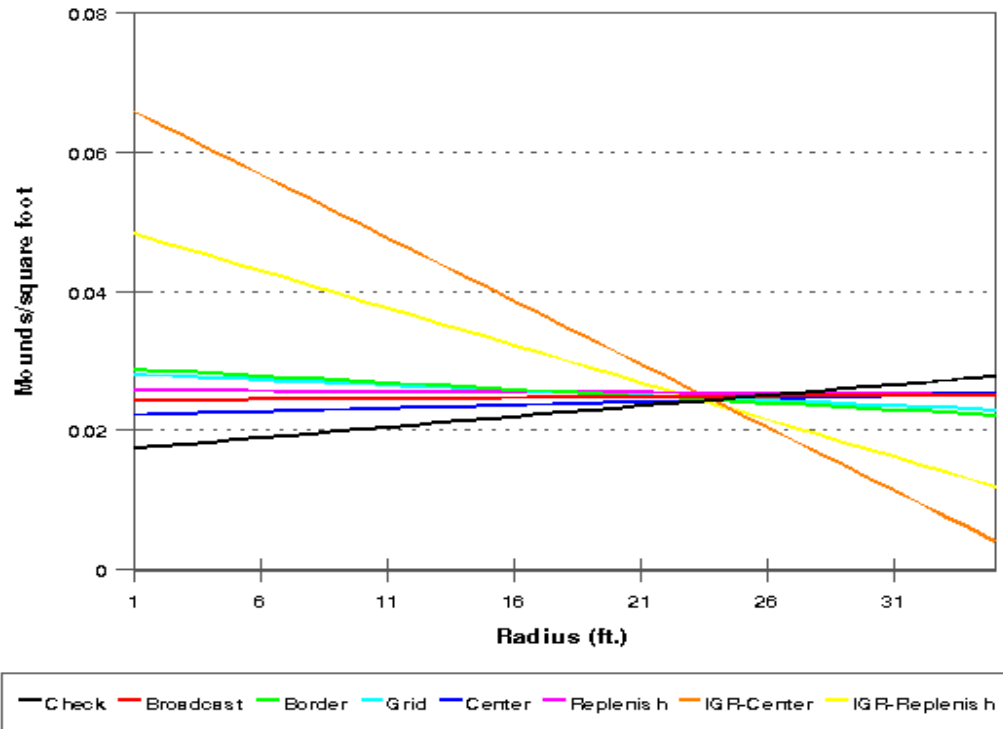


Figure 2. Linear regression of post-treatment red imported fire ant mound distribution across 35 ft. radius circular treatment plots two weeks following application of 1.5 lbs. per acre Combat® hydramethylnon or Award® fenoxycarb ant bait formulations in various patterns to 35 ft radius circular plots, initiated 12 September 1996, Brazos Co., Texas.

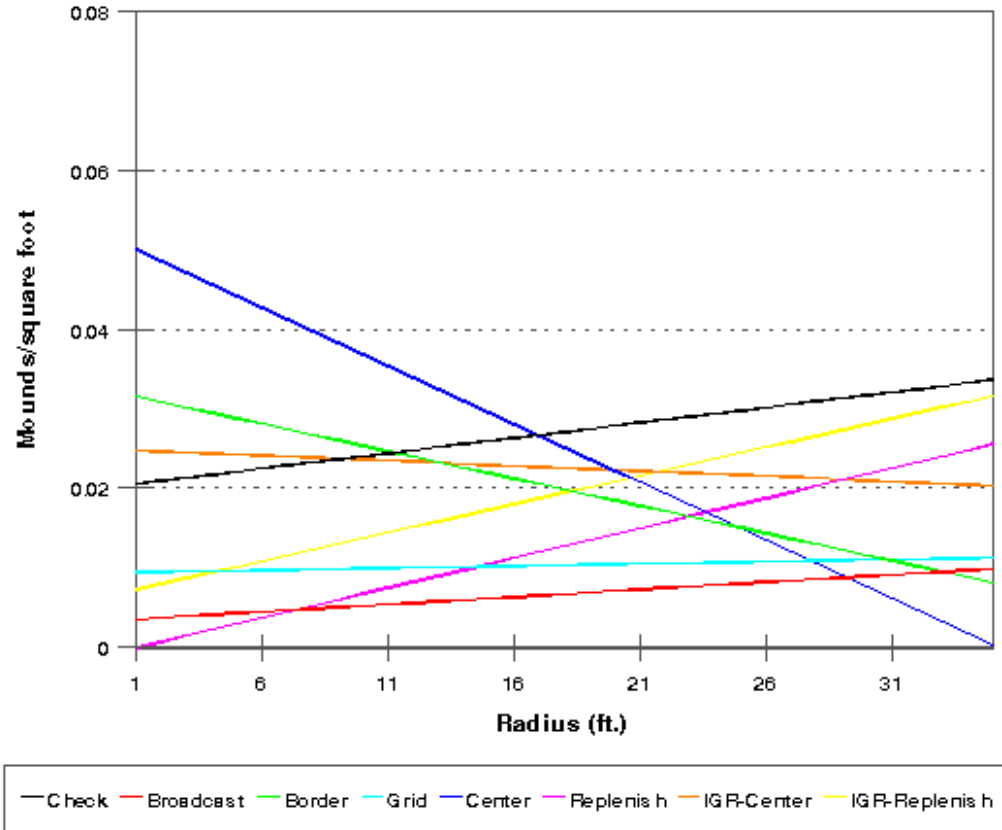


Figure 3. Moving average (3ft. on each size of each 1 ft. increment) of red imported fire ant mounds across 35 ft. radius circular *untreated control plots* in a trial initiated 12 September 1996, Brazos Co., Texas.

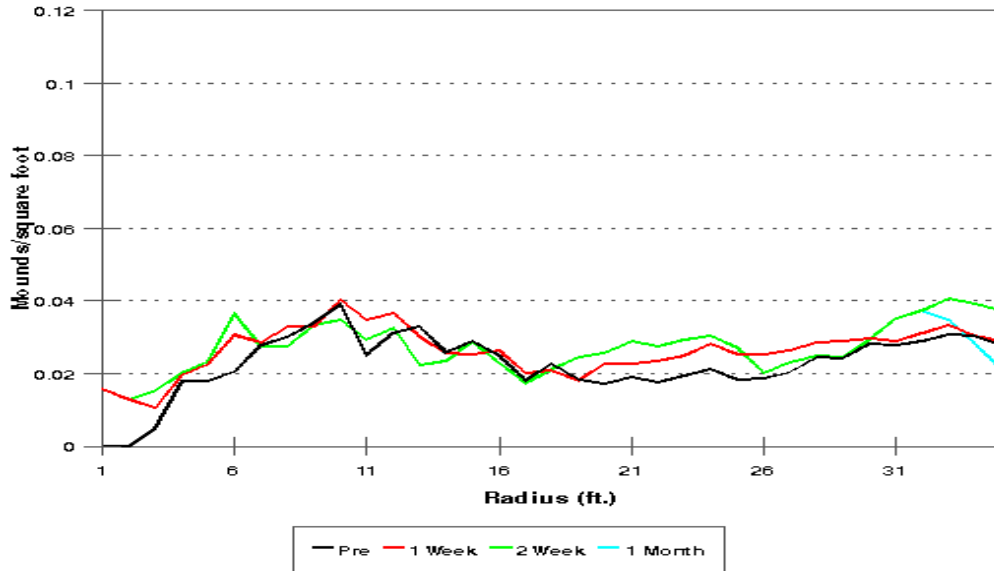


Figure 4. Moving average (3ft. on each size of each 1 ft. increment) of red imported fire ant mounds across 35 ft. radius circular plots receiving a *broadcast application* of 1.5 lbs. per acre of 1% granular hydramethylnon bait applied 12 September 1996, Brazos Co., Texas.

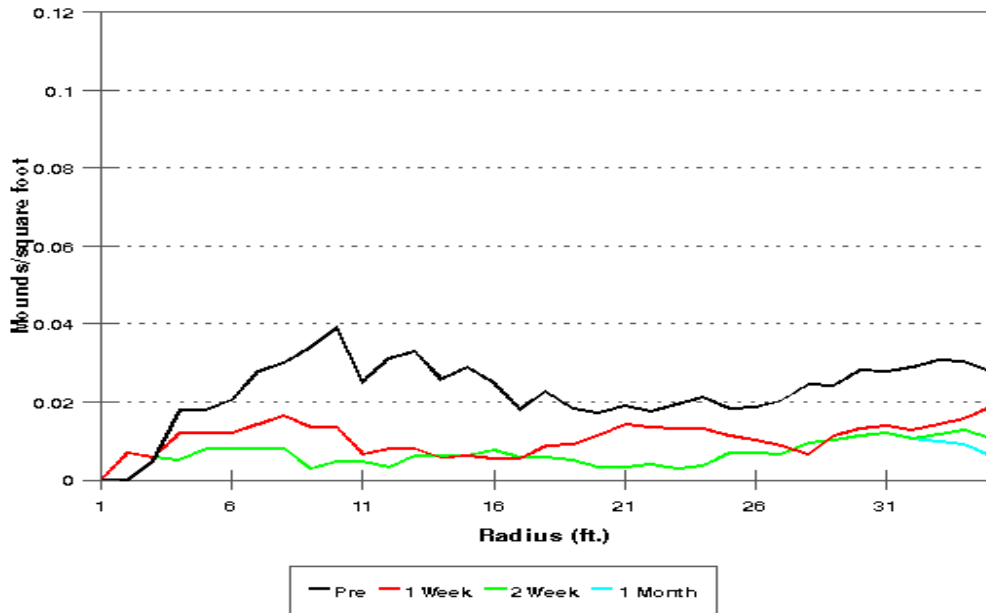


Figure 5. Moving average (3ft. on each size of each 1 ft. increment) of red imported fire ant mounds across 35 ft. radius circular plots receiving a *grid pattern of spot treatments* of 1.5 lbs. per acre of 1% granular hydramethylnon bait applied 12 September 1996, Brazos Co., Texas.

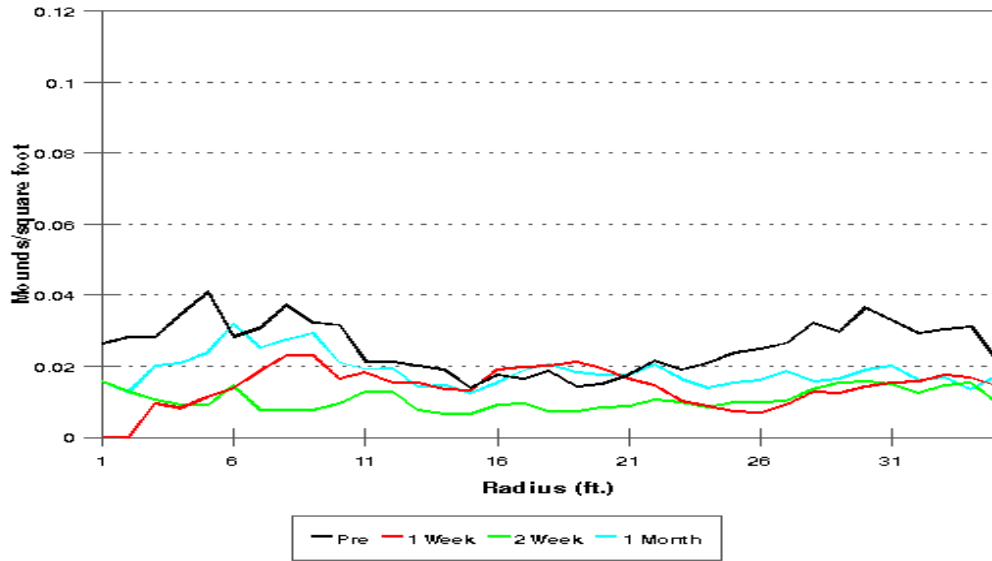


Figure 6. Moving average (3ft. on each size of each 1 ft. increment) of red imported fire ant mounds across 35 ft. radius circular plots receiving a *border spot application treatment* of 1.5 lbs. per acre of 1% granular hydramethylnon bait applied 12 September 1996, Brazos Co., Texas.

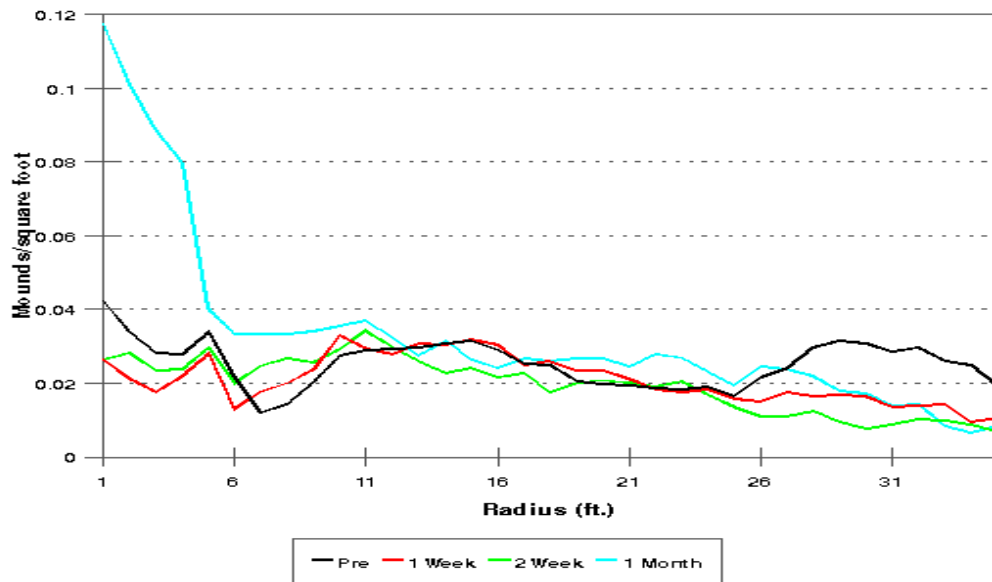


Figure 7. Moving average (3ft. on each size of each 1 ft. increment) of red imported fire ant mounds across 35 ft. radius circular plots receiving a *single center spot application* of 1.5 lbs. per acre of 1% granular hydramethylnon bait applied 12 September 1996, Brazos Co., Texas.

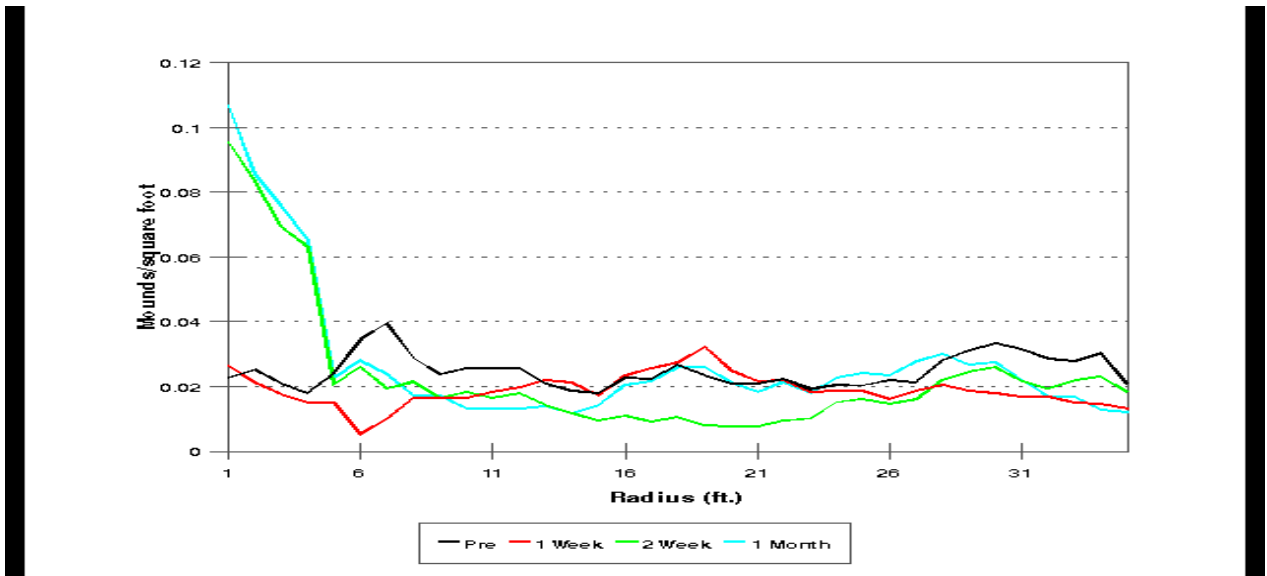


Figure 8. Moving average (3ft. on each size of each 1 ft. increment) of red imported fire ant mounds across 35 ft. radius circular plots receiving a *center spot application replenished weekly* (totalling 1.5 lbs. per acre) of 1% granular hydramethylnon bait, initiated 12 September 1996, Brazos Co., Texas.

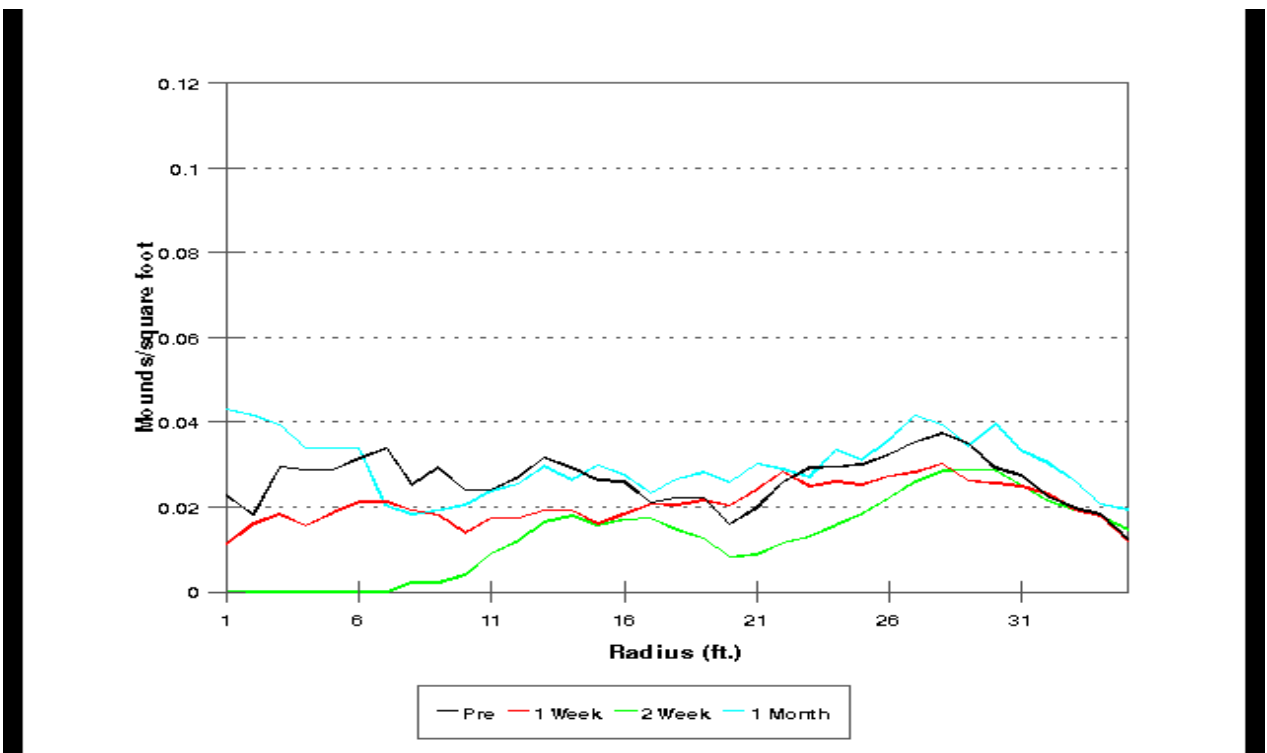


Figure 9. Moving average (3ft. on each size of each 1 ft. increment) of red imported fire ant mounds across 35 ft. radius circular plots receiving a *single center spot application* of 1.5 lbs. per acre of fenoxycarb bait (Award®) applied 12 September 1996, Brazos Co., Texas.

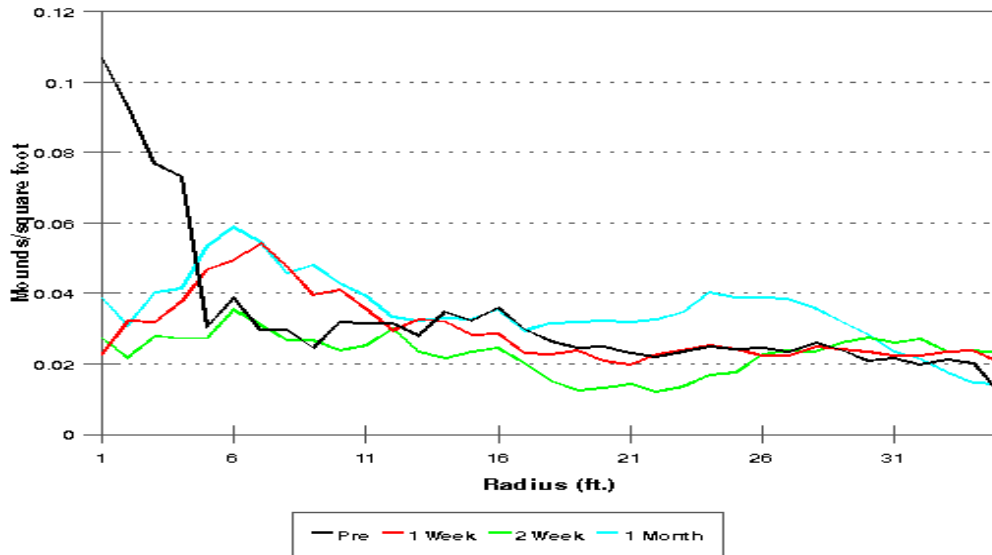


Figure 10. Moving average (3ft. on each size of each 1 ft. increment) of red imported fire ant mounds across 35 ft. radius circular plots receiving a *center spot application replenished weekly* (totalling 1.5 lbs. per acre) of fenoxycarb bait (Award®), initiated 12 September 1996, Brazos Co., Texas.

