

Evaluation of potential imported fire ant quarantine treatments for hay bales

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Abstract. This research evaluated the efficacy of broadcast insecticide bait applications in hay production systems on the number and time of red imported fire ant (*Solenopsis invicta* Buren) infestations in hay bales in treated versus untreated field plots. Our results indicate that with a single broadcast bait application of an insect metabolic inhibitor (Amdro®, hydramethylnon) the number of hay bales infested with fire ants was significantly lower in treated plots compared to untreated plots. Cumulation curves of the number of bales infested over time indicate that near peak infestation levels occur within the first week of post-baling.

Introduction

Red imported fire ants (*Solenopsis invicta* Buren) frequently move into or next to bales of hay that have been left in the field after harvesting and can interfere with cutting, baling, handling and transporting hay. Typically, red imported fire ants build large hard-packed mounds above the ground, which can damage harvesting machinery. As a result, hay producers have to adjust the cutting heights on their harvesting machinery to avoid damage by mounds, resulting in reduced yields and increased harvesting costs. The United States Department of Agriculture (USDA) has listed hay as a quarantined agricultural product. Currently, there are no USDA approved quarantine chemical treatments for assuring that red imported fire ants are not shipped to new locations. Hay bales that are not removed from fields immediately after baling and stored in an off-ground location can not be shipped out of quarantined areas. There is little data to document how quickly or to what extent fire ants move into hay bales left in the field. There are no insecticides registered specifically for treating hay bales to eliminate red imported fire ants. However, Amdro® (hydramethylnon; an insect metabolic inhibitor) is a bait-formulated insecticide product registered for use in hay fields and livestock pastures. Yet, there is no data to document if hay fields treated with insecticide bait products can reduce or prevent hay from being infested by fire ants. This information is essential for the Texas Department of Agriculture (TDA) and USDA to improve and/or expand quarantine treatment options for bales of hay and straw. The objective of this research was to evaluate the efficacy of broadcast insecticide bait applications in hay production systems on the number and time of fire ant infestations in hay bales in treated versus untreated field plots. The directional hypothesis to be tested is that broadcast bait treatments significantly reduce or eliminate ant-infested hay bales in the field.

Materials and Methods

Research was conducted May - July, 2000 in Montgomery County, Texas. Four hay fields (2 square bale and 2 round bale), of at least 15 acres in size, belonging to 3 independent hay

producers were used as replicate sites for this study. Each field was divided in half to make two plots of relatively equal size. One plot in each field was designated as an insecticide treatment plot, while the other plot was left untreated and used for ant infestation comparisons between treated and untreated areas.

To determine if there were any significant pretreatment differences in average ant densities between treated and untreated plots among fields, we counted the number of active mounds in 3 sampling circles (9.14 m radius) in each plot in May 2000. A two-tailed Wilcoxon non-parametric test showed that there was no significant differences in the mean number of active mounds between plots in all fields ($S = 149$, $Z = -0.02897$, $P = 0.9769$). The average number of active mounds per sampling circle was 20.8.

In each field, one plot was treated with a broadcast application of the insecticide bait product Amdro® (hydramethylnon), which is an insect metabolic inhibitor, to establish large areas where ants were suppressed or eliminated in May 2000. The broadcast insecticide application rate was 1.5 lbs. per acre as directed on the label. The smallest area treated in a field was 5 acres. We compared both round and square bale operations. In the round bale operations, four sets of hay bales comprised of five round bales per set were left in each plot after hay baling (5 bales x 4 sets x 2 plots per field = 40 round bales per field). In the square bale operations, four random sets of hay bales comprised of ten square bales per set were left in each plot after hay baling (10 bales x 4 sets x 2 plots per field = 80 square bales per field). Three locations on each hay bale were sampled for fire ants using 3 x 3 cm Olive oil-soaked bait cards (e.g., one card on two sides and one on the top). Sampling was conducted at four separate times after baling (1 - 3, 4 to 8, 9 to 11, and 12 or more days). The number of infested hay bales per set of bales was recorded for each sampling period. We used the total number of hay bales, per set of bales, infested with red imported fire ants after being in the field for 12+ days as our response variable. Due to the absence of normality in the data and the directionality of our hypothesis, we combined the data from both square and round bale operations into a single data set for a non-parametric test. We used a directional Wilcoxon rank sum test to test the hypothesis that broadcast bait treatments significantly reduce or eliminate infested bales in both square and round hay bale operations. Also, cumulation curves were generated to determine when (over time) and to what extent infestations occurred.

Results

Using a single treatment application, we were not able to eliminate fire ants from the hay production operation. However, results of the Wilcoxon rank sum test support our directional hypothesis that after a single broadcast application of the insect metabolic inhibitor, Amdro® (hydramethylnon), the number of infested hay bales in treated areas was significantly reduced compared to untreated areas (**Table 1**). Graphs of the number of hay bales infested over time in each treatment indicate that ants begin to move onto or into hay bales within the first day or so and that near peak infestation levels occur within the first week of post-baling (**Figure 1**).

Discussion

A single broadcast application of Amdro® in hay fields significantly reduced the level of hay bale infestations in treated areas. However, it did not eliminate the fire ant problem entirely.

This type of result suggests that not all colonies were eliminated in treated areas. Previous work has shown that periodic broadcast applications of fire ant baits provide roughly 90 percent suppression of ants when properly applied. Our results show that hay bales become infested within the first 1-3 days, reaching near peak infestation within a week. This infestation rate may be enhanced by mound and colony disturbance through normal harvesting and baling practices. Also, fire ants are known to move colonies next to upright-exposed structures for better colony thermoregulation and to escape localized flooding events. In the field, hay bales may provide a variety of microclimates which fire ants, and other arthropods find appealing; such as thermoregulation sites, flood refuges, moisture under bales during drought, and the presence of both shady and sunny areas along the sides. Given that we were not able to eliminate fire ants from our treatment plots we are encouraged by our initial results using a single application of Amdro®. Based on these significant results we are continuing studies to assess the long-term efficacy of broadcast bait applications in a repeated application program of treatment. Our goal is to develop reasonable treatments to assure shipment of ant-free hay bales from ant-infested to non-infested areas of the country.

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Table 1. Results of a Wilcoxon rank sum test comparing the mean number of hay bales, per set of bales, infested with red imported fire ants after 12+ days in insecticide treated versus untreated hay fields. N = sixteen sets of hay bales in each treated and untreated area, of these eight sets comprised ten square bales per set and eight sets comprised five round bales per set in each treated and untreated area.

Treatment	N	Score Sum	Score mean	Sample mean	S	Z	P > Z
Treated	16	172.5	10.7	2.4			
Untreated	16	355.5	22.2	6.7			
Test Statistic					355.5	3.47	0.00025

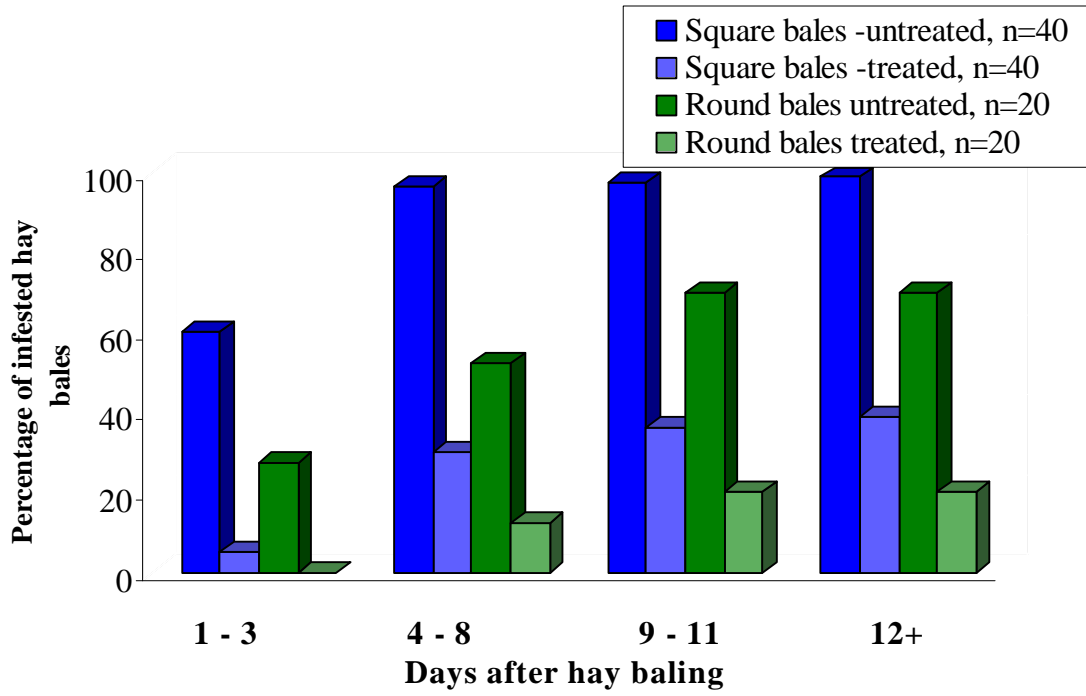


Fig. 1. Cumulation curve of ant infestation on hay bales after baling, Montgomery Co., TX, 2000.