Evaluation of Chemical Management of Fire Ants
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This is the first year in a project designed to determine the best method of chemical control of the red imported fire ant, *Solenopsis invicta* Buren, on Texas Army National Guard firing ranges. This project is an evaluation of commercially available fire ant baits that can be used in conjunction with biological control (which is being evaluated in another research project) to form an integrated pest management plan for control of the red imported fire ant. This project ran experimental tests using three commercially available baits: methoprene, an insect growth regulator or IGR (trade name Extinguish®); abemectin, a nerve-active toxicant (trade name Advance®); and hydramethylnon, a metabolic inhibitor toxicant (trade name Amdro®). To test these products, four National Guard sites were chosen, with differing climates and imported fire ant densities. Sites used were Camp Swift (near Bastrop), Fort Wolters (near Mineral Wells), Camp Bowie (near Brownwood), and Camp Maxey (near Powderly). At each site four test replications were conducted. Each replication included a toxicant, an insect growth regulator, and a control. At two of the sites, Camp Swift and Fort Wolters, treatments were made in the fall of 1998 and the spring of 1999. At the other two sites, treatments were made in the spring of 1999.

The goal of this project is to determine what type of bait is most effective at controlling the red imported fire ant on firing ranges. Another goal is to determine if the most environmentally safe control, should more than one product being tested be equal in control capability. The result of this test and evaluation will provide the Texas National Guard with an informed choice in managing red imported fire ants on firing ranges. A continuation of this project is designed to take into account the yearly differences in climate and how it effects control provided by these products.

Materials and Methods

At each of the four sites (Camp Swift, Camp Bowie, Camp Maxey, and Fort Wolters), 12 test plots were chosen on existing firing ranges. Plot size was approximately ¼ acre. The plots were established by selecting a center site and measuring out a radius of 60 feet to make a circular ¼ acre. These sites were chosen in blocks of three, each plot in the block being similar in fire ant density and each occurring on the same firing range. Four of these blocks made up the treatment sites at each National Guard location. Thus, there were a total of 48 treatment plots. Within each block, plots were randomly assigned a treatment of control, an insect growth regulator, and a toxic bait (Amdro® at two sites and Advance® at two sites).

Prior to treatment a census of fire ant colonies was made. To do so, all ant mounds were flagged, checked for activity, and all active mounds were counted. Treatments were then made at the maximum label rate. The rates applied were 1 lb./acre for Advance® (0.011% abamectin B1); 1 ½ lb./acre of Amdro® (0.73% hydramethylnon); and 1 ½ lb./acre Extinguish® (0.5% (S)-methoprene). Checks on fire ant activity and active mounds were made at regular intervals after the test and, at 16 weeks post application final counts of active mounds were made for that treatment. These final counts were used for comparison of bait efficacy. This time frame of determining when to evaluate the efficacy of the baits was chosen because of previous test results on these baits preformed by the Department of Entomology, Texas A&M University. These tests determined that nearly all of the control that would be provided by these baits would be complete in this time frame. Fall 1998 tests were conducted in October at Camp Swift and Fort Wolters. Spring tests were conducted in March and April at all four sites. Results of efficacy of treatments and comparisons of treatments were analyzed using t-tests and ANOVAs as appropriate.

Results

Camp Swift. Initial mound counts, before the fall treatment, on test plots ranged from 49 mounds to 101 mounds. This translates to a fire ant density of between 196 to 404 mounds/acre. In all bait treatments, fire ant mound density was significantly reduced ($P = < 0.001$). The untreated control mound density remained statistically the same ($P = 0.915$). However, the best control still left 6 percent of the fire ant mounds active. The reduction of fire ant mounds in bait treatments ranged from 94 to 63 percent. Mound densities of treatment areas ranged from 4 to 21 mounds per plot. Statistically, there was no difference between treatments of Advance® (abemectin) and Extinguish® (methoprene), but both were significantly lower than the control. In the spring of 1999, fire ant colonies within the same test plot had increased to nearly the levels of pretreatment in the fall. These new colonies were from new colony establishment and movement of existing colonies into the test plot area. The number of colonies at pre-treatment spring 1999 were lower than pre-treatment fall 1998, although not significantly different ($P = 0.271$). Colonies again were reduced in the spring after treatment, this time to densities ranging from 0 to 11 mounds per plot. While these numbers are numerically different, they are not significantly different ($P = 0.078$ and $P = 0.094$). Test results for Camp Swift are given in the following table:

Site	*Treatment*	*Fall 98*	*check 98*	*Spring 99*	*check 99*
1	*control*	*49*	*54*	*51*	*53*
2	*control*	*69*	*70*	*59*	*64*
3	*IGR*	*101*	*21*	*42*	*4*
4	*IGR*	*51*	*19*	*58*	*8*
5	*Advance®*	*88*	*12*	*72*	*11*
6	*Advance*	*77*	*14*	*45*	*7*
7	*IGR*	*50*	*3*	*7*	*0*
8	*Advance*	*63*	*6*	*22*	*1*
9	*control*	*72*	*67*	*41*	*58*
10	*Advance*	*53*	*4*	*28*	*1*
11	*IGR*	*58*	*7*	*22*	*2*
12	*control*	*58*	*66*	*54*	*61*

Fort Wolters. Initial mound counts, before the fall treatment, on test plots ranged from 6 mounds to 52 mounds. This translates to a fire ant density of between 24 to 208 mounds/acre. In all bait treatments, fire ant mound density was significantly reduced ($P = 0.01$ to $P = 0.03$). The control mound density remained statistically the same ($P = 0.985$). The best control eliminated fire ant mounds, but fire ant densities in some plots still existed up to 4 mounds per plot active. The reduction of fire ant mounds in bait treatments ranged from 100 to 88 percent. Mound densities of treatment areas ranged from 0 to 4 mounds per plot. Statistically, there was no difference between treatments of Amdro® (hydramethylnon) and Extinguish® (methoprene), but both were significantly lower than the control. In the spring of 1999, fire ant colonies within the same test plot had increased to nearly the levels of pretreatment in the fall. These new colonies were from new colony establishment and movement of existing colonies into the test plot area. The number of colonies at pretreatment spring 1999 were lower than pretreatment fall 1998, although not significantly different in the Extinguish® plots ($P = 0.374$), but were significantly lower in the Amdro® plots ($P = 0.141$). Colonies again were reduced in the spring after treatment, this time to densities ranging from 0 to 1 mound per plot, while controls were not significantly different. Test results for Camp Swift are given in the following table:

Site	***Treatment***	***Fall 98***	***check 98***	***Spring 99***	***check 99***
1	*Control*	*52*	*48*	*46*	*46*
2	*IGR*	*34*	*4*	*21*	*1*
3	*Amdro ®*	*43*	*2*	*18*	*1*
4	*Control*	*8*	*9*	*8*	*8*
5	*Amdro*	*6*	*0*	*4*	*0*
6	*IGR*	*8*	*0*	*4*	*0*
7	*Control*	*44*	*43*	*49*	*45*
8	*IGR*	*50*	*4*	*16*	*1*
9	*Amdro*	*21*	*2*	*11*	*0*
10	*Amdro*	*32*	*3*	*12*	*0*
11	*Control*	*30*	*33*	*36*	*37*
12	*IGR*	*27*	*1*	*14*	*0*

<u>Camp Bowie</u>. Initial mound counts, before the spring treatment, on test plots ranged from 42 mounds to 67 mounds. This translates to a fire ant density of between 168 to 268 mounds/acre. In all bait treatments, fire ant mound density was significantly reduced ($P = <0.0001$). The control mound density remained statistically the same ($P = 0.968$). The best control did not eliminate fire ant mounds, but reduced densities to a range of 8 to 13 mounds per plot. The reduction of fire ant mounds in bait treatments ranged from 84 to 77 percent. Statistically, there was no difference between treatments of Amdro® (hydramethylnon) and Extinguish® (methoprene), but both were significantly lower than the control. Test results for Camp Bowie are given in the following table:

Site	*treatment*	*Spring 99*	*check 99*
1	*IGR*	*54*	*9*
2	*Amdro ®*	*67*	*12*
3	*Control*	*63*	*66*
4	*IGR*	*56*	*12*
5	*Amdro*	*51*	*8*
6	*Control*	*60*	*57*
7	*IGR*	*56*	*13*
8	*Control*	*51*	*53*
9	*Amdro*	*57*	*9*
10	*Amdro*	*58*	*13*
11	*IGR*	*42*	*10*
12	*Control*	*47*	*44*

Camp Maxey. Initial mound counts, before the spring treatment, on test plots ranged from 6 mounds to 102 mounds. This translates to a fire ant density of between 24 to 408 mounds/acre. The fire ant mound density was significantly reduced ($P = 0.043$) in the Advance® treatment plots. The plots treated with Extinguish® were numerically reduced from a mean of 47 to a mean of 7 mounds per plot, however this reduction was not statistically different ($P = 0.062$). The control mound density remained statistically the same ($P = 1.000$). The best control did not eliminate fire ant mounds, but reduced densities to a range of 1 to 21 mounds per plot. The reduction of fire ant mounds in bait treatments ranged from 87 to 78 percent. Statistically, there was no difference between treatments of Advance® (abemectin) and Extinguish® (methoprene) ($P = 0.445$), but both were significantly lower than the control. Test results for Camp Maxey are given in the following table:

Site	*Treatment*	*Spring 99*	*check 99*
1	*IGR*	*8*	*1*
2	*Control*	*6*	*1*
3	*Advance®*	*12*	*13*
4	*Advance*	*46*	*8*
5	*IGR*	*49*	*11*
6	*Control*	*36*	*36*
7	*Advance*	*56*	*6*
8	*IGR*	*70*	*12*
9	*Control*	*63*	*57*
10	*Advance*	*79*	*14*
11	*IGR*	*102*	*21*
12	*Control*	*68*	*73*

Exact location of sites on specific firing ranges for all of the above data is available if needed. These plots will continued to be used as this project continues in coming years.

Discussion

Both treatment types reduced fire ant densities and, although there were slight differences in the treatments, all bait treatments appear to control fire ants at approximately the same level. One trend is evident, in that with high mound densities (such as densities above 200 mounds per acre) there are still a large number of ants that are not eliminated with these treatments. In high-density plots, approximately 80 percent of the mounds were eliminated, but 20 percent of the original number is still a large number of ants. If the mound density were exactly 200 mounds per acre (equal to 50 mounds in one of the test plots) and 20 percent were left after treatment, there would still be 40 mounds per acre. Since these mounds probably average over 100,000 ants per mound, this is a large number of ants (100,000 X 40 = 4 million) that can potentially sting troops using the firing ranges. The reason that larger numbers of ants are left in these high-density plots may be that there is simply not enough bait to effectively eliminate all the ants present. However, baits were applied at the maximum label rate. The solution here appears to be to in some way reduce numbers to lower densities by other means, such as biological controls and, then eliminate ants not affected by these biological controls with baits which would yield relatively fire ant free firing ranges. In plots where densities were low, densities were reduced to very low numbers of colonies, or in some cases completely eliminated. The other means to control these high densities of ants is to persuade companies to increase their legal maximum label rates. However, this option is undesirable because it means introducing larger amounts of chemicals into the environment.

One interesting result of this study is in the results of differences between a one time treatment such as the first fall treatment at Camp Swift and Fort Wolters and follow-up treatments, as occurred at Camp Swift and Fort Wolters in the spring. In the situations where a later, follow-up treatment was made, ant density was below the original starting point (although only statistically different at Fort Wolters). This lower starting point allowed for ants to be reduced further with the second treatment than had been observed in the initial treatment. A continued treatment program may reduce these even further and make it possible to essentially eliminate ant colonies for at least some time between treatments. However, as long as there are other ant populations in the vicinity, fire ants will continue to move back into the treated area and, baits have no residual effect to keep these new intruders out.

One drawback of the broadcast treatment regime described above is that not only are fire ants eliminated, but other ants are also eliminated. These baits are essentially attractive to most ants and since native ant species are almost always in fewer densities, it is much easier to eliminate them. When all ants are eliminated from an area surrounded by fire ant infestation, it is the fire ants that are able to more easily re-establish in the ant free area, and in doing so, to exclude other ant species. The red imported fire ant appears to be the master of the ant world in taking over disturbed habitat. The result of this is that a management program must be continued or fire ants will become established at even higher densities than before the treatment regime.

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