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LARGE AREA TESTS OF AC-217,300 BAIT FOR CONTROL OF IMPORTED FIRE ANTS[1/] IN ALABAMA, LOUISIANA, AND TEXAS[2/]

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ABSTRACT

The amidinohydrazone, American Cyanamid Co. compound AC-217,300 was tested in 40.5-ha plots in Alabama, Louisiana, and Texas in 1979 for control of the red imported fire ant, Solenopsis invicta Buren. When the material was applied in the spring at a rate of 14.7 g AI/ha in a defatted corn grit formulation, it produced an average reduction of about 90% in the populations of the ant.

INTRODUCTION

Registrations for bait containing mirex, which was used for area-wide control of the red and black imported fire ants (IFA), Solenopsis invicta Buren and Solenopsis richteri Forel, respectively (Lofgren et al. 1964, Banks et al. 1973) were cancelled in 1978. This cancellation left no chemical available for such programs. However, Williams et al. (1980) reported that American Cyanamid Co. compound AC-217,300 (tetrahydro-5,5-dimethyl 2(1H)-pyrimidinone [3-[4-(trifluoromethyl)phenyl]-1-[2-[4-(trifluoromethyl)phenyl]ethenyl]-2-propenylidene] hydrazone) was very effective against laboratory colonies of red imported fire ants (RIFA). Banks et al. (1981) therefore tested AC-217,300 against RIFA in small field plots (1.21-2.02 ha, 3-5 acres) and reported that the toxicant appeared promising in the field. However, additional research was needed to find the best carrier and formulation and a better method of evaluating queen mortality and IFA density. We report here on large-scale tests conducted in 1979 to obtain additional information about the effect of this toxicant against RIFA.

MATERIALS AND METHODS

The tests were conducted in areas of Alabama, Louisiana, and Texas known to have infestations of RIFA. Baits were formulated by American Cyanamid Co. by dissolving 2.5% (by weight) AC-217,300 in once-refined soybean oil-cosolvent, which was impregnated onto pregelled defatted corn grits, pregelled degermed corn grits, or extruded corn pellets (30% by weight) to produce baits containing 0.75% active ingredient. The 2 pregelled carriers were 12-30 mesh and the extruded corn pellets were 6-10 mesh.

Treatment and check plots at all 3 locations were ca. 40.5 ha (100 acres). Pretreatment and 8-and 22-wk posttreatment evaluations were conducted. Circular 0.2 ha (0.49 acre) count areas (replications) were established in each plot so a

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1/ Hymenoptera: Formicidae.
2/ This paper reflects the results of research only. Mention of a pesticide or a commercial or proprietary product does not constitute a recommendation or an endorsement by the USDA, nor does it imply registration under FIFRA as amended.
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minimum of 250 active IFA colonies were included in each treatment. The entire area inside the circle was examined for IFA nests and each nest on every plot was opened with a spade and examined for the presence of live ants and any nest containing 20 or more live ants was considered active. The % control was determined by comparing the number of active nests at the posttreatment interval with the number pretreatment. In addition, a population index was calculated because Banks et al. (1981) had found that % reduction of nests was not entirely a satisfactory method for evaluating this chemical. This new procedure was based on the fact that Williams et al. (1980), in laboratory studies, discovered that AC-217, 300 was effective in killing the colony queen even though it did not always kill the entire worker ant population in large colonies. Since normal colonies should contain worker brood during the warm periods of the year and since the absence of worker brood is strong evidence that the colony does not contain a queen, we also evaluated the colonies according to the number of worker ants and the presence or absence of worker brood and assigned each colony to a class as follows.

	Colony classes	
No. worker ants	Without worker brood	With worker brood
<100	1	6
100 - 1000	2	7
1000 - 10000	3	8
10000 - 50000	4	9
>50000	5	10

The interaction of population density and colony class was then used to establish a population index that can be expressed mathematically by

$$\text{Population index (PI)} = \sum_{K=1}^{10} K(N_k)$$

Where N_k = the number of ant colonies in a given area comprised of colony classes having the value of K, where $(10 \geq K \geq 1)$

Louisiana Test. The test in Louisiana was conducted in the southeastern part of the state near Bogalusa in a 2-to 3-year old pine forest. Seven treatment blocks and a check were used. Defatted corn grits bait or degermed corn grits bait each containing 0.75% AC-217,300 were applied at rates of 0.84, 1.4, or 1.96 kg/ha (0.75, 1.25 and 1.75 lb/acre); extruded corn pellet bait, also containing 0.75% AC-217,300, was applied at a rate of 1.4 kg/ha. Treatments were applied May 31-June 1 by a USDA, APHIS Cessna Ag Truck® flown at 192 km/hr at 9.1-m altitude; effective swath width was 18.2 m. A custom built spreader was used.

Alabama Test. The test in Alabama was conducted in the southeast near Florala in a 2-to 3-year-old pine forest. Treatments were the same as in the Louisiana test and were applied June 4 with the same airplane.

Texas Test. The test in Texas was conducted in the southeast near Beaumont on nongrazed pasture land. Six treatment blocks and a check were used. Baits formulated on defatted corn grits or on degermed corn grits were applied at rates of 0.84, 1.4, or 1.96 kg/ha. The treatments were applied July 17-18 by a commercial applicator using a Stearman biplane equipped with a Transland TSLA 4017 spreader. The aircraft operated at 160 km/hr at an altitude of 15.2 m; swath spacing was 21.3 m.

RESULTS AND DISCUSSION

Louisiana Test. In Louisiana, the greatest reduction (87.2%) in number of active nests at 22 wk posttreatment occurred in the plot treated with defatted corn grits bait at 1.4 kg/ha (Table 1). This was significantly higher than all treatments except the 1.4 kg/ha rate of degermed corn and the 1.96 kg/ha of defatted corn bait; the reduction was considerably higher (11-14%) than with these two, although the difference was not significant. The high check mortality (38%) may have been due to a number of factors, but was most likely due to extremely dry weather.

We found that the reduction in the population index at 22 wk was a better indicator of the effectiveness of the treatment, but the index also showed that defatted corn at 1.4 kg/ha was the most effective treatment (95.4% reduction). Some plots contained small new colonies at the time of the 22-wk evaluation, presumably reinfestations from newly-mated queens flying into the plots. Therefore, the class 6 and 7 colonies (classes assigned to this type of colony) were omitted in computing the % reduction in number of active nests and in calculating the population index.

Alabama Test. In Alabama, AC-217,300 on defatted corn applied at a rate of 1.96 kg/ha caused the greatest reduction in number of active nests after 22 wk (Table 2), but the difference was not always significant. The check mortality was much lower in Alabama (4.5%) than in Louisiana and was closer to the normal situation. Also, the reduction in the population index at 22 wk was greatest for the 1.96 kg/ha defatted corn treatment. However, the difference was only significant for 1 treatment, 1.4 kg/ha defatted corn.

Texas Test. In Texas, as in Alabama, defatted corn baits at 1.96 kg/ha caused the greatest reduction in the number of active nests and in the population index (Table 3). However, there was no significant difference between treatments; all produced more than 80% (range 80.3-96.5) reduction in the number of active nests and more than 89% (range 89.1-97.8) reduction in the population index. (Two of the treatments were not evaluated at 8 wk because of the threat of Hurricane Frederic to the Gulf Coast).

The results did not show any difference in the 2 carriers when all rates used in the 3 states were combined (Table 4); both reduced the number of active nests. However, when the individual rates of application were considered, the 2 rates of degermed corn were equal in effectiveness to the high rate 1.96 kg/ha of defatted corn, and these 3 treatments were superior to the other 3 treatments (puffed corn was applied in only 2 tests so it is excluded) all of which were about equal in effectiveness. Although the differences may result from factors other than carrier and the combined data do not show apparent differences in the carriers, data from the individual tests (Tables 1-3) do indicate a slight superiority for the defatted corn grit formulation. Also the mean % reduction in number of mounds after 22 wk (Table 4) shows a dosage response for the defatted corn carrier; the higher rate was significantly more effective than the 2 lower rates. Likewise combined data showed a mean reduction in the population indices of 85.5 and 84.9% for the defatted and degermed corn grit formulation, respectively.

The reductions obtained in the Texas test (Table 3) were consistently higher than the reductions in Louisiana and Alabama. The principal difference among the 3 locations was that the Texas land was in pasture and the others were in small pine trees and brush.

The population index was useful in evaluating AC-217,300 since it reflected the actual reduction in number of IFA more accurately. The fact that these values usually average 5-10% higher than the % reduction in number of active nests confirms the previous reports (Williams et al. 1980, Banks et al. 1981) that AC-217,300 is very effective in killing the colony queen though it may not always kill the entire colony.

TABLE 1. Effectiveness of AC-217,300 Against Red Imported Fire Ants. Louisiana 1979

Bait	Rate of application: Bulk bait kg/ha	Rate of application: Toxicant g/ha	Mean no. of nests/ha: Pretreat	Mean % reduction in no. of active nests[a/][b/] after indicated wk: 8	Mean % reduction in no. of active nests[a/][b/] after indicated wk: 22[c/]	Mean % reduction in population index[b/] after indicated wk: 8	Mean % reduction in population index[b/] after indicated wk: 22[c/]
Defatted corn	1.40	10.5	77	91.7 a	87.2 a	96.0 a	95.4 a
Degermed corn	1.40	10.5	56	91.7 a	76.2 ab	96.4 a	89.1 ab
Defatted corn	1.96	14.7	98	82.7 a	73.1 ab	92.6 ab	89.0 ab
Defatted corn	0.84	6.3	82	59.8 b	70.4 b	85.8 bc	85.0 b
Puffed corn	1.40	10.5	102	52.3 b	65.4 b	74.8 d	84.0 bc
Degermed corn	1.96	14.7	93	62.7 b	61.1 b	80.7 cd	80.1 bc
Degermed corn	.84	6.3	100	64.6 c	45.4 c	83.9 cd	75.8 c
Check	-	-	98	0(39.6) c	0(38.0) d	38.8 e	40.6 d

a/ Data corrected for check mortality by Abbott's formula; figures in parentheses indicate check mortality before correction.
b/ Means not followed by the same letter are significantly different at the 5% level of confidence based on Duncan's multiple range test.
c/ Some plots contained small new colonies at time of 22-wk evaluation. These were considered to be reinfestations from newly-mated queens flying into the plots; therefore the 6's and 7's were omitted in computing % reduction. See text for method of deriving population index.

TABLE 2. Effectiveness of AC-217,300 Against Red Imported Fire Ants. Alabama 1979

Bait	Rate of application: Bulk bait kg/ha	Rate of application: Toxicant g/ha	Mean no. of nests/ha: Pretreat	Mean % reduction in no. of active nests[a/][b/] after indicated wk: 8	Mean % reduction in no. of active nests[a/][b/] after indicated wk: 22[c/]	Mean % reduction in population index[b/] after indicated wk: 8	Mean % reduction in population index[b/] after indicated wk: 22[c/]
Defatted corn	1.96	14.7	59	85.0 a	85.5 a	91.3 ab	90.6 a
Puffed corn	1.40	10.5	41	83.9 a	80.5 ab	92.8 a	89.0 a
Degermed corn	1.96	14.7	63	75.0 ab	77.3 ab	85.5 abc	85.7 a
Degermed corn	1.40	10.5	66	74.9 ab	77.2 ab	86.1 abc	84.6 a
Degermed corn	0.84	6.3	66	63.1 b	71.8 ab	80.0 c	81.9 a
Defatted corn	0.84	6.3	63	70.3 b	69.2 bc	82.9 bc	81.1 a
Defatted corn	1.40	10.5	57	67.1 c	47.1 c	83.1 bc	62.9 b
Check	-	-	67	0(6.9) c	0(4.5) d	9.2 d	3.2 c

a/ Data corrected for check mortality by Abbott's formula; figures in parentheses indicate check mortality before correction.
b/ Means not followed by the same letter are significantly different at the 5% level of confidence based on Duncan's multiple range test.
c/ See Table 1 for explanation.

TABLE 3. Effectiveness of AC-217,300 Against Red Imported Fire Ants. Texas 1979

Bait	Rate of application: Bulk bait kg/ha	Rate of application: Toxicant g/ha	Mean no. of nests/ha: Pretreat	Mean % reduction in no. of active nests[a/][b/] after indicated wk: 8	Mean % reduction in no. of active nests[a/][b/] after indicated wk: 22[c/]	Mean % reduction in population index[b/] after indicated wk: 8	Mean % reduction in population index[b/] after indicated wk: 22[c/]
Defatted corn	1.96	14.7	147	85.2 a	96.5 a	94.8 a	97.8 a
Defatted corn	0.84	6.3	105	d	93.0 a	d	97.4 a
Degermed corn	0.84	6.3	94	d	85.8 a	d	91.2 a
Degermed corn	1.96	14.7	83	22.4 bc	85.1 a	73.4 b	91.1 a
Degermed corn	1.40	10.5	95	61.9 a	80.8 a	88.6 a	89.1 a
Defatted corn	1.40	10.5	106	50.3 ab	80.3 a	87.4 a	91.6 a
Check	-	-	103	0(39.2) c	0(20.1) b	46.6 c	8.1 b

a/ Data corrected for check mortality by Abbott's formula; check values in parentheses indicate mortality before correction.
b/ Means not followed by the same letter are significantly different at the 5% level of confidence based on Duncan's multiple range test.
c/ See Table 1 for explanation.
d/ No data due to Hurricane Frederic's disruption of work.

TABLE 4. Comparison of Effectiveness of Rates of Application and Carriers for AC-217,300 in Alabama, Louisiana and Texas. 1979

Formulation or rate kg/ha	Mean % reduction in no. active nests after indicated wk		Mean % reduction in population index after indicated wk	
	8	22	8	22
		Defatted corn		
1.96	88.5 a	87.6 a	91.8 a	91.6 a
1.40	79.9 a	78.1 b	88.4 ab	84.9 ab
0.84	73.8 b	73.6 b	84.1 b	82.1 b
		Degermed corn		
1.40	86.3 a	83.0 a	91.5 a	87.8 a
1.96	77.0 b	80.6 a	83.5 b	85.8 ab
0.84	71.4 b	73.6 b	81.6 b	81.5 b
		Carrier		
Defatted corn	79.0 a	78.8 a	87.2 a	85.5 a
Degermed corn	77.3 a	78.8 a	85.1 a	84.9 a

a/ Data corrected for check mortality by Abbott's formula.
b/ Means in the same column not followed by the same letter are significantly different at the 5% level of confidence based on Duncan's multiple range test.

A spring application of AC-217,300 in a defatted corn formulation at a rate of 1.96 kg/ha (14.7 g AI) should reduce IFA populations by ca. 90%. Reduced control can be expected with lower rates, e.g., 80% at 1.4 kg/ha, but the cost-benefit ratio of the lower rate may be more favorable.

A conditional registration has been granted to the American Cyanamid Co. by the EPA for a bait formulation containing AC-217,300 under the trade name Amdro^{R}.

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