1979 LABORATORY REPORT

GULFPORT METHODS DEVELOPMENT CENTER
IMPORTED FIRE ANT STATION

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE PROGRAMS

3505 - 25th AVENUE
GULFPORT, MISSISSIPPI

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Prepared January 1980

By

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These reports were assembled for the information of USDA,APHIS, PPQ personnel and key personnel in other agencies engaged in imported fire ant programs. Statements in some instances are based on preliminary, unconfirmed or uncompleted experiments or observations; therefore, information contained herein should not be cited without prior written approval.

Results of insecticide tests are reported here. Mention of trade names or proprietary products does not constitute an endorsement or recommendation by the USDA.

S T A F F

Imported Fire Ant Station

Gulfport Methods Development Center

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I. INTRODUCTION

Resources expended by this laboratory on the imported fire ant program during 1979 can be divided into two basic areas of endeavor:

(1) The development of alternate regulatory or quarantine treatments to replace chlordane.

(2) The development of effective yet environmentally acceptable toxic baits which can be used in area-wide suppression programs.

Fortunately, some progress has been made in both of these areas. As reported in last year's Annual Report, commercial formulations of Dursban (chlorpyrifos) seem to meet the necessary criteria for a quarantine treatment for nursery potting media. Meanwhile, a bait toxicant known as American Cyanamid AC-217,300 offers more promise than any one of over 5000 other compounds tested by various State and Federal Agencies as a replacement for mirex.

II. SUMMARY

A. ~~Field tests with~~ American Cyanamid AC-217,300:

Field trials were conducted in Texas, Louisiana, Mississippi and Alabama on 100 acre test plots with a wide range of experimental rates and formulations of AC-217,300. Reasonably good results were achieved with one or more treatments at each test site. However, the results were quite variable and indicate that a good dose response to the toxicant does not exhist. Consequently, no clear distinction among rates of application can be easily drawn.

B. Ferriamicide ~~shelf life~~ studies:

Four experimental formulations of ferriamicide were stored at temperatures ranging from 4 to 50°c and periodically bioassayed against captive ant colonies for feeding acceptance. Storage at high temperatures was detrimental to shelf life of all formulations. At moderate temperature (21°c), formulation code AANSBV and NAASBV were attractive fcr 45 days; while BNSVAA and SVAABN remained attractive for 7 and 4 months respectively.

C. Development ~~of~~ Quarantine Treatments:

1. Nursery potting ~~soil~~ - Granular formulations of candidate insecticides were blended into potting media, stored outdoors, and periodically bioassayed against fragmented ant colonies. Most compounds tested did not afford the residual activity required of a practical IFA quarantine treatment. However, Dursban, Amaze, Akton, Ciba Geigy CGA 4-803 and CGA 4-811 demonstrated sufficient residual activity to suggest that these compounds could be sutstituted for chlordane. Based on this data, Dow Chemical Company obtained registration of a 5% granular formulation of Dursban (FA-5) for IFA quarantine treatments.

2. Phytotoxicity trials with potting media treated with Dursban 15-G

Twenty-five vegetable and flower cultivars and 18 varieties of woody ornamentals were germinated and grown or transplanted into potting media containing various rates of Dursban 15G. Phytotoxicity to vegetable and flower cultivars did not occur at rates which represent 1, 2, and 3X the dosage required for imported fire ant quarantine treatments, but a 10X rate reduced emergence, delayed germination, and produced deleterious effects on each cultivar tested. None of the Dursban treatments caused damage to any of the woody ornamentals under study.

3. Field evaluation of slow release Dursban formulations

Trials are underway to compare soil residual activity of Dursban 15G, Oftanol, and Dursban 10CR. In previous tests against mosquito larva in open drainage ditches, 10CR has pro- provided up to 12 months control at relatively low rates. Results of the IFA tests are incomplete at the present time.

4. Root dip treatments for balled and burlapped plants

Various concentrations of Dursban and Amaze solutions were evaluated for control of Alate IFA queens infesting root balls of balled and burlapped and container grown plants. Dursban was found to be highly effective and was subsequently registered for this use by the Dow Chemical Company. Amaze was shown to be somewhat less effective. Phytotoxicity observations suggest little or no problems result from these dip treatments.

D. Contracts with industry to develop IFA control technology:

Herculite Products Inc. was awarded an $80,891 contract to develop formulations of pesticides which will extend their residual activity in order to achieve effective quarantine treatments for grass sod and/or field grown ornamental plants.

Southern Research Institute received a $99,704 contract to develop technology related to controlled-release pesticides in baits to control imported fire ants.

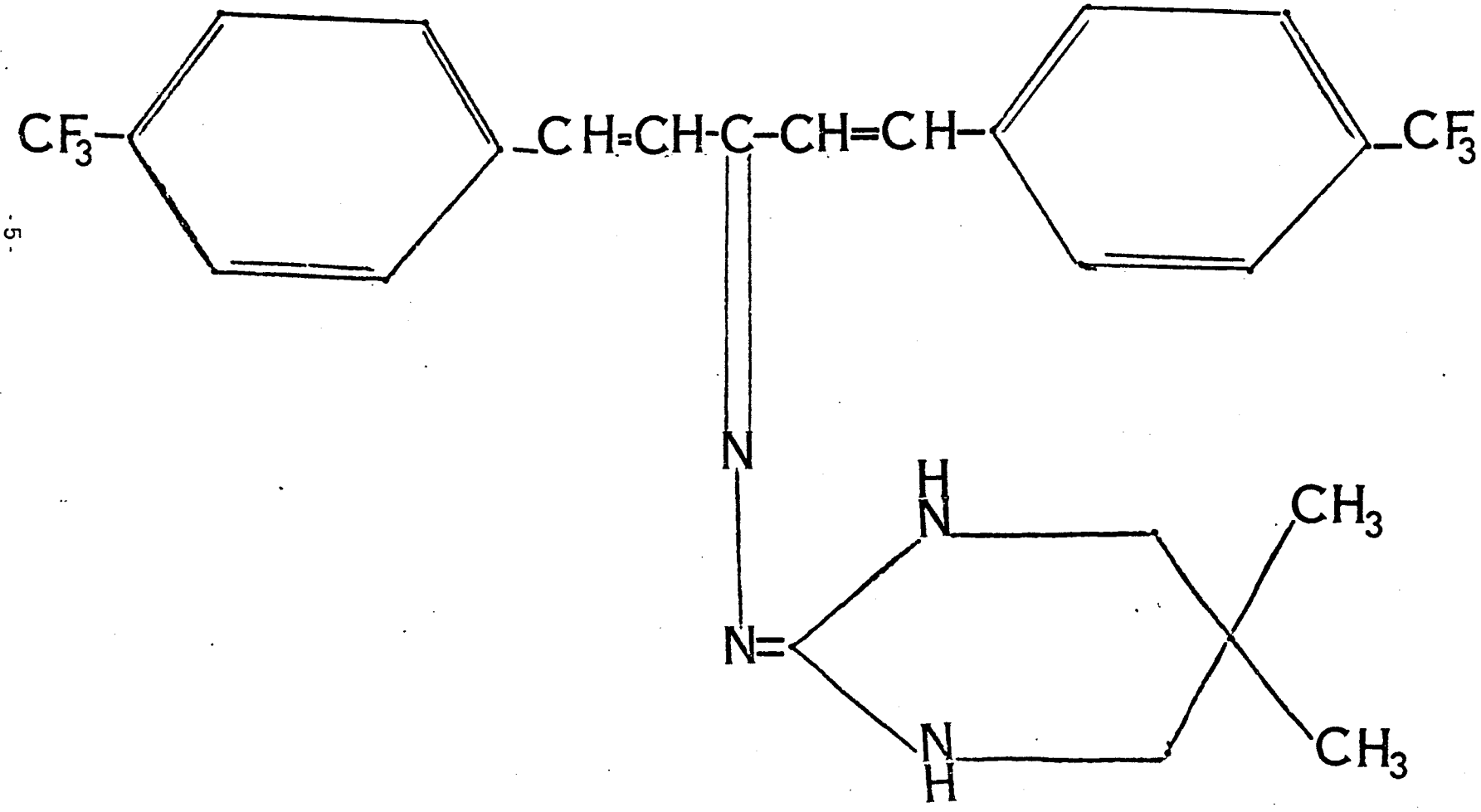
III· 1979 FIELD TESTS with American Cyanamid AC-217,300 Bait Toxicant

A. Introduction: Small plot field trials conducted by this laboratory as well as both SEA, AR Imported Fire Ant Laboratories in 1978 showed that the bait toxicant AC–217,300 offered good potential for control of imported fire ants. Testing and development of this compound was expanded in 1979 to include aerial application (both helicopter and fixed wing aircraft) to test plots ranging in size from 10 to 640 acres. AC–217,300 is being developed by the American Cyanamid Company, Princeton, New Jersey. According to information provided by this company, AC–217,300 belongs to a class of compounds known as Hydrozones. Structure and chemical designation for AC–217,300 are shown in Figure 1.

All field tests initiated in 1979 and reported here were conducted jointly by this laboratory, SEA,AR and the respective Departments of Agriculture in the states of Texas, Louisiana, Mississippi, and Alabama. Tests conducted during the spring were conducted under an experimental use permit which restricted bait application to non–cropland such as cut–over timberland, roadsides, etc. The heavy vegetation encountered in such areas undoubtedly increased experimental error associated with mound counts.

Figure 1. Structure of American Cyanamid AC-217,300

2(1H)-Pyrimidinone, tetrahydro-5,5-dimethyl-, [3-[4-(trifluoromethyl)phenyl]-1-[2-[4-(trifluoromethyl)phenyl]ethenyl]-2-propenylidene]hydrazone



B. Methods and Procedures:

Test I - Test I was conducted in southeast Louisiana near Bogalusa in a newly re-planted pine forest owned by the Crown Zellerbach Corp. A total of nine treatments were applied by PPQ aircraft (Cessna Ag Truck [R]) on May 31 and June 1, 1979. This airplane was equipped with a specially designed bait spreader which was constructed by PPQ Aircraft Operations. Prior experience with the various carriers utilized in this test had shown that they could not be applied with standard commercial spreaders.

The aircraft was operated at 120 mph at an altitude of 30 feet. This provided a working swath of 60 feet. All test plots were 100 acres in size. Efficacy data was collected by counting the number of active ant colonies in 1/2 acre subplots prior to and at 8 and 22 weeks posttreatment. The number of subplots per treatment varied according to population density. However, a minimum of 250 colonies per treatment were counted and classified on a 1 to 10 scale. This system of categorizing colonies into various classes was developed following observations in previous tests in which this toxicant often killed the queen and/or large numbers of workers but failed to provide 100% kill of all life forms in a colony. We have noted that when a majority of the workers in a colony are killed and/or reproduction stops, the remaining workers do not maintain their mound or typical agressive behavior. Since man's contact with fire ants is primarily through disturbance of active, agressive colonies, partial control may provide relief in some instances.

The classification sytem used to categorize colonies was as follows:

Estimated worker Population	Status of Worker Brood	Colony Class
<100	absent	1
100-1000	absent	2
1000-10,000	absent	3
10,000-50,000	absent	4
$>50,000$	absent	5
<100	present	6
100-1000	present	7
1000-10,000	present	8
10,000-50,000	present	9
$>50,000$	present	10

Quite obviously a fire ant population comprised of predominantly Class 10 colonies with a population density of 50 colonies per acre represents a far greater threat and nuisance to man than would a population comprised of predominantly Class 6 colonies with a population density of 10 colonies per acre. This interaction of population density and colony class (or relative size) can be defined as the population index, and can be expressed mathematically by the following formula:

$$\text{Population Index} = \sum_{k=1}^{10} K(N_k)$$

Where N_k = the number of ant colonies in a given area comprised of colony classes having the value of K

Where $(10 \geq K \geq 1)$. Colony classes are further defined above.

Changes in the population index can thus be used to measure the effects of a pesticide on natural infestations of the ant.

In addition to changes in the population index, the percent mortality of active ant colonies was used to evaluate AC-217,300. Therefore, all data tables reported herein reflect both population index changes as well as percent mortality figures.

Composition and rate of application of the experimental bait formulations evaluated in Test I are listed in Table 1.

Test II - Test II was conducted in a newly re-planted pine forest near Florala, Alabama. The same equipment and method of evaluation described in Test I were used to evaluate the 9 experimental treatments listed in Table 2. Date of application was June 4 and 5, 1979. Each experimental treatment was applied to 100 acre test plots.

Test III - Test III was conducted near Monticello, Miss., on June 21, 1979. A helicopter owned by Miss. Dept. of Agriculture and Commerce (MACFA) was used to apply the 11 experimental treatments listed in Table 3. Plot size was 10 acres.

Test IV. Test IV was conducted near Baxterville, Miss. in cut-over timberland. Plots were 10 acres in size and were treated with State-owned helicopter on June 22, 1979. Bait formulations evaluated in this test are listed in Table 4.

Table 1. AC-217,300 bait formulations evaluated at Bogalusa, La. Spring 1979.

Plot No.	Bait Formulation			Rate/acre	
	Carrier	% SBO	% AI	Bulk (lbs)	AI (grams)
1.	De-germed corn	30	.75	1.56	5.3
2.	Puffed corn	30	.75	2.40	8.2
3.	De-germed corn	30	.75	.78	2.6
4.	De-germed corn	30	.75	.78	2.6
5.	De-fatted corn	30	.75	1.63	5.5
6.	De-fatted corn	30	.75	.77	2.6
7.	De-fatted corn	30	.75	.77	2.6
8.	De-fatted corn	30	.75	1.21	4.1
9.	De-germed corn	30	.75	1.83	6.2
10.	Untreated check				

Table 2. AC-217,300 bait formulation evaluated at Florala, Ala. Spring 1979.

Plot No.	Bait Formulation			Rate/acre	
	Carrier	% SBO	% AI	Bulk (lbs)	AI (grams)
1.	De-fatted corn	30	.75	.75	2.5
2.	De-fatted corn	30	.75	.75	2.5
3.	De-fatted corn	30	.75	1.88	6.4
4.	De-germed corn	30	.75	.94	3.2
5.	De-germed corn	30	.75	.94	3.2
6.	De-germed corn	30	.75	1.99	6.7
7.	De-fatted corn	30	.75	1.00	3.4
8.	De-germed co rn	30	.75	1.88	6.4
9.	Puffed corn	30	.75	1.12	3.8
10.	Untreated check				

Table 3. AC-217,300 bait formulations evaluated at Monticello, Miss. Spring 1979

Plot No.	Bait Formulation			Rate/acre	
	Carrier	% SBO	% AI	Bulk (lbs)	AI (grams)
1.	Puffed corn	30	.75	1.24	4.2
2.	De-germed co rn	30	.75	1.55	5.3
3.	Cob-grits	30	.75	2.52	8.5
4.	De-germed corn	30	.75	.85	2.9
5.	De-germed corn	30	.75	.85	2.9
6.	De-fatted corn	30	.75	.72	2.4
7.	De-fatted corn	30	.75	.72	2.4
8.	Cob grits	30	.75	2.50	8.5
9.	De-fatted corn	30	.75	1.35	4.6
10.	De-fatted corn	30	.75	2.50	8.5
11.	De-germed corn	30	.75	2.12	7.2
12.	Untreated check				

Table 4. AC-217,300 bait formulations evaluated at Baxterville, Miss. Spring 1979.

Plot No.	Bait Formulation			Rate/acre	
	Carrier	% SBO	% AI	Bulk (lbs)	AI (grams)
1	De-fatted corn	30	.75	.93	3.1
2.	De-fatted corn	30	.75	1.35	4.6
3.	De-germed corn	30	.75	1.47	5.0
4.	De-fatted corn	30	.75	2.17	7.4
5.	De-fatted corn	30	.75	2.27	7.7
6.	De-fatted corn	30	.75	1.16	3.9
7.	De-germed corn	30	.75	1.68	5.7
8.	De-fatted corn	30	.75	.73	2.5
9.	De-fatted corn	30	.75	.73	2.5
10.	Untreated check				

Test V. Test V was conducted near Beaumont, Texas, in ungrazed pasture land. Plots ranged in size from 81.5 to 103.3 acres. The 8 experimental treatments evaluated in this test are shown in Table 5. Equipment used to apply these treatments was owned by M & M Flying Service, Beaumont, Texas. Aircraft specifications were as follows: (1) Steerman aircraft equipped with spreader modified with ram air system designed by PPQ Aircraft Operations, (2) 70 foot working swath, (3) operated at 100 mph at an altitude of 50 feet.

Test VI. Test VI was conducted near Selma, Alabama, on pasture land. This test was initiated subsequent to American Cyanamid acquiring an experimental use permit allowing application to this type of habitat. The two experimental formulations listed in Table 6 were applied to 640-acre test plots. On October 20 and 21,1979. The aircraft described in Test I was also used in this test.

This test differed from all previous trials in two important respects (1) The bait formulation used in this test consisted of 20% soybean oil instead of the 30% formulations described earlier. American Cyanamid opted for this change in formulation in an attemp to minimize problems with flowability and adherence to surfaces of application equipment.

(2) Test plots were located in well grazed pastures instead of the cut-over timberland and re-forested acres described in Tests I - V. A total of thirty 1/4-acre subplots were established in each test plot. All ant colonies within each 1/4-acre subplot were counted and classified prior to treatment and 8 weeks following treatment. Subsequent evaluations were postponed until March 1980 since cold weather precludes evaluation of insecticidal treatments.

Table 5. AC-217,300 bait formulations evaluated at Beaumont, Tex. Spring 1979

Plot No.	Bait Formulation			Rate/acre	
	Carrier	% SBO	% AI	Bulk (lbs)	AI (grams)
1.	De-fatted corn	30	.75	1.27	4.3
2.	De-fatted corn	30	.75	.57	1.9
3.	De-germed corn	30	.75	1.27	4.3
4.	De-germed corn	30	.75	.71	2.4
5.	De-fatted corn	30	.75	1.22	4.1
6	De-fatted corn	30	.75	1.33	4.5
7.	De-germed corn	30	.75	1.50	5.1
8.	De-germed corn	30	.75	1.36	4.6
9.	Untreated check				

Table 6. AC-217,300 bait formulations evaluated at Selma, Alabama
Fall 1979

Plot No.	Bait Formulation			Rate/acre	
	Carrier	% SBO	% AI	Bulk (lbs)	AI (grams)
1.	De-fatted corn	20	.5	.46	1.0
2.	De-fatted corn	20	.5	1.25	2.8
3.	Untreated check	-			

C. Results and Discussion

Results of all tests conducted in the spring utlizing formulations containing 30% soybean oil applied to non-cropland habitats are presented in Tables 7 through 11. The degree of control (% mortality) obtained in these five tests actually varied from 0 to 100%. However, both of these extremes were obtained in the Monticello, Miss. test and should be regarded with due caution since the untreated check mortality soared to 71 and 76% at 8 and 22 weeks respectively in this particular test. Fortunately this occurance was not experienced in the other tests.

When considered collectively, the data from all sites involved in the 1979 spring program indicates that a good dose response to the toxicant AC-217,300 does not exist. Consequently no clear distinction among rates of application (both in terms of bulk or AI) can be easily drawn. In general, however, reasonably good results were achieved with one or more treatments at each test site.

Differences among the 3 carriers are more clearly evident as shown in Table 12 . These data indicate that defatted corn performed slightly better than the other two carriers under trial. The defatted corn carrier also provided a drier and more flowable formulation than did degermed corn. Puffed corn will be eliminated from further consideration due both to availability and cost (Dr. T. Wang, Personal Communication).

Eight-week posttreatment results with the 20% soybean oil formulation are shown in Table 13. Subsequent evaluations are scheduled for March 1980.

Table 7 Results with various formulations and rates of AC-217,300 for control of IFA. Bogalusa, La. Spring 1979.

Plot No.	Formulation	Bulk Rate/acre (lbs.)	% reduction in No. of active colonies at indicated post-treat interval 1/		% change in population index at indicated post-treat interval	
			8 wks.	22 wks.	8 wks.	22 wks.
1.	De-germed corn	1.56	92	72	-96	-88
2.	Puffed corn	2.40	55	58	-77	-81
3.	De-germed corn	.78	60	40	-80	-73
4.	De-germed corn	.78	68	47	-87	-78
5.	De-fatted corn	1.63	82	79	-92	-84
6.	De-fatted corn	.77	56	69	-87	-85
7.	De-fatted corn	.77	78	79	-93	-89
8.	De-fatted corn	1.21	97	84	-99	-94
9.	De-germed corn	1.83	62	56	-80	-77
10.	Untreated check	-	0(40)	0(38)	-39	-41

1/ Corrected for check mortality by Abbott's formula

Table 8. Results with various formulations and rates of AC-217,300 for control of IFA. Florala, Ala. Spring 1979.

Plot No.	Formulation	Bulk Rate/acre (lbs.)	% reduction in No. of active colonies at indicated post-treat interval 1/		% change in population index at indicated post-treat interval	
			8 wks.	22 wks.	8 wks.	22 wks.
1.	De-fatted corn	.75	68	57	-81	-72
2.	De-fatted corn	.75	74	81	-84	-90
3.	De-fatted corn	1.88	89	86	-93	-91
4.	De-germed corn	.94	59	74	-79	-84
5.	De-germed corn	.94	66	69	-81	-80
6.	De-germed corn	1.99	76	73	-85	-81
7.	De-fatted corn	1.00	66	19	-83	-46
8.	De-germed corn	1.88	76	73	-87	-82
9.	Puffed corn	1.12	82	75	-92	-86
10.	Untreated check		0(9)	0(6)	-10	- 5

Corrected for check mortality by Abbott's Formula.

Table 9. Results with various formulations and rates of AC-217,300 for control of IFA. Monticello, Miss. Spring 1979

Plot No.	Formulation	Bulk Rate/acre (lbs.)	% reduction in No. of active colonies at indicated post-treat interval 1/		% change in population index at indicated post-treat interval	
			8 wks.	22 wks.	8 wks.	22 wks.
1.	Puffed corn	1.24	69	92	-95	-98
2.	De-germed corn	1.55	86	92	-97	-98
3.	Corn cob grits	2.52	45	83	-92	-98
4.	De-germed corn	.85	6	62	-87	-95
5.	De-germed corn	.85	0	46	-82	-89
6.	De-fatted corn	.72	58	71	-94	-93
7.	De-fatted corn	.72	86	87	-98	-97
8.	Corn cob grits	2.50	52	54	-90	-90
9.	De-fatted corn	1.35	79	87	-95	-99
10.	De-fatted corn	2.50	100	92	-100	-100
11.	De-germed corn	2.12	93	100	-99	-100
12.	Untreated check	-	0(71)	0(76)	-69	-72

1/ Corrected for check mortality by Abbott's formula

Table 10. Results with various formulations and rates of AC-217,300 for control of IFA. Baxterville, Miss. Spring 1979.

Plot No.	Formulation	Bulk Rate/acre (lbs.)	% reduction in No. of active colonies at indicated post-treat interval 1/		% change in population index at indicated post-treat interval	
			8 wks.	22 wks.	8 wks.	22 wks.
1.	De-fatted corn	.93	59	87	-92	-93
2.	De-fatted corn	1.35	66	92	-94	-97
3.	De-germed corn	1.47	38	90	-87	-95
4.	De-fatted corn	2.17	74	85	-95	-90
5.	De-fatted corn	2.27	79	95	-96	-96
6.	De-fatted corn	1.16	20	83	-81	-91
7.	De-germed corn	1.68	43	81	-89	-91
8.	De-fatted corn	.73	61	85	-92	-92
9.	De-fatted corn	.73	36	77	-88	-86
10.	Untreated check	-	0(61)	0(19)	-56	-24

1/ Corrected for check mortality by Abbott's Formula

Table 11. Results with various formulations and rates of AC-217,300 for control of IFA. Beaumont, Texas, Spring 1979.

Plot No.	Formulation	Bulk Rate/acre (lbs.)	% reduction in No. of active colonies at indicated post-treat interval 1/		% change in population index at indicated post-treat interval	
			8 wks.	22 wks.	8 wks.	22 wks.
1.	De-fatted corn	1.27	2/	59	2/	-84
2.	De-fatted corn	.57	2/	92	2/	-97
3.	De-germed corn	1.27	2/	86	2/	-94
4.	De-germed corn	.71	2/	80	2/	-89
5.	De-fatted corn	1.22	77	93	-87	-97
6.	De-fatted corn	1.33	89	96	-94	-97
7.	De-germed corn	1.50	55	85	-74	-91
8.	De-germed corn	1.36	82	68	-90	-83
9.	Untreated check	-	0(44)	0(28)	-44	-19

1/ Corrected for check mortality by Abbott's Formula

2/ No data collected due to Hurricane Fredrick.

Table 12. Influence of carrier on performance of AC-217,300 in Spring 1979 field tests

Carrier 1/	Rate of Application (lbs/acre)		Avg. % reduction in no. active colonies at indicated post-treat interval 2/		Avg. % change in population index at indicated post-treat interval	
	Range	Avg.	8 wks.	22 wks.	8 wks.	22 wks.
Puffed corn	1.12-2.40	1.6	68	75	-88	-88
Degermed corn	.71-2.12	1.3	60	72	-86	-87
Defatted corn	.57-2.50	1.2	71	79	-91	-89

1/ All bait formulations consisted of the indicated carrier in combination with 30% soybean oil and .75% AI.

2/ Averages are based on data which were corrected for check mortality by Abbott's Formula.

Table 13. Results with various formulations and rates of AC-217,300 for control of IFA. Selma, Alabama, Fall 1979.

Plot No.	Formulation 1/	Bulk Rate/Acre (lbs.)	% reduction in No. of active colonies at indicated post-treat interval 2/	% change in population index at indicated post-treat interval
			8 wks.	8 wks.
1.	De-fatted corn	.46	72	-85
2.	De-fatted corn	1.25	76	-87
3.	Untreated check	-	0(30)	-23

1/ 20% Soybean oil; .5% AI

2/ Corrected for check mortality by Abbott's formula.

In conclusion, it is apparent that AC-217,300 continues to show promise as a bait toxicant for fire ant control. Continued changes and improvements in the many different formulations evaluated over the past two years have enhanced efficacy of the compound. Obviously quite a bit of work remains to be done since several unresolved questions or problems confront registration and/or use of AC-217,300. All available resources of this laboratory will be directed at resolving these problems in 1980.

IV. FERRIMACIDE SHELF LIFE STUDIES

As requested by the Miss. Authority for Control of Fire Ants (MACFA) a series of tests to obtain information on the shelf life of ferriamicide bait was initiated in January 1978. These studies were continued on a limited basis during 1979. Test procedures utilized were as follows:

Samples consisting of 1 lb. aluminum foil packages of each formulation tested were stored in constant temperature cabinets at 4°C, 21°C, 36°C, 50°C, and room temperature. Periodically, bags were removed for bioassay of feeding acceptance and GLC Analysis. The GLC Analyses were conducted by the APHIS Environmental Monitoring Laboratory (NMRL) at Gulfport, Miss., and the results of those tests reported elsewhere. The bioassay for feeding acceptance was essentially the same as that employed by Lofgren et. al. (1961), i.e., the feeding activity of captive imported fire ant colonies on each ferriamicide sample was compared with that on a freshly prepared bait standard consisting of 15% soybean oil and 85% (w/w) corn cob grits. Each bait sample was tested on eight ant colonies (replicates). The acceptance ratio was computed in the following manner:

$$\text{Acceptance ratio} = \frac{N_f}{N_s}$$

Where N_f = Number of ants observed feeding on the ferriamicide sample, and

N_s = Number of ants observed feeding on the soybean oil standard.

An acceptance ratio with a value of less than 1.00 indicates that a given sample was less attractive than the standard. Values equal to or greater than 1.00 indicates that a sample was equally or more attractive than the standard. Results with the 4 formulations evaluated in 1979 are shown in Table 14. These data suggests that high temperatures are detrimental to the shelf life of these bait formulations. At moderate temperatures (21°C) Formulation Code AANSBV and NAASBV remained reasonably attractive for 45 days; while BNSVAA and SVAABN were reasonably attractive for 7 and 4 months respectively. According to the manufacturer, formulation NAASBV and SVAABN were packaged with nitrogen added to displace oxygen in an effort to slow or prevent rancidity.

Table 14. IFA feeding acceptance of various Ferriamicide formulations aged for the indicated intervals at the indicated temperature. Dec. 1978 - Aug. 1979

Manufacturer's Formulation Code	Age of Bait	Holding Temp. (Degrees C.)	Acceptance Ratio 1/
AANSBV	27 Days (Baseline)	Room	.44
"	45 Days	4	.97
"	"	21	.93
"	"	36	.83
"	"	50	.38
"	84 Days	4	1.04
"	"	21	.67
"	"	36	.43
"	"	50	.26
"	4 Months	4	.07
"	"	21	.24
"	"	36	.53
"	"	50	.05
"	7 Months	4	.46
"	"	21	.25
"	"	36	.17
"	"	50	0

Table 14 (continued)

Manufacturer's Formulation Code	Age of Bait	Holding Temp. (Degrees C.)	Acceptance Ratio 1/
NAASBV	16 Days (Baseline)	Room	.92
"	45 Days	4	.66
"	"	21	.97
"	"	36	.86
"	"	50	.39
"	84 Days	4	.43
"	"	21	.43
"	"	36	.37
"	"	50	.09
"	4 Months	4	1.16
"	"	21	.42
"	"	36	.29
"	"	50	.01
"	7 Months	4	.58
"	"	21	.44
"	"	36	.44
"	"	50	0
BNSVAA	16 Days(Baseline)	Room	.55
"	45 Days	4	1.04
"	"	21	.95
"	"	36	.68
"	"	50	.58

Table 14 (continued)

Manufacturer's Formulation Code	Age of Bait	Holding Temp. (Degrees C.)	Acceptance Ratio. 1/
BNSVAA	84 DAYS	4	.80
"	"	21	.74
"	"	36	.60
"	"	50	.42
"	4 Months	4	1.02
"	"	21	1.05
"	"	36	.61
"	"	50	.26
"	7 Months	4	.86
"	"	21	.84
"	"	36	.45
"	"	50	.29
SVAABN	16 Days (Baseline)	Room	1.35
"	45 Days	4	.56
"	"	21	.99
"	"	36	.98
"	"	50	.56
"	84 Days	4	1.07
"	"	21	.62
"	"	36	.37
"	"	50	.14

Table 14 (continued)

Manufacturer's Formulation Code	Age of Bait	Holding Temp. (Degrees C.)	Acceptance Ratio 1/
SVAABN	4 Months	4	1.12
"	"	21	.76
"	"	36	.18
"	"	50	.03
"	7 Months	4	.24
"	"	21	.38
"	"	36	.45
"	"	50	.09

1/ Average based upon observations of the feeding activity of eight IFA colonies (replicates) in the laboratory.

V. DEVELOPMENT OF QUARANTINE TREATMENTS

A. Nursery Potting Soil:

Our regulatory pesticide screening program has been underway for almost 4 years. The original goal of this program was to evaluate all registered "soil" insecticides for toxicity to fire ants and persistence in a typical nursery potting media. We felt that a residual activity of 3 to 6 months would be the best that could be expected, but hoped to select one or two of the better compounds and extend their activity through formulations research such as encapsulation, polymerization, etc.

Test procedures used to evaluate all experimental insecticides were as follows: A typical nursery potting media consisting of equal portions of Sphagnum peat moss, river sand, and milled pine bark was prepared by nixing 1.5 ft^3 batches in a 2 ft^3 portable cement mixer. Granular formulations of candidate insecticides were then added at the rate of 11.2 grams AI per cubic yard of potting media (10 lbs ai/3" acre). The cement mixer was operated for 1 hour after the insecticide was added in order to insure

thorough blending of the toxicant with the potting media. After aging outdoors on wooden freight pallets for 1 month, three pots from each treatment series were bioassayed by confining 40 cc of a fragmented IFA colony on the treated media in each pot. These test colonies were observed for 14 days or until mortality of 90 percent or more of all life forms in each of the 3 colonies occurred. Treatments which allowed survival of more than 10 percent of the colony were considered ineffective. Treatments which were effective on the first bioassay were aged and re-tested periodically to measure and compare residual activity with chlordane, the standard treatment.

Most compounds tested did not afford the residual activity required of a practical IFA quarantine treatment. However, as shown in Table 15, Dursban, Amaze, Akton, Ciba Geigy CGA 4-803 and CGA-4-811 demonstrated suf-ficient residual activity to suggest that these compounds could be substituted for chlordane.

Based on this data, Dow Chemical Company obtained registration of granular Dursban (chlorpyrifos) for IFA quarantine treatment of nursery potting media and bench soils.

In addition to its relatively long residual activity in a nursery potting soil environment, Dursban is extremely toxic to fire ants. The dosage mortality curve (Figure 2) indicates that the LD_{50} is about .18 ppm in a sandy loam topsoil with a ph of 6.5.

Table 15. Residual Activity of twenty-two candidate potting soil toxicants.

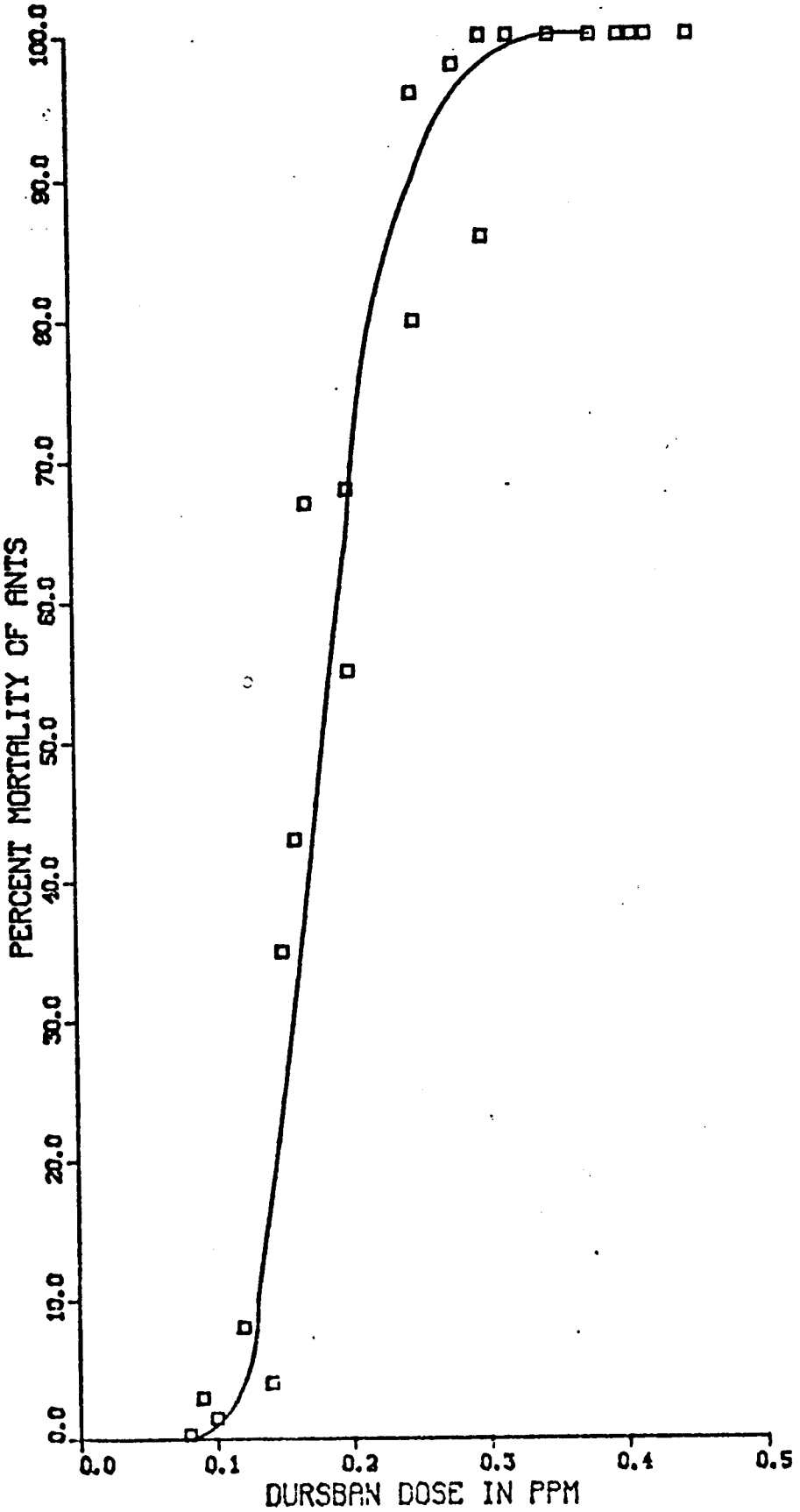
Insecticide and gms ai/yd ^{3} of potting media		No. of months of residual activity (> 80% mortality of IFA workers)
Chlordane 10G	11.2	41
Dursban 10G	11.2	39
CGA 4-803 4EC	11.2	18
CGA 4-811 4EC	11.2	18
Amaze 15G	11.2	12
Akton 15G	11.2	10
Dyfonate 15G	11.2	6
Counter 15G	11.2	6
Diazinon 2G	11.2	1
SAN 6538 5G	11.2	1
SAN 52.139 5G	11.2	1
SAN 326 5G	11.2	1
Baygon 2G	11.2	< 1
Bendiocarb 2.5G	11.2	< 1
Bux 10G	11.2	< 1
Cythion 5D	11.2	< 1
Dasanit 15G	11.2	< 1
Disyston 15G	11.2	< 1
Orthene 5G	11.2	< 1

Table 15 (continued)

Insecticide and gm ai/yd ^{3} of potting media		No. of months of residual activity (>89% mortality of IFA workers)
Temik 10G	11.2	< 1
Thiodan 3D	11.2	< 1
Furadan 10G	11.2	< 1

FIG 2

DOSAGE–MORTALITY CURVE: DURSBAN AGAINST IFA



B. Phytotoxicity Trials with Nursery Potting Media Treated with Dursban 15G

INTRODUCTION

Commercial shipments of ornamental nursery plants and grass sod have been linked with accidental introduction of imported fire ants (*Solenopsis invicta* Buren and *Solenopsis richteri* Buren) into previously non-infested areas (Culpepper 1953). Chlorinated hydrocarbon insecticides such as chlordane and heptachlor were used for many years as a quarantine treatment by USDA, APHIS, PPQ for nursery stock grown in infested areas and shipped to non-infested areas. However, the U. S. Environmental Protection Agency cancelled the registration of chlordane on December 31, 1979. Registration of all other chlorinated hydrocarbons used for quarantine treatments was cancelled prior to this date. In 1976, this laboratory initiated a screening program to evaluate candidate soil insecticides to replace chlordane. Results to date indicate that Dursban ^{R} M in .5 to 15.0% AI granular formulations is efficacious for imported fire ant control when thoroughly blended with nursery potting media at the rate of 11.2 gms ai/yd^3 of potting media (Collins et al 1980). The tests reported here were intended to determine if the addition of various rates of Dursban 15G to potting media would produce deleterious effects upon plants growing in treated media.

METHODS AND MATERIALS

Effect on Germination and Growth of Vegetable and Flower Seedlings

Germination tests and general observations on phytotoxicity to 25 varieties of vegetable and flower seedlings were conducted in the greenhouse during April and May 1979. A potting media consisting of equal portions of river sand, spagnum moss and milled pine bark was prepared by blending 2 ft^3 batches of media in a portable electric cement mixer at 11.2, 22.4, 33.6 and 1120.0 gms ai per cubic yard for a total of 4 different treatments plus an untreated check. These rates represent a 1, 2, 3 and 10X rate which is efficacious as a quarantine treatment. Fourteen 3" square peat pots (approx. 375 cc capacity) were filled with media from each treatment prior to planting. Each pot or replicate was planted with 3 seeds of a given cultivar. After emergence, each replicate was thinned to a single plant. Pots were maintained in a greenhouse at an average of 69% of relative humidity. Temp. records indicate an average of 72 % with a range of 59 to 83 %. Pots were watered as needed, and fertilized 3 weeks after emergence with 12-6-6 liquid fertilizer according to label directions. Records of seedling emergence were made daily. All plants were categorized on a 1 to 5 phytotoxicity rating scale at 2 and 4 weeks after emergence. The scale used to rate each plant was as follows: 1 - plants healthy, not different from untreated check, 2 - slight yellowing, wilting or other mild symptoms. 3 - symptoms more severe, some leaf drop, 4 - severe stunting, abnormal leaf or stem structure, 5 - dead.

Effect on Transplanted Nursery Liners:

Eighteen varieties of woody ornamentals were purchased as "liners" (4 to 6" in height growing in 3" pots) and transplanted into chlorpyrifos

treated media as described above. Again, 4 different rates (11.2, 22.4, 33.6 and 1120.0 gms ai/yd^3) plus an untreated check were evaluated. All plants were transplanted into 1 gallon plastic pots containing treated media. Five plants (replicates) of each variety were planted to each of the five different treatments under evaluation. After transplanting, all plants were maintained outdoors under partial shade. A water sprinkler system was operated on an as-needed basis. Plants were fertilized monthly with 13-13-13 fertilizer at a rate of 1 tablespoon per pot. Phytotoxicity observations were made at 30, 60 and 90 days after repotting. A 1 to 5 rating scale was used to evaluate each plant: 1 - healthy, not different from untreated check, 2 - slight yellowing, wilting or other mild symptoms, 3 - symptoms more severe, some leaf drop, 4 - severe stunting, abnormal leaf or stem structure, 5 - dead.

RESULTS AND DISCUSSION

Effect on germination and growth of vegetable and flower seedlings:

The 1X rate (11.2 gm/yd ^{3}) had little or no adverse effects on any cultivar tested (Table 16). In most cases 2X and 3X rates produced minor or no effects. However, the 10X rate reduced emergence, delayed germination, and produced deleterious effects on growing seedlings of each cultivar evaluated. Cruciferous plants seemed to be more susceptible while curcubits and cowpeas were more tolerant of all rates.

Effect on transplanted nursery liners:

No apparent damage was noted on any of the 18 varieties of woody ornamentals under study (Table 17). These results suggest that granular formulations of Dursban can be incorporated into potting media at rates efficacious for IFA quarantine treatments without adversely affecting plants growing in this media.

Table 16. Emergence and growth of vegetable and flower seedlings planted to potting media treated with various rates of Dursban R 15G. Gulfport, Miss. May-June 1979.

PLANT							
Common Name	Variety	Scientific Name	Dursban Rate (gm.ai/yd 3)	Percent Emergence 1/	Days to Cotyledon Stage 2/	Phytotoxicity Rating at indicated intervals after emergence 2/	
						2 weeks	4 weeks
Mustard	Fla. Broadleaf	Brassica alba	Untreated check	71	7	1	1
			11.2	52	7	1	1
			22.4	98	4	2	2
			33.6	98	4	2	2
			1120.0	14	32	4	4
English Peas	Alderman Tall	Pisum satirum	Untreated check	62	8	2	2
			11.2	55	8	3	3
			22.4	86	8	1	1
			33.6	86	10	1	1
			1120.0	81	8	3	4
Broccoli	Green Sprouting		Untreated check	40	11	2	2

Table 16. Emergence and growth of vegetable and flower seedlings planted in potting media treated with various rates of Dursban ® 15G. Gulfport, Miss. May-June 1979.

PLANT							
Common Name	Variety	Scientific Name	Dursban Rate (gms.ai/yd ^{3})	Percent Emergence 1/	Days to Cotyledon Stage 2/	Phytotoxicity Rating 2 at indicated intervals after emergence	
						2 weeks	4 weeks
Broccoli	Green Sprouting	Brassica oleracea var. botrytis	11.2	31	13	2	2
			22.4	40	6	1	1
			33.6	86	5	1	1
			1120.0	0	-	-	-
			Untreated check	71	8	1	1
Green beans	Black Valentine	Phaseolus vulgaris	11.2	62	8	2	2
			22.4	81	10	1	1
			33.6	90	10	1	1
			1120.0	62	15	3	3
			Untreated check	55	8	1	1
Cockscomb	Toreado	Celosia cristata	11.2	66	8	1	1

Table 16 (continued)

PLANT			Dursban Rate ($gm.ai/yd^3$)	Percent Emergence 1/	Days to Cotyledon Stage 2/	Phytotoxicity Rating 2/ at indicated intervals after emergence	
Common Name	Variety	Scientific Name				2 Weeks	4 weeks
Cockscomb	Toreado	Celosia cristata	22.4	86	7	1	1
			33.6	62	7	1	1
			1120.0	1	22	4	4
Pumpkin	Green Stripe Cushaw	Cucurbita pepo	Untreated check	90	7	1	1
			11.2	100	7	1	1
			22.4	100	6	1	1
			33.6	100	6	1	1
			1120.0	90	13	2	2
Sweetcorn	McKory King	Zea mays	Untreated check	81	5	1	1
			11.2	93	5	2	2
			22.4	71	4	1	1
			33.6	79	4	2	2
			1120.0	88	5	3	3

Table 16 (continued)

PLANT			Dursban Rate (gm. ai/yd ^{3})	Percent Emergence 1/	Days to Cotyledon Stage 2/	Phytotoxicity Rating at indicated intervals after emergence 2/	
Common Name	Variety	Scientific Name				2 weeks	4 weeks
Lima Beans	Henderson Bush	Phasoolus lunatus	Untreated check	98	7	1	1
			11.2	83	8	2	2
			22.4	91	10	2	2
			33.6	90	10	2	2
			1120.0	43	12	4	4
Okra	Cowhorn	Hibiscus esculentus	Untreated check	76	9	1	1
			11.2	76	9	1	1
			22.4	95	9	1	1
			33.6	83	9	1	1
			1120.0	26	22	2	2
Cucumber	Straight Eight	Cucumis sativus	Untreated check	98	6	1	1
			11.2	93	6	1	1
			22.4	81	3	1	1

Table 16(continued)

PLANT			Dursban Rate (gm. ai/yd^3)	Percent Emergence 1/	Days to Cotyledon Stage 2/	Phytotoxicity Rating at indicated intervals after emergence 2/	
Common Name	Variety	Scientific Name				2 weeks	4 weeks
Cucumber	Straight Eight	Cucumis sativus	33.6	79	3	1	1
"	"		1120.0	62	9	1	1
Squash	White Scallop	Cucurbita pepo var. melopepo	Untreated check	86	12	1	1
			11.2	95	12	2	2
			22.4	90	6	1	1
			33.6	88	10	1	1
			1120.0	71	14	3	2
Sweet Pepper	Banana	Capsicum frutescens	Untreated check	69	15	1	1
			11.2	71	15	1	1
			22.4	71	15	1	1
			33.6	88	15	1	1
			1120.0	7	29	4	4
Hot Pepper	Jalapena	Capsicum frutescens	Untreated check	98	9	1	1
			11.2	95	9	1	1
			22.4	98	8	1	1
			33.6	90	8	1	1
			1120.0	21	19	3	3

Table 16 (continued)

PLANT							
Common Name	Variety	Scientific Name	Dursban Rate (gm. ai/yd ^{3})	Percent Emergence 1/	Days to Cotyledon Stage 2/	Phytotoxicity Rating at indicated intervals after emergence 2/	
						2 weeks	4 weeks
Radish	White icicle	Raphanus sativa	Untreated check	95	6	1	1
			11.2	81	6	1	1
			22.4	100	5	1	2
			33.6	93	5	1	2
			1120.0	40	8	3	3
Cantalope	Honey Dew	Cucumis melo	Untreated check	64	14	1	2
			11.2	62	10	1	2
			22.4	83	9	1	1
			33.6	81	9	1	1
			1120.0	45	14	2	3
Cowpeas	Pink-eye Purplehull	Vigna sinensis	Untreated check	81	7	1	1
			11.2	79	7	2	1
			22.4	100	6	1	1
			33.6	86	6	1	1
			1120.0	83	14	2	2

Table 16 (continued)

PLANT			Dursban Rate (gm. ai/yd^3)	Percent Emergence 1/	Days to Cotyledon Stage 2/	Phytotoxicity Rating at indicated intervals after emergence	
Common Name	Variety	Scientific Name				2 weeks	4 weeks
Watermelon	New Hampshire Midget	Citrullus vulgaris	Untreated check	62	14	1	1
			11.2	69	19	1	1
			22.4	74	14	1	1
			33.6	78	14	1	1
			1120.0	62	21	2	1
Carrots	Danvers Half Long	Dacus carota	Untreated check	66	9	1	1
			11.2	59	9	1	1
			22.4	85	8	1	2
			33.6	76	9	1	2
			1120.0	11	28	4	4
Eggplant	Black Beauty	Solanum melongena	Untreated check	76	14	1	1
			11.2	95	14	1	1
			22.4	95	8	1	1
			33.6	90	8	1	1
			1120.0	24	14	2	3

Table 16 (continued)

PLANT			Dursban Rate (gms. AI/yd^3)	Percent Emergence 1/	Days to Cotyledon Stage	Phytotoxicity Rating at indicated interval after emergence 2/	
Common Name	Variety	Scientific Name				2 weeks	4 weeks
Turnips	Just Right	Brassica rapa	Untreated check	85	5	2	4
			11.2	60	6	2	4
			22.4	93	2	1	1
			33.6	100	7	1	1
			1120.0	25	6	5	-
Cabbage	Charleston Wakefield	Brassica oheracea var. capitata	Untreated check	48	9	2	2
			11.2	25	9	4	4
			22.4	64	8	3	1
			33.6	50	8	3	2
			1120.0	0	N/A	-	-
Tomatoes	Mariglobe	Lycoperscion esculentum	Untreated check	74	9	2	2
			11.2	74	9	2	2
			22.4	88	13	2	1
			33.6	76	13	2	1
			1120.0	10	30	4	4

Table 16 (continued)

PLANT			Dursban Rate (gms.AI/yd ^{3})	Percent Emergence 1/	Days to Cotgledon Stage	Phytotoxicity Rating at indicated interval after emergence 2/	
Common Name	Variety	Scientific Name				2 weeks	2 weeks
Gourds	Mixed Small	Cucurbita pepo	Untreated check	93	9	1	1
			11.2	95	9	1	1
			22.4	95	7	1	1
			33.6	93	7	1	1
			1120.0	62	21	2	2
Zinia	Giant Fantasy	Zinnia sp.	Untreated check	64	7	1	1
			11.2	59	7	1	2
			22.4	62	4	1	1
			33.6	55	4	1	1
			1120.0	43	14	2	3
Marigolds	Cracker Jack	Tagetes sp.	Untreated check	64	7	1	1
			11.2	69	7	1	1
			22.4	36	7	1	1
			33.6	43	7	1	1
			1120.0	38	18	2	2

1/ Each value represents the mean of 14 replicates of 3 seeds each.
2/ Mean based on 14 replicates.

Table 17. Phytotoxicity observations on woody ornamentals transplanted into potting media treated with various rates of Dursban 15G. Gulfport, Miss. July - September, 1979.

PLANT			Dursban Rate (gms.AI/yd.^{3})	Phytotoxicity rating at indicated interval after transplanting 1/		
Common Name	Variety	Scientific Name		30 days	60 days	90 days
Azalea	Hino Degiri	*Rhododendron sp.*	Untreated check	1	1	1.2
			11.2	1	1	1
			22.4	1	1	1
			33.6	1	1.2	1.2
			1120.0	1	1	1.2
Azalea	Hino Crimson	*Rhododendron sp.*	Untreated check	1	1	1
			11.2	1	1	1
			22.4	1	1	1
			33.6	1	1	1
			1120.0	1	1	1
Azalea	Snow	*Rhododendron sp.*	Untreated check	1	1	1
			11.2	1	1.2	1
			22.4	1	1	1
			33.6	1	1	1
			1120.0	1	1	1
Azalea	Massaoit	*Rhododendron sp.*	Untreated check	1	1	1
			11.2	1	1	1
			22.4	1	1	1
			33.6	1	1	1
			1120.0	1	1	1

Table 17. Phytotoxicity observations on woody ornamentals transplanted into potting media treated with various rates of Dursban 15G. Gulfport, Miss. July - September, 1979.

PLANT			Dursban Rate (gms.AI/yd.^{3})	Phytotoxicity rating at indicated interval after transplanting 1/		
Common Name	Variety	Scientific Name		30 days	60 days	90 days
Azalea	Coral Bell	*Rhododendron sp.*	Untreated check	1	1	1
			11.2	1	1	1
			22.4	1	1	1
			33.6	1	1.2	1
			1120.0	1	1	1.2
Azalea	Christmas Cheer	*Rhododendron sp.*	Untreated check	1	1	1
			11.2	1	1	1.6
			22.4	1	1	1.4
			33.6	1	1.4	2.0
			1120.0	1.2	1.2	1.4
Photinia		*Photinia sp.*	Untreated check	1.4	1	1
			22.4	1	1	1.6
			33.6	1.4	1	1.8
			1120.0	1	1	1.6
Japanese Holly	Rotunda	*Ilex crenata var. rotundifolia*	Untreated check	1	1	1
			11.2	1	1	1
			22.4	1	1	1
			33.6	1	1	1
			1120.0	1	1	1

Table 17. Phytotoxicity observations on woody ornamentals transplanted into potting media treated with various rates of Dursban 15G. Gulfport, Miss. July - September, 1979.

PLANT			Dursban Rate (gms.AI/yd.^{3})	Phytotoxicity rating at indicated interval after transplanting		
Common Name	Variety	Scientific Name		30 days	60 days	90 days
Ilex	Dwarf Burfordi	Ilex cornuta var. burfordii	Untreated check	1	1	1
			11.2	1	1	1
			22.4	1	1	1
			33.6	1	1	1
			1120.0	1	1	1
Ilex	Compacta	Ilex crenata var. compacta	Untreated check	1	1	1
			11.2	1	1	1.4
			22.4	1	1	1.8
			33.6	1	1	1.8
			1120.0	1	1	1.6
Boxwood	Japanese	Buxus microphylla var. japonica	Untreated check	1	1	1.4
			11.2	1	1	1.4
			22.4	1	1	1
			33.6	1	1	1
			1120.0	1	1	1
Boxwood	Wintergreen	Buxus sempervirens	Untreated check	1	1	1
			11.2	1	1	1
			22.4	1	1	1
			33.6	1	1	1
			1120.0	1	1	1

Table 17. Phytotoxicity observations on woody ornamentals transplanted into potting media treated with various rates of Dursban 15G. Gulfport, Miss. July - September, 1979.

PLANT			Dursban Rate (gms.AI/yd ^{3})	Phytotoxicity rating at indicated interval after transplanting 1/		
Common Name	Variety	Scientific Name		30 days	60 days	90 days
Gardenia		Gardenia jasminoides	Untreated check	1	1	1
			11.2	1	1	1
			22.4	1	1	1
			33.6	1	1	1
			1120.0	1	1	1
Yew	Japanese	Taxus cuspidata	Untreated check	1	1	1
			11.2	1	1	1
			22.4	1	1	1
			33.6	1	1	1
			1120.0	1	1	1
Pittosporum	Wheelers Dwarf	Pittosporum tobira	Untreated check	1	1	1
			11.2	1	1	1
			22.4	1	1	1.4
			33.6	1	1	1
			1120.0	1	1	1
Pampas Grass		Cortaderia selloana	Untreated check	1	1	1
			11.2	1	1	1
			22.4	1	1	1
			33.6	1	1	1
			1120.0	1	1	1

Table 17. Phytotoxicity observations on woody ornamentals transplanted into potting media treated with various rates of Dursban 15G. Gulfport, Miss. July - September, 1979.

PLANT			Dursban Rate (gms.AI/yd.^{3})	Phytotoxicity rating at indicated interval after transplanting		
Common Name	Variety	Scientific Name		30 days	60 days	90 days
Eronymus	Golden	*Euonymus japonicus*	Untreated check	1	1	1
			11.2	1	1	1
			22.4	1	1	1
			33.6	1	1	1
			1120.0	1	1	1
Crepe Myrtle		*Lagestroemia indica*	Untreated check	1	1	1
			11.2	1	1	1
			22.4	1	1	1
			33.6	1	1	1.8
			1120.0	1	1.8	2.4

1/ Mean value based on 5 replicates. 1 = healthy; 2 = slight yellowing, wilting or other mild symptoms; 3 = symptoms more severe, some leaf dropl 4 = severe stunting, abnormal leaf or stem structure; 5 = dead.

C. Field Evaluation of Slow Release Dursban Formulations:

As previously discussed, granular formulations of Dursban perform well as potting soil toxicants. However, the ornamental nursery industry is complex, varied, and much diversified; therefore not all growers sell and ship container grown stock in which insecticide treated potting soil is utilized. Consequently, a quarantine treatment must not only perform in potting soil, but must also afford protection for grass sod and field-grown plants which are shipped in a "balled and burlapped" condition. Standard formulations of Dursban such as 15G and 4EC do not have the required residual activity for use in sod farms and field grown ornamental operations (See 1978 lab report). A commercially available slow release formulation of Dursban (10CR) consisting of impregnated polystyrene strands is currently under evaluation as a residual soil treatment. Dursban 10CR is a product of Dow Chemical Company and is registered for use as a mosquito larvaecide in open drainage ditches. McNeill et al (1979) reported that a full season of control of mosquito larvae may be expected following treatment with 10CR. These results prompted the present study. Although our tests are not complete, results to date are reported here.

Methods and Materials:

Test procedures used to compare the residual effectiveness of Dursban 10CR, Dursban 15G, Amaze 20G and chlordane 10G were as follows: One acre test plots located in a Bahia grass pasture at Brooklyn, Miss. were disced prior to treatment to loosen the soil. Experimental treatments are listed in Table 18. All treatments were applied with a jeep mounted Skibbee applicator (Model 68GA-J). The jeep was operated at 4 mph, utilizing a 21 foot working swath. Immediately following treatment all plots were disced in two directions in order to incorporate the insecticide into the soil.

Table 18. Experimental treatments evaluated for residual activity in soil. Brooklyn, Miss.

Insecticide Formulation	Application Rate Bulk (lbs./acre)	AI(lbs./acre)	Date Applied
Dursban 10CR	56.3	5.6	8/14/79
	113.5	11.3	8/14/79
	164.2	16.4	8/14/79
Dursban 15G	39.6	5.9	8/15/79
	62.0	9.3	8/15/79
	146.0	21.9	8/16/79
Amaze 20G	54.2	10.8	8/15/79
Chlordane 10G	60.0	6.0	8/16/79
Untreated check	-		

Fifty 3" soil cores were collected from each plot with a standard soil sample (NMRL) prior to treatment, immediately after treatment, and at 30 and 90 days posttreatment. Subsequent samples will be collected at 6, 12, 18, etc months. After screening and compositing, the 50 cores from each plot were subdivided, with one-half being used for GLC Analysis by NMRL and the other half being used for a laboratory bioassay. Bioassays were conducted utilizing procedures described by Banks et al. 1964. Briefly, this procedure consists of confining 20 worker ants/replicate in 3" diameter plastic flower pots which were equipped with glass lids and plaster of paris bottoms. Ten grams of treated soil were placed in each pot prior to introducing the ants. Three replicates per treatment were assessed. Mortality counts were made at 1, 2 and 5 days after the ants were placed in contact with the treated soil.

Influence of the various treatments on foraging activity of colonies within each plot was determined by the use of bait station surveys. Bait station surveys are useful indicators for the presence of ants in areas or habitats in which visual surveys for the presence of mounds are unreliable e.g. in ploughed or disced ground.

Surveys were conducted by placing twenty bait stations within each plot for 1 hour, then recording the number of stations at which feeding ants were observed. Each station consisted of a small amount of peanut butter (a feeding attractant) smeared on a wooden tongue depressor. Bait stations were spread 10 feet apart in a diagonal line that transsected the plot. Surveys were conducted each time soil samples were collected for bioassay and residue analysis.

Results

Results of the GLC analysis of soil samples collected at 0, 30, and 90 days following treatment are presented in Table 19. These data suggest that the rate of degredation is somewhat slower with the 10CR formulation of Dursban than the 15G. Subsequent samples should clarify these results. Bioassays of samples collected 0, 30 and 90 days following treatment are shown on Table 20. These results indicate that all treatments were 100% effective at the 90-day posttreat sampling interval. Subsequent soil samples will be collected at 3 month intervals until activity of all treatments cease. All treatments drastically reduced foraging activity as shown in Table 21. Since the mode of action of contact residual treatments is through depletion of foraging workers, it is not surprising that some activity remained in some plots. It is also conceivable that some bait stations are being visited by foraging workers from colonies outside the treated area.

Table 19. Results of GLC Analysis of various residual soil treatments. Brooklyn, Miss.

Treatment		Residue (PPM) at indicated interval			
Formulation	Rate (lbs.AI/Acre)	Pretreat	0 days	30 days	90 days
Dursban 10CR	5.6	0	53.6	40.1	33.6
	11.3	0	107.0	52.3	42.9
	16.4	0	106.0	66.5	48.0
Dursban 15G	5.9	0	54.2	8.7	7.1
	9.3	0	58.8	25.2	12.7
	21.9	0	108.0	49.2	34.8
Amaze 20G	10.8	0	6.0	2.4	1.7
Chlordane 10G	6.0	0	13.8	7.3	6.9
Untreated check		0	0	0	0

Table 20. Bioassay of various residual soil treatments
Brooklyn, Miss.

Treatment		% mortality after 5 days exposure to soil collected at indicated post-treat intervals 1/			
Formulation	Rate (lbs.AI/Acre)	Pretreat	0 days	30 days	90 days
Dursban 10CR	5.6	0	95	100	100
	11.3	0	39	100	100
	16.4	6	98	100	100
Dursban 15G	5.9	38	100	100	100
	9.3	23	100	100	100
	21.9	33	100	100	100
Amaze 20G	10.8	16	100	100	100
Chlordane 20G	6.0	33	100	100	100
Untreated check	-	0(3.2)	0(6)	0(3)	0(5)

1/ Average of 3 replicates, 20 worker ants/replicate.
Corrected for check mortality by Abbott's Formula.

Table 21. Influence of various residual soil treatments on IFA foraging activity as determined by Bait Station Survey Brooklyn, Miss.

Treatment		% Bait stations with feeding workers present at indicated post-treat intervals 1/		
Formulation	Rate (lbs.AI/Acre)	Pretreat	30 days	90 days
Dursban 10CR	5.6	100	30	40
	11.3	100	10	5
	16.4	100	10	5
Dursban 15G	5.9	95	0	35
	9.3	90	5	5
	21.9	90	0	0
Amaze 20G	10.8	90	0	15
Chlordane 10G	6.0	90	0	0
Untreated check	-	100	95	90

1/ Twenty Bait Stations/treatment; counts made after stations were in place for one hour.

D. Dip Treatments for Balled and Burlapped Plants

Introduction

As mentioned above no acceptable quarantine treatments for balled and burlapped plants (field grown ornamentals) were available following cancellation of the registration of chlordane in December 1979. In an effort to provide certification for this type of plant material, root-dip treatments with Dursban and Amaze insecticide were evaluated during the summer of 1979. The primary risk involved in shipping balled and burlapped plants is that a small newly founded colony consisting of the queen, immatures and relatively small number of workers would remain undetected in the root mass and would be subsequently transported to a previously non-infested site. Movement of large aggressive colonies is considered highly unlikely (due to processing and handling by nursery workers); thus the intent of the root-dip treatments described here was to eliminate small newly founded colonies rather than large mature ones. We have therefore assumed that treatments shown to be effective against alate queens would also be effective against newly mated de-alated queens with or without an accompanying clutch of brood and/or worker force.

Methods and Materials

Alate queens were confined in perforated plastic cages constructed from 2 ml clear plastic vials. Three cages containing one alate queen each were inserted at various depths within the root balls of various ornamental plants. The root balls of 5 different plants (replicates) were immersed into insecticidal solutions which varied in concentration from 1/8 to 1/128 lbs. AI/100 gallons of water. Exposure time for a given treatment varied from 5 to .16 minutes for balled and burlapped plants and from 2.5 to .16 minutes for container grown plants. Three untreated check plants (replicates) were treated in a similiar fashion except they were submerged in pure water. After immersion for the desired interval, the plants were removed and allowed to

drain for one hour after which the caged ants were removed from the root ball and placed in petri dishes on moistened filter paper. Mortality counts were made at 24 and 48 hours following treatment.

All plants were categorized on a 1 to 5 phytotoxicity rating scale at 1,2, and 3 months following treatment. The scale used to rate each plant was as follows: 1-plants healthy, not different from untreated check; 2-slight yellowing, wilting or other mild symptoms; 3-symptoms more severe, some leaf drop; 4-severe stunting, abnormal leaf or stem structure; 5-dead.

Results

Results of the Dursban root dip treatments of balled and burlapped plants are shown in Table 21. All treatments except the lowest concentration (1/128 lbs. AI/100 gal. water) provided 100% kill of caged alates. Results of the Dursban and Amaze root dip treatments of container grown plants are shown in Table 22. Again, all Dursban treatments provided 100% kill of caged alates. Amaze was somewhat less effective. Phytotoxicity observations are shown in Tables 23 and 24. In general these results suggest that none of the treatments adversely affected plants,with the exception of Dwarf Youpon immersed in 1/8 lb. Dursban/100 gallons of water for 2 1/2 minutes. Apparently this species is somewhat sensitive to this treatment.

Table 21. Mortality of Alate Queens caged in root balls of balled and burlapped nursery stock and submerged in various rates of Dursban 4E for the indicated exposure interval.

Exposure Interval (Minutes)	Dursban Rate (lb/AI in 100 gals) H_2o	Percent Mortailty 1/ 24 hrs. Treated	24 hrs. Check	48 hrs. Treated	48 hrs. Check
5	1/2	100	22	-	22
"	1/4	100	0	-	11
"	1/8	100	11	-	22
"	"	100	0	-	11
"	"	100	22	-	22
"	"	100	11	-	11
"	"	100	11	-	11
"	"	100	0	-	0
"	"	100	0	-	0
"	1/32	100	0	-	0
"	1/64	100	11	-	33
"	1/128	72	0	72	0
2.5	1/8	100	0	-	0
1.25	"	100	0	-	0
0.75	"	100	0	-	11
0.50	"	100	11	-	11
0.50	"	100	0	-	11
0.50	"	100	11	-	11
0.50	"	100	0	-	0
0.33	"	100	10	-	10
0.16	"	100	0	-	0

1/ Avg. of 5 replicates of 3 Queens/replicate for each treatment with 3 replicates of 3 Queens/rep. for each untreated check.

Table 22. Mortality of alate queens caged in root balls of plants growing in 2 gallon pots following immersion in various rates of Dursban or Amaze solutions for the indicated exposure intervals.

Toxicant	Exposure time (mins.)	Rate (lbs.AI/100 gals.) H_2O	Percent Mortality 24 hrs. Treated	24 hrs. Check	48 hrs. Treated	48 hrs. Check
Dursban 4E	2.5	1/8	100	0	-	0
	1.25	"	100	0	-	0
	0.75	"	100	0	-	0
	0.50	"	100	11	-	11
	0.50	"	100	0	-	11
	0.50	"	100	11	-	11
	.50	"	100	0	-	0
	0.33	1/8	100	11	-	11
	0.16	1/8	100	0	-	0
Amaze 6E	0.50	1/4	80	0	80	0
	1.00	1/8	100	0	-	0
	1.00	"	100	11	-	11
	1.00	"	100	0	-	0
	1.00	"	100	0	-	0
	0.50	"	93	11	93	11
	0.50	"	100	11	-	22
	0.50	"	66	0	86	0
	0.50	"	100	0	-	0
	0.50	1/16	93	0	100	0
	0.50	1/16	100	0	-	14

Table 23. Phytotoxicity observations on various balled and burlapped plants following immersion in various rates of Dursban solutions for the indicated exposure inter val.

Plant Type	Dursban Rate (lbs.AI/100 gal.H_2O)	Exposure time (mins.)	Phytotoxicity Rating 1/					
			Treated plants			Untreated plants		
			1 mo.	2 mo.	3 mo.	1 mo.	2 mo.	3 mo
Wax Coricium	4	5	1	1	1	1	1	1
Vibtinus	2	"	1	1	1	1	1	1
Ilex bullata	1	5	1	1	1	1	1	2
Sweet olive	1/2	5	1	1	1	1	1	1
Ilex fosteri	1/4	5	1	1	1	1	1	1
Vib. odoratissimum	1/8	5	1	1	1	1	1	1
Sasanqua	1/8	5	1	1	1	1	1	1
Azalea	1/8	5	1	1	1	1	1	1
Jap yew	1/8	5	1	1	1	1	1	1
Camelia	1/8	5	1	1	1	1	1	1
Photina	1/8	5	1	1	1	1	1	1
Rotundifolia	1/8	5	1	1	1	1	1	1
Vib.tinus and Sweet Olive	1/8	5	1	1	1	1	2	2
Ilex fosteri-Vib.odoratissimum	1/8	5	1	1	1	1	1	1
Rotundifolia-Sweet Olive	1/8	5	1	1	1	1	1	1
Vib. odoratissimum Photina	1/8	5	1	1	1	1	1	1
Ilex Bullata	1/16	5	1	1	1	1	1	1
Camelia-Sasanqua	1/32	5	1	1	1	1	1	1
Mixed plants	1/64	5	1	1	1	1	1	1
Mixed plants	1/128	5	1	1	1	1	1	1
Mixed plants	1/128	5	1	1	1	1	1	1

1/ 1 = Healthy, 2 = slight yellowing, wilting, etc.; 3= symtoms more severe than 2. Leaf drop, etc.; 4 = severe stunting, abnormal leaf or stem structure; 5 = Dead.

Table 24. Phytotoxicity observations on various potted plants following immersion in the indicated insecticidal solution for the indicated exposure interval.

Plant Type	Insecticide & Rate (lbs. AI/100 gal.) H_2O	Exposure time (min.)	Phytotoxicity Rating 1/ Treated Plants			Untreated Plants		
			1 mo.	2 mo.	3 mo	1 mo.	2 mo.	3 mo
Burfordi	Amaze 1/8	1/2	1	2	2	1	2	4
Crippsi	1/8	1/2	3	3	3	2	2	4
Pfitzer	1/16	1/2	1	1	1	1	1	1
Golden Pfitzer	1/16	1/2	1	1	1	1	1	1
Var.Procumbest	1/4	1/2	1	1	1	1	1	1
Photina	1/4	1/2	1	1	1	1	1	1
Gardenia	1/8	1/2	1	1	1	1	1	1
Hibiscus	1/8	1	1	1	1	1	1	1
Dwarf Scheffleri	1/8	1	1	1	1	1	1	1
Hydrangea	1/8	1	3	2	3	3	2	3
Dwarf yeopon	Dursban 1/8	2½	4	3	3	1	1	1
Helleri	1/8	1¼	1	1	1	1	1	1
Dwarf Burfordi	1/8	3/4	1	1	1	1	1	1
Azalea	1/8	1/3	2	1	1	1	1	1
Rotundifolia	1/8	1/6	1	1	1	1	1	2
Golden Euonymus	1/8	1/2	1	1	1	1	1	1
Carissa	1/8	1/2	1	1	1	1	1	2
Pyracantha	1/8	1/2	1	1	5	1	1	5

1/ 1 = Healthy, 2 = Slight yellowing, wilting, etc.; 3 = symptoms more severe than 2. Leaf drop, etc.; 4 = severe stunting, abnormal leaf or stem structure; 5 = Dead.

VI CONTRACTING WITH INDUSTRY TO DEVELOP IFA CONTROL TECHNOLOGY

Two different government contracts were awarded in 1979 to industry groups to develop imported fire ant control technology:

(A.) Contract No. 53-3294-9-31 in the amount of $80,981 was issued on August 8, 1979, to Herculite Products, Inc. 1107 Broadway, New York, N.Y. The purpose of this contract is to conduct laboratory and/or field studies to develop formulations of pesticides which will extend their residual effectiveness in order to achieve practical quarantine treatments for grass sod and field-grown ornamental plants. Specifics of this contract are as follows:

Phase I. Formulation Preparation and Small Plot Field Trials

A. Formulation: Hercon will formulate three insecticides that have demonstrated efficacy and acceptability to EPA into multi-layer polyneric dispensers. Each insecticide will be formulated at two concentrations (i.e. based on percent active ingredient) with four different plastic types and with one particle size. Total formulations: 3 x 2 x 4 x 1 = 24.

B. Exposure in Soil: Formulations will be forwarded to APHIS, Gulfport, Mississippi for use in small plot field applications. To determine the percent insecticide in the soil, and remaining in the polymeric dispensers. APHIS will provide Hercon with soil samples from treated small plots for analyses.

C. Chemical Analyses: Hercon and APHIS will analyze polymeric dispensers, and soil samples to determine percent remaining insecticide in the dispenser, and insecticide residue in the soil. Hercon will provide APHIS with analytical procedure from dispensers;

D. Bioassays: (by Gulfport Methods Development Center): 24 formulations replicated three times = 72 bioassays to be checked at four intervals.

Phase II. Field Trials

a. Formulation: Hercon will prepare sufficient amounts of best four formulations from Phase I for field trials.

b. Biological Evaluation: Efficacy, persistence and field observations on the four formulations will be evaluated by the Gulfport Methods Development Center to determine which formulation is best. The commercial Dursban 15G granular product (Dow Chemical Co.) will be used as the standard. This will entail periodic evaluation of each formulation versus the Dursban 15G control plot treated and monitored concurrently. Minimum number of plots: 4 formulations and one Dursban 15G plot in duplicate or 5 x 2 = 10 plots.

c. Chemical Evaluation: Hercon will determine the chemical residue in the plastic formulations (and in the soil) at monthly or bi-monthly intervals. Analyses to determine insecticide residue in the dispensers (Total): 8 plots x 2 (duplicate analyses) x 8 intervals= 128. Analyses to determine insecticide residue in the soil (Total): 10 plots (i.e., 8 Hercon plots and 2 Dursban 15G plots) x 2 (duplicate analyses) x 8 intervals = 160. APHIS may also run similar analyses.

B. Contract No. 53-3294-9-30 in the amount of $99,704 was issued on Aug. 8, 1979 to Southern Research Institute, 2000 South Ninth Ave., Birmingham, Alabama. The purpose of this contract is to develop technology related to controlled-release pesticides in baits to control imported fire ants.

Specifics of this contract are as follows:

According to SRI, many design concepts have been studied in development of controlled-release formulations for pesticides. Three of the most promising are:

(1) Capsules of polymeric material filled with a solid or liquid pesticide or with a suspension or solution of the agent in a fluid in which the release of pesticide is controlled by diffusion through the capsule walls or through micropores in the capsule wells.

(2) A heterogeneous dispersion of particles or droplets of pesticide in a solid polymeric matrix, which can be either biodegradable or non-biodegradable and which controls the release of agent by diffusion through the matrix, by erosion of the matrix, or by a combination of both diffusion and erosion.

(3) Chemical bonding of a pesticide to a polymeric material or formulation of macromolecules of pesticides via ionic or covadent linkages which control the release of the agent by hydrolysis, thermodynamic dissocation, microbial degradation, or some other retrograde chemical reaction of the linkages.

The latter concept was chosen by SRI for the present study. This approach will involve preparation of polymeric toxicants having pendant insecticides bound by retrograde chemical bonds. The nature of the linkage will be such that the toxicant will be released slowly after ingestion by the ants. Preliminary evaluation of candidate formulations will be evaluated by the SEA, AR Laboratory in Gainesville, Fla. Further testing in small to medium field plots will be conducted by this laboratory.

VII · GOALS AND OBJECTIVES FOR FISCAL YEAR 1980

1. Continue development of American Cyanamid AC-217,300 bait toxicant.

   A. Evaluate the bait treatments from the Spring 1979 program on 640 acre test plots under EUP (Aerial application to Pasture Land).

   B. Test performance of 2 carriers when applied to 5000 acre test plots by Cagegory A Aircraft.

   C. Assess environmental impact on non-target organisms.

      (1) Provide assistance in residue monitoring.

      (2) Determine impact on other ants and primary bait consumers.

2. Development of alternate regulatory treatments.

   A. Screen new compounds and/or formulations for residual activity.

   B. Evaluate high volume chlorpyrifos drench treatments for certification of grass sod.

   C. Field test 3 or more slow-release formulations of chlorpyrifos or other candidate toxicants.

   D. Assist Dow Chemical with registration of chlorpyrifos

   E. Continue long-term tests initiated last year.

3. Lab screening of new bait toxicants.

   A. Screen 10 new compounds or analogues.

   B. Evaluate the performance of 5 new bait carriers.

4. Assist SEA, AR with a large-scale evaluation of Stauffer MV-678 growth regulator.

VIII

REFERENCES CITED

Banks, W. A., Lofgren, C.S. and Stringer, C.E. 1964. Laboratory evaluation of certain chlorinated hydrocarbon insecticides against the imported fire ant (Solenopsis saevissima richteri). J. Econ. Ent. 57:298-299.

Collins, H. L., Mangum, C. L., Medley, J.W. and Guenthner, A. W. 1980. Evaluation of soil insecticides for quarantine treatments against fire ants. Submitted for publication in Insecticide and Acaracide tests, Vol. 5.

Culpepper, G. H. 1953. Status of the im ported fire ant in the southern states in July 1953. U. S. Dept. Agric. Res. Serv. #867. 8PP.

Lofgren, C.S., Bartlett, F. J. and Stringer , C.E. 1961. Imported fire ant toxic bait studies. The evaluation of various food materials. J. Econ. Ent. 54:1096-1100.

McNeill, J.C., Briscoe, J. J. and Ludwig, P.O. 1979. Residual control of mosquitoes in Draining Ditches in Brazoria County, Texas. Down to Earth 35 (3): 16-18.