LABORATORY REPORT

U. S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE
IMPORTED FIRE ANT STATION

OCTOBER 1, 1980 - DECEMBER 31, 1981

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These reports were assembled for the information of the U. S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine personnel and key personnel in other agencies engaged in imported fire ant programs. Statements in some instances are based on preliminary, uncompleted, or unconfirmed experiments or observations; therefore, the data are not ready for publication or public distribution.

Results of insecticide tests are reported here. Mention of trade names or propriety products does not constitute an endorsement or recommendation for use by the U. S. Department of Agriculture.

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October 1, 1980 - December 31, 1981

Laboratory Report
Imported Fire Ant Station
Whiteville Methods Development Center

U. S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine Programs
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INTRODUCTION

1981 was a year of transition for personnel and functions assigned to this facility. Several drastic changes in employee structure and program responsibilities were made. In March 1981, a realignment of functions for the Gulfport Methods Development Center was approved for implementation. Responsibility for all Mediterranean fruit fly activities was assigned to the Brownsville Methods Development Center, while all imported fire ant activities came under the direction of the Whiteville Methods Development Center. As a result of the realignment of functions, the Gulfport Imported Fire Ant Station was created. Two basic areas of responsibility were assigned to the Station which is staffed by two entomologists, four biological technicians and a secretary. The first area of responsibility involves the testing and development of area-wide population suppression techniques, which at the present time primarily consist of dispersion of toxic baits by aircraft. The second area of responsibility concerns the development of quarantine treatments for items such as nursery stock and grass sod that could facilitate inadvertent spread of the imported fire ant into previously non-infested areas of the country. This report documents major projects and activities completed between October 1, 1980 and December 31, 1981.

CONTENTS

Project No.	Project Title	Page
IFA 80-4	Comparison of AMDRO formulated on an expanded corn cob carrier versus pre-gelled defatted corn grits.	1
IFA 81-1	Evaluation of various rates and formulations of chlorpyrifos for IFA quarantine treatments of grass sod.	19
IFA 81-2	Evaluation of EL-468 for control of imported fire ants.	20
IFA 81-3	Evaluation of bi-annual applications of AMDRO for control of imported fire ants.. . . . . , .	27
IFA 81-4	Tests with fumigants for individual mound treatments.	31
IFA 81-7	Phytotoxicity of AMAZE and Dursban to vegetable transplants grown in treated media.	33
IFA 81-10	Evaluation of a positive metering device facilitate aerial application of IFA bait toxicants.	46
IFA 81-11	Field trials with an improved EL-468 formulation for area-wide control of imported fire ants . . .	51
IFA 81-12	Shelf life studies with AMDRO and EL-468.	55
IFA 81-13	Tests with HERCON controlled release insecticide formulations for residual activity against the IFA.	61
IFA 81-14	Multiple applications of Dursban solution for quarantine treatments of balled and burlapped nursery stock.	74
IFA 81-15	Evaluation of lindane for quarantine treatments .	81
IFA 81-16	Evaluation of potting soil toxicants.	85
IFA 81-17	Root dip treatments for certification of balled and burlapped nursery stock.	87

SUMMARY

Comparison of AMDRO formulated on expanded corn cob carrier versus pregelled defatted corn:

Fall 1980 aerial applications of various AMDRO formulations to multi-state large acreage test plots produced highly variable results. However, AMDRO formulated on a defatted corn carrier provided an overall average of 76.6% kill whereas 47.3% kill was obtained with an expanded cob formulation (page 1).

Evaluation of various rates and formulations of chlorpyrifos for quarantine treatments of grass sod:

Small plot field tests with various chlorpyrifos treatments indicated that granular formulations provided greater residual activity than did comparable rates with EC formulations. Granular treatments at rates of 4.0 lbs. AI/Acre and less provided 3 to 4 weeks of control while higher rates (6.0 lbs. AI/Acre and greater) demonstrated residual activity for 8 to 12 weeks (page 9).

Evaluation of EL-468 for control of IFA

Field trials conducted on non-agricultural land in the Spring of 1981 demonstrated good potential for IFA control with EL-468. Better results were obtained with a pregelled defatted corn formulation than with an expanded corn cob formulation. An average of 77% kill 14 weeks after treatment was obtained at an application rate of 2.5 lbs/acre (8.5 gms. AI/Acre). (page 20).

Evaluation of Bi-Annual application of AMDRO:

Two AMDRO applications spaced 6 months apart (Fall 1980 and Spring 1981) were highly effective in eliminating the pretreatment population. However, reinfestation of the treated area by newly mated queens resulted in an actual increase in the ant population 28 weeks after the second application (page 27).

Tests with fumigants for individual mound treatments:

Mylone granules, Vapona Insect strips and methyl bromide were tested as single mound treatments. 45 mls. of methyl bromide injected 6-12 inches into the mound structure was found to be highly effective in eliminating ant colonies. Mylone 50D and Vapona Insect strips were totally ineffective and testing with these materials was discontinued (page 31).

Phytotoxicity of AMAZE and Dursban to vegetable transplants grown in treated media:

Both Dursban and AMAZE applied as a preplant incorporated treatment in granular form adversely affected the growth and development of several species of vegetable seedlings (page 38).

Evaluation of a positive metering device to facilitate aerial application of IFA bait toxicants:

A positive metering device produced by Elanco and designed to distribute pelleted materials from aircraft was evaluated for dispersion of IFA bait toxicants. The unit basically consists of a vaned rotor driven by an electric motor which is controlled by two independently calibrated potentiometers. The unit demonstrated capability to accurately apply a variety of materials over a wide dosage range (page 46).

Field trials with an improved EL-468 formulation for area-wide control of imported fire ants:

Field trials with an "improved" formulation of EL-468 were initiated in late October 1981. Two rates of application were applied to 7 different airport properties in Mississippi and Georgia. A preliminary evaluation previously scheduled for December 14-18, 1981, was cancelled due to bad weather. Final results of this series of trials will be available in April 1982 (page 51).

Shelf life studies with AMDRO and EL-468:

Storage of AMDRO and EL-468 at elevated temperatures was shown to adversely affect feeding acceptance by foraging workers. AMDRO stored at room temperature remained acceptable for 6 months (page 55).

Tests with Hercon controlled release insecticide formulations for residual activity against the IFA:

Tests were conducted to evaluate Hercon's controlled release technology which incorporates insecticides in a multilayer polymeric dispensing system. Twenty-four formulations of AMAZE, DIAZINON and Dursban were applied to field microplots and tested over time for residual activity.

Based on laboratory bioassays with soil samples collected from the microplots, Diazinon was effective for 4 months, while AMAZE was active for approximately 5 months. Some chlorpyrifos formulations continued to show activity after 13 months, indicating the potential for use of this product as a quarantine treatment for grass sod and field-grown woody ornamental plants (page 61).

Multiple applications of Dursban solution for quarantine treatments of balled and burlapped nursery plants:

Since root dip treatments (total immersion of the plant ball) is disfavored due to cost and labor requirements, multiple applications of Dursban solution, applied in lieu of normal watering was evaluated. Total penetration/saturation was achieved after 3 days with a twice-daily watering schedule. Six to eight weeks residual activity was obtained with this treatment (page 74).

Evaluation of lindane for quarantine treatments:

Dosage mortality tests with lindane indicated that the LD_{99} to worker ants is approximately 0.35 ppm. Residual activity in potting soil is being evaluated but results are incomplete at the present time (page 81).

Evaluation of potting soil toxicants:

A screening program to evaluate potting soil toxicants was continued. Several formulations of Orthene were tested and found to be ineffective. Methoxychlor, Toxyphene and Delnav were also ineffective. Lindane 6 WP demonstrated potential, and tests with various formulations of this product are in progress (page 85).

Root-dip treatments for certification of Balled and Burlapped nursery stock:

Lindane 20EC at a rate of 8 fl. oz/100 gal. H_2O was highly effective as a root dip treatment for B & B plants. Orthene 75SP at .5 lb AI/100 gals H_2O was also effective, but had less than 30 days residual activity (page 87).

Project Number: IFA 80-4

Project Title : Comparison of AMDRO formulated on an expanded corn cob carrier versus Pregelled Defatted corn grits.

Investigators : H. L. Collins, D.J. Adams, A. L. Ladner, B. C. Clark, M. J. Cuevas, C. J. Mauffray, and David Dreher.

INTRODUCTION

Trials conducted in three states by this laboratory in the Spring of 1980 demonstrated that AMDRO formulated as a palatable toxic bait consisting of 30% soybean oil impregnated on pregelled defatted corn grits with a .88% AI provided 79 and 88% kill at 6 and 12 weeks respectively following treatment. Four other AMDRO formulations were less effective. However, a formulation consisting of 25% soybean oil impregnated on expanded corn cob grits (produced by The Andersons, Maumee, Ohio) with .88% AI provided 71 and 80% kill at 6 and 12 weeks following treatment.

Use of the expanded cob carrier in large-scale IFA programs would have several distinct advantages over the defatted corn carrier:

(1) Cobs would probably be more economical.

(2) Cobs would not require specialized application equipment - systems previously used for Mirex would be perfectly adapted to the expanded cobs.

However, due to the lower oil absorption of cobs plus unavailability of all the absorbed oil (cobs are non-friable) performance of this carrier may not consistently match the defatted corn. More definitive tests were needed to resolve these issues.

On October 15, 1980, tests to further evaluate aerial application of various formulations of AMDRO were initiated. The two primary formulations in this series of tests were:

(1) !'Standard" AMDRO (30% SBO on Pre-gelled Defatted Corn Grits, .88% AI)

(2) "expanded cob" AMDRO (also designated as formulation F, consisting of 25% SBO on expanded corn cob grits, .88% AI).

At one site (Brookhaven, Mississippi) a third formulation based on the "10-5" concept was also applied.

AIRCRAFT SPECIFICATIONS

1. Cessna Ag-Truck
2. Delivery System
   (a) Transland slimline spreader
   (b) Ram-air system in hopper
3. 120 mph operating speed
4. 50' altitude
5. 50' working swath; 60' overall
6. Operated by Tim Roland, PPQ Pilot

GUIDANCE

Aircraft guidance and swath spacing were provided by helium-filled Kytoons tended by ground personnel.

TREATMENTS APPLIED AND BAIT FORMULATION SPECIFICATIONS

Characteristics of each formulation applied were as follows:

Type of Formulation	Lot Numbers	Carrier	% SBO	Bulk Density (lbs./ft ^{3})	GMS AI/lb. Bait
Standard AMDRO	008K0124L 008K0332L 008K0141L	De-fatted corm	30	20.0 1/	4.0
Expanded Cobs	008K0021K	Expanded cobs	25	29.3	4.0
"10-5 Concept"	008K0023K	Expanded cobs	25	29.2	4.0

1/ Considerable variation in Bulk Density was noted. The figure of 20.9 lbs ft.^{3} represents an average for 3 different sacks of bait which weighed 18.0, 23.0, and 21.9 lbs/ft ^{3} respectively.

DESCRIPTION OF TERRAIN TREATED AND LOCATION OF TEST SITES

Each test plot was approximately 200 acres in size and consisted entirely of permanent pastureland. Due to the relatively small size of these blocks, no "cut-outs" other than ponds and small streams were necessary.

Treatment blocks were located near Montgomery, Alabama: Brookhaven, Mississippi; and Hammond, Louisiana. All treatments were applied by PPQ aircraft on October 15-21, 1980.

VI. SUMMARY OF TREATMENTS

Treatments applied, acreage treated and dates of application are as follows:

Test Plot Location	Plot No.	Formulation Applied	Formulation Lot No.	Date of Application	Rate/Acre (lbs.Bulk Bait)	Plot Size (Acres)
Montgomery,Ala.	I	Standard AMDRO	008K0131L	10/13/80	1.0	200
	II	Expanded cobs	008K0021K	10/15/80	.95	200
Brookhaven, Ms.	I	Standard AMDRO	008K0141L 008K0124L	10/17/80	1.2	182
	II	Expanded cobs	008K0021K	10/20/80	1.0	130
	III	"10-5" Concept	0080023K	10/20/80	1.1	120
Hammond, La.	I	Expanded cobs	008K0021K	10/21/80	1.00	184
	II	Standard AMDRO	008K0141L 009K0332L	10/21/80	.95	182

VII. PROCEDURES USED TO ACQUIRE EFFICACY DATA:

A. Prior to treatment twenty-five 1/4-acre efficacy plots were established within each 200-acre test plot. The center of each efficacy plot was marked with a wooden engineering stake. Diagramatic sketches (field maps) showing distances, relative position, etc. of each efficacy plot facilitated location of the center stake during the posttreatment assessments.

B. While pivoting around the center stake, a team of 6 to 7 people closely searched each plot for the presence of imported fire ant colonies. After locating a colony, the mound was opened with a spade and the types of relative abundance of life forms present observed. According to Banks et al. (1981), presence of worker brood in an ant colony is strong evidence that the queen is present and the colony is normal. Williams et al. (1979) reported that AMDRO may cause death of the queen without total elimination of the worker force. In theory, such a colony will eventually die unless the queen is replaced by adoption of a newly mated queen.

Two types of data were recorded for each subplot examined:

(1) total number of ant colonies present

(2) the relative size and types of colonies present.

This data was recorded prior to treatment and twice following treatment for each of the 25 efficacy plots in each 200-acre treatment block.

The classification system 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 nuisnace 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) has

been 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.

Colony mortality (% kill) was computed in the following manner:

$$\frac{Np - Na}{Np} \times 100$$

Where Np = Number of colonies present prior to treatment and Na = number of colonies present after treatment.

All data was corrected for natural mortality by Abbott's formula:

$$Pt = \frac{Po - Pc}{100 - Pc} \times 100$$

Where Pt = corrected mortality %
Po = observed mortality %
Pc = natural or untreated check mortality %

VIII. RESULTS AND DISCUSSION

Results of this series of tests are shown in Table 1. These results are extremely variable, and cannot be attributed to climatic conditions, foraging activity, mis-application or other obvious reasons. Standard AMDRO formulations provided far better control at all test sites than did the expanded cob formulation (a mean of 76.6% kill with Standard AMDRO 5 months after treatment vs. a mean of 47.3% kill with expanded cob formulation. The highest level of control was obtained with Standard AMDRO at Brookhaven, Ms. (95%). The slightly greater rate of application (1.2 lbs/acre) at this site may have enhanced kill.

Population density is another factor which may have influenced site to site variation in control. At Montgomery, Al., the population density averaged 27.4 colonies/acre. At Brookhaven, Ms., and Hammond, La., the average was 26.7 and 38.7 respectively. Conversely, other factors may also produce equal or greater effects, but the interaction of population density and rate of application merits additional study. Theoretically, a variable dose rate based upon population density could be established and implemented for program use.

Table 1. Results with various formulations of AMDRO for control of imported fire ants.
Fall 1980 Applications

Test Site Location	Treatment		Colony Mortality 1/ No. Colonies Present			% Kill		Population Index 1/				
	Bait Formulation	Rate/Acre (lbs.)	Pretreat	6 Wks.	5 Mos.	6 Wks	5 Mos	Pretreat	6 Wks Post-treat	% Change	5 Mos. Post-treat	% Change
Montgomery, Ala.	Standard AMDRO	1.0	171	34	46	80	73	1273	239	-80	173	-86
" "	Expanded cobs	.9	172	64	87	63	49	1099	496	-55	574	-52
" "	Untreated checks	-	196	266	332	0	0	1441	2263	+57	2574	+78
Brookhaven, Ms.	Standard AMDRO	1.2	167	26	9	84	95	1233	99	-92	48	-96
" "	Expanded cobs	1.0	244	79	37	68	85	1831	463	-75	189	-90
" "	"10-5" Expanded cobs	1.1	247	126	131	49	47	2166	805	-63	814	-62
" "	Untreated check	-	246	281	330	0	0	1885	2255	+19	2627	+39
Hammond, La.	Standard AMDRO	.9	242	168	92	31	62	1907	1159	-39	655	-65
" "	Expanded cobs	1.0	220	232	202	0	8	1680	1744	+3.8	1395	-17
" "	Untreated Check	-	396	465	558	0	0	2781	3963	+42	4916	+77

1/ Based on observations made in twenty-five 1/4-acre efficacy plots/treatment.

REFERENCES CITED

Banks, W.A., H. L. Collins, D. F. Williams, C. E. Stringer, C. S. Lofgren, D. P. Harlan and C. L. Mangum. 1981. Field trials with AC-217,300 a new amidinohydrozone bait toxicant for control of the red imported fire ant. Southwestern Entomologist. 6(2):158-164.

Williams, D. F., C. S. Lofgren, W. A. Banks, C.E. Stringer and J. R. Plumley. 1980. Laboratory studies with nine amidinohydrozones, a promising new class of bait toxicants for control of red imported fire ants. J. Econ. Ent. 73(6):798-802.

Project Number: IFA 81-1

Project Title: Evaluation of various rates and formulations of chlorpyrifos for IFA quarantine treatments of grass sod

Investigators: H. L. Collins, C. J. Mauffray, Dudley Adams, Jay Speight, Avel L. Ladner, M. J. Cuevas, Jim Spence and Bob Vest

INTRODUCTION:

Commercial shipments of ornamental nursery plants and grass sod were associated with accidental introduction of imported fire ants into previously non-infested areas as early as 1953 (Culpepper 1953). Due to their effectiveness and residual activity, chlorinated hydrocarbon insecticides were used by PPQ for quarantine treatments to prevent this accidental spread until EPA issued a cancellation order for the use of chlordane for this purpose on March 6, 1978. Preliminary efforts by this laboratory to develop alternate treatments indicated that chlorpyrifos sprays, if properly timed and applied, will control certain life forms infesting grass sod. However, additional information was needed to establish a minimum dose rate for both granular and EC formulations of chlorpyrifos as well as to confirm the preliminary test results with data generated under actual field conditions.

METHODS AND MATERIALS:

It is assumed that the greatest pest risk associated with shipment of grass sod is transport of newly mated queens that may be either on the sod surface or slightly below the surface in the initial brood chamber. This assumption is based on the fact that the likelihood of removing and shipping a mature queen is nil, since vibrations from approaching harvest machinery would cause her to retreat deeply within the mound. Due to the difficulty in obtaining large numbers of newly mated queens, the more easily collected unmated queens (female alates) were utilized as the target pest in the tests reported here.

On June 23, 1981, a series of three tests to evaluate various rates and formulations of chlorpyrifos was initiated. Six rates of FA-5 and six rates of 4 EC were applied to 10' x 50' test plots in centipede sod located on the Alboa grass farm near Gulfport, Miss.

EC formulations were applied with a FMC Model FG-1010 high pressure sprayer equipped with two floodjet nozzles with TK-553 tips spaced 5 feet apart on a horizontal spray boom which was mounted 1 foot above the ground. This arrangement produced a 10 foot swath. The spray rig was calibrated to deliver 43 gallons of finished spray per acre at 25 PSI. Granular formulations were applied with a modifined Gandy® applicator mounted on a 1700 Ford tractor.

Prior to treatment, 20 alate queens were singly confined in 1 x 2.3 cm perforated plastic vials and buried 2.5 cm deep at random locations within each test plot. This procedure simulated a natural infestation in which newly mated queens would be sequestered below the surface in their initial brood chamber.

Immediately following treatment, all test plots were irrigated with an overhead pulsating sprinkler irrigation system. After three hours of operation, the amount of water applied was recorded by 3 rain guages located at strategic locations among the test plots.

Forty-eight hours following treatments, the plastic vials containing the alate queens were retrieved and the percent mortality attributable to each treatment was recorded. These procedures were replicated in Test II and Test III which were conducted on June 30 and July 7, respectively. As mentioned above, FA-5 (a 5% granular product registered by Dow exclusively for incorporation into nursery potting and bench soil) was used in Test I. FA-5 is formulated on small particles and is very "dusty", thus is not well suited for field application with conventional application equipment. Therefore, the agricultural formulation of granular chlorpyrifos (Lorsban 15G) was utilized in Test II and Test III.

Residual activity of each treatment was determined in the following manner: A wheel-type soil sampler was used to collect and composite approximately 300 soil cores (.5" x 2.0") from each plot at weekly intervals for 8 or more weeks following treatment. Samples were passed through a 1/4" mesh sieve to remove grass, rizomes and other debris from the soil. Each composited soil sample was then frozen until it was bioassayed with alate queens and later subjected to GLC analysis by NMRL. Bioassays were conducted in the laboratory by confining alate queens to treated soil which was placed in 2" x 2" plastic flower pots equipped with a Labstone® bottom. The Labstone absorbed moisture from an underlying bed of damp peat moss, while a Fluon® coating prevented the ants from escaping from the top of the open pots. Each pot (replicate)

contained 20 cc of treated soil and 5 alate queens. Queen mortality was assessed after 72 hours of continuous exposure to the treated soils.

RESULTS

Initial Kill - Mortality of caged alates implanted in grass sod immediately prior to treatment is shown in Table 2 . Results from all 3 trials are summarized in Table 3 . These results are quite variable and reflect a definite lack of dose response. Higher rates of a given formulation often provided less kill than did lower rates.

This may have been partially due to test procedure since the perforated vials used to confine the queens may have afforded some degree of protection. However, it also indicates that the presently recommended treatment of chlorpyrifos 2E or 4E applied at 8.48 lbs. AI/acre (PPQ Manual 805-25.2220) is not totally effective and is, therefore, unnecessary and ill-advised since lower rates appear to be equally effective. Granular treatments were somewhat less effective than EC treatments in providing quick initial kill. This could be attributed to uniformity of coverage and relative rate of penetration/saturation of the two types of formulations.

Residual Activity - The residual activity of each treatment evaluated is shown in Table 4. In general, EC treatments of .5 to 4.0 lbs AI/Acre were effective for 1 week or less. Rates of 6.0 and 8.0 lbs. AI/Acre were effective for only 1-2 weeks although PPQ Manual 805-25.2200 specifies a 6-week certification period for chlorpyrifos 2E and/or 4E applied at 8.48 lbs. AI/Acre.

Granular treatments in general provided longer residual activity than did EC treatments. Rates of 4.0 lbs. and less provided 3 to 4 weeks of control while higher rates (6.0 lbs. and greater) showed activity for 8 to 10 weeks after treatment.

GLC ANALYSIS of Soil Samples - GLC analysis of all samples was conducted by Jim Spence NMRL. His findings are shown in Table 5 . These results confirm and support the bioassays described above. Degradation curves for surface applications of both granular and EC formulations of chlorpyrifos in grass sod are depicted in Figure 1.

DISCUSSION:

At the present time, only two approved certification treatments for grass sod are available: (1) PPQ Manual 805-25.1210 provides a Methyl Bromide fumigation schedule for this commodity; however, this is not a practical treatment and is rarely, if ever, utilized (2) As mentioned earlier PPQ Manual 805-25.2220 specifies the use of chlorpyrifos 2E or 4E at a rate of 8.48 lbs. AI/Acre. This treatment is made under a specific exemption (Section 18 FIFRA) which will expire May 1, 1982. Data presented herein has shown this treatment to be less effective than is desired. It seems logical to recommend that those treatments which were shown to be effective (15G at 6.0 and 8.0 lbs./Acre followed by 1" irrigation water) be implemented. However, discussions with Dow Chemical Co. representatives regarding the use of Lorsban 15G on grass sod have indicated that this probably will not be favored by Dow. Due to Dow's marketing practices Lorsban 15G is intended for use on agricultural crops only, and grass sod is considered to be an industrial use. Further discussions with Dow are needed to clarify this issue.

RECOMMENDATIONS

1. Obtain a specific exemption (Section 18 FIFRA) for use of chlorpyrifos 15G applied at 6.0 lbs AI/acre with a 10 week certification period. If Dow remains opposed to the use of Lorsban 15G, it may be necessary to work with a formulator such as Security, Southern Mill Creek Chemicals, etc. to produce and register a product specifically for IFA control.
2. Discontinue the presently used treatment utilizing chlorpyrifos 2E or 4E at 8.48 lbs AI/Acre (after completion of No. 1 above).
3. Proceed with efforts to develop other treatments, especially lindane.

Table 2. Efficacy of various rates and formulations of chlorpyrifos for control of Alate Queens artificially implanted in grass sod prior to treatment.

Test No.	Date	Treatment 1/ Formulation	Rate/Acre (lbs AI)	% Mortality of caged Alate Queens 48 hrs. after treatment 2/
I	6/23/81	4EC	.5	95
"	"	"	1.0	85
"	"	"	2.0	70
"	"	"	4.0	85
"	"	"	6.0	85
"	"	"	8.0	60
"	"	FA-5	1.1	10
"	"	"	1.7	20
"	"	"	3.3	20
"	"	"	3.6	0
"	"	"	6.7	50
"	"	"	9.5	20
"	"	check	-	5
II	6/30/81	4EC	.5	90
"	"	"	1.0	80
"	"	"	2.0	95
"	"	"	4.0	95
"	"	"	6.0	90
"	"	"	8.0	70
"	"	15G	.5	55
"	"	"	1.3	50
"	"	"	2.3	65
"	"	"	4.6	40
"	"	"	6.5	40
"	"	"	11.3	75
"	"	Untreated check	-	15
III	7/7/81	4EC	.5	50
"	"	"	1.0	50
"	"	"	2.0	35
"	"	"	4.0	55
"	"	"	6.0	40
"	"	"	8.0	75
"	"	15G	.7	80
"	"	"	1.4	80
"	"	"	2.0	70
"	"	"	3.9	70
"	"	"	6.4	90
"	"	"	8.0	55
"	"	Untreated check	-	40

1/ Immediately following treatment test plots were irrigated with 3/4" to 1" water.

2/ Twenty Alate queens confined in 1 x 2.3 cm plastic vials per treatment.

Table 3. Summary of results with chlorpyrifos for control of Alate IFA queens artificially implanted in grass sod immediately prior to treatment.

TREATMENT 1/		
Formulation	Rate of Application (lbs. AI/Acre)	$\bar{X}$ % Mortality of caged alate queens 48 hrs. after treatment 2/
4EC	.5	78
	1.0	72
	2.0	67
	4.0	78
	6.0	72
	8.0	68
15G 3/	.7	48
	1.5	50
	2.5	52
	4.0	37
	6.5	60
	9.6	50
Untreated check	-	20

1/ Immediately following treatment test plots received 3/4" to 1" irrigation water.

2/ 20 alate queens confined in 1 x 2.3c perforated plastic vials per treatment. Mean based on results obtained in 3 separate trials.

3/ FA-5 used in Test I; 15G in subsequent tests. Rates of application shown are averages in all 3 tests.

Table 4. Residual activity of various rates and formulations of chlorpyrifos applied to grass sod for control of IFA queens.

Test No.	Treatment: Formulation	Treatment: Rate/acre (lbs.AI)	$\bar{X}$ % Mortality of Alate queens confined to treated soil collected at indicated post-treat interval [1/]										
			24 hrs.	1 wk.	2 wks	3 wks	4 wks	5 wks	6 wks	7 wks	8 wks	10 wks	12 wks
I	4EC	.5	0	NS	0	0	5	5	NS	15	0	NS	NS
"	"	1.0	0	NS	0	0	0	0	NS	20	0	NS	NS
"	"	2.0	0	NS	5	0	5	0	NS	5	0	NS	NS
"	"	4.0	40	NS	0	10	0	0	NS	0	0	NS	NS
"	"	6.0	100	NS	0	5	0	0	NS	0	0	NS	NS
"	"	8.0	100	NS	0	95	10	20	NS	15	0	NS	NS
"	FA-5	1.1	0	NS	0	75	0	5	NS	5	0	NS	NS
"	"	1.7	100	NS	5	100	15	0	NS	5	5	NS	NS
"	"	3.3	100	NS	25	0	75	20	NS	10	0	NS	NS
"	"	3.6	100	NS	5	80	20	15	NS	0	0	NS	NS
"	"	6.7	100	NS	100	100	100	100	NS	100	95	100	5
"	"	9.5	100	NS	100	100	100	100	NS	100	100	40	35
"	Untreated check	-	0	NS	0	0	5	0	NS	0	0	0	0
II	4EC	.5	0	5	0	0	0	NS	0	0	0	NS	NS
"	"	1.0	0	0	0	0	0	NS	5	5	10	NS	NS
"	"	2.0	0	0	0	0	0	NS	5	5	0	NS	NS
"	"	4.0	90	5	0	0	5	NS	0	0	0	NS	NS
"	"	6.0	100	45	0	0	5	NS	0	5	20	NS	NS
"	"	8.0	100	95	0	0	0	NS	10	0	0	NS	NS
"	15G	.5	0	0	20	0	10	NS	0	0	0	NS	NS
"	"	1.3	10	10	0	0	5	NS	0	0	15	NS	NS

Table 4 (continued)

Test No.	TREATMENT Formulation	Rate/acre (lbs. AI)	$\bar{X}$ % Mortality of Alate queens confined to treated soil collected at indicated post-treat intervals 1/ 24 hrs.	1 wk.	2 wks.	3 wks	4 wks	5 wks	6 wks.	7 wks.	8 wks.	10 wks	12 wks
II	15G	2.3	30	15	0	95	80	NS	70	0	20	NS	NS
"	"	4.6	100	100	0	100	100	NS	100	100	75	NS	NS
"	"	6.5	100	100	100	100	100	NS	100	100	100	100	70
"	"	11.3	100	100	100	100	100	NS	100	100	100	0	90
"	Untreated check	-	0	0	0	0	0	NS	20	0	0	0	10
III	4EC	.5	0	5	0	0	NS	15	0	0	0	NS	NS
"	"	1.0	5	0	5	0	NS	5	0	10	0	NS	NS
"	"	2.0	10	10	0	0	NS	10	0	10	0	NS	NS
"	"	4.0	100	100	10	0	NS	20	0	5	15	NS	NS
"	"	6.0	100	100	95	5	NS	5	0	10	0	NS	NS
"	"	8.0	100	100	100	5	NS	5	0	0	10	NS	NS
"	15G	.7	15	5	0	0	NS	10	0	5	0	NS	NS
"	"	1.4	5	10	0	0	NS	0	0	5	0	NS	NS
"	"	2.0	15	60	80	100	NS	30	0	5	0	NS	NS
"	"	3.9	85	100	100	100	NS	100	0	0	20	NS	NS
"	"	6.4	100	100	100	100	NS	100	10	100	50	50	30
"	"	8.0	100	100	100	100	NS	100	35	100	70	95	65
"	Untreated check	-	15	0	0	0	NS	30	10	0	5	0	0

1/ Mean based on 4 replicates with 5 Alate queens/replicate. Queens confined to treated soil for 72 hrs. prior to assessing mortality. NS = Not Sampled.

Table 5. GLC Analysis of Soil Samples Collected from grass sod test plots treated with various rates and formulations of Chlorpyrifos. National Monitoring and Residue Laboratory, Gulfport, Miss.

Test No.	Formulation	Rate/Acre (lbs.AI)	Chlorpyrifos Residues (ppm) at indicated posttreatment intervals 1/										
			24 hrs.	1 Wk.	2 Wks	3 Wks	4 Wks	5 Wks	6 Wks	7 Wks	8 Wks	10 Wks	12 Wks
I	4EC	.5	.11	NS	.05	.07	.01	.00	NS	.01	.00	NS	NS
"	"	1.0	.39	NS	.07	.06	.07	.02	NS	.02	.00	NS	NS
"	"	2.0	.50	NS	.16	.15	.06	.05	NS	.02	.01	NS	NS
"	"	4.0	1.12	NS	.33	.40	.14	.10	NS	.04	.02	NS	NS
"	"	6.0	3.17	NS	.60	.99	.16	.24	NS	.10	.02	NS	NS
"	"	8.0	4.51	NS	.67	1.66	.45	.33	NS	.15	.09	NS	NS
"	FA-5	1.1	.73	NS	.20	1.00	.09	.05	NS	.02	.02	NS	NS
"		1.7	3.15	NS	.94	6.40	.45	.24	NS	.13	.06	NS	NS
"		3.3	2.74	NS	1.89	1.00	1.61	.71	NS	.31	.17	NS	NS
"		3.6	1.50	NS	1.23	4.68	.53	.66	NS	.36	.18	NS	NS
"		6.7	10.37	NS	4.64	17.51	2.87	2.77	NS	1.15	1.10	.37	.42
"		9.5	10.40	NS	6.23	13.00	5.11	3.13	NS	2.71	1.23	.45	.74
"	Untreated Ck.	-	Neg.	NS	Neg	Neg	Neg	Neg	NS	Neg	Neg	Neg	Neg
II	4EC	.5	.07	.05	.02	.03	.01	NS	.01	.01	.00	NS	NS
"	"	1.0	.10	.07	.06	.03	.03	NS	.01	.00	.00	NS	NS
"	"	2.0	.17	.11	.07	.09	.06	NS	.04	.00	.02	NS	NS
"	"	4.0	1.37	.47	.17	.35	.21	NS	.10	.04	.04	NS	NS
"	"	6.0	2.33	.61	.44	.84	.38	NS	.22	.05	.06	NS	NS

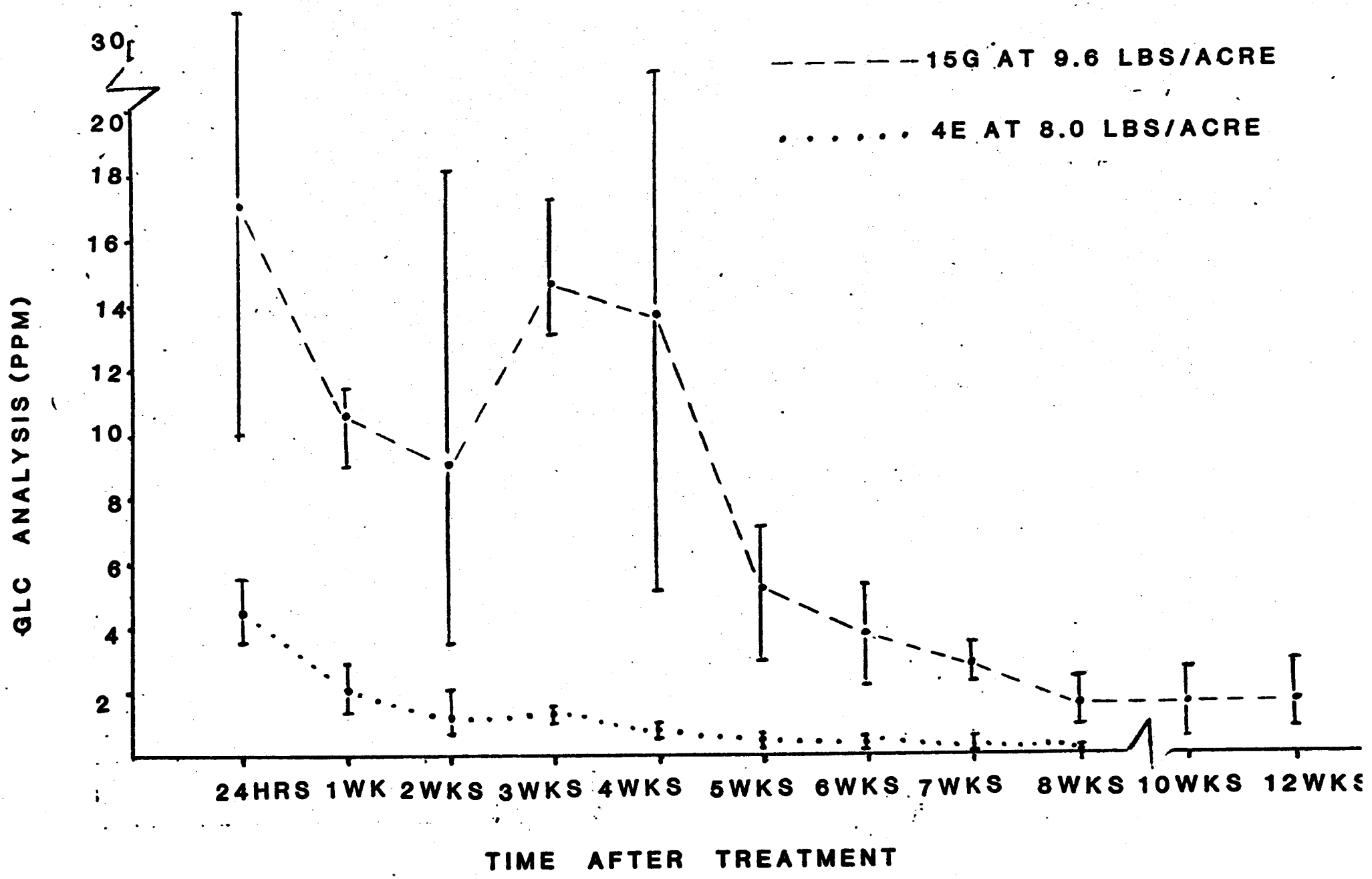
1/ Average Based on Two Analyses/Sample (Mixed Column and 3% DC 200). NS = Not Sampled.

Table 5. GLC Analyis of Soil Samples Collected from grass sod test plots treated with various rates and formulations of chlorpyrifos National Monitoring and Residue Laboratory, Gulfport, Miss.

Test No.	Formulation	Rate/Acre (lbs.AI)	Chlorpyrifos Residues (ppm) at indicated posttreatment intervals 1/										
			24 hrs.	1 Wk.	2 Wks.	3 Wks.	4 Wks.	5 Wks.	6 Wks.	7 Wks.	8 Wks.	10 Wks.	12 Wks.
II	4EC	8.0	3.42	1.40	.63	1.10	.82	NS	.37	.09	.08	NS	NS
"	15G	.5	.66	.64	1.89	1.33	.70	NS	.63	.23	.54	NS	NS
"	"	1.3	1.68	1.51	.14	1.74	.87	NS	.56	.29	.57	NS	NS
"	"	2.3	3.39	3.57	.91	4.15	2.04	NS	1.17	.35	.72	NS	NS
"	"	4.6	9.00	6.88	.58	9.23	5.77	NS	3.39	1.54	1.54	NS	NS
"	"	6.5	11.31	12.49	6.91	16.17	3.91	NS	3.28	2.61	1.62	2.41	1.32
"	"	11.3	30.88	11.25	2.96	13.32	22.62	NS	5.43	3.66	2.41	2.73	2.95
"	Untreated Ck.	-	Neg.	Neg.	Neg.	Neg.	Neg.	NS	Neg.	Neg.	Neg.	Neg.	Neg.
III	4EC	.5	.32	.13	.06	.05	NS	.16	.02	.00	.01	NS	NS
"	"	1.0	.37	.22	.12	.09	NS	.02	.05	.01	.01	NS	NS
"	"	2.0	.69	.32	.33	.16	NS	.06	.02	.04	.03	NS	NS
"	"	4.0	2.08	1.04	.71	.71	NS	.19	.06	.08	.05	NS	NS
"	"	6.0	3.30	1.21	1.11	.76	NS	.19	.09	.08	.06	NS	NS
"	"	8.0	5.86	2.81	2.09	1.09	NS	.37	.13	.14	.10	NS	NS
"	15G	.7	1.92	.70	.89	.20	NS	.11	.03	.05	.06	NS	NS
"	"	1.4	1.81	1.44	1.32	.70	NS	.37	.18	.18	.07	NS	NS
"	"	2.0	4.51	2.13	3.49	4.09	NS	1.35	.25	.42	.45	NS	NS
"	"	3.9	6.47	7.77	7.18	6.05	NS	2.38	.97	1.57	.60	NS	NS
"	"	6.4	17.15	37.84	16.47	13.66	NS	6.17	2.02	2.39	1.62	2.50	1.45
"	"	8.0	10.61	9.69	18.22	17.56	NS	6.79	2.33	3.59	1.86	1.25	1.80
"	Untreated Ck.	-	Neg.	Neg.	Neg.	Neg.	NS	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.

1/ Average Based on Two Analyses/sample (Mixed column and 3% DC 200). NS = Not Sampled.

FIGURE 1. DEGRADATION OF DURSBAN IN GRASS SOD



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Project Number: IFA 81-2
Project Title: Evaluation of EL-468 for Control of Imported Fire Ants
Investigators: H. L. Collins, D. J. Adams, A. L. Ladner, M.J. Cuevas, C. J. Mauffray and Jay Speight

I. INTRODUCTION:

A series of large acreage field trials utilizing aerial application was initiated by the IFA Station, PPQ, APHIS, USDA, in April 1981, to evaluate several experimental formulations of AMDRO (American Cyanamid) and EL-468 (Elanco). These trials were conducted as part of an on-going effort to develop area-wide suppression techniques for control of imported fire ants.

Efficacy of the active component for AMDRO fire ant baits was previously demonstrated in numerous tests conducted by various State and Federal agencies and the manufacturer. However, the optimum bait formulation in terms of ease of application, cost, and effectiveness has not been developed. A pregelled defatted corn carrier impregnated with 30% soybean oil has provided good ant kill in previous trials but is difficult to apply with certain types of conventional aerial delivery systems due to both bridging as well as phenomenon know as "peanut buttering". Peanut buttering is caused by defatted corn particles smashing against aft surfaces of bait spreaders as the particles are propelled through the spreader by the wind stream.

Another type of carrier known as "expanded corn cobs" has several desirable characteristics including high oil absorption, low cost, and availability. Additionally, expanded corn cob particles do not fracture upon impact; thus they do not cause "peanut buttering". However, additional information on the performance of this carrier under actual field conditions was needed.

EL-468 is an experimental insecticide under development by Elanco. This compound has shown promise in previous tests, but all studies prior to the Spring of 1981 were confined to laboratory or small field plots. Larger field tests are now being conducted by this laboratory as well as several other State and Federal agencies in cooperation with the manufacturer.

Since both AMDRO and EL-468 are formulated in a similar fashion, i.e. the toxicant is dissolved in a feeding attractant which is impregnated upon an inert carrier, the formulated products are very similar in appearance and other physical characteristics.

II. AIRCRAFT SPECIFICATIONS:

1. Cessna Ag-Truck
2. Delivery System:
   A. Transland slim-line spreader
   B. Ram-air system in hopper
3. 120 mph operating speed
4. 50' altitude
5. 50' working swath; 60' overall
6. Operated by Tim Roland, PPQ Pilot

III. GUIDANCE:

Aircraft guidance and swath spacings were provided by helium-filled Kytoons® tended by ground personnel.

IV. TREATMENTS APPLIED AND BAIT FORMULATION SPECIFICATIONS:

Two or more formulations of each product were evaluated. Characteristics of each formulation applied were as follows:

Formulation	Lot Number	Carrier	% SBO	Average Bulk Density (lbs/ft ^{3})	Gms.AI/lb Material
Standard AMDRO	101K0059L	De-fatted corn	30	17.6	4.0
AMDRO, "F"	103K0674L	Expanded cobs	25	28.4	4.0
AMDRO, "G"	103K0683L	Expanded cobs	25	29.0	4.0
AMDRO "Alt Source"	103K0654L	De-fatted corn	30	25.4	4.0
EL-468,CCG	X-36794	Expanded cobs	25	27.0	3.4
EL-468,PGD	X-36747 to X-36762	De-fatted corn	30	18.9	3.4

V. DESCRIPTION OF TERRAIN TREATED AND LOCATION OF TEST SITES:

EL-468 formulations were applied under an experimental use permit (1471-EUP-73) which restricted bait application to non-cropland. One of the non-cropland sites treated with EL-468 was a newly planted pine tree farm located near Brookhaven, Miss. The other non-crop sites were Dannley Field (Municipal Airport) at Montgomery, Alabama, and Tangipohoa Parish Airport at Hammond, La.

All AMDRO formulations were applied to permanent grazed pasture land located in the vicinity of Montgomery, Alabama; Brookhaven, Miss.; and Alexandria, La.

VI. SUMMARY OF TREATMENTS: Treatments applied, acreage treated, test site locations and dates of application were as follows:

Test Site	Property	Block No.	Bait Formulation Applied 1/	Date Applied	Desired rate of APPL. (lbs/acre)	Actual rate of APPL (lbs/acre)	Apprx. rate Acreage Treated 2/	Remarks
Montgomery Ala.	Dannly Field	I	EL-468(PGD)	4/11/81	1.25	1.3	192	
"	" "	II	"	"	2.5	2.6	206	"Double treated"
"	Bush Farm	I	Stnd. AMDRO	4/11/81	1.0	1.1	200	Retreatment
"	" "	II	AMDRO "F"	4/11/81	1.0	1.2	200	Retreatment
"	Casey Farm	I	AMDRO "G"	4/12/81	1.0	1.0	293	
"	" "	II	AMDRO "F"	4/12/81	1.0	1.1	300	
"	" "	III	Stnd. AMDRO	4/12/81	1.0	1.0	289	
Brookhaven, Ms.	Brookings Farm	I	Stnd. AMDRO	4/14/81	1.0	1.0	182	Retreatment
"	"	II	AMDRO "F"	"	1.0	1.2	160	"
"	"	III	AMDRO "G"	"	1.0	1.3	120	"
"		IV	EL-468 (CCG)	"	2.5	2.9	100	
"	"	V	EL-468 (PGC)	"	2.5	2.3	175	
"	"	VI	Stnd.AMDRO	"	1.0	1.0	100	
Hammond, La.	Parish Airport	I	EL-468 (PGD)	4/15/81	2.5	2.4	310	
"	" "	II	EL-468 (PGC	"	1.25	1.2	310	
Alexandria La.	Inglewood Plantation	I	AMDRO "ALT Source"	4/16/81	1.0	1.1	82	Carrier purchased from ALT.Source
"	"	II	AMDRO "G"	"	1.0	1.4	325	
"	"	III	STND AMDRO	"	1.0	1.1	200	

1/ Abbreviations used: PGC= Pregelled Defatted corn grits; CCG = Corn Cob Grits.
2/ Acreage based on computations made from aerial photographs.

VII. RESULTS AND DISCUSSION::

All test plots were evaluated twice following treatment utilizing procedures described previously in Project No. IFA 80-4. The first post-treatment assessment was conducted approximately 7 weeks after treatment while a second and final evaluation was conducted 14 weeks after treatment. Results with both AMDRO and EL-468 formulations are shown in Tables 6 and 7.

AMDRO:

Seven weeks after treatment, control with AMDRO ranged from 89% to 41% depending upon formulation applied and test site location. In general, a significant improvement in control was noted during the second evaluation. Fourteen weeks after treatment, the standard commercial formulation of AMDRO provided from 93 to 58% kill, with an overall average of 79%. Corn cob formulations were less effective.

EL-468:

EL-468 provided 84 to 54% kill seven weeks after treatment, with little change noted at the second evaluation. EL-468 formulated on defatted corn and applied at a bulk rate of 2.5 lbs/acre provided an average of 77% kill 14 weeks after treatment. The 1.25 lb/acre rate gave 68% kill versus 74% for the expanded corn cob formulation which was applied at 2.5 lbs/acre.

RECOMMENDATIONS

A. Although there have been some exceptions (notably our Spring 1980 field trials) expanded corn cob formulations of AMDRO have not in general provided the level of control seen with defatted corn formulations. Thus, additional testing of this carrier does not seem justified.

B. The presently available aerial delivery system (ram-air system in hopper operated in conjunction with a transland high volume or slim-line spreader) can be used to apply IFA toxicants formulated on a defatted corn carrier, but additional work on equipment development and modification is needed. Some of the problem areas which should be addressed include:

1. Relatively narrow swath (60' overall).
2. Slight "peanut buttering" on exposed rivet heads of spreader, etc.
3. Specialized, non-commercial design of the ram-air component, flange and orifice plates.

Table 6. Results with Various Formulations of AMDRO and Eli Lilly EL-468 for Control of Imported Fire Ants, Spring 1981 Imported Fire Ant Station, USDA, APHIS, PPQ, Gulfport, Ms.

Test Site Location	TREATMENTS APPLIED					COLONY MORTALITY 1/			POPULATION INDEX 1/			
				Rate/ Acre		% No. Colonies/Plot			% % Kill at indicated POSTTREAT INT		% Change at indicated posttreat interval	
	Toxicant	Carrier	Formulation Code	Bulk (lbs.)	AI (gms.)	Pre-Treat	7 Wks Post-treat	14 Wks Post-treat	7 Wks	14 Wks.	7 Wks	14 Wks
Montgomery, Al.	AMDRO	De-Fatted	Std.	1.0	4.0	10.9	5.0	1.6	56	86	-80	-92
" "	AMDRO	Expanded cobs	"F"	1.0	4.0	13.5	6.2	3.3	53	73	-64	-83
" "	AMDRO	Expanded cobs	"G"	1.0	4.0	10.4	5.7	2.9	41	71	-60	-81
" "	EL-468	DeFatted	PGD	1.3	4.4	10.4	4.9	3.3	54	65	-50	-64
" "	EL-468	De-Fatted	PGD	2.6	8.8	10.6	2.7	3.7	75	66	-75	-68
" "	Untreated		-	-	-	6.4	6.5	2/	14	2/	+10	2/
Brookhaven, Ms.	AMDRO	De-Fatted	Std.	1.0	4.0	22.7	7.6	8.3	63	58	3/	3/
" "	EL-468	Expanded cobs	CCG	2.9	9.9	13.6	4.7	3.4	65	74	-64	-71
" "	EL-468	DeFatted	PGD	2.3	7.8	19.5	5.6	3.8	74	82	-79	-84
" "	Untreated		-	-	-	13.2	10.2	8.9	23	30	- 6	-21
Hammond, La.	EL-468	De-Fatted	PGD	2.4	8.2	8.8	1.7	1.6	78	82	-85	-85
" "	EL-468	De-Fatted	PGD	1.2	4.1	8.5	1.7	2.2	84	72	-88	-78
" "	Untreated		-	-	-	7.9	5.7	5.6	27	29	-27	-26
Alexandria, La.	AMDRO	DeFatted	ALT.	1.1	4.4	11.8	1.3	1.2	89	89	-90	-89
" "	AMDRO	Expanded cobs	"G"	1.4	5.6	12.2	3.4	1.4	72	85	-85	-92
" "	AMDRO	DeFatted	Std.	1.1	4.4	9.8	1.8	.6	83	93	-93	-95
" "	Untreated		-	-	-	11.2	10.9	9.0	11	25	- 7	-21

1/ Based on 25 1/4-acre efficacy plots per treatment
2/ Excessively tall and dense vegetation prevented accurate assessment.
3/ Not determined.

Table 7. Summary of Results with Various Formulations of AMDRO and EL-468 for Control of Imported Fire Ants - Spring 1981. Imported Fire Ant Station, USDA, APHIS,PPQ, Gulfport, Ms.

TREATMENTS APPLIED			COLONY MORTALITY 1/		POPULATION INDEX 1/	
Toxicant	Carrier	Nominal Bulk Rate/Acre (lbs.)	$\bar{X}$ % Kill at Indicated Post-treat Intervals 7 Wks.	14 Wks.	$\bar{X}$ % Change at indicated Post-treat Intervals 7 Ws.	14 Wks.
EL-468	De-fatted corn	1.25	69	68	-69	-71
EL-468	De-fatted corn	2.50	76	77	-80	-79
EL-468	Expanded cobs	2.50	65	74	-64	-71
AMDRO	Expanded cobs "F"	1.00	53	73	-72	-83
AMDRO	Expanded cobs "G"	1.00	56	78	-72	-86
ANDRI	De-Fat. "ALT"	1.00	89	89	-90	-89
AMDRO	De-fatted "Std."	1.00	67	79	-86	-93
Untreatec Check		-	19	28	7.5	-23

1/ Mean based on results obtained at all test sites receiving a given treatment

Project Number: IFA 81-3

Project Title: Evaluation of Biannual Application of AMDRO FOR Control of Imported Fire Ants

Investigators: H. L. Collins, D. J. Adams, A. L. Ladner, M. J. Cuevas, C. J. Mauffray and David Dreher

INTRODUCTION

AMDRO has been shown to be an effective toxicant for use in baits for control of imported fire ants (Williams et al 1980, Harland et al 1981, and Banks et al 1981). Although considerable information on reinfestation following Mirex bait applications was available, (Bartlett and Lofgren 1961, Banks et al 1971, Lofgren and Weidhaas 1972), no research on reinfestation following single or dual applications of AMDRO has been conducted. At the request of the registrant (American Cyanamid Co.), a study to evaluate two AMDRO applications spaced six months apart was initiated in the Fall of 1980 and concluded in the Fall of 1981.

METHODS AND MATERIALS

In October 1980, test plots approximately 200 acres in size were established in permanent grazed pastures near Montgomery, Alabama. A USDA owned Cessna Ag-Truck equipped with a Transland Standard spreader was used to apply two different formulations of AMDRO bait. AMDRO formulation "F" was prepared with 25% soybean oil and .88% AI impregnated on an inert carrier of expanded corn cobs. The "Standard" or commercial formulation consisted of 30% soybean oil and .88% AI impregnated on an inert carrier of pregelled defatted corn. Test plots received the first bait application October 13 and 15, 1980, and the second application on April 11, 1981.

Efficacy data was based on population assessments made prior to the first treatment, 8 and 24 weeks following the first application, 8 weeks following the second application and 28 weeks after the seccnd application. Population assessments were conducted in twenty-five 1/4-acre subplots randomly located within each 200-acre test plot according to procedures described by Harlan et al (1981).

RESULTS AND DISCUSSION

A preliminary assessment conducted in December 1980 (8 weeks after the first bait application) indicated that 80% control was achieved with Standard AMDRO, while Formulation "F provided 63% control (Table 8). Plot counts made in March 1981 (24 weeks after the first treatment) changed only slightly from the previous one. The slight change noted was probably due to experimental error rather than reinfestation since mating flights are infrequent in winter months.

Colonies which survived the first application were effectively eliminated by the second bait application as shown by both population index changes and total colony mortality observed 8 weeks after the second application. Standard AMDRO provided 99% colony mortality with a corresponding reduction of 99.9% in the pretreatment population index; Formulation "F" gave 92% colony kill and a 91.9% reduction in popuation index.

A final population assessment conducted in November 1981 (28 weeks after the second application) indicated that a tremendous population resurgence had occurred during the spring and summer, and in fact far exceeded pretreatment levels. The population resurgence was undoubtedly linked to the numerous mating flights which occur March to November each year. The pretreatment population was comprised primarily of mature colonies which had stabilized at 25 to 30 colonies per acare. By virtue of the two AMDRO applications, these colonies were effectively eliminated (92 and 99% kill), thereby enabling newly mated queens to establish new colonies with little or no competition; hence a 252% increase in population index for the test plot treated with Standard AMDRO occurred.

It should be emphasized that these results were to be expected, and only serve to demonstrate the fact that AMDRO, like any other toxic bait, provides no protection against reinfestation of treated areas by newly mated alate queens.

Table 8. Results with Biannual Applications of AMDRO for Control of Imported Fire Ants
Imported Fire Ant Station, USDA, APHIS, PPQ 1/

Treatments Applied						Pretreatment 2/ Infestation		% Kill at Indicated Interval 2/				% Change in Pretreat Population Index at Indicated Interval 2/			
First Application			Second Application												
Date	Formulation	Rate/Acre (lbs.)	Date	Formulation	Rate/Acre (lbs.)	Total No. Colonies Present	Population Index	8 wks. after 1st appl.	24 wks. after 1st. appl.	8 wks. after 2nd appl	28 wks. after 2nd appl.	8 wks. after 1st appl.	24 wks. after 1st appl.	8 wks. after 2nd appl.	28 wks. after 2nd appl.
10/15/80	"F"	1.0	4/11/81	"F"	1.2	172	1099	63	49	92	0	-85	-47	-91.9	+ 38
10/13/80	Standard	1.0	4/11/81	Standard	1.1	171	1273	80	73	99	0	-60	-86	-99.9	+252
	Untreated check			-		196	1441	0	0	0	0	+57	+78	+56	+67

1/ Test plots located on Bush Dairy, Montgomery, Ala. Treatments applied to 200-acre plots with a Cessna Ag- Truck.

2/ Based on twenty-five 1/4-acre efficacy plots/treatment.

References Cited

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Project Number: IFA 81-4

Project Title: Tests with Fumigants for individual mound treatments

Investigators: Jerry G. Medley and M. J. Cuevas

INTRODUCTION:

Due to cost-effectiveness and logistics, the use of mound fumigation has limited potential for use in imported fire ant control. However, in special situations such as hypersensitive urban homeowners, etc., a small need for this technology may exist. Tests with the more commonly used fumigants were reported previously (Green 1952, Grothaus et al 1973, Hillman, 1975). We tested several others and compared the cost effectiveness of each.

METHODS AND MATERIALS:

A. Mylone granules - Two methods of application were used to evaluate the efficacy of Mylone 50D (Hopkins Agriculture Chem. Co., Madison, Wis.)

(1) Broadcast application to 10 sq. ft. surrounding the periphery of each treated mound.

(2) Direct placement of various dosages into the mound and the hole recovered with soil.

Mounds were examined weekly and mortality assessed.

B. Vapona Strips - VAPONA® insect strips (STARBAR Brand, 122000 Denton Drive, Dallas, Tex.) were evaluated as mound fumigants. Three 1-inch square strips were inserted into the apex of 10 different mounds on Nov. 17, 1981. Mounds were then examined at weekly intervals for 4 weeks and mortality recorded.

C. Methyl Bromide - various rates of application as well as depth of placement within the mound were evaluated. An injector constructed by Whiteville Methods Center was used to inject liquid Methyl Bromide from 1.5 lb. canisters into the mound structure. Efficacy of the various treatments was determined by closely examining each treated mound at various intervals following treatment.

RESULTS

Results with Mylone 50D were not encouraging (Table 9). Very poor control was obtained regardless of rate or method of application and further testing did not seem justified.

Results with VAPONA strips were also poor (Table 10)., and tests with this product were also discontinued.

However, as shown in Tables 11 and 12 , Methyl Bromide was very effective when injected at a rate of 45 to 60 mls/mound. Depth of placement within the mound was not critical, with 6 to 12 inches giving slight better results than a depth of 3 inches.

Due to their ineffectiveness, cost of treatment for fumigants other than Methyl Bromide was not considered. At current retail prices, the treatment of fire ant mounds with 45 mls. of Methyl Bromide will cost approximately $.59.

Table 9. Control of individual mounds with Mylone granules, Brooklyn, Ms. 8/12/81 - 9/17/81

Method of Application	Rate of Application (grams/colony)	No. of Mounds Treated	% Control at indicated post-treat interval (weeks)			
			1	2	3	4
Broadcast to 10 Ft.^{2} around mound periphery	150	10	40	30	-	-
"	300	10	20	20	-	-
"	600	5	20	20	-	-
Direct placement in mound and recovered with soil	10	5	0	0	0	0
"	25	10	0	20	30	40
"	50	5	0	0	40	20
"	100	5	0	40	10	0
"	150	10	0	50	30	10
"	300	10	0	100	40	60

Table 10. Evaluation of Vapona Strips as a mound Fumigant: Brooklyn, Ms. Nov. 17, 1981.

Rate of Application	No. Mounds Treated	% Control at indicated post-treat interval (weeks) 1	2	3	4
Three 1-inch Square strips per colony (inserted into Apex of Mound)	10	0	20	-	-

Table 11. Efficacy of Various Rates of Methyl Bromide for Control of IFA.

Mililiters of Liquid Methyl Bromide Applied/Mound	Number of Ant Mounds Treated 1/ (6-inch Probe Depth)	Percent Control at Indicated Interval			
		24 hrs.	48 hrs.	1 Week	2 Weeks
15	5	0	10	60	80
30	15	7	46	87	80
45	10	50	100	100	100
60	10	30	90	80	100

1/ Treated June 2, 1981. Soil Temp. 37°C.

Table 12. Optimum Probe Depth for Treating Imported Fire Ant Mounds with Methyl Bromide.

Depth Injector Probe inserted in Mound (Inches)	No. Mounds Treated 1/ with 45 ml Methyl Bromide	Percent Control of Indicated Time after Treatment					
		24 hrs.	48 hrs.	1 Week	2 Wks.	3 Wks.	4 Wks.
3	30	63	90	100	90	87	87
6	15	87	94	100	100	100	100
9	15	66	100	100	100	100	100
12	15	87	100	100	100	100	100

1/ Treated July 7, 1981 with 45 mls. Methyl Bromide/mound. Soil Temp 36°C.

REFERENCES CITED

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Hillman, R. C. 1975, Screening of Pesticides for Control of Red imported fire ants, Solenopsis invicta Buren, on home grounds in North Carolina. Unpublished data.

Project No: IFA 81-7

Project Title: Phytotoxicity of AMAZE and DURSBAN to vegetable transplants grown in treated media

Investigators: H. L. Collins and Jay Speight

INTRODUCTION:

Collins et al (1980) reported on the evaluation of various soil insecticides for use as IFA quarantine treatments of nursery potting soils. Chlorpyrifos proved to be both efficacious and highly residual; thus it was subsequently adopted for program use as a preplant incorporated treatment of nursery potting soils (PPQ MANUAL 805-25.2240).

During the summer of 1981, reports of problems resulting from the use of chlorpyrifos-treated potting media occurred. Phytotoxicity to succulents and vegetable seedlings in central Florida seemed to be the major complaint. Since the problem appeared to be unique to this area, there was a possibility that soil type might be a factor. Substitution of the insecticidal treatment would be far easier to accomplish than would substitution of soil mixes used

AMAZE® (Mobay) was the second best treatment in the series of soil insecticides evaluated by Collins et al (1980). However, no information on phytotoxicity of plants growing in AMAZE-treated soils was available. This information was needed before AMAZE could be considered for use as an IFA quarantine treatment for vegetable transplants which are grown in Florida and shipped to distant markets.

METHODS AND MATERIALS:

Commercially available potting soil purchased locally (BACCTO® produced by Michigan Peat Co., P.O. Box 66388, Houston, Texas,) was treated with AMAZE 5G at the rate of 11.2 gms AI/yd^3 of soil. This rate had provided IFA control for 12 months in previous tests. A standard treatment (chlorpyrifos 5G at 11.2 gms AI/yd^3) as well as an untreated check was also evaluated. The insecticide treatments were thoroughly blended into the potting soil by a portable cement mixer operated for two hours after the insecticides were added to the mix.

The above procedures were also used with potting soil obtained in central Florida. Prepared potting soils were then placed into 2" x 2" x 2" peat pots, and the pots planted to the following vegetables:

Vegetable	Scientific Name	Variety
Egg Plant	Solanum melongonia	"Black Beauty"
Hot Pepper	Capsicum frutescens	"Red cayenne"
Lettuce	Lactuca sativa	"Dark green Boston"
Lettuce	" "	"Iceburg"
Cabbage	Brassica oleracea	"King Cole"
Tomato	Lycoperscion esculentum	"Ponderosa Red"
Collards	Brassica oleracea	"Georgia Southern"
Sweet Pepper	Capsicum frutescens	"California Wonder"
Cucumber	Cucumis sativus	"Palomar"
Brussel Sprouts	Brassica oleracea	"Long Island"
Broccoli	Brassica oleracea	"Green Sprouting"
Radish	Raphanum sativa	"Scarlet Tipped"

A total of 10 pots (replicates) were planted to each vegetable listed, with three seeds per pot. Emerged seedlings were thinned to one plant per pot after they reached the first true leaf stage.

Phytotoxicity ratings were recorded approximately three weeks after emergence. Plants were harvested and the standing biomass determined when the untreated check of a given variety reached market size. These procedures enabled comparison of the following parameters:

(1) % germination

(2) A subjective rating according to a pre-determined scale.

(3) Determination of the standing biomass of each vegetable at harvest time.

The phytotoxicity rating scale used to compare the effects of each treatment 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

The plants were maintained in a greenhouse and subjected to normal agronomic practices. Pots were watered as needed and fertilized weekly with 12-6-6 liquid fertilizer according to label directions.

RESULTS

Results of this series of tests are shown in Tables 13 through 15. In most cases, both AMAZE and DURSBAN adversely affected vegetable seedlings growing in treated potting media. The adverse reaction seemed to be more evident in the locally purchased BACCTO potting soil than in the Florida potting media. Impact of the insecticidal treatments was not manifest through gross effects upon emerged seedlings (such as formation of abnormal leaf or stem structures, yellowing, leaf drop, etc.), but instead a prevention and/or delay in germination of most plant species was noted. After emergence, the seedlings grew normally. The adverse effects were quite dramatic in some instances, i.e., Brussel sprouts developed to cotyledon stage in 6.6 days when grown in untreated BACCTO media versus 11.3 days in Dursban treated media. Response of other species was usually less severe, but in no case did a given cultivar grown in Dursban treated media develop faster than did the same cultivar in untreated media

Delays in germination caused a reduction in growth interval which resulted in a significant reduction in the standing biomass at harvest. Since smaller plants would have a reduced market value, growers' profits would therefore be directly impacted.

Previous tests with many of these same plant species (radishes, cucumbers, broccoli, bell pepper, and hot pepper) indicated little or no adverse effects from a 1X, 2X or 3X rate of Dursban 15G incorporated into a potting media consisting of equal portions of river sand, Spagnum moss and milled pine bark. However, a 10X rate did reduce emergence and delay germination. (Collins 1980). Several important differences in the present study and the previous study might account for the apparent variation in results:

(1) The previous trials were conducted with a different Dursban formulation (15G previously, FA-5 presently)

(2) Difference in composition and bulk densities of the potting media.

Our interpretation of these results is that both Dursban and AMAZE applied as a preplant incorporated treatment in granular form can adversely impact the growth and development of vegetable seedlings. Therefore, other quarantine measures should be implemented for this commodity.

Meanwhile, no problems with the use of Dursban FA-5 on woody ornamentals, cacti, and other types of plants have occurred.

Table 13. Effects of Dursban and AMAZE on growth and Development of Vegetable Seedlings grown in BACCTO® Potting Soil. Seeds Planted 5/14/81.

Vegetable and Variety	UNTREATED CHECK			DURSBAN (FA-5) 2/			AMAZE (5G 2/		
	% Germination 1/	Days to Cotyledon	Standing Biomass at Harvest (Grams) 3/	% Germination 1/	Days to Cotyledon	Standing Biomass at Harvest (Grams) 3/	% Germination 1/	Days to Cotyledon	Standing Biomass at Harvest (Grams) 3/
Bell Pepper "California Wonder"	93.3	4/	.93	93.3	4/	1.23	86.7	4/	.78
Hot Pepper "Red cayeene"	90.0	12	1.51	83.3	12.1	1.47	90.0	11.8	.86
Cucumber "Palomar"	86.7	5	1.14	76.7	6.5	1.62	73.3	6.0	1.74
Collards "Georgia Southern	86.7	4.9	2.35	66.7	6.3	1.68	76.7	5.8	1.84
Cabbage "King Cole"	96.7	4.7	2.64	86.7	5.6	2.16	96.7	5.4	1.58
Egg Plant "Black Beauty"	83.3	8.9	1.54	70.0	11.6	.65	63.3	10.5	.65
Tomato "Ponderosa Red"	80.0	8.3	1.59	73.3	10.1	1.01	80.0	9.3	.72
Lettuce "Dark Green Boston"	36.7	6.9	1.78	66.7	7.6	1.23	83.3	7.2	.99
Lettuce "Iceberg"	83.3	4.1	2.09	86.7	4.3	2.25	96.3	4.9	1.88
Broccoli "Green Sprouting"	93.3	4.6	4.15	96.7	5.5	3.19	90.0	4.8	2.87
Brussel Sprouts "Long Island"	76.7	6.6	3.21	53.3	11.3	2.20	63.3	6.3	1.84
Radish "Scarlet tipped"	96.7	4.4	2.66	83.3	6.7	3.16	100.	5.2	3.40

1/ Avg. for 10 replicates (pots) with 3 seed/pot.

2/ 11.2 gms. AI/yd^3 of potting soil. BACCTO® soil, Bulk Density of 818 lbs/yd.^{3}

3/ Plants were harvested and standing biomass determined when the untreated check of a given variety reached market size.

4/ Not determined.

Table 14. Effects of Dursban and AMAZE on growth and Development of Vegetable Seedlings grown in Florida Potting Soil. Seeds Planted 8/21/81.

Vegetable and Variety	UNTREATED CHECK			DURSBAN (FA-5) 2/			AMAZE 5G 2/		
	% Germination 1/	Days to Cotyledon	Standing Biomass at Harvest (Grams) 3/	% Germination 1/	Days to Cotyledon	Standing Biomass at Harvest (Grams) 3/	% Germination 1/	Days to Cotyledon	Standing Biomass at Harvest (Grams) 3/
Bell Pepper "California Wonder"	53.3	17.3	.6	26.7	14.2	.4	43.3	15.2	1.0
Hot Pepper "Red Cayenne"	86.7	15.8	1.2	26.7	14.8	.6	66.7	11.9	1.1
Cucumber "Palomar"	82.3	7.2	1.7	76.7	6.5	1.8	93.3	5.0	2.1
Collards "Georgia Southern"	10.0	9.0	.5	13.3	7.7	.5	50.0	5.2	.9
Cabbage "King Cole"	50.0	7.6	1.0	63.3	6.3	1.1	100	4.2	1.9
Egg Plant "Black Beauty"	73.3	14.7	.6	46.7	14.1	.4	73.3	10.2	.9
Tomato "Ponderosa Red"	63.3	8.8	1.3	73.3	9.4	1.0	83.3	8.0	1.4
Lettuce "Dark Green Boston"	40.0	4.4	.8	26.7	4.6	.5	33.3	4.2	.8
Lettuce "Iceburg"	83.3	4.7	.8	83.3	4.4	.7	97.7	4.7	.9
Broccoli "GreenSprouting"	33.3	7.7	.2	23.3	5.5	.8	93.3	3.7	1.4
Brussel Sprouts "Long Island"	13.3	8.5	.6	10.0	5.0	1.2	36.7	6.9	.9
Radish "Scarlet tipped"	90.0	6.8	.5	50.0	5.8	.5	86.7	4.2	.9

1/ Average for 10 replicates (pots) with 3 seed/pot.

2/ 11.2 gms AI/Yd^3 of potting soil: soil from a nursery in Central Florida. Bulk density of 254 lbs/Yd.^{3}

3/ Plants were harvested and standing biomass determined when the untreated check of a given variety reached market size.

Table 15. Phytotoxicity Ratings for Vegetable Seedlings Grown in Dursban or AMAZE-treated Potting Media 1/

Vegetable and Variety	BACCTO® Media 2/			FLORIDA Media 2/		
	Untreated Check	Dursban Treated (FA-5) 3/	AMAZE Treated (5G) 3/	Untreated Check	Dursban Treated (FA-5) 3/	AMAZE Treated (5G) 3/
Bell Pepper "California Wonder"	1.0	1.0	1.0	1.0	1.0	1.0
Hot Pepper "Red Cayenne"	1.0	1.0	1.0	1.1	1.0	1.0
Cucumber "Palomar"	1.0	1.3	1.0	1.0	1.0	1.0
Collards "Georgia Southern:	1.0	1.3	1.0	1.0	1.0	1.0
Cabbage "King Cole"	1.0	1.0	1.0	1.3	1.2	1.0
Egg Plant "Black Beauty:	1.0	1.0	1.0	1.0	1.0	1.0
Tomato "Ponderosa Red"	1.0	1.1	1.0	1.0	1.0	1.0
Lettuce "Dark Green Boston"	1.0	1.4	1.0	1.0	1.0	1.0
Lettuce "Ice Berg"	1.0	1.0	1.0	1.0	1.0	1.0
Broccoli "Green Sprouting"	1.0	1.0	1.0	1.0	1.0	1.0
Brussel Sprouts "Long Island"	1.3	1.2	1.1	1.0	1.0	1.0
Radish "Scarlet Tipped"	1.0	1.0	1.0	1.0	1.0	1.0

1/ Rating Scale: 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. Ratings conducted approximately 3 weeks after emergence.

2/ Bulk Density of BACCTO Media was 818 lbs/yd^3; FLORIDA Media was 254 lbs/yd.^{3}.

3/ Incorporated into potting media at a rate of 11.2 grams AI/yd^3 of media prior to planting.

References Cited

Collins, H. L,, C. L. Mangum, J. G. Medley, and A. W. Guenthner. 1980. Evaluation of soil insecticides for quarantine treatments against imported fire ants. Insecticide and Acaracide Test 5:209.

Collins, H. L. 1980. 1979 Laboratory report. 71 pages mimeo.

Project Number: IFA 81-10

Project Title: Evaluation of a positive metering device to facilitate aerial application of IFA bait toxicants

Investigators: H. L. Collins and A. L. Ladncr

A Meterate unit is a positive metering device which is designed for distributing pelleted and other small materials (such as seed) at low rates of application from aircraft. The Meterate Unit uses a vaned rotor for dispersion of the desired material into the throat of the aircraft spreader and is powered by an electric motor. The Unit was designed by Eli Lilly and Company personnel and its use is presently limited to products sold by Elanco Products Company, a division of Eli Lilly and Company. Patent rights are pending. Eli Lilly has received approval from the FAA for the use of Meterate Units on Piper and Cessna Ag Aircraft only.

A small-scale test/demonstration was conducted August 26 and 27, 1981 at Stennis Field, Bay St. Louis, Miss. Elanco representatives Dean Hammond and John Dusing provided the unit and assisted in the installation of the Unit into the PPQ Cessna Ag-Truck which was flown by Tim Roland.

Only minor modifications to the existing system were necessary before installation of the Meterate Unit could be accomplished:

1. The hopper outlet adaptor was removed.

2. The door or "dump gate" was removed.

3. A 1 1/4" hole was drilled into the fuselage for the wiring harness.

4. Two 3/16" holes were drilled into the gate box.

The rotor unit replaces the "dump gate" on the existing system utilizing existing fittings, linkages, etc. Thus dump capability is retained should an emergency require the load to be "dumped". Considerable difficulty in obtaining proper fit of the rotor unit into the "hopper box" was encountered. A small gap between the rubber gasket and box was noted: apparently this is not a common problem in routine installation, but did cause some loss of time in this case.

Flow rate (thus calibration) is controlled strickly by revolutions of the vaned rotor; there is no facility (nor apparent need for) variatfon in dimensions of the gate opening.

Electrical leads for the unit were passed through the fusalage into the cockpit where they engaged the control box. Two independently controlled potentiometers mounted in the control box controlled the speed of the rotor. Total elapsed time for installation of the system was 6.5 hours.

Assuming 115 mph with a 50' swath and a desired rate of application of 1.25 lbs/acre, a calibration of 14.5 lbs/min. is required. A series of 1 minute static calibration trials gave the following results:

Trial No.	Rotor RPM	Output 1/ (lbs/min.)
1	800	14.0 2/
2	800	8.8
3	800	8.8
4	800	8.8
5	1100	13.5
6	1200	14.9
7	1150	13.6
8	1150	13.4
9	1275	14.2
10	1275	14.0
11	1275	13.9

1/ Bulk density of EL-468 used for each phase of this trial was 19.0 lbs/ft.^{3}. De-fatted corn was the carrier. Fifty lbs. of material in hopper.

2/ Decreased space between the rotor and rotor housing.

On August 26, 1981, an attempt was made to swath-check the airplane. Unfortunately, a slight wind prevented an accurate assessment. However, installation of a Meterate Unit should not affect swath width with any given spreader. A new transland Model 20160 spreader was installed for this series of tests.

The airplane was loaded with 201.5 lbs. of material and flown for 8 minutes with a rotor setting of 1275 RPM. This resulted in an output of 118.7 lbs. of material which represents a 5.4% divergence from tne 112 lbs. theoretical output (based on static calibration of about 14.0 lbs/min.).

A series of 1-minute airborne runs were made:

Flight No.	Wt. of Materials in hopper(lbs)	Rotor Speed (RPM)	Output (lbs.)
1	50	1275	14.0
2	50	1275	14.1
3	50	1175 1/	13.3

1/ potentiometer accidentally re-set to 1175 RPM while reloading airplane between flight 2 and flight 3.

A series of 1 minute static calibration runs were made in order to determine the effective range (maximum - minimum capability) of the unit.

RPM	Output 1/ (lbs/min.	Comments
500	3.6	" Pulsing" of material very evident
700	6.9	" Pulsing" still evident
700	6.8	" " "
1800	20.2	No pulsing observed
2500	28.5	" " "
3550	39.6	Maximum speed available

1/ a 50' swath at 115 mph = 11.6 acres/min.

In order to obtain a direct comparison between the static calibration and airborne output, the Unit was first static calibrated then flown for 1 minute without changing RPM of the rotor:

Flight No.	Static calibration (1275 RPM) Output (lbs/minute)	Airborne output 1/ (lbs/minute)
1	13.0	14.3
2	13.9	14.8
$\bar{X}$	13.4	14.5

1/ 50 lb. load

Up to this point only relatively small amounts of material had been loaded at any given time. Since hopper loads (e.g. full hopper, vs. very small amount) can affect calibration of other systems, a moderately large load (333.9 lbs) was loaded, and the aircraft flown for 21 minutes:

Operation	Output (lbs/min.)
1 minute Static calibration run	14.2
21 min. Airborne run (applied 304.6 lbs)	14.5

In order to determine the capability of the system to handle other IFA baits (particularly those formulated on corn cob grits), a series of static calibrations with AMDRO formulation "G" was conducted:

Rotor RPM	Output (lbs./min.)	Lbs/Acre 1/
1000	16.2	1.4
800	12.7	1.0
1200	20.6	1.8

I/ Assuming 50' swath at 115 mph.

Some of the more important features of the Meterate Unit are as follows:

1. Developed by Elanco; patent rights pending.

2. Probably will not be available for application of other products.

3. Cost of a unit is estimated to be $4,000 - $5,000.

4. Capability to accurately apply a variety of materials over a wide dosage range.

5. Static calibration capability.

6. Ability to change rate of application in flight (by virtue of two independently controlled potentiometers which control the speed of the vaned rotor.

Project Number: IFA 81-11

Project Title: Field trials with an improved EL-468 formulation for area-wide control of imported fire ants.

Investigators: H. L. Collins, A. L. Ladner, D. J. Adams, C. J. Mauffray and M. J. Cuevas

I. INTRODUCTION:

EL-468 is an experimental toxicant under development by Elanco, Inc. This compound has shown promise as an IFA bait toxicant in laboratory as well as field tests. The most efficacious formulation tested to date consists of 30% w/w soybean oil impregnated on pre-gelled, defatted corn grits with .75% active ingredient. This formulation provided an average of 77% kill when applied at a bulk rate of 2.5 lbs/acre in a series of field trials conducted in the spring of 1981.

One of the problems associated with this compound is its tendency to cyclize to a more toxic metabolite which causes rapid and, therefore, undesirable kill of foraging worker ants. An "improved" formulation of EL-468 has been prepared by Elanco. The new formulation differs from previous formulations primarily due to the fact that a molecular sieve was used to provide anhydrous twice-refined soybean oil in an effort to stabilize the active ingredient of the formulated bait.

Additional field trials were needed to determine success of the formulation changes, to gain information on seasonal influence on efficacy (Fall vs. Spring applications), and to amass additional data on efficacy of the compound.

The PPQ spray plane (Cessna Ag-Truck) equipped with an Elanco Meterate unit and Transland spreader was used to apply all treatments.

II. AIRCRAFT SPECIFICATIONS:

1. Cessna Ag-Truck
2. Delivery System
   A. Transland High Volume Spreader (Model 20160)
   B. Elanco Meterate® Unit.
3. 120 mph operating speed
4. 50' altitude
5. 50' working swath; 60' overall
6. Operated by Tim Roland, PPQ Pilot
7. Aircraft guidance and swath spacings were provided by flagmen.

III. BAIT FORMULATION SPECIFICATIONS:

Characteristics of the EL-468 formulation and Standard AMDRO are as follows:

Formulation	Carrier	% SBO	Avg. Bulk Density (lbs./Ft.^{3})	% AI
EL-468	De-fatted corn	30	17.4	.75
AMDRO	De-fatted corn	30	20.5	.88

IV. DESCRIPTION OF TERRAIN TREATED AND LOCATION OF TEST SITES:

Experimental use permit 1471-EUP-73 concerning field testing of EL-468 restricts application to non-crop sites. Previous experience in locating non-crop test sites for evaluation of IFA bait toxicants has shown that airport properties, if they are of sufficient size and are infested with ants, are suitable for this purpose.

The following airport properties were selected as test sites:

(1) Stennis Field- Bay St. Louis, Ms.
(2) Pinebelt Airport - Hattiesburg, Ms.
(3) Laurel Municipal Airport - Laurel, Ms.
(4) Hattiesburg Municipal Airport - Hattiesburg, Ms.
(5) Thompson Field - Jackson, Ms.
(6) Cordelle Municipal Airport, Cordelle, Ga.
(7) Thomasville Municipal Airport, Thomasville, Ga.

One or more rates of EL-468 were applied at each site. AMDRO Standard (1.0 lb. bulk formulation/acre) plus an untreated check was also included at each site.

Treatments applied, dates, acreage, etc. are summarized in Table 16. No problem in equipment, calibration or application were encountered. All formulations were uniform, readily flowable, and without foreign debris or lumps.

Table 16. Summary of Fall 1981 Aerial Treatments - Imported Fire Ant Station, APHIS, PPQ Gulfport, Ms.

Test Site Location	Block No.	Bait Formulation Applied	Date Applied	Desired Rate of APPL. (lbs/acre)	Actual Rate of Appl. (lbs/acre)	Total Acreage Treated
Stennis Field Bay St. Louis, Ms.	I	EL-468	10-27-81	1.25	1.24	50
	II	AMDRO	10-27-81	1.0	1.15	50
Pinebelt Airport Hattiesburg, Ms.	I	AMDRO	10-28-81	1.0	1.0	46
	II	EL-468	10-28-81	1.25	1.25	51
	III	EL-468	10-28-81	1.75	1.75	51
Laurel Municipal Airport, Laurel, Ms.	I	AMDRO	10-28-81	1.0	1.0	42
	II	EL-468	10-28-81	1.25	1.15	73
Hattiesburg Municipal Airport, Hattiesburg, Ms.	I	AMDRO	10-28-81	1.0	1.22	72
	III	EL-468	10-28-81	1.25	1.15	62
Thompson Field Jackson, Ms.	I	EL-468	10-29-81	1.25	1.25	97
	II	EL-468	10-29-81	1.75	1.75	97
	IV	AMDRO	10-29-81	1.0	1.0	50
Cordelle Municipal Airport, Cordelle, Ga.	I	EL-468	10-31-81	1.25	1.25	52
	II	EL-468	10-31-81	1.75	1.75	52
	III	AMDRO	10-31-81	1.0	1.0	53
Thomasville Municipal Airport, Thomasville, Ga.	I	EL-468	11-2-81	1.25	1.25	45
	II	EL-468	11-2-81	1.75	1.75	45
	III	AMDRO	11-2-81	1.0	1.0	63

V. RESULTS:

Cold, wet weather prevented the first posttreatment assessment which was originally scheduled for Dec. 14-18, 1981. These counts will be completed as soon as weather permits. A final evaluation will be made in April 1982.

Project Number: IFA 81-12
Project Title: Shelf life studies with AMDRO and EL-468
Investigators: H. L. Collins and M. J. Cuevas

INTRODUCTION:

Storage or shelf life of imported fire ant baits has long been a problem with certain types of formulations. Some inert carriers are known to enhance oxidation and rancidity of the soybean oil. Since rancid baits are not actively accepted and fed upon by foraging workers (Lofgren et al 1964), poor control may result from field applications of baits in this condition. In early studies with degradable formulations of mirex, a copper catalyst was used to enhance the degradation process. However, the copper also promoted oxidation and subsequent rancidity of the oil and was therefore excluded from further testing.

METHODS AND MATERIALS:

On April 20, 1981, a study to determine the effects of storage under two different temperature regimes was initiated for both AMDRO and EL-468. Two formulations of AMDRO (the Standard or commercial formulation which was composed of 30% soybean, pregelled defatted corn and .88% AI) as well as an experimental formulation composed of expanded corn cobs, 25% soybean oil and .88%AI) were tested. A single formulation of Elanco's EL-468 was also evaluated. The EL-468 formulation consisted of 30% soybean oil, pregelled defatted corn and .75% AI. Subsamples of each formulation were removed from larger containers (25 lb. bags, 40 lb. bags or 75 lb. fiber drums), and placed in 10" x 12" zip lock plastic bags which were in turn placed in cardboard boxes.

The boxes were then stored under two different temperature regimes: (1) one group of boxes was stored in the laboratory at ambient conditions of 70-74°F. (2) The second group was stored in a nori-temperature controlled warehouse which occasionally reached temperatures greater than 100°F. Storage under these conditions would be normal and expected for most of the area infested by the imported fire ant.

Samples were removed at approximately 1 month intervals from May to November, 1981 and subjected to the following bioassay procedures:

1. General - A laboratory bioassay for feeding acceptance is a standard test used to determine the relative attractancy of various IFA baits or components of baits. Field-collected captive ant colonies were given a free choice to select and feed on either a candidate bait (the bait under evaluation) or a freshly prepared standard bait. It is assumed that the ants will indicate their preferance by consuming greater quantities of the bait of their choice.

2. Collection of Ant Colonies - Fragments of colonies containing all life forms (workers, immature, winged sexuals and occasionally, the mated queen) are collected from infested fields by shoveling a portion of the nest tumulus into a plastic dish pan. The colonies are then transported into the laboratory and allowed to acclimate and rebuild the next structure for 3-4 days prior to testing.

3. Preparation of the Standard Bait - A standard bait known to be attractive to ants is prepared by mixing fresh soybean oil with pregelled defatted corn grits 30%:70% w/w. The standard bait is prepared one day prior to the test.

4. Candidate bait - The candidate bait is any potentially attractive oil, experimental bait formulation, or formulated bait which may have deteriorated due to storage, etc. Each candidate bait is tested on five different colonies, and the results reported as an average response of all colonies.

5. Bioassay - Four grams of a candidate bait contained in a plastic petri dish are placed on the surface of each of the 5 test colonies. Simultaneously, 4 grams of the freshly prepared standard bait in an identical container are placed approximately 4-5 inches from the candidate bait. Foraging workers are then provided a free choice to feed on the bait of their preference. After a 24-hour feeding period, the dishes are removed and the amount of each bait consumed is determined by weighing.

6. Computation of Acceptance Ratio - An acceptance ratio for each candidate bait is computed in the following manner:

$$\frac{\text{No. grams candidate consumed}}{\text{No. grams standard consumed}} = \text{acceptance ratio}$$

An acceptance ratio with a value of less than 1.0 indicates that a given candidate is less attractive than the standard. Values equal to or greater than 1.0 indicates that a candidate is equally or more attractive than the standard.

Lofgren et al. (1961) reported on the evaluation of 222 different food materials, and provided a list of those which gave an acceptance ratio of 0.75 or higher. By convention, this figure has become the minimum ratio recognized as acceptable by most IFA researchers.

RESULTS

Results of this test are shown in Table 17. Standard AMDRO held at room temperature (70° - 74°F.) was highly acceptable during the first six months of storage. By the seventh month, acceptance was greatly diminished since an acceptance ratio of 0.3 was noted. Warehouse storage conditions seemed to adversely affect acceptance of this formulation after four months of storage.

Acceptance of the expanded cob formulation of AMDRO was lower initially than the standard formulation, and also became less attractive fairly rapidly when stored under warehouse conditions.

After 1 month of storage, the acceptance ratio for EL-468 was 0.5 for bait stored at room temperature and 0.6 for that stored in the warehouse. By the second month of warehouse storage, EL-468 was totally non-acceptable. Storage of EL-468 at room temperature seemed to slightly favor acceptance, but did not increase it to satisfactory levels. As in numerous other studies, these results suggest that elevated temperatures are detrimental to storage of imported fire ant baits. Summer storage in non-temperature controlled warehouses should be avoided whenever possible.

Table 17. Feeding Acceptance of various AMDRO and EL-468 Bait Formulations stored at Two different temperature regimes. Gulfport IFA Station, USDA, APHIS, PPQ

Bait Formulation	Storage Conditions	$\bar{X}$ Acceptance Ratio after Storage for indicated Time Period (months) 1/					
		1	2	4	5	6	7
Standard AMDRO	Laboratory (70°-74°F.)	1.4	1.0	.2	1.2	1.0	.3
AMDRO on Expanded Cobs	"	.4	.6	.4	1.0	1.0	0
EL-468	"	.5	.3	0	.2	.1	0
Standard AMDRO	Warehouse (uncontrolled Temp.)	1.0	1.1	.5	.6	.7	.4
AMDRO on Expanded Cobs)	"	.7	.9	.2	.4	.8	.1
EL-468	"	.6	0	0	0	.1	0

1/ Mean based on laboratory observations of 5 ant colonies. Acceptance ratios computed after a 24-hour feeding period wherein ants were allowed equal opportunity to feed upon a candidate bait versus a freshly prepared standard bait consisting of 30% SBO and pregelled defatted corn. Test initiated April 20, 1981.

REFERENCES CITED

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

Lofgren, C.S., F.J. Bartlett, and C.E. Stringer. 1961. The acceptability of some fats and oils as food to imported fire ants. J. Econ. Ent. 57:601-602.

Project No: IFA.81-13

Project Title: Tests with HERCON controlled release insecticide formulations for residual activity against the IFA.

Investigators: A.R. Quisumbing [1/] M. L. Collins and J. H. Spence [2/]

INTRODUCTION AND BACKGROUND

On September 25, 1979, the Animal. and Plant Health Inspection Service (APHIS) cf the U.S. Dept. of Agriculture awarded the Hercon Division of Health-Chem Corporation, Mew York, NY (formerly Hercon Group of Herculite Products, Inc.) Contract No. 53-3294-9-31 to help develop a slow-release insecticide for use against the imported fire ant in the nursery and sod industry. This insecticide is needed to replace chlordane in regulatory treatment for imported fire ants because use of chlordane was terminated as of December 31, 1979.

Specifically, a new and effective treatment material is needed for

a) incorporation in potting soil;

b) treatment of plants, balled or in containers;

c) treatment of nursery stock or grass sod in the field; and

d) treatment of sod, flat or rolled, for immediate shipment.

The formulations should be efficacious, safe to use, and environmentally acceptable to the U.S. Environmental Protection Agency.

Hercon proposed to accomplish the desired objectives through use of its controlled release technology which incorporates the insecticide in a multilayer polymeric dispensing system. The proposal was based on the premise that a slow-release formulation of a non-persistent insecticide

1/. Hercon Division, Health-Chem Corporation, 1107 Broadway, New York, NY

2/ .National Monitoring and Residue Laboratory, Gulfport, Ms.

would be the most practical replacement material that would be environmentally acceptable as well as effective for the desired time periods. Amaze, chlorpyrifos (Dursban or Lorsban*), and Diazinon were chosen as the insecticides to be tested [3/].

EXPERIMENTAL

A. Formulations. Twentyfour formulations of the three insecticides[5] were prepared. There were two concentrations of each insecticide (10% and 20%), four plastic types with different permeabilities (i.e., release rates) to the insecticides, and one particle size (1/16th-inch). The size of the granules was based on samples previously submitted to APHIS.

Ten to 20-lb amounts of each formulation were shipped to the APHIS-PPQ Gulfport Methods Development Center, Gulfport, MS, and were subjected to small plot field trials.

Included in the materials tested was Dow Chemical's Lorsban 15G which was used as the standard. An untreated check plus a previously supplied Hercon formulation of chlorpyrifos (0169C) were also included. In all, there were 27 soil treatments.

B. Small plot field trials and pot tests. The 24 sample formulations were applied by USDA-APHIS personnel to 20' x 20' field plots at Brooklyn, MS on February 26 and 27, 1980. Each Hercon granular formulation was applied to obtain a 10-lb a.i./acre rate. Application was with a hand-held Chevron (Ortho) seeder/granular applicator. Immediately after treatment, each test plot was rototilled with a garden tiller to incorporate each material into the soil.

In addition to the field plot work, each of the Hercon formulations

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[3/] Amaze (Mobay, Kansas City, MO): 1-methylethyl 2-((ethoxy((1-methylethyl) amino)phosphinothioyl)oxy)benzoate.

Dursban or Lorsban (Dow Chemical, Midland, MI): O,O-diethyl O-(3,5,6-trichloro-2-pyridyl) phosphorothioate.

Diazinon (Ciba-Geigy, Greensboro, NC): O,O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate.

was blended into potted soil at the rate of 11.2 grams a.i./cubic yard. Soil used came from the Brooklyn, MS field test sites. The treated potted soil was then aged outdoors at York, PA under natural conditions in 6-inch pots starting June 13, 1980. Insecticide residues in the Hercon granules ("flakes") recovered from the soil were desired to compare with data obtained from the 20' x 20' field plots. This experiment was carried out by Hercon at its facility in York, PA.

C. Sampling. A standard 2" diameter soil sampler was used to remove 25 3" cores from each 20' x 20' field plot. The cores were composited and the soil passed through a 1/2" mesh screen and then placed in 1/2-gallon cans. Each can was labeled with the date of collection, plot number, and the Hercon formulation code. Soil samples, taken at 1, 2, 4, 5, 6, 7, 8 and 11 months, were bioassayed at Gulfport, and chemically analyzed for the insecticide by APHIS and Hercon.

Recovered Hercon granules (not the soil) were sampled from the treated potting soil at 127 and 274 days and analyzed chemically for insecticide content. Because of the small granular size, some difficulty was encountered in recovering enough granules for a reliable analysis.

Procedures for the analysis of insecticide residues in soil samples were provided by APHIS. The gas chromatographic methods are described by J. H. Spence in a separate report.

D. Imported fire ant (IFA) bioassays of soil samples. Bioassays were conducted by confining worker ants on the soil samples. The ants were observed for seven days and mortality recorded. The average bioassay results were based on three replicates; 20 worker ants were used per replicate.

RESULTS AND DISCUSSION

A. Bioassays. The data to date show clearly that chlorpyrifos is far superior to Diazinon and Amaze.

The eight Diazinon formulations killed 100% of the ants for 4 months in the IFA bioassays. At the 5-month testing, seven of the eight formulations failed to give a 100% kill. Thereafter, i.e., between 6 and 11 months post-treatment, the Diazinon formulation gave only low kills (mostly zeros) in the bioassays.

The eight Amaze formulations gave 100% kills of the IFA in the bioassay up to 5 months. Percentage kills thereafter, i.e., between 6 and 11 months, were below the 100% level except for the occasional appearance of a 100% kill. Although the Amaze formulations did outperform those with Diazinon; their duration of effectiveness is likewise considered inadequate.

As of this date, i.e., up to 11 months exposure, all of the chlorpyrifos formulations, including the Lorsban 15G standard and the earlier Hercon 0169C formulation, have given 100% kill of the IFA in the Gulfport bioassays. Furthermore, some of the chlorpyrifos formulations give indications that they will remain effective for two years (the targeted time) and possibly more.

B. Chemical analyses of soil samples. To get some idea of the duration of effectiveness of the pesticides without waiting the full two years, the treated soils were periodically analyzed to determine the insecticide remaining. The results of these analyses have been somewhat erratic, including those from the earliest samples. We are not sure why the data have been so variable. Possible reasons are incomplete extraction

of the pesticide from the soil, or non-uniform mixing of the formulation into the soil, or both. Despite these results. we are not certain there is a real problem here. Rototilling of the formulation into the soil may be less than adequate in providing a sufficiently representative sample, i.e., one that will give a consistent chemical analysis. The bioassay data, at least for chlorpyrifos, may be of greater significance here from a practical standpoint because they show that rototilling was most effective in killing the ants (in the bioassay), presumably because the ants moved about and thereby acquired a lethal dose of the toxicant.

In an attempt to "smooth" the variability encountered, the chemical and bioassay data from the 10% and 20% formulations of each insecticide were averaged and compared (Table 18). Although variability was indeed reduced by the averaging process, the correlation between the chemical and biological data on Diazinon and Amaze were rather poor, especially when one considers the sharpness of the drop in the bioassay values of the samples between months 4 and 5 for Diazinon, and months 5 and 6 for Amaze. With chlorpyrifos, bioassays of all samples (except one of the last ones) remained at 100%, making it difficult to find correlations among the chemical and biological data.

Insecticide residues in the soil samples were also determined by Hercon for the 1, 2, 4, 5 and 11-month post-treatment intervals (Table 19). Although analyses of individual formulations may differ quite a bit, available average analyses of the 10% and 20% formulations from Hercon and APHIS are in line with each other for the chlorpyrifos and Amaze formulations. For example, for the 4-month post-treatment samples, average insecticide residues for the Hercon and (APHIS) data in ppm were

4.9 and (8.0) for the 10% formulations, and 7.2 and (5.0) for the 20% formulations. For the 5-month samples, averages were 4.8 ppm and (7.5 ppm) for the 10% and 4.5 and (2.4) for the 20% formulations.

Similar results from the chlorpyrifos soil samples, given below in greater detail, illustrate the variation in the individual formulation results and the reasonably good agreement of the average ppm residue values.

Interval	Chlorpyrifos Formulation		HERCON DATA ppm	Ave.	SD	CV	APHIS DATA ppm	Ave.	SD	CV
4-month	10%	1009C	3.6				23.0			
		1011C	2.4				3.2			
		1013C	13.6	5.5	5.4	98%	11.4	10.35	9.22	89%
		1015C	2.4				3.8			
	20%	2010C	2.1				0.7			
		2012C	2.8				3.4			
		2014C	5.8	3.8	1.65	43%	7.7	3.8	2.89	76%
		2016C	4.6				3.3			
5-month	10%	1009C	4.4				7.3			
		1011C	2.4				1.1			
		1013C	4.6	3.7	1.02	28%	4.2	3.7	2.72	73%
		1015C	3.3				2.2			
	20%	2010C	2.4				1.8			
		2012C	3.5				1.6			
		2014C	3.6	3.2	0.55	17%	7.0	4.8	3.6	75%
		2016C	3.4				8.6			

SD = standard deviation
CV = Coefficient of Variation

The APHIS results for the Diazinon samples are much higher than those from Hercon, so no effort was made to study the data, especially since Diazinon appears to be out of the running. In fact, it is suggested

that further analyses on Diazinon samples be terminated.

C. Chemical analysis of Hercon granules recovered from pots. These results are shown in Table 20. Because the initial 127 days exposure of the granules in soil at York, PA (from June 13, 1980 to October 2, 1980) included the summer, the data obtained are considered reasonably comparable with what would be expected in the Gulfport area. Values for the 274-day exposure (June 13, 1980 to February 12, 1981) did not change much from the 127-day values because of the freezing and sub-freezing temperatures at York, PA during the October 2, 1980 to February 12, 1981 exposure period. Because the low winter temperatures of York, PA are not characteristic of fire ant territory, the 274-day data cannot be considered comparable with those expected from fire ant areas. Accordingly, the 274-day results will not be discussed further.

Based on the percentage of the original amount of insecticide remaining in the granule after 127 days exposure (4 months), half-lives of the insecticide (time for the insecticide content to drop to 50% of the original value) were calculated based on first-order kinetics, which normally characterize the rate of decline of pesticide concentrations in soil and other media, particularly when used at elevated levels. (Ten pounds per acre is an elevated level.) The formula used is

$$\text{half-life} = \frac{\text{months exposed} \times \log 2}{\log \text{initial \%a.i.} - \log \text{final \% a.i.}}$$

The average half-lives indicate that of the three insecticides, Diazinon in the granules or flake was released most rapidly to the soil, while chlorpyrifos and Amaze were released from their granules more slowly and at a roughly similar rate. The rapid loss of Diazinon is consistent

with its failure in the tests.

The release rate of chlorpyrifos was more rapid from the 10% than from the 20% granules. Because the 20% chlorpyrifos formulations appear to be effective for the longest time (based on the latest bioassays), the half-lives of the individual 20% formulations were calculated and listed below:

FORMULATION	HALF- LIFE (Months)
2016C	8.4
2012C	31.2
2010C	11.0
2014C	18.8

Assuming the experimental conditions were valid and the analyses were correct (the latter appears likely because the 127-day and 274-day analyses were similar), the above data indicate that the release rates of the 20% chlorpyrifos formulations fall in the following order (fastest to slowest release rate): 2016C, 2010C, 2014C and 2012C. At this time, the 2012C formulation, with a calculated half-life of 31.2 months (and still fully effective at 11 months post-treatment) appears most likely to perform effectively the longest. 4/

D. Possible mechanisms of action and other comments. We believe that the amount of pesticide in the granule can serve as an indicator of the concentration of the pesticide available in the soil for killing the ant. However, because the toxicities of the three insecticides differ, each insecticide will require a different minimum concentration in the granule to accomplish complete kill of the ant. Thus, examination of the granule half-lives shows that Amaze and chlorpyrifos are released in the soil from their granules at roughly equal rates. At the same time,

4/ Because the calculated insecticide half-lives in granules are based on laboratory rather than field trials, these values are not being taken as an absolute measure of field performance. The half-lives of formulations

the soil analyses indicate that their concentrations in the soil are roughly similar (e.g., APHIS data at 7 and 8 months). Despite this, the kill of the ants is complete with chlorpyrifos formulations and only partial with Amaze formulations. Chlorpyrifos therefore appears to be more toxic to the ant than Amaze.

We do not believe that the toxicity of the insecticides is the only factor influencing the results. Solubility of the pesticides in water or movement of insecticide downward into the soil (leaching), which generally parallels water solubility, may play a significant role. It is interesting that the efficacy of the insecticides are parallel to their water solubilities, which are 40, 20 and 0.3 ppm for Diazinon, Amaze, and chlorpyrifos, respectively. By resisting leaching, chlorpyrifos should maintain its concentration in the treated soil longer and higher than the more soluble Diazinon and Amaze, which are much more prone to leaching to lower levels in the soil, thereby removing more Diazinon and Amaze than chlorpyrifos from the treated soil.

We note that the release rate of the insecticides from the granules and the soil samples are not in line with the insecticide permeabilities expected from the formulations. A possible explanation is that most of the insecticide is released from the granules through the edges of the reservoir layer rather than through the plastic surfaces. (Granules are all the same size.) If one assumes that this is the case, the release rate can probably be regulated better by adjusting the particle size than by changing permeabilities via the formulation plastic outer layers.

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exposed to identical conditions should nevertheless provide a valid measure of the relative persistence of the different formulations of each insecticide. Considered together with the bioassay data, half-lives should also provide some idea on duration of effectiveness.

Should uniform particles be desired, Hercon has the specialized equipment to produce very uniform size granules or flakes.

Perhaps, the most encouraging aspect of this study is the complete kill of ants obtained in the bioassays with chlorpyrifos granules, and especially with the 20% formulations, which show promise of remaining effective for 31 months or more. This assessment is based on the half-lives of the formulations ranging up to 31 months and our belief that the granules are likely to remain effective with the insecticide content below half the concentration initially stored in the reservoir.

This study will have to be continued for another year to establish which formulations are best and the length of time they will remain effective.

Table Insecticide analyses[a] and percent imported fire ant kill in bioassay (in *italics*) of soil samples from 10% and 20% formulations.

Pesticide[b]	% a.i.	After months shown							
		1	2	4	5	6	7	8	11
DIAZINON	10%	108	116	71	51	85	32	13	
		100	*100*	*100*	*34*	*2.1*	*0.4*	*4.2*	*1.3*
	20%	154	62	47	10	109	50	29	
		100	*100*	*100*	*3*	*22*	*0.4*	*8*	*0.4*
CHLORPYRIFOS	10%	6.3	11	10.4	3.7	6.2	4.3	7.5	2.2
		100	*100*	*100*	*100*	*100*	*100*	*100*	*76*
	20%	13	9.8	3.8	4.8	3.6	2.0	3.8	5.6
		100	*100*	*100*	*100*	*100*	*100*	*100*	*100*
AMAZE	10%	6.7	8	8.1	7.5	4.5	6.5	2.6	
		100	*100*	*100*	*100*	*25*	*5*	*6*	*19*
	20%	15	7	5	2.4	2.5	4.2	5.1	
		100	*100*	*100*	*100*	*45*	*26*	*68*	*28*
LORSBAN 15G STANDARD		15.6	11.2	0.3	2.3	1.4	0.2	1.5	0
		100	*100*	*100*	*100*	*100*	*100*	*100*	*100*
UNTREATED CONTROL		0	0	0	0	0	0	0	0
		5	*1.6*	*0*	*5*	*0*	*0*	*0*	*0*

[a] Insecticide analyses expressed as ppm. Diazinon and Amaze data 11 mos. post-treatment not available. Chlorpyrifos 20% value based on 3 samples.

[b] Insecticide granules applied to soil at the rate of 10 lbs a.i./acre.

Table Insecticide analyses of treated soil samples from Brooklyn, MS field plots by Hercon at York, PA.

Pesticide % ai	Code No.	ppm after months shown				
		1 mo.	2 mo.	4 mo.	5 mo.	11 mo.
DIAZINON	1001D	1.2	2.6	*a*	0	
10%	1004D	3.6	3.6	0.9	0	
	1007D	2.6	2.5	1.8	1.5	
	1005D	2.8	3.4	1.8	1.2	
20%	2002D	1.4	2.5	*b*	0	
	2003D	2.0	2.9	0.7	0	
	2008D	1.2	2.5	4.2	3.0	
	2006D	5.4	5.5	4.7	1.1	
CHLORPYRIFOS	1015C	6.1	6.2	2.4	3.3	0
10%	1011C	4.5	5.4	2.4	2.4	0
	1009C	5.4	6.2	3.6	4.4	0
	1013C	4.9	12.5	13.6	4.6	8.8
20%	2016C	14.4	6.6	4.6	3.4	5.2
	2012C	5.2	6.0	2.8	3.5	2.9
	2010C	6.6	12.4	2.1	2.4	*b*
	2014C	5.0	12.0	5.7	3.6	8.8
AMAZE	1023A	7.2	10.0	6.4	5.5	
10%	1019A	6.7	4.8	4.0	6.8	
	1017A	5.2	13.4	5.4	3.8	
	1021A	7.8	13.4	3.6	3.0	
20%	2024A	9.2	4.1	11.7	4.3	
	2020A	4.2	3.8	2.8	9.0	
	2018A	7.8	4.8	2.4	3.0	
	2022A	2.8	13.3	11.7	1.7	
CHLORPYRIFOS STANDARD	Lorsban 15G	1.2	1.1	3.3	2.4	0
NONE UNTREATED	CONTROL	0	0	0	0	0

[a]Amount of insecticide not measurable.

[b]Missing sample.

Note: In each set of four formulations with the same % active ingredient, samples are listed in the expected order of fastest release to slowest release rate.

Table 20. Insecticide content of Hercon insecticide granules exposed in potting soil at York, PA, and calculated half-lives based on 127-day exposure.

Pesticide (%)	Code No.	% a.i. in granules Original (A)	After 127 days (B)	% (B)/(A)	Calc. Ave. half-life (months)
DIAZINON 10%	1001D	11.7	3.14	26.8	
	1004D	11.6	6.56	56.6	
	1005D	11.7	5.0	42.7	
	1007D	11.9	2.88	24.2	
			Ave.	37.6	2.8
DIAZINON 20%	2002D	21.7	7.07	32.6	
	2003D	22.0	14.4	65.5	
	2006D	22.8	11.6	50.9	
	2008D	22.3	13.1	58.7	
			Ave.	51.9	4.2
CHLORPYRIFOS 10%	1009C	10.9	7.82	71.7	
	1011C	11.0	8.45	76.8	
	1013C	10.8	8.00	74.1	
	1015C	11.3	7.32	64.8	
			Ave.	71.9	8.4
CHLORPYRIFOS 20%	2010C	21.0	16.3	77.8	
	2012C	21.7	19.9	91.5	
	2014C	20.1	17.4	86.3	
	2016C	21.0	15.1	71.8	
			Ave.	81.9	13.9
AMAZE 10%	1017A	10.5	8.92	85.0	
	1019A	12.2	9.20	75.4	
	1021A	12.4	10.2	82.0	
	1023A	11.9	9.26	77.8	
			Ave.	80.1	12.5
AMAZE 20%	2018A	20.4	15.7	76.7	
	2020A	19.6	16.2	82.5	
	2022A	22.6	17.4	76.9	
	2024A	21.5	16.4	76.2	
			Ave.	78.1	11.2

Project No: IFA 81-14

Project Title: Multiple applications of Dursban solution for quarantine treatments of balled and burlapped nursery plants

Investigators: H. L. Collins and C. J. Mauffray

INTRODUCTION

Surface applications of granular chlordane were used to certify movement of field-grown ornamental plants when shipped in a "balled and burlapped" condition prior to the cancellation of this use by EPA March 6, 1978. A dip treatment (total immersion of the root ball) with a Dursban solution was developed by this laboratory and subsequently adopted for program use (PPQ Treatment Manual 805-25.2230). Dip treatments are not favored by growers or by PPQ line personnel responsible for enforcement of the IFA quarantine due to the cost and labor required to implement the process.

After a series of phone conversations with Mr. W. J. Stagner, Area Director for PPQ, South Central Region Area II, San Antonio, Texas, we agreed to evaluate a procedure whereby multiple applications of Dursban solution (8 fl oz 2E/100 gal. H_2O) would be utilized in lieu of normal waterings. Routine nursery procedures call for twice-daily watering of B & B plants which have been harvested and are being held at the nursery prior to shipment.

Multiple applications of insecticide solutions could be easily adapted to the growers' normal agronomic practice. Since B & B plants are normally watered on a twice daily schedule, the addition of an insecticide to the water would not seriously disrupt routine nursery procedure.

METHODS AND MATERIALS

Two series of tests were conducted. In Test Series I, plants (Figs) grown at a nursery near San Antonio, Texas, were treated there and shipped to Gulfport for evaluation. In Test Series II, a second group of plants (azaleas) grown in Alabama and treated by IFA Station personnel was evaluated.

Treatment of Plants: Dursban solutions were prepared by mixing 4 fl. oz. of 4E/100 gal. of water in a gravity-flow mixing tank which was equipped with a hose and watering nozzle. An agricultural spray adjuvant (Ortho X-77) was added to the solution according to labeled rates (1/2 pint of X-77/100 gals. H_2O).

Balled and burlapped plants were then "watered" with the Dursban solution to the point of run-off. The initial treatment regime consisted of twice daily treatments of a group of five plants. On day 1 the first plant in the series received two applications. This process was continued so that by the fifth day of treatment, the first plant received a total of 10 treatments while the last plant was treated twice.

Sampling: After all treatments were completed (Day 6 after the first plant was treated), the burlap liners were removed from each plant and 1 ¼" diameter soil cores removed from six different sites equally spaced along the circumference of each ball. The cores extended from the periphery of the ball to the center of the ball. Standard clean-up procedures (acetone rinses, etc.) were strictly adhered to in order to prevent contamination of cores removed from different balls.

After a soil core was removed from a given ball, it was sectioned into 1" increments along the length of the core. Each increment was then labeled 2", 3", 4", 6", center, etc.

After the six cores from each ball had been sectioned into the 1" increments, like increments from a given ball were composited and well mixed, i.e., all 2" increments were composited as were all 4" increments, etc.

Biossays - Standard laboratory bioassays utilizing alate queens were then conducted on each of the composited core increments: 20 cc of soil were placed into each of 4 three-inch plastic flower pots which were fitted with plaster of paris bottoms. A fluon coating applied to the sides of the pot prevented the ants from escaping. Five alate queens were then placed into each flower pot (test chamber). Use of alate queens simulates infestation of the ball by a newly mated gravid queen. It is assumed that a newly mated gravid queen represents the greatest pest risk associated with shipment of B & B plants since there is little likelihood that nursery workers would dig, process, and transport a plant ball infested with a large aggressive IFA colony.

Mortality counts were made 1, 2, 3 and 4 days after the alates were confined to the composited core increments.

In order to compensate for natural mortality, an untreated check series (negative control) was evaluated simultaneously. Soil for the untreated check series was collected from a plant ball which had been treated with plain water.

RESULTS AND DISCUSSION

The results obtained were very encouraging. With only two exceptions, all treatments provided 100% kill of the alate queens confined to treated soil. Soil core increments 3" and 4" deep within the plant ball treated with four Dursban applications allowed survival of 25 and 70% respectively (Table 21). Interpretation of these results was that six applications of Dursban should approach the 100% level of kill of gravid IFA queens which may be intrenched within a plant ball.

Additional studies utilizing balled azaleas grown in Alabama and treated by IFA Station personnel confirmed the results obtained with the plants grown and treated in San Antonio (Table 21). Therefore, all indications were positive that this procedure could be recommended to certify movement of B & B plants. However, numerous variables including, but not limited to, the following will affect the rate and degree of absorption of the Dursban solution by various plant balls:

(1) Soil type
(2) Packing material (hemp vs. synthetic)
(3) Root structure
(4) Moisture content
(5) Size

Without thorough saturation of the plant ball, a small ant colony or gravid queen could conceivably remain sequestered in the center of the root mass. Six applications (twice daily "waterings" over a 3-day period) should compensate for most of these variables. Fewer applications will provide excellent control, and thus markedly decrease the likelihood of transport of a gravid queen. Although a wetting agent was not used with the San Antonio plants, Ortho-X-77 was used on the plants grown in Alabama and treated by IFA Station personnel. As mentioned above, results of this test were very good; 100% control was achieved with all treatments indicating that the Ortho-X-77 may have enhanced kill.

Following treatment, all plants were maintained outdoors under natural conditions for 6-8 weeks. At this time, a 100 cc composite sample from each ball periphery was collected and bioassayed with alate queens. Results of this test are shown in Table 22 and indicate that 4 to 10 applications will generally retain residual activity for 6 to 8 weeks following application.

Due to the apparent success of this procedure and the definite need for alternate regulatory treatments for this commodity, a recommendation was made to initiate action to amend PPQ Manual 805-25 to include multiple applications of Dursban to balled and burlapped plants.

Table 21 . Bioassay of Soil Cores Removed from Plant Balls Treated with Multiple Dursban Applications (4 fl. oz. 4E/100 gals. H_2O.)

Core Increment (Distance from Ball Periphery in inches)	No. Dursban Apps. to Ball	% Mortality of Alate Queens after 4 days Continuous Exposure to Treated Soil 1/
	Test Series I	
1	2	100
2	2	100
3	2	100
4	2	100
1	4	100
2	4	100
3	4	75
4	4	30
1	6	100
2	6	100
3	6	100
4	6	100
1	8	100
2	8	100
3	8	100
4	8	100
1	10	100
2	10	100
3	10	100
4	10	100
-	Untreated check	0

Table 21 (continued)

Core Increment (Distance from Ball Periphery in inches)	No. Dursban Apps. to Ball	% Mortality of Alate Queens after 4 days Continuous Exposure to Treated Soil 1/
	Test Series II	
1	2	100
2	3	100
3	2	100
4	2	100
1	4	100
2	4	100
3	4	100
4	4	100
1	6	100
2	6	100
3	6	100
4	6	100
1	8	100
2	8	100
3	8	100
4	8	100
1	10	100
2	10	100
3	10	100
4	10	100
-	Untreated check	0

1/ Avg. of 4 replicates 4 Alate Queens per replicate

Table 22. Residual activity of multiple Dursban applications to Balled and Burlapped Nursery Plants

No. Dursban Applications 1/	Type of Plant Material	% Kill of Alate Queens Six Weeks following Application 2/
2	Azaleas from Ala.	13
4	"	93
6	"	66
8	"	100
10	"	93
2	Figs from Texas	87
4	"	100
6	"	100
8	"	26
10	"	100
Untreated	Azaleas	0

1/ 4fl. oz. 4EC/100 gals. H_2O applied to "run-off" at each application.

2/ Fig plants from Texas were bioassayed 8 weeks following application.

Project No: IFA 81-15

Project Title: Evaluation of lindane for quarantine treatments

Investigators: H. L. Collins and Avel L. Ladner

INTRODUCTION

Lindane was evaluated for fire ant control prior to the tests described here (Lyle and Fortune 1948, Eden and Arant 1949).

However, those use patterns greatly diverged from our particular needs; and necessitated a re-evaluation to determine the potential of lindane treatment for grass sod, potting soils, balled and burlapped plants, etc. In addition to initial toxicity, one of the foremost requirements of an effective quarantine treatment is residual activity. Lindane demonstrates residual activity in soil similar to other chlorinated hydrocarbons (Ulmann 1972) although its persistance is less than DDT or Dieldrin.

METHODS AND MATERIALS

A. Dosage - Mortality ~~tests with~~ Lindane:

Procedures described by Banks et al (1964) were slightly modified and used to determine initial toxicity of Lindane to the IFA. Serial dilutions of technicial lindane in Acetone were used to treat 50 gram batches of soil (sandy loam top soil pH 6.5) with dosages ranging from .5 to .009 ppm. Each dose rate was tested 3 times on different days with 3 replicates per test. Each replicate consisted of 20 worker ants confined to treated soil which was placed in 2" x 2" plastic flower pots equipped with a Labstone® bottom. The Labstone absorbed moisture from an underlying bed of damp peat moss while a Fluon® coating prevented the ants from escaping from the top of the open pots. Mortality was assessed at 24 hour intervals for 72 hours.

B. Potting Soil Tests:

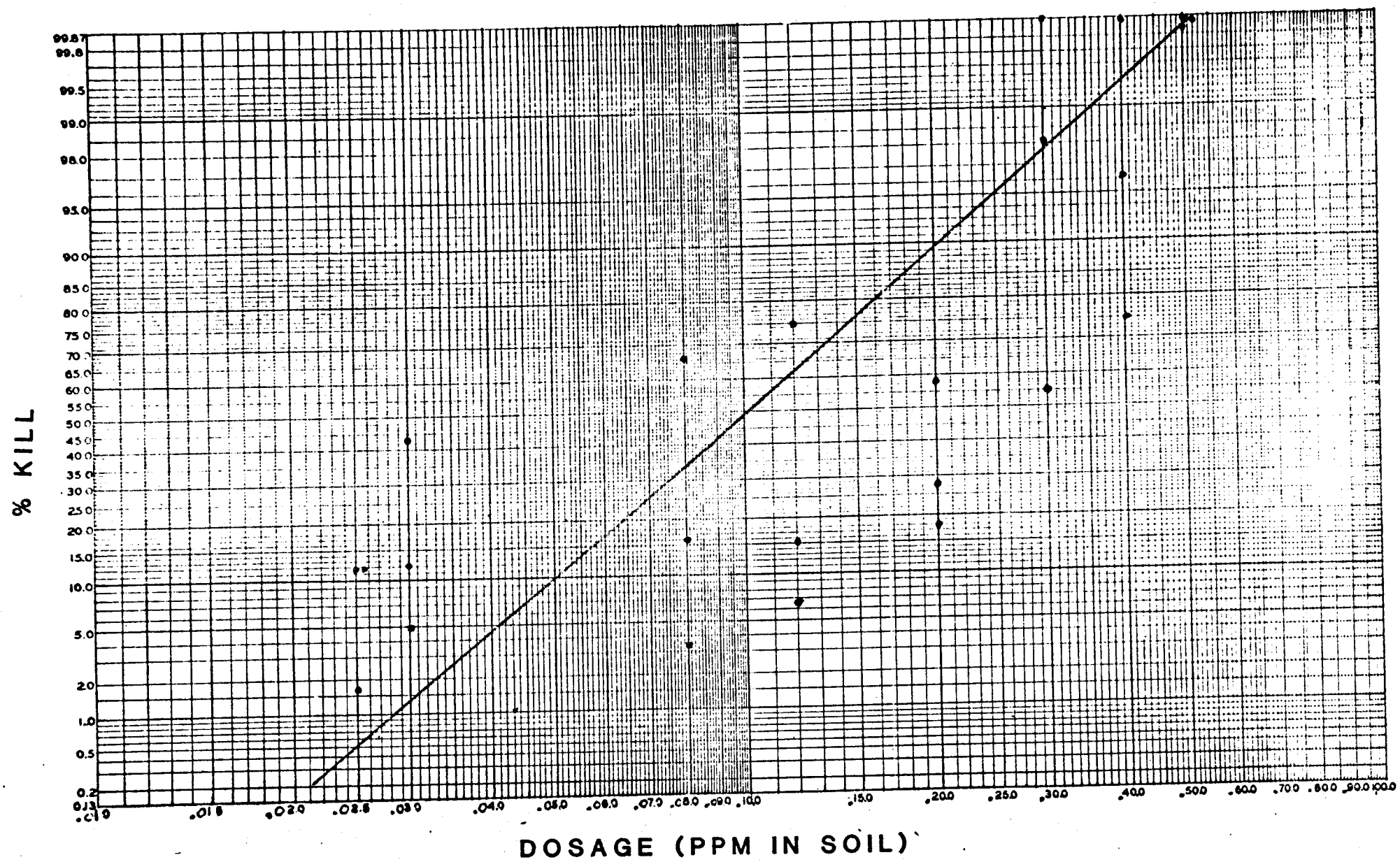
Lindane 6WP (Security Brand, Woolfolk Chemicals, Ft. Valley, Ga.) was evaluated as a preplant incorporated treatment for nursery potting soil. Various rates of application ranging from 11.2 gms. AI/cu. yd. to 0.89 gms. AI/cu. yd. were blended into BACCTO® potting soil with a portable cement mixer. The mixer was operated for 1 hour after the insecticide was added in order to insure thorough blending of the toxicant with the potting soil. The treated soil was then placed into 1 gallon plastic flower pots and aged outdoors under natural conditions for 1 month prior to the first bioassay, At this time, 3 pots from each treatment rate were bioassayed by confining 40 cc of fragmented fire ant colonies on the treated soil from each pot. The test "colonies" were then observed for 14 days or until mortality of 90% or more of all life forms in each of the 3 colonies occurred. Treatments which allowed survival of more than 10% of a colony were considered ineffective. Treatments which were effective at the first bioassay interval were aged and retested periodically to measure and compare residual activity with Dursban FA-5.

RESULTS

Results of the dosage mortality tests indicated that lindane is moderately toxic to imported fire ant workers (Figure 2). An LD_{99} (72 hrs. continuous exposure) was determined to be approximately 0.35 ppm.

Results of tests to determine residual activity in potting soil are incomplete at the present time.

FIGURE 2. TOXICITY OF LINDANE TO IFA WORKERS



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Project No. IFA 81-16

Project Title: Evaluation of Potting soil toxicants

Investigators: Jerry Medley, Michael J. Cuevas and H. L. Collins

INTRODUCTION:

The on-going screening program to evaluate insecticides applied as a preplant incorporated treatment for nursery potting soil was continued. Until its cancellation of registration in December 1979, chlordane applied at a rate of 4 oz. of 5% dust per cubic yard was used for treatment of potting soils. In January 1980, chlorpyrifos 5% granular (FA-5) was registered for use at a rate of .5 lb FA-5/yd^3 of potting media. Although FA-5 is highly efficacious, numerous complaints of phytotoxicity in Central Florida prompted the registrant to withdraw this product from the market in the Fall of 1981.

METHODS AND MATERIALS

Test procedures used to evaluate all candidate toxicants were as follows: Granular or dust formulations of each candidate tested were blended into nursery potting soil, (BACCTO ® Brand, 818 lbs/yd^3) at an initial rate of 10 lbs. AI per 3-inch acre (equivalent to 11.2 grams AI per cubic yard of media). A portable cement mixer (2 cu. ft. capacity) was used to blend the toxicants into the potting media, and was operated for 1 hour per batch to insure thorough blending. Treated media was then poured into one-gallon nlastic pots and weathered outdoor under natural conditions for one month prior to the first bioassay. Bioassays were conducted by confining 40 cc of a fragmented fire ant colony on each of 3 pots from each treatment series. The test "colonies" were then observed for 14 days or until mortality of 90% or more of all life forms in each of the 3 colonies occurred. Treatments which allowed survival of more than 10% of a colony were considered ineffective. Treatments which were effective at the first bioassay interval were aged and retested periodically to measure and compare residual activity with Dursban FA-5.

RESULTS:

Results with lindane are incomplete at the present time (Table 23). However, lindane 6WP at 11.2, 5.6 and 2.2 gms AI/yd^3 of potting soil demonstrated good activity at the initial bioassay which was conducted 1 month after application. Additional studies with different formulations and rates of lindane are scheduled for the near future.

Other compounds tested failed to provide activity at the initial bioassay.

Table 23. Residual Activity of Candidate Potting Soil Toxicants Weathered Outdoors in Plastic Pots under Natural Conditions

Toxicant	Formulation	Formulation Code	Rate (Gms AI/ yd^3 of Soil)	No. Months Residual Activity (90% or more Mortality to Test Ant Colonies)
Orthene	10G	CC 11242	11.2	< 1
Orthene	5G	CC 8158	11.2	< 1
Orthene	5G	CC 8632	11.2	< 1
Methoxychlor	50 WP	N/A	11.2	< 1
Toxaphene	15G	ORM-A NA 2761	11.2	< 1
Delnav	10G	X-23077-9	11.2	< 1
Lindane	6 WP	N/A	11.2	> 1 1/
"	"	"	5.6	> 1 1/
"	"	"	2.2	> 1 1/
"	"	"	1.12	< 1
"	"	"	.89	< 1
Dursban 2/	5G	FA-5	11.2	40
Chlordane 2/	10G	N/A	11.2	54

1/ Test still in progress.

2/ Results based on previous tests.

Project No: IFA 81-17

Project Title: Root-dip treatments for certification of Balled and Burlapped Nursery stock.

Investigators: H. L. Collins and C. J. Mauffray

INTRODUCTION

Surface applications of granular chlordane were used to certify movement of field-grown ornamental plants when shipped in a "balled and burlapped" condition prior to the cancellation of this use by EPA March 6, 1978. A root dip treatment (total immersion of the root ball) with a Dursban solution was developed by this laboratory in 1979 and subsequently adopted for program use (PPQ treatment mannual 805-25.2230).

Although dip treatments are not favored by growers or by PPQ line personnel responsible for enforcement of the IFA quarantine, (due to the cost and labor required), this procedure does provide a stop-gap measure to certify movement of B & B plants until more acceptable procedures can be devised.

METHODS AND MATERIALS

Balled and'burlapped plants were divided into groups of three plants/treatment and the root balls of each plant totally immersed into candidate insecticide solutions. The immersion was continued until bubbling ceased, indicating that total saturation of the root ball had occurred. The plants were then removed from the insecticide solution and allowed to drain overnight prior to initiation of the bioassay.

The following insecticides were evaluated:

1. Lindane 20 EC(Kill-ko Brand, formulated by Rigo Co., Buckner, Kentucky).
2. Orthene 75 SP (Ortho Division Chevron Chemicals)
3. Dursban 4E (Dow-Chemicals, Midland, Michigan).

Sampling: After all treatments were completed, the burlap liners were removed from each plant and 1 ¼" diameter soil cores removed from six different sites equally spaced along the circumference of each ball. The cores extended from the periphery of the ball to the center of the ball. Standard clean-up procedures (acetone rinses, etc.) were strictly adhered to in order to prevent contamination of cores removed from different balls.

After a soil core was removed from a given ball, it was sectioned into 1" increments along the length of the core. Each increment was then labeled 2", 3", 4", 6", center, etc.

After the six cores from each ball had been sectioned into the 1" increments, like increments from a given ball were composited and well mixed, i.e., all 2" increments were composited as were all 4" increments, etc.

Biossays - Standard laboratory bioassays utilizing alate queens were then conducted on each of the composited core increments: 20 cc of soil were placed into each of 4 three-inch plastic flower pots which were fitted with plaster of paris bottoms. A fluon coating applied to the sides of the pot prevented the ants from escaping. Five alate queens were then placed into each flower pot (test chamber). Use of alate queens simulates infestation of the ball by a newly mated gravid queen. It is assumed that a newly mated gravid queen represents the greatest pest risk associated with shipment of B & B plants since there is little likelihood that nursery workers would dig, process, and transport a plant ball infested with a large aggressive IFA colony.

Mortality counts were made 1, 2, 3 and 4 days after the alates were confined to the composited core increments.

In order to compensate for natural mortality, an untreated check series (negative control) was evaluated simultaneously. Soil for the untreated check series was collected from a plant ball which had been dipped in plain water.

RESULTS

As shown in Table 24 , all treatments were highly effective at the initial bioassay (24 hrs. following immersion), since 100% kill of alate queens confined to soil removed from treated root balls was achieved.

Treated plants were maintained outdoors under natural conditions until bioassays were conducted at 30 and 60 days following treatment in order to determine residual activity of each treatment.

Thirty days after treatment, both lindane and Dursban were 100% effective, while Orthene showed no activity (Table 25). Both Dursban and lindane remained 100% effective at the 60-day post-treat bioassay.

Table 24 . Evaluation of Root dips for treatment of Balled and Burlapped plants.

Treatment			Core increment (Distance from Ball Periphery in inches)	% Mortality of Alate Queens after indicated exposure interval (Days) 1/	
Insecticide	Formulation	Rate/100 gals. H_2O		1	4
Lindane	20 EC	8 fl. oz.	1	100	
"	"	"	2	100	
"	"	"	3	100	
Orthene	75 SP	.5 lb. AI	1	100	
"	"	"	2	95	100
"	"	"	3	90	100
Dursban	4 E	4 fl. oz.	1	100	
"	"	"	2	100	
"	"	"	3	100	
Untreated Check		-	-	5	5

1/ Avg. of 4 replicates with 5 Alates/replicate.

Table 25. Residual activity of various root dip treatments for Balled and burlapped plants

Insecticide	Formulation	Rate/100 gals. H_2O	Time After Treatment (Days)	% Kill of Alate queens exposed for the indicated days to soil from treated Plant Balls 1/			
				1	2	3	4
Lindane	20 EC	8 fl. oz.	30	100			
"	"	"	60	100			
Orthene	75 SP	.5 lb.	30	0	0	0	0
"	"	"	30	1.6	1.6	1.6	1.6
Dursban	4 E	4 fl. oz.	30	100			
"	"	"	60	100			
Untreated check -			30	0	0	5	5
			60	0	0	0	0

1/ composited soil samples from 3 treated plants were divided into 4 replicates/plant and 5 Alate queens were confined to each replicate (= 12 replicates/treatment).