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Imported Fire Ant Station

Whiteville Plant Methods Center

Science and Technology

Animal and Plant Health Inspection Service

U.S. Department of Agriculture

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These reports were prepared for the information of the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, personnel and others that are interested in imported fire ant control. Statements and observations may be based on preliminary or uncompleted experiments; therefore the data are not ready for publication or public distribution.

Results of insecticide trials 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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March, 1990

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FY 1989 OBJECTIVES
IMPORTED FIRE ANT STATION
GULFPORT, MS

OBJECTIVE #1: Development of quarantine treatments for certification of regulated articles:
- Emphasis on development of in-field treatments and management systems for field grown nursery stock.
- Continue screening for alternate potting soil and grass sod treatments.
- Assist as needed with registrations of all treatments shown to be effective.

OBJECTIVE #2: Development of eradication procedures for small isolated infestations:
- Evaluate combinations of chemicals, dose rates, application procedures, treatment intervals, etc., to determine the most effective method of eliminating a population from a given area.
- Based on results obtained, prepare written guidelines and protocol, for use by others, to achieve eradication of small isolated infestations.

OBJECTIVE #3: Continue testing and development of chemical bait formulations:
- Conduct small plots field evaluations of new bait formulations (primarily new attractants, inert carriers, and stabilizers).
- Evaluation of pheromone based baits (if ARS research has advanced to appropriate stage).

OBJECTIVE #4: Preparation/distribution of technical information on control, quarantine procedures, new technology, biological hazards, etc., to state agencies, the media, and the public.

Summary

Dose Rate Trials with Triumph 1G in Nursery Potting Media (Page 1): A study initiated in January 1986 with dose rates ranging from 5.6 to 44.8 g AI/cu. yd. of potting media indicated that residual activity from 7 to over 48 months could be achieved with Triumph 1G.

Evaluation of Candidate Potting Soil Toxicants, 1989 (Page 3): 3 Candidate synthetic pyrethroid insecticides (Ammo 0.75G, Capture 0.3G, and Force 1.5G) provided excellent results in a preliminary trial. All three of these products incorporated into nursery potting media at a rate of 11.35 gm. AI/cu. yd. of media gave over 13 months residual activity.

In-field Spot Treatments with Granular Dursban for Certification of Field Grown Nursery Stock (Page 8): Several completed studies have shown that spot treatment of individual field grown woody ornamental plants with granular Dursban may be a viable option to the currently approved root-dip treatment or the in-field combination treatment employing baits in combination with broadcast granular Dursban.

Insecticide Coatings and Paint Additives for Residual Control of Foraging IFA Workers on Painted Surfaces (Page 17): Chlorpyrifos in two formulations of paint additives (CPF® and Di-All®) and 1 insecticide coating (Super IQ®) provided quick knockdown of IFA workers. Super IQ remained active for over 15 months.

Relative Phytotoxicity of Chlorpyrifos and Izaphos to Selected Foliage and Woody Landscape Plants (Page 23): Few adverse effects were noted for any of the 38 varieties tested for phytotoxic response to granular chlorpyrifos. *Impatiens*, *Chrysanthemum*, and *Ilex compacta* showed a negative response to a drench application of Dursban 2E at 3X the labelled rate. Drench applications of Triumph 1E at 1X and 3X recommended rates provided no ill effects on 6 cultivars. However, phytotoxic response was noted for the following plants: [*Azalea*, Rosea], *Cuphea hyssopitifolia*, *Impatiens*, and *Chrysanthemum*.

Population Dynamics of IFA Colonies (Page 33): A long term study to compare rates of reinfestation, time required for incipient colonies to attain various colony colonies in two areas (Gulfport, MS and Whiteville, NC) was initiated. At the Gulfport site, all colonies were class 10 or higher 15 months after treatment. Two months after treatment only 1% of the colonies present were class 10 or higher. At the North Carolina site, 5.2% of the colonies were class 10 or higher two months after treatment, but by 19 months post-treatment, 75% of the colonies had reached class 10 or higher.

Various Dosage Rates of Dursban Tested Against Time for Worker Mortality (Page 43): The time required for various dosages of chlorpyrifos in soil to produce 100% mortality to IFA workers ranges from 7 hours at 50 ppm to 184 hours at 2 ppm.

Residual Activity of Various Insecticidal Drench Treatments for Nursery Potting Soil, 1989 (Page 46): Several products provided at least 180 days residual activity when applied as a drench to nursery potting media. These products were: Empire, Capture, Tempo, Torpedo, and Karate. Empire is a microencapsulated chlorpyrifos; all others are synthetic pyrethroid insecticides.

Effects of Irrigation on Residual Activity of Granular Chlorpyrifos and Izaphos (Page 50): Irrigation, regardless of quantity applied, enhanced the rate of degradation of both insecticides relative to treatments receiving natural rainfall.

Evaluation of Mobay NTN 33893 for Control of IFA (Page 57): Mobay NTN 33893 caused totally aberrant behavior of IFA following either contact exposure or per os. Laboratory drench applications to captive colonies caused total colony mortality at concentrations of 0.9 - 15 cc./gal. water, but a preliminary field drench trial did not provide satisfactory results.

Tests with Oftanol 5G for IFA Quarantine Treatment of Containerized Nursery Stock (Page 67): Oftanol 5G at rates ranging from 11.3 to 8.5 gms. AI/ cu. yds. of potting media was totally ineffective based on laboratory bioassays with alate IFA queens.

Performance of Triumph 1G in Various Types of Potting Media (Page 70): Although several previous trials with Triumph 1G in nursery potting media have showed relatively long residual activity, preliminary results of this trial indicate less than 90 days residual for either Triumph 1G or Lorsban 15G in 3 different commercial potting mixes.

Effect of Irrigation Water pH on the Rate of Degradation of Chlorpyrifos in Nursery Potting Media (Page 74): Preliminary and inconclusive results seem to indicate that elevated pH levels of irrigation water (11) did not enhance degradation relative to tap water or irrigation water at pH 9.

Residual Activity of Granular Formulations of Chlorpyrifos and Triumph Page 79): Significant differences in the residual activity of 3 different granular chlorpyrifos formulations were not seen. In contrast to several previous studies, Triumph 1G was effective for less than 90 days incorporated into nursery potting media at 11.3 gms. AI/cu. yd.

Effect of Multiple Applications of Logic for Population Suppression of Polygynous IFA in Commercial Grass Sod (Page 83): Preliminary data; no conclusions drawn.

Evaluation of Various Chlorpyrifos Formulations in Potting Soil (Page 85): Results of this trial confirm numerous other tests conducted in 1989 which showed that chlorpyrifos, regardless of formulation, dose rate, or media, generally provide 90 day or less activity when incorporated into nursery potting media.

Determination of Optimum Dose Rate of Triumph 1G and Suscon 10 CR in Nursery Potting Media (Page 91): A trial was initiated to evaluated dose rates of 20 to 100 ppm of both Triumph 1G and Suscon 10 CR (a controlled release formulation of chlorpyrifos). Lower rates of Suscon 10 CR were not effective 30 days after treatment, possibly due to the rate of release of the active ingredient from the polymer matrix. However, 60 days after all treatments provided 100% mortality to alate queens confined to treated media.

Residual Activity of Granular Insecticides Irrigated with Distilled versus Tap Water (Page 94): Very preliminary results indicate that degradation rates of Dursban 2.5G, Lorsban 15G or Triumph 1G are not affected by distilled vs. tap water. All treatments were inactivated 60 days after treatment.

Degradation of Dursban 2EC in Sterile and Non-sterile Potting Media Page 97): Extremely preliminary data indicates that the persistence of Dursban 2EC is greater in sterilized media that is maintained in a closed system.

Seasonal Effectiveness of Amdro and Logic for IFA Control (Page 101): A long term study was initiated in June 1989 to better define the "window of opportunity" for maximum control in the shortest period of time for both Amdro and Logic baits.

Assessments of Damage Caused to Commercially Grown Blueberries by Red Imported Fire Ant in Mississippi (Page 105): Test plots were established to determine if IFA infestations affect yield of commercially grown blueberries.

Migration of IFA Colonies into Dursban Impregnated Media (Page 110): Fragmented IFA colonies did not avoid pots containing Dursban impregnated potting media. However, even though colonies initially moved into treated pots, they eventually migrated into adjacent untreated pots.

Determination of Leachability of Various Insecticides for "Over-the-Top" Certification of Containerized Nursery Stock (Page 113): Topical applications of Talstar 10W to containerized nursery stock and packed soil columns indicated excellent potential for use as an "over-the-top" certification procedure for containerized nursery stock.

Evaluation of Candidate Toxicants for Quarantine Treatment of Grass Sod, 1989 (Page 119): Several candidate pesticides provided over 150 days residual activity against alate queens when applied to grass sod at 1/6 of the rate of application for granule Dursban standard. These candidates were: Capture 0.2G, Capture 2EC, Ammo 0.75G, and Karate 1EC. All are synthetic pyrethroid insecticides.

Quarantine Treatments for Polygynous IFA in Commercial Grass Sod (Page 125): Two trials indicated that the currently labelled and approved Dursban 10G was highly effective for control of polygynous IFA in South Texas sod farms. Combination treatments employing Amdro plus either Dursban 10G or Triumph 4E were highly effective from 4-22 weeks after application.

Systematic Survey of the Three Coastal Counties Mississippi for Incidences of Polygynous Colonies of Red Imported Fire Ant (Page 130): Annual surveys were initiated in April 1989 to monitor polygyny in the three coastal counties of Mississippi. Ironically, one of the original sites from which polygyny was discovered 16 years ago was 98% monogynous in 1989.

PROJECT NO: FA02G036

PROJECT TITLE: Dose Rate Trials with Triumph 1G in Nursery Potting Media

TYPE REPORT: Interim

LEADER/PARTICIPANT: Avel Ladner

INTRODUCTION/METHODS & MATERIALS:

A long term dose rate study with Triumph 1G was initiated in January 1986 and continued throughout 1987, 1988 and 1989. Dose rates of 5.6, 11.2, 22.4, and 44.8 grams AI per cubic yard of potting media (Baccto Brand, Michigan Peat Co., Houston, Texas) were thoroughly blended into the media with a portable cement mixer on January 30, 1986. Treated media was then weathered outdoors under natural conditions (no irrigation water, natural rainfall only) in 1 gallon plastic pots to simulate actual nursery conditions. Bioassays with alate queens were periodically conducted according to procedures described elsewhere in this report.

RESULTS:

As shown in Table 1, 5.6 grams AI/cu. yd provided 7 months residual activity, and 11.2 gms. AI/cu. yd. remained active for approximately 14 months. All other rates continued to provide 100% mortality for 27 months or longer. The highest rate tested (44.8 g. AI/cu. yd. of media), remained active 48 months after treatment. This trial will be continued until all rates become ineffective.

Table 1. Residual Effectiveness of TRIUMPH 1G in Nursery Potting Soil. 1/

Mean % Mortality to alate queens confined to treated soil after 7 days continuous exposure

DOSE RATE (Gm AI/Cu. Yd	Age of treated soil (months) (1)	(3)	(7)	(9)	(12)	(13)	(14)	(18)	(19	(20)	(21)	(23)	(25)	(27)	(29)	(31)	(34)	(39)	(40)	(41)	(42)	(43)	(44)
5.6	100	100	100	60	55	30	10	65	35	5	5	0	5	0	0	0	5	--	--	--	--	--	--
11.2	100	100	100	100	100	100	100	80	90	45	70	80	35	60	15	0	0	--	--	--	--	--	--
22.4	100	100	100	100	100	100	100	100	100	100	100	100	85	100	65	45	100	85	100	35	0	20	5
44.8	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	85	100
Check	5	10	10	10	0	0	0	0	0	10	5	5	10	0	10	5	10	10	40	10	0	25	0

1/ Test initiated January 30, 1986.

PROJECT NO: FA02G037

PROJECT TITLE: Evaluation of Candidate Potting Soil Toxicants, 1989

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Tim Lockley and Avel Ladner

INTRODUCTION:

Chlordane applied at a rate of 4 ounces of 5%Dust per cubic yard of potting soil was used as a quarantine treatment for containerized nursery stock until cancellation of registration in December 1979. An on-going screening program to evaluate insecticides applied as a pre-plant incorporated treatment for nursery potting soils has been conducted by the IFA Station since 1974. The most effective treatment thus far is chlorpyrifos (Collins et al. 1980). In January 1980, Dow Chemical Company obtained registration of a 5%chlorpyrifos granule which was marketed under the trade name FA-5. This product was applied at a rate of 0.5 lbs. FA-5 per cubic yard of potting media. Several cases of possible FA-5 related phytotoxicity to greenhouse grown succulent plants in Central Florida prompted the registrant to withdraw this product from the market in the fall of 1981. Registration of a second chlorpyrifos formulation (a 2.5% granule) for treatment of potting soil was obtained in July 1984 by Ford's Chemical and Service, Inc., Pasadena, Texas. At the current time this is the only registered product for this use pattern.

A limited number of candidate potting soil toxicants were evaluated in 1988-1989 in an effort to expand the number of options available to growers who

ship containerized plants outside the IFA regulated area. As in previous years, our efforts were impeded by the small number of suitable candidates.

METHODS AND MATERIALS:

Test procedures used to evaluate all candidate toxicants were as follows: Granular or dust formulations of each product tested were blended into nursery potting soil, (Stronglite®, 382 pounds per cubic yard) at an initial rate of 10 lbs. AI per three-inch acre (equivalent to 11.35 grams AI per cu. yd. of media). A portable cement mixer (2 cu. ft. capacity) was used to blend the toxicants into the potting media, and was operated for one hour per batch to insure thorough blending. Treated media was then poured into two-quart capacity plastic pots and weathered outdoors under natural conditions for one month prior to the first bioassay. No additional irrigation water was added.

Bioassays were conducted in the laboratory by confining alate queens to treated soil 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. There were four replicates per treatment in each bioassay. Each pot (replicate) contained 20 cc. of treated soil and five alate queens. Queen mortality was assessed after seven days of continuous confinement to the treated soil. Treatments which were effective at the first bioassay interval were aged and retested periodically to measure and compare residual activity with chlorpyrifos. Several granular formulations of chlorpyrifos have

provided up to 24 months residual activity under these conditions.

RESULTS:

As illustrated in Table 2, three candidates (Ammo 0.75G, Capture 0.3G and Force 1.5G) have demonstrated excellent residual activity for 13 months post-incorporation. It must be noted that our standard Dursban 2.5G failed to achieve its previously demonstrated residual activity during this evaluation falling out after only 4 months. Further bioassays of all currently active compounds will continue until such time as they fail to maintain 100% control of IFA.

Table 2. Residual Activity of Candidate Potting Soil Toxicants, 1989.

CHEMICAL	Rate (ppm)	Mean % Mortality of Alate Queens Confined to Treated Soil for 7 Days Age of Treated Soil (Months) 1/												
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Ammo 0.75G	86.3	100	100	100	100	100	100	100	100	100	100	100	100	100
Capture 0.30G	72.6	100	100	100	100	100	100	100	100	100	100	100	100	100
Force 1.5G	86.3	100	100	100	100	100	100	100	100	100	100	100	100	100
Pounce 1.5G	86.3	100	100	100	100	95								
Dursban 2.5G	86.3	100	100	100	100	45	75	35	0	0				
Turcam 2.5G	86.3	100	100	15	20	0								
Advantage 5G	86.3	45	100	20	40	0								
Furadan 5G	86.3	25	35	0										
Oftanol 5G	86.3	0	25	0										
Check		5	10	5	5	10	15	0	5	0	0	5	0	10

1/ Test initiated December 14, 1988.

REFERENCES CITED:

Collins, H.L., C.L. Mangum, J.G. Medley and A.W. Guenther. 1980. Evaluation of soil insecticides for quarantine treatments against imported fire ants, 1976-1979. Insecticide and Acaricide Tests. 5:209.

PROJECT NO: FA01G028

PROJECT TITLE: In-Field Spot Treatments with Granular Dursban for Certification of Field Grown Nursery Stock

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Tim Lockley, Lee McAnally, and Avel Ladner

INTRODUCTION:

Currently, the only approved treatment procedures for certification of field grown nursery plants (ball and burlap) involve either a chlorpyrifos root-dip treatment or broadcast application of baits in combination with granular chlorpyrifos. Root dips are not only highly labor intensive and costly, but are quite disruptive to the root system of plants grown in lighter, sandy soils. The cost of a broadcast application of chlorpyrifos and the difficulty of making such an application in situations where the stock is relatively large makes this method prohibitive. A simpler, relatively inexpensive in-field treatment for these plants is among the highest priorities in IFA quarantine. As an alternative, we have begun to test a "low tech" approach that would allow the grower to treat each plant individually prior to its excavation without having to waste expensive chemical on plants that may or may not be harvested for shipment outside the regulated area.

Although the residual activity associated with surface application of chlorpyrifos is relatively short (4 weeks at 4 lbs. AI/acre for granular formulations), it does provide protection against invasion by newly mated queens. Large mature colonies are weakened, but not usually killed by this treatment. However, a behavioral trait consistently manifested by IFA

colonies treated with almost any insecticide is to abandon the treated mound and establish a new nest some distance away (Hillman 1977, Bass and Hays 1982, Williams and Lofgren 1983). A simple surface application of chlorpyrifos applied to the root zone of field grown plants intended for harvest and shipment within a short time (4 to 6 weeks) might prove to be a successful (though not necessarily lethal) quarantine treatment if it would force mature colonies in the treated area (i.e., 36" band around the row of plants to be harvested) to evacuate the area and provide a 4 to 6 week residual barrier against re-invasion by newly mated queens. Theoretically, IFA colonies forced to evacuate the treatment area would relocate in the area between rows (the middles), turnrows, or field borders where they would not be subject to movement from the nursery via root balls of plants. Extensive in-field trials are needed in order to confirm this hypothesis.

METHODS AND MATERIALS:

Test 1 was carried out in a heavily infested field of commercially grown coastal bermuda grass at the Pearl River Sod Farm 10 km. east of Wiggins, Stone County, Mississippi on September 8, 1988. One hundred sixty-three mounds were marked with numbered survey flags, and treated with chlorpyrifos (Dursban 2.5G) at the rate equivalent to 6 lbs. AI/acre (17.4 g. total compound per 1 yd. diameter circle [7.04 sq. ft.]). The mounds were treated by hand application within a 1.5 ft. radius of the flag. After 14 days, on September 22, the mounds were excavated to determine if the ants were forced to abandon their nest.

RESULTS:

Of the 163 mounds treated, only 157 could be located. Of these, all had been evacuated. In 93 of the 157 located mounds, new mound of an equivalent or slightly smaller size were located outside of a radius of 6 to 10 feet from the original mound. No new mounds were found within a 6 foot radius of any of the original mounds. In 41 of the treatments, the new mounds were located in excess of 10 feet from the originally treated mound. In the remaining 23 sites, no new mounds could be located within a reasonable distance (25 feet) from the original mound.

Based on results of tests carried out in 1988, other tests were initiated to determine how rapidly IFA colonies abandon a treated site given differing climatological situations.

Tests were begun on January 4, 1989, at a Christmas tree farm approximately 9 km. NNW of Gulfport, Harrison County, Mississippi. The site was selected because of its ability to simulate a field grown nursery situation (even though the trees were to be cut and not balled and burlapped) and because of its convenient location to the IFA Lab. Twenty-six mounds were located and marked with survey flags. The area within the drip line of the tree canopy was treated at the per acre equivalent of 6 lbs. AI chlorpyrifos. The treatment area ranged from a minimum radius of 1.0 to 2.5 meters. The trees themselves ranged in height from 1.0 to 3.5 m. Results can be seen in Table 3.

During the test, temperatures ranged from 42 F for the low temperature to 73 F [on two consecutive days within the study] for the maximum. Only trace amounts of precipitation fell during the trials. Humidity ranged from 28 to 95%. No irrigation applied to the site.

A second test was begun on January 10, 1989 at the same site. Again, twenty-six mounds were marked and treated as described above. Within 13 days of treatment, all mounds had been abandoned. Eighty-five percent of the treated mounds were abandoned within the first week of treatment [Table 4]. One and three tenths of precipitation was measured during this trial. Malfunction of the hygrothermograph precluded collection of temperature and humidity data.

Test 3 was begun on January 23 and continued until February 8, 1989. Twenty-six mounds were marked and treated with Dursban 2.5G. Test 3 lasted longer than the previous two tests [14 days]. This may be a factor of either the age of the chemical used or the type of carrier. Previous tests had been carried out utilizing a Ford's Dursban 2.5G that used corn cob grit as its carrier. Supplies of that product was rapidly exhausted because of other ongoing projects. We were required to use a Ford's Dursban 2.5G that had been opened five months prior to the study and used crushed pecan hulls as the carrier. Though not exposed to extremes of of either temperature or humidity, some degradation of the chlorpyrifos may have occurred. The only measurable precipitation occurred on the morning of the day the mounds were treated. A trace amount fell on February 5. Temperatures were well above seasonal norms.

Two of the mounds were abandoned within 24 hours of treatment. By Day 8, 42.3% of the mounds were abandoned. By Day 14, all mounds had been evacuated [Table 5].

Test 4 was carried out from February 8 -14, 1989. A new bag of Ford's Dursban 2.5G was used during this trial. The carrier was corn cob grit. Within seven days of application, all mounds were vacated. Ninety-five percent of the mounds were abandoned within 5 days of treatment. No rainfall occurred during the test. Because of a malfunction in the hygrothermograph, no other meteorological data was taken.

Test 5 began on February 16, 1989 and continued until February 21 [6 days]. Sixty-two percent of the mounds were abandoned within 24 hours of treatment. Ninety-six percent were abandoned within 5 days [Table 7]. A total of 1.0 inches of precipitation fell on a single day of the test [22 Feb.].

Table 3. Rate of Evacuation of IFA Mounds Following Spot Treatment with Granular Dursban (6# AI/Acre). Test 1.

DAY	NUMBER EVACUATED 1/	PERCENT EVALUATED
0	0	0
1	3	11.5
2	5	34.8
4	16	92.3
6	2	100.0

1/ Total number of mounds treated was 26

Table 4. Rate of Evacuation of IFA Mounds Following Spot Treatment with Granular Dursban (6# AI/Acre). Test 2.

DAY	NUMBER EVACUATED 1/	PERCENT ABANDONED
0	0	0
1	5	19.2
2	13	50.0
7	22	84.6
9	23	88.5
13	26	100.0

1/ Total number of mounds treated was 26.

Table 5. Rate of Evacuation of IFA Mounds Following Spot Treatment with Granular Dursban (6# AI/Acre). Test 3.

DAY	NUMBER EVACUATED 1/	PERCENT EVACUATED
0	0	0
1	2	7.7
3	3	11.5
4	7	26.9
6	9	34.6
8	11	42.3
12	20	76.9
13	26	100.0

1/ Total number of mounds treated was 26.

Table 6. Rate of Evacuation of IFA Mounds Following Spot Treatment with Granular Dursban (6# AI/Acre). Test 4.

DAY	NUMBER EVACUATED 1/	PERCENT EVACUATED
0	0	0
1	2	8.0
5	20	80.0
6	24	95.0
7	25	100.0

1/ Total number of mounds treated was 25.

Table 7. Rate of Evacuation of IFA Mounds Following Treatment with Granular Dursban (6# AI/Acre). Test 5.

DAY	NUMBER EVACUATED 1/	PERCENT EVACUATED
0	0	0
1	9	36.0
5	24	96.0
6	25	100.0

1/ Total number of mounds treated was 25.

REFERENCES CITED:

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PROJECT NO: FA01G048

PROJECT TITLE: Insecticide Coatings and Paint Additives for Residual Control of Foraging IFA Workers on Painted Surfaces

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Tim Lockley, Lee McAnally, and Avel Ladner

INTRODUCTION:

The presence of foraging workers on interstate shipments of general cargo has sparked controversy for several years. Even though IFA workers are sterile and cannot cause an infestation in and of themselves, current regulations disallow entry into non-quarantine areas if "*Solenopsis* spp. in any stage of development..." is detected. The records are replete with such occurrences on non-hazardous cargo. Entry of these cargoes can be made only after a thorough and expensive methyl bromide fumigation is accomplished. Current cost for such a procedure is approximately $1,000.00.

We initiated a study in late September, 1988 to test the relative effectiveness and residual activity of three products against the IFA workers: Di-All Brand Paint Insecticide; CPF Insecticide (both paint additives), and Super IQ Insecticide Coating. The potential use of chlorpyrifos impregnated paints or coatings could minimize the problem of foraging IFA workers which occasionally enter non-hazardous cargoes on tractor-trailers. They may also have some utility in the control of IFA in outdoor or subterranean electrical circuitry. The Texas Department of Agriculture (TDA) experienced a significant number of documented incidences in which IFA infestations have

caused failure of diversified electrical systems.

METHODS AND MATERIALS:

TEST 1:

A one-half inch, exterior grade, pine plywood board was sectioned into 1'x1' test boards and given a coating of primer (Exterior Latex) on September 27, 1988. Three boards (replicates) were then painted with each of the following treatments on September 28:

1. CPF Insecticide (61.5% chlorpyrifos by volume) mixed 18.9 ml. with 1 gallon of paint. Manufactured by Enviro-Chem, Inc., P.O. Box 1086, Walla Walla, Washington 99362. AI= 0.25%.

2. Di-All Brand Paint Insecticide (chlorpyrifos 11.2% by volume) mixed 3 fl. oz. per gallon of paint. Manufactured by Di-All Chemical Co., P.O. Box 14347, Orlando, Florida 32857. AI= 0.31%.

3. Super IQ Insecticide Coating (pre-mixed). Manufactured by Biochemical Dynamic Corp., Indianapolis, Indiana. AI=0.90%.

CPF and Di-All were incorporated into a latex enamel patio and decking paint (Artisan Classic Brand manufactured for West Building Materials Centers, Atlanta, Georgia 30309).

Untreated paint was applied to three boards as a painted check and three boards were left unpainted as a control. The boards were then stored in the bed of a small pickup truck covered with an aluminum camper shell. The shell had plexiglass windows on all four sides. The boards were aged under natural conditions of temperature and humidity but were protected from precipitation by the shell. Bioassays were carried out at monthly intervals starting on November 21, 1988. Bioassays were conducted by confining 100 carbon dioxide anesthesized IFA major workers under an inverted petri dish placed on a test board surface. The surface of the test board was prepared by moistening the surface with a damp sponge then sealing the inverted petri dish with malleable caulking strip. Moistening the surface of tests boards was necessary to prevent lethal dessication of the ants. Mortality was assessed hourly.

TEST 2:

A second trial was begun in August 1989 to determine the effects of wear on the efficacy of Super IQ Insecticide Coating. Three 4'x 4' exterior plywood boards were painted with two coatings of Super IQ and allowed to dry thoroughly before being exposed to pedestrian traffic. Board 1 was placed at the main entrance to the Imported Fire Ant Laboratory and received a significant amount of foot traffic. Board 2 was placed at the rear entrance to the IFA Lab and received light to moderate foot traffic. Board 3 was placed atop a fifty-five gallon steel drum and received no traffic. All three boards were subjected to normal climatic conditions. Bioassays were made monthly following earlier procedures and criteria.

RESULTS:

The results of Test 1 are complete at this time for Di-all and CPF treatments. Result for Super IQ Insecticide Coating are ongoing. All current results are summarized in Table 8. Evaluations to date indicate excellent long-term residual activity with Super IQ (at least 15 months). CPF and Di-All both were initially effective but their efficacy declined sharply after 9 months. Only Super IQ continues to effectively control foraging workers within the 8 hour exposure.

Results of Test 2 are not complete at this time. However, initial data would indicate that heavy wear for up to 120 days does not lessen the efficacy of Super IQ Insecticide Coating [Table 9].

Table 8. Relative Efficacy of Various Candidate Insecticide Coatings or Paint Additives against IFA Workers.

Additive or Coating	Monthly % mortality of IFA workers confined to treated surfaces for eight hours 1/														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Super IQ	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
CPF	100	100	100	100	100	100	100	100	100	16	5	0			
Di-All	100	100	100	100	100	100	100	100	100	14	9	1			
Painted Ck.	0	1	2	2	2	2	1	0	0	0	2	0	0	0	0
Unpainted Ck.	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0

1/ Average based on 3 replicates; 100 IFA workers/replicate.

Table 9. Effects of Various Wear Patterns on the Overall Efficacy of Super IQ Insecticide Coating Against IFA Workers.

1/ Board Number	Days Post-Application	Percent Mortality of IFA Workers Confined to Surfaces Treated with Super IQ Insecticide Coating for Indicated Time [hours] 2/								
		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
1	1	0	63	100						
2	1	5	87	100						
3	1	0	49	100						
1	30	25	70	100						
2	30	33	83	100						
3	30	42	81	100						
1	60	19	63	100						
2	60	21	70	100						
3	60	20	66	100						
1	90	62	84	100						
2	90	58	80	100						
3	90	62	92	100						
1	120	63	83	100						
2	120	63	89	100						
3	120	59	87	100						

1/ Location codes: Board 1- heavy traffic; Board 2- light to moderate traffic; Board 3- no traffic.

2/ Average based on 100 IFA major workers per replicate.

PROJECT NO. FA01G058

PROJECT TITLE: Relative Phytotoxicity of Chlorpyrifos [Dursban 2.5G & 2EC] and Izafos [Triumph 1EC] to Selected Foliage and Woody Landscape Plants.

TYPE REPORT: Final

LEADER/PARTICIPANTS: Timothy Lockley, Lee McAnally, and Adolph J. Laiche [Mississippi Agriculture and Forestry Experiment Station]

INTRODUCTION:

In January of 1980, chlorpyrifos 5%granular [FA-5) was registered for use as a fire ant quarantine treatment for potting media. The registrant [Dow Chemical Company] elected to withdraw FA-5 from the market in 1981 when several cases of phytotoxicity were alleged [1]. All of the reported cases were from central Florida and, with one exception [Dwarf Yaupon, *Ilex vomitoria*], involved greenhouse grown foliage plants. Most of the reported injuries were linked to problems other than chlorpyrifos induced toxicity. Chlorpyrifos [Dursban 2.5G and Dursban 1, 2, and 4EC] is currently the only insecticide registered for the control of the imported fire ant [IFA] in commercially field grown balled and burlap and container grown plants [2, 3]. Because of the alleged phytotoxicity of chlorpyrifos, succulents must be grown under complete cover to meet certification requirements. This precludes large scale outdoor production of these plants.

METHODS AND MATERIALS:

This experiment was carried out in cooperation with the Mississippi Agriculture and Forestry Experiment Station (MAFES), (South Mississippi

Branch) at Poplarville, Mississippi.

Fourteen and twenty-six varieties of plants were selected for evaluation of possible effects of granular chlorpyrifos on plant growth and phytotoxicity when incorporated into potting media [Tables 10 and 11]. Eleven plant varieties were tested for phytotoxic effect against Dursban 2EC and Triumph 1EC [Tables 12 and 13]. Plants were selected on the basis of availability, local popularity among commercial growers or previous history of phytotoxic response to chlorpyrifos.

The experimental media was Strong-Lite® growing medium manufactured by Strong-Lite Products Corporation of Pine Bluff, Arkansas. In Tests 1 and 2, Ford's Dursban 2.5G was incorporated at two rates 1X [25.2 ppm] and 3X [75.6 ppm] the recommended rate for Dursban 2.5G. In Test 3, Dow's Dursban 2EC was applied over the top at rates equivalent to 1X [25.2 ppm] and 3X [75.6 ppm] the labelled rates. In Test 4, izafos [Triumph 1E] was applied over the top as a drench at 1X [77.7 ppm] and 3X [233.1 ppm] the recommended rates. An experimental unit consisted of 2 containerized plants per plot with seven blocks per cultivar. An identical group of plants was also transplanted into pots containing untreated potting media.

Test 1 was conducted from October 18, 1988 until February 8, 1989. Test 2 was conducted from March 7, 1989 until August 8, 1989. At the mid-points of Tests 1 and 2, half of the plants from each plot were sacrificed and evaluated based upon a visual examination of the tops and roots as compared with the untreated

check. Because Tests 3 and 4 were conducted over only a 30 day period [September 25 to October 25, 1989], no midpoint evaluation was made. The top and root phytotoxicity rating scale were as follows:

Top Rating Scale

1. Plants healthy, not significantly different from the untreated check;
2. Slight yellowing, wilting or other mild symptoms such as marginal chlorosis;
3. Symptoms more severe, leaf drop or necrosis;
4. Severe stunting, abnormal leaf or stem structure;
5. Dead.

Comparative Root Rating Scale

0.0 Roots dead;

1.0 Least developed;

2.0 Mean development;

3.0 Best developed.

Root ratings were made based upon comparisons of each plot.

A fresh weight measurement of each plant top [a total biomass above the soil line] was carried out at the same time. A final examination for phytotoxicity for Tests 1 and 2 were made 121 and 126 days post planting respectively.

RESULTS AND DISCUSSION:

As shown in Tables 10 and 11, few adverse effects were noted for any of the

plant species tested for phytotoxic response to granular chlorpyrifos. In Test 1, African Violets, Saintpaulia ionanatha showed a progressively negative response to chlorpyrifos in both top biomass and root structure. In Test 2, Azalea [Pride of Biloxi], and Ilex [William Cargill] each displayed a negative reaction to chlorpyrifos when measured in mean top biomass. However, Ilex [William Cargill] showed no negative response in root structure and Azalea [Pride of Biloxi] showed a decidedly enhanced root structure in both the 1X and 3X treatments when compared with the untreated check. Of the 26 varieties evaluated in Test 2, seven indicated enhanced growth of top biomass in either the 1X or 3X treatments and nine displayed improved root structure. No instances of superior top biomass was observed among the untreated checks when compared with the 1X and 3X treatments.

Eleven varieties of woody landscape and foliage plants were evaluated in Test 3 for phytotoxic response to a drench application of chlorpyrifos [Dursban 2E] at 1X and 3X the recommended rates. Test 3 phytotoxic readings were made 30 days post-treatment. Among the varieties tested, Impatiens showed the strongest negative response. A significant reduction in top biomass was observed along with retardation of root growth and structure. Although not displaying any significant response in top biomass weight, a negative response in root structure was noted among seven of the remaining ten cultivars. Because these evaluations were made during the early fall, some of the responses noted may be an artifact of the growth cycle of the plants. Future tests should be conducted to determine if their is a "best window of opportunity" for drench applications of chlorpyrifos.

Test 4 was carried out in conjuction with Test 3. A drench application of izafos [Triumph 1E] was made to eleven varieties of foliage and woody landscape plants on 25 September, 1989. Triumph was applied at 1X and 3X the recommended rates [78 and 233 ppm respectively]. An evaluation of top biomass weight and root structure development was made 30 days post application. Six of the plants tested showed no reaction to either of the Triumph drenchs when compared to the untreated checks. Of the five remaining cultivars, one [Azalea, Rosea] showed a moderate phytotoxic response in top biomass at the 3X rate and to root structure development at the 1X rate. Cuphea hyssopitifolia displayed a severe reaction at the 3X rate with a significant leaf drop within the top biomass and a complete destruction of the roots on the side of the container receiving the majority of the applied material. Root structure opposite showed little to no damage when compared to the untreated check. Although severely stunted by the initial drench, regrowth was observed from the base of the 3X test plants. A moderate, but still significant, stunting was noted among the 1X test plants.

The most severe reaction to the Triumph drench occurred among the Impatiens var. Accent Red. The 1X application caused severe stunting of root structure and a significant necrosis to the top biomass. The 3X application resulted in 100% mortality of the tested Impatiens. Conversely, with Ilex compacta and Evolvulus glomeratus, root structure was enhanced at the 3X and the 1X and 3X respectively. Because of the overall negative response by most of the test subjects, it is doubtfull whether this use pattern for Triumph 1EC within the nursery industry will include a pour-on drench. Further testing on a wider variety of plants is called for.

Table 10. Phytotoxicity Ratings for Various Containerized Plants Treated with Incorporated Dursban (chlorpyrifos) 2.5G at 1X and 3X Dose Rates.

PLANT	Top Biomass [g] 1/ Check	1X	3X	Root Structure Rating 1/ Check	1X	3X
Antirrhinum majus	167.4	210.8	137.2	2.17a	1.83a	2.50
Begonia sp.	573.5ab	604.9a	507.6b	1.63	2.13a	2.38a
Brassica sp.	247.5	243.0	221.0	1.50	2.17a	2.33a
Dianthus sp.	98.3a	126.3	92.2a	1.00a	1.50a	2.50
Ilex crenata	24.6a	24.0a	23.3a	1.71a	2.00ab	2.29b
Ilex opaca	17.9a	16.0a	13.7	2.00a	1.86a	2.43
Ilex vomitoria	21.1a	21.9a	20.6a	1.86a	2.00a	2.43
Juniperus pfitzeriana	26.0a	27.1a	31.1	2.00a	1.86a	2.14a
Ligustrum lucidum	12.9a	13.9a	14.0a	2.14a	2.00a	2.00a
Ligustrum sinensis	8.0a	7.4a	7.3a	2.00a	2.00a	2.43
Philodendron oxycardium	102.3a	117.0a	114.5a	1.63	2.13a	2.25a
Rhaphiolepis indica	32.0a	34.6a	37.0a	1.71a	2.00ab	2.57b
Saintpaulia ionanatha	81.6a	71.9a	57.2	2.45	1.89a	1.89a

1/ Means within cultivars followed by the same letter are not significantly different based upon a one-way ANOVA.

Table 11. Ratings of Selected Foliage and Woody Landscape Plants Grown in Potting Media in which Chlorpyrifos [2.5G formulation] was Incorporated.

PLANT	TOP BIOMASS [g] Check	1X	3X	ROOT STRUCTURE RATING 1/ Check	1X	3X
Azalea, Adelaide Pope	60.4a	63.1	53.7a	1.29	2.00	2.43
Azalea, Anna Kerr	76.6a	82.0a	77.4a	1.14	2.43a	2.86a
Azalea, Fashion	94.2a	97.2a	94.8a	2.00a	2.17a	3.00
Azalea, Pride of Biloxi	83.0a	84.6a	66.6	2.00	2.86a	2.57a
Azalea, Red Formosa	94.9a	97.0a	92.6a	2.43a	2.29a	3.00
Azalea, Rosea	60.6a	63.6a	81.7	1.43	2.43a	2.72a
Azalea, USDA-RH	53.7a	44.3a	52.2a	1.67	2.33a	2.67a
Begonia, Vodka	279.0a	380.0	225.0a	2.88a	2.75a	2.00
Centauria cineraria	61.6a	64.0a	68.9a	2.25a	2.13a	1.63
Chlorophytum comosum	61.5a	59.0a	70.4	2.75	2.00	1.50
Cuphea hyssopifolia	121.0a	132.0a	131.0a	2.00a	2.13a	2.25a
Ilex, Nellie Stevens	76.7a	62.9a	67.7a	2.13a	2.00a	2.50
Ilex, William Cargill	38.1a	33.3a	23.3	2.50a	2.25a	2.25a
Ilex vomitoria Shillings Dwarf Yaupon	26.6a	29.9a	31.0a	1.38	2.50a	2.25a
I. vomitoria Stokes Dwarf Yaupon	67.4a	68.3a	68.3a	1.38a	1.88ab	2.25b
Impatiens	82.0	125.0a	107.0a	2.25a	2.25a	2.13a
Magnolia grandiflora	124.0a	103.0a	98.0a	2.00a	1.88a	2.13a
Plectranthus australis	150.0	211.0a	214.0a	2.38a	2.75a	2.63a
Peperomia obtusifolia Emerald Ripple						
P. obtusifolia Green	389.0a	350.0a	362.0a	2.43a	2.30a	2.72
P. obtusifolia Goldengate	226.0a	240.0a	302.0a	2.00a	1.86a	2.57
P. obtusifolia Marbled	432.0a	400.0a	392.0a	2.00a	1.86a	2.29a
Portulaca	124.0a	97.0a	91.0a	3.00	1.75a	1.43a
Vinca minor	46.4a	56.9a	72.0	2.00a	2.29a	2.71
Salvia	28.4a	31.0a	34.3a	2.38a	2.00a	2.13a

1/ Means within cultivars followed by the same letter are not significantly different based upon a one-way ANOVA.

Table 12. Ratings of Selected Foliage and Woody Landscape Plants Grown in Potting Media to which a Drench Application of Chlorpyrifos was Applied.

PLANT	TOP BIOMASS [g] 1/			ROOT STRUCTURE RATING 1/		
	Check	1X	3X	Check	1X	3X
Azalea, Formosa	37.0a	33.3a	36.7a	2.83a	2.00ab	1.67b
Azalea, Rosea	31.3a	31.8a	34.7a	2.33a	1.50b	1.83ab
Chrysanthemum, Buckeye	91.7a	88.7a	67.7	3.00a	3.00a	2.00
Chrysanthemum, Tinkerbell	59.0	36.3a	36.7a	3.00a	2.33ab	1.67b
Cuphea hyssopifolia	48.2a	41.1a	39.9a	3.00a	3.00a	2.33
Evolvulvus glomeratus	59.9a	55.8a	54.7a	3.00a	3.00a	2.67a
Ilex compacta	21.3a	20.8a	23.3a	2.50a	2.50a	1.67
Ilex cornuta	14.6a	13.6a	12.4a	2.67a	2.67a	2.17a
Ilex latifolia	38.5a	37.6a	43.7a	2.83a	2.33a	2.33a
Ilex, Nellie Stevens	12.0a	10.2a	10.7a	2.83a	2.00ab	1.83b
Impatiens	140.3	98.3	58.5	2.83	1.33	0.95

1/ Means within cultivars followed by the same letter are not significantly different based on a one-way ANOVA.

Table 13. Ratings of Selected Foliage and Woody Landscape Plants Grown in Potting Media to which a Drench Application of Izafos was Applied.

PLANT	TOP BIOMASS [g] 1/			ROOT STRUCTURE RATING 1/		
	Check	1X	3X	Check	1X	3X
Azalea, Formosa	35.8a	33.7a	31.0a	2.33a	1.83a	2.13a
Azalea, Rosea	36.8a	35.3a	24.7	2.33a	1.50	1.83a
Chrysanthemum, Buckeye	113.3a	90.0a	85.6a	3.00a	2.67a	3.00a
Chrysanthemum, Tinkerbell	60.6a	53.0a	51.6a	3.00a	2.67a	2.67a
Cuphea hyssopifolia	47.0	25.3a	18.6a*	3.00a	2.67a	1.83**
Evolvulus glomeratus	59.9a	55.8a	54.7a	2.17	3.00a	3.00a
Ilex compacta	22.8a	20.2a	22.3a	2.00a	2.00a	3.00
Ilex cornuta	14.9a	14.7a	13.1a	3.00a	2.50a	2.17a
Ilex latifolia	39.2a	32.7a	35.5a	2.83a	2.33a	2.20a
Ilex, Nellie Stevens	12.9a	11.8a	11.6a	2.67a	2.00a	2.33a
Impatiens	119.6	60.0	DEAD	2.67	1.33	DEAD

1/ Means within cultivars followed by the same number are not significantly different based upon a one-way ANOVA.

* Excessive leaf drop followed by regrowth from base of plant

** Roots dead on side of pot that received the drench. Roots on opposite side of pot appear normal when compared to untreated check.

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(1) Collins, H.C., J.G. Medley, D.J. Adams, M.J. Cuevas, A.L. Ladner and C.J. Mauffrey. 1981. Annual Report of the Imported Fire Ant Station. USDA-APHIS-PPQ. 70 p.

(2) Tatum, D. 1988. Imported Fire Ant Quarantine Requirements. MS Dept. of Agric. and Comm., Div. of Plant Ind. DPI-PLT. PEST-1S-03, 3p.

(3) Imported Fire Ant Program Manual, M301.81 [Revised February, 1988], USDA-APHIS PPQ, 29 p.

PROJECT NO: PA02G018

PROJECT TITLE: Population Dynamics of Imported Fire Ant Colonies

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Anne-Marie Callcott and Rebecca Norris

INTRODUCTION:

IFA colonies grow and develop following mating flights. Small incipient colonies are often comprised of less than 100 workers and the queen. Conversely, large mature colonies can contain over 250,000 workers plus reproductive and immature forms. Only a few studies have been undertaken to determine the time interval necessary for a colony to develop from a single queen to a mature, reproductive colony. Markin et al. (1973) showed the time interval to be a minimum of 2 1/2 years, and by 3 years, all colonies examined were fully matured. Lofgren et al. (1975) and Markin and Dillier (1971) estimated that mature colonies were at least 2 years old. Many factors can inhibit or enhance the growth of a colony; climatic conditions such as air and soil temperature, soil moisture, and humidity, and environmental conditions such as food and site availability (Green 1967, Rhoades and Davis 1967 and Lofgren et al. 1975).

A numerical colony classification system based on estimated worker ant population and status of worker brood (Lofgren and Williams, 1982) is routinely used by many researchers to evaluate the effects of insecticides upon IPA populations. In this system a newly formed colony (less than 100

workers, with worker brood present) is rated as a "5". A large mature colony (more than 50,000 workers and brood present) is given a numerical rating of 25. Studies to determine the time interval required for new colonies to attain the various rating levels have not been conducted. A study was initiated in the summer of 1988, to determine the time required for incipient colonies (i.e., class "5" colony) to develop to certain colony classes (10, 15, 20, and 25) on the population index scale described by Lofgren and Williams (1982).

METHODS AND MATERIALS:

Since geographical differences in the growth rate of RIFA colonies can be expected to occur, this study was conducted at two sites. The South Mississippi site represented the epicenter of the infestation while the Whiteville, North Carolina site represented the northern periphery of the infestation.

The pre-existing population in each 20 acre study site was eliminated (reduced to a theoretical population of "0") by applying LOGIC bait at a rate of 1.5 lbs./acre on or about April 1, 1988. The bait was applied broadcast using the APHIS granular applicator mounted on a farm tractor. Population changes following application were monitored monthly in ten 1/4 acre permanently located subplots at each site. When the pre-existing population reached or approached 0, the present study began. At that time subplots were rated quarterly. As reinfestation occurred and incipient colonies grew and

developed into the various colony classes, the types and numbers of colonies present were recorded. From this data, the time required for colonies to grow and mature into the various colony classes was determined.

RESULTS:

South Mississippi Site I:

The South Mississippi site was located in Forest County, Mississippi approximately 40 miles north of Gulfport, Mississippi. However, the site was not ideal due to its small size (about 10 acres) and the number of trees in the area. The trees made even broadcast of the bait difficult. Some of the efficacy plots were located close to the edge of the treated area, resulting in a possible "edge effect" i.e., mature colonies outside the 10 acre treated area moving into the outer edges of an efficacy plot. This "edge effect" was very evident in Plot 1, thus this plot was removed from the study. A theoretical population of zero was reached at about 5 months (23 weeks) post-treatment. At this time, 5 of the plots had 100% colony mortality (Table 14), while the remaining 4 plots had 5 surviving colonies between them. Good control was still being observed 9 months post-treatment and reinfestation had not occurred. By 15 months, reinfestation was occurring. While the number of colonies and population index was still much lower than pretreat populations, all the colonies present were in class 10 and higher (Table 15).

North Carolina Site:

A theoretical population of zero was reached at about 6 months (24 weeks) post-treatment. At this time, 5 of the plots had 100% mortality (Table 14), while the remaining 5 plots ranged from 91 to 95% mortality. At 16 months post-treatment, reinfestation had begun. As in the Mississippi site, while the number of colonies and population index were still very low compared to pretreat populations, 94% of the colonies present at 16 months rated in class 5 and above (Table 15).

South Mississippi Site II:

A second trial was initiated in Saucier, Mississippi, (10 miles north of Gulfport, MS) on June 13, 1989, because we feel that the test site in Site I was relatively small. Because of the size of that site, little or no treated border was applied and migration of mature colonies into the test site biased the results ("edge effect").

A theoretical population of zero was reached at about 3-4 months post-treatment (Tables 16 and 17). Counts will continue until a mature, stable population appears.

Table 14. Population Dynamics of IFA following a Broadcast Application of Logic Bait.

Plot Number	Pretreat Colonies/ Subplot	Population Pop. Index	Status of Population at Indicated Months Post-Treatment: % Colony Mortality (1)	(2)	(3)	(4)	(5)	(6)	(9)	% Change in Pre-Treatment Population Index (1)	(2)	(3)	(4)	(5)	(6)	(9)
SOUTH MISSISSIPPI SITE I																
2	15	260	-	40	80	100	93.3	-	100	-	-85.8	-96.9	-100	- 93.3	-	-100
3	8	136	-	0	37.5	75	87.5	-	87.5	-	-69.9	-77.2	- 74.3	- 87.5	-	- 89
4	21	380	-	28.6	57.1	95.2	95.2	-	100	-	-86.1	-90	- 99.2	- 95.2	-	-100
5	17	316	-	47.1	76.5	100	100	-	100	-	-85.8	-96.8	-100	-100	-	-100
6	23	455	-	52.2	73.9	100	100	-	95.6	-	-91.4	-97.8	-100	-100	-	- 95.6
7	17	356	-	52.9	82.3	82.4	100	-	88.2	-	-91.3	-97.5	- 93	-100	-	- 92.4
8	19	385	-	42	84.2	100	100	-	100	-	-89.1	-97.7	-100	-100	-	-100
9	19	348	-	41	73.7	89.5	100	-	100	-	-88.2	-96.3	- 94.3	-100	-	-100
10	18	325	-	27.8	83.3	100	88.9	-	88.9	-	-86.8	-97.5	-100	- 96.3	-	- 89.2
NORTH CAROLINA SITE																
1	27	286	0	14.8	29.6	63	-	100	100	-58	-73.8	-77.3	- 88.1	-	-100	-100
2	22	251	0	18.2	22.7	81.8	-	100	100	-49.4	-74.1	-79.7	- 97.2	-	-100	-100
3	32	302	3.1	4.4	46.9	90.6	-	100	100	-63.9	-69.5	-82.8	- 97.7	-	-100	-100
4	23	234	8.7	4.3	21.7	65.2	-	91.3	91.3	-52.7	-57.5	-66.7	- 85	-	- 91.5	- 93.6
5	13	162	0	15.4	15.4	84.6	-	92.3	100	-58	-72.8	-79.6	- 96.3	-	- 96.9	-100
6	19	184	0	21.1	52.6	84.2	-	94.7	89.5	-46.2	-57.1	-72.8	- 93.5	-	- 94.6	- 89.1
7	19	184	26.3	10.5	68.4	100	-	94.7	100	-50.5	-50.5	-79.3	-100	-	- 94.6	-100
8	7	65	0	28.6	85.7	85.7	-	100	100	-40	-73.8	-95.4	- 98.5	-	-100	-100
9	10	90	0	0	50	100	-	90	100	-53.3	-61.1	-84.4	-100	-	- 94.4	-100
10	24	208	0	4.2	29.2	75	-	100	100	-47.6	-56.7	-64.9	- 80.9	-	-100	-100

Table 14. (continued)

Plot Number	Pretreat Colonies/ Subplot	Population Pop. Index	Status of Population at Indicated Months Post-Treatment: % Colony Mortality (12)	(13)	(15)	(16)	(19)	(21)	% Change in Pre-Treatment Population Index (12)	(13)	(15)	(16)	(19)	(21)
SOUTH MISSISSIPPI SITE I														
2	15	260	73.3	-	40	-	-		- 78.8	-	-44.2	-	-	
3	8	136	0	-	0	-	-		- 9.6	-	+80.1	-	-	
4	21	380	100	-	61.9	-	-		-100	-	-75	-	-	
5	17	316	94.1	-	58.8	-	-		- 95.2	-	-68.4	-	-	
6	23	455	82.6	-	56.5	-	-		- 85.7	-	-69.2	-	-	
7	17	356	76.5	-	35.3	-	-		- 80.3	-	-52.2	-	-	
8	19	385	78.9	-	63.2	-	-		- 83.1	-	-70.1	-	-	
9	19	348	94.7	-	47.4	-	-		- 98.6	-	-61.2	-	-	
10	18	325	94.4	-	22.2	-	-		- 93.8	-	-43.1	-	-	
NORTH CAROLINA SITE														
1	27	286	-	88.8	-	48.1	0		-	- 95.4	-	-46.8	+ 47.9	-
2	22	251	-	100	-	86.4	63.6		-	-100	-	-90	- 69.7	-
3	32	302	-	100	-	71.8	3.1		-	-100	-	-66.9	- 5.9	-
4	23	234	-	82.6	-	26.1	0		-	- 82.9	-	-20.9	+ 45.3	-
5	13	162	-	92.3	-	30.8	46.1		-	- 93.8	-	-39.5	- 44.4	-
6	19	184	-	100	-	94.7	94.7		-	-100	-	-91.8	- 89.1	-
7	19	184	-	89.5	-	47.4	42.1		-	- 89.1	-	-37.5	- 18.5	-
8	7	65	-	100	-	0	0		-	-100	-	+23.1	+149	-
9	10	90	-	100	-	20	20		-	-100	-	- 8.8	+ 30	-
10	24	208	-	100	-	25	20.8		-	-100	-	-18.8	+ 4.8	-

Table 15. Decline and Resurgance of IFA Colonies by Colony Class following a Broadcast Application of Logic Bait.

Colony Class	Pretreat	% of Total Colonies in each Colony Class at Indicated Post-Treatment Interval (Months) (1)	(2)	(3)	(4)	(5)	(9)	(12)	(13)	(15)	(16)	(19)
SOUTH MISSISSIPPI SITE I												
1	1.9	-	1.9	9.8	0	0	0	0	-	0	-	-
2	0	-	12.7	39	0	40	16.7	0	-	0	-	-
3	0.6	-	30.4	41.5	22.2	20	0	3.7	-	0	-	-
4	0	-	38.2	2.4	0	0	0	0	-	0	-	-
5	0	-	15.7	0	11.1	0	0	3.7	-	0	-	-
5	0	-	0	0	0	0	0	3.7	-	0	-	-
10	7	-	0	2.4	44.4	20	0	14.3	-	37	-	-
15	26.1	-	1	2.4	11.1	0	33.3	46.4	-	38.9	-	-
20	37.6	-	0	2.4	11.1*	20*	33.3*	21.4	-	17.6	-	-
25	26.6	-	0	0	0	0	16.7	7.1	-	6.5	-	-
NORTH CAROLINA SITE												
1	1.6	8.2	2.3	12.5	24.3	0	0	-	10	-	0	0
2	7.2	14.6	12.2	29.2	18.9	0	0	-	20	-	3.1	4
3	5.7	27.6	35.5	26.7	29.8	0	0	-	0	-	2.1	8
4	6.7	18.5	34.3	15.8	13.5	0	25	-	0	-	1	9
5	15	20.9	9.9	2.5	2.7	0	0	-	0	-	1	4
5	8.3	0	0.6	1.7	2.7	33.3	0	-	0	-	13.4	12.5
10	19	4.4	2.3	6.6	5.4	66.7	75	-	50	-	47.4	18
15	23.2	2.9	1.2	4.2	2.7	0	0	-	20	-	30	33
20	10.3	2.9	1.7	0.8	0	0	0	-	0	-	2	8.5
25	3	0	0	0	0	0	0	-	0	-	0	3

* Possible "edge effect"

Table 16. Population Dynamics of IFA following a Broadcast Application of Logic Bait.

Plot Number	Pretreat Colonies/ Subplot	Population Pop. Index	Status of Population at Indicated Months Post-Treatment: % Colony Mortality (1)	(2)	(3)	(4)	(8)	% Change in Pre-Treatment Population Index (1)	(2)	(3)	(4)	(8)
SOUTH MISSISSIPPI SITE II												
1	13	235	61.5	53.8	84.6	69.2*	69.2	-92.8	-94.5	-97.9	-81.3*	-88.5
2	15	273	66.6	66.6	93.3	80.0	80.0	-94.5	-94.5	-98.9	-83.5	-89.4
3	14	290	50.0	50.0	100	85.7	92.8	-93.4	-93.1	-100	-95.5	-99.3
4	9	175	77.7	77.7	100	55.5	66.6	-97.1	-97.7	-100	-81.7	-92.0
5	17	248	70.5	70.5	100	82.4	82.3	-94.3	-95.9	-100	-87.9	-87.1
6	14	250	78.5	64.3	71.4	92.8	78.6	-96.4	-95.2	-97.2	-98.8	-88.0
7	10	180	10.0	60.0	90.0	40.0	60.0	-84.4	-95.0	-98.9	-65.5	-82.2
8	13	245	46.1	46.1	92.3	92.3	100	-92.2	-92.2	-99.2	-99.2	-100
9	15	265	66.6	53.3	93.3	80.0	80.0	-94.3	-92.8	-99.2	-69.8	-97.3
10	18	330	55.5	22.2	83.3	50.0	77.7	-93.3	-88.8	.97.2	-73.9	-91.5

* possible "edge effect"

Table 17. Decline and Resurgance of IFA Colonies by Colony Class following a Broadcast Application of Logic Bait.

Class	Pre-Treat	% of Total Colonies in each Colony Class at Indicated Post-Treatment Interval (months)				
		(1)	(2)	(3)	(4)	(8)
SOUTH MISSISSIPPI SITE II						
1	0	1.8	3.2	7.7	0	3.6
2	1.4	30.4	41.9	69.2	19.4	35.7
3	0	44.6	51.6	23.1	8.3	7.1
4	0	21.4	3.2	0	2.7	3.6
5	0	1.8	0	0	0	0
6	0	0	0	0	0	0
7	7.9	0	0	0	33.3	32.1
8	33.3.	0	0	0	22.2	14.3
9	39.1	0	0	0	11.1*	3.6
10	18.1	0	0	0	2.7*	0

* possible "edge effect"

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PROJECT NO: FA01G019

PROJECT TITLE: Various Dosage Rates of Dursban Tested Against Time for Worker Mortality

TYPE REPORT: Final

LEADER/PARTICIPANTS: Anne-Marie Callcott

INTRODUCTION:

The Federal IFA Quarantine requires that all plants being moved outside the quarantine area be treated using an approved insecticide (IFA program Manual M301.81). These treatments include the use of granular chlorpyrifos (Dursban) incorporated into the potting media (24 month certification) or chlorpyrifos (E) as a drench (90 day certification). The present inspections on nursery stock going into unifested areas have detected ants (mostly workers) in pots that have been treated. When the soil from these pots is analyzed, Dursban has been found in some of the samples in sufficient amounts to kill IFA workers (> 2 ppm). However, at low concentrations, death is not instantaneous. This study was initiated to determine the time interval necessary for various concentrations of Dursban to cause 100% mortality to IFA workers.

METHODS AND MATERIALS:

Stock solutions, using technical Dursban (99%) in acetone, was mixed. Serial dilutions of the stocks was added to 150 g. Strong-Lite® potting media (Strong-Lite Products Corp., P.O. Box 8029, Pinebluff, AR) to obtain various

dosage rates. Additional acetone was added to bring liquid to 60 ml. to acquire a thoroughly saturated soil mixture. The solvent was evaporated by drying under a hood for 16-20 hours. (Dobbs 1985). Check soil was treated with 60 ml. acetone and also dried under the hood. Dosage rates used were: .3, .5, 1, 2, 4, 8, 15, 20, and 50 ppm.

Bioassays using 20 major workers (average weight .00284 g./worker) per replicate, and four replicates per soil sample (treated or check) were done. Each rate was bioassayed three times. The bioassays were observed for mortality at 1, 4, 7, 24, 48, 72, 120, and 168 hours post-treatment. When 100% mortality had been achieved in all 4 replicates of a dosage rate within 7 days, the time was recorded.

RESULTS:

The results of this study were as expected (Table 18), the lower rates required a longer time period to prove lethal. Rates of greater than 8 ppm were lethal within 24 hours of ant introduction; whereas, the 4 ppm rate required 64 hours for 100% mortality. At the 2 ppm, 85% mortality was achieved in two of the trials by 7 days. Therefore, this rate was allowed to proceed until 100% mortality was achieved. The average time required for 2 ppm to be effective was 184 hours.

Table 18. Time Required to Achieve 100% Mortality of Major IFA Workers with Various Dose Rates of Chlorpyrifos in Nursery Potting Media.

Chlorpyrifos Dose Rate (PPM)	Time Required to Achieve 100% Mortality (Hours) *
50	7
20	24
15	24
8	24
4	64
2	184 **
1	***
.5	***
.3	***
Check	***

* Average of 3 trials. Each trial consisted of 4 replicates; 20 major workers per replicate.

** Two trials extended past 7 days due to 85% mortality at 7 days.

*** Survived 7 day test period.

PROJECT NO: FA01G029

PROJECT TITLE: Residual Activity of Various Insecticidal Drench Treatments for Nursery Potting Soil, 1989

TYPE REPORT: Final

LEADER/PARTICIPANTS: Lee McAnally

INTRODUCTION

Drench treatments with chlorpyrifos and diazinon are listed in M301.81 for certification of containerized plants. Chlorpyrifos (Dursban) is applied at a rate of 8 fl. oz. Dursban 2EC/100 gals. water. The rate of application for diazinon is 1 pint of diazinon AG 500 or 1 lb. of diazinon 50 WP/100 gals. water. The Dursban treatment provides a 90 day certification period; diazinon provides 14 days certification. A study comparing the residual activity of insecticidal drenches was initiated in April, 1989.

METHODS AND MATERIALS:

Evaluation of treatments was conducted in two phases. Treatments listed below were applied to 6" pots containing Strong-Lite® potting media. Two pots from each treatment were collected and composited at monthly intervals and bioassayed with alate queens using standard laboratory bioassay procedures. Total volume of drench (finished solution) was 1/5 that of the pot to be drenched, i.e., if using 1 gallon pots (128 oz), then 26 oz. of drench was applied. Pots were weathered outdoors under natural conditions. Irrigation water was added to simulate normal agronomic practices, i.e., a minimum of 2"

of water/week whether by rainfall or by irrigation.

Treatments evaluated were as follows:

PHASE I

Insecticide	fl. oz./gallon of water
Dursban 2EC	.08 (2.4 ml) 1/
Empire (M/E Dursban)	3 (88.7 ml) 2/
Empire (M/E Dursban)	.09 (2.6 ml) 1/
Diazinon 2EC	.32 (9.4 ml) 1/
Cymbush 3E	.05 (1.5 ml) 1/
Capture 2EC	.08 (2.4 ml) 1/
Ammo 2.5EC	.06 (1.8 ml) 1/
Oftanol 2EC	.08 (2.4 ml) 1/
Tempo 2EC	.08 (2.4 ml) 1/
Plain water Ck.	----

PHASE II

Insecticide	fl. oz./gallon of water
Triumph	.25 (7.4 ml) 2/
	.125 (3.7 ml 3/
	.062 (1.8 ml) 3/
	.031 (.9 ml) 3/
NTN 33893	.08 (2.4 ml) 1/
	.04 (1.2 ml) 4/
	.02 (.6 ml) 5/
Dursban 2EC	.08 (2.4 ml)
Karate 1EC	.16 (4.8 ml) 1/
Torpedo	2.7 (79.8 ml) 2/
Plain water Ck.	----

1/ Labelled rate or equivalent to labelled rate for Dursban 2EC IFA drench.
2/ Maximum labelled rate for other pests.
3/ Reduced rates to determine lowest effective rate.
4/ Equivalent to 0.5X rate for Dursban 2EC IFA drench.
5/ Equivalent to 0.25X rate for Dursban 2EC IFA drench.

RESULTS:

Results are summarized in Tables 19 and 20. In Phase I, Oftanol 2E and diazinon 2EC dropped below 50% mortality at 30 days, Dursban 2EC dropped below 50% mortality after 60 days. All other candidates remained at 95-100% mortality for the remainder of the test. In Phase II, NTN 33893 (all three rates) as well as the two lower rates of Triumph fell below 50% mortality after 30 days. The two higher rates of Triumph began to show decreased mortality at 120 and 150 days. At the completion of Phase II (180 days post-treatment) Triumph had completely fallen out. Torpedo and Karate remained at 100% at the end of the test.

Table 19. Results of 1989 Drench Treatments, Phase I.

Insecticide	Average % Mortality						
	24 hrs.	30 day	60 day	90 day	120 day	150 day	180 day
Dursban	100	100	50	25	10	--	--
Empire 88.7ml/gal	100	100	100	100	100	100	100
Empire 2.6 ml/gal	100	100	95	100	100	100	100
Diazinon	100	10	30	--	--	--	--
Cymbush	100	100	100	100	100	95	95
Capture	100	100	100	100	100	100	100
Ammo	100	100	100	100	100	100	95
Tempo	100	100	100	100	100	100	100
Oftanol	100	5	50	--	--	--	--
Check	5	10	45	15	5	5	0

Table 20. Results of 1989 Drench Treatments, Phase II.

Insecticide	Average % Mortality						
	24 hrs.	30 day	60 day	90 day	120 day	150 day	180 day
NTN 2.4 ml/gal	30	5	0	--	--	--	--
NTN 1.2 ml/gal	10	0	10	--	--	--	--
NTN 0.6 ml/gal	45	5	15	--	100	--	--
Triumph 7.4 ml/gal	100	100	100	100	100	80	0
Triumph 3.7 ml/gal	100	100	100	100	85	50	0
Triumph 1.8 ml/gal	100	10	10	--	--	--	--
Triumph 0.9 ml/gal	100	5	0	--	--	--	--
Torpedo	100	100	100	100	100	100	100
Karate	100	100	90	100	100	100	100
Dursban	100	5	0	--	--	--	--
Check	5	5	10	5	5	0	0

PROJECT NO: FA01G039

PROJECT TITLE: Effects of Irrigation on Residual Activity of Granular Dursban and Triumph

LEADER/PARTICIPANTS: Anne-Marie Callcott and Lee McAnally

TYPE REPORT: Interim

INTRODUCTION:

Triumph is a relatively new organophosphate from Ciba-Geigy, which in previous trials has shown good potential for IFA regulatory use. The granular formulation (Triumph 1G) would provide an alternative to using Dursban for certification of containerized plants. Dursban granules can be used for control of IFA in containerized or field grown nursery stock (M301.81). All previous studies on residual activity, with both Dursban and Triumph, have been conducted under natural rainfall conditions. In true nursery conditions, irrigation is a constant occurrence.

Ford's Chemical Company currently holds the only granular Dursban registration for IFA quarantine certification of nursery stock. In recent months, the certification period of 24 months for incorporated Dursban has been questioned. Original residual activity studies were conducted using Dow's Dursban 10G (Collins et al. 1980). Studies were initiated to determine the effects of irrigation on the residual activity of granular Triumph and Dursban.

METHODS AND MATERIALS:

The chemicals used were Triumph 1G (Ciba-Geigy CGA-135223), Ford's Dursban 2.5G and Dow's Lorsban 15G. Each of these formulations was incorporated into Strong-Lite potting media, using a portable cement mixer, at a rate of 11.35 gms. AI/cu yd. media (Ford's 2.5G labelled rate for certification of containerized nursery stock).

Each treatment filled 288 6" standard plastic nursery pots, and was divided into 4 groups, each receiving a different amount of water per week through irrigation (in addition to rainfall). The source of the irrigation water was the Gulfport, MS municipal water department. Irrigation schedule was as follows:

1) 72 pots of each treatment receiving 1 inch water per week

2) 72 pots of each treatment receiving 2 inches water per week

3) 72 pots of each treatment receiving 4 inches water per week

4) 72 pots of each treatment receiving only natural rainfall (standard)

5) 72 untreated check pots receiving only natural rainfall

Monthly bioassays with IFA alate queens were performed using a composite sample of three pots from each treatment group.

RESULTS:

Two trials have been completed and a third initiated. The first trial tested only Ford's Dursban 2.5G. Irrigated treatments of two and four inches per week were inactivated after one month; one inch per week after two months; and the non-irrigated standard between three and six months (Table 21).

The second trial utilized both Dursban 2.5G and Lorsban 15G and Triumph. All treatments receiving irrigation were ineffective by two months post-treatment (Table 22). Dursban 2.5G and Triumph non-irrigated standards had three months residual while the Lorsban 15G had 6 months residual.

Trial three was initiated in December 1989. At one month post-treatment, all chemicals and formulations were 100% effective except the 1 inch/week Triumph (Table 23).

CONCLUSION:

At this time, all trials indicate that irrigation, regardless of the amount, decreases the residual activity of Dursban 2.5G, Lorsban 15G and Triumph 1G. Additional studies with distilled water versus tap water have been initiated to determine if factors such as carbonate level, metal ions, chlorine content, etc., in the irrigation water enhances degradation of these pesticides.

Table 21. Influence of Irrigation on Residual Activity of Dursban 2.5G Incorporated into Nursery Potting Media - Trial I.

Irrigation Schedule (inches/wk)	1 Month		2 Months		3 Months		4 Months	
	% Mort.	Cumulative Amt. H_2O (inches)	% Mort.	Cumulative Amt. H_2O (inches)	% Mort.	Cumulative Amt. H_2O (inches)	% Mort.	Cumulative Amt. H_2O (inches)
1"	100	5.45	100	14.05	0	24.6	--	--
2"	100	9.45	70	23.05	0	37.6	--	--
4"	100	17.45	5	41.05	0	66.6	--	--
Standard	100	1.45	100	5.05	100	10.6	10	30.21

Table 22. Influence of Irrigation on Residual Activity of Various Granular Insecticides Blended into Strong-Lite Potting Media - Trial II.

Insecticide Treatment	Irrigation Schedule (inches/wk)	1 Month % Mort.	1 Month Cumulative Amt. H_2O (inches)	2 Months % Mort.	2 Months Cumulative Amt. H_2O (inches)	3 Months % Mort.	3 Months Cumulative Amt. H_2O (inches)	4 Months % Mort.	4 Months Cumulative Amt. H_2O (inches)	5 Months % Mort.	5 Months Cumulative Amt. H_2O (inches)	6 Months % Mort.	6 Months Cumulative Amt. H_2O (inches)
Dursban 2.5G	1	100	7.4	5	16.3	10	24.4	0	38.8	-	-	-	-
11.3g AI/cu. yd.	2	100	11.4	100	25.3	15	37.4	0	53.8	-	-	-	-
of media	4	100	19.4	0	43.3	15	67.4 *	5	94.8	-	-	-	-
	Rain only	100	3.4	100	7.3	100	11.4	75	22.8	25	28.1	10	37.35
Lorsban 15G	1	100	7.4	10	16.3	10	24.4	5	38.8	-	-	-	-
11.3g AI/cu. yd.	2	100	11.4	5	25.3	15	37.4	0	53.8	-	-	-	-
of media	4	100	19.4	0	43.3	5	67.4 *	5	94.8	-	-	-	-
	Rain only	100	3.4	100	7.3	100	11.4	100	22.8	100	28.1	0	37.35
Triumph 1G	1	100	7.4	15	16.3	15	24.4	0	38.8	-	-	-	-
11.3g AI/cu. yd.	2	100	11.4	0	25.3	5	37.4	0	53.8	-	-	-	-
of media	4	100	19.4	5	43.3	5	67.4 *	0	94.8	-	-	-	-
	Rain only	100	3.4	100	7.3	100	11.4	20	22.8	0	28.1	0	37.35
Check	1	0	7.4	15	16.3	5	24.4	0	38.8	-	-	-	-
(untreated)	2	15	11.4	5	25.3	0	37.4	0	53.8	-	-	-	-
	4	5	19.4	0	43.3	10	67.4 *	0	94.8	-	-	-	-
	Rain only	10	3.4	0	7.3	15	11.4	5	22.8	0	28.1	15	37.35

* Received an extra 4 inches on 10/24/89 due to an oversight.

Table 23. Influence of Irrigation on Residual Activity of Various Granular Insecticides Blended into Strong-Lite Potting Media - Trial III.

Insecticide Treatment	Irrigation Schedule (inches/wk)	1 Month % Mort.	1 Month Cumulative Amt. H_2O (inches)	2 Months % Mort.	2 Months Cumulative Amt. H_2O (inches)	3 Months % Mort.	3 Months Cumulative Amt. H_2O (inches)
Dursban 2.5G 11.35g AI/cu. yd. of media	1	100	15.05				
	2	100	20.05				
	4	100	38.05*				
	Rain only	100	10.05				
Triumph 1G 11.35g AI/cu. yd. of media	1	20	15.05				
	2	100	20.05				
	4	100	38.05*				
	Rain only	100	10.05				
Lorsban 15G 11.35g AI/cu. yd. of media	1	100	15.05				
	2	100	20.05				
	4	100	38.05*				
	Rain only	100	10.05				
Check (untreated)	1	0	15.05				
	2	10	20.05				
	4	0	38.05*				
	Rain only	0	10.05				

* Received an extra 8 inches on 1/17/90 due to an oversight.

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 imported fire ants, 1976-1979. Insect. and Acaric. Tests. 5:209.

PROJECT NO: FA01G049

PROJECT TITLE: Evaluation of Mobay NTN 33893 for Control of IFA

TYPE REPORT: Interim

LEADERS/PARTICIPANTS: Anne-Marie Callcott, Homer Collins, Lee McAnally and Avel Ladner

INTRODUCTION:

Mobay NTN 33893 FS (flowable solution) is an experimental compound under investigation for use against a variety of insect pests. The chemical composition and its mode of action are undisclosed at this time. However, Mobay feels the compound may be effective against imported fire ants (IFA) due to its activity against other social insects such as termites. As with any experimental compound, efficacy against IFA must be first be determined. Once efficacy is established, the most effective method of introducing the chemical to IFA must be determined.

MATERIALS AND METHODS:

Laboratory Tests

Drench Studies:

IFA colonies were collected in the field, brought to the laboratory, and allowed to rebuild their nests in 12" x 15" x 6" plastic tubs for 3-5 days. NTN was prepared as a mound drench treatment at a variety of concentrations and applied to the colonies at a rate of one quart NTN solution per mound.

Bait Studies:

NTN was also prepared as a bait, using several different carriers and attractants such as peanut butter, honey and water, macerated mealworms (*Tenebrio* sp.), and 10% sucrose solutions.

RESULTS:

Laboratory Tests

Drench Studies:

I. Test I - May 17, 1989

Five colonies were drenched using 7.81 ml NTN/liter water/mound (equivalent to 2X Dursban 2EC label rate for mound drench). Approximately 95% mortality had occurred in each treated mound by two hours post-treatment, and survivors were moving very slowly. By 28 hours post-treatment, 100% mortality had occurred in all treated colnies.

II. Test II - June 22, 1989

IFA colonies were drenched with 1 quart of the following treatments (3 replicates/treatment):

Dursban 2EC standard - 15cc/gal water
NTN - 15cc/gal water
NTN - 7.5cc/gal water
NTN - 3.7cc/gal water
NTN - 1.8cc/gal water
NTN - 0.9cc/gal water
Check - plain water

Totally abnormal behavior was observed 6 - 24 hours after treatment and

eventually, all rates provided 100% colony mortality in 2-14 days after application (Table 24).

Bait Studies:

I. Peanut butter bait

NTN was mixed with peanut butter to provide a 2% NTN bait. Ten grams of bait in a petri dish was offered to each of five field collected IFA colonies. Up to 3 hours after bait introduction, all colonies were feeding well with some foragers around the food source showing symptoms of CNS poisoning. By 24 hours post treatment, no colonies were feeding and very little bait was removed. Colonies were observed for 7 days at which time the test was terminated due to lack of mortality.

II. Honey and water bait

A 1.5% bait was prepared using equal parts honey and water. Ten grams of the bait solution was offered in petri dishes to each of three colonies. Ants actively fed for a few hours. Check colonies continued feeding for 24 hours. By 4 days post treatment, ants in the treated colonies were "clustering" on the soil and moving very slowly when agitated, despite minimal bait ingestion. Colony mortality had not occurred by 7 days post-treatment and test was terminated.

III. Macerated mealworm bait

A macerated mealworm preparation (25 g. mealworms and 5 g. water blended for 3

minutes in a laboratory blender) was mixed with NTN to provide a 1% bait. Three colonies were given 10 g. of bait each in a petri dish. All colonies actively fed during the first hour. By 2 hours post treatment, feeding had ceased and foragers in the feeding dishes showed symptoms of CNS poisoning. Three days after treatment, some colonies were "clustering". At 7 days, all colonies were "clustering" on the soil surface, even after minimal bait ingestion. However, by 21 days, colonies had recovered and no significant mortality had occurred.

IV. Sucrose bait

A bait test using serial dilutions of NTN in a 10% sucrose solution was initiated. NTN rates of .0001%, .0005%, .001%, .01%, .05% and .1% were introduced to IFA colonies. Three colonies were treated with each dose rate. Colonies were fed the NTN/sucrose bait in micropipets, each colony receiving a maximum of 240 ul. of bait (Banks & Harlan 1982). Three untreated check colonies received 240 ul. each of 10% sucrose.

The lower rates were readily consumed, and caused some "clustering" on the soil and sluggish movements, but had little lasting effect on the colonies. The two highest rates were repellent to the foragers (avg. - 36% of the bait consumed), but did cause "clusters" for several days and reduced responsiveness to stimuli. The .001% bait was well received by the workers, with 95% of the bait consumed within 24 hours of introduction. A concentration of .01% resulted in consumption of 60% of the available bait within 24 hours. In both of these trials, extreme reduction in response to

stimuli and reduced movements were observed, but entire colony mortality was not acheived in the 21 day test period.

Residual Contact Activity in Soil

I. Drench studies:

Residual contact activity of NTN FS was tested by drenching Strong-Lite® nursery potting media contained in 1 gallon pots with NTN drenches. Activity was determined by bioassay of treated media using alate queens. Application rates were 2.4 ml/gal water (label rate of Dursban 2EC), 1.2 ml/gal water and 0.6 ml/gal water. Pots were weathered under natural conditions, and irrigation added when needed to maintain 2 inches of water per week. A composite sample of two pots from each treatment was collected at 24 hours and then monthly, and bioassayed with alate queens, using slightly modified procedures described by Banks et al. (1964).

None of the NTN drench solutions provided residual activity, even at 24 hours post treatment.

II. Granular incorporated studies:

A 0.5G formulation of NTN 33893 was incorporated into Strong-Lite® potting media at a rate of 11.35 g. AI/cu. yd. of media (Dursban 2.5G label rate) using a portable cement mixer. The treated media was placed in 1 gallon nursery pots and subjected to natural weather conditions. A composite sample of 2 pots of the treated soil was collected and bioassayed monthly.

No residual activity was detected at one month post-treatment and the test was terminated.

Field Test

A one-acre plot was established in Harrison County, Mississippi and a 1/4 efficacy subplot marked in the center. IFA colonies in the subplot were counted and rated according to the procedure described by Lofgren and Williams (1982). All mounds in the plot were marked with engineering flags prior to treatment. Each mound was then drenched with 1 cc NTN FS/gal. water/mound (lowest effective rate from the lab drench studies). The plot was counted and observations made at 5 days, 14 days and 12 weeks after treatment.

NTN at the rate applied did not provide effective control of field IFA colonies (Table 25). Movement of surviving colonies was minimal, but the same abnormal behavior of "clustering" was observed, and large bone piles appeared at 5 days post-treatment.

CONCLUSIONS:

1. Mobay NTN 33893 FS causes IFA to exhibit extremely abnormal behavior, i.e., "clustering" and decreased response to stimuli. This behavior is evident following a topical (drench) application or when ingested in bait form. Residual contact activity in soil was not seen.

2. Efforts to formulate a bait have not been totally successful. Repellency occurs at high rates, but extremely low rates cause totally aberrent behavior, and more testing is warranted. Based on results of trials completed this far, the optimum dose rate appears to be in the range of .001% to .01% in a 10% sucrose solution.

3. NTN has possibilities as a mound drench. Laboratory tests showed the drench to be effective at rates as low as 1cc/gal water. More field tests, using higher application rates, will be initiated to determine the optimum rate of application.

Table 24. Observations on Laboratory Colonies Drenched with Various Rates of NTN.

Treatment	Visual Observations at Indicated Time Post-Treatment				
	6 hrs.	24 hrs.	2 days	9 days	14 days
Dursban 2EC-Standard 15 cc/gal. water	100% mortality	-------	------	------	------
NTN 15cc/gal water	ants alive but non-responsive to stimuli very slow movements	ants unresponsive or dead large groups "clustered" on soil with slight antennal movement	100% mortality	------	------
NTN 7.5cc/gal water	ants alive but non-responsive to stimuli very slow movements	ants unresponsive or dead ants "clustered" on soil with slight antennal movement	some recovery in activity	100% mortality	------
NTN 3.7cc/gal water	ants alive but non-responsive to stimuli very slow movements	ants unresponsive or dead ants "clustered" on soil with slight antennal movement	some recovery in activity	100% mortality	------
NTN 1.8cc/gal water	ants alive but non-responsive to stimuli very slow movements	ants unresponsive or dead ants "clustered" on soil with slight antennal movement	some recovery in activity	greatly reduced activity	100% mortality
NTN 0.9cc/gal water	ants alive but non-responsive to stimuli very slow movements	ants unresponsive or dead ants "clustered" on soil with slight antennal movement	100% mortality*	------	------
Check	normal activity	normal activity	normal activity	normal activity	normal activity

* possibly due to improper mixing - each dilution mixed separately, not in serial dilutions
possible problem getting NTN into solution.

Table 25. NTN Field Drench Test, Harrison Co., MS, August 2, 1989.

Treatment	Pretreat Population		Population Status at Days Post Treatment					
	No. Colonies	Pop. Index	% Colony Mort. (5)	(14)	(82)	% Pop. Index Chg (5)	(14)	(82)
NTN FS 1 cc/gal water/nest	17	210	18	17.6	5.9	-44	-16.6	-10.9
Untreated Check	9	120	11	11.1	0	-13	-25	+12.5

REFERENCES CITED:

Banks, W.A. and D.P. Harlan. 1982. Tests with the insect growth regulator Ciba-Geigy CGA-38351 against laboratory and field colonies or red imported fire ants. J. Georgia Entomol. Soc. 17:460-466.

Banks, W.A., C.S. Lofgren and C.E. Stringer, Jr. 1964. Laboratory evaluation of certain chlorinated hydrocarbon insecticides against the imported fire ant. J. Econ. Entomol. 57:298-299.

Lofgren, C.S. and D.F. Williams. 1982. Avermectin b_1a: highly potent inhibitor of reproduction by queens of the red imported fire ant (Hymenoptera: formicidae). J. Econ. Entomol. 75:798-803.

PROJECT NO: FA01G059

PROJECT TITLE: Tests with Oftanol 5G for IFA Quarantine Treatment of Containerized Nursery Stock

TYPE REPORT: Final

LEADER/PARTICIPANTS: Lee McAnally

INTRODUCTION:

Incorporation treatment with granular chlorpyrifos is listed in M301.81 for certification of containerized plants. This treatment provides a two year certification at an application rate of 11.35 g. AI/cu. yd. Oftanol is also registered for treatment of soil mixes at a rate of 5 g. per cu. yd. of soil. A otudy comparing the efftcacy and residual activity of three rates of Oftanol 5G and chlorpyrifos 2.5G was initiated in May 1989.

METHODS AND MATERIALS:

Residual activity of each treatment was determined by bioassaying treated media with alate queens. The commercial potting media used was STRONG-LITE® (Strong-lite products, P.O. Box 8029, Pine Bluff, AR), which consists of a blend of pine bark, peat moss, and vermiculite. The rates used for treatment were as follows:

36 pots treated with 226.8 g. Oftanol 5G/cu. yd; [equivalent to labelled rate for Dursban 2.5G]

36 pots treated with 198.4 g. Oftanol 5G/cu. yd; [mid-point dose rate]

36 pots treated with 170 g. Oftanol 5G/cu. yd; [labelled rate for IFA control in soil mixes]

36 pots treated with 453.9 g. Dursban 2.5G/cu. yd; [labelled rate for treatment of potting mixes]

36 pots untreated check

From each respective treatment, three pots were composited monthly and a 80-100 cc. sample was collected. The pots were exposed to outdoor weather conditions and watered artificially to maintain a minimum of 1 inch of water per week in the absence of sufficient rainfall. Samples were subjected to standard alate queen bioassay procedure.

RESULTS:

Results are summarized in Table 26. The first month results indicate poor efficacy in the Oftanol treatments with good results for Dursban treatment. The second month showed poor results for all treatments involved. A third month bioassay was conducted to confirm the results from previous months prior to discontinuing this test.

Table 26. Relative Efficacy of Various Rates of Oftanol 5G Blended into Nursery Potting Media for Control of IFA.

Insecticide/Rate	Average % Mortality at Indicated Post-Treatment Intervals 1/		
	1 month	2 months	3 months
Oftanol 5G 226.8 g./cu. yd.	15	0	30
Oftanol 5G 198.4 g./cu. yd.	30	15	5
Oftanol 5G 170 g./cu. yd.	15	10	30
Dursban 2.5G 453 g./cu. yd.	100	10	40
Untreated Check	10	10	0

1/ Standard laboratory bioassay using alate IFA queens. 5 alate queens/replicate and 4 replicates/treatment. Test insects continuously confined to treated media for 7 days.

PROJECT NO: FA01G069

PROJECT TITLE: Performance of Triumph 1G in Various Types of Potting Media

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Lee McAnally and Anne-Marie Callcott

INTRODUCTION:

Several previous studies suggests that Triumph 1G is an effective IFA quarantine treatment for potting media. Since potting media varies greatly in composition, pH, density, and numerous other factors which could affect residual activity, more information on the performance of Triumph 1G in various potting media was needed. One previous trial utilized Triumph 1G in Baccto potting media at a rate of 22.4 gms. AI/cu. yd. yielding a theoretical dose rate of 60 ppm. This rate provided at least 27 months residual activity (Ladner and Collins 1988 Annual Report).

METHODS AND MATERIALS:

The objective of this study was to examine the residual activity of Triumph 1G and Lorsban 15G mixed at a weight-to-weight dose rate to yield 60 ppm for Triumph and 40 ppm for Lorsban (based on recommendation of IFA Technical Work Group in a May 2, 1989 position paper). Each compound was also mixed at a weight to volume ratio of 11.3 gms. AI/cu. yd. for Lorsban and 22.4 gms. AI/cu. yd. for Triumph. One and a half (1.5) cubic feet of each potting media listed below was treated with Triumph 1G at each rate listed below and 1 1/2 cubic feet of each media was also treated with Lorsban 15G at each rate listed

below.

Each mixture was thoroughly blended using portable cement mixers and then placed in 6" pots (18 pots/treatment). Three pots from each treatment were collected and composited at monthly intervals and bioassayed with alate queens using standard laboratory bioassay procedures described elsewhere. Pots were weathered outdoors under natural conditions. Irrigation water was added to simulate normal agronomic practices, i.e., a minimum of 2" of water/week, whether by rainfall or by irrigation.

Treatments evaluated were as follows:

	Triumph 1G Grams AI/cu. yd.		Lorsban 15G Grams AI/cu. yd.	
Potting Media	wt. to vol.	wt. to wt.	wt. to vol.	wt. to wt.
Stronglite	22.4	10.4	11.34	6.94
Baccto	22.4	22.3	11.34	14.85
Peat Moss	22.4	9.37	11.34	6.25
Sunshine	22.4	6.7	11.34	4.47

RESULTS:

As shown in Table 27, the initial 1 month post-treatment bioassay indicated 100% mortality for both compounds in all medias and rates with the exception of Triumph in the Sunshine potting media at the weight to weight (higher) rate (60% mortality). At the two month point, all four combinations in the peat moss and the weight to weight combinations of both Lorsban and Triumph in

Baccto were still at 100% mortality. All other combinations were at 60% or below. Bioassays will be continued for all combinations until mortality stays below 50% for at least 2 consecutive months.

Table 27. Residual Activity of Triumph 1G and Lorsban 15G in Various Types of Potting Media.

POTTING MEDIA	INSECTICIDE/ RATE/AI/YD^3	AVERAGE % MORTALITY TO ALATE QUEENS AFTER		
		1 Month	2 Month	3 Month
Baccto	Triumph 22.4	100	10	0
	Triumph 22.3	100	100	5
	Lorsban 11.34	100	10	30
	Lorsban 14.8	100	100	10
	Check	10	10	5
Sunshine	Triumph 22.4	60	30	5
	Triumph 6.76	100	15	5
	Lorsban 11.34	100	20	10
	Lorsban 4.47	100	15	5
	Check	10	25	5
Stronglite	Triumph 22.4	100	5	0
	Triumph 10.4	100	15	15
	Lorsban 11.34	100	60	15
	Lorsban 6.94	100	10	10
	Check	5	0	0
Peat Moss	Triumph 22.4	100	100	100
	Triumph 9.37	100	100	100
	Lorsban 11.34	100	100	100
	Lorsban 6.25	100	100	100
	Check	5	0	0

PROJECT NO: FA01G079

PROJECT TITLE: Effect of Irrigation Water pH on the Rate of Degradation of Chlorpyrifos in Nursery Potting Media

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Lee McAnally and Anne-Marie Callcott

INTRODUCTION:

Dursban 2.5G applied as a preplant incorporated treatment is approved for certification of nursery potting soil under the IFA quarantine. A certification period of 24 months is listed in USDA, APHIS, PPQ Treatment Manual M301.81. Previous degradation studies, conducted under local conditions in Gulfport, Mississippi, dealt with the effects irrigation water on residual activity (See Report FA01G039). Questions have been raised as to whether the pH of the irrigation water effects the rate of degradation. This study was initiated to determine if irrigation water pH effects the rate of degradation of granular chlorpyrifos blended into potting media.

METHODS AND MATERIALS:

TEST I:

Ford's Dursban 2.5G was blended into Strong-Lite® potting media with a cement mixer for one hour at a rate of 11.3 grams AI/yd^3 soil (the labelled rate of application). The potting media was then placed into 4" square pots and maintained on greenhouse benches. The pots were divided into 3 groups of 75 pots each. One group was irrigated with plain tap water (Gulfport Municipal Water Dept., pH 9.2) while each of the other two groups were irrigated with

water at pH 9 and 11, respectively. The pH of the water was amended with a 50% solution of sodium hydroxide. All three groups received 1" of water each week. At monthly intervals, 3 pots from each treatment were composited and a 80-100 cc subsample was used for bioassay. Standard laboratory alate queen bioassay procedures were used in the bioassay.

TEST II:

A second study was initiated when efficacy in the original study declined after 3 months. Three treatment groups consisting of three sub-groups each were used. One treatment group was treated with Dursban 2.5G, One treatment group was treated with Lorsban 15G, and the third group was an untreated check. One sub-group in each treatment received tapwater and the other two sub-groups in each treatment received water at a pH of 9 and a pH of 11 respectively. The same methodology and rates AI, as used in the first study, were used in the second study.

RESULTS:

Results of the first study are summarized in Table 28. After two months the tap water treatment had dropped to 45% mortality. After three months, all three groups had dropped well below 50% mortality and the study was terminated. As a result of this failure, a second study was begun. Results are summarized in Table 29. At three months two Dursban treatments (tap water and pH 11) and one Lorsban treatment (pH 11) remained at 100%. The Dursban tap water and Lorsban pH 11 remained at 100% after 6 months. The Dursban pH

11 dropped out after 3 months. The Lorsban tap water treatment fell to 35% and 75% in months 2 and 3 respectively. At months 4 and 5 it returned to 100%, but dropped back to 15% at month 6.

Table 28. Influence of pH of Irrigation Water on Residual Activity of Dursban 2.5G in Nursery Potting Media.

Insecticide/Treatment		Average % Mortality to Alate Queens at Days Post-Treatment 1/ (1)	(30)	(60)	(90)
Dursban	Tap	100	100	45	30
	pH 9	100	100	100	15
	pH 11	100	100	100	20
Untreated Check		5	20	5	5

1/ Standard laboratory bioassay using field collected alate queens.

Table 29. Influence of pH of Irrigation Water on Residual Activity of Dursban 2.5G and Lorsban 15G in Nursery Potting Media.

Insecticide/ Treatment	Average Mortality to Alate IFA Queens at Days Post-Treatment 1/						
	(1)	(30)	(60)	(90)	(120)	(150)	(180)
Dursban							
Tap	100	100	100	100	100	100	100
pH 9	100	100	0	40	5	25	40
pH 11	100	100	100	100	10	0	10
Lorsban							
Tap	100	100	35	75	100	100	15
pH 9	100	100	5	5	0	0	15
pH 11	100	100	100	100	100	100	100
Untreated							
Tap	0	10	0	0	5	0	5
pH 9	0	15	0	5	10	5	10
pH 11	25	10	10	0	0	15	20

1/ Standard laboratory bioassay using field collected alate queens.

PROJECT NO: **FA01G089**

PROJECT TITLE: Residual Activity of Granular Formulations of Chlorpyrifos and Triumph

LEADER/PARTICIPANTS: Anne-Marie Callcott and Lee McAnally

TYPE REPORT: Final

INTRODUCTION:

The USDA, APHIS, Imported Fire Ant Program Manual (M301.81) states that granular Dursban incorporated into potting media prior to potting can be used for control of IFA up to 24 months. Recent questions have arisen concerning the validity of this certification period. Ford's Chemical Company currently holds the only granular Dursban registration for IFA quarantine certification of nursery stock. Original residual activity studies were conducted using Dow's Dursban 10G (Collins et al. 1980). Possible differences in formulation between Dow's 10G and Ford's 2.5G were not considered. Ford's produced two Dursban 2.5G formulations in 1989 : *n* corn cob grit formulation *nnd* a a pecan 'hull formulation. Dow's formulation is a clay granule which is marketed as Lorsban 15G.

Triumph is a relatively new organophosphate from Ciba-Geigy, which in previous trials has shown good potential for IFA regulatory use. The granular formulation (Triumph 1G) would provide an alternative to using Dursban for certification of containerized plants. A study was done to compare the residual activity of Ford's 2.5G corn cob formulation, Ford's 2.5G pecan hull formulation, Dow's Lorsban 15, and Ciba-Geigy's Triumph 1G in nursery potting

media.

METHODS AND MATERIALS:

Each of the chemicals was incorporated into Strong-Lite® potting media, using a portable cement mixer, at a rate of 11.35 gms. AI/cu. yd. media (Ford's 2.5G labelled rate for certification of containerized nursery stock). Each chemical treatment filled 72 6" standard plastic nursery pots and was subjected to natural outdoor conditions. Check pots of untreated potting soil were weathered in the same manner. Monthly bioassays with IFA alate queens were performed using a composite sample of three pots from each treatment group.

RESULTS:

Results of this study, as shown in Table 30, indicate that formulation differences do not affect the residual activity of granular chlorpyrifos incorporated in potting soil.

The unusually rapid degradation of Triumph cannot be explained since several previously completed trials with this product have indicated good residual activity.

Table 30. Residual Activity of Various Granular Formulations of Dursban or Triumph Incorporated into Strong-Lite Potting Media at 11.3 g. AI/cu. yd. of Media and Aged at Gulfport, MS.

Insecticide	Carrier/ Formulator	% Kill at Indicated Months Post-Treatment 1/				
		(1)	(2)	(3)	(4)	(5)
Dursban 2.5G	pecan hulls (Ford's)	100	100	100	10	10
Dursban 2.5G	corn cobs (Ford's)	100	35	100	35	0
Lorsban 15G	clay (Dow)	100	100	45	25	10
Triumph 1G	corn cobs (Ciba-Geigy)	100	100	20	40	20
Check		10	30	0	20	10

1/ Standard lab bioassay using alate queens; 5 queens replicate and 4 replicates/sample.

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, 1976-1979. Insect. and Acaric. Tests. 5:209.

PROJECT NO: FA01G099

PROJECT TITLE: Effect of Multiple Applications of LOGIC [fenoxycarb] for Population Suppression of Polygynous Imported Fire Ant in Commercial Grass Sod

LEADER/PARTICIPANTS: Homer Collins, Tim Lockley, Avel Ladner, Lee McAnally, Mark Trostle and Octavio Garza [Texas Department of Agriculture]

TYPE REPORT: Interim

INTRODUCTION:

Theoretically, polygyne infestations of IFA present an even greater quarantine problem than monogyne populations. New infestations outside of the quarantined area have been traced to shipments of grass sod and recent experiments have shown that reproductive IFA queens can be removed from polygynous colonies during normal harvesting operations.

Logic® has been shown to be an effective toxicant for use as a bait to control imported fire ants. As with any other IFA bait, Logic provides no protection against reinfestation of treated areas by newly mated reproductive forms. Biannual or quarterly applications could play a vital role in control of the movement of IFA by reducing the population on commercial sod farms. A study to compare the effects of annual, biannual, and quarterly applications of Logic on polygyne populations of IFA infesting grass sod farms in South Texas was initiated on August 29, 1989.

METHODS AND MATERIALS:

The study site was located in commercial turf near Bay City, Texas. All bait

applications were made by Texas Department of Agriculture personnel using a HERD GT-77A bait applicator mounted on a John Deer AMT-600 and operated on a 24' swath at approximately 10 mph. Treatment regimens consisting of the following sequence were made to 1-acre test plots (5 replicates/sequence):

1. Fall only (September 1989).
2. Fall/spring (September 1989 and February/March 1990).
3. Spring only (February/March 1990).
4. Fall/spring/fall (September 1989 and February March 1990 plus September 1990).
5. Spring/fall (February/March 1990 and September 1990).
6. Spring/fall/spring (February/March 1990 and September 1990 plus February/March 1991).

Ratings of all test plots will be conducted at semi-monthly intervals throughout the study period.

RESULTS:

The only treatment sequence completed thus far is the fall only, which was done on August 29, 1989. Twenty-three weeks after application, 21% colony mortality and 84% change in the pre-treat population index was observed.

PROJECT NO: FA01G109

PROJECT TITLE: Evaluation of Various Chlorpyrifos Formulations in Potting Media

LEADER/PARTICIPANTS: Avel Ladner

TYPE REPORT: Interim

INTRODUCTION:

Ford's Dursban 2.5G applied as a pre-plant incorporated treatment is approved for certification of nursery potting soil under the IFA Quarantine. However, there are many other chlorpyrifos formulations made by various chemical companies. Other effective formulations, if labelled for quarantine use, would provide an alternative IFA treatment for nursery growers. A study was done to test residual activity of several different formulations of chlorpyrifos in nursery potting media.

METHODS AND MATERIALS:

TEST I - 3/22/89:

The chlorpyrifos formulations used were Ford's 2.5G (standard), Ford's 1% dust, Dow's 20% Empire liquid and Dow's 50% WDG. All the formulations were mixed into Strong-Lite® potting media (Strong-Lite Products Corp. Pine Bluff, AR), and the two Ford formulations were also mixed into Baccto potting media (Michigan Peat Co., Houston, TX).

Each formulation was mixed with the soil using a 1 1/2 cu. ft. electric cement

mixer and mixed for a minimum of 1 hour. Granular formulations were added to each soil type at a rate of 11.3 g. AI/cu. yd. The Empire formulation was prepared by mixing 3 ml. Empire with 1 pint water and spraying this solution directly onto the soil as it tumbled in the mixer using a Sure Shot Sprayer Model A pressurized to 100 lbs. PSI.

During the mixing procedure, small random soil samples from each treatment were taken and submitted to NMRAL for GLC analysis of initial chlorpyrifos present.

Treated soil was placed in trade gallon pots and placed outside for exposure to natural environmental conditions. Each treatment was bioassayed monthly using a composite of two pots from each group.

TEST II - November 3, 1989

Procedures described above were used to evaluate the following chlorpyrifos formulations: 10G, Empire, Suscon 10 CR, 2EC, WDG 50%, 1% Dust, XRD 429, Lorsban 15G, Dursban 50 WP and 2.5G.

However, rather than using a weight to volume dose rate as in Test I, (11.3 g. AI/ cu. yd of media); all treatments were applied at an application rate of 100 ppm based on dry weight bulk density of the potting media.

RESULTS:

TEST I:

As shown in Table 31, the initial concentration of chlorpyrifos as determined by GLC analysis varied greatly, primarily due to differences in the bulk densities of these potting medias. All formulations degraded rapidly as shown in Table 32. All formulations were active through the 2 month post-treat bioactivity, but only the 1% Dust remained active at 3 months. These results are totally consistent with numerous other studies conducted in 1989 (See Report FA01G089 and Appendix I).

TEST II:

Preliminary results are shown in Table 33 confirming results of Trial I and others.

Table 31. Initial Concentration as Determined by GLC Analyses.

Formulation	Rate of App. (gms. AI/ cubic yd.)	Amt. of formulation/ 1.5 cu. ft.	Soil Type	Chlorpyrifos (PPM) 1/
Ford's 1% Dust	11.3	63.06 gms.	Strong-Lite	446.50
Ford's 1% Dust	11.3	63.06 gms.	Baccto	81.79
Ford's 2.5G	11.3	25.2 gms.	Strong-Lite	93.67
Ford's 2.5G	11.3	25.2 gms.	Baccto	68.21
Dow Empire 20%	11.3	3 mls.	Strong-Lite	81.84
Dow WDG 50%	11.3	1.26 gms.	Strong-Lite	124.24
Check	--	--	Strong-Lite	0.01
Check	--	--	Baccto	0.01

1/ GLC analyses conducted by USDA, APHIS, NMRAL.

Table 32. Residual Activity of Various Formulations of Chlorpyrifos in Two Types of Potting Media 11.3 g. AI/cu. yd. of Media. 1/

Treatment	Media	% Mortality (Months Post-Treatment) 2/				
		(1)	(2)	(3)	(4)	(5)
Ford's 1% Dust	Strong-Lite	100	100	100	0	70
Ford's 1% Dust	Baccto	100	100	100	10	60
Ford's 2.5G	Strong-Lite	100	100	45	10	10
Ford's 2.5G	Baccto	100	100	5	5	5
Dow Empire 20%	Strong-Lite	100	100	5	5	5
Dow 50% WDG	Strong-Lite	100	100	5	10	15
Check	Strong-Lite	10	5	0	0	10
Check	Baccto	0	10	0	15	25

1/ Trial initiated March, 1989.

2/ Standard laboratory bioassay using field collected alate queens; 4 replicate/treatment with 5 queens/replicate.

Table 33. Residual Activity of Various Chlorpyrifos Formulations at Application Rates of 100 ppm in Strong-Lite® Potting Media. 1/

Formulation	Formulator	% Mortality at Indicated Months Post-Treatment 2/ (1)	(2)	(3)	(4)
Empire 20% 3/	Dow	100	100	100	100
10 G	Ford's	100	100	10	15
Suscon 10 CR	Incitec Int.	100	100	25	5
2 EC 3/	Dow	100	45	0	0
WDG 50%	Dow	100	20	10	0
1% Dust	Ford's	100	20	5	0
XRD 429	Dow	100	5	15	5
Lorsban 15G	Dow	100	5	0	0
50 WP	Dow	100	0	0	0
2.5G	Ford's	70	5	5	5
Check	--	5	20	5	5

1/ Trial initiated November 3, 1989.

2/ Standard laboratory bioassay using field collected queens; 4 replicates/treatment with 5 queens/replicate.

3/ Applied as drench rather than incorporated (8 oz. 2E/100 gal. water).

PROJECT NO: FA01G139

PROJECT TITLE: Determination of Optimum Dose Rate of Triumph 1G and Suscon 10 CR in Nursery Potting Media

TYPE REPORT: Interim

LEADERS/PARTICIPANTS: Avel Ladner and Homer Collins

INTRODUCTION:

Triumph 1G is a relatively new organophosphate insecticide produced by Ciba-Geigy. Several previously completed studies have demonstrated efficacy of the product, but very recent studies are producing mixed results. Serious data gaps relative to the optimum dose rate for incorporation into nursery potting media exist. Most information on-the effectiveness of this product was based on a weight to volume dose rate relationship i.e., (x) grams of insecticide per (n) volume of media. Although this is the historical manner in which granular incorporated treatments are administered, widely differing dose rates occur due to differences in bulk density of the potting media. Therefore, rates of 20, 40, 60, 80 and 100 ppm (based on dry weight bulk density of the potting media) were evaluated in the present study.

Suscon 10G is a controlled release chlorpyrifos formulation produced by Incitec International, Brisbane, Australia. Although extremely long residual activity of this product has been achieved for grub control in sugarcane (3 years), essentially no data on effectiveness against IFA after incorporation into nursery potting media is available.

METHODS AND MATERIALS:

The following dose rates were blended into Strong-Lite® potting media (382 lbs/cu. yd) [Strong-Lite Products Corp., P.O. Box 8029, Pinebluff, AR] with the aid of a 2 cu. ft. capacity cement mixer on November 22, 1989.

Dose Rate (PPM)	Grams Formulation/ 1.5 cu. ft. Batch	
	Triumph 1G	Suscon 10G
20	19	1.9
40	38	3.8
60	57	5.7
80	76	7.6
100	95	9.5

Treated media was placed in trade 1-gallon plastic containers and then weathered outdoors. A minimum of 1" of water/week was supplied by either rainfall or irrigation. Standard laboratory bioassays with alate IFA queens will be conducted until activity of each treatment ceases.

RESULTS:

Preliminary results are shown in Table 34.

Table 34. Residual Activity of Suscon 10 CR and Triumph 1G in Nursery Potting Media. 1/

Treatment		% Mortality at Indicated Months Post-Treatment 1/		
Formulation	Dose Rate	(1)	(2)	(3)
Suscon 10 CR	20 ppm	40	0	75
	40 ppm	80	100	100
	60 ppm	65	100	75
	80 ppm	70	100	80
	100 ppm	100	100	90
Triumph 1G	20 ppm	100	100	40
	40 ppm	100	100	30
	60 ppm	100	100	40
	80 ppm	100	100	20
	100 ppm	100	100	15
Dursban 2.5G	11.2 g. AI/ cu. yd. (65 ppm)	100	100	35
Untreated Ck.	--	10	10	5

1/ Trial initiated November 22, 1989.

PROJECT NO: FA01G149

PROJECT TITLE: Residual Activity of Granular Insecticides Irrigated with Distilled versus Tap Water

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Anne-Marie Callcott

INTRODUCTION:

Recent problems with the rapid degradation of granular Dursban and Triumph in nursery soils have prompted many studies to determine the cause of this degradation. Factors causing this phenomenon may be related to formulation changes, microbial action or irrigation water. Nurserymen may use pond or lake water, well water or city water for irrigation, all of which vary in chemical and microbial content. A study on the effects of irrigation (city water - Gulfport, MS) on various granular insecticides showed that irrigation rapidly increased degradation of Dursban 2.5G, Triumph 1G and Lorsban 15G (See Report FA01G039). The present study was initiated to compare the effects of city tap water and distilled water on the degradation rates of Dursban 2.5G, Triumph 1G and Lorsban 15G in nursery potting media.

METHODS AND MATERIALS:

The various granular insecticides listed above were mixed into Strong-Lite® potting media (Strong-Lite Products, P.O. Box 8029, Pine Bluff, AR) using a 2 cu. ft. portable cement mixer. Each pesticide was incorporated at a rate of 11.3 g. AI/cu. yd. of media and blended for 1 hour. This rate was chosen

because it is the labelled rate of application for Dursban 2.5G, and Triumph 1G and has provided 14 months residual at this rate in previous trials (See Report FA02G036). Treated media was placed in standard 6" plastic pots and maintained in the greenhouse for the duration of the test. Replicates of each treatment and an untreated check were set up. Each pot received 2 inches of either tap water or distilled water per week. Source of the tap water was the Gulfport, MS Municipal Water Department. This water is heavily chlorinated, high in carbonates (146 mg./liter), and has a relatively high pH (9.20). Bioassays using alate queens were performed monthly using a composite of two pots from each treatment and water group.

RESULTS:

At two months post-treatment, none of the chemicals remained 100% effective (Table 35). Thus, the type of water or its chemical content, does not seem to have an effect on the residual activity of any of these pesticides. Each is losing activity at the same accelerated rate as has been shown in other projects in this report.

Table 35. Effects of Tap Water vs. Distilled Water on Residual Activity of Various Granular Insecticides in Potting Media.

Treatment		% Mortality at Indicated Months Post-Treatment 1/					
Insecticide	Source of Irrigation Water	(1)	(2)	(3)	(4)	(5)	(6)
Dursban 2.5G	Tap	100	30				
	Distilled	100	10				
Triumph 1G	Tap	100	15				
	Distilled	100	5				
Lorsban 15G	Tap	100	85				
	Distilled	100	70				
Check	Tap	0	15				
	Distilled	10	0				

1/ Standard laboratory bioassay using alate queen IFA.

PROJECT NO: FA01G159

PROJECT TITLE: Degradation of Dursban 2EC in Sterile and Non-sterile Potting Media

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Anne-Marie Callcott and Homer Collins

INTRODUCTION:

Recent problems with the rapid degradation of granular Dursban and Triumph in nursery media have prompted many studies to determine the cause of this degradation. Factors causing this degradation may be related to formula changes, irrigation water, or even microbial action. Research has shown that chlorpyrifos does degrade more rapidly in non-sterile than in sterile muck and sand, but, this is not a major route of degradation (Miles et al. 1979, 1983, 1984). A study was initiated to compare the rate of chlorpyrifos degradation in sterile versus non-sterile nursery potting media and open versus closed containers.

METHODS AND MATERIALS:

Morris Magic Mix® (Morris Magic Soil, Hialeah, FL) potting media was used in this study. This brand of potting media was chosen because it has shown accelerated degradation in previous trials.

Approximately 500 cc. (387 g) of potting media were placed in 1 qt. mason jars and sealed with standard metal lids. One-half of the jars were steam sterilized at 17 psi for 1 hour on 2 consecutive days (Getzin 1981). One

hundred ml. of a Dursban drench solution (8 fl. oz. Dursban 2E/100 gal. distilled water) was aseptically added to half of the sterilized media as well as to half of the untreated checks. All the jars were placed in a greenhouse to simulate normal environmental conditions of light and temperature. One-half of each group (sterile, non-sterile, treated and untreated) was opened; whereas the remainder was remained sealed. Bioassays were performed monthly using potting media from one jar of each group.

RESULTS:

Only very preliminary results are available at this time. At two months post-treatment, only the closed, treated media whether it was sterilized or not, provided 100% control of IFA alate queens (Table 36).

Table 36. Residual Activity of Dursban 2EC in Sterile vs. Natural Media and Open vs. Closed Containers.

Treatment Conditions Media/Dursban/Container	% Mortality to Alate IFA Queens at Indicated Months Post-Treatment 1/ (1)	(2)	(3)	(4)	(5)	(6)	(7)
Sterile/Treated/Open	100	5					
Natural/Treated/Open	100	75					
Sterile/Treated/Closed	100	100					
Natural/Treated/Closed	80	100					
Sterile/Untreated/Open	5	5					
Natural/Untreated/Open	5	0					
Sterile/Untreated/Closed	0	0					
Natural/Untreated/Closed	10	0					

1/ Standard laboratory bioassay.

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PROJECT NO: FA01G169

PROJECT TITLE: Seasonal Effectiveness of Amdro and Logic for IFA Control

LEADERS/PARTICIPANTS: Homer Collins, Avel Ladner, Anne-Marie Callcott, Tim Lockley and Lee McAnally

TYPE REPORT: Interim

INTRODUCTION:

In order to be effective, all IFA bait toxicants must be ingested by foraging workers. Lofgren et al. (1964) noted that pickup (harvest) of bait by poikilothermic ants is dependent on their being warm and active enough to forage. Markin et al. (1974) reported that, with the exception of the very coldest weeks in Northern Mississippi and South Carolina, some foraging was recorded through winter at 6 different study sites throughout the range of the IFA. Lofgren et al. (1964) found that mirex bait applied in the cooler part of the year (November - April), eventually gave good control (96-100%). However, fast and complete kill was dependent upon warm weather. Markin et al. (1975) showed that winter applications of mirex in South Mississippi resulted in 84-94% kill, but required 4-6 months to occur. An additional study by Summerlin et al. (1976) showed that temperature at the time of treatment seemed to be the main factor affecting mortality and rate of kill with mirex bait.

Harlan et al. (1981) reported that large scale field tests with America Cyanamid AC-217,300 (Amdro) provided 90% control 22 weeks after a spring application. Banks et al. (1988) showed that baits containing fenoxycarb

(Logic) eliminated 60% of the IFA colonies and reduced the population indices by 67-99% within 12-13 weeks in a series of spring/summer treatments. Collins (1986) reported that maximum colony mortality and reduction in pre-treatment population indices were obtained 42 weeks after fall applications of both Amdro and Logic.

It is generally desirable to achieve maximum IFA control as soon as possible after bait application. Indeed, homeowners often demand rapid control although all IFA baits must provide delayed toxicity in order to be effective. Since longer delays in kill are associate with cool weather applications, it was assumed that a "window of opportunity" for maximum control in the shortest period of time exists. A study to better define that "window" was initiated in June 1989.

METHODS AND MATERIALS:

Test plots were located in non-grazed permanent pastures in Harrison County, Mississippi. Treatments were applied at monthly intervals beginning in June, 1989. Each month three 1-acre test plots (replicates) were treated with Amdro while 3 adjacent plots received Logic bait. All treatments were made with the USDA, APHIS granular applicator mounted on a farm tractor (Collins, 1987 unpublished). Effects of the treatments were evaluated monthly until reinfestation occurred. The population index method (Harlan et al. 1981), as modified by Lofgren and Williams (1982) was used to rate all test plots. Soil temperature at the 1" depth and a subjective rating of foraging activity was

also recorded immediately prior to each application.

RESULTS:

As of mid-January 1990, a total of 48 test plots had been treated and evaluations are proceeding on a monthly basis. Final results will be summarized and presented in the 1990 Annual Report.

REFERENCES CITED:

Banks, W.A., D.F. Williams and C.S. Lofgren. 1988. Effectiveness of fenoxycarb for control of RIFA. Jour. Econ. Ent. 81:83-87.

Collins, H.L. 1986. Field evaluation of Affirm, Amdro and Logic baits for control of RIFA. Ins. and Acar. Tests. 11:468.

Harlan, D.P., W.A. Banks, H.L. Collins and C.E. Stringer. 1981. Large area test of AC-217,300 bait for control of IFA in Alabama, Louisiana and Texas. Southwest Ent. 6:150-157.

Lofgren, C.S. F.J. Bartlett, C.E. Stringer, Jr. and W.A. Banks. 1964. Imported fire ant toxic bait studies:Further tests with granulated mirex-soybean oil bait. Jour. Econ. Ent. 57:695-698.

Lofgren, C.S. and D.F. Williams. 1982. Avermectin B12, a highly potent inhibitor of reproduction by queen of the red imported fire ant. J. Econ. Ent. 75:798-803.

Markin, G.P., Jerry O'Neal, J.H. Dillier and H.L. Collins. 1974. Regional variation in the seasonal activity of the imported fire ant, Solenopsis saevissima richteri. Environmental Ent. 3:446-452.

Markin, G.P., H.L. Collins and Jerry O'Neal. 1975. Control of IFA with winter applications of microencapsulated mirex bait. Jour. Econ. Ent. 68:711-712.

Summerlin, J.W., J.K. Olson and John O. Fick. 1976. RIFA:Levels of infestations in different land management areas of the Texas coastal prairies and an appraisal of the control program in Fort Bend Co., TX. Jour. Econ. Ent. 69:73-78.

PROJECT NO: FA01G179

PROJECT TITLE: Assessment of Damage Caused to Commercially Grown Blueberries by the Red Imported Fire Ant in Mississippi

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Tim Lockley, Homer Collins and Avel Ladner

INTRODUCTION:

The red imported fire ant, Solenopsis invicta Buren, causes damage to numerous crop systems. Recent field observations by the senior researcher indicates that IFA may cause indirect but significant damage to blueberries in Mississippi. Blueberries have extensive but very shallow root systems. In commercially managed blueberry orchards, IFA nests tend to be excavated at the base of a blueberry plant. This excavation exposes the blueberry roots to the surface environment. As a result, yields of blueberries may be significantly reduced, and where the field is open to the public, numerous complaints of IFA stings are registered with the grower. The objective of this project was to determine the relative damage to commercially grown blueberries by the red imported fire ant in Mississippi.

METHODS AND MATERIALS:

Beginning on July 19, 1989, a twenty-acre commercial blueberry orchard at Bryland Farms, Seminary, Covington County, Mississippi was separated into treatment plots. Each plot consisted of from 75 to 100 plants. The study site was completely described with respect to variety, age, spacing and size of each plant on a plot/crop data sheet. A plot map was drawn containing a

scaled representation of the study site. The plot map referenced permanent points so that the exact location of each plot could be determined. A granular formulation of Logic bait [lot no. 1J87012] was applied according to labelled directions at a rate equivalent to 1.5 lbs/acre to the treated plots. Applications were made to rows numbered 8, 9, 10, 11, 12, 98, 99, 100, 101 and 102. Application equipment was driven parallel to the treated rows. For the purposes of this experiment, rows 10 and 100 were considered the "treated" with the rows adjacent being buffer zone. Rows 40 and 70 will be used as untreated checks. All rows treated are planted in variety Tiftblue. Rows 8 - 12 and 40 are approximately one year older than rows 70 and 98 - 102. Treatments of rows 8-12 began at approximately 11:00A and was completed at 11:20A. Rows 98 - 102 were treated between the hours of 11:30A and 11:45A. The field was maintained by the grower in a manner that duplicated commercial agricultural practices. All operations were conducted with commercial farm equipment using good agricultural practices. The two untreated plots were maintained identically to the two treated plots.

Ten percent of the treated and untreated plants will be randomly selected at normal harvest (i.e, May-June 1990) for crop assessment. All ripe fruit will be collected on three separate dates corresponding with early-, mid- and late-season. The picked berries from each plant will be weighed immediately after collection to limit loss from dessication. Data from each plant will then be composited with all samples collected form each plot combined to give final values. Samples will be collected within 120 days post-application for Logic residue analysis.

Samples will consist of 1.0 kg. of plant material composited from the treated areas. Plant material may consist of leaves, buds, stems or fruit. The sample will be collected from no fewer than 10% of the treated plants. Residue analysis will be made at NMRAL for fenoxycarb residue. A temporary tolerance of 0.05 ppm will be used as a maximum allowable rate.

Pre-application evaluations of all IFA mounds within the treated and untreated plots was made on July 19, 1989 using the Lofgren Scale. A subsequent evaluation was made 6 and 18 weeks post application [Table 37]. A follow up and final counts will be made in early spring and at final harvest.

RESULTS AND DISCUSSION:

Initial counts were relatively high. Rows 8-12 averaged a mound per acre equivalent of 133 with a population index of 259. Row 40 had a mound per acre equivalent of 184 and a population index of 352. Row 70 had a modest mound per acre rate of only 68 with a population index of 225. Rows 98-102 also showed a modest level of infestation with an equivalency of 46 mounds per acre and a population index of 193. At 6 weeks post-application, rows 8-12 acre and a population index of 193.

At 6 weeks post-application, rows 8-12 displayed a significant decrease in mounds per acre [77] and population index [21.5]. Row 40's numbers had changed significantly with a per acre equivalent of 164 mounds and a population index of 245. Row 70's numbers had changed only slightly with 74

mounds per acre and a population index of 290. Rows 98 - 102 showed a slight increase in numbers to 61 mounds per acre but with a with a significant decrease in the population index to 31.

By week 18, IFA numbers in Rows 8-12 had declined dramatically with a per acre equivalent of 36 mounds and a population index of only 9.25. Row 40's numbers had increased by 62.5% to 266 mounds per acre and a population index increase of 83.7% to 450. Within Row 70, numbers had increased slightly to 97 mounds per acre and a population index of 290. Rows 98- 102 displayed a decrease in numbers [76%] and population index [20].

Table 37. Comparative Populations of the Red Imported Fire Ant in a Commercial Blueberry Orchard Treated with a Single Application of Logic.

Row No.	Status of Population at Indicated Weeks Post-treatment: Total Mounds (0)	(6)	(18)	No. Colonies (Per Acre Equivalent) (0)	(6)	(18)	Population Index (0)	(6)	(18)
9	10	7	1	102	72	10	200	21	3
10	22	8	4	225	82	41	415	24	10
11	11	8	7	113	82	72	230	22	19
12	9	7	2	92	72	21	190	19	5
$\bar{x}$	13	7.5	3.5	133	77	36	259	21	9
40 (Ck.)	18	16	26	184	164	266	352	245	450
70 (Ck.)	12	13	17	68	74	97	225	240	290
$\bar{x}$ (Ck.)	15	15	21	126	119	181	288	242	370
99	6	5	6	34	28	34	115	14	17
100	16	18	1	91	102	6	330	52	3
101	9	10	6	51	57	34	160	28	34
102	10	10	2	57	57	11	165	31	6
$\bar{x}$	10	11	4	58	61	21	192	31	15

PROJECT NO: FA01G189

PROJECT TITLE: Migration of IFA Colonies into Dursban Impregnated Media

TYPE REPORT: Final

LEADER/PARTICIPANTS: Anne-Marie Callcott

INTRODUCTION:

Since colony relocation is inevitable following application of any insecticide to an IFA nest, it is often assumed that IFA workers are repelled by Dursban treated soil i.e., they will not move into nursery pots containing treated soil. A Dursban surface treatment was shown to act as a feeding deterrent to IFA workers (1988 IFA Annual Report p. 38-43). The objective of this project was to determine if a fragmented IFA colony would freely migrate into a nursery pot containing Dursban treated soil.

MATERIALS AND METHODS:

A 5' diameter child's plastic wading pool was utilized to hold 100 cc. of a fragmented field colony (workers and brood present, queen status unknown) [1988 Annual Report p. 108-113] and the test pots. Dodd's Potting Media (Dodd's Nursery, Semmes, AL) was treated with Dursban 2.56, incorporated at a rate of 1.0 lb. of formulated material/cu. yd of media. The fragmented colony was released in the middle of the pool and allowed to migrate to any available pot. The pots were available at ratios of 1:1 and 2:1; treated:untreated. Pots were observed daily to note the location and activity of the ants.

RESULTS:

In one trial, the fragmented colony was given the option of moving into a newly treated Dursban pot (treated within 24 hours) or an untreated one. The ants immediately migrated into the untreated check pot.

The other four trials showed that while IFA ultimately prefer a Dursban-free environment, they will move into a pot with an aged Dursban treatment before migrating to clean or untreated soil. In the first of these trials, IFA moved into a 9 month old Dursban pot by day 2 and had worked the soil up. On day 3, the ants were distributed equally in both the old Dursban pot and the untreated check pot. By day 6, there were a number of dead workers around the treated pot, and the colony had migrated to the check pot. The test was terminated on day 7.

In trial 2, a 9 month old Dursban (old) pot, a 72 hour old Dursban (new) pot, and an untreated check pot were available for the fragmented colony to move into. On day 1, approximately 95% of the ants were in the old Dursban pot and working the soil, while 5% were in the check pot. Day 2 showed 10% remaining in the old Dursban pot with the rest of the colony in the check pot. The IFA fragmented colony had completely migrated to the check pot by day 6. The trial was observed for 15 days, during which time no changes occurred, and the trial was terminated.

Trial 3 tested a 10 month old Dursban (old) pot, a 20 day old Dursban (new)

pot and an untreated check. On day 1, approximately 95% of the ants were in the old Dursban pot. By day 4, the colony had moved into the check pot. The colony was observed for changes until day 12 and the test was terminated.

Trial 4 used an 11 month Dursban (old) pot, a 2 month Dursban (new) pot and an untreated check pot. Day 1 found 55% of the ants in the old pot, 5% in the new pot, and 40% in the check pot. On day 2, approximately 95% of the colony was in the old pot, with the remaining ants in the check. By day 6, the colony had migrated into the check pot. The test was terminated after day 9.

DISCUSSION:

The soil newly treated with Dursban 2.5G, aged up to 2 months seemed to deter the ants from moving in. The older Dursban, treated 9-11 months prior to testing, somehow attracted the colony at first, but in all trials the colony migrated to an untreated check pot within 4 to 6 days. The amount of Dursban present in these older pots is unknown, but initial concentration was approximately 71.36 ppm.

PROJECT NO: FA01G199

PROJECT TITLE: Determination of Leachability of Various Insecticides for "Over-the-Top" Certification of Containerized Nursery Stock

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Tim Lockley, Homer Collins and Lee McAnally

INTRODUCTION:

Because of the possible loss of certification of chlorpyrifos as a quarantine insecticide; alternative chemicals and treatment regimens must be investigated. If proven effective, a topical application of granular or wettable powder formulations to the soil surface of a containerized plant could be rapidly incorporated into the IFA quarantine program through Section 24C Exemptions.

Two projects to determine the efficacy of various candidates were undertaken in December 1989 and January 1990. These tests were undertaken to determine if: (1) a candidate insecticide had the potential to disseminate with reasonable homogeneity through a column of potting soil; and (2) having met criteria No. 1, could effectively act as a residual barrier to infestation by newly mated IFA queens.

METHODS AND MATERIALS:

Test 1:

A series of 1 trade gallon capacity containers containing woody landscape

plants were artificially infested with 100cc fragments of IFA colonies on December 4, 1989. Each container was placed in a tray and suspended above a water moat in order to confine the IFA colonies to the containers. Each treated container received an application of insecticide at 100 ppm based upon a dry bulk density of the nest tumulus. Five candidates were applied to 3 containers [replicates]: Bendiocarb, Diazinon, Force, Pounce and Talstar. Each candidate was applied to the surface of the soil and then irrigated with ca. 1.0 liter of water. Bendiocarb caused no significant mortality. Diazinon severely affected ants in one colony but only caused minor mortality in the remaining two. Force caused 100% mortality in two of the three treated containers and significantly reduced the number of IFA in the third colony. Lack of mortality in colony 3 may have been an artifact for the experimental protocol. Insufficient water may not have been applied in sufficient quantity to saturate the tumulus. Pounce and Talstar caused 100% mortality in all three colonies treated.

Test 2:

In our second trial, containerized woody landscape plants were treated with four chemicals at a rate of 100 ppm: Ammo 0.75G; Dursban 2.5g; Pounce 1.5G; and Talstar 10W. Chemicals were applied dry over-the-top then irrigated into the media with water equivalent to 20% the volume of the container. Pots were visually examined 1 hour post-treatment for IFA activity. All treated containers showed reduced or no activity. At 24 hours post-treatment, plants and their attending soil were removed from each container and closely examined for living IFA. All four chemicals caused 100% mortality of IFA in plants

confined to 2 gallon capacity containers. Among the plants grown in 3, 4 and 5 gallon containers, all tested material with the exception of Dursban 2.5G caused 100% mortality to IFA workers. Examination of the root balls of the larger plants revealed significant numbers of IFA concentrated near the center away from the area treated with Dursban. The relatively "quick knockdown" of Ammo, Pounce and Talstar [all pyrethroids] may be why mortality was so high within their treatments.

Test 3:

Three foot lengths of 8 inch PVC pipe were sectioned. One inch holes were bored six inches apart along a single length of the pipe beginning at a point six inches from the top and ending at a point of 30 inches from the top. Each hole was sealed with tape. A fine mesh screen was attached with glue to the base of the pipe to restrict loss of potting media. Each pipe was placed upright in a wooden rack and packed with Strong-Lite Potting media to within 1 inch of the top. The media was then drenched thoroughly with water.

The day following saturation, a topical application of the following selected chemicals was made:

Ammo [FMC - Cypermethrin]

Pounce [FMC - Permethrin]

Talstar [FMC- Bifenthrin]

Dursban [Dow - Chlorpyrifos]

Criteria for selection of these candidates were based upon their current registration, soluability in water, and residual activity [+ 4 weeks].

Immediately after treatment, the columns were saturated with water [5.0 liters]. Water that translocated through the complete column was collected [4.3 l] and a bioassay carried out using the leachate water. Discs of filter paper were soaked in the leachate and then placed in a petri dish with five alate IFA queens. Mortality of the test subjects was measured after 7 days confinement. Core samples were collected from 6 inch levels of each column to determine vertical translocation of the insecticide. The columns received and will continue to receive irrigation once per week and subsequent bioanalysis of the leachate and core samples will be accomplished weekly and biweekly respectively.

Two replicates of each treatment were made at a rate equivalent to 100 ppm based on the column and dry bulk of the potting media in each column.

RESULTS:

Preliminary results are presented in Tables 38 and 39. Bioassays of leachates were made on days 1, 7, and 14 post treatment [Table 1]. Tests carried out on Day 1 indicated 0% mortality for Ammo, Dursban and Pounce. Talstar leachate showed moderate toxicity with a mortality level of 45%. Mortality for all four treatments on Day 7 and 14 were 0.

Bioassays of core samples were made 7 days post-treatment. Results are shown in Table 39. Dursban 2.5G displayed no toxicity at any depth. Ammo 0.75G and Pounce 1.5G each showed 100% mortality at 6 inch depth. Ammo also caused 100% mortality at the 12 inch depth. Both Ammo and Pounce continued to show mortality on a descending scale correlated with depth. Talstar 10W caused 100% mortality of IFA alate queens at depths of 6 to 24 inches. At 30 inches [the maximum depth of core samples tested], Talstar caused a mean mortality of 80%.

Table 38. Relative Toxicity of Leachate Collected from Treated Columns of Potting Media.

Treatment	Percent Mortality Days Post Treatment 1	7	14	21
Ammo 0.75G	0	0	0	
Dursban 2.5G	0	0	0	
Pounce 1.5G	0	0	0	
Talstar 10W	45	0	0	
Check	0	0	0	

Table 39. Translocation of Four Candidate Chemicals Applied Topically to a Column of Potting Media One Week Post Application.

Treatment	Percent Mortality to IFA Alate Queens Depth of Core Sample [inches] 6	12	18	24	30
Ammo 0.75G	100	100	60	20	45
Dursban 2.5G	20	15	0	15	5
Pounce 1.5G	100	45	30	15	5
Talstar 10W	100	100	100	100	80
Check	5	5	5	5	5

PROJECT NO: FA01G209

PROJECT TITLE: Evaluation of Candidate Toxicants for Quarantine Treatment of Grass Sod, 1989

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Tim Lockley, Lee McAnally and Avel Ladner

INTRODUCTION:

Commercial shipments of grass sod have been directly associated with the introduction of imported fire ant (IFA) into previously uninfested areas since 1953 (Culpepper, 1953). Initially, chlorinated hydrocarbons were utilized as effective quarantine treatments. However, in 1978 the EPA issued a cancellation order eliminating the last chlorinated hydrocarbon (chlordane) for this use. Currently, there exists but a single registration (chlorpyrifos 10G) applied at either 4.0 or 6.0 lbs. AI/acre.

METHODS AND MATERIALS:

The present study was conducted in Centipede turf grass at the Pearl River Grass Farm 9 km. east of Wiggins, Stone County, Mississippi beginning on August 11, 1989. A total of 22 toxicants/formulations (Table 40) were applied to 20' x 50' plots each replicated three times.

Granular formulations were applied using a cyclone type seeder. Liquid applications were made using a tractor mounted spray system. All materials

were applied uniformily within each plot.

Soil samples were collected every 30 days with a modified core sampler. The cores were composited for each formulation assuring sufficient amounts for subsequent bioassay. Samples were screened to remove plant material and debris, placed in marked containers, sealed and returned to the laboratory. Collection of samples, handling and storage was done in a manner to assure that no cross-contamination occurred.

Bioassays of the soil for efficacy and residual activity were conducted using alate IFA queens. Twenty cc. of test soil was placed in 2" square plastic flower pots. Dental labstone was used to seal the bottom of each pot and to retain moisture. Five alate queens were placed in each pot which was then covered with an inverted petri dish to prevent escape or cross-contamination. Bioassays were carried out at approximately 30 day intervals.

RESULTS:

Twenty-four hours after application of the candidate toxicants, ca. 1" of irrigation water was applied to the treated plots. All subsequent waterings were the result of normal precipitation. As indicated in Table 41, four of the candidates have given consistently excellent results [Ammo 0.75G, Capture 0.2G, Capture 2EC, and Karate 1EC]. All four of these candidates are synthetic pyrethroids and exhibited not only long-term residual activity [currently at 150 days] but an exceptionally quick "knock down" in the

bioassay. Three other candidates [Force 1.5G, Fortress 5G and Lorsban 15G], though somewhat less successful, still show potential as IFA controls. Bioassays will continue until such time as these toxicants fail to show activity.

Table 40. Candidate Pesticides Evaluated on Commercial Grass Sod, 1989.

Insecticide [Granular Formulation]	Rate [g] 1000 sq. ft.	lb./acre equivalent	Manufacturer
Triumph 1G	208	1.0	Ciba-Geigy
Triumph 1G	416	2.0	Ciba-Geigy
XPM-4902 1G	208	1.0	Dow
Dursban 10G	625	6.0	Dow
Lorsban 15G	417	6.0	Dow
Fortress [G]	1250	6.0	Dupont
Ammo 0.75G	1388	1.0	FMC
Capture 0.2G	5207	1.0	FMC
Force 1.5G	697	1.0	ICI
Dyfonate 20G	313	6.0	ICI
Oftanol 5G	1250	6.0	Mobay
Mocap 5G	1250	6.0	Rhone-Poulenc

Insecticide [Liquid formulation]	Rate [cc] 1000 sq. ft.	lb./acre equivalent	Manufacturer
Triumph 4E	22	1	Ciba-Geigy
Triumph 4E	44	2	Ciba-Geigy
Dursban 2EC	262	6	Dow
Ammo 2.5EC	35	1	FMC
Capture 2EC	44	1	FMC
Pounce 3.2 EC	27	1	ICI
Cymbush 3EC	29	1	ICI
Karate 1EC	87	1	ICI
Torpedo 2E	**	1	ICI
Tempo 2E	44	1	Mobay

** Torpedo 2E applied at label rate for post-construction [1 part concentrate per 50 parts water].

Table 41. Residual Activity of Candidate IFA Toxicants Applied to Commercial Grass Sod, 1989.

TOXICANT [**GRANULAR**]	% Mortality to Alate Queens at Indicated Post-Treatment Intervals Days (30)	(60)	(90)	(120)	(150)
Triumph 1G 1X	35	0			
Triumph 1G 2X	35	0			
XPM 4902 1G	60	0			
Capture 0.2G	100*	100*	100*	100*	100*
Ammo 0.75G	100*	100*	100	100	100
Dursban 10G	100*	100	100	100	100
Lorsban 15G	100*	100	100	55	100
Fortress 5G	100	100	100	5	
Force 1.5G	100*	100*	100*	80	80
Dyfonate 20G	100**	75			
Oftanol 5G	25	5			
Mocap 5G	25	15			

TOXICANT [**LIQUID**]	% Mortality to Alate Queens at Indicated Post-Treatment Intervals Days (30)	(60)	(90)	(120)	(150)
Triumph 4EC 1X	25	75			
Triumph 4EC 2X	30	0			
Torpedo 2EC	100*	0			
Dursban 2EC	100	5			
Capture 2EC	100*	100*	100*	100*	100
Ammo 2.5EC	100*	0			
Tempo 2EC	95	25			
Cymbush 3EC	70	0			
Karate 1EC	100*	100*	100*	100*	100
Pounce 3.2EC	50	0			
Check	5	0			

* Within 24 hours post-exposure
** Within 48 hours post-exposure

REFERENCES CITED:

Culpepper, G.H. 1953. Status of the imported fire ant in the southern states in July 1953. Bureau Ent. Plant Quarantine, U.S. Dept. Agric., Special Report E-867.

PROJECT NO: FA01G219

PROJECT TITLE: Quarantine Treatments for Polygynous IFA in Commercial Grass Sod

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Homer Collins, Tim Lockley, Avel Ladner, Lee McAnally, Mark Trostle and Octavio Garza [Texas Department Agriculture]

INTRODUCTION:

Grass sod is certified for movement outside the regulated area following an application of granular chlorpyrifos at either 4 or 6 lbs. AI/acre (PPQ Treatment Manual 301.81). This treatment is based on the premise that, with monogynous IFA populations, the greatest risk associated with sod movement is from the thousands of newly mated queens that could be present during the cutting or harvesting operation. The chances of removing a mature fertile queen from a single queen colony is presumed to be nill, especially since populations of single queen colonies on commercial sod farms are usually relatively low (10-30 nest/acre) over most of the IFA infested area.

However, with the large numbers of queens and nests present in a polygynous population, there is a high probability that gravid queens can be removed during the harvesting operation. This has been known to occur experimentally (Lockley, unpublished data). One of the major sod growing areas in the infested area is within Matagora, Brazoria and Wharton Counties, Texas. Polygynous IFA are prevalent throughout this area, and populations of two to three-hundred nests/acre are not uncommon. Two series of trials were conducted near Bay City, Texas in 1989 to determine efficacy of the currently

approved treatment and to evaluate various combinations of baits plus short term residual pesticides.

METHODS AND MATERIALS:

Test plots were located in commercial turf in Matagorda County, Texas. Baits and granular pesticide formulations were applied with a HERD GT-77A Spreader mounted on a John Deer AMT-600 operated at 10 mph with a 24' swath. Liquid treatments were applied with a PTO driven Beam® Sprayer using Tee-Jet® 8003 nozzels spaced 20" apart on a 27' boom. The system was calibrated to deliver 30 GPA at 250 PSI.

One-acre test plots were established and population counts were made in 1/4 acre circular subplots located in the center of each treatment plot. The population index system described by Lofgren and Williams (1982) was used to rate all colonies prior to treatment and at semi-monthly intervals after treatment. Two trials were conducted. Treatments in the first series were applied in May, and treatment in the second trial was applied in August 1989.

RESULTS:

Trial I - May 1989

Both Dursban 10G at 6 lbs. AI/acre and Amdro bait at 1.5 lbs./acre were highly effective, providing good control through the 26 week evaluation

interval (Table 42).

Trial II - August 1989

Excellent control was achieved with Amdro in combination with either Dursban 10G, Triumph 4E, or alone. Control with Dursban 10G alone reached 100% 22 weeks after treatment (Table 42).

Table 42. Efficacy of Various Treatments and Combinations of Treatments for Control of Multiple Queen IFA Colonies Infesting South Texas Sod Farms.

TREATMENT		PRE-TREAT POPULATION		RESULTS AT INDICATED WEEKS AFTER TREATMENT 1/									
Insecticide & Formulation	Rate/Acre (lbs.)	$\bar{x}$ No. of Colonies	$\bar{x}$ Population Index	% Colony Mortality (8)	(12)	(16)	(20)	(26)	% Change in Pre-Treat Population Index (8)	(12)	(16)	(20)	(26)
TRIAL I – MAY 1989													
Dursban 10G	60	18	207	82	100	96	99	98	-97	-100	-99	-99	-99.7
Amdro	1.5	20.3	290	98.6	99	95	89	97.5	-99	-99.6	-98	-90	-74
Triumph 1G	100	16	190	75	100	87	12.5	25	-79	-100	-84	+16	+10
Logic	1.5	22.3	303	5	64	86	97	85	-74	-93	-98	-99.6	-89
Triumph 4E	1.0AI	17	215	50	82	65	0	0	-65	-84	-62	+49	+67
Untreated Ck.	—	16	175	0	12.5	0	0	0	+131	+11.4	+20	+134	+149

1/ Based on 1/4 acre subplot within 1.0 acre treatment plots. Some treatments in Trial 1 replicated; others unreplicated. Population index described by Lofgren and Williams (1982). Jour. Econ. Ent. 75:798-803.

Table 42. (Continued)

TREATMENT		PRE-TREAT POPULATION		RESULTS AT INDICATED WEEKS AFTER TREATMENT 1/							
Insecticide & Formulation	Rate/Acre (lbs.)	$\bar{x}$ No. of Colonies	$\bar{x}$ Population Index	% Colony Mortality (4)	(8)	(16)	(22)	% Change in Pre-Treat Population Index (4)	(8)	(16)	(22)
TRIAL II - AUGUST 1989											
Amdro + Dursban 10G	1.5 & 60	7	95	100	100	100	100	-100	-100	-100	-100
Amdro	1.5	10	125	100	90	80	90	-100	-88	-90	-98
Amdro + Triumph 4E	1.5 & .75AI	10	120	100	90	100	100	-100	-88	-100	-100
Logic + Triumph 4E (2X)	1.5 & 2.5AI	13	145	92	85	100	92	-98.6	-98.6	-100	-99
Triumph 4E	.75 AI	8	100	50	37	25	62	-91	-35	-51	-79
Logic + Dursban 10G	1.5 & 60	7	85	43	100	86	86	-89	-100	-98	-98
Dursban 10G	60	13	155	38	85	92	100	-86	-96	-99	-100
Logic + Triumph 4E	1.5 &.75 AI	18	235	33	28	61	83	-86	-86	-93	-97
Logic	1.5	8	100	0	0	25	25	-79	-82	-76	-85
Untreated Ck.	--	17	205	47	0	12	0	-40	+54	+42	+12

1/ Based on 1/4 acre subplot within 1.0 acre treatment plots. Some treatments in Trial 1 replicated; others unreplicated. Population index described by Lofgren and Williams (1982). Jour. Econ. Ent. 75:798-803.

PROJECT NO: FA04G019

PROJECT TITLE: Systematic Survey of the Three Coastal Counties of Mississippi for Incidences of Polygynous Colonies of the Red Imported Fire Ant, Solenopsis invicta

LEADER/PARTICIPANTS: Timothy Lockley and Lee McAnally

TYPE REPORT: Interim

INTRODUCTION:

Mature colonies of Solenopsis invicta Buren until recently have been considered monogynous (Lofgren et al. 1975). Tschinkel & Howard (1978) concluded, from their study of colony founding and queen replacement, that colonies often have more than one mated queen, but are nevertheless, functionally monogynous (i.e., only one of the queens lay eggs).

S. invicta entered the United States at the port of Mobile, Alabama ca. 1940 (Lofgren et al. 1975). They entered the state of Texas around 1957. Reports of polygyny (multiple queens) started to appear in 197311974 at two separate locations--Mississippi (Glancey et al. 1973) and Texas (Hung et al. 1974). These studies found that multiple queens were gravid, and when separated, produced worker brood. From theee observatione, they concluded that these colonies were functionally polygynous. Since their first discovery, polygyne colonies have been reported from Georgia (Fletcher, 1983) and Florida (Lofgren and Williams, 1984).

The mechanism behind the independent occurrences of polygyny among S. invicta

colonies is unknown, but the frequency of this form seems to be increasing (Glancey et al. 1987). However, a recent survey of the Mississippi site where polygynous colonies were first reported, showed a significant decline in polygyne colonies. Of 51 mounds examined, only two were polygynous.

A number of questions concerning polygyny in S. invicta remain to be answered. Among these are (1) How are polygynous colonies geographically distributed locally in relation to monogynous colonies? and (2) Are polygyne colonies permanent or are they merely a temporary aberrance? To help answer these questions, a systematic survey will be conducted annually to determine the current extent of polygyny in the three coastal counties of Mississippi.

METHODS AND MATERIALS:

The first survey was conducted using Mississippi State Highway Commission maps of the three Mississippi Gulf Coast counties of Jackson, Hancock, and Harrison. The survey was made at the juncture of all major paved roads within the boundries of all three counties. The area immediately adjacent to the junctures was surveyed. A total of 10 colonies at each site was excavated and examined at length for the presence of S. invicta dealate queens. When more than one dealate was observed, replicate samples of the dealates were collected, placed in 80% ethanol and returned to the Imported Fire Ant Station at Gulfport, MS, for dissection to determine the gravidity of each specimen. Examined sites were each given a code based upon the map coordinates indicated on the MSHC maps.

RESULTS:

Of the three counties surveyed, Jackson County had the least number of paved roads followed closely by Hancock County. Harrison County contained ca. 2.5 times the total number of roads as the two adjacent counties. In Jackson County, 23 sites were examined. Eighteen sites proved to be totally monogynous. Four of the remaining sites contained both monogynous and polygynous colonies. Only one site was totally polygynous. Ten of the monogynous sites contained unfertilized dealates. Hancock County contained 30 sites. Of these, 26 were monogynous, three contained both single and multiple queen colonies and only one was 100% polygynous. Five of the monogynous sites excavated contained unfertilized IFA dealates. In Harrison County, a total of 126 separate sites were examined. Of these, 113 were monogynous, 12 contained both monogynous and polygynous colonies and as in the previous two counties, only one site was completely polygynous. Thirteen of the monogynous colony sites had mounds which contained unfertilized dealates.

Mississippi can lay claim to the dubious distinction of having been the state from which the first polygynous S. invicta were reported. The site near Hurley, Jackson County, MS was known among fire ant workers as "Queen City". Sixteen years later, the same site is 98% monogynous. At the same time, in states like Florida and most notably Texas, polygynous colonies are on the increase. In each of the three counties surveyed, only a single sites was observed to be polygynous. Are polygyne colonies on the decline within the coastal counties of Mississippi? Are their numbers static or are their numbers growing? Future surveys will be made at the same sites annually over the next five years to answer this question.

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APPENDIX I

DEGRADATION OF CHLORPYRIFOS IN NURSERY POTTING 'MEDIA

Timothy C. Lockley and Homer Collins

INTRODUCTION

Granular chlorpyrifos incorporated into nursery potting media has been used as an imported fire ant quarantine treatment since 1980. The original research on efficacy of this treatment was conducted at Gulfport, MS with Lorsban 10G. Under the conditions of those trials, up to 39 months residual activity was achieved at a dose rate of 11.2 grams AI/cu. yd. of media (Collins, et al. 1980). In 1980, Dow Chemical Company (Midland, MI), was granted registration of a granular formulation of Dursban which was marketed as FA-5. This 5% granular formulation was subsequently withdrawn from the market by Dow due to alleged phytotoxicity to succulent foliage plants in Central Florida. Ford's Chemical and Specialty Company (Pasadena, TX), received registration of a 2.5% granular chlorpyrifos formulation in July, 1984. This product is the most often employed imported fire ant quarantine treatment, and is currently in use in all IFA infested states. Treatment rates of 1.0 lb of 2.5G (11.35 grams AI) per cubic yard of potting media affords a 24 month certification period (USDA, APHIS, PPQ Treatment Manual M301.81.)

Numerous interceptions of live IFA in nursery stock were made in California, Arizona, and Tennessee in 1988. Most infested shipments originated from plant nurseries in South Florida. In addition to the interceptions, several complaints of product failure were voiced by growers, and regulatory officials began to question the effectiveness of the granular Dursban treatment.

Potential causes of the alleged treatment failures included managerial practices, formulation changes, and accelerated degradation of chlorpyrifos due to microorganisms or other environmental factors. The diminished control could not be attributed to the development of insecticide resistance because an infinitely small percentage of the IFA population is exposed to the pesticide. Therefore, selection pressure is not being applied to the general IFA population by this treatment.

Enhanced degradation, a phenomenon whereby an insecticide is

degraded more rapidly than usual by microorganisms, has been reported in soil for diazinon (Forest et al. 1981), carbofuran (Felsot et al. 1981, Read 1983, and Harris et al. 1984), fensulfothion (Read 1983), and isofenphos (Chapman et al. 1986). Enhanced degradation of isofenphos also occurs in turfgrass thatch (Niemczyk and Chapman, 1987). Enhanced degradation of chlorpyrifos following field applications has not been reported. However, Getzin (1981) and Miles et al. (1979) showed that chlorpyrifos degraded faster in non-autoclaved soils than in autoclaved soils. "'Cross-conditioning' and 'cross adaptation' are terms used to describe the accelerated breakdown of a chemical after pretreatment of the soil with another chemical. Usually the two chemicals involved are structurally related analogs." (Felsot, 1988). However cross conditioning can also occur between structurally unrelated compounds such as fensulfothion and carbofuran (Read, 1983).

Several studies were initiated in 1989 to confirm that accelerated degradation of granular chorpyrifos in nursery potting media was occurring, and to elucidate the reason or reasons for the phenomenon.

METHODS AND MATERIALS

Test I: Geographical Aging Studies

Gainesville, Winter Haven and Miami, FL Study Sites

Dursban 2.5G formulated on a pecan hull carrier, [Ford's Chemical and Specialty Company, Pasadena, TX], was incorporated into Stronglite potting media [Strong-Lite Products, Pine Bluff, AR] at the rate of 1.0 lb. of formulated material/cu. yd. at Gulfport, MS on January 16-20, 1989. Stronglite potting media is a manufactured product of uniform consistency. Its major constituents are composited of pine bark, peat moss, vermiculite, and perlite; but the exact ratio of ingredients are unknown. Stronglite media dry weight bulk density is ca. 382 lbs/cu. yd. This incorporated media was then rebagged and transported to three separate study sites in Florida where replicated plots were set up in mid-January 1989. The three sites chosen were: Gainesville [North]; Winter Haven [Central]; and Miami [South]. At the central and south sites, media into which chlorpyrifos was premixed by the firm which formulates and sells the media (i.e., "premix"), was purchased and set up along with the Stronglite media which had been treated by us in Gulfport, MS.

Gainesville, FL

Test plots were set up on January 16 at Hammock Farm Nursery, 9015 NW 61st Avenue, Gainesville, FL. Two plots were set up each having 100 6 inch (3 qt) pots in a 10' x 10' pot grid. The plots consisted

of a standard potting soil (Stronglite), into which 1.0 lb of Ford's Dursban 2.5G on pecan hull carrier was incorporated at the Gulfport, MS IFA Station, and an untreated check. Soil for the untreated check came from stock at the nursery. Components of the soil could not be determined. A water sample (2 replicates of 500 cc. each) was collected, sealed, and returned to the Gulfport Station for pH analysis. Results indicated a pH of 8.7 for both water samples. The samples were collected directly from the nursery's irrigation system while they were in operation. Samples of both the water and the two test plots were collected approximately on the 15th of every month throughout the study period by Florida Department of Agriculture, Division of Plant Industry personnel, and mailed to the IFA Station in Gulfport for bioassays and GLC analyses.

"Premixed" media was not available for the Gainesville test. Nurseries in the area indicated that they prefer the drench method of certification and that premixed soils are seldom used and as such are not generally available.

Winter Haven, FL

Test plots were set up at Goochland Nurseries, Inc., 2400 Hwy.17 and 98 North, Ft. Meade, FL, on January 18, 1989. Test plots consisted of a standard potting soil (Stronglite) into which Ford's Dursban 2.5G on pecan hulls had been incorporated at 1.0 lb./cubic yard at the IFA Station in Gulfport, MS; a premixed soil treated with Ford's Dursban 2.5G (formulated on corn cob carrier) at 1 lb./cu.yd. by Tu-Co Peat Inc., 9601 Bear Road, Sebring, FL; and an untreated check purchased from Tu-Co Peat Inc. The Tu-Co Peat soils were mixed on site at Tu-Co Peat Inc. on January 18, 1989. The pre-mixed soil was mixed at the following ratio (per cubic yard): 40% peat; 40% cypress dust; 20% hardwood sawdust; 10% sand (0.1 yd); 20% Aerolite (10 cu. ft.); 1.0 lb. Dursban 2.5G; 15.0 lbs. Dolomite. The untreated soil mix consisted of the following: 50% peat; 50% hardwood sawdust; 10% sand (0.1 yd.); 7 lbs. Dolomite and; 3.5 lbs. HiCal. Wellwater was collected from two separate sites on the nursery grounds. All water was taken from a central well. Analysis of the water indicated a pH of 7.85.

Miami, FL

Three test plots were set up at the Kendall Landscape Nursery, 14750 SW 216 St., Miami, FL, on January 20, 1989. Test plots consisted of a standard as described above, a premixed Dursban incorporated soil purchased from Morris Magic Soil 14400 NW 102 Ave., Hialeah, FL and, an untreated check purchased fron Morris Magic Soil. The Morris Magic soil samples were mixed on January 20, 1989. The premixed soil consisted of 33% black soil (Everglades peat); 33% Lake Wales Sand (medium grade); 16% pine bark chips; 16% Aerolite and; 16 oz. Dursban 2.5G on a corn cob carrier. The untreated check was mixed to the same specifications with the exception of the Dursban 2.5G.

Water samples were collected from two separate points within the nursery. All irrigation water is taken from a central, municipal source. Analysis of the water showed a pH of 7.3.

Replicate samples of the two premixed media from central and south Florida were bagged and returned to Gulfport, MS where they were set up as controls. At each site, 100 one-gallon capacity pots of each media [including untreated checks] were placed in a 10 x 10 foot area and subjected to normal nursery practices, including irrigation. Two pots of each media were collected every 30 days and shipped to Gulfport for bioassay and chemical analyses.

Laboratory bioassay procedures described by Banks et al. (1964) were slightly modified to fit the needs of the current trials. Alate queen IFA were used rather than workers in all bioassays. Chemical analyses for chlorpyrifos residues were conducted by the USDA, APHIS National Monitoring and Resudue Analysis Laboratory. Procedures used are described in NMRAL laboratory procedure PR0047 (J.H. Ford, personal communication).

Old Cutler Rd. Study Site:

Eighteen cu. ft. of Stronglite potting media were shipped to the USDA Subtropical Horticultural Research Laboratory 1360 Old Cutler Rd., Miami Florida, for use in this study on May 10, 1989. Two of the most commonly used media from the South Florida area [Atlas 3000 and Morris Magic Soil] were purchased locally [2 cu.yds. each] for use in the trial. Bulk density determinations for each media were made prior to incorporating granular Dursban at various rates. Stronglite was the lightest of the three at 382 lbs/cu.yd. Atlas 3000 was second in bulk density with a weight of 451 lbs/cu.yd. Morris Magic Soil was by far the heaviest of the three media used with a bulk density of 802 lbs/cu.yd. On May 17, Ford's Dursban 2.5G on corn cob carrier was incorporated into Stronglite media using two 3.0 cu. ft. capacity electric cement mixers. Each mixing was done over a 30 minute period to assure a homogenuous incorporation. Five rates of Dursban 2.5G were prepared: 20, 40, 60, 80, and 100 ppm. Each rate was mixed and placed into 50 one gallon pots and labelled. On May 18, the Morris and Atlas media were each mixed following the procedure used with Stronglite. During this period, a drench of each media was accomplished using Dursban 2EC at the labelled rate of 8 fl. oz./100 gallons of water. Twenty-five untreated pots of each media were set aside for the drenching. Samples of each treated media were sent to Gulfport, MS for bioassay and GC analysis along with 12 cu. ft. of the untreated Morris and Atlas media. The trials that begun in Miami, FL were replicated at Gulfport, MS on May 22, 1989.

Whiteville, NC Study:

The aging studies described above were essentially replicated at the

Whiteville Methods Center (USDA, APHIS, S+T) in Whiteville, NC. Specific details of that study are as follows:

Stronglite Potting Media [Pine Bluff, AR]- 382 lbs/cu.yd
ProMix potting media [New Rochelle NY]- 359 lbs/cu.yd.
Miami A [Morris Magic Soils, Miami FL]- 909 lbs/cu.yd.
Miami B [Morris Magic Soils, Miami FL]- 475 lbs/cu.yd.

Ford's Dursban 2.5G on the corn cob carrier was incorporated into Promix potting media at Whiteville, NC on April 8, 1989, shipped to Gulfport, and placed in pots on April 14. Stronglite, Miami A, and Miami B were mixed at the Gulfport Station and potted on April 14. All pots received 1.0 inch of irrigation water on April 15. Gulfport mixture of Stronglite was shipped for potting to Whiteville, NC where it was placed in 6-inch pots along with the Whiteville Promix on April 17. Samples were collected monthly for bioassay and GLC analysis as described above.

Test II: Analysis of Water Samples

Factors affecting organophosphorus insecticide hydrolysis include chemical structure, solvent composition, temperature, pH, and presence of certain catalysts (O'Brien 1960). Chapman (1982) reported the half life of chlorpyrifos in sterile water at pH 4.5 was 11 weeks versus 2.7 weeks at pH 8.0.

Water samples from both the Miami test site and Gulfport, MS were analyzed by a local private laboratory (National Environmental Testing, Inc. NET (Gulf Coast), Inc., 601/863-3036).

Test III: Formulaton Studies:

Gulfport, MS Study - July 6, 1989

Hypothetically, formulation differences between Dow's Lorsban and Ford's 2.5G Dursban could account for the rapid degradation observed in all recent trials. Ford's produces both a corn cob grit formulation and a pecan hull formulation. Dow's formulation is comprised of a clay granule, and is marketed as Lorsban 15G. As previously stated, trials conducted in the late 1970's were conducted with Lorsban 10G, and eventually led to registration of Dursban FA-5. Therefore, a series of trials comparing residual activity of various chlorpyrifos granular formulations were initiated.

Triumph is a relatively new organophosphate from Ciba-Geigy, which in numerous previous trials has shown good potential for IFA

regulatory use. The granular formulation (Triumph 1G) would provide an alternative to the granular Dursban formulation should it prove efficacious and registration is obtained.

Each of the formulations listed above were incorporated into Strong-Lite potting media, using a portable cement mixer, at a rate of 11.35 gms. AI/cu. yd. of potting media on July 6, 1989. This is the labelled rate of application for the Ford's 2.5G formulaton. Treated soils were placed into 72 six-inch standard plastic nursery pots and subjected to natural outdoor conditions (natural rainfall only). Check pots of untreated potting soil were weathered in the same manner. Monthly bioassays with IFA alate queens were performed using a composite sample of three pots from each treatment group.

Miami FL, Whiteville NC, Gulfport, MS Study - October 18, 1989

An expanded study comparing Lorsban 15G, Dursban 2.5G, Suscon 10CR, Triumph 1G, and Capture 0.3G was initiated in October 1989. Stronglite potting media treated with each formulation at a rate of 11.3 grams AI/cu ud. was aged at 3 study sites: Miami FL, Whiteville NC, and Gulfport, MS. At monthly intervals treated media was sampled and mailed to the IFA laboratory for standard laboratory bioassays.

RESULTS

Test I: Geographical Aging Studies

Gainesville, Winter Haven, and Miami Study Sites

Ford's Dursban 2.5G incorporated into various media degraded at an alarming rate at the South Florida site. Within 30 days, the locally purchased "premix" potting soil [Morris Magic Mix] had become totally ineffective against IFA. By the second month of the experiment, the media mixed by us [Stronglite Mix] in Gulfport and shipped to Miami had also deteriorated to the point where it no longer controlled IFA [20% mortality to test alate IFA queens]. Similar results were beginning to occur in Central Florida at the same time [Table 1]. GC analysis data can be found in Table 2 and generally show a rapid degradation at all sites with each type of potting media. Significant differences in pesticide carrier or formulation were not seen. At Day 120, this test was cancelled and another, more elaborate, experiment was set up at the USDA Subtropical Horticultural Research Laboratory, 13603 Old Cutler Road, Miami, FL.

Old Cutler Rd. Study Site

A bioassay carried out on Day 30 showed disappointing, but not

necessarily unexpected results [Table 3]. All rates of Dursban 2.5G incorporated into the Morris mix failed in all five rates. All rates of Dursban 2.5G incorporated into the Atlas mixture also failed in all 5 rates but 100% mortality was achieved with the 2EC drench. Only the Stronglite media achieved 100% mortality in all treatment categories. By Day 60, the Stronglite media had also degraded to the point that it failed to achieve 100% mortality at each rate. By day 90, all rates failed.

Conversely, the same medias set up at Gulfport, MS were somewhat more successful initially [Table 4]. At day 30 all medias provided 100% mortality at the three highest dose rates. By Day 60, all media failed at all rates. Subsequent evaluations at day 90 confirmed the day 60 results.

Dursban applied as a drench had limited success as well. At both test sites the drench failed at day 30 in the Morris media. By day 60 only the Mississippi replicate of the Atlas media achieved 100% mortality; all other treatments failed [Table 5].

Results of GLC analyses are given in Tables 6 and 7 and generally confirm that rapid degradation occurs regardless of test site location or type of potting media used.

Table 1. Mortality of IFA Alate Queens Exposed to Dursban 2.5G Treated Media (11.3g AI/cu yd media) and Aged at Four Separate Locations in Mississippi and Florida. January 1989.

Location	Media	Percent Mortality 1/				
120		Day 0	Day 30	Day 60	Day 90	Day
Gulfport, MS	Stronglite	100	100	100	100	100
Gainesville, FL		100	100	100	100	20
Winter Haven, FL		100	100	20	15	40
Miami, FL		100	100	20	30	20
Gulfport, MS	TuCo Peat	100	100	100	100	100
Winter Haven, FL		100	100	100	100	65
Gulfport, MS	Morris Mix	100	100	100	100	70
Miami, FL		100	10	15	10	20

1/ Standard lab bioassay using alate queens; 5 queens/replicate and 4 replicates/sample.

Table 2. Chemical Analyses of Three Dursban Treated Potting Medias Aged at Various Geographical Locations. January 1989.

Location	Media	Residue [ppm] 1/				
		Day 0	Day 30	Day 60	Day 90	Day 120
Gulfport, MS	Stronglite	81.91	54.15	74.33	62.22	1.36
Gainesville, FL		81.91	56.93	59.73	18.37	3.05
Winter Haven, FL		81.91	7.52	4.03	3.16	0.69
Miami, FL		81.91	29.75	7.48	6.12	0.28
Gulfport, MS	TuCo Peat	19.61	10.13	15.78	25.60	1.55
Winter Haven, FL		19.61	11.80	9.38	19.93	2.48
Gulfport, MS	Morris Mix	27.66	12.35	5.15	8.44	1.14
Miami, FL		27.66	0.01	0.94	0.77	0.13

1/ GLC analyses performed by USDA, APHIS, NMRAL.

Table 3. Mortality of IFA Alate Queens Exposed to Various Rates of Dursban 2.5G Incorporated into Three Types of Media and Aged at Miami, Florida. May 1989.

Media	Initial Dose Rate (PPM)	% Mortality of Alate Queens Confined to Treated Media 1/			
		Day 0	Day 30	Day 60	Day 90
Morris Mix	20	100	0	15	0
	40	100	0	25	5
	60	100	5	60	0
	80	100	20	15	10
	100	100	40	0	5
Atlas 3000	20	100	90	10	0
	40	100	50	45	0
	60	100	60	100	40
	80	100	40	100	5
	100	100	40	100	65
Stronglite	20	100	100	100	5
	40	100	100	15	0
	60	100	100	35	25
	80	100	100	100	35
	100	100	100	100	0

1/ Standard lab bioassay using alate queens; 5 queens/rep. and 4 replicates/sample.

Table 4. Mortality of IFA Alate Queens Exposed to Various Rates of Dursban 2.5G Incorporated into Three Types of Media and Aged at Gulfport, Mississippi. May 1989.

Media	Initial Dose Rate (PPM)	% Mortality of Alate Queens Confined to Treated Media 1/			
		Day 0	Day 30	Day 60	Day 90
Morris Mix	20	100	95	10	0
	40	100	85	5	5
	60	100	100	15	0
	80	100	100	5	15
	100	100	100	0	15
Atlas 3000	20	100	25	15	30
	40	100	75	15	20
	60	100	100	10	10
	80	100	100	15	10
	100	100	100	60	60
Stronglite	20	100	100	20	0
	40	100	100	5	0
	60	100	100	10	0
	80	100	100	25	35
	100	100	100	5	25

1/ Standard lab bioassay using alate queens; 5 queens/rep. and 4 replicates/sample.

Table 5. Persistence of Chlorpyrifos 2EC Applied as a Drench (8 fl oz/100 gal HOH) to Three Types of Potting Media and Aged at Miami, Florida or Gulfport, Mississippi. May 1989.

		% Mortality to IFA Alate Queens 1/			
Media	Location	Day 0	Day 30	Day 60	Day 90
Morris Mix	MS	100	20	20	10
	FL	100	80	10	10
Atlas 3000	MS	100	100	100	60
	FL	100	100	20	15
Stronglite	MS	100	100	50	5
	FL	100	100	0	5

1/ Standard lab bioassay using alate queens; 5 queens/rep. and 4 replicates/sample.

Table 6. GLC Analyses of Potting Media Aged at Gulfport, Mississippi. May 1989.

Media ID 2/	Theoretical Dose Rate	Residues Detected 1/			
		Day 0	Day 30	Day 60	Day 90
A201MS	20	13.48	9.04	1.06	2.51
A401MS	40	44.28	24.04	2.21	1.97
A601MS	60	35.08	20.20	1.69	3.39
A801MS	80	32.68	30.21	8.28	6.74
A1001M	100	82.59	37.64	16.68	8.45
A201MS	20	14.97	11.36	0.35	0.93
A401MS	40	22.77	17.79	1.64	1.74
M601MS	60	47.94	9.07	1.09	1.95
M801MS	80	40.88	23.03	7.43	3.33
M1001M	100	53.08	36.63	3.00	2.02
S201MS	20	28.94	24.45	5.76	5.24
S401MS	40	60.68	17.29	6.96	4.88
S601MS	60	82.54	20.95	7.15	3.50
S801MS	80	75.74	24.87	4.21	5.33
S1001M	100	93.67	48.27	6.92	6.46
DRA1MS	100	94.31	21.80	2.18	9.04
DRM1MS	50	78.75	8.49	1.42	1.40
DRS1MS	100	106.47	144.41	18.26	6.36

1/ GLC analyses conducted by USDA, APHIS, NMRAL.

2/ Media ID:
First letter indicates the specific potting media being tested:
A = Atlas Mixture; M = Morris Mixture; S = Stronglite Mixture.
Numbers indicate theoretical PPM on Day 0 and the aliquot [e.g. 802 = 80 ppm aliquot 2 of that sample; 1001 = 100 ppm aliquot 1 of tht sample].

The final letter[s] indicate site location: F and FL = Miami, Florida; M and MS = Gulfport, Mississippi.
S1002F would thus indicate the second aliquot of a Stronglite mixture of 100 ppm pm Day 0 from the Miami, FL experimental plot.
A401MS would indicate the first aliquot of an Atlas mixture of 40 ppm on Day 0 collected from Gulfport.

Table 7. GLC Analyses of Potting Media Aged at Miami, Florida. May 1989.

Media ID 2/	Theoretical Dose Rate	Residues Detected			
		Day 0	Day 30	Day 60	Day 90
A201FL	20	18.00	7.92	5.86	1.28
A401FL	40	21.47	13.37	6.25	3.03
A601FL	60	26.05	16.65	7.79	4.55
A801FL	80	60.66	21.73	10.50	6.72
A1001F	100	48.70	12.22	4.45	5.69
M201FL	20	77.01	1.28	0.46	0.20
M401FL	40	36.20	2.93	1.68	0.38
M601FL	60	25.83	3.75	2.76	1.09
M801FL	80	33.50	5.48	3.09	1.42
M1001F	100	50.36	5.25	3.00	1.72
S201FL	20	21.65	7.18	4.78	5.75
S401FL	40	45.42	15.47	6.41	8.55
S601FL	60	72.52	53.48	8.27	8.84
S801FL	80	58.11	53.76	32.45	12.16
S1001F	100	96.74	95.13	29.39	44.23
DRA1FL	100	--	35.80	19.31	8.64
DRM1FL	50	--	4.39	2.39	6.00
DRS1FL	100	--	60.25	14.48	4.98

1/ GLC analyses conducted by USDA, APHIS, NMRAL.
2/ Media ID:
First letter indicates the specific potting media being tested:
A = Atlas Mixture; M = Morris Mixture; S = Stronglite Mixture.
Numbers indicate theoretical PPM on Day 0 and the aliquot [e.g. 802 = 80 ppm aliquot 2 of that sample; 1001 = 100 ppm aliquot 1 of tht sample].

The final letter[s] indicate site location: F and FL = Miami, Florida; M and MS = Gulfport, Mississippi.
S1002F would thus indicate the second aliquot of a Stronglite mixture of 100 ppm pm Day 0 from the Miami, FL experimental plot.
A401MS would indicate the first aliquot of an Atlas mixture of 40 ppm on Day 0 collected from Gulfport.

Whiteville, NC Study Site

Bioassays indicated that Dursban degraded rapidly in all types of media regardless of the location in which the treated media was aged (Table 8). GLC analyses confirmed the results of the bioassays (Table 9).

Table 8. Bioassays of Potting Media Aged at Whiteville, North Carolina and Gulfport, Mississippi. April 1989.

		% Mortality to Alate Queens				
Media	Location	Day 1	30	60	90	120
Stronglite	MS	100	100	100	100	60
	NC	100	100	100	10	70
Promix	MS	100	100	100	10	20
	NC	100	100	20	15	5
Miami A 1/	MS	100	100	100	20	10
Miami B 1/	MS	100	100	5	25	0
Check		5	5	10	5	25

1/ Morris Magic Soils, Hialeah, FL.

Table 9. GLC Analyses of Potting Media Aged at Whiteville, North Carolina or Gulfport, Mississippi.

		Residues (ppm)*				
Media	Location	Day 0	30	60	90	120
Stronglite	NC	86.62	65.27	31.29	11.27	13.41
	MS	86.62	64.77	27.67	10.22	9.58
Promix	NC	104.25	68.87	30.25	24.56	7.67
	MS	104.25	***	18.72	5.11	4.21
Miami A **	MS	24.59	***	4.52	6.52	0.85
Miami B **	MS	31.68	***	2.79	4.45	0.70

* GLC analyses conducted by USDA, APHIS, NMRAL.
** Morris Magic Soil, Hialeah, FL.
*** Lost samples.

Test III:

The data shown in Table 10 is from analyses of water taken from USDA Subtropical Fruits Research Laboratory in Miami, FL, and the Imported Fire Ant Station at Gulfport, MS.

Table 10. Analyses of Water Samples from Miami, Florida and and Gulfport, Mississippi.

	MIAMI	GULFPORT
Conductivity [microhoms]	0.27	0.28
pH	8.65	9.20
COD [mg/l]	36.00	10.00
BOD [mg/l]	24.00	4.00
Carbonates [mg/l]	36.00	146.00
Nitrates [mg/l]	0.030	0.10
Nitrites [mg/l]	0.063	0.01
Phosphorous [mg/l]	0.100	0.01
Sulfides [mg/l]	1.000	4.50
Metals [mg/l]		
As	0.0004	0.0010
Ba	0.2000	0.2000
Cd	0.0030	0.0001
Cr	0.0040	0.060
Cu	0.0051	0.0300
Fe	0.0500	0.0500
Pb	0.0016	0.0018
Hg	0.0010	0.0002
Ag	0.0004	0.0100
Na	29.4000	74.1000
Zn	0.0200	0.0600

Test IV: Formulation Studies:

Gulfport, MS Study

Results of this study indicate that formulation differences are not responsible for the rapid degradation of granular Dursban in potting media (Table 11).

Miami FL, Whiteville, NC and Gulfport MS Study

As shown in Table 12, Dursban 2.5G and Triumph 1G degraded far more rapidly at the Miami, Fl study site. Neither of these products showed activity at the 30 day bioassay. Both Lorsban 15G and Capture 0.3G remained 100% effective at all three sites through the 90 day posttreat interval. Activity of Suscon 10CR dropped to 25% at the Miami site 60 days postreat.

Table 11. Residual Activity of Various Granular Formulations of Dursban or Triumph Incorporated into Strong-Lite Potting Media at 11.3 g. AI/cu. yd. of Media and Aged at Gulfport, MS. 1/

Treatment Insecticide	Carrier/ Formulation	% Kill at Indicated Months Post-Treatment 2/ (1)	(2)	(3)	(4)	(5)
Dursban 2.5G	Pecan hulls (Ford's)	100	100	100	10	10
Dursban 2.5G	Corn cobs (Ford's)	100	35	100	35	0
Lorsban 15G	Clay (Dow)	100	100	45	25	10
Triumph 1G	Clay (Ciba-Geigy)	100	100	20	40	20
Check	---	10	30	0	20	10

1/ Trial initiated July 6, 1989.
2/ Standard lab bioassay using alate queens; 5 queens replicate and 4 replicates/sample.

Table 12. Residual activity of granular formulations of chlorpyrifos, izaphos, and bifenthrin incorporated into Strong-lite potting media at 11.3 grams AI/cu. yd. (65 ppm), and aged at Miami, FL; Gulfport, MS and Whiteville, NC. 1/

Treatment Insecticide	Formulation	Location	% Kill at indicated months post-treat 2/ (1)	(2)	(3)	(4)
chlorpyrifos	Lorsban 15G	FL	100	100	100	
		MS	100	100	100	
		NC	100	100	100	
chlorpyrifos	Dursban 2.5G	FL	25	5	0	
		MS	100	100	100	
		NC	100	40	100	
chlorpyrifos	Suscon 10 CR	FL	95	25		
		MS	100	100		
		NC	100	100		
izaphos	Triumph 1G	FL	0	5	10	
		MS	100	100	5	
		NC	100	100	100	
bifenthrin	Capture 0.3G	FL	100	100	100	
		MS	100	100	100	
		NC	100	100	100	

1/ Trial initiated October, 1989.
2/ Standard lab bioassay using alate queens; 5 queens/replicates and 4 replicates/treatment.

SUMMARY AND CONCLUSIONS

Laboratory bioassays with alate IFA queens involving 7 different types of potting media aged under actual or simulated nursery conditions at 5 geographical locations (Miami, Gainesville, and Winter Haven, FL; Gulfport, MS, and Whiteville, NC) conclusively show that Dursban 2.5G incorporated into any potting medium becomes ineffective in 30 to 120 days. GLC analyses confirm that Dursban degrades very rapidly since only a fraction of the initial concentration remains after 30 to 120 days. Pesticide binding can therefore be ruled out, because if binding were occurring, GLC analyses would indicate the presence of relatively large residues although bioassays would be negative.

Although formulation changes have been made over the years, none of the different chlorpyrifos formulations evaluated in current trials, provided the residual activity needed for an effective IFA quarantine treatment.

Several studies indicated that formulation had little effect on the residual activity of chlorpyrifos in potting media.

Results of one study showed that a five fold increase in dose rate (20-100 ppm) did not significantly extend the residual activity of Dursban 2.5G in any of 3 different types of media. Therefore, increased rates of application of Dursban 2.5G are not indicated as a solution to the problem of extending the residual activity to meet the needs of the quarantine program. Studies in other parts of the IFA infested area have not been conducted, but there is no basis to assume that the rates of degradation seen in these trials are atypical.

Registration and general use of alternate granular treatments for nursery potting media are several years in the future. Triumph 1G has shown promise in numerous trials conducted from 1986 to 1988. However, mixed results from several trials conducted in late 1989 are causing great concern for the future of Triumph as a quarantine treatment. Several synthetic pyrethroid insecticides continue to show promise for treatment of potting media. Preliminary and incomplete results of the first trial conducted with this group of compounds indicate that Ammo 0.75G, Capture 0.2G, and Force 1.5G provide a minimum of 14 months residual activity (see Project FA02G037 of this report). Numerous trials to determine optimum dose rate, maximum residual activity in various types of media, etc. are underway. All studies are

longterm in nature, and a quick fix to the problem of certification is not feasible.

A very unfavorable option for certification of containerized nursery plants would be a pour-on or immersion treatment with EC formulations of chlorpyrifos or diazinon. Several EC formulations of chlorpyrifos are registered for this use, and approval is provided in M301.81. Some states have also approved a pour-on treatment with diazinon under 24C registrations.

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APPENDIX II

A Review of Factors Influencing Residual Activity of Chlotpyrifos in Soil

By:

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Introduction

Chlorpyrifos is a broad spectrum organophosphate insecticide and is the principle treatment for nursery stock for compliance with the Federal Imported Fire Ant (IFA) Quarantine (CFR 301.81). A granular (G) formulation is incorporated into potting media for a 24 month certification period or an emulsifiable concentrate (EC) formulation may be used as a drench on containerized or balled-and-burlapped stock for a 90 day certification period. However, recent studies by USDA, APHIS, IFA Labortaory have shown that the residual activity of granular chlorpyrifos in nursery potting media is far less than originally thought. A number of studies are underway to determine the cause or causes of this reduction in longevity, but at this time the cause(s) are unknown.

Many environmental factors, alone or in combination with others, can influence the bioactivity and persistence of chlorpyrifos. Among the factors to be examined in this review are soil type, soil moisture, soil temperature, soil pH, chemical formulation and application, chemical volatility, chemical movement, and microbial activity.

Soil Type

Many different types of potting soils are used throughout the nursery industry. Components may include spagnum moss, sand, peat, perlite, vermiculite, wood shavings, bark, etc. Ion exchange capacity, % organic matter, pH, amendments, etc. vary greatly. Another variable associated with nursery soils is bulk density. Nursery soils can vary in bulk density from 200 lbs./cu. yd. to over 2,000 lbs./cu. yd. Since chlorpyrifos is labelled for incorporation into potting media, for control of IFA, on a weight to volume basis (i.e., 1.0 lb. 2.5G Dursban per cubic yard of potting soil), as the bulk density increases, the theorectical dose rate decreases (Table 1). This variable alone means that the initial concentration of chlorpyrifos can vary from 125.0 to 12.5 ppm immediately after treatment with 1.0 lb. of Dursban 2.5G per cubic yard of potting soil.

Table 1. The following table gives theoretical dose rates for potting mixes varying in bulk density from 200 to 2,000 lbs./cu. yd.

Bulk Density of Potting Soil (lbs./cu.yd.)	Theoretical Dose Rate at 1.0 lb. of 2.5% G/ cu. yd. Soil (ppm)
200	125.0
300	83.3
500	50.0
850	29.4
1000	25.0
1250	20.0
1500	16.6
2000	12.5

A. Bioactivity of Chlorpyrifos in Various Soils

Chlorpyrifos can be adsorbed to particles in the soil, especially to organic matter (Sharom et al. 1980, Zidan et al. 1984 and Sauer & Daniel 1987). Adsorption renders some of the chemical unavailable as a pesticide, thus more active ingredient must be present to maintain effective levels of bioactivity. A number of studies, using a variety of test insects, have examined the bioactivity of chlorpyrifos in various soils. Efficacy of chlorpyrifos against test insects is inversely proportional to the organic content of the soil (Whitney 1967, Harris & Hitchon 1970, Harris 1973 and Harris 1982). Harris and Svec (1968) found that surface applications of both granular and EC formulations were less toxic to cutworms on muck than on sandy soil. Table 2 shows a few specific bioactivity rates of chlorpyrifos to IFA and first instar cricket nymphs (crickets).

Table 2. Bioactivity of chlorpyrifos in various soils against various test insects.

Formulation	Soil Type	Test Insect	LD50 (ppm)	Reference
4E	sand muck	IFA worker	0.067 0.882	Eger & Hall 1988
technical	sand muck	cricket	0.26 6.18	Harris 1969
technical	sand muck	cricket	0.0795 2.27	Harris 1977

B. Persistence of Chlorpyrifos in Various Soils

While chlorpyrifos may be less toxic to insects in muck soils, it is more persistent in muck than in sand (Getzin 1981 and Miles et al. 1983). The persistence of chlorpyrifos in soils varies greatly even when the same formulation and soil type are compared (Table 3).

Table 3. Half life of various chlorpyrifos formulations in different soils.

Formulation	Soil Type	Half Life (days)	Reference
EC	sand	14	Chapman & Harris 1980
EC	muck	56	
G	muck	35-42	Davis & Kuhr 1976
EC	muck	35-42	
15G	silt loam	16-17	Szeto et al. 1988
4E	silt loam	17	
10G	sandy loam	40	Agnihotri et al. 1981
-	sandy loam	7	Miles et al. 1979
-	organic	17	
-	clay loam	120	Freed et al. 1979

Soil Moisture

Soil moisture is very important in the growing of nursery stock. The soil in nursery stock is rarely, if ever, allowed to become completely dry (i.e. equivalent to air-dried soil). Many insecticide labels suggest "watering in" the pesticide for maximum efficacy and persistence.

A. Bioactivity of Chlorpyrifos Affected by Soil Moisture

Harris et al. (1973) found chlorpyrifos to be more effective in moist muck than in air-dried muck. Whitney (1967) found efficacy greater in moist potting soil as compared to air-dried potting soil, but the level of moisture was insignificant (Harris & Svec 1968).

In sandy soils, chlorpyrifos is strongly adsorbed and inactivated by air-dried soils, and is desorbed and thus more effective in moist soils (Harris & Svec 1968, Harris & Hitchon 1970, Harris & Svec 1970, Cheng 1976, Harris 1977, Harris & Turnbull 1977 and Harris & Bowman 1981). Harris (1977) reported that chlorpyrifos toxicity was positively correlated with increasing moisture in mineral soil against first stage crickets. El-Zemaity et al. (1981) found

that higher moisture (20% vs. 80%) resulted in a higher release of toxicant in loamy sand and loamy soil extracts. Conflicting results were reported by Tashiro and Kuhr (1978) who found chlorpyrifos more toxic in sandy loam soil with 8% moisture than in soil with 18% moisture against European chafer grubs.

B. Persistence of Chlorpyrifos Affected by Soil Moisture

Persistence of chlorpyrifos as affected by soil moisture is dependent on soil type. In mineral and Ca clay soils, low amounts of moisture result in chemical dissipation through hydrolysis as opposed to volatilization. As moisture increases, greater loss occurs through volatilization. The level of moisture has little effect on disappearance of chlorpyrifos from organic soils, which produce a slower rate of degradation than mineral soils (Getzin 1981). In direct conflict with Getzin (1981), Miles et al. (1984) state that chemical dissipation was moisture related in muck soil. Higher moisture levels resulted in increased chemical degradation in muck due to maximum microbial activity, and air-dried muck had the highest degradation rate. In silt loam, Getzin (1981b) found that moisture content had no effect on chlorpyrifos persistence.

Miles et al. (1984) found that moisture did not effect the degradation rate of chlorpyrifos in sand, except in the case of air-dried sand which increased degradation. Tashiro and Kuhr (1978) tested the persistence of various chlorpyrifos formulations in sandy loam soil. Moisture levels of 8%, 13% and 18% had little effect on chemical degradation of 22.4EC, .88G (corn cob), or .95G (clay) formulations.

Soil Temperature

A. Bioactivity of Chlorpyrifos Affected by Soil Temperature

Bioactivity of chlorpyrifos to various test insects is affected by varying soil temperatures. Whitney (1967) found chlorpyrifos in potting soil more toxic at 26 C than 18 C, but aging at 50 C decreased bioactivity. In mineral soil, chlorpyrifos was more effective at 32 C than 16 C, showing positive correlation between bioactivity and temperature up to 32 C (Harris 1977 and Harris & Turnbull 1977). El-Zemaity et al. (1981) showed greater toxicant release in loamy sand and loamy soil at 35 C than at 25 C.

B. Persistence of Chlorpyrifos Affected by Soil Temperature

Smith (1966) stated that chlorpyrifos degradation increased with increasing temperature due to a slow hydrolysis of the chemical, and in situations where volatilization has no major role (i.e. in soil), the half-life would be 80-100 days.

In silt loam, chlorpyrifos degrades more rapidly as temperatures increase from 15 C to 35 C (Getzin 1981, 1981b). Miles et al. (1983) looked at the effect of temperature on persistence of chlorpyrifos in both sand and muck. In sand, the degradation rate was similar at 3 C and 15 C while at 28 C the rate was increased. In muck, chemical dissipation increased rapidly with increasing temperatures.

Getzin (1985) studied the persistence of a chlorpyrifos 4E formulation when applied to silt loam fields as incorporated or surface sprays. Treatments applied in the summer degraded faster than the same type of application made in the spring.

Soil pH

Soil pH is an important factor in growing agricultural crops and nursery stock. Most naturally occurring organic or muck soils are acidic in nature, often with pH values of 5.5 or less. The common range for mineral soils is from a little below 5 to just above 7 in humid regions, and from just below 7 to about 9 in arid regions (less than 20 inches of rain per year) (Brady 1974). Whitney (1967) found that pH had no effect on the degradation of chlorpyrifos in soils with pH values of 5.2 to 6.8. However, at higher pH values (> pH 7), degradation increases with increasing pH (Smith 1966 and Racke & Coats 1988).

Chemical Formulation and Application

Formulation and application are important factors in the persistence and bioactivity of chlorpyrifos in soils. A wettable powder formulation is more effective than an EC (Whitney 1967). An EC formulation initially is more effective than a granular formulation, but the granular is more persistent (Whitney 1967) in organic soil (Davis & Kuhr 1976 and Chapman & Chapman 1986) and in silt loam (Getzin 1985). Tashiro and Kuhr (1978), using three different chlorpyrifos formulations (22.4 EC, .88G - corn cob and .95G - clay), found the .88G to be most persistent in sandy loam soil. Getzin (1985) also found that residual activity of surface applications of either a granular or an EC formulation declined faster than an incorporated application of the same formulation.

Chemical Volatility

Volatilization is another possible route of degradation for chlorpyrifos. Whitney (1967) found that vapor losses for Dursban mixed in soil were not significant until temperatures were above 50 C. From dry surfaces of clays and most soils, volatility was not a major dissipation route, however it did account for most of the loss in sand and peat moss (Getzin 1981). Chapman and Chapman (1986) tested the volatility of granular and EC formulations of chlorpyrifos in sand and muck. In sand, volatilization was a major route of dissappearance in both formulations, while in muck it was not.

Chemical Movement - Horizontal and Vertical

A number of studies have determined that chlorpyrifos has little to no capacity for leaching in a variety of soils (Smith 1966, Whitney 1967, Kuhr & Tashiro 1978 and Sharom et al. 1980). There is no significant movement, either horizontally or vertically, of a 10G formulation in sandy loam soil (Agnihotri et al. 1981) or in organic soil (Chapman et al. 1984). Pike and Getzin (1981b), using a 4EC formulation in a peppermint field, found 99% of the residue in the upper 2.5 cm of soil. A 4E formulation applied to turfgrass also showed only small amounts of leaching past the grass-thatch zone (Sears & Chapman 1979), indicting adsorption of the pesticide by the highly organic thatch (Niemczyk et al. 1977).

Microbial Activity

Sethunathan and Yoshida (1972) found that the cell-free extract of a Flavobacterium sp., isolated from soil previously treated with diazinon and raised in mineral media and diazinon, rapidly degraded chlorpyrifos apparently by cleaving its P-O-C bond. However, Hirakoso (1969) states that various bacteria, including Flavobacterium aquatile, did not inactivate Dursban's insecticidal activity against mosquito larvae.

Other reseachers have studied the persistence of chlorpyrifos in autoclaved (sterile) vs. non-sterile soils. All agree that microbial activity plays a minor role in the decomposition rate of chlorpyrifos in various soils (Miles et al. 1979, Getzin 1981b and Chapman 1982). Miles et al. (1983) found that increasing temperature increased degradation due to microbes in sand and muck soils under natural conditions. Increased moisture content in sand and muck under natural conditions also promoted maximum microbial degradation of technical chlorpyrifos (Miles et al. 1984).

Enhanced biodegradation, which occurs when microorganisms adapt to a pesticide and degrade subsequent applications of that pesticide, is well known (Felsot et al. 1981, Forrest et al. 1981, Kaufman & Edwards 1983, Read 1983, Abou-Assaf et al. 1986 and Racke & Coats 1987). However, there is no evidence that chlorpyrifos undergoes enhanced biodegradation after repeated applications (Racke et al. 1988).

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APPENDIX III

PROTOCOL FOR BIOASSAY OF INSECTICIDE TREATED POTTING MEDIA WITH ALATE IFA QUEENS

Introduction: The development of quarantine treatments to prevent artificial spread of imported fire ants (IFA) in nursery stock requires the evaluation of candidate pesticides, dose rates, formulations, etc. The use of a laboratory bioassay procedure for these evaluations provides a rapid and inexpensive means of evaluating the numerous candidates tested each year. Various bioassay procedures have been devised over the years, but the procedure currently used by the USDA, APHIS Imported Fire Ant Laboratory in Gulfport, Mississippi is described herein. This procedure is a slight modification of the test described by Banks et al., 1964 (Jour. Econ. Ent. 57: 298-299).

Collection of test insects: Field collected alate imported fire queens are used as the test insect. IFA colonies are opened with a spade and given a cursory examination for the presence of this life stage. Alate queens are seldom, if ever, present in all IFA colonies in a given area. Some colonies will contain only males, others may have few or no reproductive forms present, others may contain both males and queens, while some will contain only alate queens. Seasonal differences in the abundance of queens is quite evident; in the warmer months of the year 50% or more of the colonies in a given area may contain queens. However, in the cooler months, it is not uncommon to find that less that 10% of the colonies checked will contain an abundance of alate queens. Therefore it is necessary to examine numerous colonies, selecting only those which contain large numbers of alate queens for collection. During winter, ants will often cluster near the surface of the mound facing the sun. Collection during midday on bright, sunny days is highly recommended for winter; whereas the cooler time of day is recommended for hot, dry days of summer. Once a colony (or colonies) has been selected for collection, the entire nest tumulus is shovelled into a 3-5 gallon pail. Pails should be given a liberal dusting with talcum powder on the interior sides to prevent the ants from climbing up the sides of the pail and escaping. Approximately 3-6" head room should be left to prevent escape. An effort should be made to collect as many ants as possible while minimizing the collection of adjacent soil which will contain few ants. Collected colonies are then transported to the laboratory for a 3-5 day acclimation period. The addition of food or water during this short acclimation period is not necessary. Alate queens are collected with forceps after placing a 1-2 liter aliquot of the nest tumulus in a shallow laboratory pan. Again, the use of talc on the sides of containers prevents escape while talced

rubber gloves minimizes the number of stings experienced by the collector. The forceps should be used to grasp the queens by the wings in order to prevent mechanical injury. An experienced collector can collect 2-300 queens per hour. It is generally advisable to place collected queens in a 500 cc beaker or other suitable vessel containing moist paper towels prior to being introduced into the test chamber.

Test chambers: Test chambers are 2.5" x 2.5" plastic flower pots which have been equipped with a labstone bottom. Labstone is generally avalable through dental supply firms such as Patterson Dental Co., 2323 Edenborn Ave., Metairie, Louisiana. The labstone bottom prevents the queens from escaping through the drain holes in the bottom of the pot and also serves as a wick to absorb moisture from an underlying bed of wet peat moss (see Figure 1). Ants are susceptible to dessication so humidity/moisture levels must be optimized. Pots should be soaked in water to moisten the labstone prior to placing potting media in the pots. Plastic petri dishes are inverted over the tops of the pots to prevent escape from the top of the test chambers. Prior to placing queens in the test chamber, 50 cc of treated potting media is placed in the bottom of each pot. Due to possible pesticide contamination, test chambers are discarded after use.

Replicates: Each treatment to be evaluated is subdivided into 4 replicates; with one test chamber per replicate. Five alate queens are then introduced into each replicate.

Test interval: All evaluations are based on a 7 day continuous exposure period. i.e., introduced queens remain in the test chambers for 7 days. At this time the contents of each chamber are expelled into a shallow laboratory pan and closely searched for the presence of live IFA alate queens.

Recording of data: Results of each bioassay are entered on the attached data form. Conclusions regarding efficacy and residual activity of the candidate treatments are drawn from this raw data.

Time estimates: The time required to conduct a bioassay will vary greatly, dependent upon a number of factors:

1.) Availability of queens; supply is primarily influenced by season. More time will be spent collecting queens in winter or during extreme droughts.

2.) Number of treatments to be evaluated; e.g., if only a single treatment and an untreated check are to be evaluated

only 40 queens/month are needed. Conversely, a test involving 4 insecticides at 3 rates of application (12 treatments + untreated check) will require 260 queens monthly for the duration of the test.

Duration of the trial: A successful preplant incorporated treatment for nursery potting soil must provide a minimum of 12-18 months residual activity in order to conform with normal agronomic practices of the nursery industry. Since some plants may be held for longer periods of time prior to sale, a 24-36 month certification period (residual activity) would be ideal. Therefore, most initial or preliminary trials with a given candidate treatment are scheduled for 18 months.

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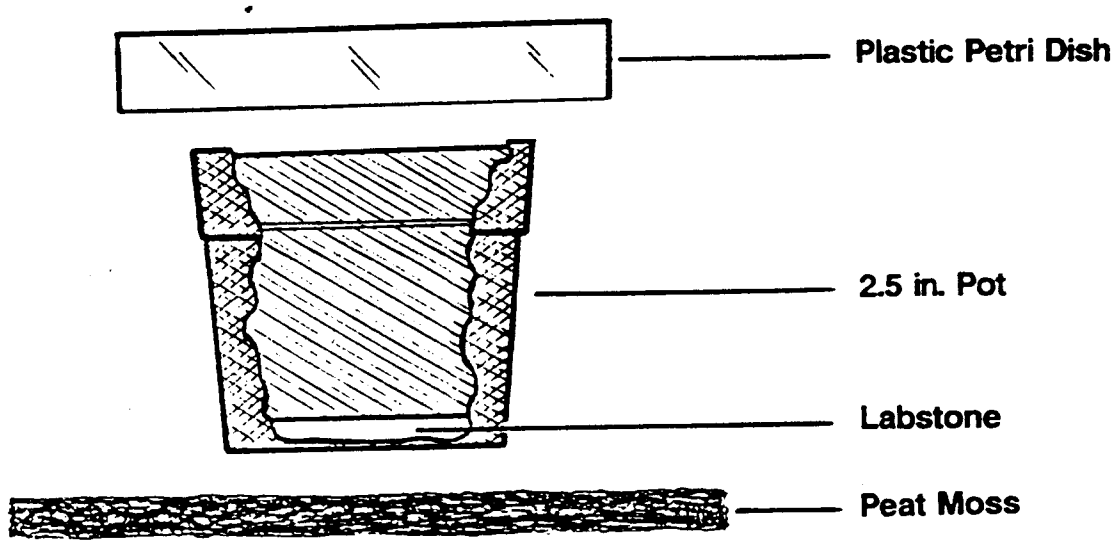

Figure 1. Test Chambers & Peat Moss Used in IFA Alate Queen Bioassays