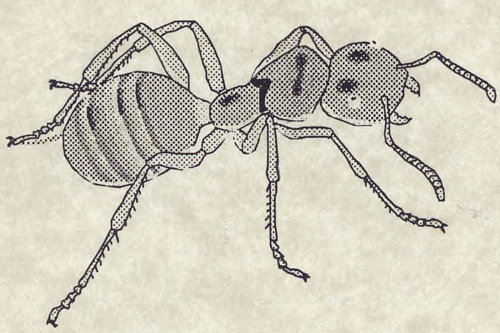
1998
ACCOMPLISHMENT REPORT

GULFPORT PLANT PROTECTION STATION

U.S. DEPARTMENT OF AGRICULTURE

ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE
CENTER FOR PLANT HEALTH SCIENCE AND TECHNOLOGY



3505 25th Ave., Bldg. 16
Gulfport, MS 39501

1998 ACCOMPLISHMENT REPORT

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CENTER FOR PLANT HEALTH SCIENCE AND TECHNOLOGY

PLANT PROTECTION AND QUARANTINE

U.S. DEPARTMENT OF AGRICULTURE

HOMER L. COLLINS	Station Leader
ANNE-MARIE A. CALLCOTT	Entomologist
TIMOTHY C. LOCKLEY	Entomologist
AVEL L. LADNER	Biological Science Technician
LEE R. McANALLY	Agriculturalist
SHANNON O. WADE	Biological Science Technician
PETRA Y. VALENTINE	Secretary

These reports were prepared for the information of the U.S. Department of Agriculture, Animal and Plant Health Inspection Service personnel, and others interested in imported fire ant control or sweet potato weevil programs. 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 herein. Mention of trade names or proprietary products does not constitute an endorsement or recommendation for use by the U.S. Department of Agriculture.

Compiled and Edited by:

Anne-Marie A. Callcott and Homer L. Collins

June 1999

FY 1998 IMPORTED FIRE ANT OBJECTIVES

GULFPORT PLANT PROTECTION STATION
GULFPORT, MS

OBJECTIVE 1: Development and refinement of quarantine treatments for certification of regulated articles.

- Emphasize development of quarantine treatments for containerized nursery stock.
- Evaluate candidate toxicants, formulation, and dose rates for various use patterns.
- Test and evaluate candidate pesticides for use on grass sod and field grown nursery stock.
- Assist in registration of all treatments shown to be effective.

OBJECTIVE 2: Advancement of technology for population suppression and control.

- New product/formulation testing and evaluation.
- Conduct label expansion studies.
- Evaluation of non-chemical biocides including microbial, nematodes, and predaceous arthropods.

OBJECTIVE 3: Preparation/distribution of technical information on control, quarantine procedures, new technology, biological hazards, etc., to state agencies, the media, and the public.

- Provide training to state regulatory agencies and nursery associations.
- Publish and distribute informational aids for state agencies, nursery associations, PPQ personnel, and other interested stakeholders.

OBJECTIVE 4: Determine impact of IFA on biodiversity of various ecosystems.

- Provide technical support and assistance to other research organizations such as ARS, Universities, Mississippi Heritage Foundation, etc. to expedite ecological studies on the impact of IFA on T&E species.

- Conduct bait transects and compare current myrmecofaunal records with similar surveys done in the past to determine impact of IFA on other ant species.

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SWEETPOTATO WEEVILS

PROJECT NO: FA01G025

PROJECT TITLE: Evaluation of Fipronil as a Potting Media Toxicant Under Actual Nursery Conditions

TYPE REPORT: Final

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

COOPERATORS: Flowerwood Nursery (Loxley, AL), Wight Nursery (Cairo, GA), Georgia Dept. of Agric., Windmill Nursery (Folsom, LA) and Louisiana Dept. of Agric.

INTRODUCTION:

Fipronil is a broad spectrum pyrazole insecticide under development by Rhone-Poulenc Ag. Co. The insecticide acts on the central nervous system of the insect and enters by ingestion or contact. Thus, fipronil has shown excellent control of a variety of foliar and soil insects (Colliot et al. 1992).

In 1993, we initiated a trial using fipronil as a preplant incorporated treatment against IFA (FA01G123). In this trial fipronil provided 24 months of excellent control at rates of 100 and 300 ppm. The 25 ppm rate provided 23 months of residual activity and rates of 5 and 10 ppm provided 8 and 13 months of residual activity, respectively.

Products which show promise as potting media treatments for control of IFA are further evaluated by subjecting them to actual nursery conditions. However, due to cost restrictions, plants are not included in the pots with treated media. Colliot et al. (1992) reported no phytotoxicity on any crops tested and we also found (FA01G015) no apparent phytoxicity to the eight species tested.

MATERIALS AND METHODS:

Three nurseries cooperated in this trial: Wight Nursery (Cairo, GA), Windmill Nursery (Folsom, LA), and Flowerwood Nursery (Mobile, AL). IFA lab personnel blended fipronil granular insecticide into media provided by each nursery on site. The media contained all fertilizer and nutrients normally used by the nursery. After blending, treated media was potted up in trade gallon nursery pots and aged on site under normal conditions of irrigation and other cultural practices. Fipronil 0.1G (EXP 60818A) was incorporated at rates of 5, 10, 25 and 50 ppm.

The Flowerwood trial was initiated on April 25, 1995, the Wight trial on August 9, 1995, and the Windmill trial on October 24, 1995.

At monthly intervals, three pots from each treatment rate were collected, composited, and sent to the IFA lab. IFA personnel subjected the treated media to a standard alate female bioassay as described in Appendix I.

RESULTS:

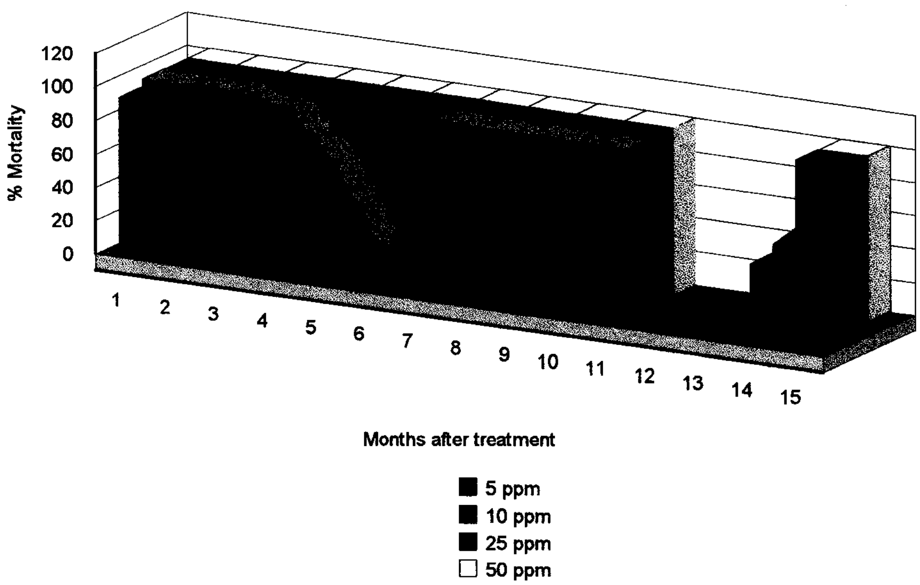
Media was treated at Flowerwood Nursery, Loxley, AL on April 25, 1995. The 10 ppm rate was effective for 4 mths and rates of 25 and 50 ppm provided excellent control through 15 mths PT (Figure 1). However, all test pots were accidently destroyed by nursery workers after 15 mths.

Media was treated at Windmill Nursery, Folsom, LA on October 24, 1995. The 10 ppm rate was effective for 2 mths, the 25 ppm rate for 18 mths, and the 50 ppm rate has been effective for 29 mths (Figure 2). Traditionally, we have utilized a 7-day exposure period for our bioassays. However, at 17 months after treatment, we began determining mortality daily for a 14-day exposure period. If the exposure period is extended to 14 days, the 10 ppm rate consistently provided 100% mortality through 28 months, and the 25 and 50 ppm rates provided 100% mortality through 29 months. This media was no longer collected after the 29 month bioassay.

Media at Wight Nursery in Cairo, GA was treated on August 9, 1995. The 5 ppm rate was effective for 9 mths, and the 10 and 25 rates for 13 mths. Both the 10 and 25 ppm rates showed decreased efficacy at 14 mths after treatment, however, both recovered and maintained ≥90% mortality through 23 and 38 mths, respectively. The 50 ppm rate has been effective for 38 mths. Again, if the exposure period is extended to 14 days (begun at 19 months after treatment), the 5 ppm was effective for 22 months, and the 10, 25 and 50 ppm rates were effective through the 38 month evaluation period. This trial was terminated at this time.

There appears to be some variability at the 5 and 10 ppm rates of application, probably due to non-uniform mixing, but the 25 and 50 ppm rates are providing excellent control at the 7-day exposure period. However, if the exposure period is extended to 14 days, the 10 ppm rate performs as well as the higher rates.

Figure 1. Efficacy of Fipronil Incorporated into Flowerwood Potting Media and Aged Under Actual Nursery Conditions - initiated April 25, 1995



Blanks in chart indicate where samples not collected for the month

Figure 2. Efficacy of Firponil Incorporated into Windmill Nursery Potting Media and Aged Under Actual Nursery Conditions - initiated October 24, 1995

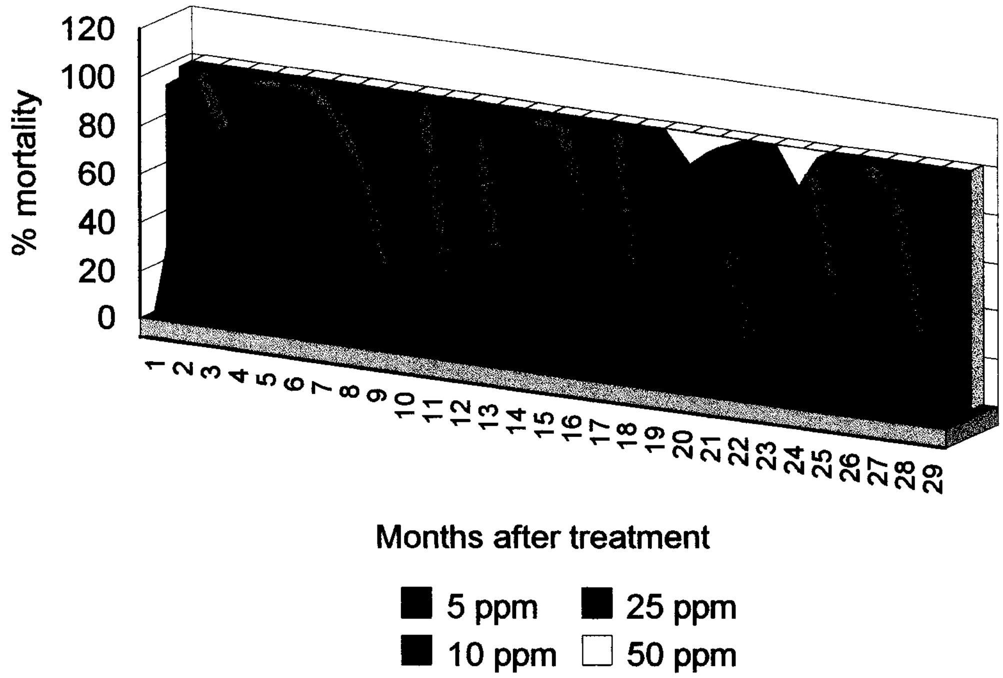
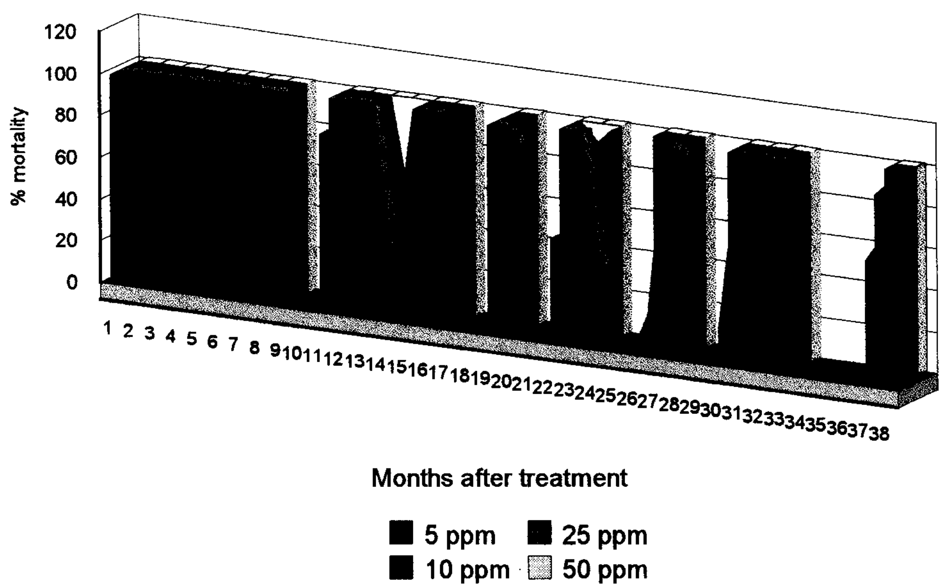


Figure 3. Efficacy of Fipronil Incorporated into Wight Nursery Potting Media and Aged Under Actual Nursery Conditions - initiated August 9, 1995



Blanks in chart indicate where samples not collected for the month

References Cited:

Colliot, F., K.A. Kukorowski, S.W. Hawkins and D.W. Roberts. 1992. Fipronil: a new soil and foliar broad spectrum insecticide. Brighton Crop Protection Conference. pp. 29-34.

PROJECT NO: FA01G076

PROJECT TITLE: Expanded Trials with Fipronil as a Quarantine Treatment for Containerized Nursery Stock - Incorporated and Drench Treatments

TYPE REPORT: Final

LEADER/PARTICIPANTS: Homer Collins, Anne-Marie Callcott and Lee McAnally

COOPERATORS: Turkey Creek Farms, Houston, TX
Tavo Garza, Texas Dept. of Agriculture

INTRODUCTION:

Fipronil (common name) is produced by Rhone-Poulenc Ag. Co. (Research Triangle Park, NC) and is currently marketed in numerous countries for control of many insect pests in a variety of crops. Currently, the only U.S. registration for the product is for mole cricket control in sod. Our laboratory has achieved excellent results with a granular formulation of the product when used as a preplant incorporated treatment (FA01G123, FA01G025). In 1996, we expanded our evaluation of the 0.1% granular formulation of fipronil, and also began preliminary testing of a water dispersable formulation as a drench treatment.

MATERIALS AND METHODS:

Incorporated trial:

Treatments were applied at Turkey Creek Farms, Houston, TX on July 9, 1996. Media and space was provided by the nursery. We traveled to Turkey Creek Farms and incorporated granular fipronil (EXP 60818A) into the nursery media at rates of 10, 15, 20 and 25 ppm. Incorporation was achieved by using a portable cement mixer to blend the toxicant into the media. Media was aged on site, under normal agronomic practices of irrigation, weeding, etc. On a monthly basis, three pots from each treatment group were collected and composited into one sample, and sent to the IFA laboratory. At the IFA lab, the samples were subjected to standard alate female bioassay.

Drench trial:

Treatments were applied at the IFA laboratory on June 25, 1996. Media consisted of the standard IFA media mix (MAFES mix - 3:1:1 pine bark:sphagnum peat moss: sand). One gallon nursery pots were filled with the untreated potting media. Fipronil 80WD (EXP 60720A) was applied at rates of 10 and 20 ppm. The drench solution was applied at a rate of 400 ml of finished solution per container. Containers were placed outdoors under simulated nursery conditions, including a pulsating overhead irrigation system which supplied ca 1-1½" water per week. At monthly intervals, three pots from each treatment were composited and subjected to standard alate female bioassay.

RESULTS:

Incorporated trial:

The 10 ppm rate provided excellent control of IFA through 9 months (Figure 1). There have been three dates of significant decreased efficacy for all rates, once at 12 months after treatment and again at 16 and 17 months after treatment. Because of these decreases we have only achieved 11 months of residual activity with rates of 15, 20 and 25 ppm. However, this data is for 7-day exposure to treated media. If the exposure period is extended to 14 days, all rates have provided 100% mortality of IFA for 21 months. This trial was terminated early due to the test pots being inadvertantly destroyed by nursery workers.

Drench trial:

The 20 ppm rate provided >95% control for 5 months (Figure 2). The lower rate of 10 ppm, did not provide consistent control. The exposure period in this trial was not extended to 14 days. Based on our experience to date with this compound, this extension may have shown consistent 100% mortality throughout the 12 month duration of the trial.

Figure 1. Residual Activity of Fipronil 0.1% Granular Incorporated into Nursery Potting Media at Turkey Creek Farms.

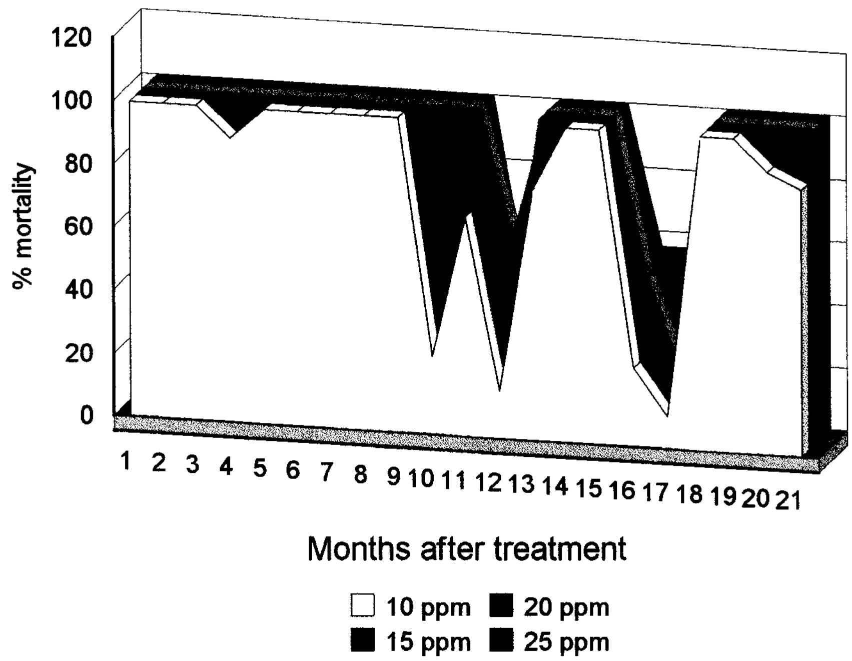
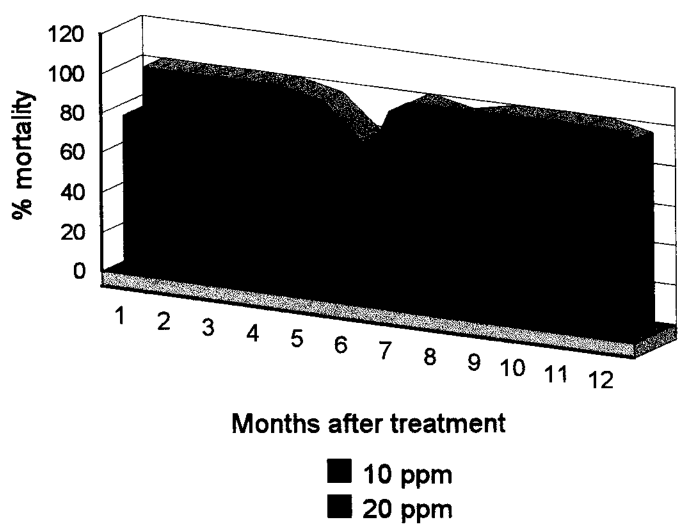


Figure 2. Residual Activity of Fipronil 80WD Applied as a Drench to Containerized Nursery Stock.



PROJECT NO: FA01G037

PROJECT TITLE: Residual Activity of Fipronil 0.1G in Nursery Potting Media

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Lee McAnally

INTRODUCTION:

Fipronil is produced by Rhone-Poulenc Ag. Co. (Research Triangle Park, NC) and is currently marketed in numerous countries for control of many insect pests in a variety of crops. Currently, the only U.S. registration for the product is for mole cricket control in sod. Our laboratory has achieved excellent results with a granular formulation of the product when used as a preplant incorporated treatment (FA01G123, FA01G025). In 1996, we expanded our evaluation of the 0.1% granular formulation of fipronil, and also began preliminary testing of a water dispersable formulation as a drench treatment (FA01G076). In 1997, we again expanded our evaluation to include the incorporation of the granular formulation into several different media and aged at the Gulfport site.

MATERIALS AND METHODS:

The product was blended into nursery potting soil from Windmill Nursery, Folsom, LA (360 pounds per cubic yard) on May 14, 1997. A portable cement mixer (2 cu ft capacity) was used to blend the toxicant into the potting media, and was operated for 15 minutes per batch to insure thorough blending. Treated media was then poured into one-gallon capacity plastic pots and weathered outdoors under simulated nursery conditions. A pulsating overhead irrigation system supplied ca. 1-1½" water per week. At monthly intervals, 3 pots from each treatment were composited and subjected to standard alate queen bioassay.

Theoretical treatment rates used were 10, 15, 20, 25, 40 and 50 ppm. Due to an error in calculating bulk density, the actual initial treatment rates were 7, 10.5, 14, 17.5, 28, and 35 ppm.

Rates of 40 and 50 ppm were mixed and added to the trial in September 1997. An additional trial was set up on August 7, 1997 using Flowerwood media (Flowerwood Nursery, Mobile, AL, 550 pounds per cubic yard), and on August 11, 1997 with our standard potting mix (MAFES mix, 650 pounds per cubic yard).

RESULTS:

Windmill media:

Through 9 months (35 ppm and below) and 5 months (40 and 50 ppm) these trials were evaluated on the 7-day exposure period. Seven days is the traditional exposure period called for in the standard protocol used by this lab. Due to the slower acting nature of some of the newer compounds, it was decided to change the exposure period to 14 days. It was also decided to start checking the bioassays daily to determine the length of exposure required by each rate to reach 100% mortality. Bioassays were checked daily for a 14-day exposure period beginning at 10 and 6 months post-treatment.

Treatment rates below 35 ppm were either poor or erratic at less than 7 days exposure. The 7 and 10.5 ppm rates were dropped from the trial and discarded after 4 months. The higher rates maintained 95-100% efficacy through 15 months for the 35 ppm rate, and 100% efficacy through 11 months for the 40 ppm rate and 19 months for the 50 ppm rate in 7 days or less (Table 1). All rates retained in the trial have reached 100% within 14 days exposure (Table 2).

MAFES media:

All treatment rates except 10 ppm have maintained 95-100% efficacy through 16 months at exposures of 7 days or less (Tables 3 & 4). The 10 ppm rate maintained 95-100% through 14 months. Through 7 months these trials have been evaluated on the 7-day exposure period. Bioassays conducted at the 14-day exposure period began at 8 months post-treatment. Bioassays were also checked daily beginning at 8 months. All rates have maintained 100% efficacy through 16 months at the 14 day exposure.

Flowerwood media:

All treatment rates maintained 100% efficacy through 16 months at exposures of 7 days or less (Tables 5 & 6). Through 7 months these trials have been evaluated on the 7-day exposure period. Bioassays conducted at the 14-day exposure period began at 8 months post-treatment. Bioassays were also checked daily beginning at 8 months.

Table 1. Residual Activity of Fipronil 0.1G in Windmill Media After 7 Days Exposure to Treated Media

Rate of application (ppm)	% mortality of alate females at indicated months post-treatment (7 days exposure)																		
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19
7	30	60	10	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10.5	30	30	5	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
14	65	55	15	25	10	0	20	--	--	--	60	30	50	25	20	*	10	10	40
17.5	95	75	75	20	10	55	55	60	100	35	95	75	60	40	60	*	35	35	70
28	100	100	90	100	50	100	100	90	100	95	100	100	100	100	100	*	40	80	100
35	100	100	100	100	95	100	100	100	100	100	100	100	100	100	100	*	75	80	85
Check	0	25	15	15	0	5	5	15	10	5	10	10	40	15	15	*	5	5	10
40	100	100	100	100	100	100	100	100	100	100	100	*	80	95	100				
50	100	100	100	100	100	100	100	100	100	100	100	*	100	100	100				
Check	0	5	5	15	10	5	10	10	40	15	15	*	5	5	10				

* not evaluted at 7 days due to Hurricane Georges

Table 2. Residual Activity of Fipronil 0.1G in Windmill Media (# days to reach 100% mortality or % mortality at 14 days exposure)

Rate of Application (ppm)	% mortality of alate females at indicated months post-treatment (# of days to reach 100% mortality or % mortality at 14 days exposure)																		
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19
7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
14	--	--	--	--	--	--	--	--	--	--	10d*	12d	9d	13d	11d	**	12d	10d	13d
17.5	--	--	--	--	--	--	--	--	--	9d*	10d	12d	9d	10d	8d	**	12d	10d	11d
28	--	--	--	--	--	--	--	--	--	8d*	5d	12d	7d	7d	7d	**	12d	10d	7d
35	--	--	--	--	--	--	--	--	--	7d*	5d	6d	4d	7d	7d	**	8d	10d	11d
Check	--	--	--	--	--	--	--	--	--	5%*	10%	10%	40%	15%	15%	45%	10%	15%	10%
40	--	--	--	--	--	7d	4d	5d	4d	6d	5d	**	8d	10d	7d				
50	--	--	--	--	--	7d	4d	5d	4d	6d	5d	**	7d	7d	7d				
Check	--	--	--	--	--	5%	10%	10%	40%	15%	15%	45%	10%	15%	10%				

* daily readings of bioassays not performed prior to this evaluation period
** was not read 4-9 days exposure due to Hurricane Georges all were 100% at 10 days

Table 3. Residual Activity of Fipronil 0.1G in MAFES Media After 7 Days Exposure to Treated Media

Rate of Application (ppm)	% mortality of alate females at indicated months post-treatment (7 days exposure)																	
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	(13)*	-14	-15	-16	-17	-18
10	100	100	100	100	100	100	100	100	100	100	100	100	95	100	60	85		
15	95	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
20	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
25	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
40	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
50	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
75	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Check	0	10	10	5	5	15	0	10	15	15	15	15	15	10	15	10		

* readings taken at 6 days exposure due to Hurricane Georges

Table 4. Residual Activity of Fipronil 0.1G in MAFES Media (# days to reach 100% mortality or % mortality at 14 days exposure

Rate of Application (ppm)	% mortality of alate females at indicated months post-treatment (# of days to reach 100% mortality or % mortality at 14 days exposure)																	
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18
10	--	--	--	--	--	--	--	5d*	6d	7d	7d	7d	13d**	7d	9d	11d		
15	--	--	--	--	--	--	--	4d*	6d	7d	7d	6d	6d	7d	7d	7d		
20	--	--	--	--	--	--	--	5d*	6d	4d	5d	5d	5d	6d	7d	7d		
25	--	--	--	--	--	--	--	4d*	6d	4d	6d	5d	5d	6d	7d	7d		
40	--	--	--	--	--	--	--	4d*	6d	3d	4d	5d	4d	6d	7d	7d		
50	--	--	--	--	--	--	--	3d*	3d	3d	5d	5d	4d	6d	4d	4d		
75	--	--	--	--	--	--	--	3d*	3d	3d	4d	4d	3d	3d	4d	4d		
Check	--	--	--	--	--	--	--	15%*	15%	15%	15%	15%	55%	10%	15%	15%		

* daily readings of bioassays not performed prior to this evaluation period
** was not read 7-12 days exposure due to Hurricane Georges

Table 5. Residual Activity of Fipronil 0.1G in Flowerwood Media

Rate of Application (ppm)	% mortality of alate females at indicated months post-treatment (7 days exposure)																	
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18
10	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
15	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
20	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
25	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
40	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
50	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
75	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Check	0	5	0	30	20	0	10	0	25	25	20	5	5	5	0	15		

Table 6. Residual Activity of Fipronil 0.1G in Flowerwood Media

Rate of Application (ppm)	% mortality of alate females at indicated months post-treatment (# days to reach 100% mortality or % mortality at 14 days exposure)																	
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18
10	--	--	--	--	--	--	--	5d*	7d	7d	7d	7d	6d	7d	7d	7d		
15	--	--	--	--	--	--	--	4d*	6d	7d	5d	5d	6d	6d	7d	4d		
20	--	--	--	--	--	--	--	4d*	6d	4d	5d	7d	6d	6d	7d	4d		
25	--	--	--	--	--	--	--	3d*	6d	4d	5d	5d	5d	6d	7d	4d		
40	--	--	--	--	--	--	--	3d*	3d	3d	4d	4d	5d	6d	4d	4d		
50	--	--	--	--	--	--	--	4d*	3d	3d	4d	4d	5d	6d	4d	4d		
75	--	--	--	--	--	--	--	3d*	3d	2d	3d	4d	5d	3d	3d	4d		
Check	--	--	--	--	--	--	--	0%*	25%	25%	20%	5%	5%	5%	0%	15%		

* daily readings of bioassays not performed prior to this evaluation period

PROJECT NO: FA01G067

PROJECT TITLE: Residual Activity of Fipronil 0.05G Incorporated into Potting Media and Applied "Over-the-Top"

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Lee McAnally

INTRODUCTION:

Fipronil is produced by Rhone-Poulenc Ag. Co. (Research Triangle Park, NC) and is currently marketed in numerous countries for control of many insect pests in a variety of crops. Currently, the only U.S. registration for the product is for mole cricket control on golf courses. Our laboratory has achieved excellent results with a 0.1% granular formulation of the product when used as a preplant incorporated treatment for containerized nursery stock (FA01G123, FA01G025). In 1996, we expanded our evaluation of the 0.1% granular formulation of fipronil, and also began preliminary testing of a water dispersable formulation as a drench treatment (FA01G076). In 1997, we again expanded our evaluation of the 0.05% granular formulation to include incorporation and an over-the top application.

MATERIALS AND METHODS:

Incorporated Treatment:

Test procedures used were as follows: The product was blended into nursery potting soil (MAFES mix, 650 pounds per cubic yard) on 2 October 1997. A portable cement mixer (2 cu ft capacity) was used to blend the toxicant into the potting media, and was operated for 15 minutes per batch to insure thorough blending. Treatments rates used were 5, 10, 15, 25, and 50 ppm. Treated media was then poured into one-gallon capacity plastic pots and weathered outdoors under simulated nursery conditions for one month prior to the first bioassay. Subsequent bioassays were conducted at monthly intervals. A pulsating overhead irrigation system supplied ca. 1-1½" water per week. 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 absorbs moisture from an underlying bed of damp peat moss. There were four replicates per treatment in each bioassay. Each pot (replicate) contained 50 cc of treated soil and five alate queens. Initially queen mortality was assessed after seven days of continuous confinement to the treated soil. At 6 months post-treatment, bioiassays were checked daily for 14 days or until 100% mortality was attained. On 23 June 1998 Windmill potting media (Windmill Nursery, Folsom, LA, 200 pounds per cubic yard) at rates of 5, 10, 15, 20, 25, 40, and 50 ppm was added to the trial. On 1 July 1998 Flowerwood potting media (Flowerwood Nursery, Mobile, AL, 390 pounds per cubic yard) was also added at the same rates as the Windmill media. Both of these later trials were bioassayed in the same manner described above and were read daily for 14 days or until 100% mortality.

Over-the-top Treatment

One gal. nursery pots were filled with media and placed on a masonry brick in a 12" x 18" x 5" plastic pan. The sides of the pan were talced and ca. 1" of water was added to prevent escape. Five replicates per treatment rate were set up. Field collected colonies were separated from their nest tumulus by the floatation method (Banks et al. 1981) and 50 cc of workers and brood were added to each media-filled pot. The fragmented colonies were allowed to acclimate 3-5 days before treatment. Fipronil 0.05G was applied by sprinkling over the surface of the soil. Each container was then watered in with approximately 400 ml of water. Rates of 0.012, 0.12, and 1.2 grams per pot were used in the first trial. (approximately 0.01 ppm, 0.1 ppm, and 1 ppm). A second trial was initiated using rates of 12, 18, and 25 grams per pot (10 ppm, 15 ppm, and 25 ppm). Containers were watered as needed for the duration of the 7 day trial. Ants were inspected daily for mortality and colonies were considered dead when less than 20 workers were present.

RESULTS:

Incorporated Treatment:

MAFES Media:

The 25, and 50 ppm rates provided 95-100% efficacy (at 7 days exposure) for 15 months, and the 10 ppm rate through 12 months (Table 1). The 5 ppm rate was somewhat erratic through six months, then showed a decline in efficacy. However the 5 & 10 ppm rate were still attaining 100% mortality at 8-11 days exposure (Table 2). The 15 ppm rate showed some unexplained drops in efficacy at 1 and 4 months post-treatment, but otherwise has maintained 100% efficacy through 15 months.

Windmill Media:

At six months post-treatment (7 day exposure period) the 5, 10, 15 and 20 ppm rates are showing poor results, the 25 and 40 ppm rates appear to be starting to decline while the 50 ppm rate remains at 100% (Table 3). All rates are attaining 100% mortality at 14 days or less (Table 4).

Flowerwood Media:

At six months post-treatment, all rates except the 5 and 10 ppm rate showed 100% mortality at less than 7 days (Table 5). The 10 ppm rate was at 90-100%, while the 5 ppm rate dropped to 50-55% at 7 days exposure. All rates were at 100% at 11 days exposure or less (Table 6).

Over-the-top Treatment:

In the first trial, no treatment rate provided more than 30% efficacy. In the second trial, no treatment rate provided more than 75% efficacy.

References Cited:

Banks, W.A., C.S. Lofgren, D.P. Jouvenaz, C.E. Stringer, P.M. Bishop, D. F. Williams, D.P. Wojcik and B.M. Glancey. 1981. Techniques for collecting, rearing, and handling imported fire ants. USDA, ARS, Science & Education Administration, Advances in Agricultural Technology, Southern Series, No. 21.

Table 1. Residual Activity of Fipronil 0.05G in MAFES Media (7 days exposure)

Rate of Application (ppm)	% mortality of alate females at indicated months post-treatment														
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15
5	100	30	100	100	75	95	60	60	25	20	60	100	100	50	90
10	100	100	100	95	100	100	100	100	100	100	100	100	80	100	95
15	55	100	100	50	100	100	100	100	100	100	100	100	100	100	100
25	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
50	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Check	5	0	0	10	0	20	10	15	15	0	15	35	15	10	15

Table 2. Residual Activity of Fipronil 0.05G in MAFES Media (# days to reach 100% mortality or %mortality at 14 days exposure)

Rate of Application (ppm)	% mortality of alate females at indicated months post-treatment (# of days to reach 100% mortality or % mortality at 14 days exposure)														
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15
5	--	--	--	--	--	8d*	10d	10d	10d	11d	8d	5d	7d	10d	11d
10	--	--	--	--	--	7d*	5d	7d	7d	6d	5d	5d	9d	6d	11d
15	--	--	--	--	--	5d*	5d	5d	7d	7d	5d	4d	6d	6d	6d
25	--	--	--	--	--	5d*	4d	3d	5d	5d	5d	3d	6d	6d	5d
50	--	--	--	--	--	5d*	4d	3d	4d	4d	5d	5d	6d	6d	4d
Check	--	--	--	--	--	20%*	10%	20%	20%	5%	15%	35%	25%	25%	15%

* daily readings of bioassays and exposure beyond 7 days began

Table 3. Residual Activity of Fipronil 0.05G in Windmill Media (7 days exposure)

Rate of Application (ppm)	% mortality of alate females at indicated months post-treatment											
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12
5	70	20	40	35	0	5						
10	95	80	65	55	20	10						
15	100	100	95	90	75	45						
20	100	100	100	100	85	95						
25	100	100	100	100	100	75						
40	100	100	100	100	100	75						
50	100	100	100	100	100	100						
Check	60	20	50	35	20	25						

Table 4. Residual Activity of Fipronil 0.05G in Windmill Media (# days to reach 100% mortality or %mortality at 14 days exposure)

Rate of Application (ppm)	% mortality of alate females at indicated months post-treatment (# of days to reach 100% mortality or % mortality at 14 days exposure)											
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12
5	10d	11d	13d	10d	14d	14d						
10	8d	8d	9d	10d	11d	14d						
15	7d	6d	8d	10d	9d	9d						
20	6d	6d	7d	5d	8d	9d						
25	6d	5d	7d	5d	7d	9d						
40	6d	5d	7d	4d	7d	9d						
50	6d	5d	7d	4d	4d	7d						
Check	60%	20%	50%	40%	30%	25%						

Table 5. Residual Activity of Fipronil 0.05G in Flowerwood media (7 days exposure)

Rate of Application (ppm)	% mortality of alate females at indicated months post-treatment											
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12
5	75	100	100	100	50	55						
10	100	100	100	100	90	95						
15	100	100	100	100	100	100						
20	100	100	100	100	100	100						
25	100	100	100	100	100	100						
40	100	100	100	100	100	100						
50	100	100	100	100	100	100						
Check	0	0	5	5	20	20						

Table 6. Residual Activity of Fipronil 0.05G in Flowerwood media (# days to reach 100% mortality or %mortality at 14 days exposure)

Rate of Application (ppm)	% mortality of alate females at indicated months post-treatment (# of days to reach 100% mortality or % mortality at 14 days exposure)											
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12
5	8d	7d	5d	6d	10d	11d						
10	6d	5d	5d	6d	8d	11d						
15	6d	5d	5d	6d	6d	6d						
20	4d	5d	3d	6d	6d	7d						
25	4d	5d	5d	6d	6d	5d						
40	4d	5d	3d	6d	6d	6d						
50	4d	5d	3d	3d	6d	4d						
Check	0%	0%	5%	5%	25%	20%						

PROJECT NO: FA01G097

PROJECT TITLE: Efficacy of Chlorfenapyr as an Imported Fire Ant Quarantine Treatment

PROJECT TYPE: Interim

PROJECT LEADER/PARTICIPANT(s): Anne-Marie Callcott, Lee McAnally, Charlene Russell

INTRODUCTION:

The Federal Imported Fire Ant Quarantine Program (7CFR §301.81) states that all regulated products (nursery stock) leaving the quarantined area must be treated in a prescribed manner. Currently, treatments for containerized nursery stock include the use of granular insecticides incorporated into potting media or liquid drenches applied prior to shipping. Nursery stock treated with incorporated insecticides (bifenthrin or tefluthrin) may be certified for 6 months to 2 years, depending on the rate incorporated into the media (10-25 ppm based on bulk density of media). This allows the grower to use less insecticide on nursery stock that will be held on site for a short period of time, and more on those that need a longer growing period prior to selling. Drench treatments (chlorpyrifos, diazinon or bifenthrin) are generally used just prior to shipping, and those currently approved for use in the quarantine have certification periods of 10 days to 6 months. Since drench treatments are used just prior to shipping, long residual activity is not a requirement.

Chlorfenapyr is an experimental insecticide-miticide under development by American Cyanamid (Princeton, NJ). The product is active against many pests, and works as a broad spectrum contact and stomach poison. We tested a liquid formulation to determine whether the product showed significant activity against IFA in containerized nursery stock. In August 1997, we began testing a 0.5G granular formulation as an incorporated treatment.

MATERIALS AND METHODS:

Drench Trials

A 2SC liquid formulation of chlorfenapyr was tested as a drench application to containerized nursery pots. Trade gallon nursery pots were filled with standard potting media (3:1:1 sphagnum peatmoss: pine bark: sand - bulk density = 650 lb/cu yd). The filled pots were left for 3-5 days under simulated nursery conditions (ca. 1-1½" irrigation per week) to allow the media to become fully saturated before treating. Individual pots were then drenched at rates of 25, 50, 100 and 200 ppm. Each pot (ca. 900 g media) was drenched with a volume of solution equal to 1/5 the volume of the pot (i.e. 400 ml solution). Two types of bioassays were performed at 72 hours after treatment, and then monthly thereafter.

Whole colony bioassay - The first bioassay evaluated chlorfenapyr in its ability to prevent infestation or eliminate whole colonies in nursery pots using field collected RIFA colonies. One container from each treatment series was placed in the center of a 2' x 8' test arena. Sides of the test arena were talced to prevent ants from climbing out and escaping. A field collected colony complete with associated soil and nest tumulus was then placed in the arena. Overhead incandescent bulbs slowly desiccated the nest so that the ants were encouraged to migrate to the more moist container. Pots were observed at 24 hour intervals for at least 21 days after introduction, and rate of infestation and percent mortality recorded.

Standard alate female bioassay - The second bioassay performed on the drench treated media was a standard alate female bioassay. Test chambers are 2.5" x 2.5" plastic flower pots which have been equipped with a labstone bottom (Patterson Dental Co., Metairie, LA). 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. 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. 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. All evaluations were based on at least 14 days continuous exposure period, i.e., introduced queens remain in the test chambers for at least 14 days. At specified intervals, the contents of each chamber were expelled into a shallow laboratory pan and closely searched for the presence of live IFA alate queens. Data was recorded as percent mortality.

Incorporated treatment - The granular 0.5% formulation was blended into our standard potting mix (MAFES mix, 650 pounds per cubic yard). A portable cement mixer (2 cu ft capacity) was used to blend the toxicant into the potting media, and was operated for 15 minutes per batch to insure thorough blending. Treated media was then poured into one-gallon capacity plastic pots and weathered outdoors under simulated nursery conditions. A pulsating overhead irrigation system supplied ca. 1-1½" water per week. At monthly intervals, 3 pots from each treatment were composited and subjected to alate queen bioassay described above for a 7 day exposure period.

RESULTS:

Drench trials

Whole colony bioassay - RIFA did move into pots containing potting media treated with chlorfenapyr (drench), but the ants did not behave normally; they tended to move into the edges of the pot (between the media and the pot) and under the pot, or in the bottom 1" layer of media, and did not actively "work up" the media. The 200 ppm rate provided 100% colony mortality within 7-14 days of moving into the treated media through the 3 month assessment, and within 14-21 days through the 5 month assessment (Tables 1 & 2). The 100 ppm rate provided 100% mortality within 14-21 days through the 3 month assessment. The 50 ppm rate provided 100% mortality through 2 months, but required a longer period of time to cause mortality (up to 30 days). The 25 ppm rate was very slow to kill whole colonies (always >21 days). At 6 months after treatment, all rates required >21 days to achieve 100% mortality. At 7-12 months after treatment the 25 ppm rate still required >21 days to kill the whole colony, while the other rates became somewhat variable in the length of time required to kill the whole colony.

Standard alate female bioassay - We have achieved similar results with this bioassay. No bioassay was performed at 3 months after treatment, and the 4 month test was inadvertently destroyed after 7 days. Through 7 months after treatment, the 200 ppm rate provided 100% alate female mortality within 7-12 days, while the 50 and 100 ppm rates required up to 14 days to achieve 100% mortality (Table 3). The 25 ppm rate was not consistent. The alate female bioassays were terminated at 7 months since drench treatments do not need to be long term.

Incorporated treatment - Traditionally, we have utilized a 7-day exposure period for our bioassays. However at 8 months after treatment, we began determining mortality daily for a 14-day exposure period. Rates of 25 and 50 ppm have not provided adequate control of IFA under the 7-day exposure testing standard (Table 4). The 75 and 100 ppm rates have provided >85% efficacy through 16 months, and the 200 ppm rate has been 100% effective through 16 months. When the exposure period is extended to 14 days all rates have consistently provided 100% mortality through 16 months.

CONCLUSIONS:

Drench Trials

The high rates of 100 and 200 ppm, showed fairly fast and consistent results through 3 months, which is acceptable for quarantine drench treatments. Drench treatments have a distinct disadvantage over granular incorporated treatments in that thorough saturation is not always achieved. This was particularly evident in the whole colony bioassays where colonies survived in the bottom layer of media in the pot, indicating that the active ingredient remained in the top layers of the media, not penetrating the entire pot. This is a definite problem with products whose active ingredient is fairly immobile in potting media. A granular formulation of chlorfenapyr may alleviate this problem since granular products are blended into the media prior to potting up, ensuring a fairly even distribution of active ingredient.

Incorporated trials

Incorporation at rates of 75-200 ppm look promising thus far (based on 7-day exposure results). These rates are much higher than those of insecticides currently approved for use in the IFA quarantine. However, actual cost of material, not the dose rate required, will be the deciding factor for the end-user (nurserymen).

Table 1. Efficacy of chlorfenapyr as a drench against whole RIFA colonies.

Rate	% population mortality at indicated time after treatment and days after colony introduction																				
	3 days						1 mth					3 mth					6 mth				
	1d	3	7	14	21	30	1	3	7	14	21	1	3	7	14	21	1	3	7	14	21
25	0	0	10	10	50	100	0	0	75	75	95	0	0	0	50	75	0	0	0	5	5
50	0	0	20	95	99	100	0	0	75	95	100	0	25	50	75	95	0	0	0	25	25
100	0	50	75	99	100	--	0	10	99	100	--	0	25	75	100	--	0	0	5	75	90
200	25	95	100	--	--	--	0	20	99	100	--	0	50	75	100	--	0	0	50	95	95

Table 1. Cont.

Rate	% population mortality at indicated time after treatment and days after colony introduction									
	9 mth					12 mth				
	1d	3	7	14	21	1	3	7	14	21
25	0	0	10	95	95	--	0	52	75	90
50	0	10	50	99	100	--	25	90	100	--
100	0	50	75	99	100	--	50	99	100	--
200	0	50	90	99	100	--	100	--	--	--

Table 2. Efficacy of chlorfenapyr as a drench against whole RIFA colonies - summary.

Rate of Application	Days required to obtain 100% mortality at indicated months PT												
	(3 days)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
25 ppm	30	+28	22	+21	+21	+21	+21	+21	+21	+21	+21	21	+21
50 ppm	30	22	14	+21	+21	+21	+21	14	21	21	14	14	14
100 ppm	21	14	14	14	+21	14	+21	14	21	21	14	7	14
200 ppm	7	14	7	14	21	14	+21	+21	10	21	14	7	7

Table 3. Efficacy of chlorfenapyr as a drench against RIFA alate females.

Rate of Application	Days required to obtain 100% mortality at indicated months PT							
	(3 days)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
25 ppm	9	+21	14	--	+7	14	10	12
50 ppm	7	7	7	--	+7	7	14	7
100 ppm	7	7	14	--	7	7	7	7
200 ppm	7	12	7	--	7	7	7	7

Table 4. Efficacy of chlorfenapyr as an incorporated treatment against RIFA alate females (7 day exposure).

Rate of Application	Percent mortality at indicated months post-treatment											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
25 PPM	20	25	40	15	10	20	10	75	65	75	20	35
50 PPM	85	40	50	100	100	95	95	95	100	95	50	50
75 PPM	95	95	100	100	100	95	100	100	100	100	85	100
100 PPM	100	90	100	100	100	100	100	100	100	100	100	100
200 PPM	100	100	100	100	100	100	100	100	100	100	100	100
CHECK	5	20	5	10	0	10	0	20	15	15	15	0

Table 4. Cont.

Rate of Application	Percent mortality at indicated months post-treatment											
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
25 PPM	20	40	50	25								
50 PPM	100	95	100	90								
75 PPM	100	100	100	85								
100 PPM	100	100	100	100								
200 PPM	100	100	100	100								
CHECK	15	35	35	10								

PROJECT NO: FA01G086

PROJECT TITLE: Evaluation of Deltamethrin as a Potting Media Toxicant, 1996

TYPE REPORT: Final

LEADER/PARTICIPANT(s): Lee McAnally

INTRODUCTION:

An ongoing screening program to evaluate insecticides for use as quarantine treatments for nursery potting media has been conducted by the Gulfport Plant Protection Station since 1974. This trial tested a 0.1% granular formulation of deltamethrin produced by AgrEvo USA.

MATERIALS AND METHODS:

The product was blended into nursery potting soil (MAFES mix, 750 pounds per cubic yard). A portable cement mixer (2 cu ft capacity) was used to blend the toxicant into the potting media, and was operated for 15 minutes per batch to insure thorough blending. Treated media was then poured into one-gallon capacity plastic pots and weathered outdoors under simulated nursery conditions. Treatment rates used were 10, 20, 30, and 40 ppm.

RESULTS:

Results are summarized in Table 1. The 10 ppm rate maintained 80-100% mortality through 11 months but dropped below 50% at 12 months and was dropped from the study after remaining below 50% for 4 months. The 20 & 30 ppm rates maintained 85-100% mortality through 13 months. Both rates became extremely erratic beyond 13 months. The 40 ppm rate maintained 90-100% mortality through 14 months, then it too became extremely erratic.

Table 1. Residual Activity of Deltamethrin Granule.

Rate of Application (ppm)	Mean % mortality to alate females at indicated months PT											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
10	95	100	95	80	95	85	100	100	100	90	85	25
20	100	100	100	100	100	100	100	100	100	100	100	85
30	100	100	100	100	100	100	95	100	100	100	100	85
40	100	100	100	100	100	100	100	100	100	100	100	100
Check	10	15	10	0	5	0	0	0	0	5	5	10

Table 1. Residual Activity of Deltamethrin Granule (Cont.).

Rate of Application (ppm)	Mean % mortality to alate females at indicated months PT											
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
10	40	35	20	--	--	--	--	--	--	--	--	--
20	95	45	80	75	85	55	75	95	100	100	55	70
30	100	60	35	70	95	60	90	100	90	95	30	45
40	100	90	45	50	100	50	100	100	100	80	15	35
Check	15	10	5	0	0	0	20	0	10	10	15	15

PROJECT NO: FA01G017

PROJECT TITLE: Expanded Trials with Spin Out® Technology Used in Combination with Bifenthrin Insecticide to Prevent Imported Fire Ant Infestations in Containerized Nursery Stock, 1997

TYPE REPORT: Interim

PROJECT LEADER/PARTICIPANTS: Anne-Marie Callcott, Homer Collins, Lee McAnally and Shannon Wade

COOPERATORS: Lerio Corporation, Mobile, AL (Mark Christian)
Griffin Corporation, Valdosta, GA (Mark Crawford)
Turkey Creek Nursery, Houston, TX (Tom Henry)
Windmill Nursery, Folsom, LA (Dennis McCloskey)
Flowerwood Nursery, Loxley, AL (Jim Berry)
Wight Nursery, Cairo, GA (Jerry Lee)
Grass Roots Nursery, Leesburg, FL

INTRODUCTION:

Spin Out root growth regulator technology was developed by Griffin Corporation to enhance the development of dense, compact root growth. The active ingredient is 26% copper hydroxide contained in a latex matrix which is sprayed onto the interior of plastic nursery pots. In 1995 Griffin supplied this laboratory with Spin Out treated pots that also contained various concentrations of bifenthrin (0.25% AI, 0.5% AI, and 1.0% AI) or tefluthrin (0.1%). Pots were filled with potting media and then placed in a simulated can yard. Laboratory bioassays were then conducted on a monthly basis by allowing red imported fire ant (RIFA) colonies free choice to move into either a Spin Out treated pot or an untreated control pot. The Spin Out treated pots containing bifenthrin prevented fire ant colonies from invading the test pots for at least 24 months, (24 for tefluthrin). These results warranted an expanded study to include actual rather than simulated nursery conditions, various size containers, different potting medias, and varying climatic conditions.

MATERIALS AND METHODS:

Griffin Corporation supplied Spin Out 300 (a different formulation than used in the preliminary trial mentioned above) containing bifenthrin (0.25%, 0.5%, and 1.0% AI by weight) for treatment of a sufficient number of pots to conduct a three year study. Lerio Corporation provided the containers (one and three gallon sizes) used in the expanded study and applied the Spin Out 300/bifenthrin to the pots using automated equipment. After treatment, Lerio delivered treated pots to the Gulfport Plant Protection Station for distribution to the nurseries. Lerio also transported test pots from each nursery to this laboratory at each sampling interval. Griffin and Lerio purchased all plants for the test. Nurseries listed above provided space, irrigation, fertilization, and weed control for the test pots. The Gulfport Plant Protection Station color coded the pots with paint on the exterior of the pots to designate the different bifenthrin concentrations. Gulfport personnel delivered treated pots to the participating nurseries, purchased potting media from each nursery, filled the pots and placed the test pots in a designated test area (or bed). All pots were planted with slow growing, relatively pest free woody ornamentals such as Japanese boxwood. Each individual nursery determined the best species of plants to use at that particular location.

Nursery	Location	Media Type	1-gal Plants	3-gal Plants
Turkey Creek	Houston, TX	70% bark 8% sand 8% hadite 14% peat	*Buxus microphylla* 'Winter Gem'	*Buxus microphylla* 'Winter Gem'
Grass Roots	Leesburg, FL	60% pine bark 40% local peat	*Juniperus parsonnii*	*Ilex crenata*
Flowerwood	Loxley, AL	65% new bark 35% aged bark	*Ilex crenata*	*Ilex crenata*
Windmill	Folsom, LA	100% pine bark	*Ilex crenata*	*Ilex crenata*
Wight	Cairo, GA	80% bark 20% sand	*Juniperus horizontalis*	*Juniperus horizontalis*

The Gulfport Plant Protection Station was responsible for determining the efficacy of the Spin Out technology by conducting bioassays in the laboratory.

Bioassay - prevention of whole colony infestation: All treatments were tested against field collected RIFA colonies. Three containers (replicates) from each treatment were bioassayed at 1 and 3 months after the pots were filled with media, then quarterly after that. Plant tops were removed prior to bioassaying as needed. Each replicate was bioassayed by placing the treated container at one end of a 2' x 8' test arena (Fig. 1). Sides of the test arena were coated with talcum powder or Fluon® to prevent the ants from climbing out and escaping. An untreated check container filled with media was placed at the distal end of the test arena. A field collected RIFA colony complete with associated soil and nest tumulus was then placed in the center of the arena. Overhead incandescent light bulbs slowly desiccated the nest tumulus so the ants were encouraged to migrate to the more moist and hospitable containers. Therefore, the RIFA colony was provided a free choice to invade either a Spin Out treated pot or the untreated check pot. Pots were observed at 24 hour intervals for 7 days after introduction, and the estimated number of workers successfully invading each pot recorded.

Bioassay - partitioning of bifenthrin between Spin Out coating and potting media: A second bioassay was conducted at 6 months after treatment to determine partitioning of bifenthrin between the Spin Out/bifenthrin coating and the potting media. Media from each nursery was transported back to the Gulfport lab, placed in untreated pots (1 and 3 gallon), and placed in our simulated nursery for aging. At the prescribed interval, media from each treated pot was swapped with media from an untreated but aged pot of the corresponding size; i.e. the treated pot now contained "clean" media and the untreated pot now contained "treated" media. Bioassays were performed as described above using the newly paired pots.

Bioassay - invasion by "newly mated" queens: To determine whether Spin Out/bifenthrin treated pots could prevent a newly mated queen from founding an incipient colony, a trial simulating a newly mated queen flying into the top of a pot was initiated at 1, 3, and 9 months. The one-gallon treated nursery pots from Wight Nursery only were used in this trial. Due to the difficulty in collecting newly mated females, we collected fertile queens from polygynous colonies in Hancock County, MS, along with workers from the same colonies. Since mature, mated queens do not have a reserve of wing muscle for a nutrient source, workers to tend her in our trial were necessary. Two fertile females, along with approximately 100 workers, were introduced into each test nursery pot. Untreated check pots filled with MAFES media were used as controls. There were three replicates per treatment. Pots were watered as needed. Meal worm larvae or peanut butter was placed near the drain holes of each pot twice a week. Treatments were observed daily for the first week and then twice weekly thereafter for a total of 3 months. Observations included noting feeding habits, worker activity, mortality, movement out of the pot, etc.

RESULTS:

Bioassay - prevention of whole colony infestation: Results through 9 months showed some movement of whole colonies (workers and brood) into pots treated with 0.25 and 0.5% bifenthrin. A few workers (<100) had moved into some of the 3 gallon pots treated at 1.0%, but no whole colonies had moved into these pots. No workers moved into any of the 1.0% 1 gallon pots through 9 months. The pots used in this trial were treated by the companies (Griffin and Lerio) and the amount of latex coating applied to the pots was about 1/3 the amount applied to the pots we began testing in 1995. This may account for the differences in efficacy seen between the two trials.

After a meeting with Lerio and Griffin to discuss results and "next steps", it was decided to drop the lower two rates from the trial, and only continue evaluating the 1.0% bifenthrin rate from all sites except Turkey Creek (dropped due to delivery logistics). Efficacy continued to be erratic. Two and one 1 gallon pots were infested with workers only at 12 and 15 months, respectively, while only one 3 gallon pot was infested at 12 months (none infested at 15 months). The 3 gallon pot was infested by a whole colony that entered the pot by climbing a trailing branch of the juniper plant in the pot and avoided having to enter through a "treated" drain hole. This problem was eliminated in subsequent tests by trimming the trailing limbs prior to testing. At 18 months, two more nurseries were dropped due to logistics, leaving two nurseries with the test pots to be evaluated (Flowerwood and Windmill). The 1.0% rates continues erratic through 24 months.

Bioassay - partitioning of bifenthrin between Spin Out coating and potting media: Because ants readily moved into pots treated with the two lower rates of bifenthrin, only the 1.0% bifenthrin treated pots were used in this trial. At 6 months after potting up, results were very inconsistent. While the ants did not immediately move into either pot and many died (probably due to contact with the insecticide), eventually (after 7 days) the ants moved into either pot at about the same rate, showing no preference for either the treated pot with "clean" media or the untreated pot with "treated" media. This indicates that some of the bifenthrin is moving into the media from the latex coating.

Bioassay - invasion by "newly mated" queens: Trials were performed at 1 and 3 months after potting up. No polygynous queens or workers survived in the treated pots (all rates), while queens and workers survived in the untreated check pots.

CONCLUSIONS:

At this time, it is evident that with the Spin Out 300 formulation the thinner coating of latex and therefore less insecticide applied to the pots has affected the efficacy of the treatment. It also appears that the larger pots (3-gallon) with proportionally larger drain holes may require more insecticide per surface area to adequately protect this vulnerable spot. The 0.25 and 0.50% rates were dropped from the trial 9 months after treatment due to unacceptable efficacy. Additional trials were initiated in the spring of 1998 utilizing a greater amount of insecticide in the latex coating (see FA01G018).

Figure 1. Diagram of test arena.

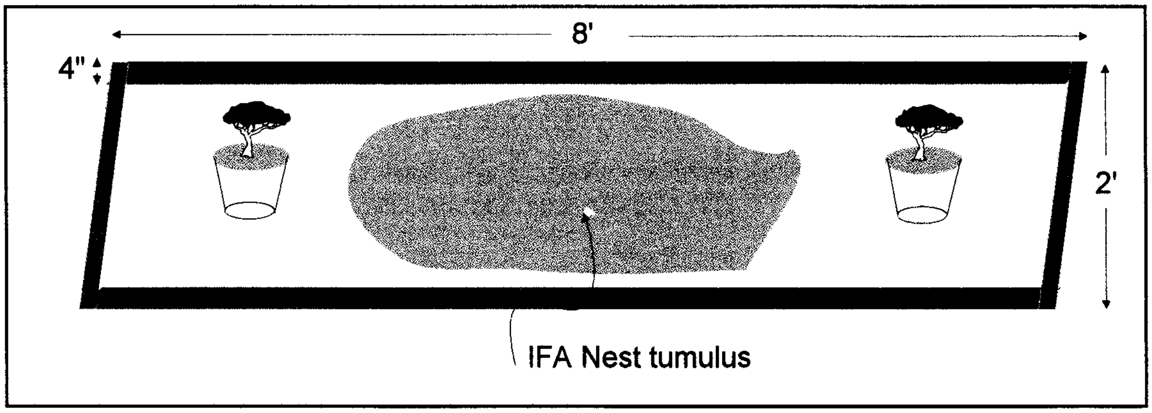
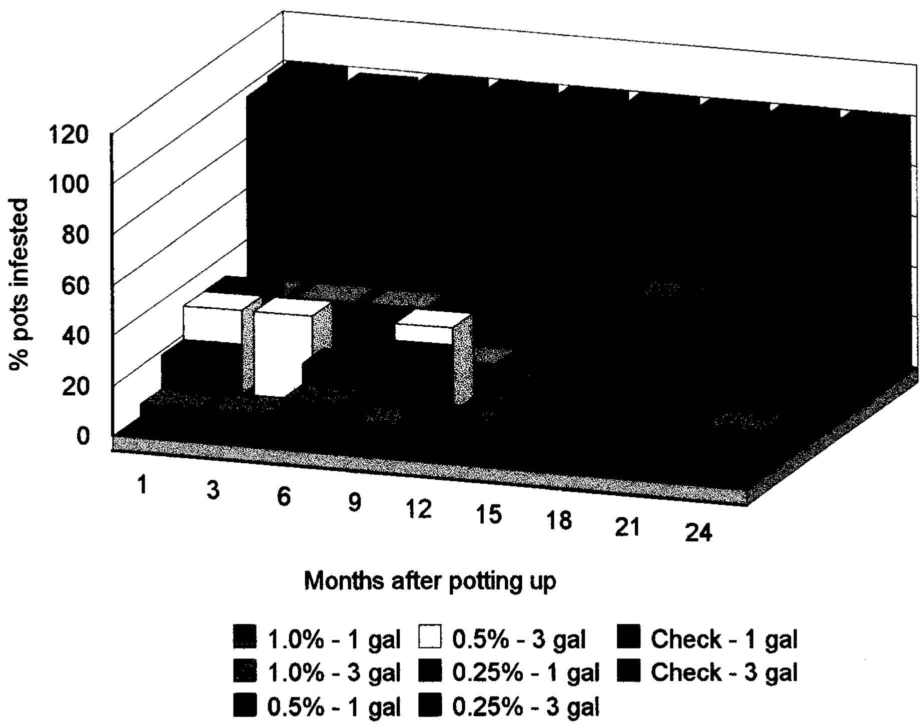


Figure 2. Percent of Spin Out 300 + Bifenthrin Treated pots Infested with Imported Fire Ants. Multi-State Trial - initiated March 1997.



PROJECT NO: FA01G018

PROJECT TITLE: 1998 Expanded Trials with Spin Out® Technology Used in Combination with Bifenthrin Insecticide to Prevent Imported Fire Ant Infestations in Containerized Nursery Stock

TYPE REPORT: Interim

PROJECT LEADER/PARTICIPANTS: Homer Collins, Anne-Marie Callcott, Lee McAnally, Avel Ladner and Shannon Wade

COOPERATORS: Lerio Corporation, Mobile, AL (Mark Christian and Andy Zimlich)
Griffin Corporation, Valdosta, GA (Mark Crawford)
Windmill Nursery, Folsom, LA (Dennis McCloskey)
Flowerwood Nursery, Loxley, AL (Jim Berry)
Rocky Creek Nursery, Lucedale, MS (Lee Howell)

INTRODUCTION:

Spin Out root growth regulator technology was developed by Griffin Corporation to enhance the development of dense, compact root growth. The active ingredient in the current formulation is 7% copper hydroxide contained in a latex matrix which is sprayed onto the interior of plastic nursery pots. In 1995 Griffin supplied this laboratory with Spin Out treated pots that also contained various concentrations of bifenthrin (0.25, 0.5, and 1.0% AI). Pots were filled with potting media and then placed in a simulated can yard. Laboratory bioassays were then conducted on a monthly basis by allowing red imported fire ant (RIFA) colonies free choice to move into either a Spin Out treated pot or an untreated control pot. The Spin Out treated pots containing bifenthrin had prevented fire ant colonies from invading the test pots for 24 months (trial duration). These results warranted an expanded study to include actual rather than simulated nursery conditions, various size containers, different potting medias, and varying climatic conditions. A trial initiated in 1997 at 5 nurseries in the Southeast used Spin Out 300 combined with various concentrations of bifenthrin (0.25, 0.5 and 1.0% AI). The Spin Out 300 was applied to 1 and 3 gallon nursery pots, however the rate of application of bulk material was 3X less than in the original 1995 trial (this was the result of Griffin perfecting the Spin Out product to deal with economic concerns). Therefore 3X less bifenthrin was available in each pot as an insecticide.

Results from this trial were less effective, with 7-33% of the 0.25 and 0.5% treated pots becoming infested with fire ants at 1-6 months after treatment. The 1-gallon pots treated at 1.0% provided protection from infestation for 3 months, while the 3-gallon pots treated at 1.0% failed 7-13% of the time at 1, 3, and 6 months after treatment.

Due to the less than acceptable results from the 1997 trial, Lerio, Griffin, and GPPS jointly decided to initiate another trial in 1998 using higher rates of bifenthrin (1.5 and 2.0% AI) combined with the Spin Out 300 to accommodate the lower amount of material applied to the pots. We also evaluated pots with the Spin Out/bifenthrin applied in a band to the inside or outside of the pot.

MATERIALS AND METHODS:

Griffin Corporation supplied Spin Out 300 containing bifenthrin (1.5% and 2.0% AI by weight) for treatment of a sufficient number of pots to conduct a three year study. Lerio Corporation provided the containers (one and three gallon sizes) used in the expanded study and applied the Spin Out 300/bifenthrin to the pots using automated equipment. Treatments included:

- 1.5% AI combined with Spin Out 300 sprayed on entire inside of pot; both 1-gallon and 3-gallon sizes
- 2.0% AI combined with Spin Out 300 sprayed on entire inside of pot; both 1-gallon and 3-gallon sizes
- 2.0% AI combined with Spin Out 300 sprayed in a 1-2" band on the inside bottom side of pot; band will overlap side drainage holes; there will be no bottom drainage hole; both 1-gallon and 3-gallon sizes
- 2.0% AI combined with Spin Out 300 sprayed in a 1-2" band on the outside bottom side of pot; band will overlap side drainage holes; there will be no bottom drainage hole; both 1-gallon and 3-gallon sizes

Lerio color coded the pots for identification of treatment type. After treatment, Lerio delivered treated pots to the nurseries and assisted with potting up, and at each sampling period, they transported test pots from each nursery to this laboratory. Griffin and Lerio purchased all plants for the test. Cooperating nurseries provided space, irrigation, fertilization, and weed control for the test pots. Gulfport personnel purchased potting media from each nursery, filled the pots and placed the test pots in a designated test area (or bed). All pots were planted with slow growing, relatively pest free woody ornamentals such as Japanese boxwood. Each individual nursery determined the best species of plants to use at that particular location.

Nursery	Location	Soil Type	Plants (1-gal and 3-gal)
Flowerwood	Loxley, AL	65% new bark 35% aged bark	*Berberis thunbergi atropurpurea* Redleaf Japanese Barberry
Windmill	Folsom, LA	100% bark	*Ilex vomitoria nana* Dwarf Yaupon Holly
Rocky Creek	Lucedale, MS	unknown	*Cleyera japonica* Japanese Cleyara

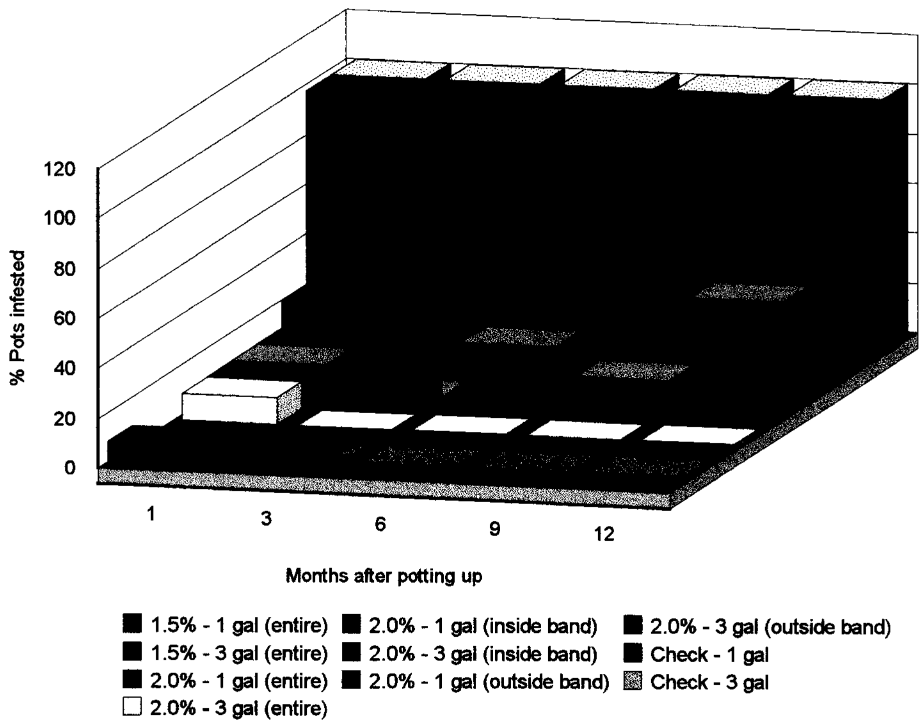
The Gulfport Plant Protection Station was responsible for determining the efficacy of the Spin Out technology by conducting bioassays in the laboratory.

Bioassay - prevention of whole colony infestation: All treatments were tested against field collected RIFA colonies. Three containers (replicates) from each treatment were bioassayed at 1 and 3 months after the pots are filled with media, and then quarterly thereafter until activity ceased. Plant tops were removed prior to bioassaying as needed. Each replicate was bioassayed by placing the treated container at one end of a 2' x 8' test arena. Sides of the test arena were coated with talcum powder or Fluon® to prevent the ants from climbing out and escaping. An untreated check container filled with media was placed at the distal end of the test arena (see FA01G017 for diagram of test arena). A field collected RIFA colony complete with associated soil and nest tumulus was then placed in the center of the arena. Overhead incandescent light bulbs slowly desiccated the nest tumulus so the ants were encouraged to migrate to the more moist and hospitable containers. Therefore, the RIFA colony was provided a free choice to invade either a Spin Out treated pot or an untreated check pot. Pots were observed at 24 hour intervals for 7 days after introduction, and the estimated number of workers successfully invading each pot recorded. A pot was considered infested if +25 workers were inside the pot.

RESULTS:

The higher rates of insecticide in latex coating the entire inside of the pot appear to be providing better protection against IFA infestation than the previous year's lower rates of insecticide (Figure 1). However, the 1.5% 1-gallon rate, the 2.0% 1-gallon and 3-gallon rates have had one pot infested within the first 3 months of testing. The band treatments are not working as well as the entire inside coating.

Figure 1. Percent of Spin Out 300 + Bifenthrin Treated Pots Infested with IFA.
Multi-State Trial - Initiated March 1998



PROJECT NO: FA01G038

PROJECT TITLE: Effectiveness of Permethrin Impregnated Nursery Pots in Preventing Imported Fire Ant Invasion of Containerized Nursery Stock: A Preliminary Appraisal

TYPE REPORT: Interim

PROJECT LEADERS: Anne-Marie Callcott, Shannon Wade and Homer Collins

INTRODUCTION:

Nursery stock and other regulated articles cannot be shipped outside the imported fire ant (IFA) quarantined area unless treated with an approved insecticide (7CFR §301.81) to prevent inadvertent spread of IFA. Several treatment options are approved and registered for this use pattern. Both liquid drenches (chlorpyrifos, diazinon, and bifenthrin), and granular insecticides (tefluthrin and bifenthrin) are approved for use. The most frequently used treatment is incorporation of either granular tefluthrin or bifenthrin into the potting media prior to "potting up". The residual activity of the insecticide prevents IFA invasion of containerized nursery stock for up to 24 months, depending upon dose rate employed.

A totally new and novel approach currently under investigation by us involves the addition of the insecticide bifenthrin to the SpinOut® technology. SpinOut (Griffin Corp., Valdosta, GA) is a coating of copper hydroxide applied to the interior surface of pots, grow bags, etc. to control root development by chemical root pruning. We have hypothesized that IFA colonies invade containerized nursery stock through the drain holes in the bottom of the pots, rather than climbing up the sides of the pot and entering from the top. Preliminary studies with SpinOut have demonstrated potential for use of this technology to prevent IFA invasion of nursery containers (FA01G017, FA01G018).

MATERIALS AND METHODS:

Following several telephone conversations with Dr. Earl Tryon, representing Brandywine

Compounding, Chadds Ford, PA, we received 12 one pint (4.75" x 4.75") nursery containers on October 7, 1997. No information other than the pots contained permethrin was provided. The pots were filled with potting media (MAFES mix, pine bark, sphagnum peat and sand 3:1:1), and placed on raised benches in a simulated can yard. Irrigation water (ca. 0.5 inches per day), was provided through overhead pulsating sprinklers in addition to natural rainfall. The pots did not contain plants, because the extremely low numbers of pots provided required that we conduct periodic resampling of the same 12 pots rather than destructive sampling normally done in similar trials. Bioassays were conducted with field collected fire ant colonies after 24 hours, and on a monthly basis thereafter. Bioassays were conducted in the laboratory in 2' x 4' test arenas (Figure 1). Sides of the test arena were talced to prevent ants from climbing out and escaping. A permethrin pot was placed at one end of the arena, and an untreated check container filled with potting media was placed at the distal end of the arena. A field collected IFA colony complete with associated soil and nest tumulus was then placed in the center of the arena. Overhead incandescent light bulbs (60 watts, placed 14" above the test arena), slowly desiccated the nest so that the ants were encouraged to migrate to the more moist containers. Therefore, the IFA colony had an equal opportunity to move into either a permethrin pot or the untreated check pot. Pots were observed at 24 hour intervals for 7 days after introduction, and the estimated number of worker ants successfully invading each pot was recorded. There were 4 replicates per sampling interval.

At 4, 6, and 9 months after potting up, we subjected four permethrin pots to a test in which the ants had no choice of pots. Only a permethrin treated pot was placed in the test arena with a field collected colony. Pots were observed for at least 7 days after introduction.

RESULTS:

Permethrin treated pots have prevented IFA invasion for 11 months (Figure 2) when ants were given a choice of pots. There has been one pot infested with 25-100 workers at 12 and 13 months after potting up. When the ants have no choice, they will try to move in the permethrin treated pots. At 4 mths, all ants exposed to the permethrin pots died. At 6 mths, some ants successfully infested the pots, but the majority of the workers preferred to live in the arena. By 9 mths, the ants successfully infested all the replicates when there was no other choice. Based on these results, we recommend that the current study be continued, and a larger trial with various dose rates and different container sizes be initiated.

Figure 1. Diagram of test arena.

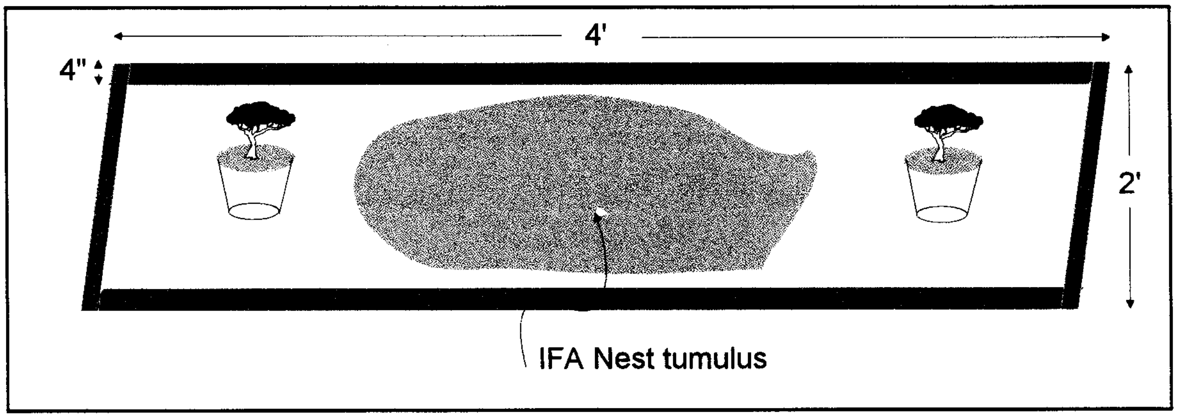
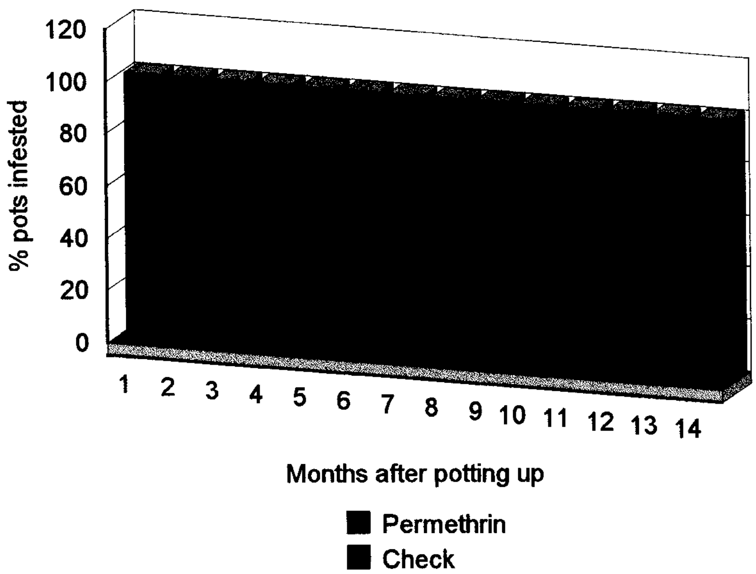


Figure 2. Percent of Original Permethrin Pots Infested with IFA - Preliminary Trial at Gulfport, MS - initiated 1997.



PROJECT NO: FA01G077

PROJECT TITLE: Tennessee Mating Flight Study: Can the Biology of the Imported Fire Ant Be Used to Aid in Certification of Field Grown Nursery Stock?

TYPE REPORT: Interim

LEADERS/PARTICIPANTS: Homer Collins and Anne-Marie Callcott

COOPERATORS: Drs. Rick Brenner and David Williams, USDA, ARS, CMAVE (Gainesville, FL)
Randy Dodd, Frank Heery and Rick Joyce, Tennessee Dept. of Agriculture (Jackson and Chattanooga, TN)
Dr. Catharine Mannion, Tennessee State University (McMinnville, TN)

INTRODUCTION:

Practical and cost-effective quarantine treatments for certification of field grown/balled and burlapped (B&B) nursery stock are not currently available. Growers wanting to ship their nursery stock outside the IFA quarantined area have several treatment options available, but none are user-friendly or practical. Treatment options that are currently listed in 7CFR §301.81 include the following:

1. Total immersion (dipping) the root ball in a chlorpyrifos solution

2. Twice daily irrigation of root balls for three consecutive days with a chlorpyrifos solution

3. In-field treatments with a combination of bait plus granular chlorpyrifos

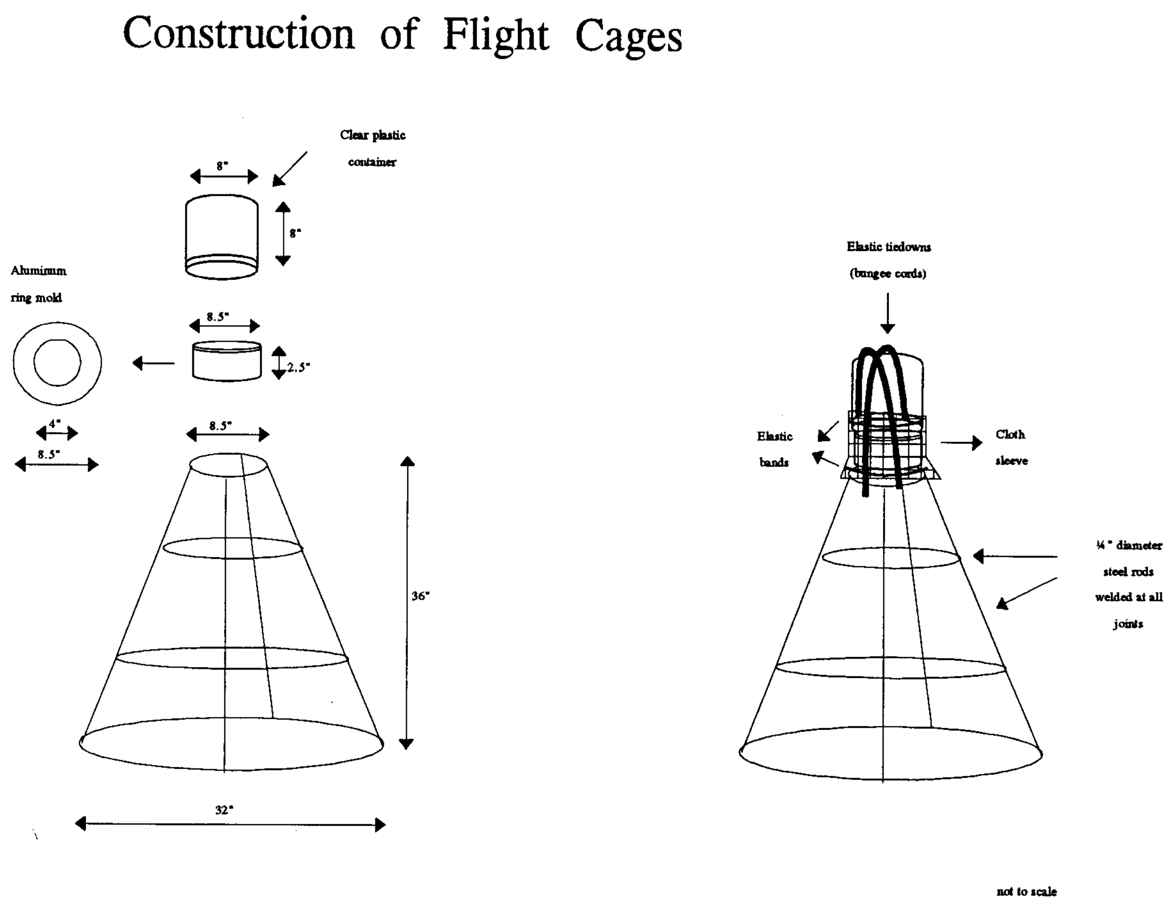
Total immersion of the root balls in insecticidal solutions disrupts the root ball, is logistically unfeasible, and causes worker exposure problems. Other options such as twice daily irrigation of root balls with insecticidal solutions causes problems with run-off and is highly labor intensive. Research into development of practical and cost-effective treatments is a high priority with the American Nursery & Landscape Association, Tennessee Nurserymen's Association, and the Southern Nurserymen's Association.

Since imported fire ant (IFA) mating flights occur year-round in most of the infested area, we have historically relied entirely upon contact action insecticides to certify movement of nursery stock outside the quarantine area. However, it seems likely that as the IFA extends its range to more northerly areas, differences in the biology of the ant may begin to occur. Mating flight cages will be used in a pilot study in Tennessee to determine if a window of opportunity exists in which we can use the biology of the pest in combination with easily applied and highly efficacious baits to certify movement of nursery stock, specifically field grown nursery stock. The Tennessee pilot study was recently initiated in cooperation with ARS, PPQ, Tennessee Department Agriculture, and Tennessee State University. Flight cages were deployed at three sites (East, Central, and Western Tennessee), and will be monitored to determine mating flight patterns. This study is designed to last two or more years, and will be used to correlate weather with emergence, and thereby, use satellite information to develop probability contour maps showing the likelihood of alate emergence at any part of the infested area.

MATERIALS AND METHODS:

Flight traps were supplied by USDA, ARS, CMAVE in Gainesville, FL to the Gulfport Plant Protection Station (GPPS). GPPS repaired and slightly modified traps for use in clay soils of Tennessee. The cages are conical in shape with the frames made of ¼" diameter steel rods (Fig. 1). Fiberglass window screen was inserted in the frame and secured in place with 50 lb. test monofilament fishing line. The cages were placed over active IFA mounds and held in place with 8" aluminum tent pegs. An elastic cotton cloth sleeve (8" diameter) was placed over the top of the cage and the bottom of the sleeve held in place with an elastic band or bungee cord. An aluminum ring mold (cake pan) was placed on top of the cage and filled ca. ½ full with preservative (1:1 mixture of antifreeze and 70% alcohol). A plastic dome covered the ring mold. The cloth sleeve was pulled up over the ring pan onto the plastic dome and held in place with another elastic band. Elastic tiedowns (bungee cords) were criss-crossed over the dome, securing the entire catching apparatus to the wire cage.

Figure 1. Construction of Flight Cages.



Flight traps were placed over 8 mounds in three locations in Tennessee the week of September 8, 1997; Ooltewah (Hamilton Co.), Pulaski (Giles Co.) and La Grange (Fayette Co.), TN. Every two weeks, cooperators count and record the number of male and female alates caught in the preservative in the ring mold of each trap. Alates are discarded after counting. If a mound has moved the trap is also moved. Recorded data is transmitted to the Gulfport Plant Protection Station and ARS, CMAVE.

The Gulfport Plant Protection Station coordinates with collectors, assists in maintenance of traps and transmits collected data to ARS, CMAVE. ARS, CMAVE will correlate flight trap data with satellite information.

RESULTS:

East Tennessee (Ooltewah):

Both male and female alates were captured at the eastern Tennessee site in Ooltewah between September 9 (when the traps were set up) and October 13, 1997 (Figure 2). No alates were captured between October 13, 1997 and March 13, 1998 when 2 males were captured in one trap. In 1998, major alate production in this area began in mid June and continued through the end of July. There was a small production of alates in September and October. Data is current through October 22, 1998.

Central Tennessee (Pulaski):

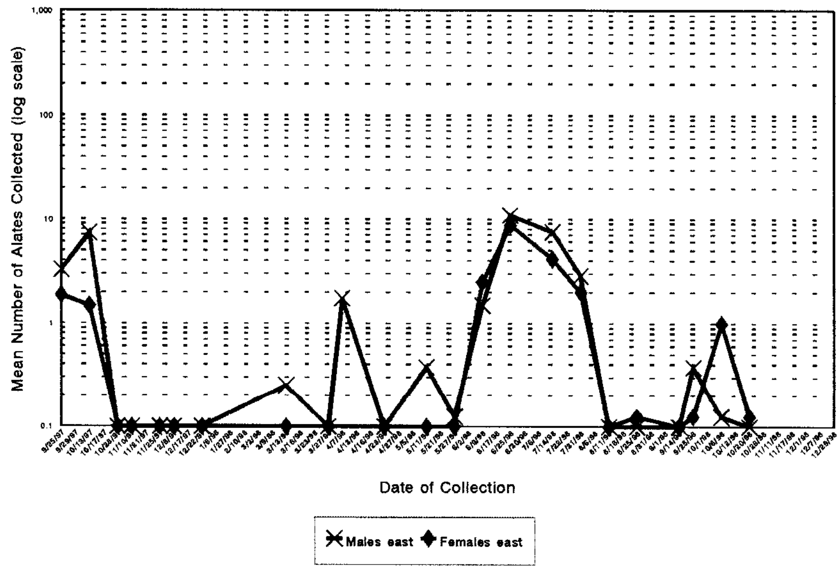
Only males were captured at the central Tennessee site in Pulaski between September 9 and October 13, 1997; one male was captured between October 13 and October 28, 1997. No alates were captured between November 28, 1997 and February 10, 1998 when 2 males were captured in two traps. In 1998, there was one surge of alate production in this area between March 27 and April 13, with the major production beginning in late May and continuing through the end of July. However, a reduced rate of alate production continued through November 11, 1998. Data is current through December 7, 1998, at which time no alates were captured.

West Tennessee (La Grange):

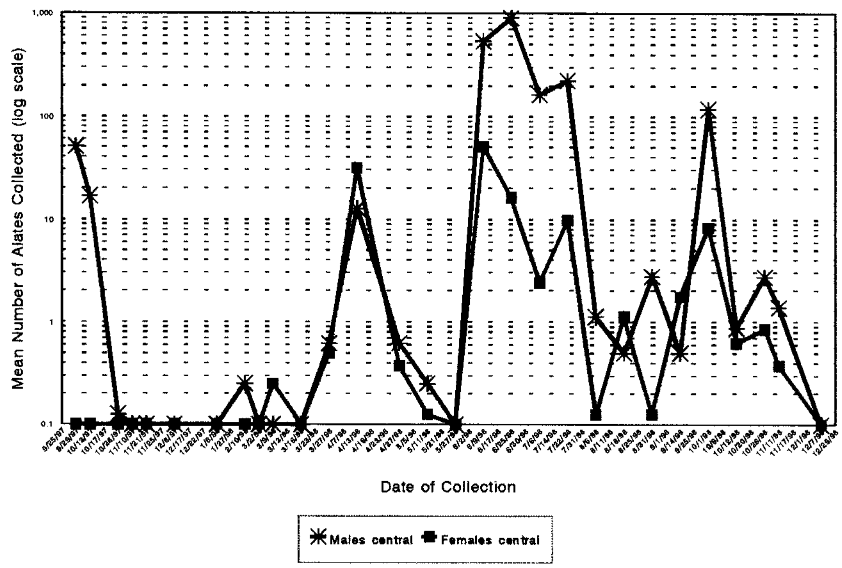
Both male and female alates were captured at the western site in La Grange between September 10 and September 29, 1997. Between late September and October 17, only females were captured. No alates were captured between late October, 1997 and mid May, 1998. In 1998, major production of alates at this site began in late May and continued through the end of June. A reduced rate of alate production continued through the first of December. Data is current through December 29, 1998, at which time no alates were captured.

Figure 2. Average Number of Alates Captured in Flight Traps at Three Sites in Tennessee.

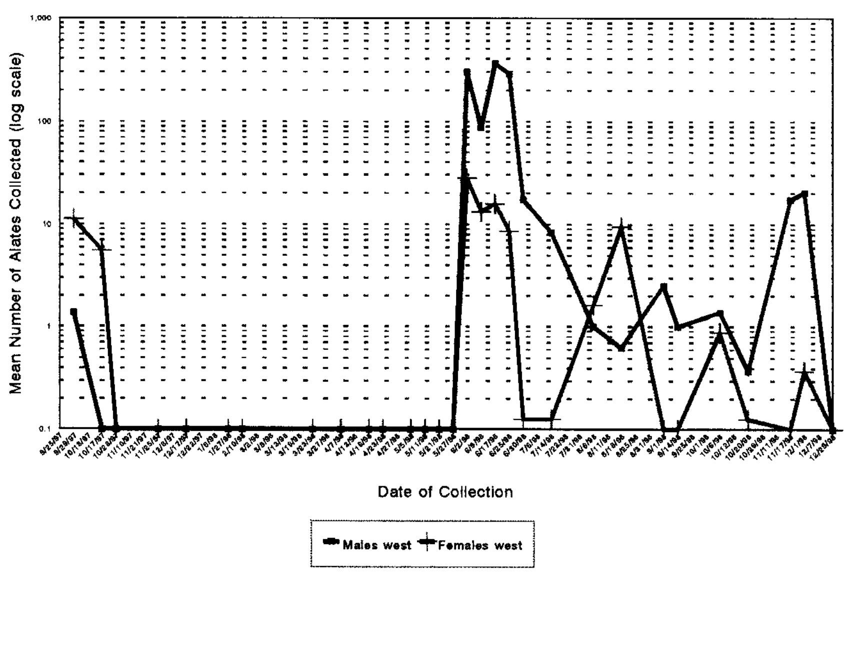
East



Central



West



PROJECT NO: FA05G055

PROJECT TITLE: Biobarrier as a Prophylactic Treatment for Control of Phytophera Root Rot in Blueberry and Its Effects on Populations of Imported Fire Ants in Commercially Grown Blueberry Orchards

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Timothy C. Lockley/Barbara J. Smith[1]

INTRODUCTION:

Phytophera Root Rot (*Phytophera cinammoni*) is a major pest of blueberries in commercial orchards in the southeastern United States and causes considerable economic losses every year (Caruso & Ramsdell 1995). The mode of transmission of phytophera is from wild host plants to the blueberries. Standard practice is to spray various biocides to either kill the pathogen or the host plant. By restricting the development of the wild hosts, the effects of the phytophera on commercial blueberries can be limited to acceptable economic levels. Biobarrier (Reemay Corp., Nashville, TN) is designed to eliminate weedy species from landscaping by emitting small amounts of Treflan herbicide over extended periods. Imported fire ants, although not a direct pest of blueberries, also play a major deleterious role in commercial blueberry fields by clogging drip irrigation systems and stinging field workers and customers in "pick-your-own" fields. Biobarrier has shown significant potential to repel active fire ant colonies (FA05G045). Tests were undertaken at the USDA-ARS-Small Fruits Research Laboratory in Poplarville, MS to determine the effects Biobarrier would have on the phytophera pathogen. In conjunction with this trial, Biobarrier was also examined for its effects on imported fire ants and the movement of colonies of this pest ant.

MATERIALS AND METHODS:

Blueberries/treatments were established in April 1995 as shown in Table 1. Plot design for the Biobarrier treatment is shown in Table 2. Plants were spaced ca. 1.0 m apart. Peatmoss was incorporated into the plantings with the exception of the Tung Press Cake treatment. Post planting treatments of

[1] USDA, ARS, Poplarville, MS

Ridomil and Subdue were applied in the spring of 1996. Plants were visually rated for phytophera root rot symptoms every 3 months and were assayed for the presence of *Phytophera cinammoni* every 6 months. Fire ant populations were determined every 6 months.

RESULTS:

At 30 months into the evaluation, RIFA colonies have established themselves throughout the untreated plots. To date, no activity has been noted within any of the treated plots. However, a significant reduction in plant vigor has been observed within the Biobarrier mulched plots. This was most notable on the Misty variety with the Tifblue cultivar showing the least effect. A statistical analysis made by BJS showed significant reductions in plant growth, vigor; though fruit production did not seem to be significantly impacted.

REFERENCES CITED:

Caruso, F.L. & D.C. Ramsdell. 1995. *In*: Compendium of Blueberry and Cranberry Diseases. Amer. Pathol. Soc. Press, St. Paul, MN. pp. 7-8.

Table 1. Phytophera Root Rot/Fire Ant Experimental Protocol.

No.	Treatments Chemical	Bed Height	Cultivars Tifblue	Gulfcoast	Misty	Reville	Other*	TOTAL
1	None	Raised	4	4	4	4	27	43
2	None	Flat	4	4	3	3	0	14
3	Ridomil Prep	Raised	4	4	4	3	0	15
4	Ridomil Prep	Flat	4	4	4	3	0	15
5	Ridomil Post	Raised	4	4	4	3	0	15
6	Ridomil Post	Flat	4	4	4	3	0	15
7	Subdue Post	Raised	4	4	4	3	0	15
8	Biobarrier	Raised	4	4	4	3	0	15
9	Tung Press Cake	Raised	4	4	4	3	0	15

* Other cultivars: Georgia Gem; Pearl River; Magnolia; Marimba; Cooper; Premier.

Table 2. Phytophera Root Rot Study Biobarrier Plot Protocol.

CULTIVAR	REP	NO.	BED HEIGHT	ROW	PLOT
Gulfcoast	1	8	Raised	4	31
Misty	1	8	Raised	4	33
Reville	1	8	Raised	4	32
Tifblue	1	8	Raised	4	34
Gulfcoast	2	8	Raised	3	23
Misty	2	8	Raised	3	24
Reville	2	8	Raised	3	22
Tifblue	2	8	Raised	3	25
Gulfcoast	3	8	Raised	3	9
Misty	3	8	Raised	3	8
Reville	3	8	Raised	3	6
Tifblue	3	8	Raised	3	7
Gulfcoast	4	8	Raised	1	29
Misty	4	8	Raised	1	30
Tifblue	4	8	Raised	1	31

PROJECT NO: FA05G065

PROJECT TITLE: Effect of Mulches on Grape Root Borer and Establishment of Colonies of the Imported Fire Ant in Orchards of Commercially Grown Muscadines

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Timothy C. Lockley/Barbara Smith[1]

INTRODUCTION:

The Grape Root Borer (*Vitacea polistiformis*) is a pest of muscadine grapes *Vitis rotundifolia muscadina* in the southeastern United States (Olien et al. 1993). The presence of this pest often goes unnoticed by commercial growers until the vines begin to decline in vigor. Grape Root Borer (GRB) is difficult to detect and control because it spends most of its life on the roots and in the crown of muscadine vines. Vines are infected over several seasons and decline may not become evident for several years. Adult GRB emerge in mid-summer and oviposit on the shoots and foliage of muscadines and other plants. The larvae emerge ca. 2 weeks later, fall to the ground and burrow into the soil; then into the roots.

Imported fire ants (IFA), while not a major pest of muscadines, do present unique problems when they infest these plants. The mounds tend to be built at the base of the plant. When the grapes are harvested mechanically, the ants respond aggressively to the vibrations of the machine and can swarm over the picker and sting the operator. In pick-your-own fields, people harvesting the grapes can unwittingly step into mounds and be subjected to numerous stings. In fields irrigated by constant drip, IFA mounds are often built over the emitters clogging or restricting the flow of the system. Fire ant workers nurse numerous homopteran species including hard scales, soft scales and aphids, all of which can cause significant primary damage to muscadine vines.

MATERIALS AND METHODS:

Muscadine plants were set at 20 foot intervals and trained on wire trellis.

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[1] USDA, ARS, Poplarville, MS

Plants are maintained according to Mississippi Agriculture and Forestry Experiment Station recommendations. Irrigation is supplied as needed via drip lines placed under mulch. Plants are monitored three times a year for potential phytotoxicity and are surveyed quarterly for the presence of fireants and weeds. Plants will be assayed for the presence of crown gall bacterium and, at the end of the study (24 months), grape root borer damage will be assessed.

Mulches consists of Pine bark (2-4" depth); black fabric with pine bark and Biobarrier with pine bark. Mulches were applied on raised beds after plants were transplanted. Eight muscadene cultivars were used in the trials: Carlos; Doreen; Jumbo; Magnolia; Noble; Sterling; Summit; and Tarheel.

RESULTS:

Examination of the various replicates throughout 1996, 1997 and 1998 showed no indication of fire ant activity among any of the Biobarrier treatments (Table 1).

REFERENCES CITED:

Olien, W.C., B.J. Smith & C.P. Hegwood, Jr. 1993. Grape root borer: a review of the life cycle and strategies for integrated control. Hortscience. 28: 1154-1156.

Table 1. Efficacy of Biobarrier as a Deterrent to the Red Imported Fire Ant.

PLOT	CULTIVAR	MULCH TREATMENT	NUMBER OF RIFA MOUNDS 1996	1997	1998
1	Tarheel	Biobarrier	0	0	0
2	Carlos	Fabric	5	4	1
3	Summit	Fabric	4	4	0
4	Carlos	Bark	4	3	1
5	Sterling	Bark	3	4	2
6	Carlos	Biobarrier	0	0	0
7	Noble	Biobarrier	0	0	0
8	Carlos	Fabric	2	5	1
9	Magnolia	Fabric	3	2	0
10	Carlos	Bark	8	4	1
11	Jumbo	Biobarrier	0	0	0
12	Carlos	Bark	2	4	0
13	Doreen	Bark	1	2	0

PROJECT NO: FA01G087

PROJECT TITLE: Prevention of IFA Colony Establishment in Hay Bales Stored Outdoors on the Ground

TYPE REPORT: Final

LEADER/PARTICIPANTS: Homer Collins, Anne-Marie Callcott, Lee McAnally, Charlene Russell

INTRODUCTION:

Baled hay or straw stored in direct contact with the ground is ineligible for movement outside the imported fire ant quarantine area (7CFR Ch. III §301.81-16). Fire ant colonies will nest in baled hay that is left in place for relatively long periods of time. Usually the colonies will seek refuge and invade the bales when the soil moisture is at or above field capacity. We conducted a small field trial to determine if one or more simple, cost effective procedures would prevent IFA nesting in baled hay stored on the ground. We evaluated baiting the storage site prior to moving the hay, and also placing the hay on polyethylene sheeting rather than in direct contact with the ground.

MATERIALS AND METHODS:

The test site was a well drained bahia grass field in Harrison County, Mississippi. The site was part of the Harrison County Prison Farm, and was kept mowed for appearance. Immediately prior to initiating the study, the IFA population was determined by visually counting all colonies within three ¼-acre plots. Test plots were 16' x 16' with 10' borders on all sides. Round hay bales (4' x 4') were placed in the center of each test plot. There were three treatments, and each treatment was replicated four times. Treatments included Amdro® bait applied with a hand seeder at labelled rate of application (1.5 lb bait/acre), 6-mil black polyethylene sheeting, and an untreated check. The polyethylene sheeting was secured on all four sides with nails driven into the ground. By placing the 4' x 4' bale in the center of 16' x 16' plots, the bales were 6' from the nearest uncovered ground. Bales were visually inspected quarterly for the presence of IFA colonies.

RESULTS:

The IFA population at the test site averaged 56 colonies per acre prior to initiating the test. Hay bales were put in place on August 18, 1997. Polyethylene sheets were positioned before the hay bales were placed. Amdro was applied, as stated above, on August 20, 1997. Over a one year observation period, no IFA colonies infested the plots treated with Amdro or bales placed on polyethylene. Some of the untreated check bales were infested with IFA colonies over the course of the trial.

This preliminary trial indicates that using a polyethylene sheet to store bales of hay on, or treating the storage area with a bait such as Amdro prior to storage may prevent IFA colonies from infesting baled hay stored on the ground. Larger and more extensive trials are needed to verify this data.

PROJECT NO: FA01G028

PROJECT TITLE: Evaluation of Various Granular Insecticides for Control of Imported Fire Ants in Turfgrass, 1998

TYPE REPORT: Interim

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

COOPERATORS: Rhone-Poulenc Ag. Co. (Ken Kukorowski, Ken Lewis)
Zeneca Ag Products (Steve Kammerer)
Slidell Municipal Airport

INTRODUCTION:

Several companies are developing new chemistries with potential as granular products for control of imported fire ants. These products have the potential to be used in both the homeowner market and the Federal IFA Quarantine as lawn or sod treatments. In 1998, several companies supplied us with new granular products for evaluation.

MATERIALS AND METHODS:

The test site was located at the Slidell Municipal Airport in Slidell, Louisiana. Mowed areas between taxiways and runways simulated conditions that occur in commercial turfgrass. Granular products were applied broadcast to test plots using a Herd® GT-77 spreader (Herd Seeder Co., Logansport, IN) on a farm tractor on June 3-4, 1998. There were 3 replicates per treatment. Products, producers, and rates of application are listed below:

Product	% active ingredient	Producer	Rate of application (lbs/acre)
Fipronil	0.05%	Rhone-Poulenc Ag. Co., Raleigh, NC	25.0, 37.5, 50.0
Force	1.5% tefluthrin	Zeneca Ag Products, Wilmington, DE	46.7
Lambda-cyhalothrin	0.1%	Zeneca Ag Products, Wilmington, DE	120
Talstar	0.2% bifenthrin	FMC Corp., Philadelphia, PA	100

A ¼ acre circular efficacy plot was established in the center of each 1.0 acre test plot. Prior to and at 2, 4, and 6 weeks after treatment, and at 6 week intervals thereafter, IFA populations in each efficacy plot were evaluated using the population index system developed by Harlen et al. (1981) and revised by Lofgren and Williams (1982). Using this data, both colony mortality and decrease in pre-treatment population index were calculated. Data were statistically analyzed using analysis of variance and means separated using Tukey's test (P=0.05) for each post-treatment interval.

RESULTS:

Treatments were applied on June 3-4, 1998 with air temperatures between 87-94°F and soil temperatures between 80-82°F. At 2 weeks after treatment, Talstar and the two high rates of fipronil provided the greatest control of IFA (Tables 1 & 2). By 4 weeks, all treatments, except lambda-cyhalothrin reduced pretreatment population indices by >85%, and all except lambda-cyhalothrin and the lowest fipronil rate, reduced colony numbers by >70%. The 50.0 lb/acre rate of fipronil provided 100% control at 4 weeks. At 6 weeks after treatment, all fipronil rates and the Force treatment were still significantly better than the check; the low fipronil rate and Force providing >80% reduction in population indices, and the two higher fipronil rates providing >95% reduction in population indices.

By 12 weeks after treatment, all fipronil rates provided 100% control of IFA. All other products provided 60-75% control of IFA. At 18 weeks after treatment, the 2 lower fipronil rates were still providing 100% control of IFA; one plot in the high fipronil rate had one large reproductive colony, which probably moved into the area from the untreated surrounding area. All other treatments had reproductively viable colonies. The Talstar and lambda-cyhalothrin plots were not evaluated after this time.

At 24 weeks after treatment, the two higher fipronil rates were at 100% mortality; the one mound found on a high rate plot at 18 weeks had either moved out of the area or succumbed to the treatment. Two of the plots of the lowest fipronil rate (25 lb/acre) had reproductively viable colonies on them, showing possible reinfestation. The Force plots were all reinfested with reproductively viable colonies, and were not evaluated after this time.

Fipronil rates of 37.5 and 50 lb/acre continue to provide excellent control of IFA through 53 weeks after treatment. Plots treated with the low rate continue to have a few reproductively viable colonies present.

All fipronil treatments will continue to be evaluated until general reinfestation is noted; although the time interval between evaluations was lengthened to 8 weeks during the winter months.

DISCUSSION:

Talstar 0.2G, at 100 lbs/acre (0.2 lb AI/acre), provided extremely fast knockdown of IFA (>88% mortality at 2 weeks after treatment), but did not provide adequate residual control, as evidenced by the rapid reinfestation by either movement into the treated area, or possibly rejuvenation of treated colonies. Lambda-cyhalothrin at the rate used (120 lbs/acre or 0.12 lb AI/acre) never provided better than 75% control of IFA, and at all evaluation periods there were reproductively viable colonies present. Force at 46.7 lbs/acre (0.7 lb AI/acre) performed a little better numerically, providing 70-80% control of IFA through 18 weeks.

In general, the higher the rate of application with fipronil, the faster the control of IFA in grass sod. The 2 higher rates provided >84% control of IFA by 4 weeks after treatment, >91% after 6 weeks, and by 12 weeks after treatment, all rates provided 100% control. The lower rate achieved the same control (100%) at 12 weeks, but in the preceding weeks was numerically inferior to the higher rates of application. The lowest rate has shown good control of IFA through 18 weeks, while the 2 higher rates have provided excellent control through 53 weeks.

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Table 1. Efficacy of various granular insecticides applied broadcast to grass sod: change in pretreatment population indices. Slidell Airport, LA; June 3-4, 1998.

Treatment	Rate of Applic. (lb/acre)	Mean pretreat population index/acre*	% change in pretreatment population indices at indicated wks PT**							
			2 wks	4 wks	6 wks	12 wks	18 wks***	24 wks	32 wks	41 wks
Fipronil	25.0	526.8	-43.0abc	-85.1a	-85.9a	-100.0a	-100.0a	-85.1ab	-86.3a	-87.5a
Fipronil	37.5	313.2	-91.1a	-89.7a	-99.3a	-100.0a	-100.0a	-100.0a	-100.0a	-100.0a
Fipronil	50.0	404.0	-76.9a	-100.0a	-95.2a	-100.0a	-90.5a	-100.0a	-100.0a	-96.4a
Force	46.7	440.0	-70.5ab	-89.6a	-80.2a	-59.2ab	-75.7a	-23.9c	--	--
Lambda-cyhalothrin	120.0	366.8	-16.2c	-64.9ab	-74.3ab	-61.6ab	-66.9a	--	--	--
Talstar	100.0	312.0	-94.7a	-88.7a	-63.9ab	-75.6a	-20.3a	--	--	--
Check	--	620.0	-19.4bc	-34.0b	-30.1b	-28.8b	-48.1a	-36.8bc	-37.3b	-18.3b

* Mean of 3 replicates.
** Means within a column followed by the same letter are not significantly different (Tukey's test, P=0.05).
*** 18 wk count made on 10/9/98 after Hurricane Earl (9/1-9/3), T.S. Frances (9/10-9/13), T.S. Hermine (9/17-9/22), and Hurricane Georges (9/26-9/28) impacted the count area with tremendous rainfall amounts. Total rainfall for the 5 weeks proceeding this count was approximately 32 inches.

Table 1. Cont.

Treatment	Rate of Applic. (lb/acre)	Mean pretreat population index/acre*	% change in pretreatment population indices at indicated wks PT**							
			47 wks	53 wks	59 wks					
Fipronil	25.0	526.8	-87.5a	-93.8a						
Fipronil	37.5	313.2	-100.0a	-100.0a						
Fipronil	50.0	404.0	-96.0a	-100.0a						
Force	46.7	440.0	--	--						
Lambda-cyhalothrin	120.0	366.8	--	--						
Talstar	100.0	312.0	--	--						
Check	--	620.0	-3.0b	-49.0b						

* Mean of 3 replicates.
** Means within a column followed by the same letter are not significantly different (Tukey's test, P=0.05).

Table 2. Efficacy of various granular insecticides applied broadcast to grass sod: decrease in pretreatment colony numbers. Slidell Airport, LA; June 3-4, 1998.

Treatment	Rate of Applic (lb/acre)	Mean no. pretreat colonies/ acre*	% decrease in no. of pretreatment colonies at indicated wks PT*							
			2 wks	4 wks	6 wks	12 wks	18 wks***	24 wks	32 wks	41 wks
Fipronil	25.0	30.8	41.1bc	56.1ab	72.3ab	100.0a	100.0a	83.9ab	81.1a	86.7a
Fipronil	37.5	24.0	88.6a	83.8ab	95.2a	100.0a	100.0a	100.0a	100.0a	100.0a
Fipronil	50.0	25.2	68.3ab	100.0a	91.7a	100.0a	93.3ab	100.0a	100.0a	95.8a
Force	46.7	29.2	63.9ab	79.3ab	74.5ab	63.4ab	76.3ab	34.8c	--	--
Lambda-cyhalothrin	120.0	24.0	22.9c	35.7b	73.0ab	56.8ab	67.1ab	--	--	--
Talstar	100.0	21.2	88.6a	70.0ab	53.8ab	75.2ab	28.6b	--	--	--
Check	--	40.0	19.7c	35.6b	31.4b	27.8b	40.3ab	41.7bc	30.6b	25.3b

* Mean of 3 replicates.

** Means within a column followed by the same letter are not significantly different (Tukey's test, P=0.05).

*** 18 wk count made on 10/9/98 after Hurricane Earl (9/1-9/3), T.S. Frances (9/10-9/13), T.S. Hermine (9/17-9/22), and Hurricane Georges (9/26-9/28) impacted the count area with tremendous rainfall amounts. Total rainfall for the 5 weeks proceeding this count was approximately 32 inches.

Table 2. Cont.

Treatment	Rate of Applic (lb/acre)	Mean no. pretreat colonies/ acre*	% decrease in no. of pretreatment colonies at indicated wks PT*							
			47 wks	53 wks	59 wks					
Fipronil	25.0	30.8	86.7a	93.3a						
Fipronil	37.5	24.0	100.0a	100.0a						
Fipronil	50.0	25.2	90.3a	100.0a						
Force	46.7	29.2	--	--						
Lambda-cyhalothrin	120.0	24.0	--	--						
Talstar	100.0	21.2	--	--						
Check	--	40.0	10.0b	44.4b						

* Mean of 3 replicates.
** Means within a column followed by the same letter are not significantly different (Tukey's test, P=0.05).

PROJECT NO: FA01G027

PROJECT TITLE: Multi-State Field Trials with Fipronil Bait (EXP 61443A) and Chipco® (EXP 60818A) for Control of Imported Fire Ants (IFA), Cutworms (Noctuidae), and Ground Pearls (*Margarodes* spp.)

TYPE REPORT: Final

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

COOPERATORS: Rhone-Poulenc AG Company; Hattiesburg, MS Airport; Camden, AR Airport; La Porte, TX Airport; University of Arkansas; Texas Agric. Extension Service; Texas Dept. Agriculture

INTRODUCTION:

Fipronil is a relatively new broad spectrum pyrazole insecticide currently under development by Rhone-Poulenc Ag Company, Research Triangle Park, NC. Fipronil is registered in the U.S. as Chipco® Choice™ (0.1% AI granule) for control of mole crickets on golf courses. Fipronil has demonstrated potent insecticide and acaricide properties on a large number of pests including fleas, ticks, boll weevils, thrips, flies, and others (Colliot et al. 1992, Burris et al, 1994, Postal et al. 1995, Searle et al. 1995). We tested fipronil as a bait toxicant and found it to be effective for control of IFA (Collins and Callcott, 1998). Chipco® Choice™ applied at 12.5 lbs formulated material per acre provided 100% control of IFA at 6 and 12 weeks after application, but plots became reinfested by the 20th week (Collins et al., unpublished data). These trials demonstrated the potential for both fipronil bait (EXP 61443A-15 ppm ai on defatted corn grit + 20% vegetable oil) and Chipco® Choice™ for control of IFA. Larger, and more extensive trials with both fipronil bait and Chipco® EXP 60818A (0.1% AI granule) were needed to confirm our preliminary results.

MATERIALS AND METHODS:

Test sites were located on airports in Camden, AR, Hattiesburg, MS, and La Porte, TX. All test plots were 0.8 acre in size, with a ¼ acre efficacy subplot located in the center of the test plots. Bait applications were made with a shop-built granular applicator mounted on a farm tractor. Chipco® EXP 60443A was applied with a Herd® Granular Applicator mounted on a farm tractor. Liquid treatments (Dursban® 50WP) were applied with a roller pump boom sprayer. The spray rig was equipped with three TKSS tips which provided a 10 ft. swath. The system was operated at 50 psi providing 37.5 gallons of finished spray per acre. Each treatment was replicated three times. Rates of application, and formulations tested are as follows:

TREATMENT	RATE OF APPLICATION
EXP 61443A bait (15 ppm ai)	1.5 lbs formulated material/acre
Commercial standard bait (Amdro®)	1.5 lbs formulated material/acre
Chipco® EXP 60818A (0.1G)	12.5 lbs formulated material/acre
Chipco® EXP 60818A (0.1G)	18.75 lbs formulated material/acre
Chipco® EXP 60818A (0.1G)	25.0 lbs formulated material/acre
Commercial std. (Dursban® 50WP)	16.0 lbs formulated material/acre
Untreated check	-

Treatment dates were May 21, 1997 in Hattiesburg, MS with the air temperature at 75-85°F, the soil temperature at 72-80°F, and the soil moist; June 11, 1997 in Camden, AR with the air temperature at 72-82°F, the soil temperature at 72-76°F, and the soil moist; and June 18, 1997 in La Porte, TX with the air temperature at 80-89°F, the soil temperature at 80°F, and the soil moist.

Temperature and rainfall data for all treatment sites was acquired from the National Climatic Data Center, Asheville, NC.

Imported Fire Ant Populations - Imported fire ant population were evaluated primarily at the Arkansas site, but also at the other sites as they occurred. Population counts were made before application and at 6 week intervals thereafter using the population indexing system described by Lofgren and Williams (1982). Colony mortality and changes in pretreatment population indices were calculated. Data was statistically analyzed by ANOVA and treatment means separated by LSD test ($P<0.05$) for each posttreatment rating interval.

Cutworm Populations - Cutworm populations were evaluated at the Mississippi site by excavating 6 in^3 areas within the ¼ acre circular subplot and examining the soil for presence of cutworms. There were 5-15 examinations per plot.

Ground Pearl Populations - Ground pearl populations were evaluated at the Texas site by excavating 6 in^3 areas within the ¼ acre circular subplot and examining the dirt for presence of cutworms. There were 5-15 examinations per plot.

RESULTS AND DISCUSSION:

Imported Fire Ant Populations

Arkansas site: The Camden, AR site was composed of Cohoba fine sandy loam soil and was heavily infested with imported fire ants. Initial colony counts at this site, averaging 204 colonies/acre, indicated that this might be a polygynous site. Exhumation and examination of numerous nests indicated that over half of the colonies examined had multiple de-alated females with worker ants congregating around them. Thus, we considered this site to be polygynous.

Granular formulations of fipronil provided excellent control of IFA 24 weeks after treatment, providing >92% reduction in colony numbers throughout the period and >95% reduction in population indices (Tables 1 & 2). There were no statistical differences in the various rates of fipronil. Control with fipronil was not different from the Dursban standard until 24 weeks after treatment, at which time all fipronil rates were maintaining significantly better reduction of IFA colonies and populations indices. All fipronil rates maintained >95% control through 49 weeks.

The fipronil bait formulation numerically outperformed the Amdro standard throughout the trial. Both baits provided >90% reduction in colony numbers and population indices at 6 and 12 weeks after treatment (Tables 3 & 4). Reinfestation of plots treated with both baits began at the 18 week evaluation, however, reinfestation of the Amdro plots was much faster than that of the fipronil plots.

The untreated control (check) plots experienced heavy losses in number of colonies and population indices (Tables 1, 2, 3 & 4). This is a fairly normal cycle for the deep south (FA05G013), but usually not seen this prominently in more temperate areas of the IFA infestation.

Mississippi site: No cutworms were observed in any of the plots before or after insecticide applications.

However, the Hattiesburg, MS site, comprised of Trebloc silt loam soil, was lightly infested with IFA. Initial colony counts averaged 29.3 colonies/acre, indicating a monogynous IFA site.

All rates of the granular fipronil provided >91% reduction of colony numbers and >94% reduction in population indices through 52 weeks after treatment (Tables 5 & 6). There were no statistical differences between the various rates of fipronil and the Dursban standard.

The fipronil bait formulation decreased colony numbers by more than 83% over an 18 week period and reduced population indices by more than 94% over the same time period (Table 7 & 8). By the 24 week evaluation, reinfestation with small incipient colonies had occurred. By the 40 week evaluation in February 1998, many of the small colonies had disappeared. This is probably not a result of the bait treatment, but rather evidence of winter kill. Markin et al. (1973) showed that only large, established mounds (produced by newly mated queens from early in the year) overwintered successfully in south Mississippi. The colonies that appeared at the 24 week evaluation (November 1997) were probably 3-4 months old and were very small (<1000 workers).

Texas site: No ground pearls were observed in any of the plots before or after insecticide applications.

However, the La Porte, TX sit, comprised of Bernard clay loam soil, was moderately infested with IFA. Initial colony counts averaged 39.2 colonies/acre, indicating that this site was monogynous..

Again, excellent control was obtained with the fipronil granular formulations. The 12.5 lb/acre rate provided 93-100% reduction of IFA colonies and population indices through 18 weeks (Tables 9 & 10). However, by the 24 week evaluation, reinfestation was noted for this rate as well as the Dursban standard. By the 40 week evaluation in March 1998, the loss of the small colonies detected in the 12.5 lb/acre plots in early December 1997 was again attributed to winter kill.

Rates of 18.75 and 25.0 lb/acre provided 100% control throughout the 40 week evaluation period. While these two rates were not statistically better than the lower fipronil rate or the Dursban standard due to large variations in the number of colonies present, numerically these rates provided greater control of IFA.

The fipronil bait formulation decreased colony numbers by more than 93% over an 18 week period and also reduced population indices by more than 93% over the same time period (Table 11 & 12). By the 24 week evaluation, reinfestation with small incipient colonies had occurred. Again, at the 40 week evaluation, most of the small colonies detected in early December had been eliminated by winter kill.

CONCLUSIONS:

Evaluations during the summer of 1998 were severely hindered by above normal heat and below normal rainfall, both of which began in early June and continued through August. Therefore, no evaluations were made between early June and late August.

These results clearly indicate that 0.1% granular fipronil (EXP 60818A) applied at rates of 12.5, 18.75 and 25.0 lbs formulated material per acre effectively controls IFA in turfgrass, with the two higher rates providing 40-52 weeks of control. Fipronil formulated as a 15 ppm bait on defatted corn grit carrier (EXP 61443A) provided control equivalent to or better than the Amdro standard and confirm results of prior studies (Collins and Callcott 1998).

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Table 1. Control of Imported Fire Ants in Turfgrass with Fipronil 0.1% Granular - Decrease in Number of Colonies; Camden, AR. Airport

Treatment	Rate of Applic. (lb/ acre)	Mean No. Colonies Pretreat (per acre)	% decrease in number of colonies at indicated weeks PT*					
			-6-	-12-	-18-	-24-	-43-	-49-
EXP60818A 0.1G	12.5	232	98.9a	99.5a	98.2a	100.0a	98.4a	95.7a
EXP60818A 0.1G	18.75	132	96.1a	100.0a	92.4a	100.0a	100.0a	98.2a
EXP60818A 0.1G	25	181.3	99.2a	100.0a	97.0a	98.4a	97.6a	96.1a
Dursban 50WP	16	222.7	100.0a	100.0a	91.5a	88.5b	85.1b	88.7a
Check	--	142.7	53.5b	85.6b	61.8b	20.5c	63.1c	38.1b

* means within a column followed by the same letter are not significantly different, LSD test, P=0.05.

Table 2. Control of Imported Fire Ants in Turfgrass with Fipronil 0.1% Granular - Change in Population Index; Camden, AR. Airport

Treatment	Rate of Applic. (lb/ acre)	Mean Pop. Index Pretreat (per acre)	% change in population index at indicated weeks PT*					
			-6-	-12-	-18-	-24-	-43-	-49-
EXP60818A 0.1G	12.5	3,257.3	-99.7a	-99.9a	-99.3a	-100.0a	-99.7a	-97.4a
EXP60818A 0.1G	18.75	1,638.7	-98.2a	-100.0a	-95.4a	-100.0a	-100.0a	-98.2a
EXP60818A 0.1G	25	2,297.3	-99.9a	-100.0a	-98.3a	-99.6a	-99.6a	-96.0a
Dursban 50WP	16	3,100	-100.0a	-100.0a	-92.9a	-92.3b	-94.2a	-91.7a
Check	--	1,873.3	-58.1b	-88.2b	-66.3b	-32.0c	-78.7b	-49.3b

* means within a column followed by the same letter are not significantly different, LSD test, P=0.05.

Table 3. Control of Imported Fire Ants in Turfgrass with Fipronil 0.0015% Bait - Decrease in Number of Colonies; Camden, AR. Airport

Treatment	Rate of Application (lb/acre)	Mean No. Colonies Pretreat (per acre)	% decrease in number of colonies at indicated weeks PT*					
			-6-	-12-	-18-	-24-	-43-	-49-
EXP61443A bait	1.5	314.7	97.3a	99.3a	96.7a	92.4a	87.8a	85.6a
Amdro	1.5	202.7	90.3a	94.7a	77.2b	74.2a	56.0b	70.4a
Check	--	142.7	53.5b	85.6a	61.8b	20.5b	77.7a	38.1b

* means within a column followed by the same letter are not significantly different, LSD test, P=0.05.

Table 4. Control of Imported Fire Ants in Turfgrass with Fipronil 0.0015% Bait - Change in Population Index; Camden, AR. Airport

Treatment	Rate of Application (lb/acre)	Mean Pop. Index Pretreat (per acre)	% change in population index at indicated weeks PT*					
			-6-	-12-	-18-	-24-	-43-	-49-
EXP61443A bait	1.5	4,142.7	-98.8a	-99.9a	-96.9a	-94.9a	-94.5a	-85.4a
Amdro	1.5	2,900	-90.6a	-96.3a	-80.1b	-79.4a	-86.4a	-78.0a
Check	--	1,873.3	-58.1b	-88.2a	-66.3b	-32.0b	-77.8a	-49.3b

* means within a column followed by the same letter are not significantly different, LSD test, P=0.05.

Table 5. Control of Imported Fire Ants in Turfgrass with Fipronil 0.1% G ranular - Decrease in Number of Colonies; Hattiesburg, MS. Airport

Treatment	Rate of Applic. (lb/ acre)	Mean No. Colonies Pretreat (per acre)	% decrease in number of colonies at indicated weeks PT*						
			-6-	-12-	-18-	-24-	-40-	-46-	-52-
EXP60818A 0.1G	12.5	26.7	95.8a	95.2a	100.0a	95.8a	95.8a	91.7a	95.2a
EXP60818A 0.1G	18.75	30.7	100.0a	100.0a	100.0a	100.0a	100.0a	100.0a	100.0a
EXP60818A 0.1G	25	32	100.0a	95.8a	95.8a	91.7a	95.8a	95.8a	100.0a
Dursban 50WP	16	29.3	100.0a	100.0a	100.0a	100.0a	100.0a	85.2a	87.8a
Check	--	29.3	3.3b	33.3b	25.6b	31.1b	17.8b	10.0b	11.1b

* means within a column followed by the same letter are not significantly different, LSD test, P=0.05.

Table 6. Control of Imported Fire Ants in Turfgrass with Fipronil 0.1%Granular - Change in Population Index; Hattiesburg, MS. Airport

Treatment	Rate of Applic. (lb/ acre)	Mean Pop. Index Pretreat (acre)	% change in population index at indicated weeks PT*						
			-6-	-12-	-18-	-24-	-40-	-46-	-52-
EXP60818A 0.1G	12.5	360	-99.4a	-99.3a	-100.0a	-97.0a	-99.4a	-93.9a	-96.5a
EXP60818A 0.1G	18.75	413.3	-100.0a	-100.0a	-100.0a	-100.0a	-100.0a	-100	-100.0a
EXP60818A 0.1G	25	426.7	-100.0a	-99.4a	-99.0a	-94.2a	-97.1a	-97.1a	-100.0a
Dursban 50WP	16	413.3	-100.0a	-100.0a	-100.0a	-100.0a	-100.0a	-91.5a	-89.7a
Check	--	380	43.7b	-46.1b	-34.8b	-15.8b	-14.5b	13.6b	0.2b

* means within a column followed by the same letter are not significantly different, LSD test, P=0.05.

Table 7. Control of Imported Fire Ants in Turfgrass with Fipronil 0.0015% Bait - Decrease in Number of Colonies; Hattiesburg, MS. Airport

Treatment	Rate of Application (lb/acre)	Mean No. Colonies Pretreat (per acre)	% decrease in number of colonies at indicated weeks PT*					
			-6-	-12-	-18-	-24-	-40-	-46-
EXP61443A bait	1.5	24	88.9a	83.3a	94.4a	50.0a	61.3ab	10.0a
Amdro	1.5	33.3	100.0a	100.0a	100.0a	92.6a	84.3a	59.7a
Check	--	29.3	3.3b	33.3b	25.6b	31.1a	17.8b	22.2a

* means within a column followed by the same letter are not significantly different, LSD test, P=0.05.

Table 8. Control of Imported Fire Ants in Turfgrass with Fipronil 0.0015% Bait - Change in Population Index; Hattiesburg, MS. Airport

Treatment	Rate of Applic. (lb/ acre)	Mean Pop. Index Pretreat (per acre)	% change in population index at indicated weeks PT*					
			-6-	-12-	-18-	-24-	-40-	-46-
EXP61443A bait	1.5	340	-97.5a	-94.2a	-98.8a	-25.8a	-88.6a	-15.6a
Amdro	1.5	453.3	-100.0a	-100.0a	-100.0a	-94.7a	-93.2a	-69.5a
Check	--	380	43.7b	-46.1b	-34.8b	-15.8a	-14.5b	13.6a

* means within a column followed by the same letter are not significantly different, LSD test, P=0.05.

Table 1. Number of Marked Male Sweetpotato Weevils Collected By Commercial Pheromone Baited Traps At Various Distances From the Point of Release.

NUMBER OF SPW CAUGHT
DISTANCE FROM RELEASE POINT

DIRECTION	MARKED 1.0 kilometer	UNMARKED 1.0 kilometer	MARKED 0.5 kilometer	UNMARKED 0.5 kilometer	MARKED 100 meters	UNMARKED 100 meters	MARKED Periphery	UNMARKED Periphery
North	0	2	0	8	0	12	1	40
Northeast	0	210	0	0	0	1	20	19
East	0	0	0	3	0	4	38	31
Southeast	0	11	0	9	*	*	12	58
South	0	42	1	52	1	36	21	61
Southwest	0	0	0	12	2	112	29	32
West	0	1	0	0	2	170	18	16
Northwest	0	0	0	0	0	4	0	12
TOTAL	0	236	1	75	5	339	139	269

1.0 km prevailing wind southeasterly
0.5 km prevailing wind northerly
100 m prevailing wind easterly (TS/Hurricane Earl)
* trap not placed because of cattle in area
Periphery - prevailing wind from north
at termination, winds primarily from east (T.S. Frances)

Table 2. Number of Marked Male Sweetpotato Weevils Collected By Commercial Pheromone Baited Traps At Various Distances From the Point of Release.

DIRECTION	MARKED 1.0 KILOMETER	UNMARKED 1.0 KILOMETER	MARKED 0.5 KILOMETERS	UNMARKED 0.5 KILOMETERS	MARKED 100 METERS	UNMARKED 100 METERS	MARKED PERIPHERY	UNMARKED PERIPHERY
North	0	0	0	23	0	30	44	29
Northeast	0	41	0	1	0	6	62 (1**)	15
East	0	0	0	8	0	7	0	17
Southeast	0	0	0	2			1	20
South	0	50	0	0	1**	69	0	33
Southwest	0	0	0	15	0	61	6 (1**)	90
West	0	0	0	0	0	42	37 (6**)	120
Northwest	0	0	0	0	0	2	80	99
Total	0	91	0	49	1**	217	230 (8**)	423

* 1.0 km winds from east; 0.5 km winds from south; 100m winds from north; periphery winds from southeast
** south trap capture of marked SPW was from previous elease (pink)

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At 1.0 km, traps placed at the west, northwest, north, northeast were separated from the release point by large areas of mixed deciduous and pine woods. Traps placed at the southwestern, southern and southeastern points were separated from the sweetpotato field by open pasture land. At the 0.5 km range, the western, northern and northeastern points were separated by mixed hardwood and pine woodlands. All other points were separated from the release site either by pasturage, vegetable/fruit crops or mowed grassland. At 100 m, only the western trap had any obstruction (a muscadine vinyard) between it and the release site.

RESULTS:

Windrose # 1:
467 marked SPW males released in 0.5 acre field of sweet potatoes on 25 VIII 1998. No marked SPW were collected at 1.0 km. At 0.5 km, a single marked male was taken at the southern trap. Traps placed at 100 m captured a total of 5 marked SPW (1.1% of total released). Traps placed along the periphery of the field captured 139 marked weevils (29.8% of released) (Table 1).

Windrose #2:
500 marked SPW males and 500 SPW females were released into the sweetpotato field on 11 IX 98. No marked SPW were collected at either the 1.0 or 0.5 km range (Table 2).

CONLUSIONS:

SPW males are not attracted over long distances to commercial SPW pheromone baited bollweevil traps.

PROJECT NO: 98SPW002

PROJECT TITLE: Effectiveness of Commercial Sweetpotato Weevil Pheromone in Detecting Isolated Populations of Sweetpotato Weevils.

TYPE REPORT: Final

LEADER/PARTICIPANTS: Tim Lockley, Homer Collins, Ned Edwards[1]

INTRODUCTION:

Sweetpotato weevils (*Cylas formicarius elegantulus* Summers) are one of the most important pests of sweet potato (*Ipomoea batatas* L.) in tropical and subtropical areas (Chalfant et al. 1990, Jannson and Raman 1991). Several studies on dispersal of male sweet potatoweevils (SPW) have been published (Jannson et al. 1991, Miyatake et al. 1995). However, the maximum dispersal distance of SPW is unclear because of differing dosages of pheromone, geography, climate, and various experimental designs used in the studies.

MATERIALS AND METHODS:

A one half acre field of Beauregard variety sweetpotatoes was planted on 6 June 1998 at the McNeil Experimental Farm in Pearl River County, MS. Potatoes were subjected to normal agronomic practices but received no artificial irrigation. Marked male SPW were released in the sweet potato field along with a comparative number of unmarked female SPW. Traps were deployed the same day of release (28 August, 1998) at a distance of 1 km from the field at the cardinal points and subcardinal points of the compass. After three days, traps were retrieved and counts were made of marked and unmarked SPW captured. Traps were reset at 0.5 km distance that same day and were collected three days later. Once again, counts were made and traps were reset at 100 m from the release point. After three days traps were collected, counts made and traps were reset along the immediate periphery of the field. Traps were left in place 3 days at which time they were collected and counts were made. The procedure was repeated beginning on 11 September, 1998.

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[1] Mississippi Agriculture and Forestry Experiment Station, Poplarville, MS

Table 2. Relative Attractiveness of Leaf and Root Volatiles of Selected Species of Convulvaceae to the Sweet Potato Weevil.

	MEAN NUMBER OF SPW			
	LEAVES		ROOTS	
TAXON	MALE	FEMALE	MALE	FEMALE
Ipomoea alba	2	2	0	3
I. aquatica	6	5	0	20
I. batatas	9	10	0	21
I. coccinea	4	7	0	7
I. cordato-triloba	11	16	1	23
I. cyanchifolia	5	8	0	10
I. grandifolia	4	7	0	6
I. hederaceae	6	6	1	9
I. imperati	5	10	1	12
I. indica	3	3	0	5
I. lacunosa	0	2	0	2
I. x leucantha	0	1	0	1
I. nil	1	3	0	4
I. pandurata	2	3	0	5
I. pes-caprae	4	8	1	10
I. purpurea	3	6	0	7
I. quamoclit	0	1	0	1
I. ramosissima	2	4	0	7
I. setosa	7	10	0	13
I. tabascana	2	6	0	6
I. tenuissima	2	5	0	8
I. tiliaceae	6	9	0	11
I. trifida	12	15	1	17
I. triloba	13	16	1	19
I. turbinata	2	4	0	5
I. wrightii	0	1	0	1
I. umbraticola	1	2	0	2
Merrimia dissecta	0	2	0	2
Turbina corymbosa	0	1	0	0

Table 1. Relative Attractiveness of Various Whole Leaves and Root Surfaces to Male and Female Sweetpotato Weevils.

	MEAN NUMBER OF SPW			
	LEAVES		ROOTS	
TAXON	MALES	FEMALES	MALES	FEMALES
I. alba	2	1	NA	NA
I. aquatica	0	5	NA	NA
I. batatas	9	5	1	8
I. coccinea	5	2	NA	NA
I. cordato-triloba	7	4	0	9
I. cordato-triloba x lacunosa	4	3	1	6
I. cyanchifolia	10	4	NA	NA
I. grandifolia	0	2	NA	NA
I. hederaceae	1	0	0	3
I. imperati	6	8	NA	NA
I. indica	4	3	NA	NA
I. lacunosa	2	1	NA	NA
I. x leucantha	1	0	NA	NA
I. pandurata	0	1	1	3
I. pes-caprae	7	9	NA	NA
I. quamoclit	1	0	NA	NA
I. tiliacea	5	2	NA	NA
I. trifida	7	4	NA	NA
I. triloba	2	5	NA	NA
I. umbraticola	1	4	NA	NA
I. wrightii	0	2	NA	NA
M. dissecta	2	2	0	3
Turbina corymbosa	6	4	NA	NA

<u>References Cited</u>:

Nottingham, S.F., K-C. Son, R.F. Severson, R.F. Arrendale & S.J.Kays. 1989. Attraction of adult sweetpotato weevils, *Cylas formicarius elegantulus* (Summers), (Coleoptera: Curculiondae), to sweet potato leaf and root volatiles. J. Chem. Ecol. 15: 1095-1106.

Visser, J.H. 1986. Host odour perception in phytophagous insects. Ann. Rev. Entomol. 31: 121-144.

RESULTS:

In those trials comparing relative attractiveness of whole leaves to root periderm, females showed a decided preference for roots over leaves. Male SPW displayed the opposite preference (Table 1). The sweet potato (45%) and its closest relatives (*Ipomoea cordato-triloba* [35%], *I. cyanchifolia* [50%], *I. trifida* [35%], *I. tiliaceae* [20%]) along with two closely related species (*I. imperati* [30%], *I. pes-caprae* [35%]) and *Turbina corymbosa* [30%] showed the greatest attractiveness for male SPW. Among female SPW, the greatest attractiveness were for, in descending order of preference, *I. pes-caprae* (45%), *I. imperati* (40%), *I. aquatica* (20%), *I. batatas* (20%) and *I. triloba* (20%).

The second phase of the study, the leaf/root volatile choice test, was undertaken in the spring of 1998. As with the whole leaf/root trial, significant differences were noted between male SPW and female SPW preferences between roots and leaves. In all instances, male SPW preferred leaf volatiles to root volatiles; female SPW showed a consistent preference for root volatiles over leaf volatiles. Those samples of leaf volatiles exhibiting the greatest response from male SPW were: *I. triloba* (52%); *I. trifid* (48%); *I. cordato-triloba* (44%); *I. batatas* (36%) and; *I. setosa* (28%). A very limited response (averaging less than 4%) was noted for root volatiles for male SPW (Table 2). Among female SPW, the highest level of attractiveness for both root and leaf volatiles was noted from *I. cordato-triloba* (92% root, 64% leaf). *I. batatas* ranked 2nd and 3rd in attractiveness from root (84%) and leaf (40%) volatiles respectively. *I. triloba* tied for first in leaf volatile attractiveness with a 64% response. In root volatiles tests the response was ca. 78% (4th). *I. trifida* placed second in leaf volatiles; attracting ca. 60% of female SPW. Its root volatiles were fifth in attractiveness (68%). *I. aquatica* only attracted ca. 20% of females to its leaf volatiles; but ranked third among root volatiles (80%). *I. imperati*, *I. setosa*, *I. tiliaceae*, *I. cyanchifolia* and *I. pes-caprae* ranked high in attractiveness of leaf volatiles (40%, 40%, 36% 32% and 32% respectively); but showed little comparative attraction with their root volatiles (Table 2).

hours. Leaves, sufficient to make 100g, were removed from the terminal 1.0 meter of healthy vines.

Leaf Material. All leaf material was collected in the field from healthy, growing plants. Leaf surface extracts were made by placing 100 g of leaf material in 300 ml of methylene chloride for 24 hours in a 1 liter teflon jar. The jar was agitated for two hours on a shaker and the liquid was filtered into a 500ml roundbottom flask and rotovapped. Hexane (50 ml) was added and the extract was rotovapped almost to complete dryness. The material was transferred with a Pasteur pipet into a 15 ml centrifuge tube and reduced to 1.0 ml on N-Vap. The material was then transferred into a glass vial, sealed with a Teflon-lined cap and kept at 0°C until required.

Root Material. Roots were collected from perennial wild host plants at the same time as the leaves were collected. Roots were severed at the root crown, transported in separate plastic bags and stored in the same manner as the leaves. One hundred grams of root from wild host plants and 100 g of sweet potato root periderm were used in the extractions. Procedures for extraction were accomplished as described for leaf material.

Bioassays. A dual-choice olfactometer, as described by Nottingham et al. (1989) was used to test the response of both male and female SPW to volatiles of various wild hosts.

Experimental procedures. SPW were starved for 2 hours prior to exposure to whole leaf/root or plant volatiles. Twenty-five male or female SPW were placed in the main arena. Air was drawn through the experimental chamber by vacuum pump. Plant volatile extracts were dried on filter paper and placed in test tubes. Root periderm or whole leaves were placed on a moistened 100mm filter paper and placed in the bottom of the chamber. Weevils were exposed for a period of 2 hours in the whole leaf/root study and 1 hour in the study of volatile attraction. After timed exposure, numbers of weevils in each chamber were counted. Three replicates per host plant were carried out.

PROJECT NO: 97SPW004

PROJECT TITLE: Attraction of Leaf and Root Volatiles of Wild Host Plants to the Sweet Potato Weevil, *Cylas formicarius elegantulus* (Summers)

TYPE REPORT: Final

LEADER/PARTICIPANTS: Tim Lockley, Mike Legendre[1], & Flowers White[1]

INTRODUCTION:

Cylas species weevils are serious pests of sweet potato, *Ipomoea batatas* (L.) Lam. throughout the world. They infest plants and storage roots both in the field and during postharvest storage (Nottingham et al. 1989). Plant volatiles are considered to be the main attractants to phytophagous species of insects (Visser 1986). Over 300 insect species within five orders were listed in Metcalf's review (1987) as selectively responding to 64 different plant odorants. Although some data has been collected about volatiles of sweet potatoes (Nottingham et al. 1989), little is understood concerning alternate wild hosts within the convolvulaceae.

MATERIALS AND METHODS:

Sweetpotato weevils (SPW) were reared in the laboratory on sweet potato storage roots in containers held at ca. 28°C and 70% relative humidity. Emerging weevils were removed weekly and transferred to containers with fresh sweet potato storage roots. SPW had no previous contact with sweet potato leaves or to any wild host plants.

WHOLE LEAF/ROOT STUDY - Leaves and roots were collected ca. 1 hour prior to use. Leaves sufficient to equal an area of ca. 50 cm. sq. were used. Root periderm was shaved from the root surface in amounts equal to ca. 50 cm. sq. Experimental protocol for both trials is described below.

LEAF AND ROOT VOLATILE STUDY - Leaves were collected from 7:00 to 10:00 am on the 25th and 26th of August, 1997. Leaves were placed in plastic bags and transported to the laboratory where they were cooled to 10°C and held for 24

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[1]National Monitoring and Residue Analysis Laboratory

MAXILLA The second pair of jaws

MAXILLARY PALPS The pair of jointed appendages originating from the maxillae

MESOSOMA The middle of the three major body parts; alitrunk

OCCIPITAL LOBES The rear corners of the head

OCELLUS One of the 3 simple, bead-like eyes located in the rear of the head

PECTINATE Comb-shaped

PEDICEL The waist (petiole + postpetiole)

PEDUNCULATE Stalk-like

PETIOLE The first segment of the "waist"

PILOSITY Longer, stouter hairs which are outstanding above the shorter pubescence

PLUMOSE Hairs that are multiply branched and feather-like in appearance

POSTPETIOLE The second segment of the "waist"

PROPODEUM The epinotum; the first abdominal segment fused to the thorax

PSAMMOPHORE A basket-like array of long, curved hairs beneath the head of some ants

PUBESCENCE Exceptionally short, fine hairs

PUNCTATE Bearing fine punctures like pinpricks;

PUNCTURES Pinpoint depressions in the exoskeleton

RECUMBENT Referring to a hair lying on the body surface

RETICULATE Covered with a network of carinae, striae or rugae

RETICULATE-PUNCTATE Covered with a network of carinae, striae or rugae with punctures in the interspaces

RUGOSE With multiple wrinkles, especially running approximately in parallel

RUGULOSE With multiple small wrinkles, especially running in parallel

SCAPE The first, elongate segment of the antenna

STRIAE Any fine, impressed line

STRIATE Transversely striate

SUTURE A seam or line separating two body parts

TUBERCULATE Covered with tubercles (small thickened spines or pimple-like structures)

GLOSSARY OF TERMS

ACUMINATE Tapering to a fine point

ACUTE Sharp angulate but less than 90 degrees

ALITRUNK Mesosoma; the middle major division of the thorax to which is fused rearward the propodeum

ANGULATE Forming an angle

ANTENNAL FOSSAE The cavity or depression of the head into which the first antennal segment is inserted.

APICAL At or near the tip

APPRESSED Referring to a hair that runs parallel to the body surface

CARINA An elevated ridge or keel

CLYPEUS The foremost section of the head capsule, just aft of the mandibles

DECUMBANT Referring to a hair that stands 10 - 40 degrees from the surface

DENTATE Toothed

DENTICULATE Furnished with minute teeth

DEPRESSED Flattened

DISTAL Farthest away from the body

DORSAL The upper surface

EMARGINATE Notched

EPINOTUM Propodeum, first abdominal segment fused to the rear of the thorax

ERECT Referring to a hair that stands straight up from the cuticle

FALCATE Sickle-shaped

FOVEOLATE With multiple small deep pits which are deeper and larger than punctures; hence coarser than punctate

FUNICULUS All of the antennae other than the scape

GASTER The globular terminal 4 or 5 segments of the abdomen immediately posterior to the pedicle

GLABROUS Smooth, hairless and shining

GULA The central part of the lower surface of the head

HUMERUS The shoulder; the anterior corners of the first segment of the thorax

LABIAL PALPS The pair of jointed appendages originating from the labium

LABIUM The second maxilla, forming the lower lip of the maxilla

LABRUM A broad lobe suspended from the clypeus forming the upper "lip"

LAMELLA A thin, plate-like process

LATERAL Towards the sides

MANDIBLES First pair of jaws

ECITONAE

Only one genera in Mississippi..Eciton

Eciton

1. Body pitch black, legs and other appendages lighter; smooth, shining throughout, except for sculpturing on the mandibles and pleura of the thorax..pilosum F. Smith

   Body sometimes very darkly colored, but never pitch black; not so smooth and shining, especially on the thorax which, due to heavy sculpturing, is somewhat subopaque..2
2. Head, thorax, petiole and postpetiole subopaque, foveolate-puctuate....... ....nigrescens (Cresson)

   Head, postpetiole and gaster shining....................................3
3. Petiole not much longer than broad, subrectangular; antennae more strongly incrassated than following species......................carolinense Emery

   Petiole very distinctly longer than broad...............opacithorax Emery

Stenamma

One species from Mississippi........................fovolocephalum M.R. Smith

Aphaenogaster

1. Antennal scapes with a prominent lobe at its base......................2
   Antennal scapes without a prominent lobe at its base....................3
2. Lobe considerably longer than broad, very much swollen or elevated near the base when viewed in lateral profile....................treatae Forel
   Lobe only slightly longer than broad, not preceptibly elevated at base... ....ashmeadi Emery
3. Base of first gastric segment longitudinally striated........mariae Forel
   Base of first gastric segment not longitudinally striated...............4
4. Head with posterior angles distinctly rounded..........................6
   Head with posterior angles not distinctly rounded......................5
5. Epinotal spines somewhat longer than half the base of the epinotum, length 4.5 - 5.0 mm..fulva Roger
   Epinotal spines shorter, body length 4.0 - 4.5 mm.......rudis picea Emery
6. A prominent tooth-like plate or disc extending laterally from the frontal carina and covering part of the base of the antennal scape............. ....lamellildens Mayr
   Frontal carina without a prominent tooth-like plate or disc...........7
7. Head constricted posteriorly; posterior surface of head and dorsum of prothorax almost smooth and glabrous...............flemingi M. R. Smith
   Head with rounded angles, but not as much constricted as in the preceding species...carolinensis Wheeler

Pseudomyrma

1. Body distinctly brown.................................brunnea F. Smith
   Body distinctly yellowish.............................pallida F. Smith

2. Antennal scapes distinctly flattened at the base when viewed in profile .... crassicornis Emery
Antennal scapes not flattened at the base 2
3. Epinotum with vestigial or very short blunt or tuberculate spines .... morrisi Forel
Epinotal spines not short 4
4. Head elongate with subparallel sides 5
Head not strikingly elongate or with subparallel sides 6
5. Head elongate, gular border with 2 prominent spines .... tysoni Forel
Head elongate, subcylindrical, truncated anteriorly .... lamia Wheeler
6. Head, for the most part, finely but thickly punctate throughout 7
Head not punctate throughout, the posterior half smooth and shining 8
7. Antennal scapes short, extending only about half the length of the head... .... vinlandica Mayr
Antennal scapes longer .... dentata Mayr
8. Head exceedingly large in proportion to the body, occipital angles coarsely rugose .... pilifera Roger
Head large, but not exceedingly so, occipital angles not rugose reticulate 9
9. Gular border, viewed from lateral profile, with 2 large, coarse teeth; postpetiole strikingly broader than long, each side very sharply conulate .... dentiqula M.R. Smith
Gular border, viewed from lateral profile, with small barely perceptible teeth; postpetiole connulate, but not sharply so 10
10. Posterior surfaces of occipital lobes of head smooth and shining 11
Posterior surfaces of occipital lobes not smooth and shining, with fine transverse striae .... sitarches campestris Wheeler
11. Posterior third of head, dorsally, reticulate-punctuate, with definite fovoelae .... metallescens Emery
Posterior third of head, dorsally, finely and closely punctuate, but without the reticulations and foveolae .... floridana Emery

Pogonomyrmex

One species from Mississippi .... badius Latr.

Myrmica

One species from Mississippi .... spatulata M.R. Smith

3. Size 2.0 to 2.5 mm; epinotal spines slender; gaster with an infuscated spot on each side near the base........................curvispinosus Mayr

Size 2.2 to 2.9 mm; epinotal spines more robust; gaster without an infuscated spot on each side near the base.............wheeleri M.R.Smith

4. Summit of petiolar node, when viewed from behind, impressed or concave..pergandei Emery

Summit of petiolar node, when viewed from behind, straight or rounded..pergamdei floridanus Emery

Trachymyrmex

One species from Mississippi...........................septentrionalis Wheeler

Monomorium

1. Dorsal alitrunk and occiput with green tint; mesopleron punctate...viridum Brown

Not as above...2

2. Head, thorax, petiole and post petiole smooth and shining; body deep brownish-black or black................................minimum (Buckley)

Head, thorax, petiole and post petiole finely, but closely, punctuate throughout; color yellowish or yellowish-red............pharaonis (Linn.)

Myrmecina

One species from Mississippi..................................americana Emery

Tetramorium

One species from Mississippi..................................guineense (Fabr.)

Triglyphothrix

One species from Mississippi................................striatidens (Emery)

Pheidole

MAJOR WORKERS

1. Large species, total length over 6 mm; head heavily sculptured, scapes very thick and bent at the base.............fallax obscurithorax Santschi

Species measuring 5 mm or less, if larger, head never heavily sculptured, scapes never thick nor strongly bent at base...........................2

11. Mandibles somewhat narrowly triangular, flatter dorso-ventrally, each with large coarse teeth on its entire inner border; clypeus broadly truncate or slightly emarginate.........................rostrata Emery
Mandibles triangular but shorter, each toothed on only a part of its inner surface; clypeus slilghtly truncate but never emarginate........12
12. Hairs on head abundant, distinctly scale-like........creightoni M.R.Smith
Hairs on head less abundant, longer and although slightly enlarged apically, not distinctly scale-like.................scupturata M.R.Smith

Solenopsis

MAJOR WORKERS

1. Second funicular segment of antennae at least 1 1/2 times as long as broad 2
Second funicular segment of antennae less than 1 1/2 times as long as broad; color yellow; small, 1.8 mm...........................molesta Say
2. Head strongly bilobed and extraordinarily large in proportion to body; mandibles abruptly curved, teeth largely aborted...........geminata Fabr.
Head of moderate size and only slightly bilobed; mandibles evenly curved, with 3 or 4 teeth...3
3. Antennal scape of smaller workers not reaching the occipital border of the head by the length of the first 2 funicular segments; mandible with 3 teeth...xyloni MacCook
4. Scapes of antennae reaching or nearly reaching occipital peaks; thorax with strong pronotal shoulders and a distinct promesonotal suture; color dark brown with large often strikingly bright orange spot on the first tergite of the gaster..................................richteri Forel
Scapes of antennae failing to reach occipital peaks by at least one or two scape diameters; thorax without angular shoulders; color of thorax reddish-brown, gaster very dark brown with gastric spot, if present, not as bright and occupying a smaller area of the first gastric tergite..invicta Buren

Leptothorax

1. Antennae with 11 segments...2
Antennae with 12 segments...4
2. Epinotal spines very short and tooth-like..................schaumi Roger
Epinotal spines long and curved.......................................3

Strumigenys

1. Mandibles slender, subparallel, longer than half the length of the head; apex with 2 prominent teeth..............................louisianae Roger
   Mandibles of various shapes but never longer than half the length of the head...2
2. Dorsal surface of first gastric segment clearly subopaque; infraspinal lamella absent......................................margaritae Forel
   Dorsal surface of first gastric segment smooth and shining; infraspinal lamella present...3
3. Prothorax flattened and very strongly marginate laterally; head nearly lacking pilosity except for a pair of short, more or less erect, club-like hairs on the vertex..............................membranifera Emery
   Prothorax not so strongly flattened and margined; head abundantly covered with variable types of pilosity.....................................4
4. Clypeus with a few very long, erect, enlarged hairs...dietrichi M.R.Smith
   Clypeus bearing different types of pilosity............................5
5. Mandibles elongate, slender, and somewhat subparallel, each with a distinct tooth on its inner margin just in front of the clypeus.........6
   Mandibles only moderately or not at all elongated; if similar to above description, tooth on inner margin is hidden beneath the clypeus when mandibles are closed...7
6. Clypeus decidedly truncate anteriorly; antennal scapes short and very strongly angulate basally..........................angulata M. R. Smith
   Clypeus moderately truncated anteriorly; scapes longer and less angulate basally..pergandei Emery
7. Anterior border of clypeus rounded....................................11
   Anterior border of clypeus either truncate or emarginate................8
8. Sides of head gradually converging anteriorly..........................9
   Sides of head nor noticeably converging anteriorly, more or less subparallel...10
9. Clypeus broadly rounded, hairs strikingly spatulate....rohweri M.R. Smith
   Clypeus with short, appressed scale-like hairs............clypeata Roger
10. Head relatively robust in proportion to its length; upper half rugulose or tuberculate; mandibles rather robust, convex...missouriensis M.R.Smith
    Head relatively slender in proportion to its length; surface, although reticulate, not tuberculate; mandibles slender somewhat laterally compressed...pulchella Emery

Crematogaster

1. Antennal club 2 segmented; epinotal spines shorter than their interbasal space; postpetiole broader than long, without a longitudinal furrow.....2
   Antennal club 3 segmented; epinotal spines longer than their interbasal space; postpetiole with a longitudinal furrow.........................3
2. Epinotal spines about half as long as the interbasal space and directed upwards; pronotum with the rugae usually lateral in position...missouriensis Emery
   Epinotal spines less than half as long as the width of the interbasal space, directed more backward than upward; two prominent rugae near the middle of the pronotum.................................minutissima Mayr
3. Pleurae of pronotum sculptured, giving a roughened, opaque surface......4
   Pluerae of pronotum largely unsculptured with a large, smooth, reflective or shining surface..6
4. A band of erect hairs occurs transversely across the pronotum; other erect hairs scattered randomly on mesonotum.......................lineolata Say
   Erect hairs of pronotum confined to humeral shoulders, occasional erect hairs may exist about anterior margin of propodeum.....................5
5. Thoracic dorsum rugose with a reticulate pattern of anastomosing ridges ....vermiculata
   Thoracic dorsum with longitudinal, short striations or ridges, intervening cuticle granulate or punctate.........................cerasi
6. Propodeal spines short and, in dorsal view, inner margins are parallel to longitudinal body axis......................................ashmeadi Mayr
   Propodeal spines long and apices, in dorsal view, diverge from longitudinal body axis...7
7. Pubescense on head and thorax appressed, hairs on head fine and oriented in orderly rows.......................................atkinsoni Wheeler
   Pubescense on head and thorax, in part, suberect to erect, and hairs on head do not lie in orderly rows.......................................8
8. Head and thorax brown; gaster black.....................laeviuscula Mayr
   Head and thorax distinctly red or reddish-brown; gaster black ....clara Emery

6. Epinotum without teeth or spines; pronotum never angular; petiole long and slender..Monomorium
Epinotum with teeth, spines or tubercles..............................7

7. Epinotum with a pair of small spines in front of the larger pair.........
....Myrmecina
Epinotum with only one pair of spines or tubercles....................8

8. Clypeus elevated in the form of a carinae in front of the antennal socket
....9
Clypeus not elevated in front of the antennal socket..................10

9. Body covered with dense, soft erect hairs many of which are branched or trifid; thorax strongly arched dorsally and without sutures..............
....Triglyphothrix
Body hairs simple; humeri angulate; clypeus usually with carinae.........
....Tetramorium

10. Last 3 antennal segments enlarged forming a club......................11
Last 3 or segments enlarged but not forming a distinct club............12

11. Meso-epinotal constriction present when humeri are rounded; absent when humeri are angulate; workers not dimorphic..................Leptothorax
Meso-epinotal and pro-mesonotal constrictions are present; workers strongly dimorphic with head of soldiers very large; antennal club longer than the remainder of the funiculus............................Pheidole

12. Meso-epinotal constriction present and pro-mesonotal suture usually distinct...13
Meso-epinotal and pro-mesonotal constrictions absent; ventral surface of the head with psammophore; heads of major workers very large............
....Pogonomyrmex

13. Middle and hind tibial spurs pectinate.........................Myrmica
Middle and hind tibial spurs not pectinate............................14

14. Small species with vestigial eyes and 2 carinae on the clypeus; Antennal scape not reaching the occipital border........................Stenamma
Larger species, usually with well-developed eyes; clypeus emarginate, without carinae; antennae usually surpassing the occipital border of the head. Body long, slender; legs long......................Aphaenogaster

2. Head, thorax and petiole yellowish-red; gaster black with yellowish spots ....mariae Forel

Body black or brownish-black; legs dark brown.........taschenbergi (Mayr)

Dorymyrmex

1. Head, thorax and gaster pale yellow; gaster more or less infuscated...... ....bureni Trager

Head and alitrunk dark brown; gaster darker than the rest of the body.... ....medeis

Tapinoma

A single species from Mississippi..............................sessile (Say)

Linepithema

A single species from Mississippi..................................humile

Forelius

1. Body uniformly brown, covered with a pine pubescense....pruinosus (Roger)

Head and thorax brown, abdomen paler giving a bicolor appearance......... ....pruinosus analis Andre

KEY TO THE GENERA OF MYRMECINAE

1. Postpetiole joined to the dorsal surface of the gaster near the front end which is flattened dorsally and convex ventrally............Crematogaster

Postpetiole joined to the front end of the gaster......................2

2. Antennae with 6 segments, antennal fossae as long as the scale, club longer than the remainder of the funiculus; head heart-shaped............ ....Strumigenys

Antennae with more than 6 segments....................................3

3. Antennae with 10 segments and a 2-segmented club..............Solenopsis

Antennae with more than 10 segments...................................4

4. Antennae with 11 segments...5

Antennae with 12 segments...6

5. Antennae with last 3 segments enlarged to form a club.........Leptothorax

Antennae with 3 or 4 segments enlarged but not forming a club............ ....Trachymyrmex

Hypoponera

1. External border of mandibles sinuate; base of epinotum laterally compressed; color ferruginous yellow.................... inexorata Wheeler
   External border of mandibles not sinuate..................................2
2. Petiole slender laterally and triangular; body slender; color from light brown to black...opacior Forel
   Petiole laterally subrectangular..3
3. Head with dense coarse punctures; subopaque..........pennsylvanica Buckley
   Head with dense fine punctures........................opaciceps

Cryptopone

A single species from Mississippi.............................gilva (Roger)

KEY TO THE GENERA OF THE DOLICHODERINAE

1. Epinotal declivity strongly concave; meso-epinotal constriction deep..... ....Dolichoderus
   Epinotal declivity not concave; meso-epinotal constriction less conspicuous...2
2. Epinotum with a prominent conical elevation; weakly developed psammophore ....Dorymyrmex
   Epinotum not conical; psammophore not present.........................3
3. Scale of petiole vestigial, covered by the base of the gaster; pronotum generally lacking erect hairs..................................Tapinoma
   Scale of petiole well developed and not covered by base of gaster.......4
4. Metanotal groove reduced to a suture; mesonotum and propodeum forming a continuous surface in profile...............................Liometopum
   Metanotal groove present..5
5. Head triangular; no erect hairs on alitrunk; propodeum two times as high as long...Linepithema
   Head rectangular; erect hairs on alitrunk; propodeum not two times as high as long..Forelius

Dolichoderus

1. Body distinctly hairy above; base of gaster with reddish-yellow spots.... ....pustulatus Mayr
   Body hairless or nearly so above..2

3. Clypeus on the truncated part of the head twice as long as broad, slightly broader above, extending onto the dorsal surface of the head by about 1/4 of the total length of the clypeus............impressus (Roger)
Clypeus on the truncated part of the head subrectangular, slightly longer than broad, not broader above, slightly raised above the surface; extending onto the dorsal surface of the head by about 1/2 the length of the clypeus....................................obliquus M.R. Smith

KEY TO THE GENERA OF THE PONERINAE

1. Frontal carinae close together, tip of gaster directed downward or forward underneath...Proceratium
Frontal carinae not close together, tip of gaster not directed backwards..2
2. Mandibles long and slender, with a row of coarse, bidenticulate teeth; front border of the clypeus with numerous teeth...............Stigmatomma
Mandibles and clypeus not as described above............................3
3. Tibia of middle and hind leg each with one spur, first joint of middle tarsi without stiff bristles on its extensor surface...........Hypoponera
Tibia of middle and hind legs with two spurs, the smaller of which is not easily observed, first joint of middle tarsi with strong bristles on its extensor surface..Cryptopone

Proceratium

1. Petiolar node in the form of a thick, erect scale with nearly parallel anterior and posterior faces; apex truncate in side view; second gastric segment curved downward, but not strongly inflated or produced caudad...2
Not as described above................................pergandei (Emery)
2. 3-4 mm in length, color rufous, antennal scapes reaching the posterior quarter of the head; scale of the petiole 1/3 the length of the dorsal side of the first gastric segment........................croceum (Emery)
Smaller, antennal scapes reaching only to the posterior third of the head; scale of petiole 1/4 the length of the dorsal side of the first gastric segment...silaceum Roger

Stigmatomma

A single species from Mississippi........................pallipes (Haldeman)

6. Body and legs with short hairs, middle and hind tibiae each with a row of rather short graduated bristles extending nearly their entire length; base of gaster with yellow bands, ; clypeus with a broad notch in the middle of lobe in front...<u>socius</u> Roger

   Body with long yellow hairs, legs without graduated bristles...<u>abdominalis</u> <u>floridanus</u> (Buckley)

7. Mandibles, clypeus, and cheeks with numerous foveolate punctures........8

   Mandibles, clypeus and cheeks without elongate foveolae.................9

8. Body brownish to black, mandibles, clypeus, front border of cheeks, funiculi and appendages paler; gaster black with posterior border of segments pale...<u>caryae</u> (Fitch)

   Head, thorax, petiole and appendages yellowish-red; gaster black, funiculi often darker toward tip..............................<u>discolor</u> Buckley

9. Head black or reddish-brown, thorax partly red, reddish-brown or yellowish with brown spots; gaster black, sometimes with yellow on first segment of petiole, or yellow posterior margins to abdominal segments...<u>nearcticus</u> Emery

   Head and thorax brownish red, gaster black, sometimes the base of first abdominal segment and the venter deep red; mandibles sometimes red, teeth black; cheeks and front of clypeus somewhat infuscated, funiculi red..<u>decipiens</u>

<u>Colobopsis</u>

1. Anterior truncated surface of head deeply concave; lateral margins sharp..<u>mississippiensis</u> M.R. Smith

   Anterior truncated surface of the head not deeply concave; lateral margins not sharp..2

2. Head with subparallel sides; anterior truncated surface of the head slightly concave, slightly carinate, or not carinate laterally...........3

   Head wider in front than behind, cheeks inflated, anterior truncated surface of head not carinate laterally; clypeus more or less triangular, distinctly narrower at the apiccal forth than at the base.........<u>pylartes</u>

2. Apical margin of the petiolar scale angulate at the middle forming a blunt point; color reddish brown, gaster dark brown or black, somewhat shining with sparse pubescense..................................*integra* Nylander
Apical margin of petiolar scale not as described above.................3
3. Body color red or dark red, thorax deeply infuscated, gaster darker, almost black; pubescense on gaster sparse......................*rufa* Forel
Color of body black or very dark brown; pubescense dense and silky; petiolar scale flattened behind..............................*fusca* Linne
4. Erect hairs presenton gula and petiole; maxillary palp with 6 segments..6
Erect hairs absent on gula and petiole; maxillary palp with 5 segments..5
5. Gaster dark brown or black, shining; head and thorax brown or reddish; scale of petiole almost straight behind dorso-ventrally.................
nitidiventris Emery
Gaster yellow or but slightly infuscated, body pale yellow; scale of petiole curved behind dorso-ventrally as well as laterally..............
pallida fulva Latreille
6. Gaster darker than head and thorax; hairs on gula and petiole numerous and conspicuous...*schaufussi* Mayr
Gaster very little, if any, darker than head and thorax, pubescense longer and denser; hairs on gula and petiole not so numerous.......*dolosa* Wheeler

Camponotus

1. Clypeus with a deep narrow notch in the front margin..................7
Clypeus without a deep narrow notch in the front margin................2
2. Clypeus without a lobe in front, margin straight......................3
Clypeus with a lobe in front...6
3. Body color, for the most part, reddish yellow.........................4
Body color darker..5
4. Body color entirely yellow or reddish-yellow............*castaneus* (Lat.)
Body color reddish-yellow, head dark brown or black.....*americanus* Mayr
5. Body entirely black, pubescense pale yellow or white..................
....*pennsylvanicus* (DeGeer)
Body black, except posterior part of petiole, base of gaster and legs reddish-yellow; pubescense golden yellow...............*ferruginea* (Fab.)

6. Cephalic pubesense dilute; preoccipital area with most spaces between setae as wide as length of setae or wider; anterior half of head lacking pubescense..7
Cephalic pubescense denser; preoccipital area with more spaces between setae no wider than length of setae, usually less...........faisonensis
7. Eye about 1/4 HL or slightly larger.................vividula (Nylander)
Eye smaller...terricola

Lasius

1. Last 3 segments of maxillary palpi elongated, of nearly equal length...2
Last 3 segments of maxillary palpi short, successively diminishing in length...3
2. Scapes and legs without erect hairs....................alienus (Foerster)
Scapes and legs with erect hairs..........................neoniger Emery
3. Tips of scapes not reaching to the posterior corners of the head.........
....brevicornis Emery
Tips of scapes extending beyond the posterior corners of the head......4
4. Tips of scapes extending only slightly beyond the posterior corners of the head; color pale yellow..............................nearcticus Wheeler
Tips of scapes extending some distance beyond the posterior corners of the head; color brownish yellow...............................speculiventris

Acanthomyops

1. In profile, petiole low and blunt above..................latipes (Walsh)
Petiole higher, acute and thin above.................................2
2. Penultimate segments of the funiculus somewhat broader than long; gaster with abundant long hairs...............................claviger (Roger)
Penultimate segments of the funiculus not broader than long; gaster with sparse long hairs.................................interjectus (Mayr)

Formica

1. Body of workers robust; heads of largest not or scarcely longer than broad; antennal grooves diverging behind; scale of the petiole usually with a sharp apical border, or flattened behind or both................2
Body of workers more slender; head of largest workers usually distinctly longer than broad; antennal grooves not diverging behind; scale of petiole thick with a blunt border...4

KEY TO THE SPECIES OF FORMICINAE

Brachymyrmex

1. Concolorous very dusky red; thoracic dorsum with 6-8 short stout hairs; gastric pubescence not concealing shining surface; 1.25-1.5 mm in length. ....musculus Forel

   Concolorous strong brown to reddish-yellow; no erect hairs on thoracic dorsum; gaster pubescense dense..........................depilis Emery

Prenolepis

1. Only one species known from Mississippi....................imparis (Say)

Paratrechina

1. Scapes and legs unusually long; weakly shining black or grey with bluish reflections; sparse, barely visible pubescense......longicornis (Latr.)

   Scapes and legs of normal proportions; various colors but never with bluish tint..2

2. Yellowish to pale white; nests in sandy soil with entrances surrounded with conspicuous crater of subsoil in clearings between vegetation....3

   Uniformly dark colored or bicolored; nests inconspicuous..............4

3. Yellow with gaster infuscated posteriorly; thoracic pilosity flexuous and dark brown; scape with 5-17 machrochaetae and suberect pubescense...... ....arenivaga (Wheeler)

   Yellow or whitish with gaster, at most, only slightly darker; thoracic pilosity nearly straight; nearly the same color or only slightly darker than body color; scape with 0-4 macrochaetae and short, appressed pubescence..phantasma

4. Scapes with not more than 4 standing machrochaetae.........parvula (Mayr)

   Scapes with at least 4 (usually 7+) standing machrochaetae............5

5. Uniform dark brown with appendages somewhat lighter; propodeum with a dense row of longitudinally aligned pubescense along the anterior edge; head with dense pubescense that is mostly aligned with the long axis of head...concinna

   Middle and hind coxae and/or thorax and legs lighter than gaster and head; pubescense very sparse or absent from promesonotum; head smooth and shining or irregularly and weakly punctate beneath pubescense........6

5. Eyes large, reniform or subelliptical, about half as long as the side of the head; ocelli usually present........................PSEUDOMYCINAE
Eyes very small, ocellus-like or absent; ocelli absent.....ECITONINAE

KEY TO THE GENERA OF THE FORMICINAE

1. Antennae with only nine (9) segments, workers minute, monomorphic. Thorax short and stout..Brachymyrmex
Antennae with 12 segments...2
2. Clypeal fossae confluent with the antennal fossae; antennae inserted near the posterior edge of the clypeus.............................5
Clypeal fossae completely separated from the antennal fossae.......3
3. Antennae inserted far from the rear edge of the clypeus; workers polymorphic; dorsum flattened.......................................7
Antennae inserted very near the rear edge of the clypeus............4
4. Eyes in front of the middle of the side of the head......Paratrechina
Eyes behind the middle of the side of the head............Prenolepis
5. Segments 2-5 of the funiculus shorter, or at least not longer, than the succeeding segments; ocelli absent or indistinct..............Lasius
Segments 2-5 not shorter than the succeeding segments, ocelli distinct.
....6
6. Mandibles nearly triangular, maxillary palpi 6-segmented, labial palpi 4-segmented..Formica
Mandibles marrow and pointed, maxillary palpi 4-segmented, labial palpi 2-segmented..Polyergus
7. Workers dimorphic (medias absent); Head of major worker obliquely truncate in front..Colobopsis
Workers completely polymorphic. Head of major not obliquely truncate.
....Camponotus

PROJECT NO: FA04G018

PROJECT TITLE: A Simplified Taxonomic Key to the Ants of Mississippi

TYPE REPORT: Interim

LEADER/PARTICIPANTS: Timothy C. Lockley

INTRODUCTION:

In order to facilitate identification of the Formicidae collected during various studies undertaken in the state of Mississippi, the following work in progress is proposed.

MATERIALS AND METHODS:

Modifications of selected keys were used in the development of this key. Ants identified by this key were selected based upon the author's personal knowledge; from previously published species distributions; and collections stored at the Mississippi Entomological Museum at Mississippi State University.

RESULTS:

KEY TO THE IDENTIFICATION OF SUBFAMILIES

1. Pedicel composed of only one segment..............................2
   Pedicel composed of two segments..................................4
2. Cloacal orifice circular, terminal and surrounded by a fringe of hairs. Gaster without a constriction between the first and second segments ....FORMICINAE
   Cloacal orifice slit shaped, not terminal.........................3
3. Gaster with a definite constriction between the first and second segments ....PONERINAE
   Gaster without such a constriction....................DOLICHODERINAE
4. Frontal carinae not close together, often covering the base of the antennae. Clypeus usually prolonged back between the frontal carinae. ....MYRMECINAE
   Frontal carinae close together, not covering the base of the antennae..5

Table 3. Cont.

NUECES CO. TAXON	NUMBER COLLECTED 1973	1997	1998	MEAN NUMBER PER SITE 1973	1997	1998	PERCENT OF SITES 1973	1997	1998
S. geminata	1658			55.3			23.6	0.0	
S. xyloni	1769			63.2			22.0	0.0	
Ph. dentata	621	3		51.8	3.0		9.5	1.3	
Ph. floridana	416			41.6			7.9	0.0	
S. invicta	449	1106	714	99.8	44.2	42.3	3.9	31.3	21.3
F. pruinosus	141	64	1	28.2	21.3	1.0	3.9	3.8	1.3
M. minimum	75			15.0			3.9	0.0	
Ph. tepicana	356			89.0			3.1	0.0	
S. (Diplorhoptrum) sp.	40			10.0			3.1	0.0	
C. laeviuscula	27			13.5			1.6	0.0	
C. nuda	2			1.0			1.6	0.0	
Paratrechina sp.	2			2.0			0.8	0.0	
P. terricola	3	46	3	3.0	4.6	1.5	0.8	12.5	2.5
D. bureni		4	45		1.3	22.5	0.0	3.8	2.5

CAMERON CO. TAXON	NUMBER COLLECTED 1973	1997	1998	MEAN NUMBER PER SITE 1973	1997	1998	PERCENT OF SITES 1973	1997	1998
S. geminata	3817	1333	1049	61.6	49.4	65.6	48.8	31.0	18.2
Ph. floridna	953			31.8			23.6	0.0	
F. pruinosus	635	554	639	23.5	36.9	40.1	21.3	17.2	17.1
Ph. dentata	390	92	433	17.0	30.7	86.6	18.1	3.5	5.7
M. minimum	665	3	4	33.3	3.0	2.0	15.8	1.2	2.3
P. barbatus	57	85	6	5.7	7.1	1.2	7.9	13.8	5.7
C. laeviuscula	148	1	169	124.0	1.0	33.8	1.6	1.2	5.7
S. (Diplorhoptrum) sp.	2	40		2.0	40.0	0.8	1.2		
Paratrechina sp.	1	64	2	1.0	10.7	2.0	0.8	6.9	2.3
P. terricola	1		36	1.0		7.2	0.8	0.0	5.7
Tetramorium similimum	1			1.0		0.8	0.0		
Cardiocondyla emeryi	1			1.0		0.8	0.0		
Macromischa subditiva	1			1.0		0.8	0.0		
S. invicta		163			163.0	0.0	1.2		
Forelius sp.		40			5.0	0.0	9.8		
D. bureni		127	118		31.8	13.1	0.0	4.6	10.2
Pheidole sp.		2	91		2.0	91.0	0.0	1.2	2.3
Leptothorax nr. schmitti		64	73		64.0	14.6	0.0	1.2	5.7
A. texana		1			1.0	0.0	1.2		

Table 3. Species List of Ants Captured By Bait Trap in Four Texas Counties in 1973, 1997 and 1998.

GALVESTON CO. TAXON	NUMBER COLLECTED 1973	1997	1998	MEAN NUMBER PER SITE 1973	1997	1998	PERCENT OF SITES 1973	1997	1998
Solenopsis invicta	452	700	976	37.6	38.9	46.5	**50.0**	**28.6**	52.4
Monomorium minimum	367	72	522	30.2	24.0	**65.8**	**50.0**	**4.8**	12.7
Paratrechina terricola	27	143	75	5.4	11.0	7.5	20.8	20.6	15.9
Tetramorium bicarinatum	151			75.5			**8.3**	**0.0**	
Crematogaster sp.	161		47	161.0		25.5	**4.2**	**0.0**	3.2
S. geminata	120			120.0			**4.2**	**0.0**	
Pheidole dentata	10	8		10.0	2.7		4.2	4.8	
Forelius pruinosus	3	6	1	3.0	3.0	1.0	4.2	3.2	1.6
S. xyloni	1			1.0			**4.2**	**0.0**	
Cardiocondyla nuda	1			1.0			**4.2**	**0.0**	
Aphaenogaster texana		5			5.0		0.0	1.6	
Crematogaster pilosus		2			2.0		0.0	1.6	
Pseudomyrmex pallidus		1			1.0		0.0	1.6	
Brachymyrmex depilis			8			4.0			3.2
Formica sp.			7		7.0				1.6
Dorymyrmex bureni			2		2.0				1.6
Monomorium viridum			1		1.0				1.6

BEXAR CO. TAXON	NUMBER COLLECTED 1973	1997	1998	MEAN NUMBER PER SITE 1973	1997	1998	PERCENT OF SITES 1973	1997	1998
Ph. dentata	455	76		12.0	76.0		**32.5**	**1.8**	
S. geminata	471			22.4			**18.0**	**0.0**	
M. minimum	140		151	28.0		75.2	**4.3**	**0.0**	2.8
Pheidole tepicana	39			9.8			**3.4**	**0.0**	
S. xyloni	80			40.0			**1.7**	**0.0**	
Pheidole floridana	12			12.0			0.9	0.0	
P. terricola	9			9.0			0.9	0.0	
Crematogaster laeviuscula	2			2.0			0.9	0.0	
D. bureni	1		17	1.0		8.5	0.9	0.0	2.8
S. invicta		1046	3732		49.8	149.3	**0.0**	**36.9**	**35.2**
F. pruinosus		250	1292		27.8	99.4	**0.0**	**15.8**	**18.3**
Pogonomyrmex barbatus		31	31		15.5	15.5	**0.0**	**3.5**	3.5
Leptothorax nr schmitti		56			56.0		0.0	1.8	

Table 1. Red Imported Fire Ants as a Percentage of Ants Collected

LOCATION	1973	1997	1998
Galveston Co.	35.0	74.7	59.5
Nueces Co.	8.9	90.4	69.8
Bexar Co.	0.0	71.7	93.7
Cameron Co.	0.0	6.4	0.0

Table 2. Changes in Diversity of Ant Species Captured In Four Texas Counties From 1973 to 1997.

	1973		1997		1998	
LOCATION	NUMBER GENERA	NUMBER SPECIES	NUMBER GENERA	NUMBER SPECIES	NUMBER GENERA	NUMBER SPECIES
Galveston Co.	8	10	8	8	9	9
Nueces Co.	7	13	5	5	6	6
Bexar Co.	6	9	5	5	4	4
Cameron Co.	10	13	10	13	10	12

spring collections. The county experienced over 20 inches of precipitation in 48 hours. Estimates by the Texas Emergency Management Agency suggested that 93% of Nueces County had been innundated. Ten of the native ant species found in 1973 were not taken in the 1997 collections. One of these, *Pheidole floridana*, had previously been found at 7.9% of the sites.

In Cameron County, some decline in numbers of *S. geminata* was seen. A big headed ant, *Ph. floridana*, was not taken in 1997 or 1998. Another of the big headed ants, *Ph. dentata*, had also decreased; falling from a high of 18.1% in 1973 to a low of 3.5% in the 1997 sampling and 5.7% in 1998. *Monomorium minimum* likewise declined sharply from 15.8% to 1.2% (1997) and 2.5% (1998). Some increases had also occurred. The harvester ant, *Pogonomyrmex barbatus*, went from being found at 7.9% of the sampling sites to 13.8% (1997). In the 1998 samples, it dropped back to near the 1973 numbers being taken at only 8.7% of the collection points. *Paratrechina* species also increased going from 0.8% in 1973 to 6.9% in 1997 to 11.4% in 1998. Six species of ants found in 1973 were not found in either of the later surveys. While seven new species were collected in 1997/1998 as compared with 1973. An unidentified *Forelius* species not found in 1973 was taken from 9.8% and 17.1% of the sites in 1997 and 1998 respectively and *Dorymyrmex bureni* was found at 4.6% and 10.2% of the sites (1997 & 1998).

confirmed the identifications. Specimens are maintained at the Gulfport Plant Protection Station.

RESULTS:

In all four counties, increases in RIFA abundance (as a percentage of ants caught) were observed (Table 1). Both Bexar and Nueces counties had exceptionally large increases in RIFA numbers. These counties also reflected the largest decreases in ant species diversity (Table 2).

The congenera of RIFA (*Solenopsis geminata* and *S. xyloni*) were completely eliminated in three of the four counties surveyed (Bexar, Galveston, and Nueces). In 1973, *S. geminata* was found at 4.2% of the sites in Galveston county, 18.0% of the sites in Bexar County, and 23.6% of the sites in Nueces county. Some decrease in *S. geminata* numbers was also noted in Cameron county. With *S. xyloni*, similar results were observed with decreases occurring in the three counties where it had been previously collected (Table 3).

Precipitous decreases in numbers of other ant species was noted in the 1997 survey. In Galveston county (1973), *Monomorium minimum* had been collected at 50.0% of the sites. By 1997, it could only be found at 4.8% of the collection points; in 1998 it was collected at 12.7% of the sites. *Tetramorium bicarinatum* dropped from 8.3% to 0.0% in 1997 and 1998.

In Bexar county, *Pheidole dentata* had been collected at 32.5% of the sites in the first survey. In 1997, it had declined to only 1.8%; by 1998, it had dropped to 0.0%. During that same period, RIFA increased from zero collections to being found at 36.9% of the sites in 1997 (39.2%, 1998). *Forelius pruinosus*, a species of ant that seems to compete well with RIFA (pers. obs.) also increased significantly between samplings; going from 0.0% (1973) to 15.8% of the locations in 1997 and 18.3% in 1998.

Data from Nueces County reflected much the same changes as seen in Bexar county. RIFA numbers rose from 3.9% of the sites to 31.3% (1997) and 21.3% (1998). Differences in species numbers and abundance between 1997 and 1998 may be attributed to massive flooding that occurred three weeks prior to the

PROJECT NO: FA05G017

PROJECT TITLE: The Ants of East Texas: a Twenty-Five Year Comparative Survey

TYPE REPORT: Final

LEADER/PARTICIPANT: Tim Lockley

INTRODUCTION:

In 1973, a survey was conducted to determine the ant species currently extant in eastern Texas. Four counties (Bexar, Cameron, Galveston, Nueces) were selected for the survey based upon their history with regards to the imported fire ant, *Solenopsis invicta*. Although separated from the contiguously infested area of Texas until the mid 1980's, Bexar county has been under federal quarantine the longest of the four (1959) for red imported fire ants (RIFA). Galveston County was next to be declared officially infested by RIFA in 1969. Nueces County came under Federal quarantine in 1973 (the first year of the survey). Cameron County was the last to come under the quarantine in 1996.

In 1997, the first of two follow-up surveys was made to determine the change in RIFA and native ant status in east Texas. A second survey was carried out six months later in the spring of 1998.

MATERIALS AND METHODS:

In September, October, and November, 1997 and April and May of 1998, bait transects were run along major roadways within each county at 0.5 mile intervals. Care was made to attempt, where possible, to repeat the same lines of transect as used in the Glancey et al. (1973) unpublished study. A liquid bait supplied by Dr. David Williams (USDA, ARS, CMAVE, Gainesville, FL) was used as the attractant. Bait traps were placed along the roadsides and left for ca. one hour before retrieval. Within two hours of collection, specimens were removed from the bait traps; separated into distinct groupings and counted. Ants were placed in 70% ETOH and returned to the USDA facilities at Gulfport MS where they were examined under magnification and identified to the lowest level possible. Dr. Daniel Wojcik (USDA, ARS, CMAVE, Gainesville, FL)

Figure 3. Mean number of genera collected (includes *S. invicta*).

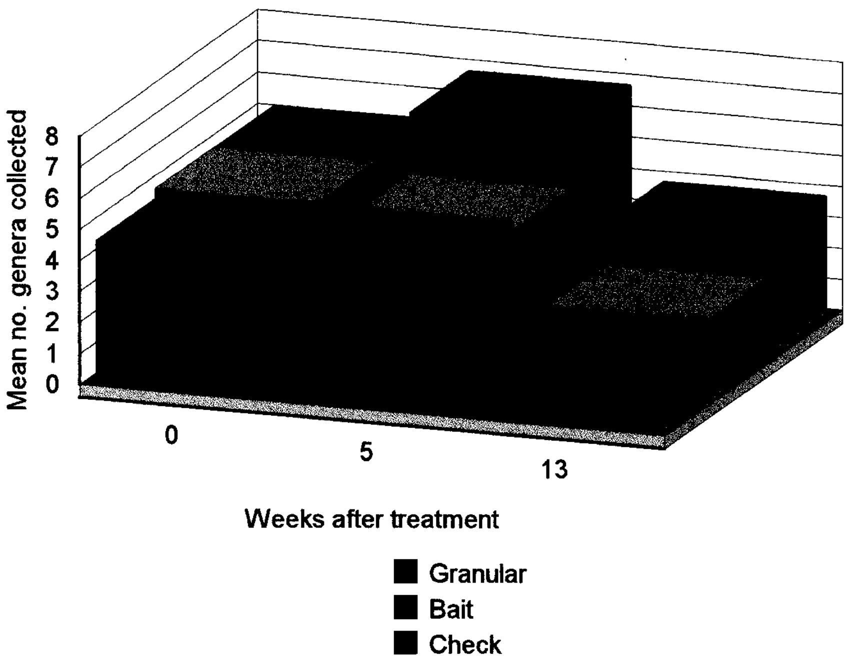


Figure 1. Mean number of *Solenopsis invicta* collected in bait traps.

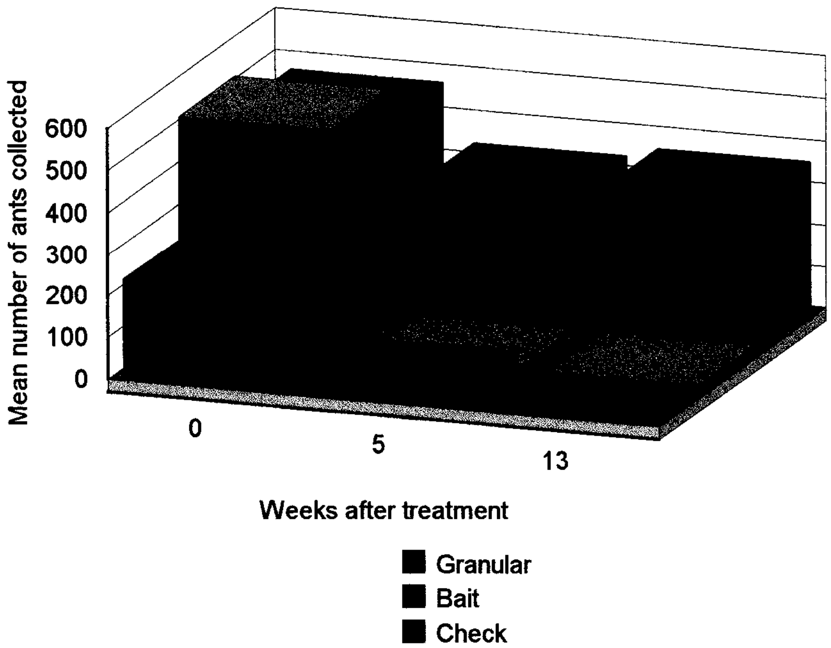
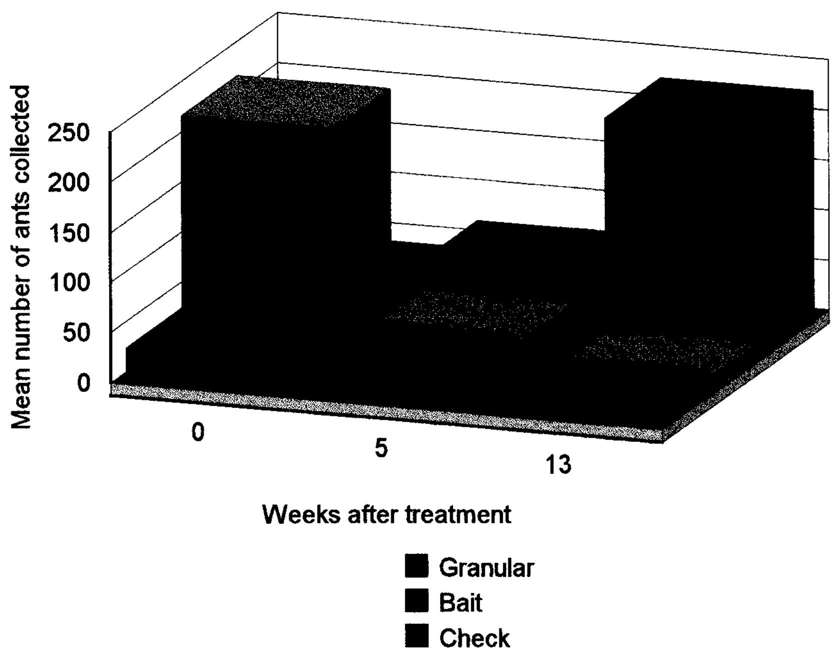


Figure 2. Mean number of *Solenopsis invicta* collected in pitfall traps.



The most common ants collected besides *S. invicta* were *Dorymyrmex bureni* and *Brachymyrmex sp.* (Table 1). Although numbers of *S. invicta* collected decreased dramatically in the treated plots they remained the highest percentage of ants collected at all collection times. At this time, there are no apparent patterns in species presence.

Table 1. Percentage of total ants collected in plots at indicated time periods.

	Check			**Granular**			**Bait**		
Genera/species	pret	5 wk	13 wk	pret	5 wk	13 wk	pret	5 wk	13 wk
S. invicta	86.8	92.4	98.0	83.3	93.3	85.3	88.3	70.1	83.3
D. bureni	5.7	0.9	0.5	10.7	2.6		9.1	1.6	
Brach. sp.	1.0	0.3	1.5	4.1	1.1	14.7	2.0	20.5	
Forelius sp.	5.1								
Camponotus sp.	1.1								
Pheidole sp.				1.5	1.9				
C. rimosus		2.0						1.6	10.0
Leptothorax sp.		2.4							
Paratrechina sp.									6.7
Formica sp.								1.6	
Aphenogaster sp.								1.6	
Other	0.3	2.0	0.0	0.4	1.1	0.0	0.6	3.0	0.0

applied at 10 lbs bait per acre, fipronil 0.05% granular applied at 25 lbs formulated product per acre, and an untreated control. Insecticide treatments were applied with a shop-build granular applicator mounted on a farm tractor. Ants were collected prior to application of fipronil using bait and pitfall transects placed diagonally across each test plot. Ten bait stations spaced ca. 50 feet apart were used in each transect. Stations were baited with the multiple ant bait (MAB) developed by Williams, Oi, and Vail (ARS, patent pending). Pitfall traps consisting of 4" diameter plastic cups (16 oz), containing ethyl alcohol were established adjacent to each bait station. Pitfalls and bait stations were employed prior to application and at 4, 12, 20 and 28 weeks after application. Pitfalls were left in place for 48 hour intervals, and bait stations were retrieved after being in place for approximately one hour. Tim Lockley from this laboratory provided taxonomic identification and enumeration of all ants collected. Verification of taxonomic accuracy was provided by Dr. Dan Wojcik, ARS, Gainesville, FL. Voucher specimens of all species were retained at the Gulfport Plant Protection Station.

RESULTS:

The bait treatment reduced the mean number of *S. invicta* collected in all traps by 96% at week 5 and 99% at week 13: bait traps by 99% and pitfall traps by 87-97% (Figures 1 & 2). The granular treatment also reduced the mean number of RIFA collected in all traps by 70% at week 5 and 92% at week 13: bait traps by 81-99% through 13 weeks, however pitfall traps increased 5% at 5 weeks after treatment, but then a 42% reduction was shown at 13 weeks after treatment. It should be noted that the pitfall traps in the granular treated plots did not collect many RIFA prior to treatment, which may explain the low percentage decrease in numbers collected by this method.

The total number of genera (species) collected in all traps prior to treatment was 7, 7, and 8, respectively in the check, granular and bait treated plots. Mean number of genera collected in the different plots over a 13 week period are shown in Figure 3. All treatments and the check show a decrease in number species at 13 weeks after treatment, however this evaluation was made in late January, a time when many ant species are not very active.

PROJECT NO: FA05G028

PROJECT TITLE: Impact of Fipronil on Non-target Ant Species

TYPE REPORT: Interim

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

COOPERATORS: Mississippi Dept. of Wildlife, Fisheries, and Parks (Deborah Epperson)
Camp Shelby Environmental (Cindy King)
Rhone-Poulenc Ag Company (Ken Lewis)
USDA, ARS (Dan Wojcik)

INTRODUCTION:

Fipronil is a relatively new insecticide under development by Rhone-Poulenc, Research Triangle Park, NC. Fipronil has been shown to be effective for control of imported fire ants when applied as a 15ppm bait (Collins & Callcott 1998). Non-bait granular formulations are also highly effective for control of imported fire ants (1997 Annual Report, Gulfport Plant Protection Station). Impact of fipronil on native ant species such as *Solenopsis molesta, Paratrechina sp., Brachymyrmex sp.,* and others has not been determined, although a pilot study is currently underway at the Hattiesburg, MS airport by T. C. Lockley and H. L. Collins (FA05G038). Native ant species compete with, and to some degree assist with control of imported fire ants by preying upon newly mated fire ant queens. Therefore information on the impact of fipronil on native ant populations could be very useful.

MATERIALS AND METHODS:

Test plots were located in an ecologically diverse habitat in order to maximize the number of native ant species present. Non-diverse habitats such as grazed pastures, athletic fields, airports, etc. do not support large numbers of native ant species. The test site chosen for this study was a power line right of way at Camp Shelby National Guard Base (Mississippi). Test plots were one acre in size, with three replicates for each treatment. Treatments were fipronil 0.00015% bait

TABLE 2. Numerically Dominant Species of Ants Collected By Pitfall Trapping By Date and Treatment.

TAXON	V	VI	VII	IX	X	XI	XII	I
			UNTREATED SITES					
Solenopsis invicta	8	72	70	19	22	4	9	18
Brachymyrmex depilis		2	1		2			3
Cyphomyrmex rimosus	1	3			1	1		
Forelius spp.	3	2	21	2		2		
Monomorium minimum		4	6	1	1			
Paratrechina spp.	2	4	8	5	1			
Pheidole spp.		5	4	4	4			
			BAIT TREATMENT					
Solenopsis invicta	24	4	40	65	27	18	6	0
Cyphomyrmex rimosus		1		4	1	1		
Monomorium minimum	8	6	3	11	2	2		
Pheidole spp.	1		1	4		1	1	
			GRANULAR TREATMENT					
Solenopsis invicta	11	6	1	7	6	4	1	6
Brachymyrmex depilis		1		2	5	1		
Pheidole spp.		2	6	6	15	4	1	1

The granular treatment plots showed the least number of dominant species. However, *Pheidole* spp. complex was the most consistent and numerous in these plots; as were the numbers for *B. depilis*.

Insufficient diversity was observed among bait trap sites and dates to draw any conclusions on the impact of fipronil on nontarget species.

Table 1. Species of Ants Collected By Bait Sampling and Pitfall Trapping At the Bobby Chain Airport, Hattiesburg, MS.

PONERINAE
1. Hypoponera opacipes
2. Proceratium croceum

MYRMECINAE
3. Aphaenogaster carolinse
4. Crematogaster ashmeadi
5. C. clara
6. C. missouriensis
7. Cyphomyrmex rimosus
8. Leptothorax pergandei
9. Monomorium minimum
10. Myrmecina americana
11. Pheidole dentata
12. P. dentigula
13. P. moerens
14. P. tysoni
15. Pseudomyrma pallida
16. Solenopsis invicta
17. S. molesta

DOLICHODERINAE
18. Dorymyrmex bureni
19. D. medeis
20. Forelius mccooki
21. F. pruinosus

FORMICINAE
22. Brachymyrmex depilis
23. Camponotus pennsylvanicus
24. Paratrechina faisonensis
25. P. longicarnis
26. P phantasma
27. P. terricola

RESULTS:

Twenty-seven species of ants were collected within all sites (Table 1). Within these, six nontarget species or species complexes were commonly collected in the untreated sites by pitfall trapping. In the bait treated plots, only three species/complexes were collected with any regularity; and in the granular treated plots, one nontarget species and one species complex were found through most of the trapping periods (Table 2). The red imported fire ant was continuously taken at all sites and during all sampling periods.

Greater species diversity occurred in the untreated sites. Ants capable of directly competing with imported fire ants (RIFA) such as *Forelius* spp. and species that aggressively defend their nests such as *Dorymyrmex* spp. and *Pheidole* spp. were more commonly found within these plots. All three of these species complexes are omnivorous and, with the possible exception of *Pheidole* spp. because of their relatively small size, would have been directly impacted by bait applications. *Forelius* spp. generally have large colony sizes and can recruit to food sources in numbers readily comparable to those produced by RIFA (pers. obs.). *Dorymyrmex* spp. have only modest sized colonies even when polydomous and can only recruit to food sources in relatively small numbers. The impact of bait would have had a disproportional impact on this complex because of the small size of the colonies. *Brachymyrmex depilis* is primarily a sugar feeder and would not have been affected by bait application. Their small size (generally 1.0 mm) would have precluded their collecting any bait granules and returning them to the colony even if they had been so disposed. Why they were found in so few numbers within the bait plots cannot be ascertained. *Monomorium minimum* is another omnivorous feeder with a relatively large colony size. However, like *B. depilis*, their small size would have made collection of the bait granules difficult. Their numbers in the bait treated plots were higher and more consistent than in the untreated plot. *Cyphomyrmex rimosus* is a fungus feeder. It collects organic material (eg. dead insects, leaves) to use as a substrate on which it grows its fungi. It would not have been affected by bait treatment nor would it have been a competitor of any of the other species collected in any of the plots. It is so noncompetitive that colonies of this species have been excavated directly from RIFA colonies (pers. obs.).

PROJECT NO: FA05G038

PROJECT TITLE: Effects of Fipronil Formulations on Non-target Species of Ants

TYPE REPORT: Interim

LEADER/PARTICIPANTS: T.C. Lockley & H. L. Collins

INTRODUCTION:

Both bait and granular formulations of fipronil are proposed for use against imported fire ants. To ascertain effects on non-target ant species and to quantify any deleterious results, the following project was undertaken.

MATERIALS AND METHODS:

Sixteen acres of grass dominated field (Bobby Chain Airport, Hattiesburg, MS) was separated into 6 roughly equal parts. The site was surveyed and delineated in April 1998. Six pitfall traps consisting of a permanent 1 inch PVC sleeve and a 75 ml glass test tube were placed in a T pattern from the middle of the plot to the closest peripheral margin. Traps were set on approximately 6 week intervals and retrieved 72 hours after placement. Bait traps were also set adjacent to each pitfall trap and left in place for 1 hour. All traps were returned to the Gulfport Plant Protection Station where ants were separated, identified and counted under magnification. Trapping began immediately prior to fipronil application.

Application of fipronil in bait and granular formulations was made on 11 May, 1998. Air temperature was 74 F and soil temperature was 80 F (one inch depth) at the time of application. The bait formulation was applied using a Herd Seed Spreader (model GT-77) mounted on a farm tractor operated at 4 mph with a 21 foot swath. Bait was applied at a rate of 15.0 lbs per acre. The granular formulation was applied at 15.0 lbs per acre using a shop built granular applicator (double throat) mounted on a farm tractor operated at 4 mph using a 21 foot swath.

Table 1. Change in colony numbers of *Thelohania solenopsae* inoculated sites.

Type of Site	Treatment	No. colonies/ acre - pretreat	% change in number of colonies at indicated weeks after inoculation				
			-8-	-18-	-25-	-34-	
Monogyne	Inoculated	52	-7.7	-30.8	-23.1	-46.1	
	Control	40	30.0	-20.0	40.0	20.0	
Polygyne	Inoculated	384	-39.3	-39.3	-7.1	*	
	Control	896	-37.5	-41.7	-33.3	*	

* lost due to construction

Table 2. Change in population indices of *Thelohania solenopsae* inoculated sites.

Type of Site	Treatment	No. colonies/ acre - pretreat	% change in population indices at indicated weeks after inoculation				
			-8-	-18-	-25-	-34-	
Monogyne	Inoculated	880	-23.6	-25.0	-52.7	-38.6	
	Control	680	23.5	-14.7	52.9	11.8	
Polygyne	Inoculated	10,784	-44.5	-27.3	-34.4	*	
	Control	4,336	-29.9	-16.9	9.6	*	

* lost due to construction

By 25 weeks after inoculation, we were not able to find a mound associated with one of the original inoculated sites. Three of the remaining four inoculated mounds were no longer reproductively viable (class 2s). These plots were lost due to construction after the 25 week evaluation.

Monogyne Site

In the monogyne site, at 8 weeks after inoculation, numerous spores were detected in one of the inoculated mounds. Two of the inoculated mounds were deserted and no new mounds were detected within an 8-10' radius of the original inoculated mounds. At 18 weeks after inoculation, we were not able to find any monogyne inoculated mounds (no mound within 8-10 ft of the placard), and no workers collected from any mounds contained *Thelohania* spores. By 25 weeks after there were 2 reproductively active mounds very near the sites of 2 of the original inoculated mounds, and one non-reproductively active (class 4) within about 10-12 feet of another original site. However, again at 34 weeks after inoculation, no mounds were found within 10 feet of the original inoculation sites. Workers from the 25 and 34 week evaluations have not been examined for spores at this time.

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RESULTS:

Colony mortality

Polygyne Site

At 8 weeks after inoculation, the inoculated and the control sites had large decreases in number of colonies and in population indices (Tables 1 & 2). By late November, 1998, (25 weeks after inoculation) the number of colonies in the inoculated site was almost back to the pretreatment level, but the population index of the site was 34% less than the pretreatment level. The control site had the opposite; colony numbers were down 33% compared to the pretreatment level, but the population index of the site was a little above pretreatment levels. Unfortunately, this site was lost due to construction.

Monogyne Site

At 8 weeks after inoculation, the control plot had an increase in number of colonies (+30%) and in population index (+23%), while the inoculated site had a decrease in number of colonies (-7%) and in population index (-23%) (Tables 1 & 2). At this evaluation period, we tried to collect worker brood from the inoculated colonies. This resulted in a lot of mound destruction, and was therefore not attempted at future evaluation periods. Since the 8 week evaluation, we have experienced difficulty in finding mounds close to the original inoculated mounds. In general, the inoculated monogyne site has shown a decrease in colony numbers and population indices throughout the 34 week evaluation period, while the control site has shown an increase in colony and ant numbers.

Presence of pathogen

Pretreatment samples were examined and no spores were detected at either site.

Polygyne Site

In the polygyne site, spores were not detected in any of the inoculated mounds at the 8 week evaluation. At 18 weeks after inoculation, a few spores were detected in two of the originally inoculated mounds, and numerous spores were detected in a mound not originally inoculated.

PROJECT NO: FA02G048

PROJECT TITLE: Evaluation of Field Releases of *Thelohania solenopsae*

TYPE REPORT: Interim

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

COOPERATORS: Drs. David Williams and David Oi, USDA, ARS, CMAVE, Gainesville, FL

INTRODUCTION:

The microsporidium *Thelohania solenopsae* (Microsporidia: Thelohaniidae) was discovered in Brazil in the red imported fire ant (Knell et al. 1977). Since that time, USDA, ARS, CMAVE personnel in Argentina have also discovered the pathogen in the black imported fire ant in that country and have determined that the pathogen does decrease colonies and colony vigor and therefore may be a good candidate for use as a biological control agent in the United States (Briano et al. 1995a, 1995b, 1996).

MATERIALS AND METHODS:

In June, 1998 we assisted ARS with the initiation of a trial to evaluate field releases of the pathogen *Thelohania solenopsae*. On June 10, five mounds at two sites (polygyne site in Hancock Co. and monogyne site in Harrison Co.) were inoculated with brood infected with *T. solenopsae*. Every two months, we monitor the inoculated plots, and corresponding non-inoculated control plots, by evaluating mounds with the mound index system, geo-referencing each mound within the plots, and collecting worker samples from each mound within the plots. We also assist by microscopically examining collected workers for pathogen spores.

between groups. Colonies continued to decline in numbers through week 10. Activity and overall behavior was not altered at any time.

In conclusion, there seems to be no significant effect of either dimilin bait on any of the imported fire ant colonies used in this test.

PROJECT NO: FA02G038

PROJECT TITLE: Dimilin Bait Test on Imported Fire Ants in the Laboratory

TYPE REPORT: Final

LEADER/PARTICIPANTS: Charlene Hebert-Russell

INTRODUCTION:

Laboratory reared imported fire ant colonies were obtained from the ARS laboratory in Gainesville, Florida in November 1997. All nine colonies were reared from newly mated queens collected May 22, 1996.

MATERIALS AND METHODS:

Two dimilin baits were administered to colonies in a standard laboratory bait test. The bait labeled UBI-9276 was given to 3 colonies, while UBI-9275 was given to 3 colonies. A standard bait was used for 3 check colonies. All replicates received 10 grams of bait.

Initial observations of fire ant colonies were recorded for comparison. Brood was evaluated along with size of colony. Colonies then fed on baits for 7 days (ants fed continuously on bait throughout the week). Feed amounts were evaluated, and observations were recorded. Following removal of baits, colonies were maintained in laboratory setting receiving crickets and water each week.

RESULTS:

Average grams of bait removed from check group was 6 grams. UBI-9276 had an average of 1 gram removed, while UBI-9275 had an average of 3.5 grams removed.

Weeks 1-4 saw no change in any group based on brood production or colony size. By week 5, all colonies indicated an increase in brood productions which continued through week 8. Week 9 evaluations revealed a decline in brood amounts and colony size; however, there seemed to be no significant difference

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control colonies, as well as alate females from the laboratory treated colonies. These females were sent to USDA, ARS, CMAVE (Gainesville, FL) for determination of reproductive status. Dissection and microscopic examination found no ovaries in any females collected from methoprene treated colonies. Therefore, even if methoprene-treated alates fly and mate, they would be incapable of producing viable eggs and beginning a new colony. Thus, the life cycle appears to have been broken.

Table 1. Effect of Extinguish fire ant bait on number of IFA colonies present.

Treatment	Mean no. colonies/acre - pretreat	% decrease in no. colonies at indicated wks posttreatment				
		-5-	-12-	-20-	-27-	-33-
Extinguish	78.7	0.0a	0.0a	0.0a	9.3a	79.9a
Logic	38.7	0.0a	5.6a	16.7a	44.4a	68.7a
Untreated	60.0	3.0a	0.0a	0.0a	3.0a	3.0b

Table 2. Effect of Extinguish fire ant bait on IFA population indices.

Treatment	Mean pop. index/acre - pretreat	% decrease in no. colonies at indicated wks posttreatment				
		-5-	-12-	-20-	-27-	-33-
Extinguish	1000.0	-29.4a	-53.3a	-56.6a	-80.4a	-96.2a
Logic	513.3	-37.6a	-67.6a	-70.0a	-88.8a	-95.0a
Untreated	1013.3	17.8b	21.7b	27.7b	14.7b	3.5b

Means within a column followed by the same letter are not significantly different (LSD test, P=0.05)

RESULTS:

Laboratory Trial:

Within 2 weeks after treatment, 80-90% of the brood present in the treated colonies was large (sexual), although the amount of brood present was comparable to the controls. By 5-7 weeks after treatment, brood production in the treated colonies was severely slowed; approximately 15 pieces of large, sexual brood present vs. 100s of pieces of mostly small worker brood in the control colonies. At 11 weeks after treatment, brood production in the treated colonies was still occurring, but at a very reduced rate and in the few weeks prior to the 11 week evaluation only larva were present. From 12-16 weeks after treatment, the treated colonies were still producing small numbers of larva (10-30 present each week), and the only pupae present were sexual. The check colonies continued producing large numbers of workers and worker brood. By 16 weeks, the treated colonies contained approximately 200-400 workers each vs. the checks which contained +1000 workers each. Populations decreased from around 200 workers to <100 workers in the treated colonies at 25 weeks after treatment. However, at 28 weeks after treatment, both treated colonies began producing small numbers of worker pupae (<10 pupae each). Check colonies continued to grow, producing 1000s of brood (the majority of which is worker brood) and containing >5,000 ants.

Field Trial:

Fall is not the optimum time to treat IFA colonies with baits. With fall bait applications, we usually do not see optimal control until the following spring (Collins et al. 1992). As seen in the data from this trial (Table 1), neither treatment has reduced the number of colonies present at 12-20 weeks after treatment. However, since we did not find worker brood present in many of the treated colonies, the population indices have been significantly reduced (Table 2). As anticipated, the level of control increased significantly at the 27 and 33 week counts (April and June 1999).

Reproductive Status of Sexual Females:

On January 19, 1999, we collected alate and dealate females from field treated colonies and electrical and phone boxes, pump houses, and other associated areas, forestry sites, commercial nurseries including field grown and container stock, school grounds, sports fields, pastures, rangeland, citrus groves, sod farms, and cropland. We initiated a field study in October 1998 to examine effects of methoprene on colonies of IFA and to compare efficacy and rate of control of fall versus spring applications of Extinguish.

MATERIALS AND METHODS:

Laboratory Trial:

Small field colonies were collected to ensure collection of the queen. The ants were then separated from the nest tumulus by the floatation method (Banks et al. 1981). The queen, brood, and approximately 1000 workers placed in an artificial nest in a 17" x 22" plastic tray with the sides coated with Fluon® to prevent escape. On September 23, 1998, two colonies were given 5 g of Extinguish bait each, and two colonies were given 5 g of a non-toxic standard bait. The bait was removed after 1 week, and a normal diet of water and sugar-water, supplemented by crickets, mealworms or a prepared diet (Drees & Ellison 1998) continued throughout the trial.

Field Trial:

The test site was located in a pasture located in Harrison County, MS. All baits were applied to test plots using a shop-built granular applicator mounted on a farm tractor on October 19, 1998. Soil temperature at the time of application was 73°F, and air temperature was 78°F. Extinguish was applied at a rate of 1.5 lbs formulated bait per acre. Logic® was also applied at 1.5 lbs per acre as a standard, and there was also an untreated control. There were 3 replicates per treatment, and all test plots were 1.0 acre in size. A ¼-acre circular efficacy plot was established in the center of each 1.0 acre test plot. Prior to bait application and at 6 week intervals thereafter, IFA populations in each efficacy plot were evaluated using the population index system developed by Harlen et al. (1981), and revised by Lofgren and Williams (1982). Using this data, both colony mortality and decrease in pretreatment population index were calculated. Experimental data were statistically analyzed using analysis of variance and means were separated using the LSD test (P=0.05) for each posttreatment rating interval.

PROJECT NUMBER: FA02G028

PROJECT TITLE: Field Evaluation of Extinguish™ (methoprene) Fire Ant Bait, 1998

TYPE REPORT: Interim

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

INTRODUCTION:

Juvenile hormone analogues or insect growth regulators (IGR's) were investigated by several researchers for control of imported fire ants in the 1970's. Laboratory studies by Cupp and O'Neal (1973) found that methoprene (ENT-70460) and another compound (hydroprene), caused deformities in immatures and increased mortality. Troisi and Riddiford (1974) reported that the same two compounds interfered with egg production, embryonic development, and metamorphosis in *Solenopsis invicta*. Vinson et al. (1974) reported that topical application of several insect growth regulators including methoprene to pharate reproductive pupae reduced the number of adults eclosing and prevented the development of normal pigmentation in those adults that did eclose. Vinson and Robeau (1974) found that insect growth regulators administered to small colonies (300-400 workers) by feeding or through contact or fumigation caused delayed cessation of egg laying by the queen, initiation of sexual brood production, and ultimate death of the colony.

Research with numerous other IGR's continued throughout the 1980's (Banks et. al. 1978, Banks and Schwarz 1980, Banks and Harlan 1982), but additional studies with methoprene were not conducted until several trials were conducted between 1992-1996 (Drees and Barr, 1998). Results of those tests suggested that methoprene baits provide control equivalent to a fenoxycarb standard. In the summer of 1998 Extinguish™ Professional Fire Ant Bait containing 0.5% (S)-methoprene was registered by Wellmark International (Bensenville, IL 60106). Extinguish may be applied to, but not limited to, the following areas: residential turf and landscape, parks, zoos, golf courses, roadsides, airports, cemeteries, perimeter areas of buildings, homes, sheds,

Table 1. Efficacy of Various Fenoxycarb Formulation on Field Populations of Imported Fire Ants, 1997 - decrease in number of colonies.

Treatment	Mean No. Colonies - Pretreat (per acre)	% decrease in number of colonies (wks posttreat)				
		(6)	(12)	(18)	(24)	(36)
FL971038	61.2	68.5a	94.4a	100.0a	100.0a	90.5a
FL971039	52.0	67.8ab	91.0a	88.7ab	100.0a	81.9a
FL971040	57.2	66.8ab	95.1a	81.2b	90.4b	88.6a
FL971041	80.0	62.9ab	95.8a	95.8ab	89.4b	85.6a
CHECK	56.0	48.2b	45.0b	39.2c	0.0c	0.0b

LSD test, P=0.05

Table 2. Efficacy of Various Fenoxycarb Formulation on Field Populations of Imported Fire Ants, 1997 - change in pretreat population index.

Treatment	Mean Pop. Index - Pretreat (per acre)	% change in population index (wks posttreat)				
		(6)	(12)	(18)	(24)	(36)
FL971038	993.2	-94.7a	-97.9a	-100.0a	-100.0a	-96.2a
FL971039	996.8	-95.6a	-99.1a	-97.6a	-100.0a	-94.5a
FL971040	1244.0	-95.8a	-99.3a	-95.1a	-98.9a	-98.9a
FL971041	1413.2	-95.0a	-99.6a	-97.4a	-96.7a	-92.9a
CHECK	913.2	-50.5b	-57.6b	-44.9b	-0.2b	6.6b

LSD test, P=0.05

weeks after treatment. In the spring of 1998, 36 weeks after treatment, reinfestation was evident by the decrease in control in all treatments, particularly in the number of colonies present (small, incipient colonies had appeared in one or more plots of all treatments).

While no fenoxycarb treatment was significantly better than the others, numerically, FL971038 provided better overall control than the other formulations.

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PROJECT NO: FA02G017

PROJECT TITLE: Efficacy of Various Fenoxycarb Formulations, 1997

TYPE REPORT: Final

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

INTRODUCTION:

Logic® is a commercially available fire ant bait containing the insect growth regulator fenoxycarb (1%) as the active ingredient, and is produced by Novartis Crop Protection, Inc. (Greensboro, NC). In 1997, Novartis supplied us with several different formulations of the fenoxycarb-based bait for field testing. All baits were comprised of corn grit, soybean oil and 1% fenoxycarb.

MATERIALS AND METHODS:

Four baits were sent to us as numbered formulations. One was the standard commercially available formulation, the other three were proprietary formulations. All baits were applied to 1-acre test plots at a rate of 1.5 lb/acre on June 24, 1997 using a shop-built spreader mounted on a farm tractor. Prior to treatment and at 6 week intervals thereafter, evaluations of IFA populations were made in ¼-acre circular plots in the center of each one-acre test plot, using the procedures described by Lofgren and Williams (1982) and Collins and Callcott (1995). Differences in treatment means were separated by a LSD test (P=0.05).

RESULTS:

All treatments showed a significant decrease in populations at 6 weeks after treatment, but reduction in number of colonies was not significantly different from the check (Tables 1 & 2). By 12 weeks after treatment, there was >91% reduction in populations and >97% reduction in colony numbers in all treatments. Control has remained high (>89%) in all treatments through 24

Table 2. Efficacy of Various Bait Formulations: initiated May 12/13, 1998 in Harrison Co., MS. - % change in colony numbers.

Treatment	Application Rate (lb/acre)	Mean no. pretreat colonies/acre*	% decrease in pretreatment colony numbers ± SEM @ wks PT*				
			-6-	-12-	-18-	-24-	-30-
Clinch	1.0	54.8	18.9 ± 9.6a	94.5 ± 2.7a	96.0 ± 2.2a	94.5 ± 2.7a	61.2 ± 30.6ab
Clinch	2.0	66.8	37.1 ± 4.9a	85.4 ± 3.5ab	93.0 ± 5.0a	90.7 ± 4.9a	75.9 ± 16.5ab
Clinch	3.0	73.2	26.9 ± 6.5a	81.9 ± 9.0ab	91.5 ± 4.8a	86.2 ± 3.4a	91.2 ± 2.3ab
Fipronil	1.5	102.8	87.7 ± 8.7b	86.7 ± 6.9ab	84.4 ± 11.7ab	72.7 ± 17.5a	64.9 ± 27.1ab
Fipronil	15.0	97.2	91.9 ± 4.8b	100.0 ± 0.0a	98.8 ± 1.2a	93.4 ± 3.6a	94.3 ± 1.7a
Spinosad	1.5	118.8	53.3 ± 7.9ab	52.5 ± 10.2bc	63.2 ± 1.0bc	30.4 ± 7.0b	***
Logic	1.5	109.2	34.8 ± 7.2a	95.8 ± 2.8a	96.5 ± 3.5a	89.4 ± 3.8a	82.7 ± 5.9ab
Amdro	1.5	105.2	61.3 ± 5.7ab	86.1 ± 4.3ab	86.0 ± 5.5ab	85.8 ± 7.1a	80.7 ± 9.7ab
Check	--	61.2	33.9 ±17.1a	31.7 ± 17.4c	43.2 ± 5.8c	12.2 ± 9.1b	8.9 ± 5.9b

* Mean of 3 replicates.
** Means within a column followed by the same letter are not significantly different (Tukey's test, P=0.05).
*** dropped from trial

Table 1. Efficacy of Various Bait Formulations: initiated May 12/13, 1998 in Harrison Co., MS. - % decrease in population indices.

Treatment	Application Rate (lb/acre)	Mean pretreat population index/acre*	% decrease in pretreatment population index ± SEM @ wks PT**				
			-6-	-12-	-18-	-24-	-30-
Clinch	1.0	1020.0	-86.3 ± 1.9a	-99.5 ± 0.3a	-99.7 ± 0.2a	-99.4 ± 0.3a	-59.0 ± 38.9a
Clinch	2.0	1153.2	-89.9 ± 2.6a	-97.9 ± 0.4ab	-98.8 ± 1.0a	-96.3 ± 1.9a	-88.7 ± 8.7a
Clinch	3.0	1222.8	-88.0 ± 0.3a	-94.6 ± 2.4ab	-94.5 ± 4.8a	-92.2 ± 1.9a	-92.8 ± 3.3a
Fipronil	1.5	1646.8	-98.1 ± 1.6a	-96.0 ± 3.3ab	-92.7 ± 5.6a	-76.0 ± 14.6a	-72.9 ± 18.9a
Fipronil	15.0	1500.0	-98.7 ± 0.9a	-100.0 ± 0.0a	-99.8 ± 0.2a	-95.4 ± 2.4a	-94.6 ± 1.5a
Spinosad	1.5	2086.8	-60.5 ± 8.4b	-66.4 ± 11.4bc	-69.8 ± 0.6b	-41.7 ± 7.2b	***
Logic	1.5	1806.4	-88.9 ± 1.6a	-99.5 ± 0.3a	-96.9 ± 3.1a	-91.1 ± 3.6a	-84.9 ± 5.6a
Amdro	1.5	1680.0	-91.4 ± 1.2a	-93.9 ± 4.4ab	-94.2 ± 2.7a	-87.7 ± 6.2a	-83.6 ± 7.1a
Check	--	1266.8	-54.9 ± 7.6b	-37.5 ± 15.0c	-53.9 ± 6.5b	-36.3 ± 3.9b	-19.0 ± 10.4a

* Mean of 3 replicates.

** Means within a column followed by the same letter are not significantly different (Tukey's test, P=0.05).

*** dropped from trial

plot in all treatment regimens had a reproductively viable mound present, indicating reinfestation. By 30 weeks, all treatments were reinfested with small incipient colonies.

DISCUSSION:

Spinosad applied broadcast at a rate of 1.5 lb/acre did not provide adequate control of IFA colonies. Both rates of fipronil were very fast acting decreasing not only population indices, but also colony numbers at 6 weeks after treatment. The higher rate of fipronil appears to be numerically superior to the lower rate. Clinch (abamectin) was a little slow in reducing the number of colonies on the plots, but this is expected with an IGR. Ultimately, it provided control similar to Logic. Numerically, some rates and chemicals appear to be better than others, however, statistically both fipronil and Clinch were similar to each other and to the standards (Amdro and Logic).

References Cited

Harlan, D.P., W.A. Banks, H.L. Collin & C.E. Stringer. 1981. Large are test of AC217,300 bait for control of imported fire ant in Alabama, Louisiana, and Texas. Southwest. Entomol. 8: 42-45.

Lofgren, C.S. & D.F. Williams. 1982. Avermetin B_1a, a highly potent inhibitor of reproduction by queens of the red imported fire ant. J. Econ. Entomol. 75: 798-803.

Product	% active ingredient	Producer	Rate of application (lbs/acre)
Amdro	0.73% hydramethylnon	American Cyanamid, Princeton, NJ	1.5
Clinch	0.011% abamectin B_1	Novartis Crop Protection, Greensboro, NC	1.0, 2.0, and 3.0
Fipronil	0.00015%	Rhone-Poulenc Ag. Co., Raleigh, NC	1.5 and 15.0
Logic	1.0% fenoxycarb	Novartis Crop Protection, Greensboro, NC	1.5
Spinosad	0.015%	Dow Agrosciences, Inc., Indianapolis, IN	1.5

A ¼ acre circular efficacy plot was established in the center of each 1.0 acre test plot. Prior to and at 6 week intervals thereafter, IFA populations in each efficacy plot were evaluated using the population index system developed by Harlen et al. (1981) and revised by Lofgren and Williams (1982). Using this data, both colony mortality and decrease in pre-treatment population indices were calculated. Data were statistically analyzed using analysis of variance and means separated using Tukey's test (P=0.05) for each post-treatment interval.

RESULTS:

Treatments were applied on May 12-13, 1998 with air temperatures between 74-82°F and soil temperatures between 66-70°F.

Results of posttreatment evaluations (6, 12, 18, 24 and 30 weeks after treatment) are shown in Tables 1 and 2. At 18 weeks after treatment, several individual plots had reproductively viable colonies on them: one Ascend 3.0 lb/acre, one Logic, two Amdro, and two fipronil 1.5 lb/acre replicates. All the Spinosad replicates had healthy colonies on them for the duration of the trial, and at no evaluation period was the Spinosad treatment significantly different from the untreated check. At 24 weeks after treatment, all treatments except the Fipronil 1.5 lb/acre rate, Amdro, and Spinosad were still providing >90% reduction in population indices. However, at least one

PROJECT NO: FA02G018

PROJECT TITLE: Evaluation of Various New Baits for Control of Imported Fire Ants, 1998

TYPE REPORT: Final

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

COOPERATORS: Rhone-Poulenc Ag. Co. (Ken Kukorowski, Ken Lewis)
Novartis Crop Protection (Scott Lawson)
Dow Agrosciences (Ray Cooper)

INTRODUCTION:

Several agrochemical companies are developing new chemistries with potential as bait products for control of imported fire ants. These products have the potential to be used in both the homeowner market and the Federal IFA Quarantine (baits are used in the Fire Ant Free Nursery Program and as a portion of an infield stock treatment). In 1998, three companies supplied us with new bait products for evaluation.

MATERIALS AND METHODS:

The test site was located in Harrison Co., Mississippi. Baits were applied to test plots using either a shop-built spreader (1987 Annual Report, USDA, APHIS, PPQ, IFA Station, Gulfport, MS) or a Herd® GT-77 spreader (Herd Seeder Co., Logansport, IN) mounted on a farm tractor on May 12-13, 1998. There were 3 replicates per treatment. Baits, producers, and rates of application are listed below:

Table 11. Control of Imported Fire Ants in Turfgrass with Fipronil 0.0015% Bait - Decrease in Number of Colonies; La Porte, TX. Airport

Treatment	Rate of Application (lb/acre)	Mean No. Colonies Pretreat (per acre)	% decrease in number of colonies at indicated weeks PT*					
			-6-	-12-	-18-	-24-	-40-	-46-
EXP61443A bait	1.5	42.7	86.9a	90.5a	93.3a	68.5a	91.1a	86.3a
Amdro	1.5	40	90.8a	100.0a	97.9a	58.8ab	70.6a	80.0a
Check	--	37.3	53.3b	37.1b	4.8b	0.0b	0.0b	0.0b

* means within a column followed by the same letter are not significantly different, LSD test, P=0.05.

Table 12. Control of Imported Fire Ants in Turfgrass with Fipronil 0.0015% Bait - Change in Population Index; La Porte, TX. Airport

Treatment	Rate of Applic. (lb/ acre)	Mean Pop. Index Pretreat (per acre)	% change in population index at indicated weeks PT*					
			-6-	-12-	-18-	-24-	-40-	-46-
EXP61443A bait	1.5	702.7	-96.5a	-97.7a	-93.3a	-70.1a	-89.8a	-92.0a
Amdro	1.5	693.3	-98.4a	-100.0a	-98.7a	+9.7ab	-70.4a	-82.2a
Check	--	513.3	-51.0b	-42.3b	+9.3b	+189.6b	+88.9b	+27.9b

* means within a column followed by the same letter are not significantly different, LSD test, P=0.05

Table 10. Control of Imported Fire Ants in Turfgrass with Fipronil 0.1% Granular - Change in Population Index; La Porte, TX. Airport

Treatment	Rate of Applic. (lb/ acre)	Mean Pop. Index Pretreat (per acre)	% change in population index at indicated weeks PT*						
			-6-	-12-	-18-	-24-	-40-	-46-	-62-
EXP60818A 0.1G	12.5	586.7	-99.1a	-100.0a	-100.0a	-75.6a	-91.3a	-87.2a	-82.2ab
EXP60818A 0.1G	18.75	522.7	-100.0a	-100.0a	-100.0a	-100.0a	-100.0a	-100.0a	-81.8ab
EXP60818A 0.1G	25	452	-100.0a	-100.0a	-100.0a	-100.0a	-100.0a	-83.1a	-100.0a
Dursban 50WP	16	889.3	-100.0a	-99.5a	-91.6b	-73.9a	-93.4a	-75.2a	-88.1a
Check	--	513.3	-51.0b	-42.3b	+9.3c	+189.6b	+88.9b	+27.9b	-47.9b

* means within a column followed by the same letter are not significantly different, LSD test, P=0.05.

Table 9. Control of Imported Fire Ants in Turfgrass with Fipronil 0.1%Granular - Decrease in Number of Colonies; La Porte, TX. Airport

Treatment	Rate of Applic. (lb/ acre)	Mean No. Colonies Pretreat (per acre)	% decrease in number of colonies at indicated weeks PT*						
			-6-	-12-	-18-	-24-	-40-	-46-	-62-
EXP60818A 0.1G	12.5	34.7	93.3a	100.0a	100.0a	73.3a	89.2a	84.1a	86.7a
EXP60818A 0.1G	18.75	34.7	100.0a	100.0a	100.0a	100.0a	100.0a	100.0a	83.3a
EXP60818A 0.1G	25	37.3	100.0a	100.0a	100.0a	100.0a	100.0a	80.9a	100.0a
Dursban 50WP	16	48	100.0a	97.0a	89.8a	62.1a	91.6a	69.9a	84.4a
Check	--	37.3	53.3b	37.1b	4.8b	0.0b	0.0b	0.0b	44.2b

* means within a column followed by the same letter are not significantly different, LSD test, P=0.05.