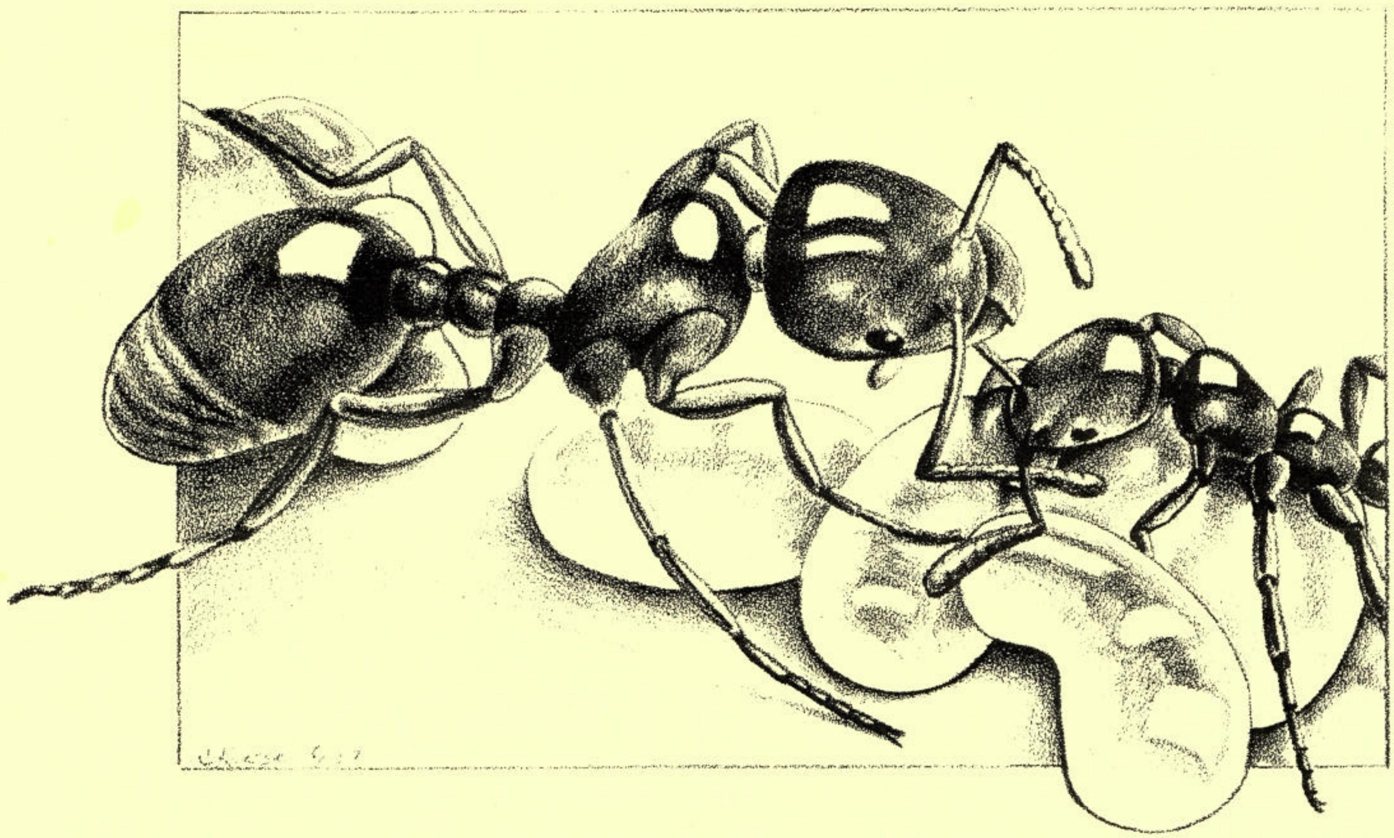
PROCEEDINGS OF THE 1987 IMPORTED FIRE ANT CONFERENCE

April 15-16, 1987



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Publication of this Proceedings was supported by a grant from the Veterinary Medical Experiment Station, College of Veterinary Medicine, The University of Georgia, Athens, GA.

This publication is the result of a Symposium called and sponsored by Dr. Gene Reagan, Dept. of Entomology, Louisiana State University. The opinions, conclusions and recommendations are those of the participants and are advisory only. Trade and company names are used in this publication solely to provide specific information. Mention of a trade or company name does not consitute a warranty or an endorsement by any state or federal agency to the exclusion of other products or organizations not mentioned.

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IMPORTED FIRE ANT CONFERENCE

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Hosted by:

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Louisiana State University
Baton Rouge, Louisiana

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SYMPOSIUM PROGRAM AND TABLE OF CONTENTS

(NS indicates that a contribution to this Proceedings was Not Submitted)

A Quarter Century of Imported Fire Ant Research Conferences

C. S. Lofgren

At the March 1986 Imported Fire Ant Conference, I was asked to prepare an historical review of the origin and development of these conferences. With the help of Mr. W. A. Banks I was able to determine the location, dates, and chairman of the meetings since their origin in 1963 and various other miscellaneous information.

Before elaborating on this information, however, it is important to recognize that research on imported fire ants (IFA) pre-dates these conferences. Of particular interest is the work of Wilson and Eads (1949). Their report presents the first biological observations on the IFA in the U.S. The USDA established a research station in Spring Hill, Alabama in 1949. Surveys by Mr. George Culpepper while at this laboratory from 1949-1953 revealed for the first time the extent of the IFA infestation and its link with nursery stock. Control techniques using chlorinated hydrocarbons were developed at Auburn and Mississippi state universities and at the USDA lab. A more detailed account of this early history is published in the proceedings of the Fire Ants and Leaf-Cutting Ant Conference held in Gainesville, FL in March 1985 (Lofgren, C. S. 1986. History of the Imported Fire Ant in the United States. pp. 36047. In Fire Ants and Leaf-Cutting Ants: Biology and Management. C. S. Lofgren and R. K. Vander Meer (eds.). Westview Press, Boulder, CO, 435 pp.).

The first large scale effort to control IFA started with the Federal-State Control Program initiated by the U.S. Congress in 1957. At that time I became involved in IFA research when I was transferred from the ARS Insects Affecting Man and Animals Research Laboratory in Orlando, FL to the Plant Pest Control Division (PPCD) of ARS in Gulfport, MS to organize an IFA Methods Development Laboratory for the purpose of developing improved methods to control IFA. After several years it became evident that we needed more direct exchange of information between this laboratory and other IFA researchers. Communications with Dr. Murray S. Blum, who was at LSU at that time, and Mr. Henry Green, Mississippi State University, resulted in the decision to hold a workshop in Gulfport in 1963. In July of that year I transferred back to the Insects Affecting Man and Animals Research Laboratory (now located in Gainesville, FL); however, other entomologists at the IFA laboratory, Mr. W. A. Banks, Mr. F. J. Bartlett, and Mr. C. E. Stringer, continued contacts with Dr. Blum and Mr. Green and the first conference was held in Gulfport, MS in October, 1963. Correspondence between Mr. C. C. Fancher, Regional Supervisor of PPCD, ARS, and Dr. Carroll N. Smith, Laboratory Director, Insects Affecting Man and Animals Research Laboratory, Outline the agenda and organization. The letters are reproduced on the next 2 pages.

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
Southern Plant Pest Control Region
P. O. Box 989
Gulfport, Mississippi 39502

September 24, 1963

Dr. Carroll N. Smith
Insects Affecting Man Investigations
ERD, ARS, USDA
1600 S. W. 23rd Drive
Gainesville, Florida

Dear Dr. Smith:

Reference is made to an exchange of correspondence with most of the State cooperators last May and June concerning an Entomology Research meeting on the imported fire ant. The replies indicated that the dates of October 15 and 16 were preferred over the proposal for last June and that Gulfport was suitable for the location.

During the interim, we have had an opportunity to discuss subject matter for the meeting with those engaged in research on the imported fire ant. The response was unanimous in limiting the discussion to entomological phases of research and methods improvement. It is realized that the results of research and methods improvement influence control, survey, and regulatory operation methods. The representatives participating in this meeting are cognizant of field problems and prefer to discuss the research phases separately from field operations.

An informal agenda is suggested that would permit each state and the Gulfport Methods Improvement Laboratory to discuss (1) present research studies in operation and results, (2) research studies that will be initiated, and (3) research studies that are needed. To preclude the necessity for taking voluminous notes, we suggest that a brief outline of the above be made available in mimeographed form for distribution to the conferees for reference.

We would welcome reconfirmation of your intention to attend this research meeting and the number in your party. This will be helpful in locating a meeting room. If you desire, we will make reservations for you at the Markham Hotel.

Sincerely yours,

C. C. Fancher
Regional Supervisor

October 9, 1963

Mr. C. C. Fancher
Regional Supervisor
U. S. Department of Agriculture
ARS, Southern Plant Pest Control Region
P. O. Box 989
Gulfport, Mississippi

Dear Mr. Fancher:

Many thanks for your letters of September 24 and October 1 regarding the fire ant meeting. I am sorry to say that previous commitments will prevent me from attending the meeting, but Mr. Lofgren will be glad to attend and will be honored to serve as chairman. He plans to arrive on Monday, and would appreciate it if you would make reservations for him for the nights of October 14, 15, and 16, at the Markham Hotel.

Mr. Lofgren is, of course, still intensely interested in the success of the fire ant program and will continue to keep in touch with the work in his new capacity as a representative of the Entomology Research Division.

With best personal regards, I remain,

Sincerely yours,

Carroll N. Smith
Investigations Leader

bc: C. S. Lofgren
CNS/ns

At the termination of the first meeting, Dr. M. S. Blum was elected chairman for the next meeting in 1964. Unexplained delays resulted in this conference being held in February, 1965 in Gulfport, Mississippi. The third conference was hosted by Mr. H. B. Green at Mississippi State University in November, 1965. There is no record of a meeting in 1966, but a conference was held in Biloxi, MS in March 1967. Correspondence in our files indicated that this meeting was to be hosted by Mr. W. C. Rhoades, University of Florida, at Quincy, FL; however, travel restrictions caused it to be moved to Biloxi.

A meeting announcement from Mr. Carl Scott, Georgia Department of Agriculture, stated that the next conference, which was held in Biloxi in March 1968, was the 5th Annual Research Conference. From this time forward a conference was held in all years except 1985. In 1985 the conference was to be held in Puerto Rico; however, the chairman appointed did not fulfill this commitment. A late attempt was made by Dr. S. B. Hays, Clemson University, to organize a conference, but lack of commitments by persons to attend caused its cancellation.

A list of all the conferences, locations, chairmen and number of attendees is given in Table 1. The initial guidelines for the conferences specified that no proceedings would be published. These guidelines were changed in 1984. At this time, a committee chaired by Dr. Mike Mispagel assumed responsibility for assembling a non-refereed proceedings of abstracts, short papers, etc. Prior to this time unofficial notes, papers, and abstracts were found in our files for the years 1967, 1973, and 1980.

A review of the information in Table 1 reveals two periods when attendance at the meeting increased significantly: 1972 to 1975 and after 1978. The first of these coincides with a period during which grant money was provided by the USDA to university personnel. The second occurred following the cancellation of registrations for Mirex by the EPA. The latter resulted in a large number of attendees from commercial concerns interested in IFA control.

In conclusion, I have kept all the records, sparse as they are, at this office. If anyone reading this report has any information on the conferences, I would appreciate receiving a copy for the files.

Table 1. General information of imported fire ant research conferences.

Conf. No.	Date	Location	Chairman	Attendees
1	Oct 1963	Markham Hotel Gulfport, MS	C. S. Lofgren	15-20
2	Feb 1965	Markham Hotel Gulfport, MS	M. S. Blum	-
3	Nov 1965	Alumni Student Bldg. Starkville, MS	H. B. Green	-
4	Mar 1967	Buena Vista Hotel Biloxi, MS	W. C. Rhoades	27
5	Mar 1968	Buena Vista Hotel Biloxi, MS	Carl Scott	25
6	Mar 1969	Monteleone Hotel New Orleans, LA	Dick Carlton	30
7	Apr 1970	Div. Plant Ind. Gainesville, FL	Will Whitcomb	-
8	Mar 1971	USDA Conference Rm. Gulfport, MS	S. O. Hill G. P. Markin	33
9	Mar 1972	University Club Athens, GA	Murray Blum	62
10	Mar 1973	Monteleone Hotel New Orleans, LA	Dick Carlton	-
11	Mar 1974	Fort Brown Hotel Brownsville, TX	David Ivie	38
12	Mar 1975	IAMARL Conf. Rm. Gainesville, FL	Cliff Lofgren	50
13	Mar 1976	Best Western Motel Gulfport, MS	Mike Glancey	64
14	Mar 1977	Rudder Ctr-Texas A&M College Station, TX	Brad Vinson	54
15	Apr 1978	McKimman Ctr, NCSU Raleigh, NC	C. S. Apperson R. C. Hillman	83

Conf. No.	Date	Location	Chairman	Attendees
16	May 1979	LSU Std Union Bldg. Baton Rouge, LA	Bob Wilson Gene Reagan	89
17	Mar 1980	Doyle Connor Bldg. Gainesville, FL	Ralph Brown	78
18	Mar 1981	Admiral Benbow Inn Biloxi, MS	Al Banks	85
19	Mar 1982	Stephen Austin Bldg. Austin, TX	Mark Trostle	97
20	Mar 1983	Clay Lyle Ent. Complex Starkville, MS	Kathy Kalasinsky	122
21	Mar 1984	Doyle Connor Bldg. Gainesville, FL	Everett Nickerson	126
22	Mar 1986	Best Western Motel Austin, TX	Mark Trostle	97
23	Apr 1987	LSU Agricultural Ctr. Baton Rouge, LA	Gene Reagan Jack Bryant	
24	- 1988	College of Vet. Med. U. of GA, Athens, GA	Mike Mispagel	

Ant Assemblages along the Westernmost Range of *Solenopsis invicta* Buren

Gerardo R. Camilo and Sherman A. Phillips, Jr.

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Lubbock, Texas 79409

INTRODUCTION

An assemblage is defined as a group of taxonomically related species that coexist in the same habitat, exploiting a variety of resources. The structure of an ant assemblage depends on which species of ants are present, in what numbers, and the type of interactions occurring at any given time (Levins et al., 1973; Heatwole and Levins, 1972; Torres, 1984). The high diversity, density, and specialized behavior of ants make them important members in almost every community where they are found (Carrol and Jenzen, 1973; Levings and Trianello, 1981; Torres, 1984).

Since the introduction of the red imported fire ant, *Solenopsis invicta* Buren, into the southeastern United States, this species has been considered a threat to the native ant fauna (Lofgren et al.,1975; Wilson et al., 1971). The occurrence of *S. invicta* has been associated with the selective extinction or displacement of other ant species. Studies conducted in Alabama, Louisiana, and Florida demonstrated this fact (Baroni-Urbani and Kannowski, 1974; Glancey et al., 1976; Whitcomb et al., 1972).

The main objectives of our work are to determine the structure of the ant assemblages in: 1) exclusively infested; 2) moderately infested, and; 3) non-infested fire ant areas. In addition, our second objective is to determine the spatial arrangement of these assemblages and how they change through time.

MATERIALS AND METHODS

The study area is located within Kimble and Kerr Cos. in central Texas. Interstate Highway 10, traversing these counties, is the route along which the transect for monitoring ant populations was established. Thus far, the community has been monitored monthly from August through November of 1986. The transect consists of twelve plots, ca. 4.8 km apart. Each plot consists of 24 pitfall traps in two rows of twelve. Each row, and each trap in a row is 1 m apart from the other. Every time the transect was monitored, the traps were in place for only 72 hrs. (Janzen and Metz, 1979), since we were more interested in community structure than in circadian activities of the ants (Adis, 1979).

The ordination analysis of the data was determined using the PROCEDURE CLUSTER, SAS System, Version 5, 1985. The dendrograms were generated by the PROCEDURE TREE. Reference points were determined by the centroid method.

RESULTS

Because plots K and L were exclusively infested with *S. invicta*, and because their densities were too high, the data from these plots were excluded from the analyses. No other ant species was found coexisting with *S. invicta* in these two plots. The first assemblage is one of high diversity and high density, and is characterized by highly specialized species; whereas, the second assemblage is characterized by high diversity, but low density (Table 1). The third assemblage is less diverse than the first two, and the species densities, including *S. invicta*, are not high (Table 2). The fourth assemblage exhibits low diversity, as typified by only five species, and high densities. This last assemblage is also characterized by *S. invicta*.

In August the structure of the ant assemblages, which are represented by continuous lines in the vertical axis, was influenced to a greater extent by the high diversity of plot A than by the density of ants in other plots as detected by cluster centroids (Fig. 1). The presence or density of *S. invicta* was a less important factor in determining cluster centroid distances than the species richness of the entire community. As the season progresses, the presence or absence of *S. invicta* becomes a more influential factor in the structuring of the ant assemblages than any other species (Fig. 2). The diversity of plot A is still influential enough to stand as an individual assemblage, but not influential enough to cause a rearrangement of the assemblages as in the month of August. In October, the richness dependent assemblage, plot A, has been clustered along with the non-infested plots (Fig. 3). The fire ant infested plots are clustered together independent of *S. invicta* density. Therefore, ant assemblages are dependent upon the presence or absence of this species. No significant difference was detected between the mean squared distance of centroids between October and November. This finding indicates that the species richness and densities of the total communities were similar. Plots infested with *S. invicta* were clustered together and were more similar to each other than to the other plots (Fig. 4). Therefore, we now can detect only three assemblages and not four. Plot F, which in September was found to contain *S. invicta*, was not found to contain this species in October. This plot, therefore, re-assembles from the *S. invicta* assemblage to the non-infested assemblages, because at this point in the season, species presence is extremely influential.

CONCLUSIONS

Ant assemblages where *S. invicta* are not found, keep their integrity through time. The presence of *S. invicta* is correlated in October and November with the disturbance of the assemblage structure (Kendall's $\tau = 0.62$; $0.01 < P < 0.05$). Thus, as season progresses, diversity in red imported fire ant infested plots decreases at a faster rate than in non-infested plots.

The continuation of this project should indicate or point toward a specific disturbance pattern of the native ant community by *S. invicta*.

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TABLE 1. Ant assemblages in Kimble and Kerr Cos, Texas, as determined by cluster hierarchical centroid method.

SPECIES ASSEMBLAGE 1	SPECIES ASSEMBLAGE 2
SUBFAMILY PONERINAE	SUBFAMILY PONERINAE
Pachycondyla harpax	*Leptogenys elongatus*
SUBFAMILY ECITONINAE	SUBFAMILY ECITONINAE
Labidus coecus	*Nievamyrmex nigriscens*
SUBFAMILY MYRMICINAE	SUBFAMILY MYRMICINAE
Pheidole tepicana	*Pogonomyrmex barbatus*
Solenopsis aurea	*Monomorium minimum*
Solenopsis geminata	*Pheidole crassicornis tetra*
Crematogaster laeviuscula	*P. hyatti*
Crematogaster pilosa	*P. tepicana*
Leptothorax terragina	*Solenopsis xyloni*
Tetramorium spinosum	
SUBFAMILY DOLYCHODERINAE	SUBFAMILY DOLYCHODERINAE
Forelius pruinosus	*Conomyrma insana*
SUBFAMILY FORMICINAE	SUBFAMILY FORMICINAE
Paratrechina terricola/vividula *	*Paratrechina terricola/vividula* *

* Unable to distinguish between species.

TABLE 2. Ant assemblages in Kimble and Kerr Cos, Texas, as determined by cluster hierarchical centroid method.

SPECIES ASSEMBLAGE 3	SPECIES ASSEMBLAGE 4
SUBFAMILY MYRMICINAE	SUBFAMILY MYRMICINAE
Pogonomyrmex barbatus	*Pheidole tepicana*
Monomorium minimum	*P. crassicornis tetra*
Pheidole crassicornis tetra	*Monomorium minimum*
P. tepicana	*Solenopsis invicta*
P. sp.	SUBFAMILY FORMICINAE
Solenopsis invicta	*Paratrechina terricola/vividula* *
Solenopsis (D.) tennessensis	
SUBFAMILY DOLICHODERINAE	
Forelius foetidus	
F. pruinosus	
SUBFAMILY FORMICINAE	
Paratrechina terricola/vividula *	

* Unable to identify between species.

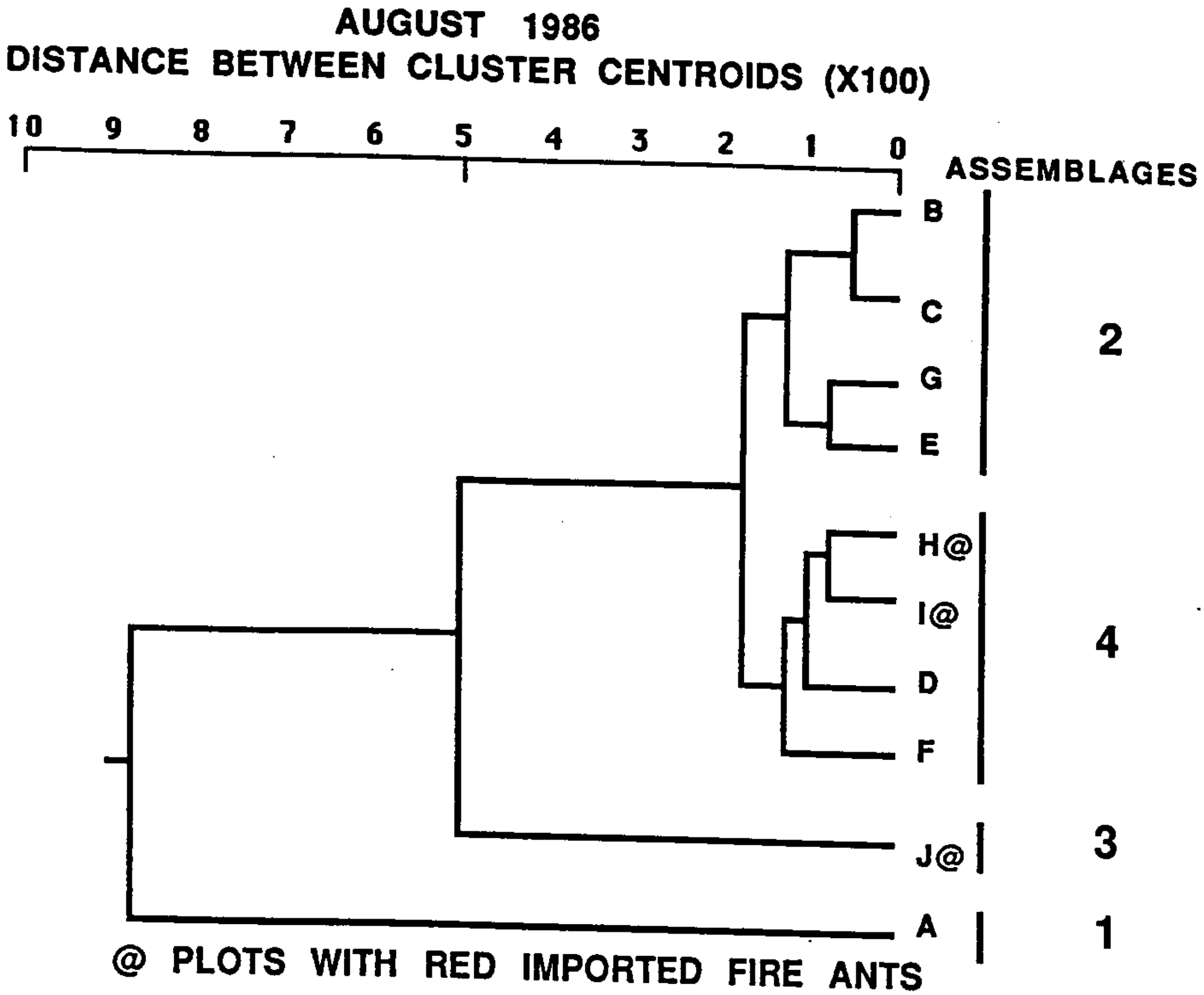

FIGURE 1. Distribution of plots in assemblages as detected by clustering procedure.

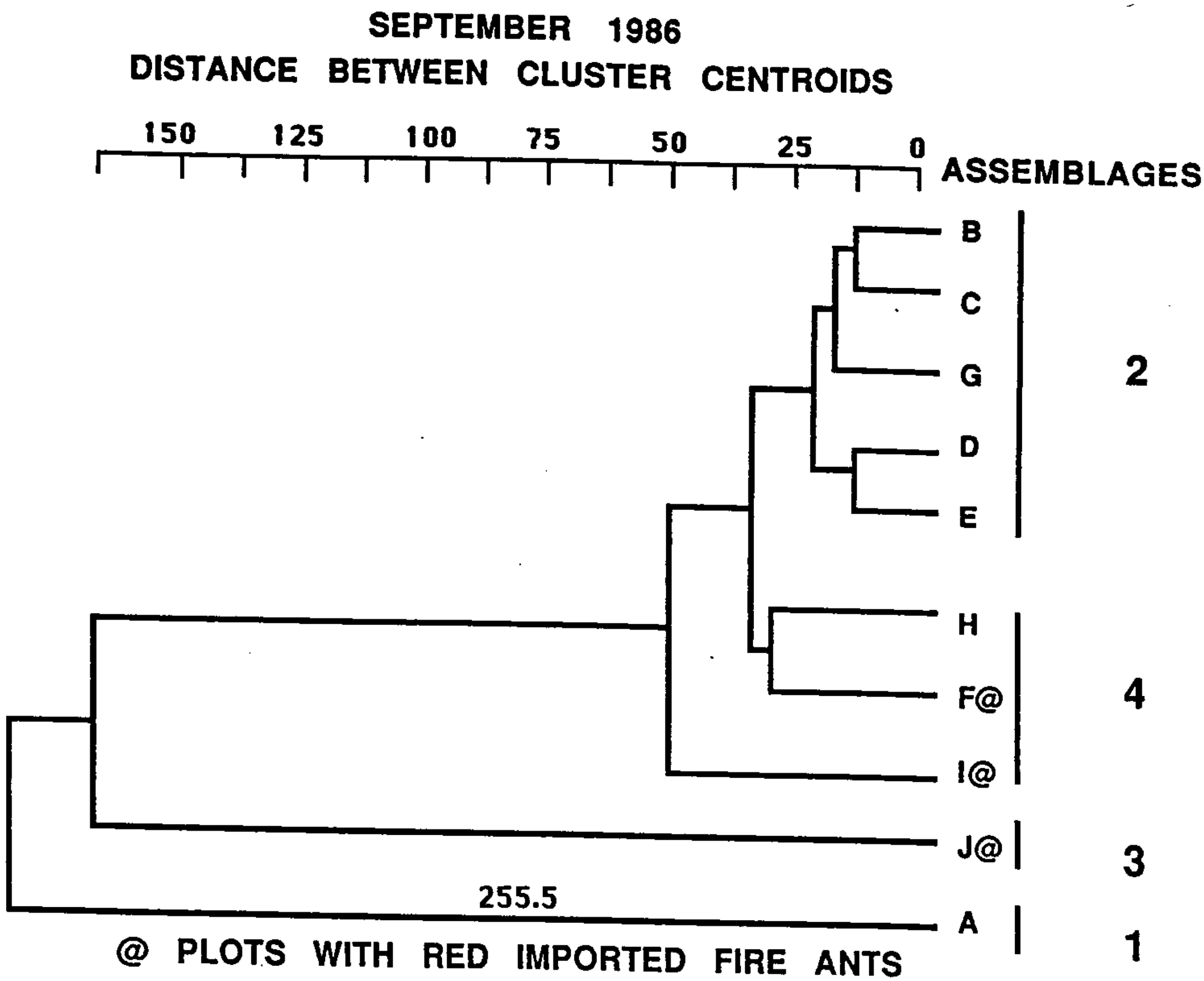

FIGURE 2. Distribution of plots in assemblages as detected by clustering procedure .

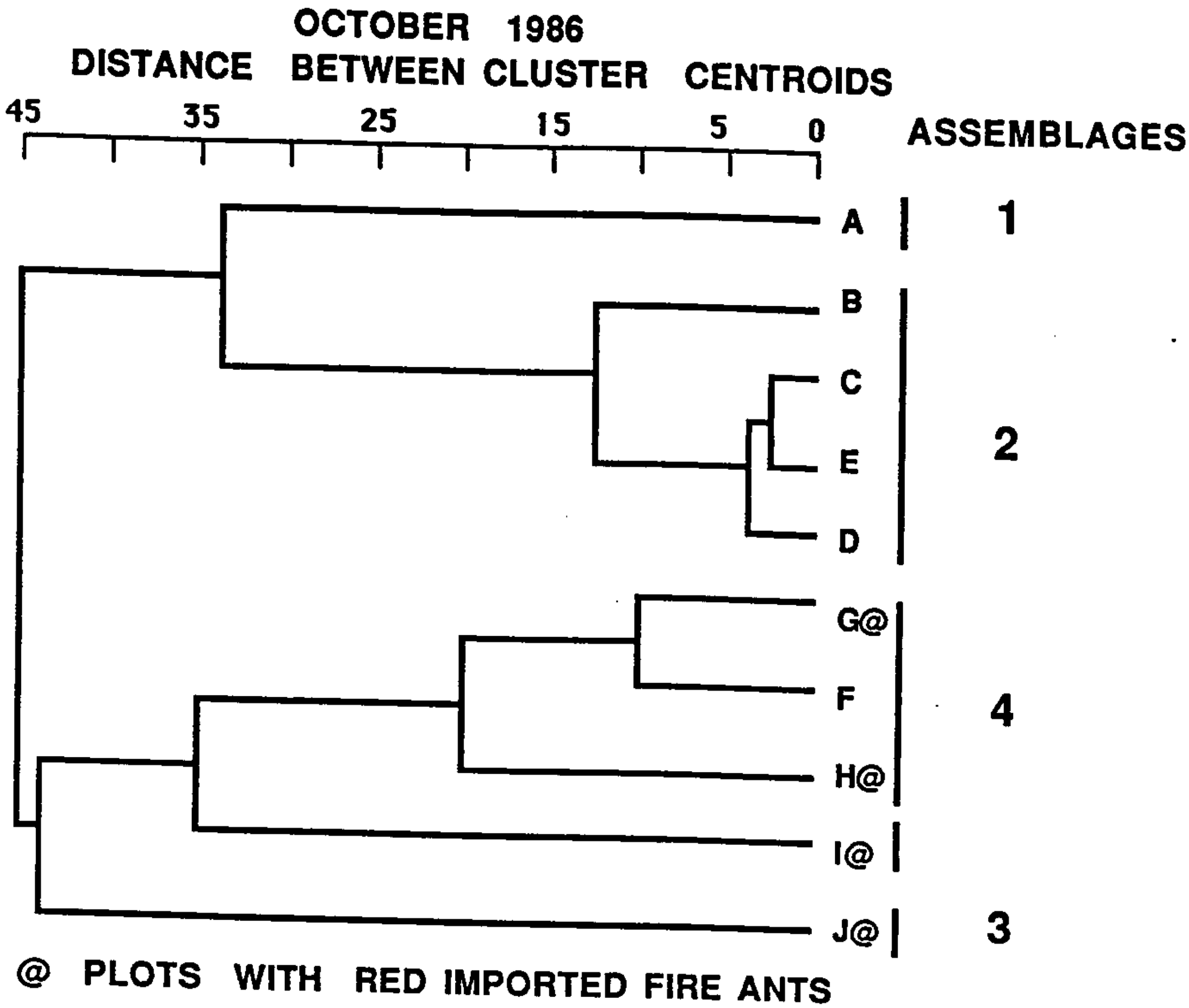

FIGURE 3. Distribution of plots in assemblages as detected by clustering procedure.

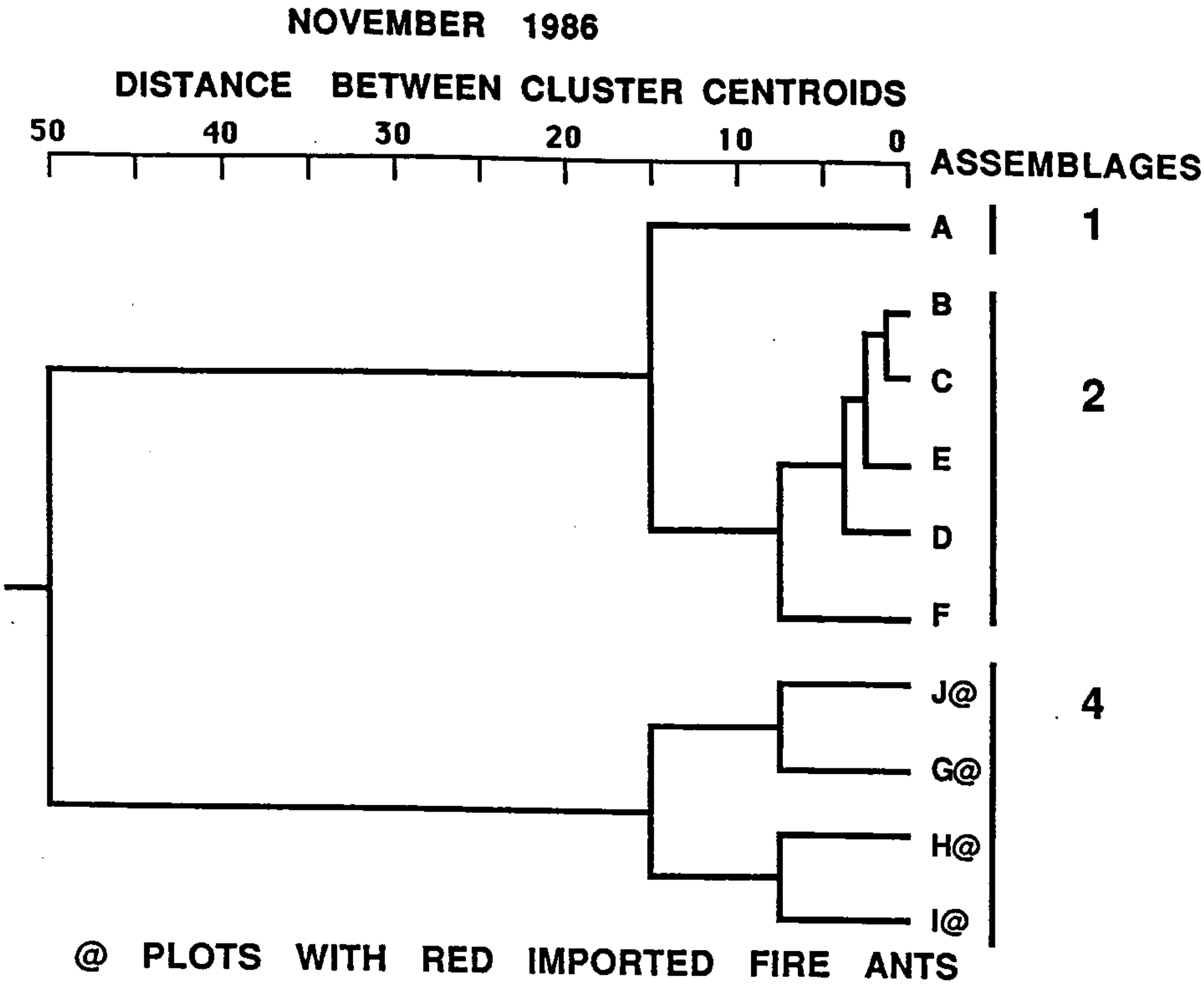

FIGURE 4. Distribution of plots in assemblages as detected by clustering procedure.

SOME STUDIES OF OVIPOSITION RATES OF IMPORTED FIRE ANT QUEENS

David F. Williams

INSECTS AFFECTING MAN AND ANIMALS RESEARCH LABORATORY

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Oviposition rates of *Solenopsis invicta* queens have been reported in the past with some contradictory results. Since accurate data is necessary to some of our research, we carried out several studies in order to obtain additional information on egg production by *S. invicta* queens.

For most of our tests, a 24-hr oviposition period was used. In the first 24-hr oviposition test, we used physogastric queens from large monogynous IFA laboratory colonies (70,000-150,000 members) which had been started 16 months earlier as newly-mated queens. All of these colonies were maintained in the laboratory on a standard diet of insects, hard-boiled chicken eggs, and honey:water (1:1). The food provided in test colonies was egg yolk and honey:water agar. All queens were removed from their lab colony and immediately placed in the holding container. Twenty-four hours later, they were removed and returned to their colonies. In the 1st test, we did not weigh each queen before or after the test since our major objective was to determine what type of oviposition chamber was most suitable. Also, we wanted to find out the importance of the presence of workers and food with the queen during oviposition.

In all of the remaining oviposition tests, a 30ml cup with a Castone base was used since these containers resembled the laboratory rearing cells in which these queens had been held since the time of their collection and provided an excellent environment. The queens laid significantly more eggs when held in these containers.

In the 2nd test, queens from the same 10 colonies, plus an additional 2 were evaluated. In this test, we placed 20 brood-tending workers with the queens in the cups. In addition to the presence of workers, 10 larvae (5 each of 3rd and 4th instar) were placed with some of the queens. Finally, food (egg yolk and honey:water agar) was made available in two of the test chambers (A and B). During this test, we recorded the numbers of eggs oviposited by the queens in the first 4 hrs, the second 4hrs, and the final 16hrs during the 24-hr test period.

The analysis of the results (see Tables 1 & 2) revealed that food was not a significant factor for oviposition in tests carried out for 24-hrs or less. The need for the presence of larvae and pupae is not clear. For example, the mean no. eggs (data not in Table 1) laid by queens with brood and workers was 219 in 4 hrs (55/hr) and 928 in 24 hrs (39/hr), while queens without brood, but with workers, deposited 162 eggs in 4 hrs (41/hr) and 699 in 24 hrs (29/hr), a significant difference. However, in later studies, (see Table 1), a comparison of queens from colonies which did not have brood added to the test chamber oviposited significantly more eggs than the queen with brood present.

Overall, weight loss was related to the no. of eggs deposited by the queens. In fact, the queen that lost the least amount of weight, even though being one of the heaviest, did not lay any eggs. Also, the 2 queens that lost the greatest amount of weight during the 24 hrs laid the largest no. of eggs.

A 3rd oviposition test, using the same IFA laboratory queens as described in the first and second tests, was set up to verify the observation that workers were necessary for maximum oviposition to take place. The same no. of workers (ca. 20 brood-tenders), along with all the other techniques described in the previous tests, were used. We should also mention here that the colonies had increased in size from the first study period two months before. Again, significantly more eggs were laid in the presence of workers than in their absence.

In another phase of this study, we compared the weights of eggs laid by the monogynous queens with those of polygynous queens. Eggs of monogynous queens weighed an average of 0.013mg per egg while those of polygynous queens averaged 0.009mg/egg. It has been said that an IFA queen is capable of producing her own body weight in eggs every 24-hrs (Tschinkel, unpublished data). Based on our data of the average weight of a single egg being 0.013mg, a monogynous IFA queen weighing for example 19mg and producing 1500 eggs in 24-hrs, would have laid an egg mass weighing 19.5mg or 0.5mg more than her own body weight. It should be pointed out however, that the average body weight loss in 24-hrs of all of the queens we studied was only 3.8mg.

In conclusion, the following points can be made based on our studies with queens from monogynous IFA laboratory colonies: (1) queens laid significantly more eggs in the presence of workers, (2) the presence of food for egg production during 24-hrs was not significant, (3) a need for 3rd and 4th instar larvae and pupae for maximum egg production was not shown since one test indicated they were while 2 others indicated they weren't, (4) the number of eggs oviposited in 24-hrs was positively correlated to initial queen weight, queen weight loss, and percent of weight loss (queens that weighed the most, produced the most eggs in 24-hrs and lost the most weight),and finally, (5) eggs of monogynous queens weighed an average of 0.013mg per egg while those of polygynous queens averaged 0.009mg/egg.

TABLE 1

SUMMARY OF OVIPOSITION DATA

IFA MONOGYNOUS LAB QUEENS

N = 12

Colony size (est.) = 100,000 - 150,000

Initial Queen Wts (mg) = Mean 19.81
Range 18.73 - 24.17

Condition	Mean No. Eggs Per 24 hrs	1 hr
Food present	1001	42
Food absent	1152	48
(Workers present)		
Not significant (P = >.02)		
3rd & 4th Larvae present	928	39
3rd & 4th Larvae absent	1225	52
(Workers present)		
Significant (P = >0.01)		
Workers present	1092	46
Workers absent	769	32

Significant (P = >0.01)

TABLE 2

OVIPOSITION DATA

IFA MONOGYNOUS LAB QUEENS

N = 33

GENERAL LINEAR MODELS

SOURCE	DF	$R^2 = 0.8499$
MODEL	3	
ERROR	28	
CORRECTED TOTAL	31	

SOURCE	F VALUE	Pr > F	SLOPE
INITWGT	65.95	0.0001	- .0022
WGTLOSS	68.51	0.0001	- .0090
PERCENT	92.15	0.0001	- .0018

TABLE 3

EGG WEIGHTS

	NO. EGGS	TOTAL WT. (mg)	WT. (mg) PER ANT
		Monogynous	
	221	3.2487	0.0147
	163	2.2983	0.0141
	145	2.0010	0.0138
	115	1.4950	0.0130
	149	1.9966	0.0134
	140	1.6940	0.0121
	108	1.5012	0.0139
	222	2.7528	0.0124
	200	2.5600	0.0128
	133	1.6492	0.0124
Mean	159.6	2.11968	0.01326
Range	108-222	1.4950-3.2487	0.0121-0.0147
		Polygynous	
	242	2.2506	0.0093
	388	3.6472	0.0094
	299	2.8405	0.0095
	242	2.0570	0.0085
	298	2.7118	0.0091
	261	2.4012	0.0092
	180	1.7460	0.0097
	172	1.5480	0.0090
	124	1.1532	0.0093
	275	2.4475	0.0089
Mean	248.1	2.2803	0.0092
Range	124-388	1.1532-3.6472	0.0085-0.0097

Fusion of Incipient Colonies of the Imported Fire Ant

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Fusion of incipient colonies of the imported fire ant was investigated. Two incipient colonies each consisting of one queen and her minims and brood were placed adjacent to one another. The replicates were videotaped and/or observed for 60 days. Three of seventeen replicates merged completely, and the queens remained in a polygynous association in the colony. Fourteen of the seventeen replicates merged but reverted to monogyny. Intraspecific brood-raiding was observed. A variety of behaviors were observed to lead to monogyny. No conclusions could be drawn as to the relationship of the victorious queen with queen weights, minim number, or brood amount.

Neutron Activation Analysis for Determining the Territorial Areas of Discrete Fire Ant Colonies

by

A. T. Showler, R. M. Knaus, and T. E. Reagan

ABSTRACT: Selected fire ant, Solenopsis invicta Buren, colonies in weedy and weed-free sugarcane habitats were labeled with the stable-activable tracer samarium-152, presented to each colony after mixing with raw animal fat. A bait station sampling system set on a 4.4 X 4.4 m grid permitted us to determine the territorial areas of each colony after the ant samples were activated in a neutron bombardment chamber. Colonies in weed-free habitats foraged from 6.4 to 11.3 percent of the sampling stations and traveled maximum distances that ranged from 11.0 to 15.1 m from their respective mounds. Colonies in weedy habitats foraged from 4.8 to 6.4 percent of the sampling stations and traveled maximum distances that ranged 5.2 to 8.2 m from their respective mounds. Aspects of neutron activation methods were discussed in terms of ecological experimentation.

SEX RATIOS IN MONO- AND POLYDOMOUS *SOLENOPSIS INVICTA* COLONIES

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Abstract

Solenopsis invicta or the fire ant occurs in mono- and polydomous colonies in Texas. The monogynous colonies are characteristically monodomous (50-100 mounds/acre) and polygynous colonies are polydomous (200-500 mounds/acre). The selection of foraging sites is discrete in the former and diffused in the latter. The monogynous colonies are mobile as against comparatively stable polygynous supercolonies (Bhatkar and Vinson, 1987, Proc. 10th IUSSI Congr. 1986, Verlag Peperny, Munich). The "effective" (nuptial) sex ratio in these populations in Texas was determined by capturing their alates, using a cone-shaped portable flight cage (Bhatkar, Dunton and Vinson, unpubl.) during the spring and summer of 1986. The 6 study sites were 500 ft apart at the A&M Farm and 10-15 miles apart at other parts in the Brazos County where the populations are both syntopic and sympatric. About 15-20 cages were used at each site on the approximately predicted days of nuptial flights and the captured alates were sexed as to males and females. A subsample of up to 125-150 males was dissected to determine the proportion of male sterility during each flight. The "aspermic", "sperm deficient" and "spermic" males categorized were subjected to starch gel electrophoresis (Dunton, Bhatkar and Vinson, unpubl.). There was a temporal fluctuation in the sex ratio, more males being produced in April (4 males:1 female), as against May when the male:female production approached 1:1 in the monodomous colonies. The productivity of polydomous colonies was not clear due to the limited data and appeared female biased. Male and female sterility was observed in both the population types, except in the polydomous, polygynous population it was to the tune of 30-80%, while in monodomous, monogynous population it was less (up to 20%). The aspermic males were biparental, developed from fertilized eggs, while the spermic males were developed from unfertilized eggs as evidenced from the alfa-GPDH starch gels. The flight time difference, observed in these two biotypes, was suggestive of the respective alfa-GPDH polymorphism. The sterility pattern, temporal and spatial fluctuation in sex raios, and flight time differences of the reproductives in mono- and polydomous *S. invicta* populations are under further study to understand the possible reproductive isolating mechanisms in the two biotypes.

SYSTEMATICS AND NEST BIOLOGY OF THE ORASEMINAE: CHALCIDOID PARASITES OF ANTS

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The family Eucharitidae (Hymenoptera: Eucharitidae) is comprised of two subfamilies, the Eucharitinae and Oraseminae. Presently, there are 44 genera and 332 species from around the world. The Oraseminae is comprised primarily of the genus Orasema which consists of about 39 poorly described species distributed almost entirely in the New World. Members of the genus Orasema Cameron, like other members of the family Eucharitidae, are parasitic upon ant pupae. Adult females lay their eggs into incisions made into plant tissue, away from the host, and the active first-instar larvae (planidia) seek adult ant hosts for transport back to the nest. Females of Orasema have been found to oviposit into a wide range of plants which include the involucral bracts of composites, leaves of oak and mango, bananas, tea leaves and various other plants. Planidia are carried back to the ant nest where they tranfer to host larvae, burrow just under the cuticle, and begin feeding. As soon as the ant pupates, the first-instar larva becomes ectoparasitic and completes its development - cradled in the deformed legs of the host. Pupation and adult emergence occurs within the nest and mating takes place after emergence from the nest. Presently, host records from various species of Orasema include Formica (1 sp.), Pheidole (10 sp.), Solenopsis (3 sp.) and Wasmannia (1 sp.). Eucharitids can contribute substantially to the mortality of an ant colony and a single colony of Pheidole in Texas had an estimated 50% of the brood parasitized by Orasema. [The author is currently revising the genus Orasema and any specimens or biological information would be appreciated.]

Comparison of Desiccation Resistance of Three Species of Fire Ants from Texas

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Abstract

Since its arrival in North America, the red imported fire ant (RIFA), *Solenopsis invicta* (Buren) has spread over most of the southeastern United States. With the exception of some resistance by native ants, the ultimate distribution of the RIFA may be dependent on abiotic factors (Buren et al., 1974). Temperature and humidity are two of the factors that exert a strong influence on the geographical range of the RIFA (Hung and Vinson, 1978).

Desiccation resistance of the worker castes of three of the fire ant species found in Texas; *Solenopsis invicta* , *Solenopsis geminata* , and *Solenopsis xyloni* , were tested. Minor, media, and major workers of the three species were exposed to 0% relative humidity. Ant weights were measured and recorded for minor workers at two hour intervals, media workers at three hour intervals, and major workers at eight hour intervals. The weighing procedure was terminated when a LT_{50} had been determined. Abbott's (1925) formula was used to correct for mortality in the controls.

Linear regression analysis was performed designating time as the independent variable and percent weight loss as the dependent variable. Analysis of covariance was performed on the slopes of the regression lines to determine significant differences ($P<.05$). The slopes of the regression lines for castes within a species were significantly different. The slopes of the regression lines for species within a caste revealed a significant difference among the major caste of the three species. Analysis of variance and a protected LSD mean separation test were performed on the mean times required to reach LT_{50} ($P<.05$). Within species, minor workers reached a LT_{50} at a significantly faster rate than media workers and media workers at a significantly faster rate than major workers. Within the minor caste of the three species, *S. invicta* reached a LT_{50} at a significantly faster rate than *S. xyloni*. No significant difference was found between the media and major castes of the three species. Of the three species tested, *S. invicta* was the least able to resist desiccation treatment.

ABUNDANCE OF FORAGING ANT PREDATORS OF THE SUGARCANE BORER IN RELATION TO SOIL AND OTHER FACTORS

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ABSTRACT

Extensive, weekly, summer surveys of sugarcane borer (SCB), Diatraea saccharalis (F), infestations and collections of predatory arthropods were made in 80 different sugarcane fields on as many different farms in eight sugar-producing parishes of Louisiana during 1982-83. Soil from each field was analyzed for various chemical properties and textural characteristics. An additional spring survey of cane fields in 12 Louisiana parishes was conducted during May 1984 for ants only.

The red imported fire ant (RIFA), Solenopsis invicta Buren, occurs more abundantly in fields of fine textured clay soils than in those of coarser textured loam soils. This significant find explains why SCBs have long been known to cause less crop stress in south Louisiana fields of heavy clay soil than in fields of coarser textured soils.

More than 98% of all predaceous arthropods collected on cane plants during two summers were ants. Ants were found foraging actively in all kinds of summer weather, at all times of day and at night.

The RIFA has increased in Louisiana cane fields from a subdominant species in 1960 to a position of undisputed dominance today, and in the process has replaced the once dominant argentine ant, Iridomyrmex humilis (Mayr). The RIFA now easily accounts for more than 90% of the cane field ant fauna in Louisiana.

The need for insecticide treatment to control the SCB decreases with increasing abundance of foraging ants in cane fields. The insecticides, Azodrin (monocrotophos) and Guthion (azinphos-methyl), have no significant effects on the abundance of foraging predatory ants when used on the farm to control SCBs in sugarcane.

INTRODUCTION

For many years the presence of ants in sugarcane fields was considered to be unimportant (23), or even harmful (3,9,10,25). The latter idea may still persist and be valid in some places under some conditions. Early workers (before 1940) had reported predation by ants on immature stages of the SCB (20,27). In 1951 Ingram et al (11), working in Louisiana, stated that the value of ants in SCB control was more than offset by the increase in mealybugs and aphids which they caused. Apparently ants in Louisiana cane fields were believed to be either unimportant or somewhat detrimental.

However, in 1958 Long et al (14) reported drastic increases of SCB populations and associated damage in cane fields treated with heptachlor to eradicate the RIFA. At this time, the RIFA was not the only ant species present in those fields, and it had not yet become the most abundant ant species there. These observations prompted new research on the role of ants in sugarcane fields.

Hensley et al (7) published data on the catastrophic increases in SCB numbers and associated crop damage which occurred in cane fields treated with heptachlor to eradicate the RIFA. They cited numbers of predatory arthropods collected in pit-traps from other insecticide-treated and untreated plots. They compiled a long list of arthropod predators from cane fields among which beetles, ants, and spiders were most prominent.

A series of studies followed using the pit-trap to collect arthropod predators from insecticide-treated and untreated plots (15,16,17,18,22). The major conclusions reached were that spiders, predatory beetles, and ants, particularly the latter, are all beneficial in the natural control of the SCB, and that any insecticide application which significantly reduces the numbers of these predators should be expected to increase problems from the SCB.

In Florida cane fields, Adams et al (1) obtained quantitative population data for four ant species using honey-agar and meat bait stations placed on the ground.

They calculated correlation coefficients between numbers of ants and SCBs, and concluded that the reduction of all ant species by mirex bait in some fields resulted in increased damage from the SCB.

Much of the evidence supporting the concept that predatory ants are the most important biological agents in the natural control of the SCB is of a correlative type. However, Negm and Hensley (17,18) published records of field observations of predation by the RIFA on all immature stages of the SCB and by other predators on various SCB stages. The senior author of this paper, on rare occasions over the years, has observed ants attacking SCBs in the field. However, much time and patience generally is required to observe this.

Carroll (4) collected ants in Florida sugarcane fields by hand and with pitfall traps. He reported 28 species of ants in Florida cane fields, 23 of which were found foraging on the cane plants. Fifteen ant species were found attacking SCB eggs, while 13 killed first instar larvae. Pheidole dentata Mayr, and P. floridana Emery were reported to be the most avid feeders on SCBs. However, he indicated that, at that time, RIFAs were reaching Glades County and south Florida sugarcane fields for the first time.

Ali et al (2) departed from the pit-trap technique. They used aspirators or forceps to collect foraging RIFAs returning to the mound with food. They found that more frequent foraging occurred in grassy than in weed-free sugarcane habitats. They reported a great variety of food items intercepted, of which 4.74% were lepidopterous larvae. They concluded that RIFA population levels could be enhanced through judicious vegetation management which would result in greater ecological stability of the sugarcane ecosystem.

White (24) indicated that predation increases with the age of the sugarcane crop. He found less predation of SCBs in the plant cane crop than in the 1st ratoon crop, and less in the latter than in 2nd ratoon cane. He also found a greater frequency and proportion of abandoned RIFA mounds in weed-free plots than in weedy plots. This was not due to herbicides since weeds were controlled by hand.

Many factors may influence the abundance of SCBs in the field. Some of these are known and are utilized in a sugarcane insect pest management program which takes advantage of the suppressive effects of arthropod predators, varietal resistance, and weather conditions, and utilizes insecticides only as a last resort (6,12,21).

The objectives of the studies reported in this paper were: 1) to determine how the abundance of foraging ants is related to SCB infestation and the need for insecticide applications to control the SCB; 2) to monitor the effects of insecticide applications in the field on the abundance of foraging ants; 3) to determine how the species composition of the cane field ant fauna has changed in Louisiana since 1960; 4) to determine how time of day and weather conditions affect the abundance of foraging ants; and 5) to study the relationships between the chemical and textural characteristics of soil and the abundance of ants foraging in Louisiana cane fields.

MATERIALS AND METHODS

Eight weekly collections of predatory arthropods and determinations of SCB infestation were made from late June through mid-August in each of 80 sugarcane fields on as many different farms in eight sugar-producing parishes of south Louisiana. All fields were first year stubble (ratoon) of the variety CP 65-357. Collections and determinations from 40 fields were made in 1982 and from the remaining 40 in 1983.

The weekly collection from each field consisted of a 5-minute search by one person, who collected predaceous arthropods by aspirator and by hand from sugarcane plants. Collected specimens were placed in jars of alcohol for later counting and identification in the laboratory. The jars were labeled for date, location, time of day, prevailing weather conditions (clear, overcast, or rainy), and percent borer infestation.

On the same dates that predator collections were made, the percent of stalks infested with SCBs was estimated in each field by examining 25 stalks for the presence of young SCB larvae in or behind the plant leaf sheaths and not yet bored into the stalks. The 25 stalks examined were 2 paces apart, located on one or two rows near the middle of each field and at least 10 paces from the field border (drainage ditch or field road). Recommendations for spraying to control the SCB were made as needed, and records were kept of the dates of all insecticide applications.

Soil samples were taken from each of the 80 fields and sent to A & L Agricultural Laboratories in Memphis Tennessee, for analysis. Analyses were made for percentages of organic matter, sand, silt and clay, for parts per million (ppm) of phosphorus (by both weak and strong Bray methods), potassium, magnesium and calcium, and for soil pH and cation exchange capacity (CEC).

An additional spring survey of 100 sugarcane fields in 12 Louisiana parishes was conducted during May 1984 for ants only. This survey was made during the same month and in approximately the same way as a survey made 24 years earlier (13). Two people collected by aspirator all the ants they could find during five minutes in each field. Fields were selected systematically and were several miles apart in each parish to insure that the survey would be representative of the Louisiana sugarcane area. Collected ants were later counted and identified in the laboratory.

RESULTS AND DISCUSSION

When the 80 sample fields were grouped according to the numbers of insecticide applications required in each for SCB control, it was found that the largest numbers of ants were collected in those fields which required no insecticide for SCB control (Figure 1). As the number of insecticide applications required increased from zero to four, the average numbers of ants collected per field decreased from 140 to 3, respectively. Differences among these means are significant by analysis of variance with $F = 7.12$, $df = 4$ and 75, and $P<.01$. In other words, less insecticide was needed to control the SCB in those fields where more ants were present.

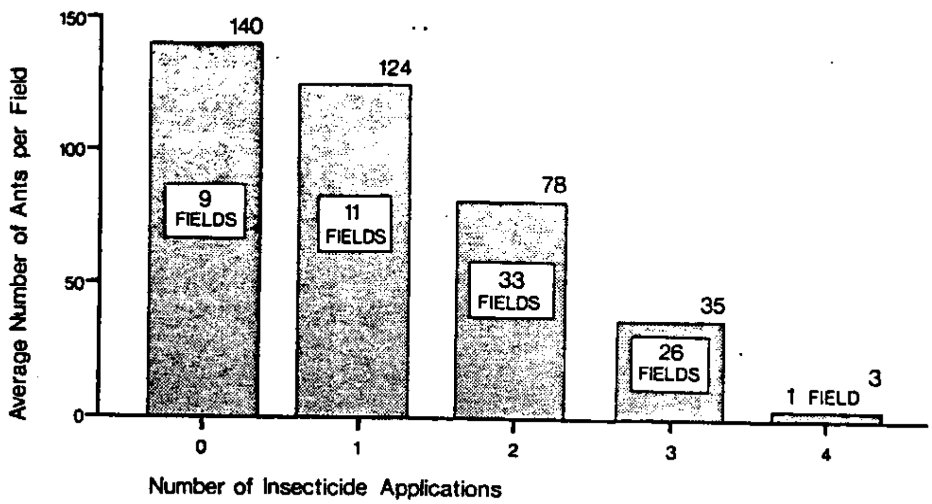

Figure 1. Average numbers of ants collected in fields requiring different numbers of insecticide applications for control of the sugarcane borer, 1982-83.

There was no indication that these differences in foraging ant abundance among the sampled fields had been affected by insecticides applied to control the SCB. When numbers of ants collected during the 2-week intervals before and after first insecticide application were compared, there was no significant difference between them. In fact, an average of only 3.4% fewer ants were collected following the first Azodrin treatment in 51 fields than before the treatment, while 8.7% more ants were collected following the first Guthion treatment in 14 fields than before the treatment. For both insecticides together in 65 fields, the difference between pre- and post-treatment ant abundance was less than 1%.

This does not mean that these insecticides do not kill ants. Indeed, dead ants are commonly found on cane plants following treatment with either insecticide. However, since most ants of a colony are in the nest at any particular time, and since insecticide residues begin to dissipate following their application, it is not surprising that the mortality observed does not significantly affect the abundance of ants foraging during the 2-week period following treatment.

In the survey of ants in Louisiana cane fields made in the spring of 1960 (13), 11 species were identified. The four most abundant, ranked according to decreasing abundance, were I. humilis, RIFA, Pheidole dentata Mayr, and Paratrechina melanderi Whlr. (Figure 2). These four species collectively accounted for 95% of Louisiana cane field ant fauna at that time. Of these four, I. humilis, the most abundant, probably already had begun to yield to pressures from increasing populations of the RIFA, which is believed to have entered south Louisiana between 1949 and 1953 (5). According to Wojcik (26), scattered, incipient infestations, known to exist in Louisiana in 1950, grew and coalesced until most of the state was infested by 1962.

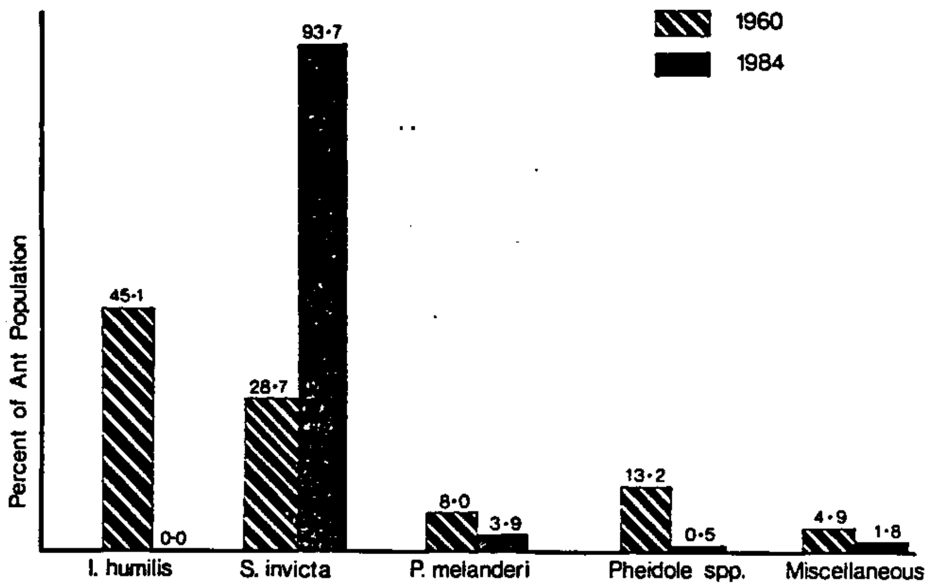

Figure 2. Relative abundance of ant species collected in Louisiana sugarcane fields in 1960 and 1984.

By 1984, the RIFA had increased to make up almost 94% of the Louisiana cane field ant fauna (Figure 2). This is based on results from the spring survey conducted in May 1984 in which a total of 1,470 ants were collected from 100 fields in 12 Louisiana parishes. During the summer collections of 1982-83, a total of 6,154 ants were caught, of which 91.5% were RIFAs. These data indicate that the RIFA now accounts for more than 90% of Louisiana's cane field ant fauna. Indeed it likely reached this level of relative abundance several years earlier, although no previous attempts were made since 1960 to document this.

It is interesting to note that the argentine ant, I. humilis, was not found at all in the 1984 spring ant survey (Figure 2), nor was it found in the summer collections of 1982-83. This was the most abundant ant present in 1960 (13), when the application of heptachlor to some cane fields for eradication of the RIFA resulted in dramatic increases in SCB populations (14). These observations suggest that, although the RIFA has now become the dominant species and I. humilis apparently has disappeared from Louisiana cane fields, the earlier complex of I. humilis and other ants constituted a significant force in the natural control of the SCB. I. humilis still occurs in south Louisiana. The senior author collected it in July 1985 from a parking lot in Donaldsonville, Louisiana.

The cane field ant fauna in Louisiana is dominated today by a single species, the RIFA, and is obviously less diverse than it was in 1960 (Figure 2). Although Adams et al (1) working in Florida, have suggested that a multiple predator ant complex is more effective than one dominated by the RIFA, we do not believe that this is necessarily true, particularly with a species as aggressive, abundant, and territorially tenacious as the RIFA.

More than 98% of all predaceous arthropods collected during two summers, 1982-83, were ants. This relative abundance of ants found on plants emphasizes their importance as a factor in the natural control of the SCB, since predators must forage on plants to find SCBs. Previous studies in which quantitative data were obtained on numbers of arthropod predators in cane fields have emphasized the use of pit-traps which catch organisms running about on the ground, many of which may never encounter a SCB (7,15,16,17,18,22).

The abundance of ants foraging at different times of day during the 1982-83 collections differed little during daylight hours between 7 a.m. and 7 p.m. ranging from 100 to 122 ants collected per man-hour. Additional cane field ant collections made during spring and summer months of 1984 between 10 p.m. and midnight, using both aspirators and bait traps, indicate that ants are foraging actively at night also. Ants also were actively foraging under all weather conditions during the summer, but were on the average less abundant during rainy weather than when skies were clear or overcast. Average numbers of ants collected per man-hour ranged from 75 in rainy weather to 108 when skies were overcast to 123 under clear skies.

Coefficients of linear regression were calculated for numbers of RIFAs on the various soil chemical and textural characteristics studied. Tables 1 and 2 show which of these calculated regression coefficients were statistically significant.

Table 1. Statistical significance of coefficients of regression of ants on soil chemical characteristics.

Soil Characteristics	F - Values		
	Calculated	P = .05	P = .01
Phosphorus (weak bray)	0.40	3.96	6.97
Phosphorus (strong bray)	1.08	3.96	6.97
Potassium	1.62	3.96	6.97
Magnesium	3.78	3.96	6.97
Calcium	7.21**	3.96	6.97
pH	0.01	3.96	6.97

**Significant at 1% level.

Table 2. Statistical significance of coefficients of regression of ants on soil textural characteristics.

Soil Characteristics	F - Values		
	Calculated	P = .05	P = .01
Cation Exchange Capacity	3.69	3.96	6.97
% Sand	0.001	3.96	6.97
% Silt	5.71*	3.96	6.97
% Clay	3.45	3.96	6.97
% Organic Matter	0.83	3.96	6.97

*Significant at 5% level.

Among the soil chemical characteristics, a positive and significant regression coefficient was found only between RIFA numbers and soil calcium (Ca) levels (Table 1). The calculated regression formula indicates an average increase of 30 RIFAs per field collected during a summer for each increase of 1000 ppm of soil calcium (Figure 3). A positive relationship between RIFAs and magnesium (Mg) only approached significance at the 5% level (Table 1).

Among the soil textural characteristics, only % silt was significantly related to RIFA numbers (Table 2). The calculated regression formula indicates that the number of RIFAs collected per field during a summer decreased on the average by 14.2 ants for each 10% increase in silt content of the soil (Figure 4).

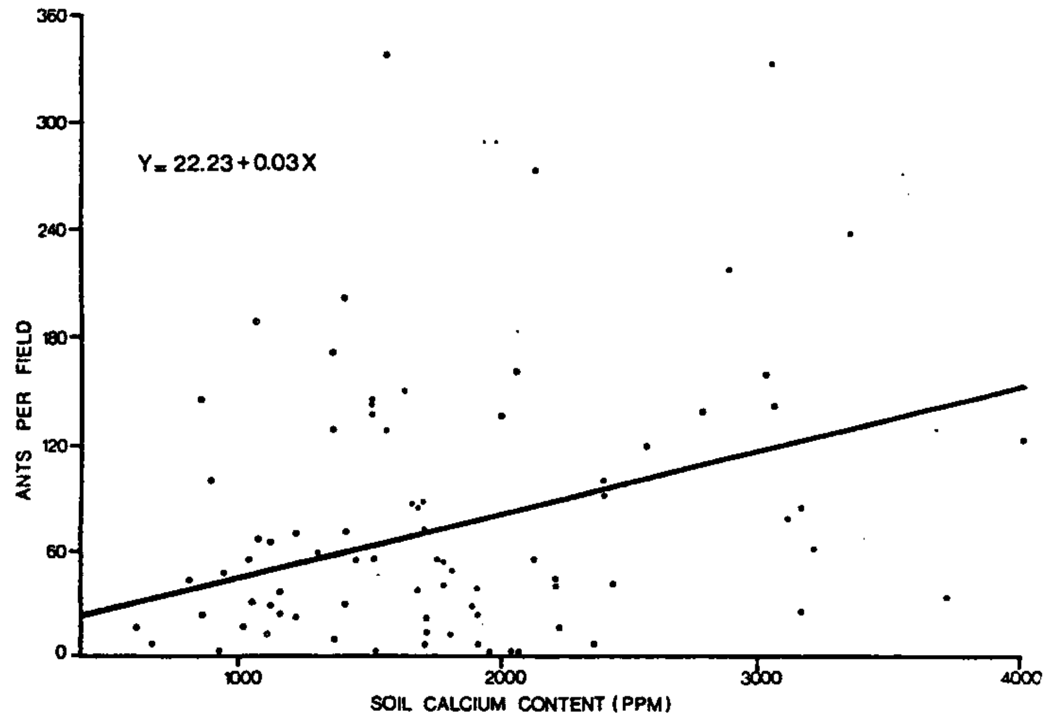

Figure 3. Numbers of S. invicta relative to soil calcium content.

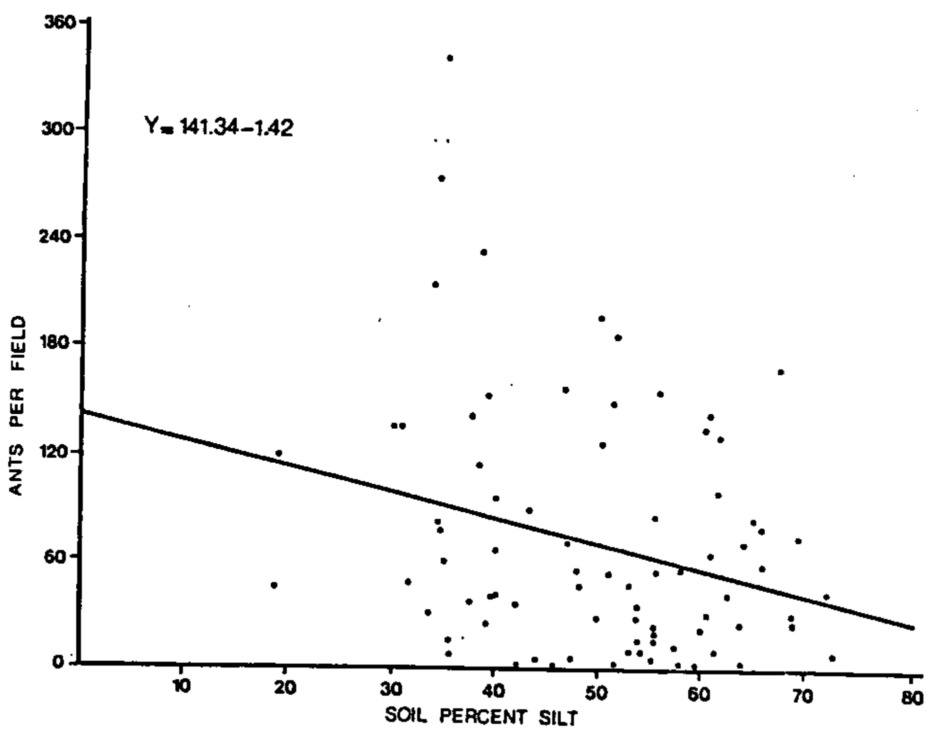

Figure 4. Numbers of S. invicta relative to soil silt content.

RIFA numbers decreased with increasing % silt in the soil (Figure 5); their numbers were greatest with maximum % clay (Figure 5) and with maximum CEC (Figure 6). Although ant abundance was not significantly related to % clay and CEC, it is not surprising that these relationships did approach statistical significance (Table 2).

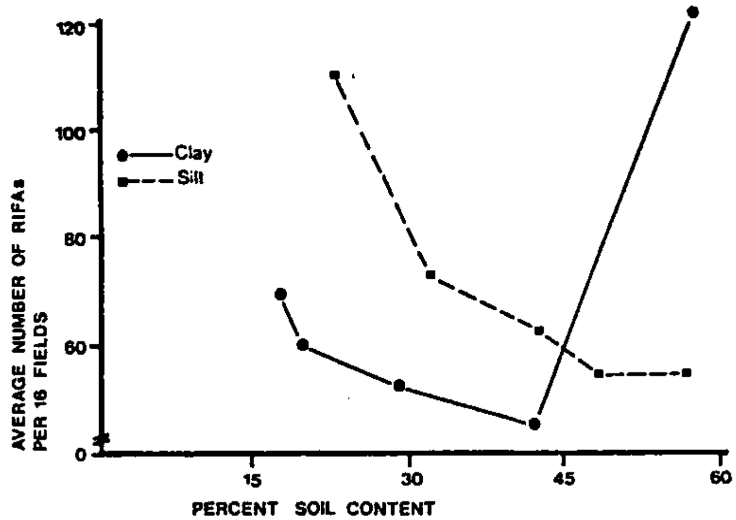

Figure 5. Numbers of <u>S. invicta</u> relative to soil content of clay and silt.

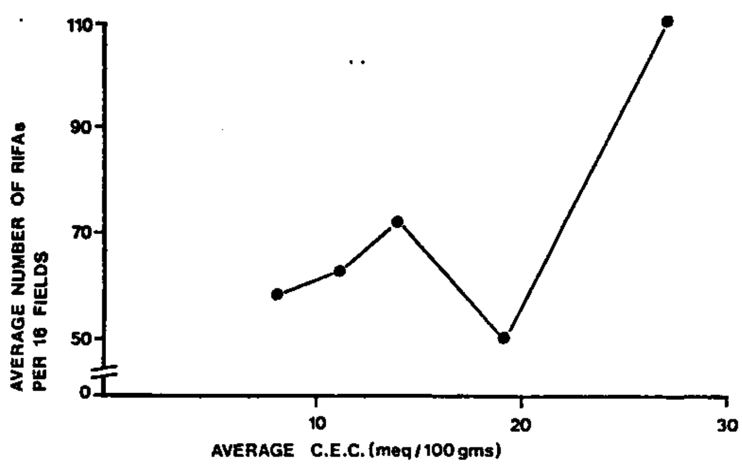

Figure 6. Numbers of <u>S invicta</u> relative to soil cation exchange capacity.

CEC is affected by soil texture and by % organic matter. It generally increases with increasing amounts of clay or organic matter. As % clay increases in soil, there must be an accompanying decrease in % silt or % sand or both. Therefore, the observed positive relationships between RIFA abundance and % clay and CEC are not surprising in view of the significant negative relationship between RIFA abundance and % silt.

For all 80 fields in which weekly collections were made during the summers of 1982-83, there were 64% more RIFAs in clay soils than in loam soils (Figure 7).

This difference is statistically significant by analysis of variance with $F = 5.03$, $df = 1$ and 78, and $P = .02$. This find largely explains why both farmers and researchers for many years have observed more SCBs in fields of coarser textured soils, which often are on the fronts of farms in south Louisiana, than in fields of heavier or finer textured soils.

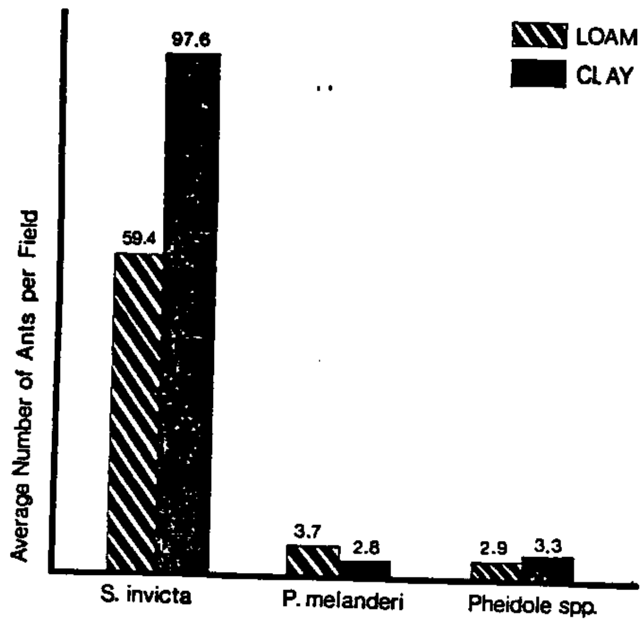

Figure 7. Relative abundance of ant species in clay and loam soils of south central Louisiana.

It is not known whether the greater abundance of RIFAs in clay soils is directly dependent on some relationship between the insect's biology and soil texture, or if it might be due to some other factor which only happens to be correlated with texture. For example, a higher water water table probably is more often associated with the clay than with the loam soils of south Louisiana.

Regarding soil texture as an ecological factor of importance to ants generally, Hess (8) found that clay soils support the largest number of ant species, while sands support the fewest. He reported a number of species which were cosmopolitan, one which seemed to favor sandy loams, and one (Solenopsis xyloni) which seemed to favor clays. In our studies, ant species, other than the RIFA, were not sufficiently abundant to permit conclusions about the effects of soil texture on their abundance.

The significant positive regression of RIFA numbers on soil Ca levels (Figure 3) and the near significance of a similar relationship with soil Mg (Table 1) may be only coincidental and not based upon any causal relationship. Clay soils with high CECs normally contain more Ca and Mg than do lighter textured soils with lower CECs.

CONCLUSIONS

From these studies, the following conclusions were reached. 1) The need for insecticide treatment to control the SCB decreases with increasing abundance of foraging predatory ants in cane fields. 2) The insecticides, Azodrin and Guthion, have no significant effects on the abundance of foraging ants when used on the farm to control SCBs in sugarcane. 3) Cane field ants are foraging actively in all kinds of summer weather and at all times of day as well as at night. 4) More than 98% of all predaceous arthropods collected on cane plants during two summers of extensive surveys were ants. 5) The RIFA has increased in Louisiana cane fields from a subdominant species in 1960 to a position of undisputed dominance today, and in the process has replaced the once dominant argentine ant, I. humilis. 6) The RIFA now accounts for more than 90% of the cane field ant fauna in Louisiana. 7) RIFAs are more abundant in the fine textured clay soils of the Louisiana sugarcane growing region than in the coarser loam soils.

ACKNOWLEDGMENTS

The authors gratefully acknowledge assistance from Dr. John H. Green, Head of the Department of Biological Sciences, NSU, who ran many of the statistical analyses on his personal computer.

Time, labor and travel for conducting the field collections and surveys were donated by Long Pest Management, Inc., and Viator Consulting Service of Thibodaux, Louisiana.

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Studies With Baits for Control of Multiple Queen Populations Of Red Imported Fire Ants

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Populations of the imported fire ants, *Solenopsis invicta* Buren and *S. richteri* Forel in the United States were until the mid-1970s considered to be essentially constituted of monogynous, i. e., single queen colonies. Glancey et al. (1973) reported the discovery of colonies containing multiple queens at several locations in Mississippi, with colonies in one location (Hurley) containing hundreds of mated queens. Multiple queen populations were reported shortly thereafter in Texas (Hung 1974) and by the early 1980s multiple queen populations of *S. invicta* were known to exist also in Alabama, Florida, Georgia, and Louisiana (Fletcher 1983, Lofgren and Williams 1984). We have increased, since 1983, from one known multiple queen location in Florida to at least 15 locations in eight counties with suspected infestations in four other counties. Available evidence suggests that the incidence of multiple queen colonies is increasing in Florida and possibly in other states as well.

Although several studies have been conducted on the multiple queen phenomenon in recent years, our understanding of the situation and whether multiple queen populations may cause greater problems is still uncertain. The studies have outlined several characteristics of multiple queen populations.

The typical distribution of worker sizes gives way to a distribution in which the workers tend to be small and more nearly uniform in size, however, the size distribution appears to be variable among multiple queen populations. Glancey (personal communication) has found that the predominant head width for workers from multiple queen colonies in Florida is about 30 percent larger than that reported by Greenberg et al. (1985) for workers from multiple queen colonies in Texas. Greenberg et al. (1985) found that about 65 percent of the workers in Texas colonies had average headwidth of .624 mm with an additional 20 percent at 0.720 whereas Glancey found (6 colonies) that the most predominant headwidth in Florida multiple queen colonies was 0.816 mm (39 percent) followed by 0.912 mm (30 percent).

The clumping or clustering effect results in a substantial increase in the number of nests and ants per unit of area. Typically a multiple queen population in Florida has a very few extremely large colonies (mounds 24 or more inches) interspersed with many small to medium colonies (mounds 4 to 10 inches). The extremely large nests may contain up to 300,000 or more ants. The vital statistics of one field in Marion Co., Florida infested by multiple queen colonies showed that each acre contained an average of 181 mounds (the minimum number was 93/acre; maximum was 445/acre). Calculations using the population index method of Harlan et al.(1981) and the total ant method of Lofgren and Williams (1985) showed an average of 7,809,300 ants/acre (minimum - 774,200; maximum - 22,569,400).

Reports have indicated that multiple queen populations of RIFA may be more difficult to control with chemicals. The Division of Plant Industry of the Florida Department of Agriculture and Consumer Services found that broadcast applications of AMDRO at the recommended rate of 1.0 lb/acre was not giving adequate control of RIFA in 3 Florida counties. Post-treatment surveys revealed that multiple queen colonies were present at every site where failure was experienced.

These reports prompted us to conduct tests to evaluate the effectiveness of AMDRO, AFFIRM, and LOGIC baits against multiple queen populations. Commercial formulations of each bait (0.88% Amdro, and 0.011% Affirm, and 1.0% Logic) were used.

Plots (0.2 ha) were established in the aforementioned pasture in Marion Co., Florida. Each bait was applied broadcast to 3 plots each at rates of 1.12, 2.24, and 3.36 kg/ha. The baits were applied with a tractor-mounted granular applicator. Three plots were left untreated as controls.

Circular one-tenth ha. evaluation plots were established in the center of each plot for pre and posttreatment evaluations. The population index method of Harlan et al. (1981) as modified by Lofgren and Williams (1982) was used to evaluate effective-ness.

The data (Tables 1-3) showed that none of the treatments had given complete control of the ants after 26 wk posttreatment. At the currently recommended rate of 1.12 kg/ha (1.0 lb/acre) Logic had produced the highest level of population index reduction (76.5%) and was the only treatment in which none of the surviving nests contained worker brood. At the 2.24 kg/ha rate Affirm had given the highest level of population index reduction (85.3%) and surviving nests in both the Affirm and Logic treatments were devoid of worker brood. At the 3.36 kg/ha (3.0 lb/acre) rate all three baits had given equal reductions in population indices. Amdro at the two higher rates was the only chemical to produce any significant reduction in the number of active nests.

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TABLE 1. EFFECTIVENESS OF 1.0 LB/ACRE OF AMDRO, AFFIRM & LOGIC AGAINST MULTIPLE QUEEN POPULATIONS OF RED IMPORTED FIRE ANTS (AVG. OF 3 REPLICATIONS).

Chemical	Pretreatment		Percent Reductions After Indicated Wk In*						Percent Surviving Nests With Worker Brood		
	Number nests	Pop'n Index	Number nests			Pop'n Index					
			6	11	26	6	11	26	6	11	26
AMDRO	57	1050	38.2	35.3	30.0	56.6	34.2	31.3	58.6	90.0	80.7
AFFIRM	56	983	42.6	17.2	- 2.4	57.5	45.6	53.4	56.4	45.7	26.6
LOGIC	58	1097	37.1	-17.7	-23.4	88.5	76.3	76.5	0	0	0

* Figures preceded by minus indicate increase rather than reduction.

TABLE 2. EFFECTIVENESS OF 2.0 LB/ACRE OF AMDRO, AFFIRM & LOGIC AGAINST MULTIPLE QUEEN POPULATIONS OF RED IMPORTED FIRE ANTS (AVG. OF 3 REPLICATIONS).

Chemical	Pretreatment		Percent Reductions After Indicated Wk In*						Percent Surviving Nests With Worker Brood		
	Number nests	Pop'n Index	Number nests			Pop'n Index					
			6	11	26	6	11	26	6	11	26
AMDRO	60	1087	78.9	76.7	73.3	89.3	88.0	77.3	28.9	28.6	68.8
AFFIRM	57	958	62.9	61.8	28.8	90.9	88.4	85.3	2.9	7.7	0
LOGIC	59	984	37.3	- 7.9	-44.6	86.7	76.6	69.7	0	0	0

* Figures preceded by minus indicate increase rather than reduction.

TABLE 3. EFFECTIVENESS OF 3.0 LB/ACRE OF AMDRO, AFFIRM, & LOGIC AGAINST MULTIPLE QUEEN POPULATIONS OF RED IMPORTED FIRE ANTS (AVG. OF 3 REPLICATIONS).

Chemical	Pretreatment		Percent Reductions After Indicated Wk In*						Percent Surviving Nests With Worker Brood		
	Number nests	Pop'n Index	Number nests			Pop'n Index					
			6	11	26	6	11	26	6	11	26
AMDRO	64	1115	82.9	79.3	72.0	93.4	82.1	77.2	37.6	67.5	63.0
AFFIRM	54	938	37.3	36.0	9.3	87.7	88.1	79.4	0	0	3.4
LOGIC	60	1060	35.9	3.9	-12.7	86.0	79.4	76.1	0	0	0

* Figures preceded by minus indicate increase rather than reduction.

Recent Chemical Studies on Fire Ants

ROBERT K. VANDER MEER

Our laboratory has developed the analysis of the species-specific fire ant venom alkaloids and hydrocarbons as a tool for studying a variety of problems. These range from behavioral and caste to the taxonomy of the S. saevissima complex. I would like to relate some of our recent discoveries regarding the hybridization of S. invicta and S. richteri in the United States and the current status of chemical taxonomy in South America.

HYBRID

Hybridization between the red and black forms of the imported fire ant was initially discovered by our group using chemical taxonomy based on hydrocarbon and venom alkaloid gas chromatographic patterns. Our findings were later confimed by isozyme studies carried out by Dr. Ross at the University of Georgia. In addition, Dr. Ross could state from his data that the hybrid was reproductively viable. We in turn analyzed preserved samples from 1964, and showed that hybridization occurred at that time and probably whenever the two forms met. Surveys conducted by the USDA and Stan Diffie of the University of Georgia demonstrated that the hybrid's range extended at least from northeastern Mississippi to northwestern Georgia; a range much more extensive than orginally thought.

However this survey was not very satisfactory, since only one or two samples were collected from each county. A collaborative survey between APHIS and ARS was initiated to conduct a systematic survey. The affected states were marked off in a 20 km grid. Three samples are to be taken around each intersecting point. The results of this survey will be available for the next meeting.

SOUTH AMERICA

The hybrid discussed above throws doubt on the species designation of the two imported fire ants. Because chemical taxonomic characters were invaluble in this case, we feel that they will also be very important in helping the classical taxonomist to unravel the extremely complicated fire ant taxonomic problem in South America. To this end we have begun to collect and analyze samples from Caseres and Campo Grande, Brazil. The chemical profiles from the two areas are distinctly different; however, we can not say at this time whether or not they represent two different species or are simply racial variants of a single species. Additional samples from the areas between the two sites are necessary to determine if there is a geographic cline or not.

In addition to the above differences, we have detected less distinct population nodes within each of the two sites. By the end of this year we hope to have the necessary samples to begin to answer some of the questions about Solenopsis taxonomy and perhaps even the specific origin of our imported fire ants.

Studies with Fenoxycarb on Alates of RIFA

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When I spoke to you last year, I reported on our research on fenoxycarb and its effects on the colony queens. I mentioned to that we were in the process of studying what effects the chemical had upon the alates, both male and female. And today, I'd like report on our studies. But first I want to review for you the effects of fenoxycarb on the mother queen.

When fenoxycarb is fed to colonies of RIFA, the chemical will arrest the development of the oogonia as early as two weeks after treatment. In the following weeks, the material will suppress the development of the nutritive tissues, e.g. nurse cells and follicular epithelium. In addition, developing eggs are resorbed and no new workers are produced. Eight weeks after treatment, all that remains of the queen's reproductive system are some thin strands of tissue which produce oogonia, but do not support their growth and development.

When the observations had been made on the effects on the colony queen, we naturally began to question what was occurring to the alates that were being produced in the colony. One of the first effects of the chemical is to shift the caste from that of workers to sexuals. Our feeling upon seeing this was that such a shift might be counterproductive in control measures. Our report today covers the effects of fenoxycarb upon alates produced by treatment of the colony with the chemical.

Materials and Methods

Twenty-seven queenright laboratory colonies of red imported fire ants, consisting of 20 to 30 ml of immatures, and 40-60,000 worker ants, were each fed 0.5 ml of once-refined soybean oil containing 2.0% fenoxycarb (10 mg/colony active ingredient). Three additional colonies of comparable size were used as untreated controls and were given an equal volume of neat soybean oil. The oil solution was administered in micropipets from which the ants drank. Ingestion of the oil solution was complete within 24 hr after which the ants were returned to the normal laboratory diet [Banks et al. 1981]. The colonies were maintained in the laboratory at 27 ± 2 C.

At weekly intervals through 8 wk, the queens from 3 of the 27 treated colonies were sacrificed, and the ovaries removed,examined, and fixed in Kahle's fixative. After fixation, the ovaries were embedded in paraffin (mp:57^0 C),sectioned at 5um and stained with Harris's hematoxylin and eosin. The remaining 3 colonies were held for observation of the effects of fenoxycarb on the colonies. The three normal colony queens were also sacrificed at the same time and fixed to serve as controls. In addition, at weekly intervals, female and male alates were removed, and fixed as per the colony queens.

Results

Firstly, nothing happens to the males even after they have been held in treated colonies for up to 16 weeks. The males remain quite normal and produce viable sperm.

It is in the female sexual alates that we see dramatic events occurring. And the first of these is that of de-femininization. By this I mean that larvae which have been fed fenoxycarb and which have eclosed as alate females, possess a spermatheca, fat body, alary muscles, can fly, and can even histolyze these same wing muscles, but they cannot reproduce, and the reason they cannot reproduce is that the ovarian tissues have been retarded to such a degree as to be non existent. All that these females have is a microscopic piece to tissue that might have been functional ovaries. And this de-feminization begins in the early stages of the reproductive larva. Here is a slide showing the ovary taken from a normal sexual female 4th instar larva. The ovary is shaped much like a ripe Bermuda onion, its quite large, visible to the naked eye, and easily dissected out. Its so large that you need to use the dissecting scope to photograph it in its entirety.

Here is a slide of a female sexual larva fed fenoxycarb. As you can see, its not quite the same organ as the previous slide. It is microscopic in size, the ovarioles have failed to differentiate, and it cannot be detected with the naked eye. Whereas the other slide was photographed at 18X, this slide is at 600X magnification.

This slide is of the ovary taken from a normal female sex pupa. Notice how the individual ovarioles are separated and growing. Each ovariole shows oogenesis actively taking place with the production of oogonia, follicular epithelium, nurse cells and cytoplasm. The slide also shows the two oviducts, the spermatheca and the bursa copulatrix.

This slide shows a pupa of the same age, but one that received fenoxycarb while in the larval stage. Again it is 18X vs 600X magnification. All that is shown here is a small patch of gonadal tissues connected to the spermatheca. That is the entire ovary. Again, it cannot be seen with the naked eye in order to dissect it out. It can be seen only in serial sections and with the aid of a microscope.

This is a slide of a normal 7 day old virgin alate. You can see the bursa, the spermatheca, the oviducts and some vitellogenic trophic eggs.

This is the comparable slide of a 7 day old virgin alate which was fed fenoxycarb. You can see the bursa, the spermatheca and the oviducts, but that's it. The ovaries are non existent. So although this female has all her working parts, she is in essence, a sterile female, one that is capable of mating and as such represents our first and only success with the use of a sterile female release program.

There are some other effects of fenoxycarb upon the colony alates, and these effects seem to be dosage dependent. The alates produced during the first few weeks of treatment all are of the same size as the control alates, i.e. about 12mg in weight. But as the experiment is continued, you begin to see the size of the females diminishing. Here is a slide of a normal female and one of a female taken from a colony treated 6 weeks earlier. The weight of the small female is 7mg vs 12mg. In this slide, the small female is from a treatment 12 weeks earlier and she weighed only 4mg. Both these small females are capable of flight and wing muscle histolysis. But both are sterile.

Another condition which presents itself over time and diminution of the dose of logic is that of ovarian recovery. Notice I did not say functionality. In the laboratory, from 8 to 12 weeks, we begin to see some ovarian tissues formed as seen in these slides. We have termed these partial atrophied ovaries. The ovaries are small, show nurse cell production, cytoplasm and follicular epithelium, but these fail to produce vitellogenic eggs. So again, these females, although they have ovaries are still sterile. Now my co-worker, Al Banks gave me some females collected from the field 20 weeks after treatment and these females all showed the defeminized condition. So its quite possible that what we are seeing in the laboratory is just an artifact, and that what happens in the field is the crash of the colony. Oh, one other effect takes place in the laboratory as a result of the time dilution factor and that is the production of intercastes. These are ants with characteristics of both sexual and worker traits. Here , is one with wing buds, this is one with ocelli, and internally, these may have or have not the spermatheca.

If you take the defeminized queens or the virgins with partial ovaries and hold them for two weeks with sibling workers, the ovarian tissues do not develop and the females remain sterile. As far as we know, this defeminization has occurred only in fire ants treated with logic.

We have come across many chemicals through out the years of our research program on fire ants, yet this is the first time we have seen anything of this nature. Many implications are found with this new compound, exciting ones at that.... for it is one of the few compounds that will give control of the multiple queen type of colonies. Because it causes defeminization, we can study the effect of the presence of ovaries on the production of the various queen pheromones. Additionally, we can use fenoxycarb treated colonies to investigate the nature of caste determination.

Death of fire ant colonies treated with fenoxycarb can be attributed to a number of interrelated causes. Of primary importance is the lack of worker brood production which results eventually in a greatly reduced worker population. Concomitant with this is a lower rate of food gathering, queen tending and colony maintenance. All of this can lead to the death of the queen and eventually to the death of the colony itself. The success of fenoxycarb in controlling the fire ant is due in a large measure to the fact that the replete workers store the chemical in the crop and the postpharyngeal glands and thus serve as a reservoir for the constant introduction of the material into the colony (Banks et al. 1983). As long as a certain titer of the material remains present in the colony, the queen and all the future alates will be subjected to its effects.

In some of our most recent studies, we have found that in field treated colonies (1#/AC), after 26 weeks, some of the queens in multiple queen colonies were beginning to recover ovarian function. However, the virgin alates found in these colonies all had atrophied ovaries. The ovaries were about 1/4 their normal size even though the alates were of normal size and weight. We know that there is still enough fenoxycarb present in the workers to cause an abnormal ovarian condition in the alates, but not enough to cause the sterility in the queen. So even though we are not affecting the queen, we are still affecting the resulting sexuals. This ability for treated colonies to survive 26 weeks is due in part to their being treated just at the onset of cool weather. Warm weather should show a drastic reduction in these treated colonies. This same effect was seen by Homer Collins in the treatments in 1984 and 1985 in the Gulfport area.

We also did some behavioral studies with some of the queens and small alates from the logic treated colonies. This work is being submitted as a manuscript by Marty Obin. The conclusions from this particular piece of work show that queens from logic treated colonies are significantly different from control queens in their ability to keep alates from dealating. (4/50 for control vs 21/50 in logic queens). Alates from logic treated colonies have just as much queen recognition pheromone as alates from control colonies, but they do not have the amount of inhibitory pheromone that the controls do.(8% dealation vs 54%). It appears that the presence of the inhibitory pheromone is correlated with the presence of ovaries and not with the weight of the female. Absence of ovaries gives an absence of the inhibitory pheromone.

Title: Fire ant predation in sweet sorghum insect pest management.

Authors: B. W. Fuller and T. E. Reagan

SUMMARY

Sweet sorghum, Sorghum bicolor (L.) Monech, was recently introduced into south Louisiana for ethanol production. The sugarcane borer, Diatraea saccharalis (F.), is the major pest for both sugarcane and sweet sorghum. Previous research by Reagan and Flynn at LSU suggested the need to assess the impact that the introduction of this susceptible crop would have on permanency of sugarcane insect pest management which incorporates a careful balance of host plant resistance, natural and insecticidal controls.

In a study during 1985 and 1986 to determine the arthropod faunal composition and the role of predator control of D. saccharalis, the red imported fire ant, Solenopsis invicta Buren, comprised 70.4 and 62.3% of the predators collected from pitfall and canopy samples. Spiders, carabids, and tiger beetles were present at much lower levels during both years.

Weather effects preceeding the 1985 season reduced D saccharalis populations such that sweet sorghum plots with natural predator populations did not exceed the economic injury level of 10% bored internodes. However, this threshold was surpassed in both predator suppressed and non-suppression treatments during 1986; but plots which contained predators suffered 44.1% less damage. Thus, natural predator populations alone were not able to control D. saccharalis populations in sweet sorghum, and would necessitate additional management tactics. Diatraea saccharalis moths were reduced 42.8% in plots with predators, providing broader implications relative to the area-wide pest management of the sugarcane/sweet sorghum ecosystem.

1987 IMPORTED FIRE ANT CONFERENCE
LOUISIANA STATE UNIVERSITY
BATON ROUGE, LOUISIANA

MARK R. TROSTLE -- IMPORTED FIRE ANT SPECIALIST

TEXAS DEPARTMENT OF AGRICULTURE

IMPORTED FIRE ANT CONTROL PROGRAM 1987

The Texas Department of Agriculture has expanded its Fire Ant Control Program for 1987 in an effort to better serve all Texans -- rural and urban, young and old -- regardless of whether they live in an infested area or non-infested region of the state. The three major goals of the TDA's 1987 Fire Ant Program are:

- to halt the spread of imported fire ants into non-infested areas
- to assist in controlling imported fire ants in the infested regions
- to provide critical information to the public about IFA in an effort to maximize the success of the previous two goals.

These goals will be achieved through two key components -- Enforcement and Education/Outreach.

EDUCATION/OUTREACH

The Education/Outreach component is designed to educate Texans about the importance of effectively controlling imported fire ants and their spread into non-infested regions. Increasing the public's awareness about IFA is an important prelude to enlisting their assistance in TDA's battle to halt further IFA infestations. The groups targeted for the educational programs are the school districts, public officials, civic groups, utilities and public events. These groups will be contacted through mailings of pamphlets, surveys, IFA Biology book, public service announcements and demonstrations of proper control techniques. (Attached are samples of the pamphlets, surveys and IFA biology book.)

ENFORCEMENT

The Enforcement component of TDA's IFA control program is designed to stop the transportation of IFA to non-infested areas by identifying the responsible party and penalizing them for their failure to adhere to state quarantine laws. Key elements of the enforcement plan are:

- Targeted Inspections of Sod Farms. Continuous inspections of all sod farms will improve current mandatory treatment programs that require only fire ant free sod and other nursery products be sold to the public.

TDA contacted the sod growers and found that the commercial sod production in Texas is relatively new in comparison with most agricultural enterprises. Much of the production technology associated with sod production was developed through practical experience and initiative of the individual growers.

Commercial sod production in Texas began in the 1940's with neighbors getting sprigs of common St. Augustine from each other, and is now a highly specialized business with about 250 growers. Currently some 50,000 acres in Texas are in commercial sod production with about 500 million square feet of sod marketed per year. An additional 10,000 acres of pasture grass are harvested and marketed each year.

Sod production is, of course, limited to those turfgrasses for which there is a market demand. These include warm season grasses, such as St. Augustine, bermudagrasses, zoysia and centipede. Currently, 80 percent of the sod being produced and marketed in Texas is St. Augustine grass. The reason that Texas has large production of sod is due to the climate, deep soil and water.

An average of one harvest is obtained each year for St. Augustine sod. If a harvest is made as early as March, then another may be possible in the early fall. In harvesting a grass such as St. Augustine, the sod cutter harvests a 12, 16 or 20 inch wide strip along approximately one-fourth inch of soil. Approximately 25,000 square feet of sod are harvested per acre per year.

The sod growers have also introduced new turfgrasses such as Raleigh and Floratam St. Augustine in an attempt to improve their markets. Even with the introduction of new grasses and improved techniques two elements are still making it extremely tough for the sod grower to stay in the business. These two elements are:

- o The economics of Texas at the current time. The difference is price due to the slump in the economy.

	1985 & 1986	1987
Common St. Augustine	.80	.40
Raleigh St. Augustine	.95	.50
Common Bermudagrass	.95	.40
Centipede	1.25	.80
Zoysia	2.50	1.00 to 1.25

- o The economics of treating for the Imported Fire Ant. Past regulatory treatments for the IFA averaged $8.00 per acre and enabled the grower to be IFA free for two to three years. The current regulatory treatment which consists of applying 40 pounds per acre of 10% granular chlorpyrifos for four weeks of control at a cost of $100.00 per acre is out of the question. The high rate of application is 60 pounds per acre of 10% granular chlorpyrifos and it will give ten weeks of control. The cost of this application would be $120.00 per acre. The sod grower is economically unable to comply with these certification requirements due to economics.

The TDA during the past three weeks has been inspecting the different sod farms in the state in an attempt to stop the distribution of sod with IFA and obtain an workable solution to the treatment of infested sod farms. To date TDA has conducted 188 inspections involving 16,905 acres of sod. There has been a Stop-Sale Order placed on 5,385 acres of sod due to heavy infestations of IFA. TDA has developed a procedure that currently is allowing the sod farmer to continue selling their sod. The procedure is:

- For the sod farmer to mound treat with a contact insecticide only those mounds in the area to be cut in the immediate future.
- To demonstrate to the sod grower that a broadcaste application of a bait will reduce the populations of IFA to a lower level and less mound treatments will be required by the sod farmer.

The TDA will have a more stringent inspection of sod farms and other outlets which are selling sod. TDA will also be doing record inspections when IFA are found and will be requiring treatment of infested sod. The TDA will also be conducting road inspections of trucks hauling sod to ensure that IFA are not being transported throughout the state.

TDA will also be working with USDA/APHIS/PPQ in surveying the state for newly IFA infested counties to enable each group to update their quarantines. In January 1986, TDA showed 113 counties to be infested with IFA. The survey is showing that we currently have 122 counties infested with IFA as of April 1987.

I would like to thank Richard L. Duble, Turfgrass Specialist, Texas Extension Service and Arthur Milberger, Owner, Milberger Turf Farms for their contribution of information about the history of Sod production in Texas.

I would also like to thank Gene Reagan and LSU for their hosting the Imported Fire Ant Conference this year. The meeting has been excellent.

IFA FOLLOW-UP SURVEY

DISTRICT ____________ IFA SPECIALIST ____________________

NAME OF SCHOOL: ____________________ ADDRESS: ________________________

CITY: ____________________ COUNTY: ________________________

CONTACT PERSON ____________________ TITLE: ________________________

1. Do you feel your staff is adequately trained on proper application techniques? yes no
   If not: ____
   ____

   Would another field demonstration on proper control tactics be helpful? yes no

2. Did you treat your grounds? yes no

3. What was the primary product used for treatment of Fire Ants? ____________________.
   How often and what method? ____________________
   ____

4. What type of control was achieved from this product?
   ____

5. Would you use other commercial products in treating Fire Ants if available at reduced rates? yes no

6. TDA, because of budget restraints, has initiated a new bait program offering reduced rates to schools and governmental entities on various products. Explain products and their cost. Would you be interested in obtaining a listing of participating companies, their products and cost? yes no
   DATE MAILED: ______________

7. Would you be interested in receiving TDA's New Imported Fire Ant Biology Book? yes no
   DATE MAILED ______________

8. Any comments on issue of Fire Ants and what is being done to control them: ____________________
   ____
   ____

THE FIRE ANT AND ENVIRONMENTAL TOXICOLOGY PROGRAM AT THE UNIVERSITY OF GEORGIA

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While the chance of developing a successful pesticide has decreased from 1 in 1000 chemicals in 1956 to 1 in 18,000 chemicals in 1984, the cost of producing a new pesticide has risen from an average of $2 million in 1956 to about $20 million in 1984. Add to this the extensive toxicological and environmental fate data now required by federal agencies and it is no surprise to learn that the introduction of new pesticide products has declined sharply since 1970. In light of these facts and because of the extensive Imported Fire Ant problem in the state of Georgia, our state legislators have committed funds to aid industry in screening and testing new fire ant pesticides and other agrochemicals through research at the University of Georgia's Veterinary Medical Experiment Station (VMES).

For almost two years now, VMES scientists have been conducting extensive toxicological tests to determine the safety of the Griffin Corporation's promising new fire ant bait, GX-071, a fluorinated sulfonamide. We have utilized the expertise of individuals in many departments of the College of Veterinary Medicine (including Pathology, Physiology, Medical Microbiology, and Avian Medicine), and in the College of Pharmacy. Conducted tests required by the Environmental Protection Agency have included acute and subchronic oral and dermal batteries on rodents, fish, quail, dogs, and invdrtebrates. Tests for chronic effects have included studies of the chemical's affects upon avian reproduction, teratology, and metabolism. Follow-up tests have been conducted as necessary, and chemical assays have been developed as needed. All of the mandated tests -- past, present, and future-- follow strict EPA guidelines and are subject to Good Laboratory Practice regulations with approved protocols and monitoring by a Quality Assurance Unit instituted at the university for this program.

A Fire Ant Research Laboratory is maintained to conduct efficacy tests and additional research on laboratory-reared colonies of the ants. In the coming year, this program will sponsor the production of a documentary film about Imported Fire Ants, a project which will be undertaken in cooperation with entomologists in the Agricultural Experiment Station.

The Environmental Toxicology Program also has established the first regional center of the National Animal Poison Control Center. This regional center provides a 24-hour poison control hotline for animal toxicity problems for the southeastern states and is computer-linked to the national center to provide timely advice in emergency situations.

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