D.P. Wojcik

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(NS = Not Submitted)

Abstract - Fire Ant Population Dynamics Computer Model

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A computer simulation model of red imported fire ant population dynamics was developed to incorporate major population mechanisms and features in colony life history, and to test it with real field data. The model's main feature provides an explicit description of spatial expansion or contraction of individual colony territories. Six aspects of colony life history are modelled: nest founding, brood raiding, territory growth, queen death, possible 're-queening', and colony death. With parameter modification, colonies may realize some adaptive elements in their territorial growth behavior. The model assumes a homogeneous habitat, constant environment, monogyne colonies, and post-claustral queens. One hectare is the practical spatial scale. The model is scientifically-oriented, programmed in Pascal 6.0, and is suitable for examination of the relative role of different mechanisms and parameters in red imported fire ant population dynamics. A forthcoming article destined for Environmental Entomology will describe the model: M.D. KORZUKHIN and S.D. PORTER. A spatial model of territorial competition and population dynamics in the fire ant, ***Solenopsis invicta*** (Hymenoptera: Formicidae).

CURRENT STATUS OF FIRE ANT INFESTATIONS IN VIRGINIA

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HISTORY OF FIRE ANT INFESTATIONS IN VIRGINIA

Imported fire ants were first discovered in Virginia in the Tidewater area in 1989, on a golf course in Hampton. By May 1992, 391 fire ant mounds associated with 40 separate locations had been reported throughout the area. After discovery, mounds were treated by Virginia Department of Agriculture personnel. Treatment consisted of baiting with Amdro for six weeks followed by a Dursban drench. The area surrounding the mounds was visually searched for the presence of other mounds.

By June 1993, a total of 579 imported fire ant mounds had been discovered at 64 locations in the Tidewater area over the four-year period (Table 1). Several of the new mounds were found near previously treated nests. In most cases it was not possible to determine whether the new mounds represented 1) new introductions, 2) movement of the treated nests to new locations, 3) established colonies that had been missed during earlier inspections, or 4) reproduction by budding (Porter et al. 1988) or reproductive flights from the original mounds prior to treatment. In one location at Chesapeake Square shopping mall, however, it seems likely that the new mounds resulted from mating flights; the original mounds were located in landscaping around the mall parking lot, and the new mounds appeared in a wooded area adjacent to the lot.

BAITING TO DETECT NEW MOUNDS

In order to locate incipient colonies or established colonies that had moved, I baited for ants near treated areas in Chesapeake (2 sites), Hampton (1 site) and Newport News (2 sites) in spring 1993. Baits consisted of cotton balls saturated in peanut oil and placed in a transect at 1-m intervals. At one Newport News site (CEBAF), transects were 10-m in length, and at all other sites transects were 24-m. Ants visiting the baits were collected after approximately two hours.

No fire ants came to baits at the majority of sites, but at Chesapeake Square Mall two baits in a transect near the woods adjoining the mall attracted fire ants.

BIOCHEMICAL IDENTIFICATION OF VIRGINIAN FIRE ANTS

The recent spread of the *invicta x richteri* hybrid in Georgia and Alabama (Diffie et al. 1988) raises the possibility that it might invade northward. In order to determine whether the colonies found in Virginia were *S. invicta* or the hybrid, hexane extracts of worker ants were prepared and sent to R.K. Vander Meer in Gainvesville, FL, for biochemical analyses of the cuticular hydrocarbons and venom alkaloids which are diagnostic of fire ant species (Ross et al. 1987). Samples from colonies in Chesapeake (1 site), Newport News (6 sites), and Richmond (1 site) all had the biochemical profiles of *Solenopsis invicta* (Vander Meer, personal communication).

CONCLUSIONS

The pattern of fire ant infestation in Virginia illustrates the factors associated with an area's vulnerability to ant invasion. Tidewater Virginia consists of a constellation of adjacent cities in various stages of development. Rapidly growing areas such as Chesapeake, Newport News and Virginia Beach have experienced the greatest number of fire ant mounds. Established cities such as Hampton and Norfolk that have run out of space for expansion have reported only a few mounds. Landscaping of shopping malls and new developments appears to be primarily responsible for the movement of fire ant mounds into Virginia. Perhaps the new chemicals used to treat nursery stock in quarantined areas will inhibit transport of fire ants via the nursey trade and slow their northward progress.

ACKNOWLEDGMENTS

I thank Jim Pierce of the Virginia Department of Agriculture for access to VDA records on fire ant mounds, and Bob Vander Meer for biochemical analyses.

REFERENCES

Diffie, S., R.K. Vander Meer & M.H. Bass. 1988. Discovery of hybrid fire ant populations in Georgia and Alabama. J. Entomol. Sci. 23: 187-191.

Porter, S.D., Van Eimeren, B. & L.E. Gilbert. 1988. Invasion of Red Imported Fire Ants (Hymenoptera: Formicidae): Microgeography of competitive replacement. Ann. Entomol. Soc. Amer. 81: 913-918.

Ross, K.G., Vander Meer,R.K., Fletcher, D.J.C. & E.L. Vargo. 1987. Biochemical phenotypic and genetic studies of two introducted fire ants and their hybrid (Hymenoptera: Formicidae). Evolution 41: 280-293.

Table 1. Distribution of the 579 fire ant mounds discovered in Tidewater, Virginia, from 1989 - 1993.

	# Sites	# Mounds
CHESAPEAKE		
apartment	1	5
business	10	332
home	7	15
HAMPTON		
business	4	9
golf course	1	10
LIGHTFOOT		
business	1	20
NEWPORT NEWS		
apartment	2	6
business	18	62
development	1	21
home	6	11
vacant lot	2	5
NORFOLK		
apartment	2	29
business	2	4
PORTSMOUTH		
home	2	5
VIRGINIA BEACH		
business	4	26
home	5	12
YORKTOWN		
business	2	4
home	1	1
YORK COUNTY		
home	1	2

M-2792

The Gainesville transect: Twenty-one years of RIFA population increases[1]

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Solenopsis invicta Buren, the red imported fire ant (RIFA), is a pugnacious, immensely successful invader of disturbed habitats throughout the Southeastern United States (Tschinkel 1987). Changes in native ant fauna resulting from insecticide treatment for control have been documented (Apperson et al. 1984, Markin et al. 1974), along with subsequent reinfestation by RIFA (Summerlin et al. 1977). The effects of RIFA invasion on native ant fauna (in the absence of insecticide treatments) have usually been studied by comparing habitats with and without RIFA (Camilo & Philips 1990, Phillips et al. 1987, Porter et al. 1988, Whitcomb et al. 1972). However, after invasion by RIFA, some native and other introduced species of ants are known to persist (Baroni-Urbani & Kannowski 1974, Glancey et al. 1976). The successful movement of RIFA into uninfested areas by taking advantage of man-made ecological disturbances, other than large-scale insecticidal treatments, has not been properly documented.

Gainesville, Florida, an area that has never received any large scale insecticide treatment, first became lightly infested with RIFA in late 1971. In March 1972, a long-term study was initiated to assess the long-term effects of population increases of RIFA on non-target ants in the absence of insecticide treatments.

Materials and Methods

One hundred permanent bait stations were designated and marked about every 0.8 km (0.5 mile) along 4 paved roads in Gainesville, Alachua Co., Florida (Wojcik 1983). The baits [a 1.9 cm, (0.7 inch) diameter ground-beef ball and a 1.3 cm (0.5 inch) honey-agar cube] were individually placed on 2.5 cm (1 inch) aluminum squares. In the field, the 2 baits were placed at bait stations in the same relative positions, 0.3 to 1 m (1-3 ft) apart, at 9 AM each sampling period (Wojcik et al. 1975). The baits were collected after one hour, the ants were preserved in alcohol, sorted to species and counted. Sampling of the ant populations has been conducted periodically for 21 years (March 1972 to September 1992). Initially, sampling was done every other month, but it varied with the demands of other projects and the rate of increase of RIFA populations (Table 1). The areas of Gainesville sampled by the transect are occupied only by monogyne RIFA colonies.

[1] This article represents the results of research only. Mention of a proprietary product does not constitute an endorsement or recommendation for its use by the USDA.

Number of sites is defined as the number of bait stations out of 100 bait stations (each had 2 baits) for each sampling period with a species. For each species, percent occurrences is defined as the number of baits with a given ant species out of 200 baits per sampling period. For each species, percent specimens is defined as the percent of all ant specimens collected per sampling period.

Data were transformed to rank values for each species with means for ties (Conover & Iman 1976). Correlation coefficients were calculated, for the ranked values of monthly percent occurrence of the various species to ranked monthly values percent RIFA occurrence, using linear regression analysis with Lotus 123 ver. 3.3 and significance determined by t-test (Steel & Torrie 1960).

Results and Discussion

To date (September 1989), 23 genera and 55 species of ants have been collected on the transect. After 17 years, 62 sampling periods, 12,400 bait collections and 825,648 specimens have been examined. Approximately 1/3 of the baits were collected with more than one species of ant on them and 2,126 baits did not have any ants on them. RIFA has gradually increased to where they now represent 45% of the collections and 60% of the specimens collected. Over 60 sites are now permanently occupied by RIFA. This increase in RIFA populations in shown in the figure. This increase occurred in spite of high populations of Solenopsis geminata (F.) and Pheidole dentata (Mayr). These two species are the two most common species besides RIFA collected on the transect and are usually considered good competitors of RIFA.

During 68 sampling periods over 21 years, 13,600 bait samples and 990,079 specimens were collected and identified. More than one ant species was collected on approximately 33% of the baits; 16% of the baits were blank. RIFA, S. geminata and Pheidole dentata were the 3 major species collected on the transect over the years in total occurrences (58.33%) and specimens (82.5%). Through September 1992, the following 55 species of ants from 5 subfamilies and 22 genera have been collected on the transect: Aphaenogaster ashmeadi Emery, A. flemingi Smith, A. floridana Smith, A. fulva Roger, A. near rudis, Brachymyrmex depilis Emery, Camponotus decipiens Emery, C. floridanus (Buckley), C. socius Roger, Cardiocondyla ectopia Snelling, C. emeryi Forel, C. nuda (Mayr), C. venustula Wheeler, C. wroughtoni (Forel), Conomyrma bureni Trager, C. medeis Trager, Crematogaster ashmeadi Mayr, C. atkinsoni Wheeler, C. lineolata (Say), C. pilosa Emery, Cyphomyrmex rimosus (Spinola), Forelius pruinosus (Roger), Formica archboldi Smith, F. pallidefulva Latreille, Hypoponera opaciceps (Mayr), Lasius alienus (Foerster), Leptothorax pergandei Emery, Monomorium viridum Brown, Odontomachus brunneus (Patton), Paratrechina boubonica (Forel), P. concinna Trager, P. faisonensis (Forel), P. longicornis (Latreille), P. parvula (Mayr), P. vividula (Nylander), Pheidole carrolli Naves, P. dentata Mayr, P. floridana Emery, P. metallescens Emery, P. moerens Wheeler, P.

morrisi Forel, P. vinlandica Forel, Prenolepis imparis (Say), Pseudomyrmex ejectus F.Smith, Solenopsis geminata (F.), S. invicta Buren, S. globularia littoralis Creighton, S. picta Emery, S. (Diplorhoptrum) spp., S. near truncorum, Tetramorium bicarinatum (F.), T. lanuginosum Mayr, T. simillimum (F.Smith), Trachymyrmex septentrionalis (McCook), Trichoscapa membranifera (Emery).

The RIFA population has gradually increased until in September 1992 it dominates the ant fauna: 43.3% of the sample occurrences (Fig. 1A, maximum 55.8% in March 1990 & April 1992), 63.1% of the sample specimens (Fig. 1B, maximum 74.3% in April 1992), and 50 sites (Fig. 1C, maximum 59 sites in April 1991). This increase has undoubtedly been aided by habitat disturbances and habitat simplification (the process of urbanization) which have gradually occurred in Gainesville. The increase occurred in spite of high populations of S. geminata and Pheidole dentata, two species which are predaceous on newly-mated RIFA queens (Whitcomb et al. 1972). RIFA is an r-strategist or weed species with great reinfestation abilities, enabling it to invade, establish, and rebuild populations quickly (Buren & Whitcomb 1977, Tschinkel 1987). Once established, it persists and dominates its habitat, becoming a keystone species and influencing community structure. Like its congener, S. geminata (F.) (Risch & Carroll 1983), RIFA dominates the ant fauna numerically.

Both S. geminata and P. dentata showed significant negative correlations ($P<0.01$) when compared to RIFA in percent occurrences (Fig. 1A), in specimens (Fig. 1B), and in number of sites occupied (Fig. 1C). Tschinkel (1988) found that the outcome of the competition between RIFA and S. geminata is usually mediated by the degree of disturbance in the environment. S. geminata was able to overcome moderate disturbance, and persist and flourish in the presence of the RIFA invasion. S. geminata populations can return to pre-disturbance levels if they are not displaced by competitors (Risch 1981). Whitcomb et al. (1972) reported that S. geminata was one of the first species to decrease or disappear after RIFA invasion of soybean fields, but pesticide usage was not considered and no time parameters were given. Despite having an alarm-recruitment defense system specific to Solenopsis species ants (Wilson 1976), P. dentata has decreased wherever it has been studied following RIFA invasion (Glancey et al. 1976, Cherry & Nuessly 1992). This decrease is at least partially attributable to the superior recruitment and displacement abilities of RIFA over P. dentata (Fraelich 1991).

An additional 13 species occurred often enough to allow calculation of significant correlations against occurrences. These species can be divided into native ants and introduced ants. Each group had species which were either negatively or positively correlated with the ranked percent occurrences of RIFA (Table 2).

Native species which occur in habitats and niches similar to RIFA have generally been negatively affected by the habitat disturbances in Gainesville and the corresponding increases in RIFA populations. The population changes, as reflected in the percent changes in the ranked occurrences, of Pheidole metallescens, Pheidole floridana, Pheidole morrisi (Fig. 2), Paratrechina vividula, Forelius pruinosus, and Monomorium viridum (Fig. 3) are all significant (P<0.01) and represent real population decreases of these ants. Although many of these species are predators and will attack newly mated RIFA queens, Whitcomb et al. (1972) report decreases in their populations as a result of RIFA invasion. The smaller nest sizes, seasonally restricted mating flights, and limited ability to withstand habitat disturbance (Naves 1985, Smith 1965, Trager 1984, Harada 1990, DuBois 1986) puts these species at a disadvantage in relation to RIFA.

The decrease in Crematogaster ashmeadi occurrences (Fig. 2) is statistically significant (P<0.05). The change in C. ashmeadi occurrences probably represents habitat changes as this ant nests in trees, shrubs, and vines (Johnson 1988). This ant has not been collected on the transect since 1981, but it still can be found in wooded areas in and around Gainesville. Conomyrma bureni occurrences (not figured) are weakly negatively correlated (P<0.05) with RIFA occurrences. This native species is an ant of disturbed areas (Trager 1988), preferring small areas of bare soil for its nests. The decreasing number of occurrences probably do not represent a real population decrease as this species and its congeners can exist quite well in areas infested with RIFA (Hung 1974, Claborn et al. 1988, Trager 1988).

Odontomachus brunneus occurrences (Fig. 3) showed an unexpected positive correlation (P<0.05) with increasing RIFA occurrences. This native predator nests in small colonies (Brown 1976), which it successfully defends against RIFA and other ants with a unique defensive mechanism (Carlin & Gladstein 1989). This species has an excellent ability to defend itself against RIFA in direct confrontation as measured by Bhatkar (1988). The dynamics of habitat disturbance and urbanization have somehow improved the habitat for this ant in spite of the increases in RIFA population. This species has been collected on both meat and honey-agar baits belying its strictly predatory reputation (Whitcomb et al. 1972).

The second group of ants consists of introduced species most of which show a positive correlation (P<0.01) in the percent changes in the ranked occurrences (Table 2). This indicates their populations increases with corresponding increases in RIFA populations. The habitat disturbance and urbanization of Gainesville should favor population increases in these species. Paratrechina longicornis (Fig. 2) has the largest positive correlation with RIFA. This introduced species is a structural pest which can nest outdoors in northern Florida (Trager 1984). Tetramorium simillimum (Fig. 2) and Pheidole moerens (Fig. 3) are introduced pests which show weaker positive correlations (P<0.01) with RIFA occurrences. These introduced species are structural pests which can nest outdoors in northern Florida (Smith 1965, Naves 1985).

Cardiocondyla emeryi was the only other introduced species collected in sufficient numbers for analysis (Table 2). This tiny ant is generally ignored by other ants and occupies slightly to heavily disturbed habitats (Creighton 1950). It showed a negative correlation ($P<0.05$) (Fig. 3). As this species nests in plants as well as under items on the ground, the reasons for its decrease probably are similar to those responsible for the decrease shown by *Crematogaster ashmeadi*.

The habitat disturbance and urbanization of Gainesville has included the widening of streets and right-of-ways, which has resulted in the removal of native vegetation on the transect since the study began. These changes will undoubtedly continue in the future. The lack of a large area-wide insecticide treatment for RIFA has allowed us to study the gradual changes in other ant populations which have taken place over the last 21 years. The processes operating on the ant populations in Gainesville are also at work throughout the southeastern United States. In very few areas have the RIFA populations reached stable levels. In the absence of large area-wide insecticide treatments, RIFA populations may take years to reach their peak and stabilize. The Gainesville populations of RIFA have not stabilized (reached the carrying capacity) and will continue to be monitored in the future.

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References

Apperson, C.S., R.B. Leidy, and E.E. Powell. 1984. Effects of Amdro on the red imported fire ant (Hymenoptera: Formicidae) and some nontarget ant species and persistence of Amdro on a pasture habitat in North Carolina. J. Econ. Entomol. 77: 1012-8.

Baroni-Urbani, C., and P.B. Kannowski. 1974. Patterns in the red imported fire ant settlement of a Louisiana pasture: Some demographic parameters, interspecific competition and food sharing. Environ. Entomol. 3: 755-60.

Bhatkar, A.P. 1988. Confrontation behavior between *Solenopsis invicta* and *S. geminata*, and competitiveness of certain Florida ant species against *S. invicta*, p. 445-64. In J.C. Trager (ed.), Advances in myrmecology. E.J. Brill, New York 551 p.

Brown, W.L., Jr. 1976. Contribution toward a reclassification of the Formicidae. Part VI. Ponerinae, Tribe Ponerini, subtribe Odontomachiti. Section A. Introduction, subtribal characters, Genus *Odontomachus*. Stud. Entomol. 19: 67-171.

Buren, W.F., and W.H. Whitcomb. 1977. Ants of citrus: some considerations. Proc. Int. Soc. Citriculture 2: 496-8.

Camilo, G.R., and S.A. Philips <sic>, Jr. 1990. Evolution of ant communities in response to invasion by the fire ant Solenopsis invicta, p. 190-8. In R.K. Vander Meer, K. Jaffe, and A. Cedeno (eds.), Applied myrmecology, a world perspective. Westview Press, Boulder, CO, 741 p.

Carlin, N.F., and D.S. Gladstein. 1989. The "bouncer" defense of Odontomachus ruginodis and other Odontomachine ants (Hymenoptera: Formicidae). Psyche 96: 1-19.

Cherry, R.A., and G.S. Nuessly. 1992. Distribution and abundance of imported fire ants (Hymenoptera: Formicidae) in Florida sugarcane fields. Environ. Entomol. 21: 767-770.

Claborn, D.M., S.A. Phillips, Jr., and H.G. Thorvilson. 1988. Diel foraging activity of Solenopsis invicta and two native species of ants (Hymenoptera: Formicidae) in Texas. Texas J. Sci. 40: 93-9.

Conover, W.J., and R.L. Iman. 1976. On some alternative procedures using ranks for the analysis of experimental designs. Commun. Statist.-Theor. Meth. A5: 1349-1368.

Creighton, W.S. 1950. The ants of North America. Bull. Mus. Comp. Zool. Harvard Coll. 104: 1-585, plates 1-57.

DuBois, M.B. 1986. A revision of the native New World species of the ant genus Monomorium (minimum Group) (Hymenoptera: Formicidae). Univ. Kansas Sci. Bull. 53: 65-119.

Fraelich, B.A. 1991. Interspecific competition for food between the red imported fire ant, Solenopsis invicta, and native floridian ant species in pastures. M.S. Thesis, University of Florida, 158 p.

Glancey, B.M., Wojcik, D.P., Craig, C.H., and J.A. Mitchell. 1976. Ants of Mobile County, AL, as monitored by bait transects. J. Georgia Entomol. Soc. 11: 191-7.

Harada, A.Y. 1990. Ant pests of the Tapinomini tribe, p. 298-315. In R.K. Vander Meer, K. Jaffe, and A. Cedeno (eds.), Applied myrmecology, a world perspective. Westview Press, Boulder, CO, 741 p.

Hung, A.C.F. 1974. Ants recovered from refuse pile of the pyramid ant Conomyrma insana (Buckley) (Hymenoptera: Formicidae). Ann. Entomol. Soc. Am. 67: 522-3

Johnson, C. 1988. Species identification in the eastern Crematogaster (Hymenoptera: Formicidae). J. Entomol. Sci. 23: 314-32.

Markin, G.P., J. O'Neal, and H.L. Collins. 1974. Effects of mirex on the general ant fauna of a treated area in Louisiana. Environ. Entomol. 3: 895-8.

Naves, M.A. 1985. A monograph of the genus Pheidole in Florida (Hymenoptera: Formicidae). Insecta Mundi 1: 53-90.

Phillips, S.A., Jr., W.M. Rogers, D.B. Wester, and L. Chandler. 1987. Ordination analysis of ant faunae along the range expansion front of the red imported fire ant in South-central Texas. Texas J. Agric. Natur. Res. 1: 11-5.

Porter, S.D., B. Van Eimeren, and L.E. Gilbert. 1988. Invasion of red imported fire ants (Hymenoptera: Formicidae): microgeography of competitive replacement. Ann. Entomol. Soc. Am. 81: 913-8.

Risch, S.J. 1981. Ants as important predators of rootworm eggs in the Neotropics. J. Econ. Entomol. 74: 88-90.

Risch, S.J., and C.R. Carroll. 1983. Effect of a keystone predaceous ant, Solenopsis geminata, on arthropods in a tropical agroecosystem. Ecology 63: 1979-83.

Smith, M.R. 1965. House-infesting ants of the eastern United States. USDA, Tech. Bull. 1326, 105 p.

Steel, R.G.D., and J.H. Torrie. 1960. Principles and procedures of statistics. McGraw-Hill Book Co., Inc. New York.

Summerlin, J.W., A.C.F. Hung, and S.B. Vinson. 1977. Residues in nontarget ants, species simplification and recovery of populations following aerial applications of mirex. Environ. Entomol. 6: 193-7.

Trager, J.C. 1984. A revision of the genus Paratrechina (Hymenoptera: Formicidae) of the continental United States. Sociobiology 9: 49-162.

Trager, J.C. 1988. A revision of Conomyrma (Hymenoptera: Formicidae) from the southeastern United States, especially Florida, with keys to the species. Florida Entomol. 71: 11-29. Errata Florida Entomol. 71: 219.

Tschinkel, W.R. 1987. The fire ant, Solenopsis invicta, as a successful weed, p. 585-8. In J. Eder, and H. Rembold (eds.), Chemistry and Biology of Social Insects. Verlag J. Peperny, München, 757 p.

Tschinkel, W.R. 1988. Distribution of the fire ants Solenopsis invicta and S. geminata (Hymenoptera: Formicidae) in northern Florida in relation to habitat and disturbance. Ann. Entomol. Soc. Am. 81: 76-81.

Whitcomb, W.H., H.A. Denmark, A.P. Bhatkar, and G.L. Greene. 1972. Preliminary studies on the ants of Florida soybean fields. Florida Entomol. 55: 129-42.

Wilson, E.O. 1976. The organization of colony defense in the ant Pheidole dentata Mayr (Hymenoptera: Formicidae). Behav. Ecol. Sociobiol. 1: 63-81.

Wojcik, D.P. 1983. Comparison of the ecology of red imported fire ants in North and South America. Florida Entomol. 66: 101-11.

Wojcik, D.P., W.A. Banks, and W.F. Buren. 1975. First report of Pheidole moerens in Florida (Hymenoptera: Formicidae). U.S. Dept. Agr. Coop. Econ. Insect Rpt. 25: 906.

Table 1. Summary of collections by year on the Gainesville transect from March 1972 to September 1992.

YEAR	NUMBER OF MONTHS SAMPLED[1]	NUMBER OF BAIT SITES OCCUPIED BY RIFA/YEAR
1972	5(3,5,7,9,11)	1
1973	6(1,3,5,7,9,11)	1
1974	3(1,3,7)	0
1975	2(1,7)	8
1976	2(1,7)	8
1977	5(3,5,7,9,11)	17
1978	6(1,3,5,7,9,11)	28
1979	6(1,3,5,7,9,11)	34
1980	5(1,3,5,7,9)	34
1981	5(3,5,7,9,12)	48
1982	5(3,5,7,9,11)	48
1984	2(3,10)	57
1985	2(3,10)	58
1986	2(3,10)	59
1987	2(3,9)	50
1988	2(3,9)	61
1989	2(3,9)	63
1990	2(3,9)	64
1991	2(4,9)	66
1992	2(4,9)	65

[1]Month: 1=January, 3=March, 4=April, 5=May, 7=July, 9=September, 10=October, 11=November, 12=December.

Table 2. Correlation of species ranked percent occurrences to ranked percent *Solenopsis invicta* occurrences (df = 66).

SPECIES	R	Number of Occurrences	Percent of Occurrences
Solenopsis invicta	-----	2659	20.27
Solenopsis geminata	-0.782**	2745	20.93
Pheidole dentata	-.543**	2247	17.13
Pheidole metallescens	-.589**	777	5.92
Pheidole floridana	-.551**	191	1.46
Paratrechina longicornis	+.745**	131	1.00
Tetramorium simillimum	+.554**	219	1.67
Pheidole morrisi	-.489**	537	4.09
Pheidole moerens	+.421**	144	1.10
Odontomachus brunneus	+.410**	251	1.91
Paratrechina vividula	-.400**	144	1.10
Forelius pruinosus	-.389**	83	.63
Cardiocondyla emeryi	-.376**	194	1.48
Crematogaster ashmeadi	-.353*	27	.21
Monomorium viridum	-.349*	80	.61
Conomyrma bureni	-.298*	1216	9.27

(*significant at the 0.05% level; **significant at the 0.01% level)

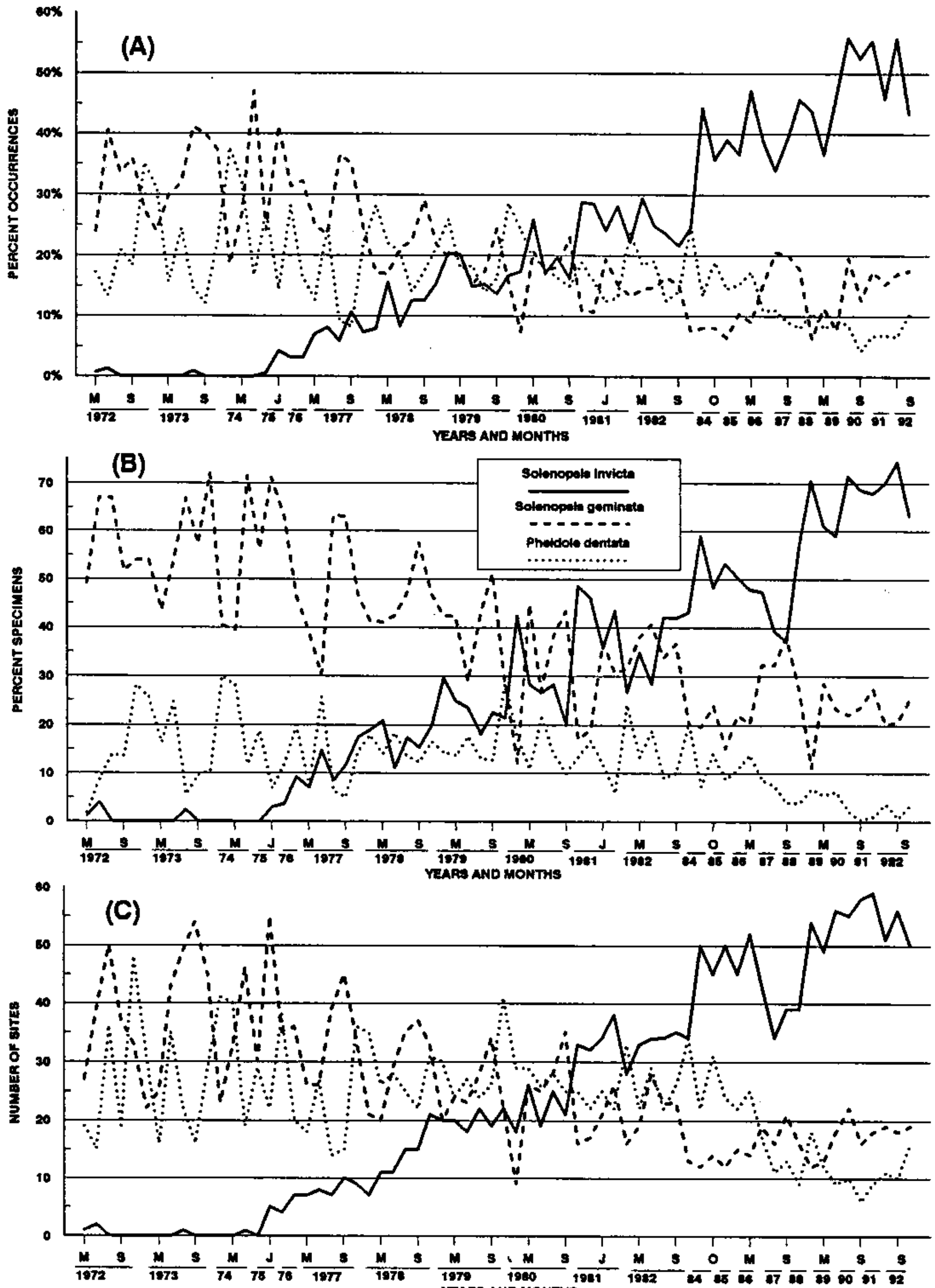

Figure 1. Percent occurrences (A), Percent specimens (B), and number of sites (C) for major species of ants collected on the Gainesville transect from March 1972 to September 1992.

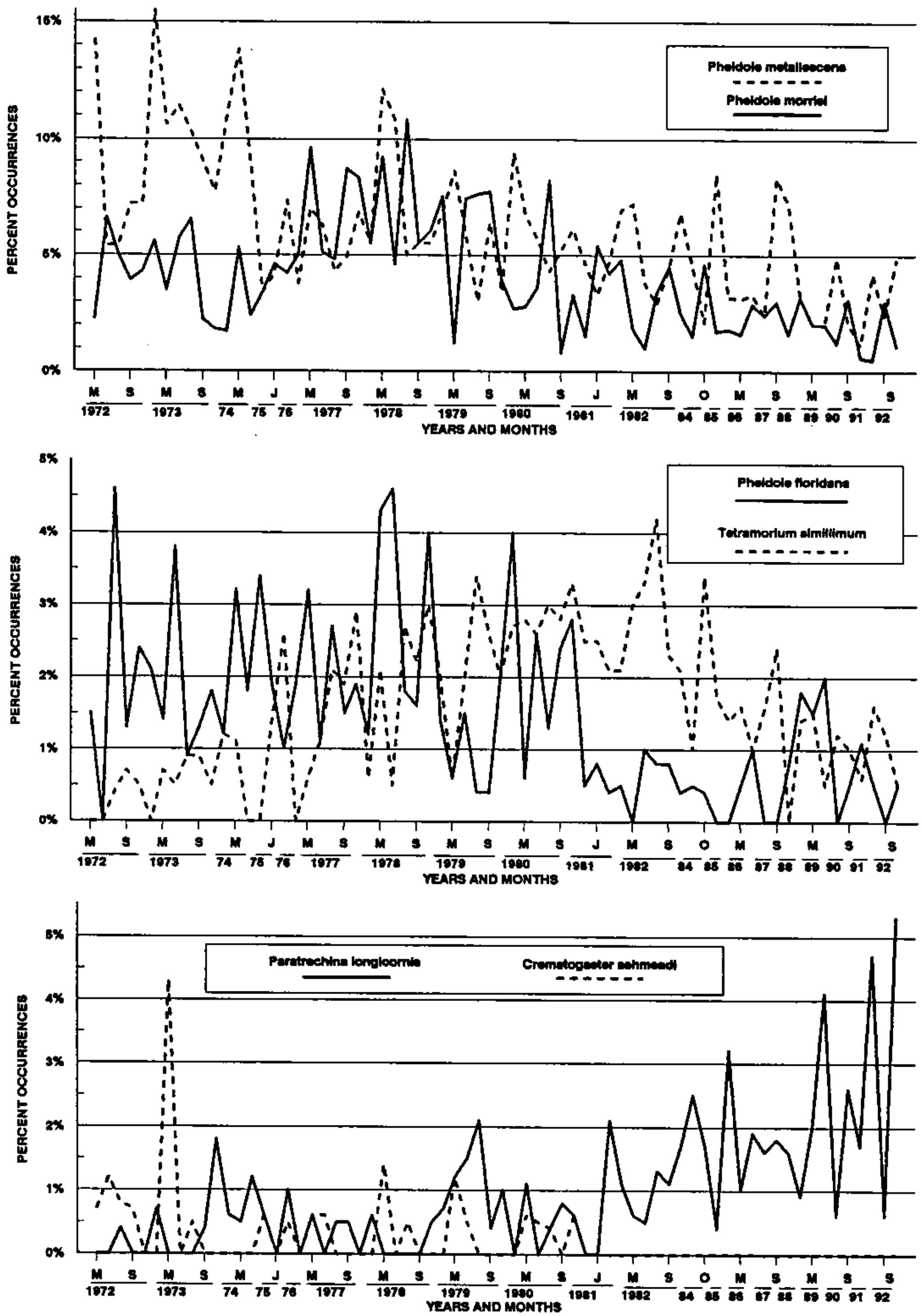

Figure 2. Percent occurrences of 6 species of ants collected on the Gainesville transect from March 1972 to September 1992.

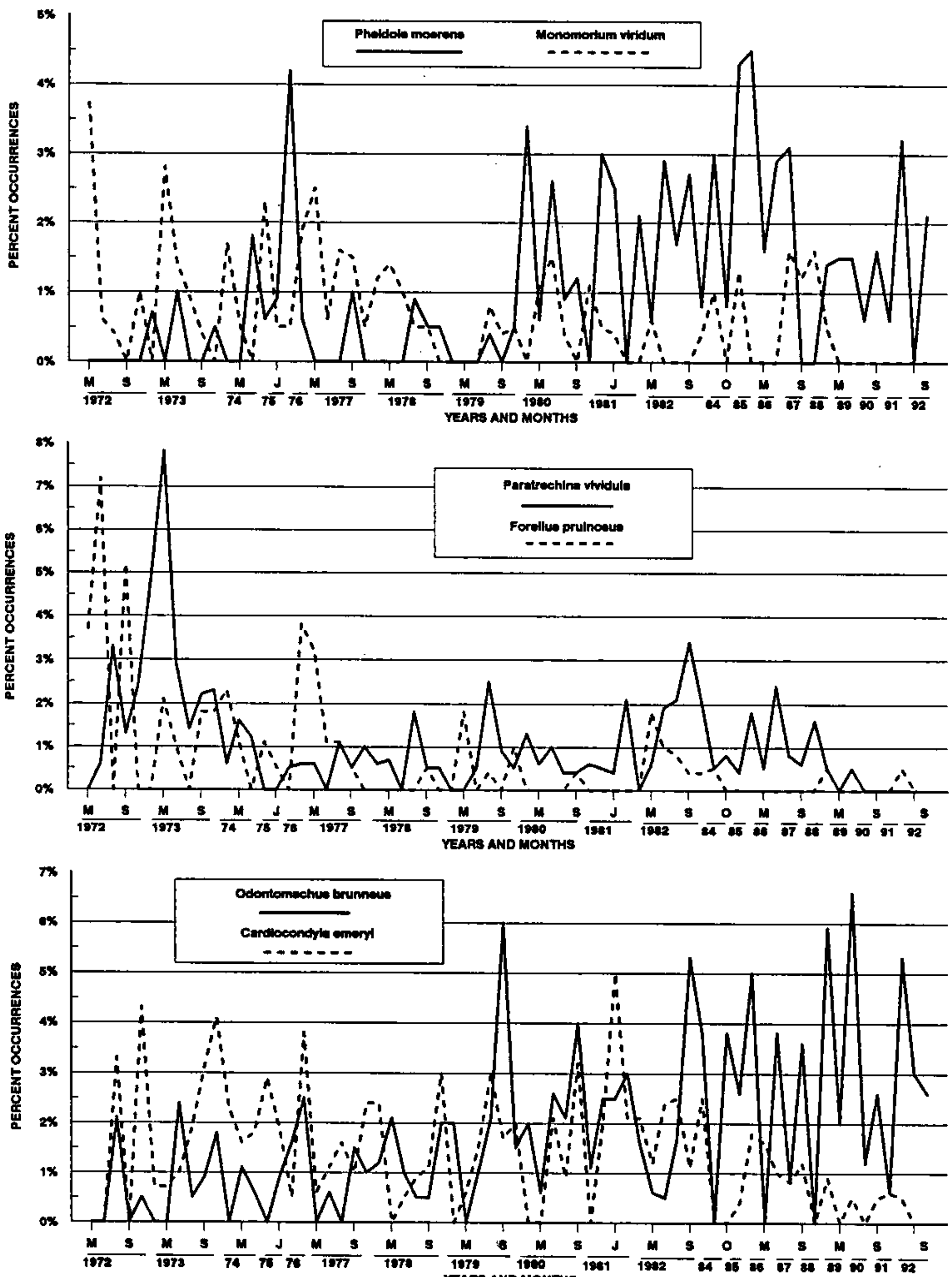

Figure 3. Percent occurrences of 6 species of ants collected on the Gainesville transect from March 1972 to september 1992.

Abstract

Gainesville, Florida, has never received any large scale insecticide treatment, and was first invaded in early 1971 by *Solenopsis invicta* Buren, the red imported fire ant. Ants were sampled periodically from March 1972 to September 1992 using baits. After 21 years, 990,079 specimens have been examined, representing 55 species in 22 genera in 5 subfamilies. RIFA has gradually increased to where in September, 1992, it was 43.3% of the occurrences (maximum 55.8% in March 1990 and April 1992) and 63.1% of the specimens (maximum 74.3% in April 1992). Positive or negative correlation with RIFA populations were shown by 11 native ant species and by 4 introduced ant species.

INTERPRETIVE SUMMARY

Solenopsis invicta Buren, the red imported fire ant, is a pugnacious, immensely successful invader of disturbed habitats throughout the Southeastern United States. The successful movement of RIFA into uninfested areas on its own by taking advantage on any man-made ecological disturbances, other than large-scale insecticidal treatments, has not been documented. Gainesville, Florida, an area that has never received any large scale insecticide treatment, first became lightly infested with RIFA in late 1971. Ants were sampled periodically with baits, from March 1972 to September 1992.

After 21 years, 990,079 specimens have been examined, representing 55 species in 22 genera in 5 subfamilies. RIFA has gradually increased to where in September, 1992, it was 43.3% of the occurrences (maximum 55.8% in March 1990 and April 1992) and 63.1% of the specimens (maximum 74.3% in April 1992). This increase was undoubtedly aided by the habitat disturbances and process of urbanization which have gradually occurred in Gainesville. Positive or negative correlation with RIFA populations were shown by 11 native ant species and by 4 introduced ant species.

The Imported Fire Ant in Louisiana Sugarcane: Some Comments on Stability and Enhancement of Predation

by

T.E. Reagan and L.M. Rodriguez-LSU Dept. of Entomology

Imported Fire Ant research in Louisiana sugarcane has been concentrated in areas which would develop and identify cultural practices to enhance the ant as a biological control agent. This research has involved studies to quantity the relative abundance of different diet items utilized by fire ants in various weed and soil type habitats. These components in addition to planting and harvesting regimes which promote winter cover and crop rationing to enrich insect and weed diversity are among the factors identified to enhance Imported Fire Ant density for improved biological control.

This research has shown that because of their diversity of feeding habits, populations of fire ants can be enhanced before the target pest has an opportunity to buildup in the field. As compared to classical biological control, taking advantage of the predatory habits of the imported fire ant does not have to deal with the traditional "time-lag" problems involving a delayed buildup of beneficials only after a drastic increase in pest numbers has occurred. It is also pointed out that the converse of many of these fire ant enhancing cultural practices can also be used to reduce ant populations.

In accordance with several ecological principles involving diversity and stability to enhance pest management, the imported fire ant fits compatibly in the Louisiana sugarcane agroecosystem. In contrast to utilizing a large number of predator species, each with restricted diets, efficiency is achieved in this system by having a smaller number of predator species (dominated by the fire ant) eating a wide variety of prey species. When there are few predator species, stability is enhanced because the imported fire ant eats a wide variety of foods in several trophic levels.

M-2791

Seasonality of RIFA mating flights.

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This project is a cooperative effort by the USDA, ARS; J.L. Knapp, Citrus REC, IFAS, University of Florida, Lake Alfred; and R.H. Cherry, Everglades REC, IFAS, University of Florida, Belle Glade, FL. Flight traps were placed over 10 red imported fire ant, Solenopsis invicta Buren, mounds in Belle Glade, Lake Alfred, and Gainesville, Florida. All of the mounds monitored were located within the same acre and were occupied by single-queen colonies.

A trap, consisting of a wire frame, screen cone, cake pan, plastic dome, tiedown, and fluid preservative, was placed over a fire ant mound with a minimum of disturbance. The traps were emptied weekly, and the number and sex of the alate fire ants determined. When a colony moved from under the trap, the trap was moved to the new mound.

The traps were monitored from January 1991 to March 1993, for over 2-full years (Fig. 1, 2, 3). Seasonal flight patterns were basically similar, which was contrary to expectations. Flights in Belle Glade were predicted to be uniform over the entire year.

Data representing several dates from each location are given in detail to show the variation in sexual production among the 10 mounds monitored at each location. The sex ratio of the mounds sampled was highly skewed to male production with Belle Glade, Lake Alfred, and Gainesville yielding 97.3%, 86.6%, and 88.4% total males, respectively. This predominance of male production is unlike any sex ratios previously reported for RIFA. The variations in sex-ratio shown by individual mounds in this study are consistent with previous studies.

Table 1. Comparison of mating flight trap collections by weekly intervals

	Belle Glade	Lake Alfred	Gainesville
weeks without flights	59	67	60
weeks with flights	52	48	55
<10 alates/flight	8	5	10
10-100 alates/flight	17	27	14
100-1000 alates/flight	23	12	17
>1000 alates/flight	8	4	14
Total females	715	1955	5645
Total males	25330	12625	42860
Total alates	26045	14580	48505

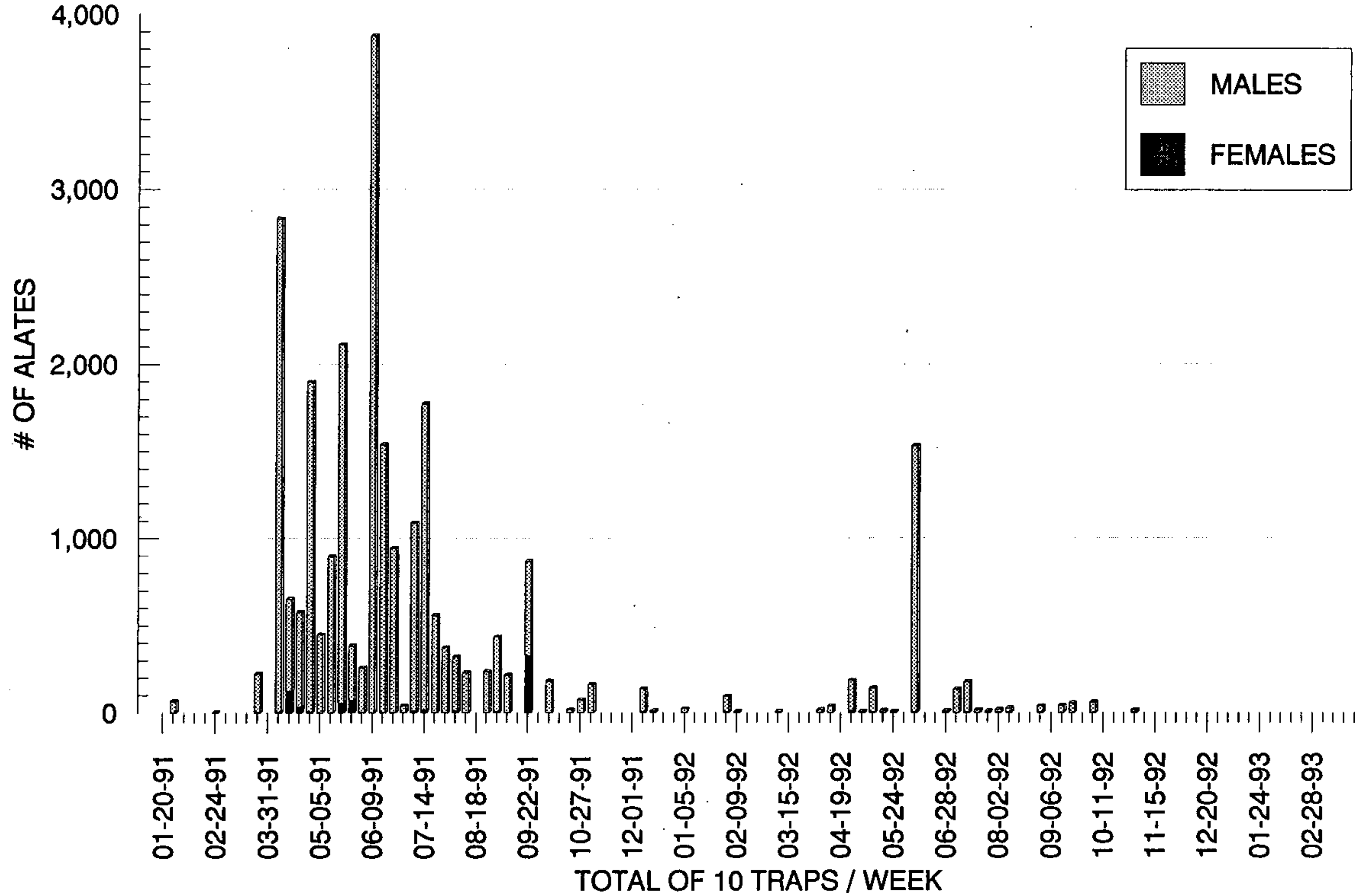
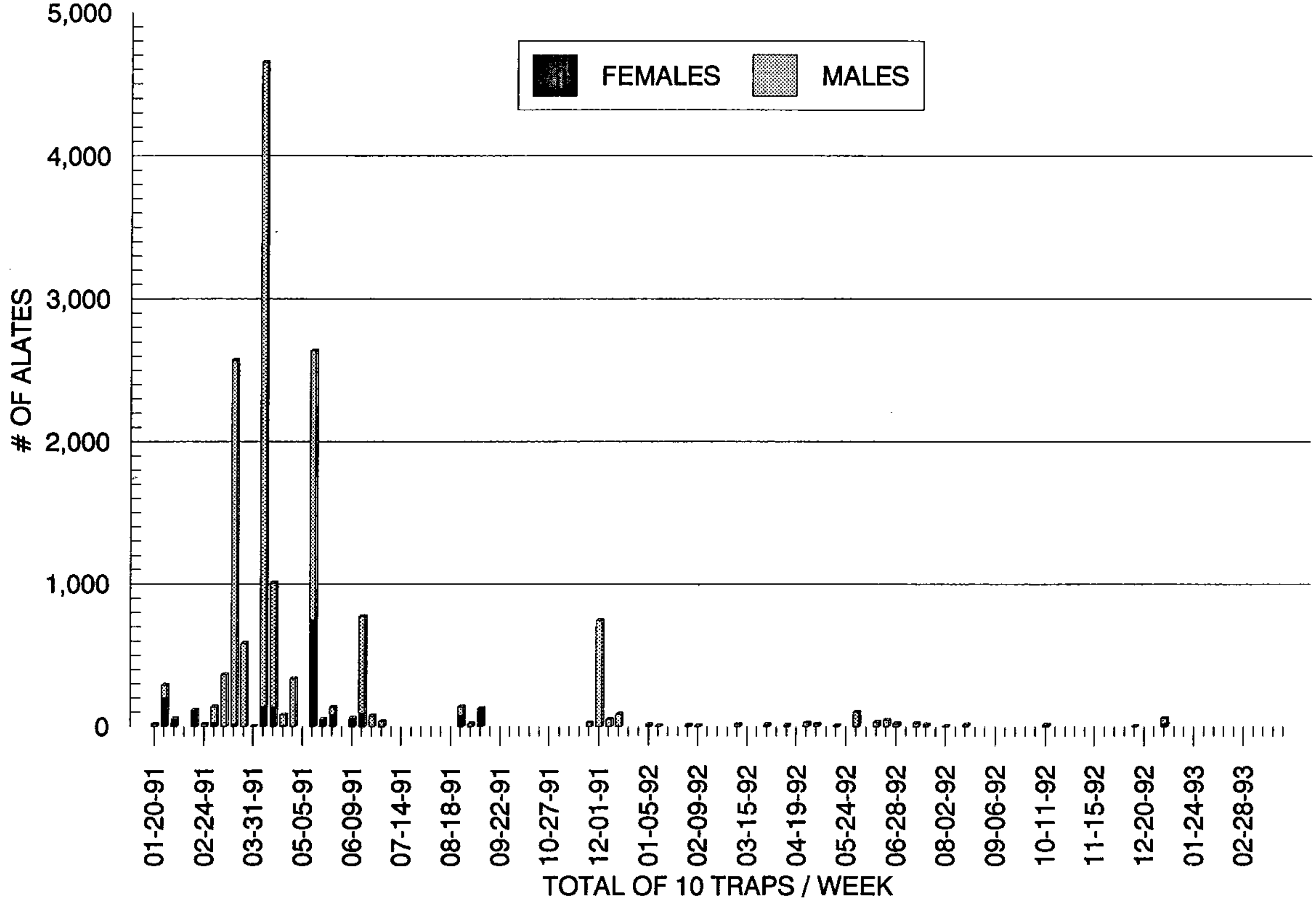


Figure 1. Total numbers of RIFA alates captured in flight traps from Belle Glade, Palm Beach Co., FL.



Fgure 2. Total numbers of RIFA alates captured in flight traps from Lake Alfred, Polk Co., FL.

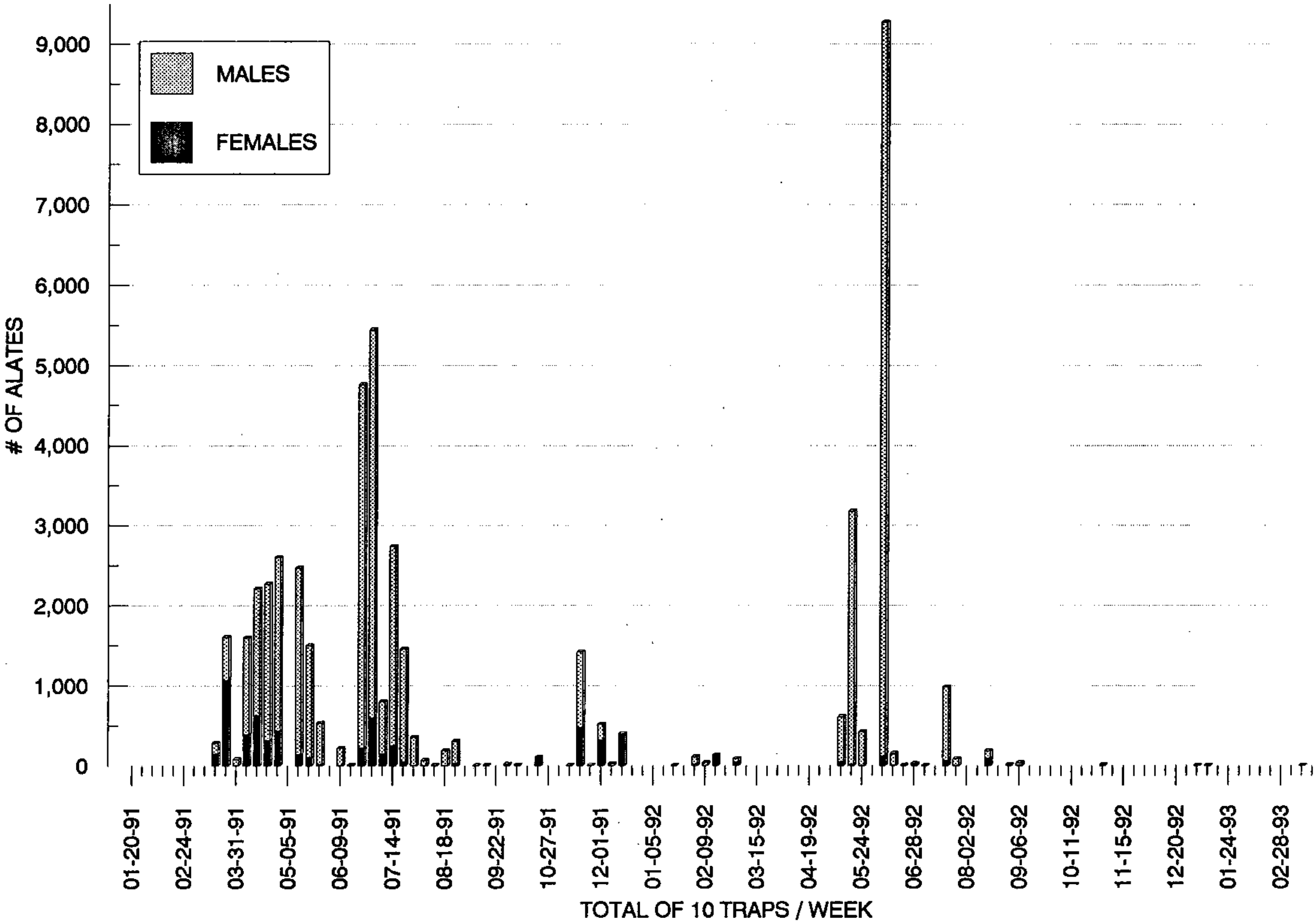


Figure 3. Total numbers of RIFA alates captured in flight traps from Gainesville, Alachua Co., FL.

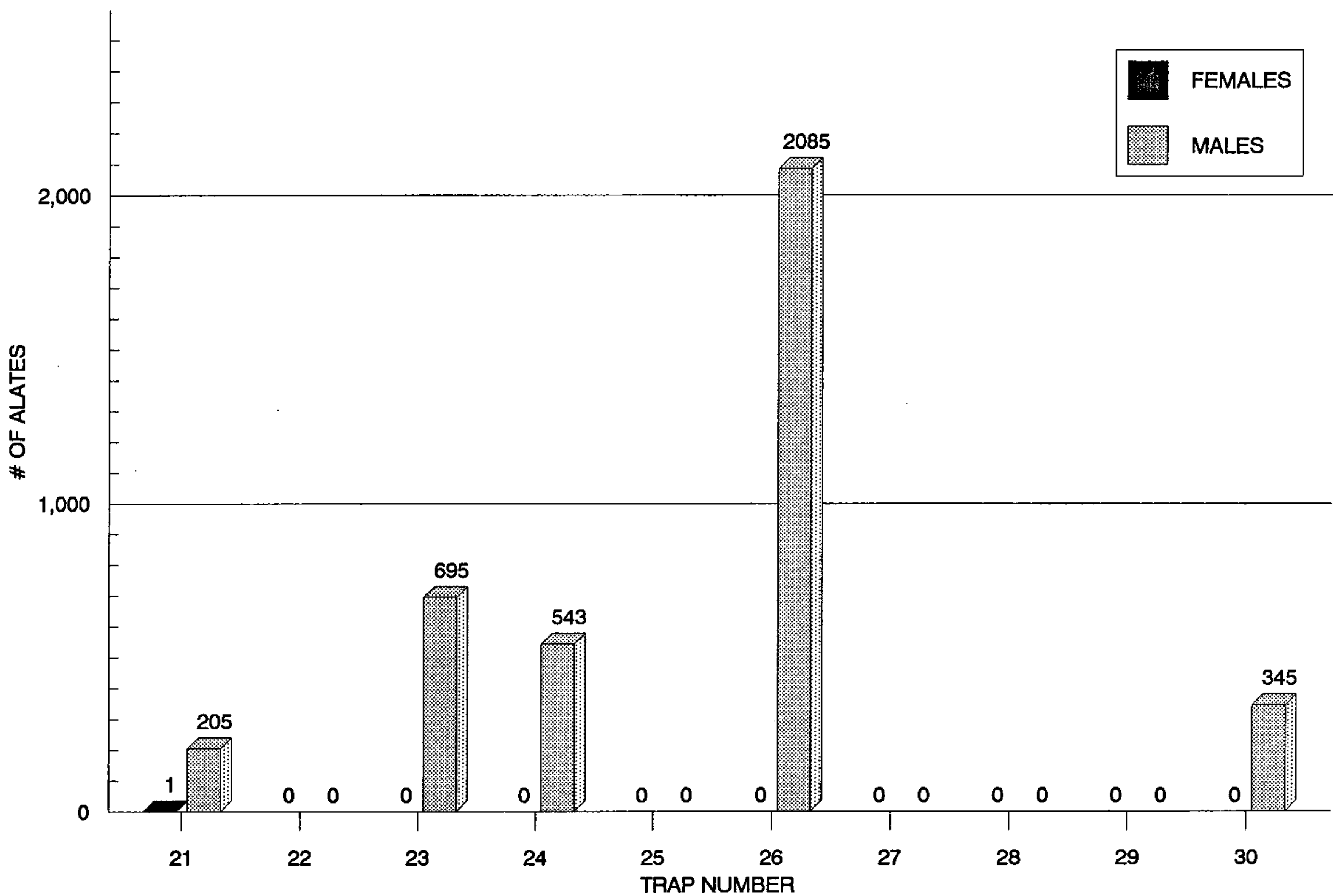


Figure 4. Number of RIFA alates in each trap from Belle Glade during the week of June 9, 1991.

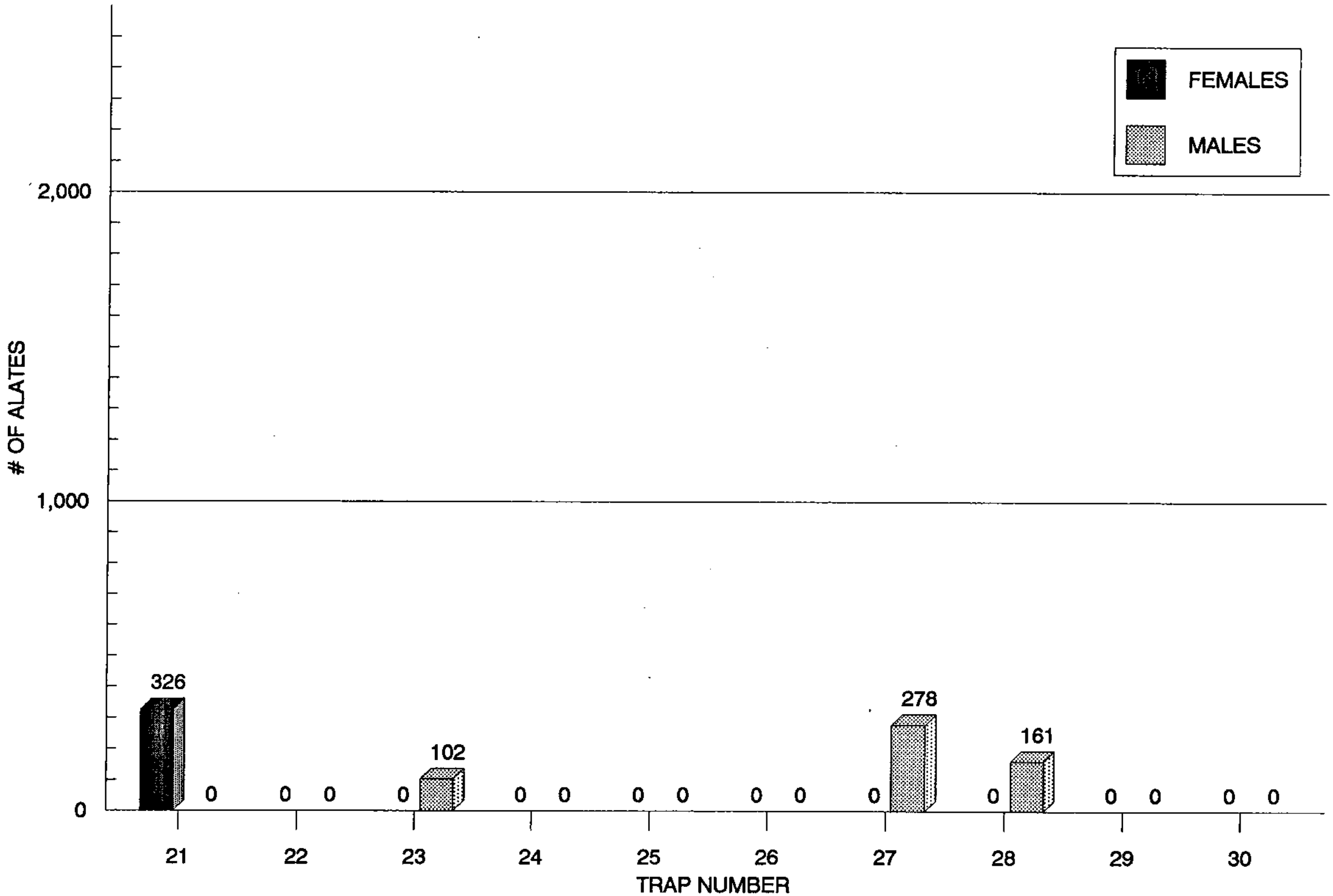


Figure 5. Number of RIFA alates in each trap from Belle Glade during the week of September 22, 1991.

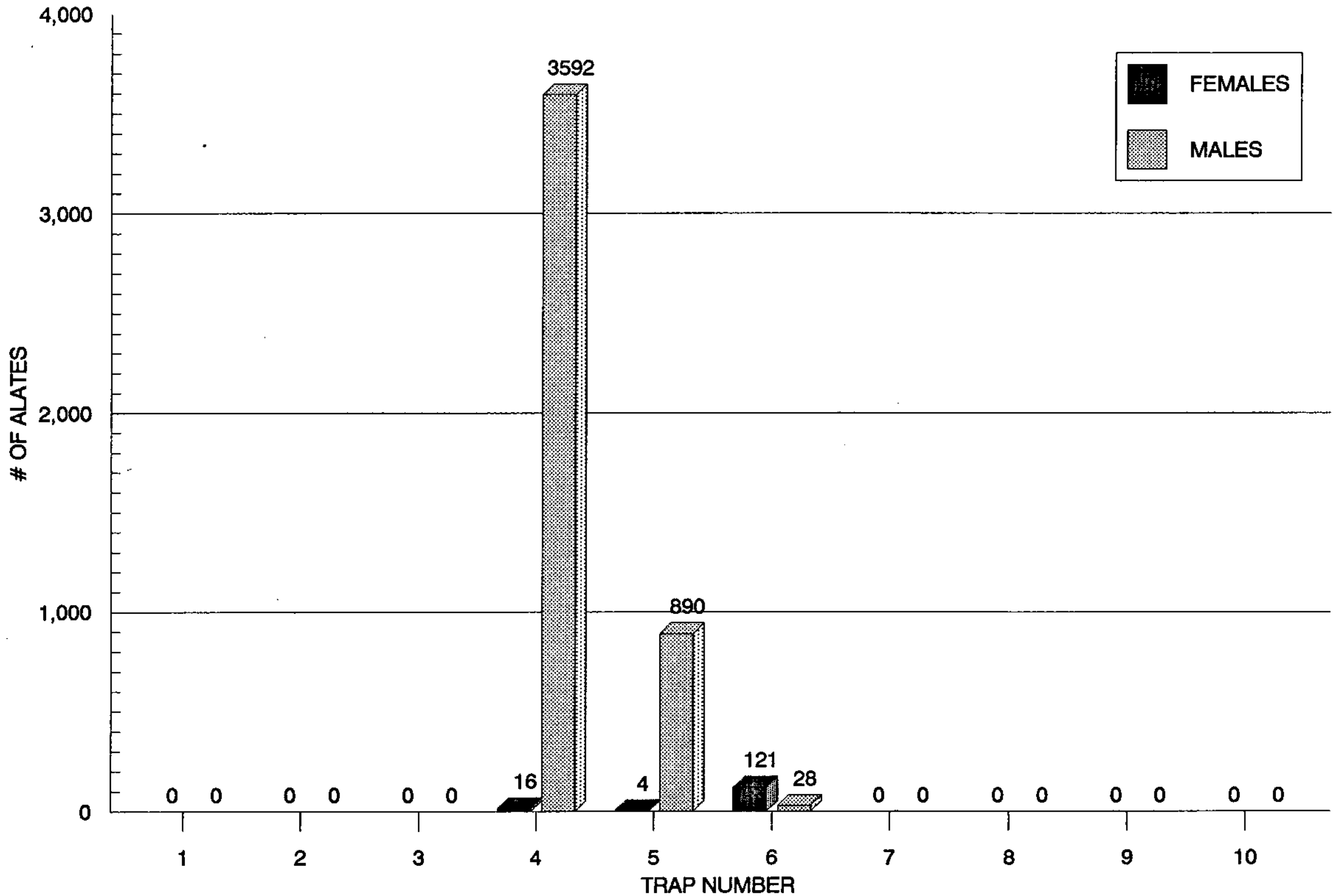


Figure 6. Number of RIFA alates in each trap from Lake Alfred during the week of April 7, 1991.

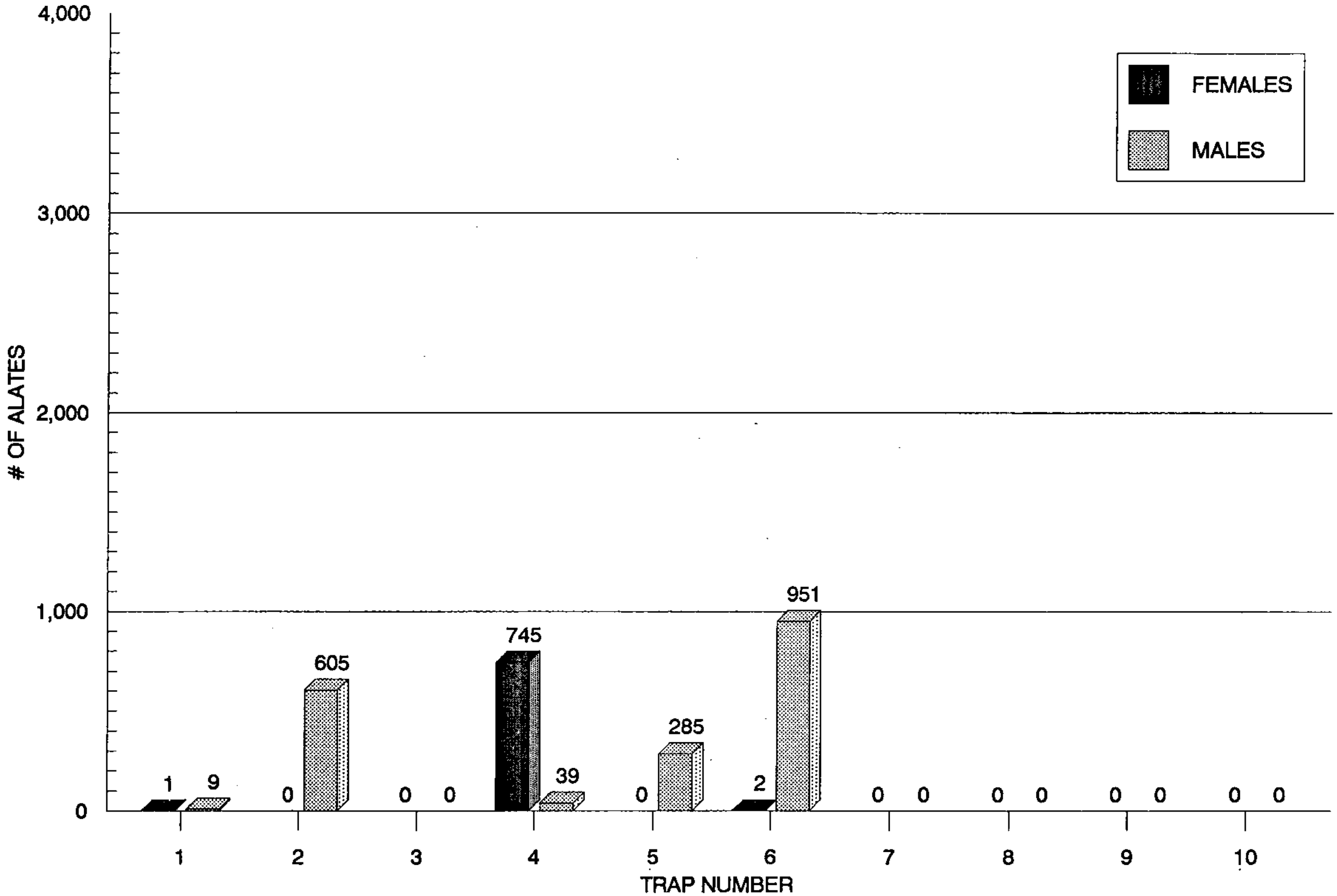


Figure 7. Number of RIFA alates in each trap from Lake Alfred during the week of May 12, 1991.

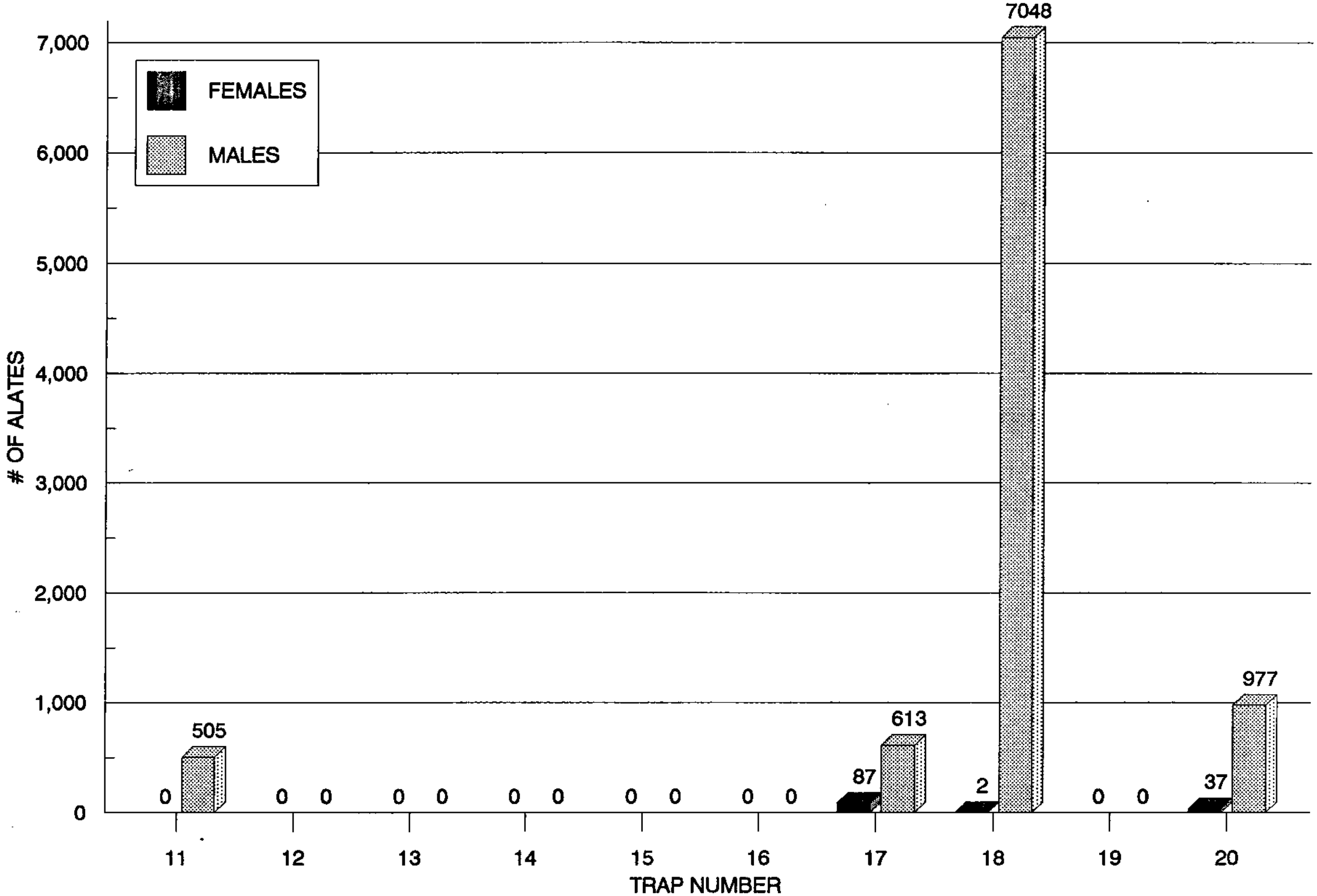


Figure 8. Number of RIFA alates in each trap from Gainesville during the week of June 7, 1992.

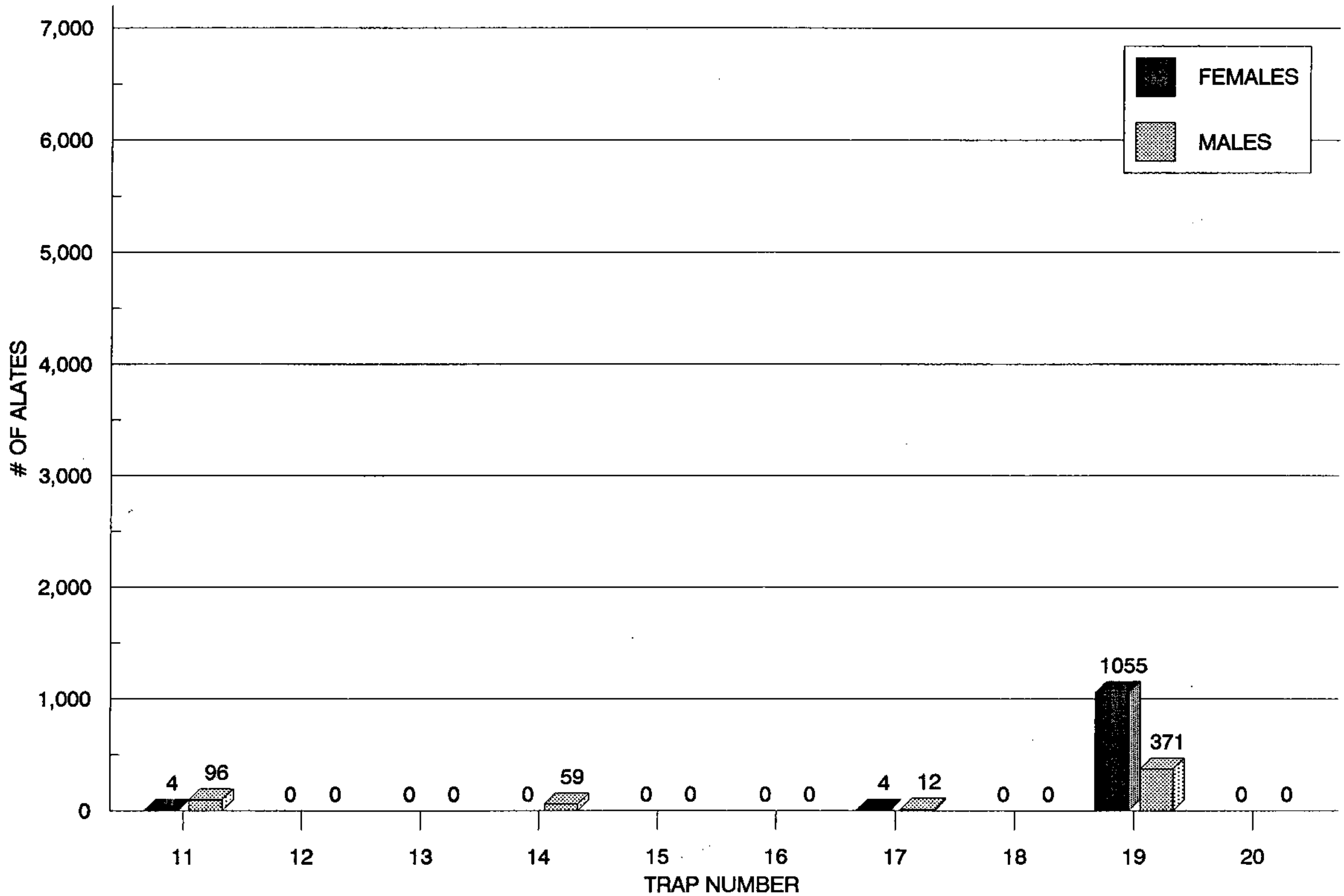


Figure 9. Number of RIFA alates in each trap from Gainesville during the week of March 24, 1991.

ABSTRACT:

Flight traps were placed over 10 red imported fire ant mounds in Gainesville, Lake Alfred, and Belle Glade, Florida. The traps were emptied weekly and the number and sex of the alate fire ants determined. The traps were monitored from January 1991 to March 1993. The data show very unequal sex ratios. Seasonal flight patterns were basically similar among the 3 locations, which was contrary to expectations.

INTERPRETIVE SUMMARY

The seasonality of red imported fire ant mating flights was studied in a cooperative project by the USDA, ARS, MAVERL, Gainesville, FL, University of Florida, IFAS, Citrus Research & Education Center, Lake Alfred, Florida, and UF, IFAS, Everglades Research & Education Center, Belle Glade, FL. Flight traps were placed over 10 RIFA mounds at locations. The traps, monitored from January 1991 to March 1993, were emptied weekly and the number and sex of the alate fire ants determined. Contrary to expectations, seasonal flight patterns were basically similar. Flights in Belle Glade had been predicted to be uniform over the entire year. The sex ratio of the mounds sampled was highly skewed to male production with Belle Glade, Lake Alfred, and Gainesville yielding 97.3%, 86.6%, and 88.4% total males, respectively. This predominance of male production is unlike any sex ratios previously reported for RIFA. The variations in sex-ratio shown by individual mounds in this study are consistent with previous studies.

1993 Imported Fire Ant Conference

June 15-18 Charleston, SC

The Imported Fire Ant Hybrid in Georgia: Its Survivability, Range Expansion, and Control

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Introduction

Imported fire ants were first reported in Floyd County, Georgia around 1980. Collections made in the mid-1980s showed the ants to b hybrids (*Solenopsis invicta* X *S. richteri)*. This discovery raised several questions immediately. Since the hybrid was occupying an area once considered too cold for imported fire ants (Maxwell et al. 1976 , the first question asked was, "can the hybrid survive the winter temperatures typical of this region?," and, if so, "can it expand it range even further north?" While considering the hybrid's range expansion, the question of its ability to expand eastward into *S. invicta's* territory also must be addressed. Whenever dealing with fire ants, the question of control must be addressed, especially when fire ants are new in an area. The fact that this is a "hybrid" fire ant seems to make these questions even more urgent.

Survivability

The ability of the hybrid to survive in north Georgia during th winter months was studied from 1985 to 1990. During this period the technique described by Morrill (1977) was utilized. This involved marking active mounds in the fall of the year and rechecking the mounds in the spring of the following year. In the present study mounds were marked in pastures infested with the hybrid in Floyd County. Mounds were marked in Morgan County to represent the northern most *S. invicta* population. Mounds were marked in Tift County in south Georgia to serve as controls. Approximately 100 mounds were marked in the fall in each county. Some stakes were lost during the winter due to cattle, grass, mowers, etc., thus mortality was determined using the number of stakes recovered in the spring. Colony movement was assumed to be minimal during the winter months.

Data from the National Weather Service stations in Calhoun, Watkinsville, and Tifton were collected for four inch soil temperatures during the test period. The number of days with sub-freezing temperatures at this depth was recorded.

The hybrid survived better than the two parental species in three of the five years (Table 1). However, the survival was not statistically significant either year (Chi-square homogeneity test). *S. invicta* survived better than the hybrid the other two years; this was not significant either. When the percent mortality for each county is combined for all five years, no significant difference is observed (Table 2). If the counties are combined for each of the five years, the winter of 1988-89 and the winter of 1989-90 are significantly different from each other but not from the remaining three winters (Table 3).

Data from the National Weather Service showed four days of sub-freezing weather at the four inch soil level in Morgan County in January 1986. Only 3.2 percent colony mortality was recorded at that location. In December 1989 Morgan County experienced five days of sub-freezing temperature, and there was 4.5 percent colony mortality. The highest mortality was recorded in Floyd County (hybrid area) in 1988-89. This timeframe correlates with a day in February 1989 when a Canadian cold front dropped temperatures in the U.S. almost 60°F in some places. This front barely dipped down into Georgia, but did reach Floyd County. The sudden drop may have caught the ants unprepared.

Established colonies of hybrid fire ants do appear to be able to survive the winter in Georgia. However, they do not appear to be any better at surviving than *S. invicta*. The colony mortality seen in this study appears to be coorelated with environmental factors and not with ant type.

Range Expansion

A survey conducted by The University of Georgia Coastal Plain Experiment Station personnel in November 1986 (Diffie et al. 1988) showed the presence of the hybrid fire ant in ten counties in northwest Georgia (Fig. 1). These counties were bordered on the north by uninfested counties and on the east by seven counties occupied by *S. invicta*. Since that time, UGA Extension Service surveys have shown that imported fire ants have moved into six previously uninfested counties; four of these counties are on the Tennessee border. In April 1993, another survey was conducted by Experiment Station personnel to determine the present range of the hybrid fire ant in Georgia. Of particular concern was the situation along the border where the two populations met. Counties were surveyed and samples were collected from various locations in each county. The samples were visually identified, then they were sent to the Insects Affecting Man and Animals Laboratory in Gainesville, Florida. Dr. Bob Vander Meer identified the ants according to venom analysis and cuticular hydrocarbons using gas chromatography.

The hybrid fire ant was identified in twelve additional counties (Fig. 2). Five of the six previously uninfested counties were found to contain the hybrid. *S. invicta* was found in one previously uninfested county. Seven counties previously containing only *S. invicta* were found to now contain the *S.* hybrid.

Control

Several field trials have been conducted over the past eight years on the control of the hybrid fire ant. In a two-year study using diazinon and chlorpyrifos drenches, very similar results were obtained on the hybrid and *S. invicta* (Table 4). This study was designed to compare the control of the two ants. Table 4 shows that in both years the chemicals gave similar control regardless of the ant. Chlorpyrifos afforded almost identical control on the two ants both years. Diazinon produced a wider range of effectiveness but the differences were not enough to be significant. In fact, the hybrid appeared to be harder to control the first year and easier to control the second year.

Tests conducted by UGA personnel in earlier years were not designed to compare the control of the two ants. However, when data from similar tests in the same year were compared, the results were very similar for the two ants. Amdro was broadcast at 1 lb/A to two fields in south Georgia in the spring of 1986. Seven weeks after a May 27th application, 100% control was recorded. Seven weeks after a June 23rd application 57% control was recorded. Amdro was broadcast at 1.2 lb/A to a field in Floyd County on June 25. Seven weeks posttreatment results showed 82% control (Table 5).

Individual mound treatment trials conducted in June 1990 provided similar control for both ant groups for some chemicals and varied control for others. Amdro, Logic, Finitron, and Orthene were applied to mounds in Floyd (hybrid) and Oconee (*S. invicta*) Counties. Finitron gave a maximum control of 88% in both locations. Orthene provided 90% (*S. invicta*) and 75% (hybrid) control. Amdro and Logic gave mixed results. Amdro afforded 95% (*S. invicta*) and 62% (hybrid) control while Logic provided 60% (*S. invicta*) and 32% (hybrid) control (Table 6).

Summary

The imported fire ant hybrid has existed in northwest Georgia since the early 1980s. Its presence in this area is probably due more to the hybrid moving into an unoccupied niche than its being genetically superior than either of the parental species.

The hybrid has been able to survive through the winters of north Georgia, but freezing temperatures seem to affect the hybrid as much as they affect *S. invicta*. The hybrid appears to be able to continue its northward movement if it is allowed to establish before freezing temperatures arrive.

Drenches, powders, and baits all appear to control hybrid colonies as well as they control *S. invicta* colonies.

The one interesting note is that the hybrid appears to have moved into some areas previously infested by *S. invicta*. "Has the hybrid outcompeted *S. invicta* or has there been intermating between the two types?"

Table 1. Percent mortality of imported fire ant colonies during the winters from 1985-1990.

	Percent mortality				
	85-86	86-87	87-88	88-89	89-90
Solenopsis hybrid	2.5a	12.0a	2.3a	26.0b	0.0a
S. invicta north Georgia	3.2a	3.3a	5.8a	9.0a	4.5a
S. invicta south Georgia	4.8a	11.3a	10.8a	7.8a	4.7a

Column means followed by the same letter are not significantly different.

Table 2. Effect of location on winter mortality of imported fire ants in Georgia.

	Percent Colony Mortality		
Location	N	Mean	SError
Floyd	5	8.7	2.7
Morgan	5	5.2	2.7
Tift	5	7.9	2.7

Table 3. Effect of year on winter mortality of imported fire ants in Georgia.

	Percent Colony Mortality		
Year	N	Mean	SError
1985	3	3.6ab	3.5
1986	3	8.8ab	3.5
1987	3	6.3ab	3.5
1988	3	14.5a	3.5
1989	3	3.1b	3.5

Table 4. Percent mortality of *S. invicta* and *S.* hybrid one month posttreatment. 1990 and 1992.

	Percent Mortality	
	diazinon	chlorpyrifos
1990		
S. invicta	84	84
hybrid	76	81
1992		
S. invicta	79	90
hybrid	88	86

Table 5. Percent mortality of *S. invicta* and *S.* hybrid seven weeks following broadcast application of Amdro. 1986.

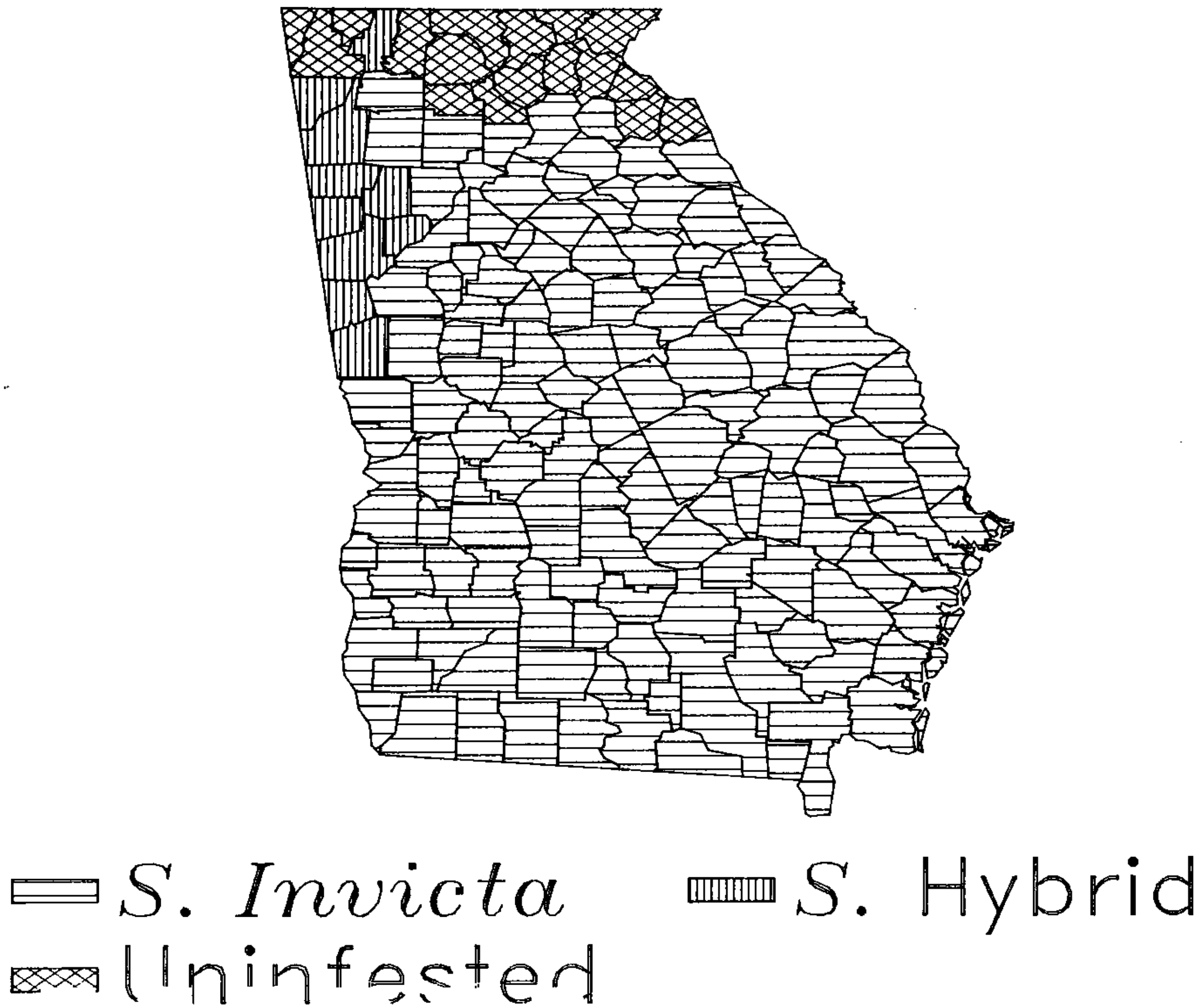
	Percent Mortality	
	S. invicta	*S.* hybrid
May 27	100	
June 23	57	
June 25		82

Table 6. Percent mortality of *S. invicta* and *S.* hybrid six weeks following individual mound applications. 1990.

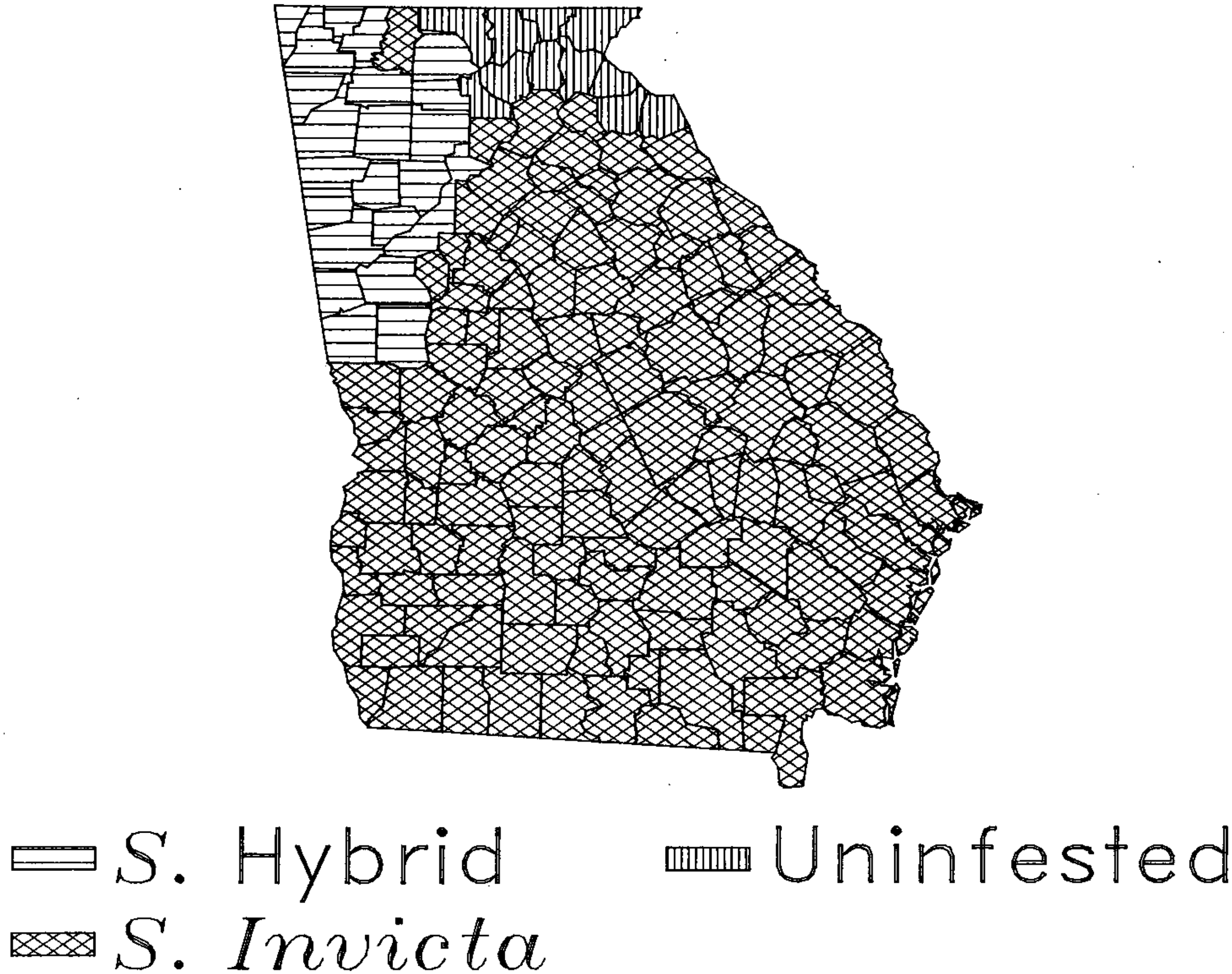
	Percent Mortality	
	S. invicta	*S.* hybrid
Amdro	95	62
Finitron	88	88
Logic	60	32
Orthene	90	75

Fig. 1

1986 Imported Fire Ant Infestations



1993 Imported Fire Ant Infestations



LITERATURE CITED

Diffie, S. K., R. K. VanderMeer and M. H. Bass. 1988. Discovery of hybrid fire ant populations in Georgia and Alabama. J. Entomol. Sci. 23: 187-191.

Maxwell, F. G. 1976. Fire ant control: 2nd edition. Council for Ag. Sci. Tech. 65. 24 pp.

Morrill, W. L. 1977. Overwinter survival of the red imported fire ant in central Georgia. Environ. Entomol. 6: 50-2.

THANKS

A special thank you is extended to Dr. Bob Vander Meer and his staff for their efforts in identifying the survey specimen.

Tefluthrin: A Promising New Imported Fire Ant Quarantine Insecticide For Containerized Nursery Stock

Anne-Marie Callcott
U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Imported Fire Ant Station
Gulfport, MS

1993 Imported Fire Ant Research Conference
June 16-17, 1993
Charleston, SC

INTRODUCTION:

Tefluthrin is a pyrethroid insecticide produced by Zeneca, Inc., Wilmington, DE (formerly ICI Americas). Chemically, the compound is known as (2,3,5,6-tetrafluoro-4-methylphenyl)-methyl-(1α,3α,)-(Z)-(±)-3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethylcyclopropanecarboxylate.

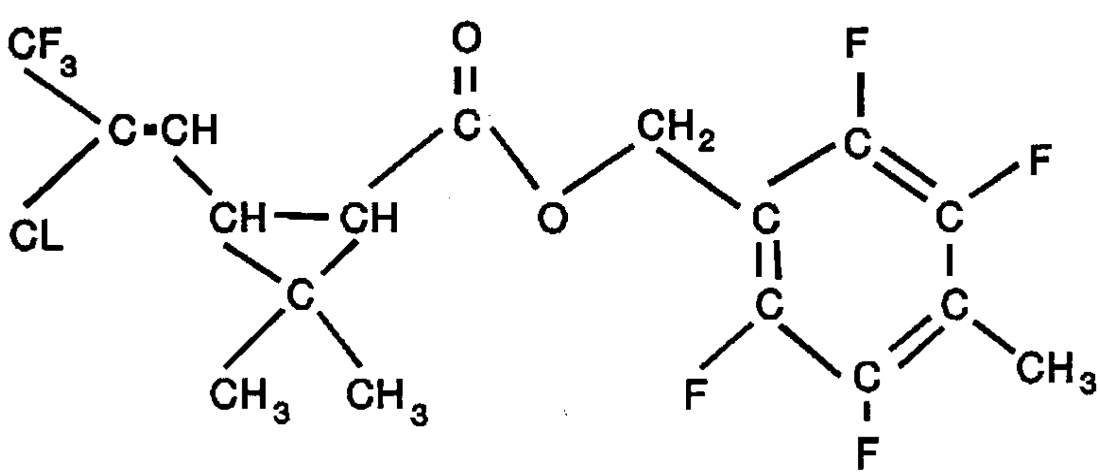
Currently, a 1.5% granular formulation marketed as Force® 1.5G is registered for use on field corn, seedcorn and popcorn for the control of rootworms, seedcorn maggots and beetles, white grubs and others. Force is applied at planting time by band or in-furrow treatments at a rate of 8-10 oz./1000 ft. row. Granules must be incorporated into the top 1" of soil for maximum insect control and to reduce potential for adverse environmental effects.

Some toxicological properties of tefluthrin are presented below (adapted from EPA Pesticide Fact Sheet No. 190.0, issued Feb. 3, 1989, 540/FS-89-025).

TEST	SPECIES	RESULT
Acute oral LD50	rat	21.8 mg/kg - male (tech)
		>2940 mg/kg - male (1.67%)
Acute dermal LD50	rat	316 mg/kg - male (tech)
		>2000 mg/kg -male & female (1.67%)
Avian oral LD50	mallard duck	4190 mg/kg
Fish acute (96-hr) LC50	bluegill	130 ppt (parts per trillion)
	rainbow trout	60 ppt
Teratogenicity	rat	maternal NOEL = 1 mg/kg
		LEL = 3 mg/kg
	rabbit	maternal NOEL = <3 mg/kg

Tefluthrin is a very stable and persistent compound in soil due to low water solubility (0.02 ppm) and being highly adsorbed to soil organic matter. Data indicate that the compound and its degradates have low leachability and are unlikely to contaminate groundwater. Tefluthrin is stable in water at pH 5 and 7, and with respect to degradation under sunlight in water or soil. Under field conditions, tefluthrin shows a half-life of 92-124 days, and under anaerobic soil conditions is even more stable. Translocation does not occur (EPA Pesticide Fact Sheet No. 190.0, issued Feb. 3, 1989, 540/FS-89-025).

STRUCTURAL FORMULA OF TEFLUTHRIN



MATERIALS AND METHODS:

This report summarizes work conducted over a 5 year period by Imported Fire Ant (IFA) Station personnel. The first trial with tefluthrin was initiated in December, 1988 in Gulfport, MS during a routine screening for potential IFA potting soil toxicants. Since that time, numerous other trials have been initiated. Some trials were conducted under local environmental conditions, while others were conducted at various geographical locations including commercial nurseries in Miami, FL; Whiteville, NC; El Campo, TX (Greenleaf Nursery); Cairo, GA (Wight Nursery); Franklinton, LA (Windmill Nursery); Perkinston, MS (Green Forest Nursery); and Houston, TX (Turkey Creek Nursery).

Test procedures used to evaluate Force as an incorporated treatment for nursery potting media were as follows: dose rates ranging from 2.5 to 100 ppm were blended into nursery potting media using a portable cement mixer (2 cu. ft. capacity). The mixer was operated for 15 minutes per batch to insure thorough blending. Treated media was then poured into three-quart capacity plastic pots and weathered outdoors for one month prior to the first bioassay. Additional irrigation was applied to simulate nursery conditions when treatments were aged at the IFA Station in Gulfport, MS. Treatments aged at nurseries were subjected to normal watering schedules.

Bioassays were conducted at the IFA Station in Gulfport, MS. Alate females were confined to treated media placed in 2"x2" plastic pots equipped with Labstone® bottoms, which rested on a layer of damp peat moss. There were four replicates per treatment in each bioassay. Each pot (replicate) contained 50 cc. of treated media and five alate females. Mortality was assessed after seven days of continuous confinement to the treated media. Treatments which were effective at the first bioassay interval were aged and retested periodically. Untreated media (controls) was also aged and bioassayed.

Leachability of candidate chemicals is routinely tested in order to determine their potential use as "over-the-top" or topical treatments for containerized nursery stock. An 8" diameter PVC pipe was sectioned into 3' lengths. A fiberglass screen bottom was glued in place, and 1" diameter holes were drilled every 6" along one side of the column. After closing the holes with duct tape, the columns were loosely packed with ca. 1 cu ft of media consisting of 3:1:1 pine bark, sand and peat moss. Columns were then moistened by the addition of 1 gal water per column. After 24 hours, the treatments were applied to three different (replicate) columns by evenly sprinkling the material onto the surface of the media in each column. Immediately after treatment and weekly thereafter, 2" of irrigation water was applied to each column. After 6 wks, the tape was removed and cores removed with a 1" soil corer. Cores at 6", 12", 18", 24" and 30" levels were collected from each replicate and composited prior to subjection to standard bioassays.

The results of these trials are arranged more or less in chronological order, with the project leader indicated at the end of each table title.

RESULTS:

The initial trial with Force was initiated in Nov. 1988 by Tim Lockley. All candidates were incorporated into Strong-Lite® Potting Media at 86.3 ppm except Capture® 0.3G which was incorporated at 72.6 ppm. Force was 100% effective for 42 months and continued showing good control (>85%) through 46 months (Table 1).

Since such good results were obtained from the original trial, another was initiated in March 1990, using a variety of initial dose rates: 12.5 ppm to 100 ppm. The 25 ppm rate was effective through 16 months, the 50 and 75 ppm rates effective through 24 months, and the 100 ppm rate is still effective at 32 months (Table 2).

A third trial initiated in May 1990 gauged activity of selected pyrethroids at low rates of application. Force gave inconsistent results at 5 ppm and less, but showed excellent control for 12 months at 10 ppm (Table 3 - trial terminated at 12 months).

More rigorous trials were then initiated to test tefluthrin in various geographic locations and under more strenuous nursery conditions. Force incorporated into potting media at rates of 10, 25, and 50 ppm, and aged in Miami FL was effective for 11 months (trial terminated by Hurricane Andrew). At Greenleaf Nursery (El Campo, TX), under commercial production conditions, rates of 25 and 50 ppm have provided 20 months of residual activity, and the trial is still incomplete.

To further document the influence of irrigation on the residual activity of Force, a trial was initiated at the IFA Station where media treated with 50 ppm of insecticide was subjected to either 1", 2" or 4" of irrigation in addition to natural rainfall each week. After 18 weeks, media subjected to all irrigation regiments provided 100% efficacy against alate females while receiving in excess of 415 inches of rainfall and irrigation (ca. 5.3 inches of water per week).

In a separate trial initiated in Gulfport, MS in October 1991, rates of 10, 50 and 100 ppm have provided 18 months residual activity under normal agronomic practices.

Insecticides which show promise as potting media incorporated treatments are also evaluated for potential use as "over-the-top" (topical) treatments. While tefluthrin has a low solubility in water and thus low leachability, it was included in a routine leaching trial at rates of 10, 25 and 50 ppm. The 50 ppm rate was 100% effective at 6 inches, indicating that high rates of Force may be feasible for use as an over-the-top treatment for small containers (Table 4).

Additional trials using media from four commercial nurseries and aged under localized environmental and production conditions were initiated in 1992. Green Forest Nursery in Perkinston, MS, Wight Nursery in Cairo, GA, Windmill Nursery in Franklinton, LA and Turkey Creek Nursery in Houston, TX provided space, potting media and labor. At the first three nurseries, Force was incorporated into media at 25 and 50 ppm. These treatments have been effective for 12 months. At Turkey Creek, tefluthrin incorporated at 10 and 25 ppm has been effective for 7 months.

REGISTRATION:

Historically, labelled dose rates for the Federal IFA Quarantine Program were based on a weight to volume ratio, i.e. 1 lb Dursban 2.5G/cu yd media. However, all nursery media is made from a variety of components and combinations of components. Therefore bulk densities (lb/cu yd) vary greatly. Dose rates based on the weight to volume ratio result in heavier media (higher bulk density) being treated with lower initial dose rates than lighter media.

THEORETICAL DOSE RATES FOR NURSERY POTTING MEDIA
VARYING IN BULK DENSITY

BULK DENSITY (lb/cu yd)	THEORETICAL DOSE RATE (ppm) at 1.0 lb 2.5G/cu yd
200	125.0
300	83.3
500	50.0
850	29.4
1000	25.0
1250	20.0
1500	16.6
2000	12.5

To alleviate this variation, future chemicals registered for IFA Quarantine should have treatment rates based on dry weight bulk density (weight to weight ratio) and a standard initial theoretical dose rate (ex. 25 ppm), as is the case with the current Talstar® T&O granular and 10WP labels, and the proposed Force label (an excerpt is shown below).

Pest	Rate	Potting Media Bulk Density (lb/cu yd)*	Pounds of Force in 1 cu yd	Comments
Imported Fire Ant	25 ppm	400	0.666	Incorporate appropriate amount of Force in one cu yd of potting media based on the known bulk density.
		600	1.000	
		800	1.333	
		1000	1.666	
		1200	2.000	
		1400	2.333	

*Bulk density = laboratory determined dry weight of a unit volume of potting media

A request for registration was filed by Zeneca, Inc. in late Dec., 1992-early Jan, 1993 (Jeff Dobbs, personal communication). Approval is anticipated by mid-May, 1993.

ECONOMICS:

Pyrethroid insecticides are relatively more expensive than their organophosphate or carbamate counterparts. In many cropping systems, the additional expense is offset by lower rates of application. Final cost for the use of Force in the Federal IFA Quarantine Program is unknown at present. However, cost estimates can be obtained from the current retail price of the agricultural product (Force 1.5G), which is \$3.20/lb (personal communication from Jeff Dobbs, Zeneca, Inc.).

Talstar® 0.2G was registered for quarantine use in June 1992. In November 1992, the retail price was approximately \$0.72/lb (personal communication Duane Melton, FMC Corp., November 12, 1992).

The largest nurseries in the southeast annually gross \$15-20 million in sales. These nurseries are estimating that compliance with the current IFA quarantine program may cost them as much as \$200,000 per year. For example, if a nursery ships out 1,000,000 azaleas potted in 1-gallon pots with media having a bulk density of 600 lb/cu yd, the cost to treat with Talstar at 25 ppm would be \$19,200. The cost of treating those same 1,000,000 azaleas with Force at 25 ppm, using the currently known agricultural product retail price, would be \$11,500. I would like to reiterate that the actual cost of Force formulated for IFA quarantine use is NOT known; these numbers were calculated based on the Nov. 1992 retail agricultural product price.

SUMMARY AND CONCLUSIONS:

Force® 1.5G is highly effective against IFA when incorporated into nursery potting media. Trials conducted over the past 5 years indicate that dose rates of 25 ppm and higher are effective in various types of media at several test sites. Use patterns, dose rates, and certification periods recommended by the IFA Station for containerized nursery stock are as follows:

		Certification Period	
Use Pattern	Dose Rate (ppm)	"Stand-alone" treatment	IFA free nursery program
Incorporated	25	1 year	indefinite
Incorporated	50	2 years	indefinite

As the data base on this product increases, it may be possible to extend certification periods on dose rates or to lower rates of application.

Table 1. Evaluation of Candidate Potting Soil Toxicants, 1988. Nov. 1988. (Lockley)[1]

Candidate	% Mortality of IFA Alate Females at Indicated Months Posttreatment (PT)														
	(2)	(4)	(6)	(8)	(10)//	(18)	(20)//	(30)//	(41)	(42)	(43)	(44)	(45)	(46)	(47)
Force 1.5G	100	100	100	100	100	100	100	100	100	100	95	85	100	95	30
Capture 0.3G	100	100	100	100	100	100	100	100	100	50	100	100	70	100	80
Ammo 0.75G	100	100	100	100	100	35	50								
Pounce 1.5G	100	100	45	0											
Dursban 2.5G	100	100	75	0											

[1] All candidates incorporated into Strong-Lite Potting Media at 86.3 ppm, except Capture 0.3G which was incorporated at 72.6 ppm.

Table 2. Evaluation of Tefluthrin 1.5G and Bifenthrin 0.2G Incorporated at Various Rates in Strong-Lite Potting Media. March 1990. (Lockley)

Candidate	Rate (ppm)	% Mortality of IFA Alate Females at Indicated Months PT										
		(1)\\	(15)	(16)	(18)	(20)	(22)	(24)	(26)	(28)	(30)	(32)
Tefluthrin	12.5	100	100	30								
	25.0	100	100	100	15							
	50.0	100	100	100	80	100	100	100	15			
	75.0	100	100	100	100	100	100	100	25			
	100.0	100	100	100	100	100	100	100	100	100	100	100
Bifenthrin	12.5	100	100	100	100	95	100	100	100	85	75	
	25.0	100	100	100	100	100	100	100	100	100	75	100
	50.0	100	100	100	100	100	100	100	100	100	100	100
	75.0	100	100	100	100	100	100	100	100	100	100	100
	100.0	100	100	100	100	100	100	100	100	100	100	100
Check	--	0	0	0	5	0	0	0	0	0	5	10

Table 3. Activity of Selected Pyrethroid Insecticides at Low Rates of Application. May 1990. (McAnally)[1]

Insecticide	Dose Rate (ppm)	% Mortality of IFA Alate Females at Indicated Months PT											
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Tefluthrin 1.5G	2.5	20	5	65	55	10	0	15	55	65	*		
	5.0	85	100	100	15	95	0	20	15	80	55	30	*
	10.0	100	100	100	100	100	100	100	100	100	100	100	100
Bifenthrin 0.2G	2.5	10	35	100	60	70	30	95	95	100	100	40	15
	5.0	10	70	100	20	100	85	100	100	100	100	100	95
	10.0	40	60	100	100	100	100	100	100	100	95	100	100
Cypermethrin 0.75G	2.5	5	35	90	5	15	0	60	70	5	*		
	5.0	10	15	60	5	15	15	90	70	100	30	55	*
	10.0	25	40	95	45	10	5	95	100	100	100	40	*
Check	--	5	5	5	0	0	5	10	5	20	5	15	15

[1] Incorporated into Strong-Lite Potting Media.
* Dropped due to decreased efficacy.

Table 4. Leachability of Force 1.5G Through a Column of Potting Media. Dec. 1991. (McAnally)[1]

Rate (ppm)	Depth (inches)	% Mortality to IFA Alate Females[2]
10	6	35
	12	0
	18	0
	24	5
	36	0
25	6	40
	12	10
	18	5
	24	10
	36	5
50	6	100
	12	20
	18	50
	24	25
	36	0
Check	--	10

[1] Over-the-top treatment using MAFES mix (3:1:1 pine bark:sphagnum peat:sand)

[2] Bioassays initiated six weeks after treatment

Phytotoxicity of Tefluthrin (Force® 1.5G) to Selected Cultivars of Foliage and Woody Ornamental Plants

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INTRODUCTION:

Tefluthrin formulated as Force® 1.5G (Zeneca, Inc.) is one of the many toxicants being evaluated for use as a quarantine treatment to prevent imported fire ant (IFA) infestations in nursery stock. Numerous trials have demonstrated exceptional residual activity against imported fire ants at a number of rates of application and use patterns. Although a significant amount of data has been gathered concerning the effect of tefluthrin on IFA, no data exists as to its potential phytotoxic effect on nursery stock. As part of a continuing evaluation of tefluthrin, tests were undertaken at the Mississippi Agricultural and Forestry Experiment Station (MAFES), Poplarville and the Alabama Agricultural Experiment Station, Ornamental Horticultural Substation, Mobile to determine if tefluthrin poses any potential phytotoxic effect on containerized plants. Trials were initiated by Timothy C. Lockley (IFA Lab), Adolph J. Laiche, Jr. (MAFES), James C. Stephenson (AL Agric. Exp. Station), and Lee R. McAnally (IFA Lab).

MATERIALS & METHODS:

Three trials have been conducted to date and a fourth and fifth trial are currently being run at the Poplarville and the Alabama site. A sixth trial was set up on May 12, 1993 at the IFA Lab, Gulfport, MS. Plants were selected on the basis of local availability, popularity among commercial growers and a previous history of phytotoxic responses to insecticides. All plants were potted in 3-quart containers in a media composed of a mixture of pine bark, peat moss and sharp sand (3:1:1) with a dry bulk density of 741 lbs/cu.yd. All plants in Trials I, II, and IV conducted at the South Mississippi Branch, were maintained in a greenhouse under normal horticultural practices. In Trials III & V, conducted at the Ornamental Horticultural Substation in Mobile, all plants were maintained out of doors and subjected to normal horticultural practices. The following rating system was used to evaluate root and shoot growth:

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

Mean fresh shoot weights for all plants were subjected to ANOVA and Duncan's new multiple range test (Duncan 1955) at the $P<0.05$ level.

Trial I

On 23 March 1992, ten selected cultivars were treated with two rates of Force® 1.5G incorporated into the media at rates of 50 ppm (1X) and 150 ppm (3X). Seven replications per cultivar/treatment were established. A control was made using untreated media. Plants were sacrificed 85 days post-treatment (16 June 1992). Because of vigorous growth, Coleus were sacrificed on 22 April and top biomass measurements were taken. Fresh shoot weights were measured and shoot and root systems were visually compared for each replicate/cultivar.

Trial II

On 1 September 1992, seven selected cultivars of succulent and woody ornamental plants were treated with two rates of Force® 1.5G incorporated into the media at the same rates as in trial I. Again seven replicates per cultivar/treatment were made. Plants were sacrificed 181 days post-treatment (1 March 1993). Shoots and roots were examined for possible phytotoxicity. Fresh shoot weights were measured as described in Trial I.

Trial III

Twelve selected cultivars were transplanted from liners into pots containing media into which Force® 1.5G had been incorporated at the same rates as trials I & II on 2 September 1992. Shoots and roots were observed for possible phytotoxicity. Plants were sacrificed 177 days after planting and fresh shoot weights were measured.

Trial IV

Seventeen selected cultivars were transplanted from liners into pots containing media into which Force® 1.5G had been incorporated at the same rates as trials I, II & III on 30 March 1993.

Trial V

Fourteen selected cultivars were transplanted from liners into pots containing media into which Force® 1.5G had been incorporated at the same rates as trials I, II, III, & IV on 7 April 1993.

RESULTS AND DISCUSSION:

Trial I Among the 10 cultivars tested, some variation in top biomass and root growth was observed. (Table 1) Negative responses were as indicated below:

Rhododendron 'Pink Ruffle' indicated some phytotoxic response in total top biomass at the 1X rate. However, root response at the 3X rate showed a positive response to the treatment.

Abelia grandiflora showed some negative response in top biomass at both the 1X and 3X rates. However, in root evaluation, results were mixed.

Among the remainder of the woody ornamentals, no phytotoxic response was observed. Indications of growth enhancement were as follows:

Ilex compacta showed enhanced top biomass growth at the 1X rate and enhanced root growth at the 1X and 3X rates.

Rhododendron 'Wakeibisu' displayed no significant differences in top biomass but did show superior root growth at the 1X rate.

Among the foliage plants, significant increases in top biomass were indicated at the 1X rate for Coleus, Salvia, Pothos, and Portulaca. Only Lisianthus failed to show any response. Similar results were observed in root development with all five foliage plants displaying positive root structural responses to the 1X rate.

Trial II No significant differences were noted for either fresh shoot weights or root systems among all seven cultivars (Table 2).

Trial III No indications of phytotoxic effects were observed among the twelve cultivars tested (Table 3).

Results of 30 cultivars to preplant incorporation of tefluthrin showed only Rhododendron 'Pink Ruffles' displaying any significant phytotoxicity. Some enhanced top growth was noted among Ilex compacta, Coleus, Salvia, Pothos, and Portulaca at the 1X and Coleus at the 3X rate.

Bifenthrin is presently the only insecticide registered for quarantine use against IFA. The Imported Fire Ant Laboratory is constantly seeking and evaluating new products to control the spread of IFA. Force® 1.5G is currently in the process of becoming registered as a quarantine treatment material.

<u>LITERATURE CITED</u>

1. Imported Fire Ant Program Manual, M301.81 (Revised July 1990). USDA-APHIS-S&T, 29 pp.

2. Duncan, D.B. 1955. Multiple Range and Multiple F Tests. Biometrics 11: 1-42.

Table 1. Relative Phytotoxicity of Tefluthrin (Force® 1.5G) Preplant Incorporated to Selected Foliage and Woody Ornamental Containerized Plants.

	SHOOT FRESH WEIGHT (g)[1]			ROOTS[2]		
CULTIVAR	CHECK	1X	3X	CHECK	1X	3X
WOODY ORNAMENTALS						
Abelia grandiflora	151.4a	127.7b	131.0b	3.1a	2.7b	3.4a
Ilex 'San Jose'	22.3a	21.6a	20.1a	3.0a	3.1a	3.0a
Ilex crenata Compacta	46.3b	58.9a	52.7ab	2.9b	3.6a	4.0a
Rhododendron 'Pink Ruffles'	82.6a	65.9b	77.6ab	3.1a	2.7a	3.3b
Rhododendron 'Wakeibisu'	45.9a	46.6a	42.1a	3.0a	3.3b	3.1a
FOLIAGE PLANTS						
Coleus blumei	185.6b	242.7a	215.3ab	2.8b	3.3a	3.3a
Lisianthus	58.1a	59.2a	57.3a	2.3b	3.3a	2.9b
Portulaca grandiflora	523.1b	606.4a	547.9b	2.7b	3.5a	3.0b
Scindapsus aureus	290.3b	327.0a	276.6b	3.1b	3.6a	3.6a
Salvia splendens	222.4a	284.1b	208.7a	1.9a	4.0b	2.0a

[1] Means within cultivars followed by the same letter are not significantly different at the 5% level using Duncan's multiple range test ($P<0.05$).

[2] Mean root rating scale: 0.0 roots dead; 1.0 poor root structure; 2.0 good root structure; 3.0 better root structure; 4.0 best root structure.

Table 2. Relative Phytotoxicity of Tefluthrin (Force® 1.5G) Preplant Incorporated to Selected Foliage and Woody Ornamental Containerized Plants.

	SHOOT FRESH WEIGHT (g)[1]			ROOTS[2]		
CULTIVAR	CHECK	1X	3X	CK	1X	3X
WOODY ORNAMENTALS						
Ilex minerva 'Blue Girl'	55.9a	59.7a	53.1a	3.1a	3.2a	3.2a
Ilex 'Ole Spring'	28.7a	27.9a	28.3a	2.9a	3.3a	3.4a
Juniperus conferta						
'Emerald Sea'	44.6a	45.9a	44.6a	2.9a	2.9a	3.0a
Rhaphiolepis indica						
'Elizabeth'	62.0a	55.6a	54.3a	3.0a	3.0a	3.1a
FOLIAGE PLANTS						
Antirrhinus majus						
'Tahiti Yellow'	188.6a	160.0a	143.6a	3.0a	3.0a	3.0a
Petunia x *hybrida*	805.0a	771.4a	847.0a	3.1a	3.2a	3.3a
Syngonium podophyllum						
'Butterfly'	277.6a	307.9a	272.0a	3.2a	3.4a	3.3a

[1] Means within cultivars not followed by the same letter are not significantly different at the 5% level using Duncan's multiple range test ($P<0.05$).

[2] Mean root rating scale: 0.0 roots dead; 1.0 poor root structure; 2.0 good root structure; 3.0 better root structure; 4.0 best root structure.

Table 3. Relative Phytotoxicity of Tefluthrin (Force® 1.5G) Preplant Incorporated Into Media to Various Woody Ornamental Containerized Plants.

	SHOOT FRESH WEIGHT (g)[1]			ROOTS[2]		
CULTIVARS	CHECK	1X	3X	CHECK	1X	3X
WOODY ORNAMENTALS						
Abelia grandiflora						
cv 'Edward Goucher'	36.9a	38.9a	44.0a	3.0a	3.0a	3.2a
Barberis thunbergii 'Aurea'	4.0a	4.6a	3.7a	3.0a	3.5a	2.9a
Cotoneaster dammeri	46.0ab	40.9a	56.8b	3.0a	3.0a	3.6b
X Cupressocyparis lelandii	62.9a	69.1a	71.4a	2.9a	3.1a	3.4a
Euonumus japonicus 'Golden'	38.9a	36.0a	38.3a	3.0a	3.0a	3.1a
Ilex cornuta 'Carissa'	16.3a	14.6a	15.1a	2.9a	3.1a	3.0a
Ilex crenata 'Helleri'	36.9a	33.7a	37.1a	3.1a	3.0a	3.3a
Juniperis chinensis						
'Green Sargent'	16.3ab	14.6a	21.1b	3.2a	3.0a	3.5b
Myrica cerifera	73.4a	62.6a	74.9a	3.0a	3.1a	3.2a
Rhaphiolepis indica						
'Enchantress'	34.9ab	29.4a	35.7b	3.1a	3.0a	3.2a
Rhododendron 'Pink Gumbo'	27.4a	25.4a	25.1a	3.0a	3.0a	3.1a
Rhododendron 'Rene Michelle'	27.4a	24.0a	25.1a	3.1a	3.2a	3.3a

[1] Means within cultivars not followed by the same letter are not significantly different at the 5% level using Duncan's multiple range test ($P<0.05$).

[2] Mean root rating scale: 0.0 roots dead; 1.0 poor root structure; 2.0 good root structure; 3.0 better root structure; 4.0 best root structure.

Fire Ant Orientation, Repellents, and Bait Enhancement with Pheromones

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Investigation into the homing mechanism for fire ants revealed that they utilized light as a visual cue to monitor their position relative to where they left their nest. However, even in complete darkness they were able to form a trail. Their use of the geomagnetic field was determined using a large Helmholtz coil, which was used to manipulate the geomagnetic field. This is the first demonstration of a magnetic sense in an ant species.

About 30 compounds have been discovered, using a Y-tube olfactometer bioassay, that have good repellent activity against the fire ant. These compounds represent several chemical classes. A patent application is being pursued and we are collaborating with industry to develop formulations that can be commercialized. Repellents will find a use where ever it is advantageous to exclude fire ants from specific areas, such as electrical switch boxes and in nursery stock.

Bait enhancement with pheromones requires different evaluation techniques then those developed over the decades for fire ant insecticide discovery tests This is because we are trying to make baits that already have good efficacy better. Paired treatments must be used, and everything in each test plot for a given replicate must be as identical as possible. Each treatment in a pair must be put out within a few minutes of each other since the foraging activity of the fire ant varies greatly with the soil temperature. This work will be reported on in detail at the 1993, ESA meeting in Indianapolis.

M-2793

Factors Affecting Densities of Fire Ants in North and South America

Sanford D. Porter, David F. Williams, Richard S. Patterson

When the imported fire ant, *Solenopsis invicta*, was introduced into the United States from South America, dozens of natural enemies were left behind. This situation lends to several questions that are vital to the proposition of classical biological control of fire ants in the United States. The first question is whether fire ant populations in the United States are greater than those in South America. In order to answer this question, we surveyed fire ant populations along roadsides at five sites around each of 12 cities in North America and 13 cities in South America. Results of this survey indicated that *S. invicta* is 4-7 times more common in North America than *Solenopsis* species in South America.

These differences lead to a second important question; that is, what are the causes of intercontinental population differences? Specifically, can differences in populations between the two continents be attributed to biological release from natural enemies left behind in South America? Population differences can result from many factors. Careful examination of the data indicated that population differences could not be attributed to poor sampling conditions or seasonal effects. Similarly, population differences were not merely a result of intercontinental differences in the suitability of roadside habitat because fire ant abundance in pastures and mowed lawns was also much lower in South America than in the United States. Soil chemistry might be a factor but no obvious patterns were observed. Careful examination of precipitation and temperature indicated that these climatic variables were not associated with intercontinental population differences. Surrounding habitats and differences in the frequency of polygyny were also of little importance. Grass cover probably affected fire ant populations at some sites, but no correlations were found either within or across continents.

A major difference between the two continents was that imported fire ants accounted for 79% of occupied baits at North American sites while in South America fire ants accounted for only 22% of occupied baits. Clearly fire ants have much more competition from other ants in South America, but it is uncertain whether this is the cause of observed population differences or whether low occurrence at baits is merely a symptom of some other factor. Other factors may be important, but it seems likely intercontinental differences are the result of competition from other species of ants working in concert with natural enemies such as parasites and pathogens. If this is true, then introduction of biocontrol agents from South America might have the potential to reduce fire ant populations in North America to levels similar to those found in South America.

SKIP-SWATH APPLICATION OF AMDRO® AND LOGIC® BROADCAST BAITS FOR THE SUPPRESSION OF THE RED IMPORTED FIRE ANT

Bastiaan M. Drees[1], Charles L. Barr[2], and Michael E. Heimer[3]

Abstract

Logic® Fire Ant Bait applied at 0.75 lbs./acre in alternate 35 foot swaths provided similar initial and long-term ant mound suppression to a full rate, full coverage application. Amdro® Fire Ant Granules applied at 0.75 lbs./acre in alternate swaths yielded approximately half the initial mound suppression as a full rate, full coverage application followed by faster reinfestation. A hopper box blend of 0.75 lbs./acre each Amdro and Logic gave quicker initial suppression similar to full rate, full coverage Amdro and long-term suppression similar to an application of Logic only.

Previous studies have indicated that Logic® Fire Ant Bait (fenoxycarb) is effective at active ingredient concentrations of 1% (regular formulation), 0.5% and 0.25% (Drees, et. al., unpublished). Furthermonre, spot applications (3 tablespoons) of Logic to active mounds or along a transect affect fire ant mounds up to 20 feet away in areas of multiple queen infestations (Drees, et. al., 1993). Logic is an insect growth regulator (IGR) and relatively slow to act, taking up to six months to achieve full ant suppression, but reinfestation is very slow and suppression often lasts for over a year. Amdro® Fire Ant Granules (hydramethylnon) is a direct toxicant to worker, larval and reproductive fire ants. Broadcast applications of Amdro usually attain maximum suppression within five to eight weeks. However, reinfestation begins thereafter.

The objectives of this trial were: 1) To evaluate the effectiveness of Amdro and Logic for fire ant suppression when applied at half the label rate (full rate over half the treatment area or skip swath); and 2) To attempt to gain the fast suppression of Amdro plus the long residual effectiveness of Logic with a single application of a hopper mix of half rates of both chemicals.

Materials and Methods

This test was located on the earthen dam impounding Lake Conroe, in Montgomery County, Texas. The area is managed by the San Jacinto River Authority and access is strictly limited to

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authorized personnel. The site is gently sloping, well drained, and with a few scattered clumps of trees. Vegetation is dominated by bahia grass closest to the dam graduating to johnsongrass. Due largely to heavy spring rains and flooding, ant densities were somewhat clumped, concentrating on the higher patches of ground within the test plots.

This trial consisted of one-acre square blocks, 210 feet on a side. Plots were established with corners flagged and the centers marked with 3-foot wooden stakes and 6 by 8 inch metal plates nailed into the ground. Minimum of a 30-foot buffer was left between adjacent plots. Before treatment (June 11 and June 15, 1992) fire ant-active mounds were counted within an 83-foot radius circle (approx. 0.5 acre) in the center of each plot. Mounds were considered to contain an active fire ant colony if ants came to the surface in numbers within 15 seconds after disturbance with a pointed stick. Treatments were assigned by first ranking the plots from highest to lowest in active mound numbers. The highest six were blocked into the first replication, the next highest six the second replication, and so on to make four replications. Treatments were numbered from one through six and, using a random number table, were randomly assigned to plots within each block.

The treatments were as follows:

1) Untreated Control
2) Logic, solid coverage (1.5 lbs total)
3) Logic, skip swath coverage (0.75 lbs. total)
4) Amdro, solid coverage (1.5 lbs. total)
5) Amdro, skip swath coverage (0.75 lbs. total)
6) Logic/Amdro (1:1 by weight) hopper mix, solid coverage (1.5 lbs. total)

Application of all treatments was delayed by the threat of thunderstorms until June 24 from approximately 4:30 p.m. to 8:30 p.m. The bait was broadcast using a tractor-mounted Herd® Model 77 seeder. Swath width was 35 feet. Six swaths were required to cover the solid coverage plots and four swaths were applied to the alternate swath plots, two on the outer edges and two roughly straddling the center.

Subsequent evaluations were made on 13 July, 13 August, 25 September, 1992 and 13 January, 1993 using the minimal disturbance technique. Data were analyzed using analysis of varaince (ANOVA) and separated using Tukey's studentized range test (PC SAS) at $P \leq 0.05$.

Results and Discussion

The broadcast treatment of Amdro® Fire Ant Granules required complete area coverage at full label rate to provide significant initial and long-term suppression (Table 1, Fig. 1). Application of Logic® Fire Ant Bait provided statistically similar suppression at both full rate, full coverage and when applied at the same rate to every other pass across the plot (skip-swath or strip application)(Table 1). The slow-acting nature of Logic is the probable cause of the effects of the treatment extending into the 35 ft. strips left untreated within each skip swath treated plot.

Results suggest that the treatment costs of Logic may be reduced considerably. The Amdro plus Logic combination appeared to offer the best characteristics of both products: fast suppression and long-term suppression (Fig. 1, Table 1). Data reported here are for the first six months of an 18 month trial. Results must therefore be considered preliminary.

A primary deterrent to large scale application of fire ant bait products in cattle production systems is cost. Product and application costs are usually in the $10 per acre range (Drees and Vinson, 1992), making their use unfeasible in most production systems. Applying less product and applying it with less labor are both ways in which costs can be reduced. The use of a mixture of Amdro plus Logic can be a good method of achieving rapid suppression characteristic of Amdro and the long-term effectiveness of Logic.

Literature Cited

Drees, B. M., C. L. Barr, and S. B. Vinson. 1993. Effects of spot treatments of Logic® (fenoxycarb) on polygynous red imported fire ants: an indication of resource sharing? Southwestern Entomologist. 17:4 313-317.

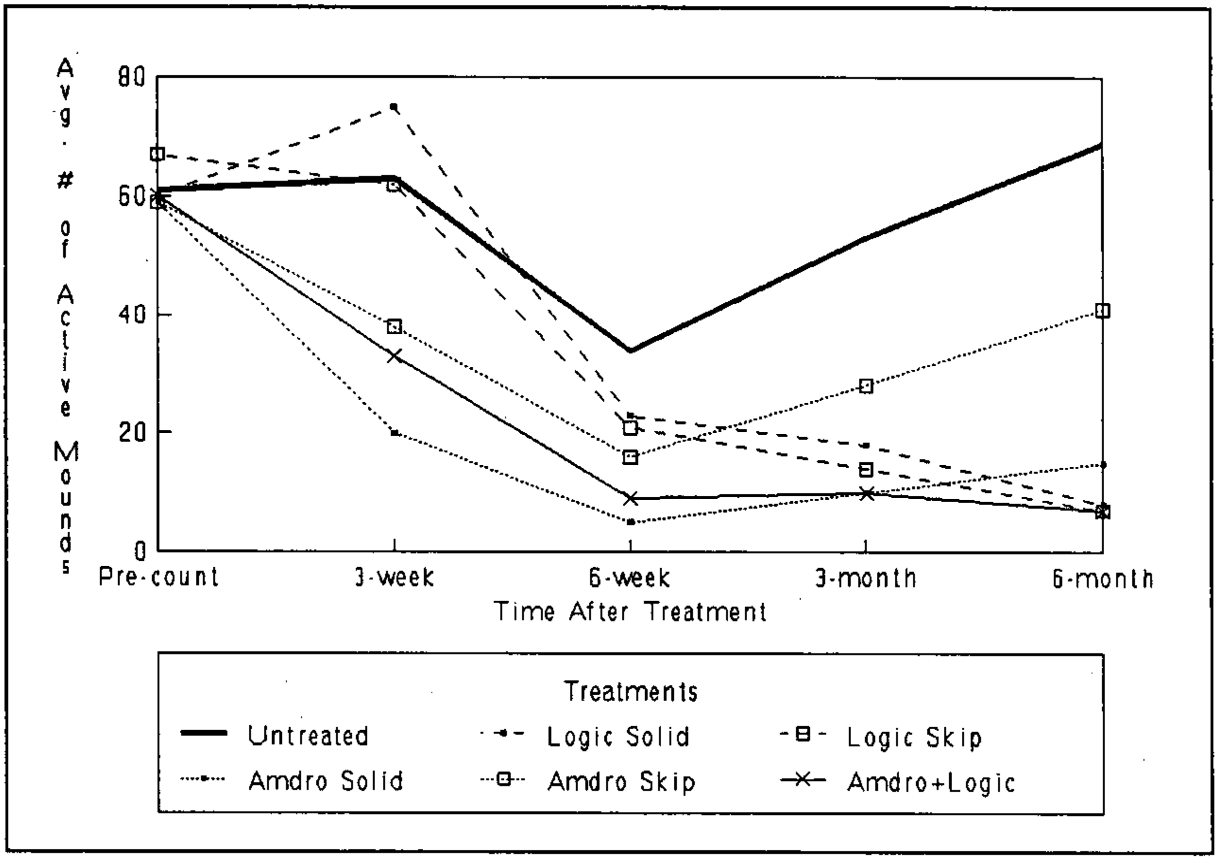
Drees, B. M. and S. B. Vinson. 1992. Fire ants and their management. TAEX B-1536. Texas A&M University System, College Station, Texas.

Table 1. Fire ant active mound numbers per 0.5 acre subplot within one acre treatment plots before and after June 24, 1992 treatments, Conroe, Texas.

Treatment	Mean no. fire ant active mounds/0.5 acre*				
	Pre-count	3-weeks	6-weeks	3-months	6-months
untreated control	61.25a	62.50ab	34.00a	52.50a	69.00a
Logic® solid	60.25a	75.25a	22.50ab	17.50b	8.25c
Logic® skip-swath	66.50a	61.75ab	21.25ab	13.75b	6.75c
Amdro® solid	59.00a	20.25b	5.00b	9.50b	14.75c
Amdro® skip-swath	59.00a	38.25ab	15.50ab	27.75ab	41.25b
Amdro® + Logic®	59.75a	33.25ab	9.25b	10.25b	6.50c
F	7.57	2.15	5.19	4.56	13.44
R-square	0.8016	0.5336	0.7345	0.7085	0.8776
$Pr > F$	0.0004	0.0964	0.0031	0.0056	0.0001

* Means followed by different letters are significantly different using analysis of variance and Tukey's studentized range test (PC SAS)

Figure 1. Fire ant active mound numbers per 0.5 acre subplot within one acre treatment plots before and after June 24, 1992 treatments, Conroe, Texas.



1992 Bait Trials with Fenoxycarb

Homer L. Collins
U. S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Imported Fire Ant Station
Gulfport, MS

1993 Imported Fire Ant Conference
June 16-18, 1993
Charleston, SC

Introduction:

A series of field trials with fenoxycarb baits (Ciba-Geigy Corp., Greensboro, NC), was conducted in 1992. Some trials were designed to compare efficacy of experimental formulations, while others investigated the effects of dew on efficacy of Award™, or impact of blending Award into a controlled release fertilizer prior to application. Results of each trial will be presented separately.

Methods and Materials:

Plot design, application techniques, rating system, and statistical analysis of data were essentially identical for all tests. Test plots were located in non-grazed permanent pastures in Harrison County, MS. All plots were 1 acre in size (210′ x 210′), with a circular 0.25 acre efficacy subplot located in the center of each plot. A totally monogynous red imported fire ant (RIFA) population averaging 74 colonies per acre infested the property. All treatments were made with a shop-built granular applicator mounted on a farm tractor (Collins 1987) or a Herd® GT-77 granular applicator mounted on a farm tractor (Herd Seeder Co., Logansport, IN). Test plots and untreated checks were arranged in a completely randomized block design with 4 replicates per treatment. The population index method (Harlan et al. 1981) as modified by Lofgren and Williams (1982), as well as colony mortality was used to rate all plots at 6, 12, 18, and 24 weeks after treatment or until reinfestation of test plots was noted. Analysis of variance and Tukey's studentized range

(HSD) test (SAS Institute 1988) were used to determine statistical differences in treatment means at the P <0.05 level for each posttreatment rating (PT) interval.

Test IA-Formulations:

Treatments evaluated included a 1% AI formulation, 0.5% formulation, and the standard commercial formulation of Amdro®. Treatments were applied on June 4, 1992.

Test IB-Formulations, Continued:

A second formulation trial was similar to first trial, since the test plots were located in an adjacent field and the same application equipment and rating system was employed. However, plots were treated on August 5, 1992. Treatments evaluated included formulation codes FL-921424, FL-921425, and FL-921414. All contained 0.5% fenoxycarb.

Test II-Influence of Dew on Efficacy of Award™ Fire Ant Bait:

Effectiveness of all fire ant baits is known or thought to be influenced by a number of variables including soil temperature, soil moisture, rain, and dew (Lofgren et al. 1964, Porter & Tschinkel 1987). Amdro® (American Cyanamid Co., Princeton, NJ) must be harvested and ingested by foraging IFA workers soon after application in order to prevent photolysis of the active ingredient (Vander Meer et al. 1982). Pesticide labels for most fire ant baits caution users not to apply the product to grass or vegetation that is wet from dew or rainfall, and control programs are often delayed to allow dew to dry before treatment begins. These delays are costly, inefficient, and may be unnecessary because hard data on the effect of dew on efficacy of baits is not available. A study to investigate the influence of dew on efficacy of Award was initiated on July 8, 1992. Since all baits employ soybean oil as a feeding attractant and pregelled defatted corn as an inert carrier (Illinois Cereals, Paris, IL), the results of this trial should be representative of other baits as well as for Award.

Treatment Procedure

Test plots were established in a non-grazed permanent pasture in Harrison County, MS. Four plots (replicates) were treated with labelled rates of Award (1.0 lb/acre) under "heavy" dew conditions in early morning (before the dew began to dry — about 6:30 AM). Treatment of four adjacent plots was delayed until late in the afternoon when dew had dried and conditions were similar to morning application — about 6:30 PM of the same day. The amount of dew present on vegetation was measured by weighing the amount of dew formed on 36" x 36" (8361.273 cm^2) panels of flannel cloth (n=4), placed directly in contact with the soil/vegetation surface and pinned in place with No. 6 nails. The cloth panels were placed directly in the test plots late in the afternoon on the day immediately preceding treatment. The amount of dew present at the time of treatment was determined by re-weighing each panel and expressing the amount of dew as g/1000 cm^2. Soil temperature at the 1" depth was recorded immediately prior to both applications.

Test III- Fertilizer Trials:

Due to the low rate of application (1.0 to 1.5 lbs/acre), all fire ant baits are difficult to apply with most commonly used granular applicators. Most agricultural products such as seeds, fertilizers, etc. are dispersed at much higher rates of application. Therefore, dispersal equipment is designed for these higher rates of application and cannot be calibrated to deliver labelled rates of fire ant baits. One method of eliminating these problems would be to blend fire ant baits into fertilizer or grass seeds which would then be applied as a "tank mix" of the two products. Past attempts to control fire ants with a blend of fire ant baits and conventional fertilizers were not successful (1984 IFA Station Annual Report). Although accurate calibrations and delivery are possible with these mixes, efficacy is greatly decreased. It is hypothesized that the loss in efficacy is due to the dust granules from the fertilizer which adhere to the bait particles rendering then unpalatable to the ants. In addition to solving some calibration problems, the use of a fertilizer/bait blend offers an economic incentive as well, because an area to be treated for ants and also fertilized would require only a single application.

Polyon® polymer coated urea granules (Pursell Industries, Sylacauga, AL) containing 42% nitrogen (42-0-0), like other controlled release fertilizer formulations, are essentially non-dusty, and appeared to be compatible with fire ant baits. At the request of Pursell Industries, a small test to evaluate IFA control with Award blended into Polyon urea granules was conducted.

Trial IIIA- Freshly mixed Fertilizer:

Award was blended into the urea granules at a rate of 1.5 lb bait per 100 lbs fertilizer on June 3, 1992. An electric cement mixer (2.0 cu ft capacity) was operated for approximately 5 minutes per batch. This mixture was applied approximately 24 hours later at a rate of 101.5 lbs/acre with a Herd GT-77® Granular Applicator (Herd Seeder Co., Logansport, IN), which was mounted on a farm tractor. This equipment was operated on a 32′ swath at 4 mph. Control plots were treated with Award only at a rate of 1.5 lbs bait/acre using a shop built granular applicator mounted on a farm tractor (Collins 1988). Due to the sticky, unflowable nature of the Award, it was necessary to operate the equipment on a 10′ swath at 4 mph. All treatments were applied on June 4, 1992.

Trial IIIB- Shelf life study:

On July 27, 1992, Award was blended into polyon granules at a rate of 1.5 lbs Award (Batch #RA11019) to 100 lbs fertilizer using an electric cement mixer. The mixed materials were resealed into original fertilizer bags and stored in the laboratory at ambient temperature and humidity. This material was applied to 4 one-acre plots at a rate of 101.5 lb/acre on May 11, 1993.

RESULTS:

Test IA-Formulations

Soil was very moist, and soil temperature (1" depth) was 68°F. Air temperature was 78°.

Light rain (estimated at <0.1") occurred during application of the 1.0% formulation. All treatments provided excellent reduction in pretreatment population indices through 12 weeks (Table 1). Reinfestation was apparent in all plots at the 18 week count and the trial was terminated.

Test IB -Formulations

Results indicated no difference in efficacy of the various formulations through 38 weeks (Table 2). Only the 921424 formulation has achieved greater than 90% control, but acceptable control was achieved with all treatments. Although population indices were greatly reduced by all treatments, colonies survived for at least 10 months in a non-reproductive mode. This delayed colony kill effect may be related to the low dose rate (0.5% AI) applied.

Table 1. Efficacy of Various Award Formulations, 1992.
Test IA.

Treatment	% Change in Population Index at Indicated Weeks PT[1]		
	(6)	(12)	(18)
Award 1.0%	-94.9a	-91.9ab	-61.8a
Award 0.5%	-91.1a	-99.2a	+51.7a
Amdro	-96.3a	-95.8ab	-56.1a
Check	-38.2b	-1.3b	+45.7a

[1] Means within columns followed by the same letter are not significantly different according to Tukey's studentized range (HSD) test (SAS Institute 1988).

Table 2. Efficacy of Various Award Formulations, 1992.
Test IB.

Treatment	% Change in Population Index at Indicated Weeks PT					
	(6)	(12)	(18)	(25)	(30)	(38)
921414 (0.5%)	-86.1a	-86.1a	-83.2a	-83.1a	-80.5a	-89.0a
921424 (0.5%)	-89.2a	-88.9a	-93.2a	-89.8a	-89.4a	-95.0a
921425 (0.5%)	-81.6a	-81.0a	-80.3a	-70.3a	-78.5a	-85.7a
Check	+0.6a	+44.9b	+7.6b	+15.6b	-26.3b	+38.0b

[1] Means within columns followed by the same letter are not significantly different according to Tukey's studentized range (HSD) test (SAS Institute 1988).

Test II - Influence of Dew on Efficacy of Award Bait

All treatments were applied on July 8, 1992 to a pasture comprised of approximately 75% Bahia grass (*Paspalum notatum*), mean height 17.53 ± 1.45 cm and 25% dog fennel (*Eupatorium capillifolium*), mean height 70.10 ± 2.97 cm Sunrise was 6:00 AM and sunset 8:01 PM on the day of treatment. The treatment applied under dew conditions occurred between 6:55 AM and 7:40 AM, with air temperature of 78°F and soil temperature at 68°F. An average of 24.23 g/1000 cm^2 of dew was present on the cloth panels in the four replicates. The "dry" treatment was applied between 6:40 PM and 7:25 PM with air temperature at 88°F and soil temperature at 80°F. An average of 0.92 g/1000 cm^2 of moisture was present, probably due to high summer humidity.

Results indicate that the presence of dew during application does not negatively affect the efficacy of Award bait (Table 3).

Table 3. Effect of Dew on Efficacy of Award Fire Ant Bait.

Treatment	% Change in Population Index at Indicated Weeks PT[1]			
	(6)	(12)	(18)	(24)
Dew	-88.6a	-91.9a	-89.6a	-92.2a
No Dew	-86.4a	-84.9a	-75.5a	-91.3a
Check	+5.6b	+31.5b	+21.6b	+24.2b

[1] Means within columns followed by the same letter are not significantly different according to Tukey's studentized range (HSD) test (SAS Institute 1988).

Trial III - Fertilizer:

Weather conditions during treatment were as follows: skies clear to partly cloudy. Air temperature was 80°F, and soil temperature (indirect sun, 1" depth) was 68°F. A light rain shower (estimated at < 0.1") occurred within 1 hour of application.

As shown in Table 4, there was no significant difference in population index reduction at 6 and 12 weeks PT for either treatment. Thus, fertilizer does not appear to enhance or degrade the efficacy of Award. This trial was terminated after the 18 week count because reinfestation had occurred.

Table 4. Effect of Fertilizer on Efficacy of Award™ Fire Ant Bait.

	% Change in Population Index at Indicated Weeks PT[1]		
Treatment	(6)	(12)	(18)
Fert. + Award	-92.4a	-95.8a	-67.8a
Award only	-83.8a	-98.6a	-31.2a
Check	-26.0b	+29.5b	+52.4a

[1] Means within columns followed by the same letter are not significantly different according to Tukey's studentized range (HSD) test (SAS Institute, 1988).

Acknowledgements:

Avel Ladner, Tim Lockley, Lee McAnally, and Randy Cuevas assisted with bait applications and plot evaluations. Special thanks are due to Anne-Marie Callcott for data analysis and summarization, slide preparation, and for providing assistance in plot counts.

References Cited:

Collins, H. L. 1988. Description of a shop-built granular applicator (Appendix I). 1987 Annual Report. USDA, APHIS, PPQ, Imported Fire Ant Station. Gulfport, MS. 107 pp mimeo.

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

Ladner, A. L., P. M. Bishop, C. J. Mauffray and D. J. Adams. 1984. IFA control with Amdro® mixed with fertilizer or rye grass seed. 1984 Annual Report (FA012184). USDA, APHIS, PPQ, Imported Fire Ant Station.

Lofgren, C. S., and D. F. Williams. 1982. Avermectin B_1a: A highly potent inhibitor of reproduction by queens of the red imported fire ant. Jour. Econ. Ent. 75: 798-803.

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

Porter, S. D., and S. R. Tschinkel. 1987. Foraging in *Solenopsis invicta* (Hymenoptera: Formicidae): effects of weather and season. Environ. Entomol. 16: 802-808.

SAS Institute 1988. SAS User's Guide: Statistics Version 6. Cary, NC.

Vander Meer, R.K., D.F. Williams and C.S. Lofgren. 1982. Degradation of the toxicant AC217,300 in Amdro® imported fire ant bait under field conditions. J. Agric. Food Chem. 30:1045-1048.

"Moundville, Alabama: A Community RIFA Control Project"

Don Taylor, Date Houmes, Jamey Clary and John Harper

1993 IFA Research Conference
Charleston, SC

DT/5-13-93/bb

First Committee Meeting

Moundville Fireant Project

<u>September 25, 1991</u>

Bob Lake, Mayor

Cary Findlay, Landowner

Ed Thornton, Landowner

Larry Taylor, Owner Local Telephone Company

John Harper, Tombigbee RC&D Coordinator

Jamey Clary, Hale County Extension Agent

DT/5-13-93/bb

Second Meeting

Moundville Fireant Project

Mid-October, 1991

John Harper and Jamey Clary

Developed Strategy

Developed Proposal

- Statement of Problem and Background
- Proposed Solution - Treat With Award™
- Benefits

Contacted Ciba-Geigy For Information and Technical Support on Award

DT/5-13-93/bb

Third Meeting

Moundville Fireant Project

<u>November 13, 1991</u>

Fireant Committee and Ciba

- Committee Presented Proposal
- Discussed Specific Plans
- Toured Treatment Area (780 A)
- Mapped Areas For Aerial Application
- Mapped Out Nontreatment Areas

DT/5-13-93/bb

Fourth Meeting

Moundville Fireant Project

Early December, 1991

John Harper and Jamey Clary

- Finalized Proposal
- Developed Presentation For Town Meeting
- Developed Funding Strategy

DT/5-13-93/bb

Town Meeting

Moundville Fireant Project

<u>January 9, 1992</u>

- Everyone in Town Invited
- Committee Presented Proposal
- Past Test Results With Award™
- Reasons For Selecting Award
- Set Final Expectations
- Many Questions From Citizens
- Full Support From Residents

DT/5-13-93/bb

Preapplication Activities

Moundville Fireant Project

Mayor Arranged Funding

- Telephone Company
- Gas Company
- Alabama Power Company
- City of Moundville

Jamey Clary Handled Details

- Award Purchase
- Aerial Applicator
- Ground Equipment
- Publicity (TV and Press)
- Technical Support

DT/5-13-93/bb

Application Activities

Moundville Fireant Project

Planned April 28th

- Rained, Postponed

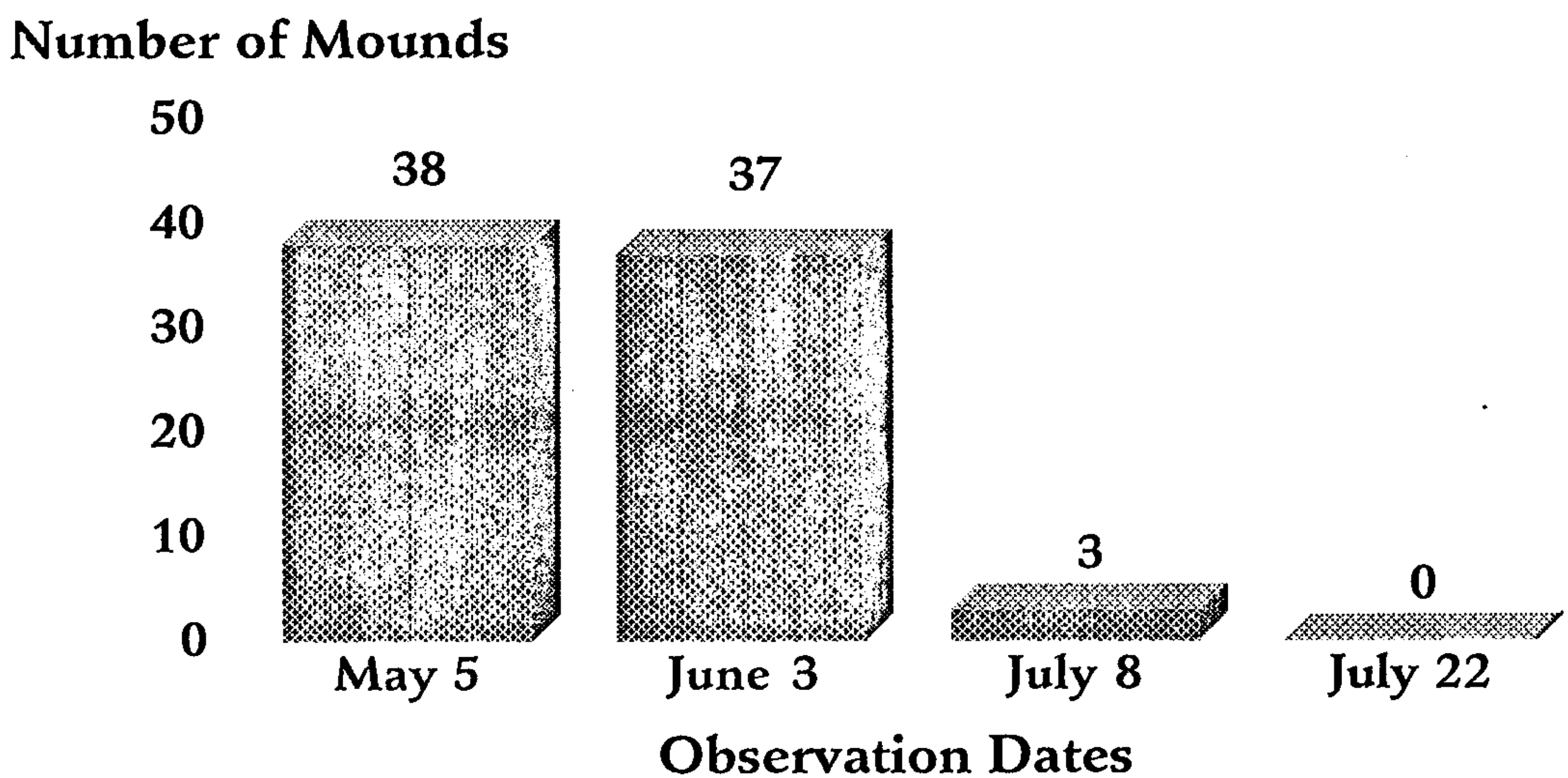
Applied May 5th

- 10:00 to 11:35 a.m.
- Aerial (Major Part)
- Ground With 4-Wheel Herd Seeders
- Ground With Walking Spiker Spreader
- Mound Counts Made
- Observations of Ant Feeding Activity
- Worked With Press and TV

DT/5-13-93/bb

Red Imported Fireant Control With Award™ Fireant Bait

Moundville, AL - 1992



Applied May 5, 1992
Award Applied at 1 Lb./A

DT/5-13-93/bb

News Accounts

Moundville Fireant Project

Local TV - Birmingham and Tuscaloosa

National TV - CNN September/October

Local Newspaper - Multiple Stores

State and Regional Newspapers

- Independent Reporting
- Wire Service

Auburn University News Release

- Headline - "Sterile "Grits" Control Fireants in Moundville"
- Hale County Office 750 - 800 Calls/Day
- Pat Cobb - How Many Calls??

DT/5-13-93/bb

Follow-Up Activities

Moundville Fireant Project

- Mound Counts - 6/3, 7/8, 7/22
- Town Meeting/Lunch/Tour July 22th
- Committee Meeting Early Fall - Planning For Larger Area Application (Still in Process)
- Fall Application October 9, 1992
- "Happy" Easter Sunrise Service in Moundville State Park 1993

DT/5-13-93/bb

Broadcast Spreader Equipment for Amdro Applications

Kyle Miller And Kaye Iftner
American Cyanamid Company

The Red Imported Fire Ant (RIFA) continues to be a problem in home lawns, commercial turf, nurseries, pastures, and many other areas. Due to their ability to completely infest areas, broadcast applications of a bait such as Amdro have been found to be one of the most effective ways for controlling RIFA. When compared, there are many benefits to broadcasting a RIFA bait in lieu of treating individual mounds. These include 1) controlling small mounds not visible when mound treating 2) controlling RIFA invading from adjacent property 3) easy application with available spreader equipment 4) low use rates.

Realizing that broadcasting baits is an effective method of controlling RIFA, and that the spreader equipment available for this use is not well documented, an attempt was made to identify and test available equipment. The following spreader equipment was evaluated: hand-held, chest, backpack, walk-behind, vehicle mounted, and aircraft mounted.

Five hand-held spreaders were evaluated which included the Precision Handi-Spred, Plant Mates Scatter Box, Republic EZ Spread, Scotts Handy Green, and Ortho Whirlybird. All spreaders were found to broadcast Amdro acceptably at the lowest setting, requiring two passes to apply the labeled rate of 1- 1.5 lbs of product per acre. Adjusting to the next available setting resulted in excessive application.

A total of eight chest spreaders were tested with five being found acceptable for bait application. Our evaluations indicated that chest spreaders with an oscillating gate plate (plate moves back and forth slightly while cranking) were the only ones effectively applying the proper rate. These included the Plant Mates canvas, Spyker poly model 75, Earthway canvas model 2700A, Cyclone poly 1C1, and Cyclone canvas 1A1. The Warrens poly, Murayama poly, and Earthway poly applied excessive rates.

The SP D/S backpack spreader which works by using a blast of air to spread product was found to effectively apply Amdro at the required rate. The distribution of product over an area is not as uniform as spinner spreaders due to a continuous hand pumping motion being required.

All Walk-behind rotary spreaders were found to apply excessive amounts of product with the exception of the Spyker model 24-22 and 44-22. Similar to the findings with the chest spreaders, those units with an oscillating gate plate (which provides even flow) were the only spreaders capable of applying the labeled rate. All other spreaders tested which included the Lesco rotary, Scotts R7, and Earthway Poly applied excessive product when uniform flow was achieved.

The Herd GT77A broadcast spreader continues to be the most effective vehicle mounted unit for applying baits to large areas. Use rate can easily be changed by altering the ground speed.

Two unique modification systems have been identified for the aerial application of Amdro. These two systems are designed to control bridging and flow rate of product through the spreader hopper. Both systems require a ram air induction tube into the hopper area to provide agitation of product. Details of the two systems is found in a Cyanamid publication entitled "Amdro Aerial Application Guide". In addition, information on ground broadcast spreader equipment can be found in the publication entitled "Broadcast Applications of Amdro".

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A MODIFIED PLOTTING TABLE AND PLOT LOCATOR FOR RIFA FIELD STUDIES

Mac Horton, Department of Entomology, Clemson University, 113 Long Hall, Box 340365, Clemson, SC 29634-0365

A variety of modified types of plane tables have been used to survey and map replicate plots in field studies of the red imported fire ant, *Solenopsis invicta* Buren (RIFA). Problems encountered in using previous types of field tables in field studies in South Carolina led to the development of a new table.

To construct the plane table, a 31 X 41 X 0.64 cm steel plate was welded to the top of a square, hollow steel leg with a cross section of 2.54 X 2.54 cm and 91 cm in length. A 10 penny nail ca. 2 cm long was welded to the center of the top surface of the steel plate to serve as a pivot for a scale cursor.

Steel stakes approximately 30 cm long were made from square steel tubing. Each stake is angled approximately 60 degrees at one end. The inside dimensions of each stake are 2.54 X 2.54 cm so the stake can receive the leg of the plane table. Additional steel squares, 41 X 41 cm in dimension, were manufactured from the same 0.64 cm steel plate. Each steel plate had a 3 cm square hole cut in its center. All of the above materials were painted a high visibility day-glow fluorescent orange.

Once a replicate plot is selected in the field, a 30 cm stake is driven into the center of the plot. One of the steel plates is then laid on the ground with the stake protruding through the center hole. The leg of the table is then placed into the stake. Because of the square dimensions of the leg and the stake, once the table is positioned, and a plot map with orientation points properly drawn on its surface, the plot and map are easily reoriented in the future. The table may be easily moved and set up, and reoriented to another plot. The large steel plates on the ground facilitate future finding and relocation of the plot centers and stakes.

The stakes and plates may be left in the field plots throughout the research season. Their construction and dimensions render them relatively immune to damage caused by weather, animals, and men and machines operating in the fields. Their ease of use greatly simplifies the process of mapping and relocating RIFA field colonies.

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ALBERT F. FINN, JR., M.D.

ALLERGY, ASTHMA &
CLINICAL IMMUNOLOGY

CLINICAL ASPECTS OF FIRE ANT HYPERSENSITIVITY (ALLERGY)

Reactions to fire ant stings may be classified as local, systemic (anaphylactic) and other. Immediate pain, associated with a wheal and flare reaction followed by intense itching is a typical local reaction experienced by all who are stung by fire ants. The wheal and flare reaction usually resolves in thirty minutes to an hour. A papule forms and evolves into a fully developed sterile pustule at the site of the sting within 24 hours. This pustule is characteristic for the imported fire ant sting in the United States. Usually no treatment is indicated to prevent or resolve the pustules. If there are multiple lesions, secondary infection can occur.

Between 17 and 56% of patients have large local reactions at the site of the fire ant sting. They are extremely pruritic (itching) and last 24 to 72 hours. These reactions are best treated symptomatically with oral antihistamines, topical adrenocorticosteroid ointments and local anesthetic creams. If they are severe, they may require elevation of the extremities and systemic steroids for a few days to relieve the discomfort. These reactions do not require further evaluation or immunotherapy (allergy injections). In as much, they have not been shown to predispose patients to systemic allergic reactions.

Systemic or anaphylactic reactions on the other hand involve sites remote to the sting site. They are generalized urticaria (hives, cutaneous laryngeal edema, bronchospasms, asthma, and/or cardiovascular collapse). Hives and generalized angioedema estimated occur 16% of stings and life threatening anaphylaxis follow 0.6 to 4% of stings. Thirty-two documented deaths due to imported fire ant stings have been reported in the southern United States. Emergency room physicians in areas infested with imported fire ants know to check between the toes and elsewhere on the lower extremities for evidence of fire ant stings when patients present with anaphylaxis. Anaphylaxis occurs shortly after sting.

Other unusual neurotoxic reactions can occur including seizures and peripheral neuropathy. Much of what we know about fire ant anaphylaxis is based on information we have obtained from stinging hymenoptera (bee, wasp, yellow jackets or hornets). Experience with immunotherapy for stinging hymenoptera has demonstrated that whole body extracts have no value because they contain little or no venom. Venom immunotherapy on the other hand has been shown to be safe and effective in patients with systemic reactions after honeybee and yellow jacket stings. Extracts of imported fire ant venom are not yet commercially available and whole body imported fire ant extracts presently are used to diagnose and treat thousands of affected patients who live in infested areas. There is a substantial, although variable amount of venom in imported fire ant whole body extracts.

The Journal of Allergy and Clinical Immunology 1992; 90:210-05 by Freeman, Hylander et al demonstrated clearly that imported fire ant whole body extract was very effective in decreasing instances of anaphylaxis after subsequent field stings. Therefore, we do have a proven effective therapy for these very frightening cases of anaphylaxis.

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Emergency Department Management of Fire Ant Stings

This year U.S. hospital emergency departments will have 100 million patient visits. In the Southeast, especially during the spring and summer, fire ant stings will be a common cause of emergency department visits.

Modes of presentation include 1) life-threatening anaphylaxis; 2)urticaria; and 3) local reactions.

Life-threatening anaphylaxis to fire ant stings is a true medical emergency. Patients present with respiratory distress, either upper airway stridor or expiratory wheezes; shock or hypotension; or full-blown cardiac arrest.

Establishment of an airway with an endotracheal tube inserted either nasally or orally is the traditional means of airway resuscitation in respiratory arrest. With a patient in severe respiratory failure who is struggling for air, rapid sequence intubation may be indicated. Cricothyrotomy may be necessary in the patient with severe angioneurotic edema of the larynx.

For patients with expiratory wheezes, traditional treatment for asthma is utilized, with nebulization of bronchodilators such as albuterol. Oxygen is indicated.

Establishment of an intravenous line is essential in these patients, as fluid resuscitation with normal saline is necessary in the event of hypotension and/or shock. Intravenous steroids and epinephrine are generally indicated.

Observation of patients with anaphylaxis is always necessary and hospitalization may well be indicated. Patients with anaphylactic reactions should ultimately be referred to an allergist for desensitization.

Generalized allergic reactions to fire an stings is usually manifested as urticaria, and the patient will present in marked distress, suffering from generalized pruritus.

Intravenous fluids, oxygen and treatment with cimetidine (Tagamet) or diphenhydramine (Benadryl) IV or by mouth is all that is usually indicated.

Following a brief period of observation, discharge home with a prescription for Tagamet or Benadryl is indicated, with follow up care. Further referral to an allergist is left to the family physician.

Local reactions are a quite common source of visits, although they hardly need an expensive visit to the emergency room. The typical case is a mother who notes pustules on her child's ankle or foot from fire ant stings and wants an antibiotic to "cure the problem." Trying to convince the mother that the lesions are sterile and will heal on their own if they are just kept clean is always a challenge, especially after she has just committed to a small fortune and a long wait. A good public education program can help prevent these unnecessary emergency department visits.

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Underrecognition of Morbidity from Stings of the Red Imported Fire Ant in the Southeastern United States

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Abstract This cross-sectional study was conducted to determine the health-seeking behaviors of a group of patients stung by red imported fire ants (RIFA) and the number of nursing referrals resulting in treatment. The following two research questions were asked: (1) Is there a delay in seeking the care of a board-certified allergist for symptoms of fire ant hypersensitivity? (2) Are nurses referring patients for treatment? The entire population of board-certified allergists in Alabama, Georgia, and South Carolina ($n=98$) was sampled. A questionnaire was developed for the office nurses to use to collect information from allergy patients actually receiving fire ant injections ($n=257$). Each patient reported on the reaction, when it occurred as well as age, sex, and county of residence. Descriptive statistics revealed that a delay of a month or more in seeking care of an allergist was experienced by 154 (56%) of patients who completed the questionnaire. The average delay was 1.8 years. The main source of referrals was a general practitioner or emergency room personnel. Nursing and other health professionals must recognize the problem and to institute prompt referral for treatment. In areas where RIFA colonies are spreading, they have to be fully informed and trained in effective primary and secondary techniques to prevent serious reaction to the stings of these ants.

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In areas of the United States that have an average minimum yearly temperature greater than 10°F and average annual rainfall of greater than 10 inches, the potential for a public health problem exists. These environmental conditions foster the growth and spread of the red imported fire ant (RIFA), *Solenopsis invicta buren*, a member of the order Hymenoptera. This order includes the more familiar species, such as honey bee, wasp, yellow jacket, yellow hornet, and white hornet. While all of the members of the order Hymenoptera, or stinging winged insects, create a public health problem to sensitive individuals, RIFA is causing a major increase in morbidity in the southeastern United States. South Carolina first identified RIFA in two counties in 1952. By 1973, 27 counties were infested, and all 46 counties reported the ant by 1986. Because the bite of RIFA can cause severe reactions in humans, an increase in their numbers is cause for alarm. In fact, 1% to 2% who are stung are at risk of a fatal reaction (Schuman, Banov, Caldwell, Horton, & Kissam, 1987).

The RIFA arrived in the 1930s at the port of Mobile, Alabama, aboard a ship from Brazil and has continued to spread throughout the south. This motivated researchers to attempt to identify the population at risk for fatal reactions and thus plan patient education. We conducted a cross-sectional survey to determine the health-seeking behavior of patients who are currently receiving RIFA injections.

REVIEW OF THE LITERATURE

The RIFA is one of the few insects that poses a problem to both rural and urban areas. These ants are aggressive; they bite the victim with their mandible and then inject venom that causes pain. After the initial bite, which attaches the ant to its prey, the ant may sting the victim many times. The sting hurts for a few minutes, after which the area reddens and swells. Characteristically, a pustule forms within 8 to 24 hours after the sting. In allergic individuals, complications such as anaphylaxis and even death may occur.

The chemical Mirex, which controlled the spread of fire ants in the past, was banned in 1975 by the Environmental Protection Agency. Since that time, RIFA colonies have continued to spread throughout the South for the following reasons: (1) colonies or mated queens are transported in nursery rootstock, sod, or soil to different areas; (2) reproductive forms leave their nest, mate in the air, and fly or are blown into new areas; (3) mated queens land in trucks or train beds and are moved from place to place; and (4) colonies form rafts during heavy rains and float to new locations (Vinson & Sorenson, 1986, p. 6).

For many reasons, fire ant mounds are frequently encountered by humans. Large mounds may reach a foot or more in diameter and height. Some can be hidden from view by tall grasses, and numerous tunnels may lead out from them for several feet to several yards.

An overview of the literature assisted the researchers in assessing the implications of RIFA spreading into the southeastern United States. For an individual to develop an allergic reaction, a previous sting is necessary to elicit an immune response. This fact accounts for the time lapse between RIFA arriving in an area and physicians treating patients with hypersensitivity to the sting. Brown (1972) in Charleston, South Carolina, and Triplett (1973) in Mississippi began to identify sensitive patients. By 1973, RIFA was recognized as a new public health problem in South Carolina (Lawrence, Keil, Brown, & Jackson). According to these authors 1088 cases of stings were reported by practicing physicians over three years. Thus from 1952 to 1972 RIFA spread gradually into the southeastern part of the country.

In New Orleans, Clemmer and Serfling (1975) considered the prevalence of fire ants in an urban community. A telephone survey revealed that 55% of RIFA stings were in children under 10 years of age. Ground-oriented play activities and lack of avoidance behavior were hypothesized as the reasons for the high rate in children. Sting rates declined earlier for girls than boys, but among adults they were higher for women than for men. The authors suggested that gardening and laundry activities contributed to the greater frequency in women. They estimated an overall hypersensitivity to fire ants of 16.6%.

A study was conducted in Sumter County, Georgia, to determine the frequency of attacks (Adams & Lofgren, 1981). The authors reported that exposure decreased with age. Those 45 years and older were half as likely to be stung as those under 10. March through September were reported as fire ant contact months, with most stings reported from March through May.

In Bryan, Texas, RIFA stings were most common in summer months, with ankles and feet the most frequent sites (Paull, 1984). As with other anaphylactic reactions, immediate treatment with epinephrine relieved symptoms within 30 minutes. The author recommended that all persons allergic to Hymenoptera stings should be instructed in the use of epinephrine for treatment of systemic reactions.

In 1985, a medical examiner in north central Florida reported that a middle-aged (47 yrs) female apparently died within 25 minutes of being bitten by RIFA. This case was documented to have been anaphylaxis from the stings (Stablein, Lockey, & Hensel, 1985). Hymenoptera anaphylaxis is primarily restricted to the respiratory tract and when it results in death, it is similar to drug-induced anaphylactic death. The authors observed that insect stings are more common in children, but that death as a result is more common in adults (Stablien et al., 1985).

Schuman et al. (1987) surveyed the primary care physicians listed in the 1985–1986 Directory of the State Board of Medical Examiners in South Carolina. With a 50.7 response rate, 12,127 cases of RIFA stings were reported during 12 months. Allergists were included in the survey and reported that 11% (141) of their patients received fire ant desensitization injections. Anyone reacting to a RIFA sting with hives or swelling distant from the site of the sting is in the 1% to 2% high-risk category for an anaphylactic reaction.

A survey of 5300 physicians (24% response rate) revealed 2573 patients in 28 states were receiving immunotherapy for fire ant stings (Stafford, Rhoades, Thompson, & Impson, 1988). The largest numbers of patients resided in Texas (1176), Florida (761), South Carolina (216), Louisiana (178), and Georgia (93). The authors recommended continuing education regarding health hazards and indications for immunotherapy for health professionals.

A survey of fatal anaphylactic reactions to RIFA in which 8.6% of 29,300 physicians responded, revealed 83 fatalities (Rhoades, Stafford, & James, 1989). Florida (22) and Texas (19) reported the largest numbers of deaths. One-half occurred in field or occupational settings, with patients' ages ranging from newborn to 65 years.

Fire ant stings represent a serious health threat to severely allergic individuals. If patients report to a nurse with symptoms of fire ant allergy, it is imperative to make prompt referral to a board-certified allergist. This physician is able to test the individuals, determine sensitivity, and prescribe treatment. Due to the limited number of allergists, however, general practitioners and internists may often test and treat RIFA-sensitive patients.

Treatment consists of whole-body desensitization injections weekly for an average of six months. Once a titration level is determined, patients receive a maintenance dose that is taken monthly. Treatment must be continued for an average of 10 years. Research is continually being performed to perfect pure RIFA venom, which may shorten this time.

Without treatment, an allergic individual must continually practice avoidance behaviors that may interfere with normal daily living. Once a patient exhibits hypersensitivity to RIFA, the therapeutic options should be elucidated by health professionals. Nurses, as first responders to this subgroup, are frequently the ones to provide this information.

Currently, examination by an allergist must occur at least a month after a sting to ensure testing accuracy. If this is not to be performed immediately, patients should be given information about avoidance, use of epinephrine, and control of insects. A delay in obtaining testing and treatment of longer than a month may place these individuals at risk for serious complications.

METHODS

The study was designed to determine if persons stung by RIFA experienced a delay in being referred to an allergist for definitive treatment. The investigators surveyed board-certified allergists in Alabama, Georgia, and South Carolina to determine the number of patients receiving injections for RIFA. To identify the patients, the investigators enlisted the support of allergy nurses working in the allergists' offices. These nurses were instrumental in counting patients, flagging charts, and administering the study questionnaire to patients.

The questionnaire asked patients to indicate the date of their first reaction, the signs and symptoms that accompanied the reaction, and the length of time between reaction and referral to an allergist. On the basis of the responses, the investigators believed they would obtain important information about the effects of the stings and the methods by which patients received health care. From this information health-education programs directed to providers of primary, secondary, and tertiary care could be designed.

The research questions were as follows: (1) Is there a delay between onset of symptoms of red imported fire ant hypersensitivity and referral to a board certified allergist? (2) Are community health nurses or school nurses referring patients to board-certified allergists?

Setting and Sample

To be eligible for the study, the subjects had to be receiving injections for fire ant hypersensitivity from a nurse in a board-certified allergist's office in Alabama, Georgia, or South Carolina. When they arrived for their weekly or monthly injections, the nurse administered the study questionnaire to the patients or their parent or guardian. The following report is based on data from ($n = 157$) respondents.

Two types of nonprobability sampling were used to obtain the desired information, that is, a purposive sample of allergy nurses and a convenience sample of patients receiving RIFA injections. The purposive sample consisted of the allergy nurses who chose to participate by following the procedure outlined below. The convenience sample consisted of patients receiving fire ant injections who chose to respond to the questionnaire.

Data Collection

Letters were mailed to the identified physicians and their nurses requesting their participation. Red stickers were included in the letter to be used to tag the charts of the appropriate patients. Two weeks later, investigators telephoned the offices to confirm whether or not participation could be expected and to obtain the results of their counts.

In all offices the allergy nurse served as the primary data collector. Nurses were instructed to tag the records of patients receiving allergy injections with the red sticker. Based on their counts of participating patients, project investigators sent an appropriate number of questionnaires to each office. The nurses gave each patient a questionnaire when they came to the office for treatment. At the end of two months, the nurses were called to remind them to send the completed questionnaires to the researchers.

TABLE 1. *Distribution of Respondents Being Treated for RIFA Desensitization*

Patients	Age (Yrs) <18 M	F	19–43 M	F	44> M	F	Totals M	F	Totals
Without delay*	15	10	10	15	4	11	29	36	65
With delay†	15	10	12	24	6	21	33	55	89
Average delay by sex (yrs)	0.8	1.5	1.9	1.8	4.3	1.9	1.9	1.8	154
Average delay (yrs)	1.1		1.8		2.4		1.8		

*Patients referred in less than 30 days or those patients ($n=20$) who did not discriminate between time of first allergic reaction and referral to an allergist.
†Patients referred later than 30 days. One patient age 19–43 years did not identify sex.

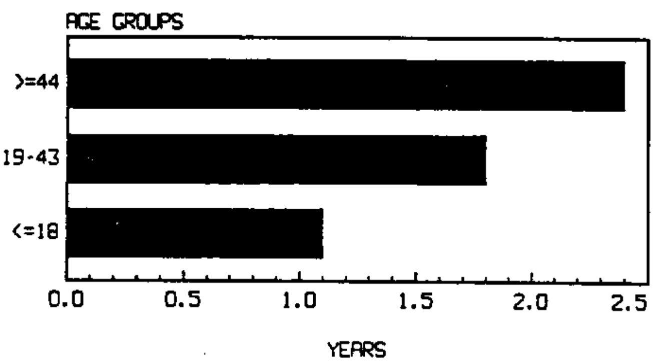

Figure 1. Schematic diagram of the average delay in referral showing results for three age groups based on patient recall ($n=89$).

TABLE 2. *Source of Referral to Allergist*

Source	Percentage of Patients*
General practitioner	34
Emergency room personnel	25
Self	23
Pediatrician	15
Friend	10
Community nurse	<1

*Respondents could check more than one source, however 32 patients had the general practitioner as only source and 18 had emergency room personnel as only source.

RESULTS

Forty-six percent of the offices surveyed agreed to participate. Within those offices, 61% (154) of 257 patients completed the survey questionnaire (Table 1). They ranged in age from 2 to 75 years. The sample was divided into three age groups: 32% 18 and under, 40% between 19 and 43, and 27% 44 and older.

Our survey confirmed that 89 (57%) of patients who exhibited symptoms of hypersensitivity to RIFA experienced a delay in seeking the care of a board-certified allergist (Fig. 1). The average delay was 1.8 years for all age groups.

From 10 possible choices, patients were asked to select who referred them to the allergist (Table 2). Those selecting two sources most often selected a combination of general practitioner and the emergency room personnel. A nurse was the referral source for one patient, however emergency room personnel could have included doctors, nurses, or clerks.

Additional information collected and displayed in Table 3 lists the patient reports of symptoms experienced with the first allergic reaction. The signs and symptoms of anaphylactic shock include difficulty breathing, urticaria, and itching. Patients reported these as well as local swelling and hives most frequently. When reviewing the reports of shock, trouble breathing, and unconsciousness, the researchers found that the severity of the symptoms did not seem to affect delay in seeking care from an allergist. In fact, of patients experiencing shock, 17% had a delay and 18% did not.

The seasonal distribution of first reactions is shown in Figure 2. In 64% of patients this occurred between June and September. Suburban areas were reported by 45% as the location of first reaction, followed by rural areas (29%) and cities (25%). Previous studies indicated the seasonality of reactions, however, our results demonstrated a trend toward a more year-round problem.

Previous studies showed the pediatric population to be more likely than adults to receive RIFA stings, but did not relate whether the children received more or

TABLE 3. *Rank Order of Symptoms of First Allergic Reaction to RIFA Sting*

Symptoms*	Patients (%) Delay† (n=89)	No Delay‡ (n=65)
Itching	84	83
Local swelling	67	58
Hives	59	63
Trouble breathing	56	55
Puffy eyes	40	51
Faintness	33	34
Other	20	20
Headache	21	17
Shock	17	18
Loss of consciousness	12	14
Seizures	3	3

*Respondents could select more than one.
†More than 30 days from time of reaction to examination by allergist.
‡Less than 30 days from time of reaction to examination by allergist, or did not discriminate between time of first allergic reaction and referral to allergist.

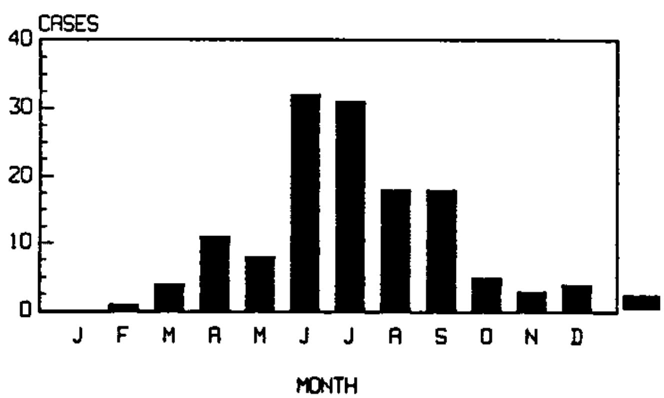

Figure 2. Distribution of patients' first reactions to RIFA stings.

fewer injections. Fifty patients (32%) completing the questionnaire were age 18 years or younger, with more males ($n=30$) than females ($n=20$) receiving injections. Of these 50, 25 experienced an average delay of 1.1 years in seeking an allergist's care. More males ($n=15$) than females ($n=10$) had such a delay. Pediatric patients are under the care of their parents who tend to take them to an allergist.

Other studies have shown that adults over age 30 are most likely to react to Hymenoptera stings and our results suggest a similar pattern. Forty percent (63) of respondents were age 19 to 43 years, and constituted the largest population receiving allergy injections for RIFA. Thirty-six (57%) had an average delay in seeking care of 1.8 years. Females characteristically seek health care more often than males, and although more women ($n=41$) than men ($n=22$) received injections, twice as many delayed this treatment than men (24 vs 12).

Forty-three patients receiving RIFA injections, 27% of the total sample, were 44 years of age and older. They had an average delay in requesting allergists' care of 2.4 years. Again more women ($n=33$) than men ($n=10$) received injections, however, delay time was longer for the men.

Descriptive statistics were used for all data collected and the data were analyzed nominally. The research questions did not address relationships; however, because of their interest, the researchers performed analysis of variance to explore for relationships. For example, differences among the average delay means for each of the three age groups were tabulated, and it was concluded that none existed between the ages or the sexes of the groups. Therefore, generalizations regarding distribution are not possible.

DISCUSSION

We attribute our success in obtaining the information from a hard-to-reach population to the diligent help of nurses in the three states. Previous studies concerning RIFA surveyed physicians and asked them to give reports of patients treated for RIFA hypersensitivity. Compared to Stafford et al. (1988), we discovered half as many patients receiving injections in South Carolina (124) but the same number in Georgia (93). Alabama was not surveyed by Stafford. This information assisted us to verify numbers of patients currently receiving injections.

It was interesting that the severity of symptoms did not greatly affect the length of time of patients' referral to an allergist (see Table 3). It was hypothesized that acute reactions would have caused a prompt referral.

Anaphylactic shock is the reaction that concerns patients who are aware of their sensitivity. Several patients indicated that death would have been imminent if they had not been rushed to the hospital. As health professionals are aware, anaphylactic shock is a medical emergency that is precipitated by many antigens and often results in death. Patients can be treated for Hymenoptera sensitivity to prevent needless death. Thus the documented delay in health-seeking behaviors indicates that persons living in RIFA-infested areas must be made more aware of the severity of stings.

First Aid for Hymenoptera Stings

Patient with insect sting
approaches a nurse.

↓

Assess for signs of insect sting—
itching, pain at site, swelling

↓

Is there a history of
allergic reactions to
Hymenoptera: bees, wasps
yellow jackets, hornets, fire ants (RIFA)?

YES ←

Patient begins wheezing,
having hives all over.
Epinephrine needed,
medical emergency.
Summon physician or
emergency medical service
in area.

↓

Continually assess for
airway, breathing, circulation.

↓

Patient stabilized.
Prepare for discharge.

Teach:

- Avoidance of insects
- Administration of epinephrine
- Medic-Alert identification
- Inquire about home environment
- Refer to allergist

→ **NO**

Is there a stinger?
Remove with tweezers.
Usually honey bees leave
a stinger, others do not.
Pustule formation occurs
six (6) hours after RIFA sting.

↓

Wash sting site
with soap and water.

↓

Apply ice compresses or
meat tenderizer mixed with
water (which denatures protein).

↓

Be alert for delayed reaction:
Most severe reactions
occur in five (5) minutes.

- Watch for hives or swelling distant from site.
- Have patient watch for infection and use antibiotic ointment.
- Teach to be aware of future stings, and signs or symptoms.
- If future stings produce difficulty breathing or hives, and swelling distant from the sting site, refer to an allergist.

Original work by V. J. Owens

Figure 3. First aid for Hymenoptera stings.

Limitations

The investigators recognize some important limitations of this study. Survey research information tends to be superficial, and cause-and-effect relationships cannot be applied or inferences made. To reach the affected individuals, an intermediary, in this the case the office nurses, had to be identified to assist the researchers. As different nurses might have handled the procedure differently, there was no way to verify if patients' reports were accurate.

The questions asked allowed patients to select more than one answer, which made data analysis more complicated. The important questions asking for the month and year of the first fire ant allergic reaction and month and year of the first visit to the allergist were not answered by 20 respondents. If either question was unanswered, we could not tabulate delay in seeking referral to an allergist. Further limitations involved the fact the spring months find the allergist quite busy with tree and grass pollen desensitization. This may have caused a decreased interest in the study.

Nursing Implications

Underrecognition of RIFA sting morbidity poses serious questions for nursing. The delay in recognizing RIFA hypersensitivity by patients themselves is a significant finding. Whether patients are unaware of the symptoms of a future reaction, and whether health professionals fail to recognize RIFA hypersensitivity are questions unanswered by the study.

Since the spread of RIFA is apparent in certain areas of the country, and the literature does not address RIFA anaphylaxis, nurses must increase their knowledge of the subject. By taking the time to do this, they also will become more knowledgeable about the other Hymenoptera. Public health nurses can significantly affect client outcomes by becoming aware of the signs and symptoms of RIFA hypersensitivity. Once this is accomplished, they can deliver and reinforce the message to the public.

Nursing practice includes primary, secondary, and tertiary prevention. Primary prevention can be implemented by developing programs to teach awareness and avoidance of RIFA. A system is necessary whereby emergency room personnel, including nurses, physicians, and clerks, should be informed of all of the allergic reactions resulting from RIFA stings, and establish a protocol for treatment management, and referral.

Secondary prevention, consisting of recognition of signs and symptoms to diagnose a RIFA-sensitive individual, should be a component of new nursing and medical textbooks. Figure 3 gives an example of first aid for Hymenoptera stings. Continuing-education programs focused on increasing awareness of signs and symptoms of RIFA for health professionals in schools, workplaces, and emergency rooms would ensure the public a prompt, accurate diagnosis.

Tertiary care should consist of placing a national protocol in clinics, physicians' offices, hospitals, and emergency rooms to manage care of individuals with RIFA anaphylaxis. Once a patient's condition is stabilized, information on self-administration of epinephrine, avoidance of RIFA, and knowledge of Medic-Alert® programs should be given. After an individual has been released from an acute care setting, follow-up with a board-certified allergist should be carried out to determine the degree of sensitivity and measures for desensitization. In addition, information on the control of RIFA should be given.

While all areas of the country are not affected by these ants, the solution to the RIFA problem can be applied to all Hymenoptera stings. Increased knowledge of signs and symptoms of anaphylaxis will alert health professionals to perform a thorough assessment of a patient for a history of insect hypersensitivity.

REFERENCES

Adams C. T., & Lofgren C. S. (1981). Red imported fire ants (*Hymenoptera: Formicidae*): Frequency of sting attacks on residents of Sumter County, Georgia. *Journal of Medical Entomology, 18*(5), 378–382.

Brown L. (1972). Fire ant allergy. *Southern Medical Journal, 65*(3), 273–277.

Campbell B. (1986, May–June). Deadly Stings. *South Carolina Wildlife*. 36–37.

Clemmer D. I., & Serfling R. E. (1975). The imported fire ant: Dimensions of the urban problem. *Southern Medical Journal, 68*(9), 1133–1138.

Lawrence R. S., Keil J. E., Brown L. L., & Jackson H. B. (1973). The imported fire ant: A newly recognized public health problem in South Carolina. *Journal of the South Carolina Medical Association, 69*(9), 319–321.

Paull B. R. (1984). Imported fire ant allergy perspectives on diagnosis and treatment. *1984 Postgraduate Medicine, 76*(1), 155–160.

Rhoades R. B., Stafford C. T., & James F. K. (1989). Survey of fatal anaphylactic reactions to imported fire ant stings [abstract]. *Journal of Allergy and Clinical Immunology, 84*(2), 159–162.

Schuman S. H., Banov C. H., Caldwell S. T., Horton P. M., & Kissam J. B. (1987). Impact of fire ant sting morbidity in South Carolina. *Journal of the South Carolina Medical Society, 83*(5), 249–252.

Stablein J. J., Lockey R. E., & Hensel A. E. (1985). Death from imported fire ant stings. *Immunology and Allergy Practice, 7*(7), 53–56.

Stafford C. T., Rhoades R. B., Thompson W. O., & Impson L. K. (1988). Survey of immunotherapy for imported fire ant sting allergy [abstract]. *Journal of Allergy and Clinical Immunology, 81*(1), 203.

Triplett F. R. (1973). Sensitivity to the imported fire ant: Successful treatment with immunotherapy. *Southern Medical Journal, 66*(4), 477–480.

Vinson S. B., & Sorensen A. A. (1986). *Imported fire ants: Life history and impact*. College Station: Texas A&M University Department of Entomology. Austin: Texas Department of Agriculture & Environmental Sciences.

Epidemiology of Imported Fire Ants
Morbidity/Mortality in South Carolina

Stanley H. Schuman, M.D., Dr. P.H.

A questionnaire with postage-paid return envelope was mailed to a total of 2,366 physicians in South Carolina whose practice was identified in the 1989-1990 Directory of the State Board of Medical Examiners as family practice, internal medicine, pediatrics, general practice, emergency medicine and occupational medicine. The physicians were asked to estimate the number of patients treated for red imported fire ants (RIFA) stings. A total of 902 physicians (40.6 percent) responded to the initial survey.

Table 1 lists 4,975 cases of RIFA stings treated by the respondents in 1990.[1] Cases were classified by location of treatment with those treated in physician offices representing 81 percent of the total. Sixteen percent of the children and adults were treated in emergency rooms while less than one percent of the cases were severe enough to require hospitalization. Anaphylaxis was experienced by 2.1 percent of the patients and 3.4 percent were referred to an allergist for desensitization. One adult was reported to have died from a fire ant sting. This case represents the first reported RIFA death in the state.

There were fewer reports of patients seeking medical attention for RIFA stings in 1990 as compared to a 1986 study.[2] This may be the result of a lower physician response rate, 42.3 percent versus 50.7 percent. The decrease in number of reports may also reflect more knowledgeable victims who may not be as quick to seek medical attention for fire ant stings as they were in their first encounters. The percentages of patients treated in the office, emergency room and in the hospital were similar between the two studies. A total of 104 patients (2.1 percent) were reported to have experienced anaphylaxis.

TABLE 1

PHYSICIAN REPORTS OF RED IMPORTED
FIRE ANT CASES IN SOUTH CAROLINA, 1990

Patient ge	Total	Treated in Office	Treated in E.R.	Hospital-ilized	Anaphy-laxis	Referred to Allergist	Deaths
<14	2,366	1,909	387	8	27	70	0
15	2,609	2,108	440	19	77	100	1
Total	4,975	4,107	827	27	104	170	1

A cross-sectional study[3] was conducted to determine the health-seeking behaviors of a group of patients stung by RIFA and the number of nursing referrals resulting in treatment. The entire population of board-certified allergists in Alabama, Georgia, and South Carolina (n=98) was sampled. A questionnaire was developed for the office nurses to use to collect information from allergy patients actually receiving fire ant injections (n=257). Descriptive statistics revealed that a delay of a month or more in seeking care of an allergist was experienced by 154 (56%) of patients who completed the questionnaire. The average delay was 1.8 years. The main source of referrals was a general practitioner or emergency room personnel.

1. Schuman SH and Caldwell ST: 1990 South Carolina physician survey of tick, spider and fire ant morbidity. J SC Med Assoc 87:429-432, 1991.

2. Schuman SH, Banov CH, Caldwell ST, Horton PM, Kissam JB: Impact of fire ant sting morbidity in South Carolina. J SC Med Assoc 83: 249-252, 1987.

3. Owens VJ et al: Underrecognition of Morbidity from Stings of the Red Imported Fire Ant in the Southeastern United States. Public Health Nursing, 7:88-95, 1990.

Fire Ant and Native Ant Population Responses after Amdro® Applications.

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ABSTRACT

Ten, red imported fire ant-infested pastures in five paired blocks were established on ranches of cooperating owners near Victoria, Texas. Bait-formulated Amdro was applied by air (1.25 - 1.5 lb. per acre) to one of each pair in April and October, 1991 and May 1992. Red imported fire ant and native ant populations were evaluated by establishing ten 0.1 ha circles and 20 pitfall traps in each plot. Mean population indices of RIFA's were significantly less after Amdro application. The numbers of foraging RIFA's collected in pitfall traps were reduced after insecticide application. Analysis of covariance did not detect significant affects on native ant population numbers.

INTRODUCTION

The impact of *Solenopsis invicta*, the red imported fire ant (RIFA), on native ant species has been investigated in Texas (Camilo & Phillips 1990), but few scientific studies have addressed the effects on birds, rodents, reptiles, and deer. A field study on properties of cooperating ranchers near Victoria, Texas, was initiated in spring 1991. This study involved cooperation among several agencies, including the USDA, the Texas Department of Agriculture, and the Departments of Agronomy, Horticulture, and Entomology and Range and Wildlife Management of Texas Tech University.

MATERIALS AND METHODS

Ten, 500-700-acre pastures in five paired blocks were established on ranches of cooperating owners near Victoria, Texas, in March 1991. Ten 0.1 ha circles were permanently established in each plot (pasture) and all red imported fire ant (RIFA) colonies within each circle were located and rated (Harlan et al. 1981 as modified by Lofgren & Williams 1982). The population index (PI) of each circle and the total PI of each plot were calculated. The PI's of each plot were measured before the first Amdro application and on eight other sample dates from April 1991 to June 1993. As an additional measure of RIFA and native arthropod activity, two transects each with 10 pitfall traps containing ethylene glycol were established in each plot. Pitfalls traps were left in place for 72 h during each sample period, and the collected arthropods were stored in 70% ethyl alcohol vials until identification and enumeration in the entomology laboratory at Texas Tech University.

Amdro (Ciba Corp.) was aerially applied to one pasture of each pair on April 15-19, 1991, October 20, 1991, and early May 1992 at the rates of 1.25 - 1.5 lb. per acre. Comparisons of population measurements before the first application of the bait-formulated insecticide were made with analysis of variance. Population parameters from Amdro-treated and untreated plots on subsequent sample dates were compared by analysis of covariance.

RESULTS AND DISCUSSION

Before insecticide application, no significant differences (Pr=0.05) in RIFA PI's, numbers of mounds, and numbers in pitfall traps were detected. Also, numbers of non-RIFA species and percent non-RIFA's in pitfall traps were not different (Figs 1-5). All indices tended to be higher in plots that were later treated with insecticide.

Mean RIFA population indices were significantly less in treated plots after each Amdro application (Fig. 1). Analysis of covariance considered the slightly higher (although not significant) pre-treatment population indices in plots that later received Amdro and detected differences on June 1, 1991, January 13, March 20, and June 24, 1992 (Pr-values: 0.07, 0.08, 0.05, and 0.06, respectively). Not unexpectedly, the number of RIFA mounds in 0.1 ha circles reflected population index data (Fig. 2).

The first Amdro application significantly reduced (Pr=0.07) the numbers of foraging RIFA's collected in pitfall traps (Fig. 3). The number of RIFA foragers remained low in treated plots throughout the study period and did not rebound during summer 1992. The failure of analysis of covariance to detect differences between treatments was probably caused by large variations among plots.

Other than the RIFA, 23 ant species were collected in untreated plot pitfall traps, and 20 species in Amdro-treated plots during the study period. The numbers of native ant species were apparently not significantly affected by treatments (Fig. 4). Native ants collected in pitfall traps usually made up less than 25% of collections (Fig. 5); however, data from summer 1992 and 1993 may indicate a resurgence of native ant populations in insecticide-treated plots. Additional samples will be collected in August 1993 to investigate this trend.

ACKNOWLEDGMENT

We appreciate the cooperation of the USDA, the Gulfport, Mississippi, laboratory, and the Texas Department of Agriculture, especially Mark Trostle and Andy Feild, in this study. Craig Allen and Scott Lutz, Texas Tech University Department of Range and Wildlife Management, were great co-workers, and special thanks to Entomology graduate students Rafael Atresino, Sergio Maldonado, and Amadou Ba for helping in the field and for processing and recording specimens in the laboratory.

REFERENCES CITED

Camilo, G. R., and S. A. Phillips, Jr. 1990. Evolution of ant communities in response to invasion by the fire ant *Solenopsis invicta*. p. 190-198. In Vander Meer, Robert K., Klaus Jaffe, and Aragua Cedeno (eds.). Applied Myrmecology: A World Perspective. Westview Press, Boulder.

Harlan, D. P., W. A. Banks, H. L. Collins, & C. E. Stringer. 1981. Large area tests of AC-217,300 bait for control of imported fire ants in Alabama, Louisiana, and Texas. Southwest. Entomol. 6: 150-157.

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

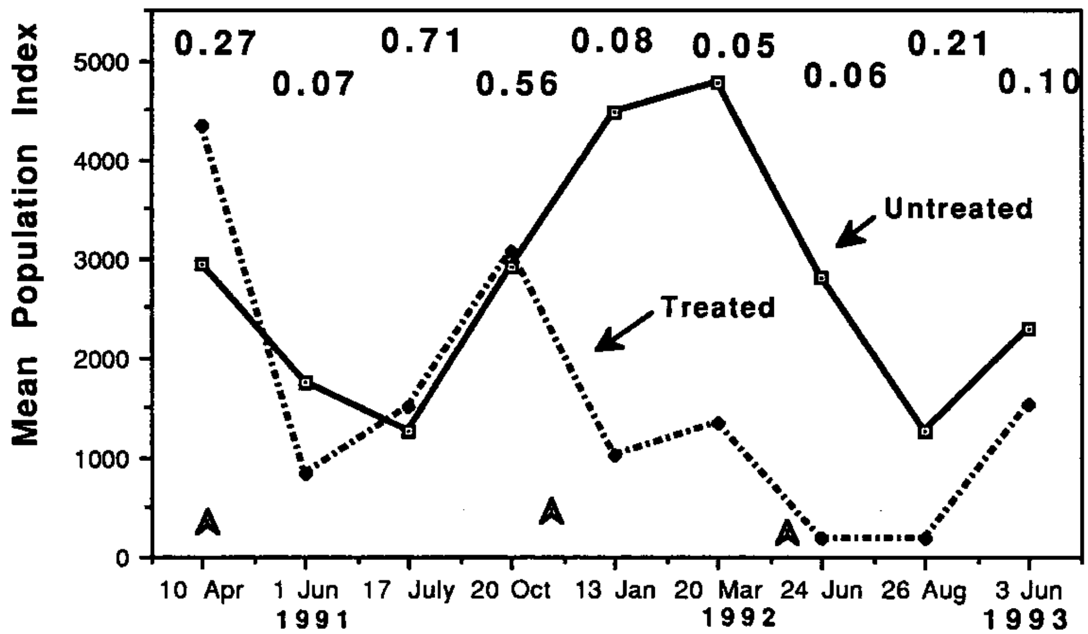

Fig. 1. RIFA Population Indices, Victoria, Texas. ANOVA and Analysis of Covariance Pr>F are listed near the top of the figure.

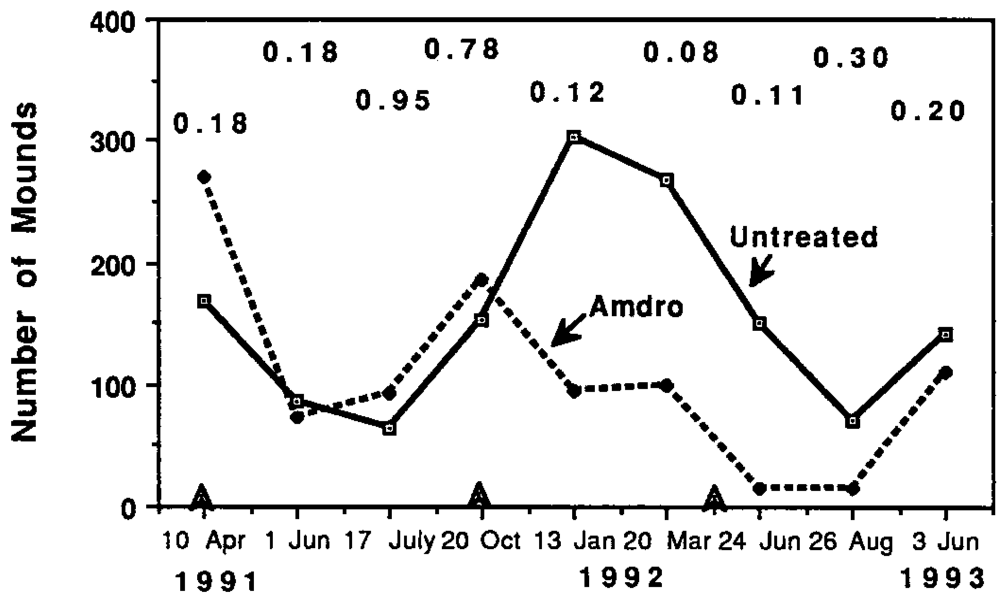

Fig. 2. Number of RIFA Mounds, Victoria, Texas.

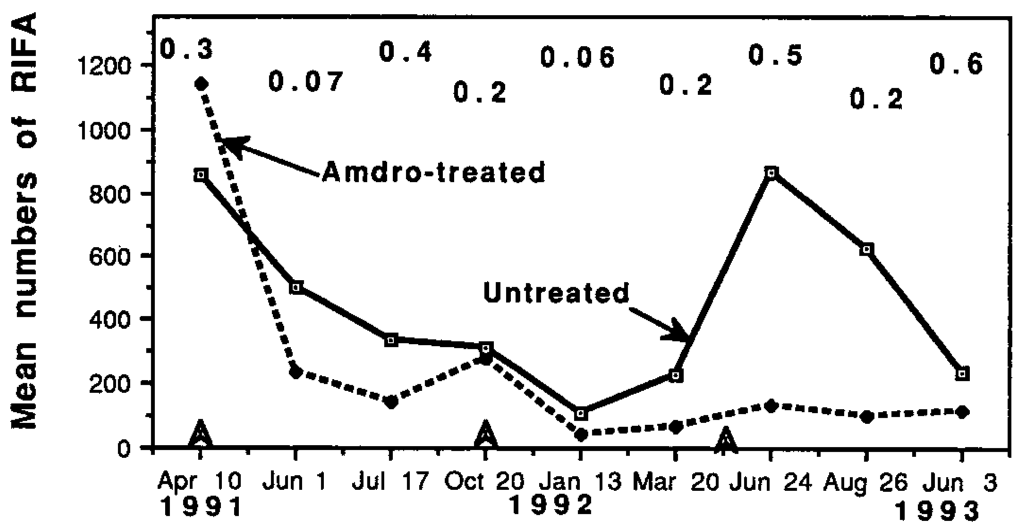

Fig. 3. Mean number of RIFA's in Pitfall Traps, Victoria, Texas.

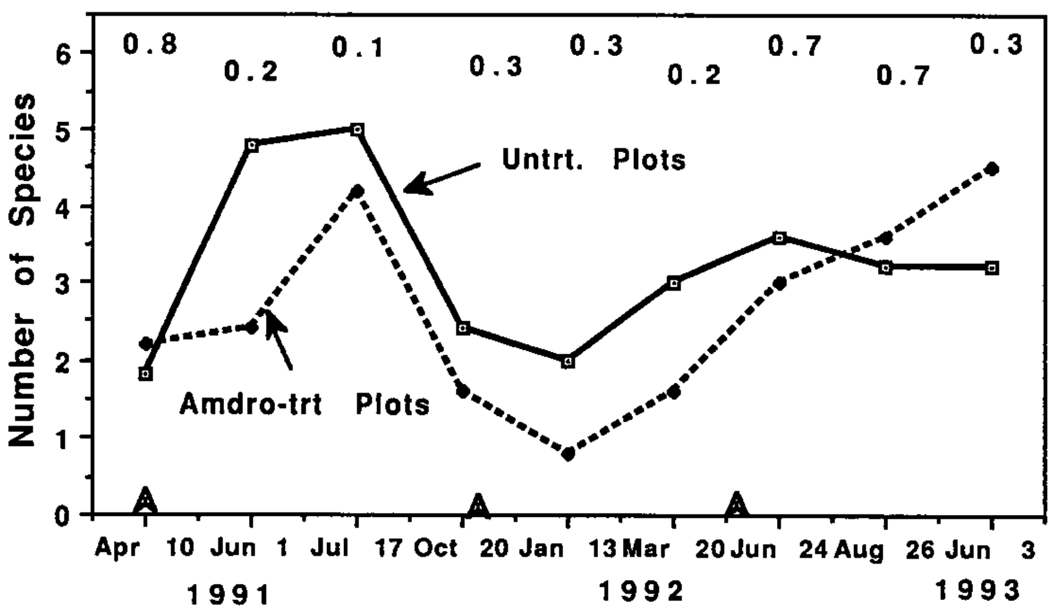

Fig. 4. Numbers of Non-RIFA Species Collected in Pitfall Traps, Victoria, Texas.

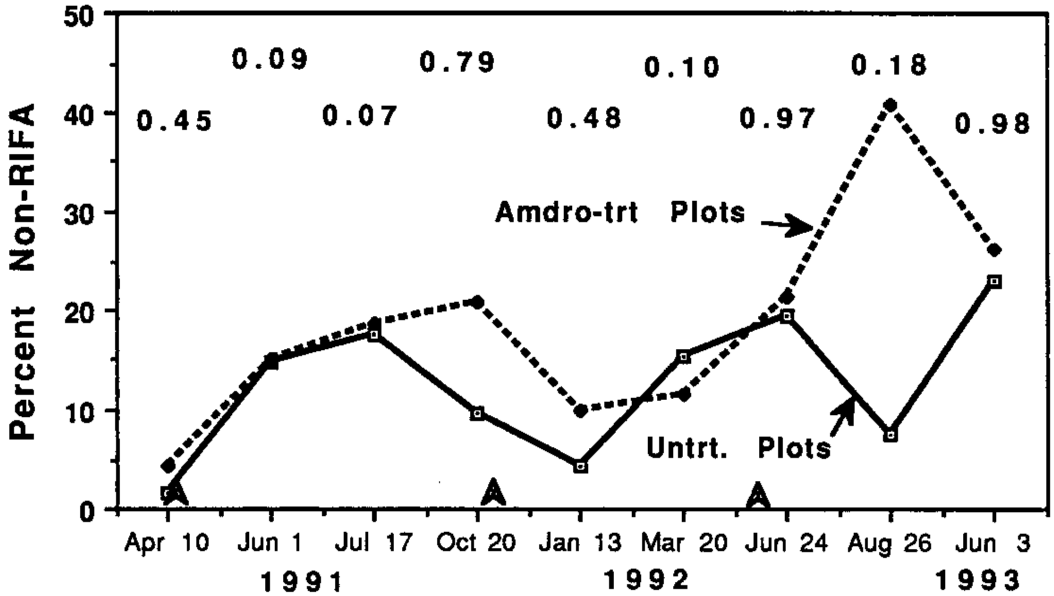

Fig. 5. Percent of Ants in Pitfall Collections That Were Not RIFA's, Victoria, Texas.

Red imported fire ant impacts on wildlife: an update

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In 1990 we initiated research investigating the response of selected wildlife species to red imported fire ant population reductions in the Texas Coastal Bend. A broad approach was utilized to determine which, and to what extent, wildlife species were impacted by fire ants. Several wildlife species/groups were chosen as representative of the wildlife community. These included white-tailed deer, northern bobwhite, loggerhead shrikes, small mammals, and reptiles and amphibians.

Ten 500 acre study areas in the Texas Coastal Bend were selected and paired. One randomly chosen member of each pair was treated with AMDRO© fire ant bait in April and October 1991, and May 1992 to reduce red imported fire ant populations. Red imported fire ant populations were effectively reduced during the treatments, especially during late spring/early summer of 1991 and 1992, the period of peak reproduction for most vertebrates in southern Texas.

Our first presentation concerned the response of northern bobwhite to fire ant population reductions. No differences were detected between bobwhite densities on treated and untreated areas in 1991, but higher densities were detected on treated areas in 1992. Furthermore, we demonstrated that bobwhite abundance in Texas was highly negatively correlated to years of fire ant infestation.

In our second presentation, we reported differences observed in white-tailed deer fawn recruitment on treated and untreated study areas. In both 1991 and 1992 significant differences were detected, and in both years fawn production was approximately twice as high on treated areas as compared to untreated areas.

Our third presentation presented data from our monitoring of non-game wildlife populations. Small mammal trapping was ineffectual due to red imported fire ant recruitment to small mammal baits, compounded by the lack of cool weather in the fall of 1992. Reptile and amphibian abundance, quantified with the use of pitfall-driftnet arrays, was not different between treated and untreated areas in 1991 or 1992, but in 1992 treated areas yielded 3 times more herpetofauna specimens, and statistical significance was approached. Loggerhead shrike abundance was monitored in 1992 only, and was significantly higher on treated areas.

We conclude that high density red imported fire ant infestations may negatively impact a number of wildlife populations, and that this impact is not necessarily via direct predation: indirect competition for food sources, especially with insectivorous species (e.g., many herps, loggerhead shrikes, northern bobwhite during their first 2 weeks of life and reproductive periods), and mortality due to exposure to fire ant venom (e.g., northern bobwhites) may also impact vertebrate populations.

Manuscripts thoroughly describing the methods and results of our research investigating red imported fire ant impacts on white-tailed deer fawn recruitment, northern bobwhite, and herpetofauna are presently in review. Other manuscripts are presently in preparation.

M-2794

Red Imported Fire Ant predation on Kestrels[1]

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Red Imported Fire Ants, Solenopsis invicta Buren, have been reported attacking a variety of birds, but not birds of prey. While conducting kestrel (sparrow hawk) life-history and population studies in North central Florida, JAS observed repeated instances of RIFA predation on kestrel chicks and pipping eggs which led to reproductive failure (Table 1).

In 1992, Bio-Tac® was applied to the outside-back of the wooden nest boxes, as a barrier to fire ant foraging. The test was concluded after the first breeding season, since the material was difficult to apply and no statistically significant relationship was detected between application and reproductive success. A preliminary test to determine the effectiveness of Amdro® to protect the hatching eggs and chicks was initiated during the second season period in 1992. The results were not statistically significant perhaps due to small sample size, but treated nest boxes appeared to have greater reproductive success. A full scale test with Amdro® was initiated in 1993 which is currently in progress and will be reported elsewhere.

[1] This article represents the results of research only. Mention of a proprietary product does not constitute an endorsement or recommendation for its use by the USDA or the University of Florida.

Table 1. Failed breeding attempts by American Kestrels in North Central Florida, 1991.

Circumstance	Number of breeding attempts
Mortality factors known	
Chicks killed by RIFA	11
Incubating females died in nest box	1
Chicks eaten by snake	1
Lighting struck nest box containing eggs	1
Eggs in nest box destroyed by shotgun	1
Mortality factors unknown	
Clutch disappeared	7
Eggs failed to hatch	5
Chicks disappeared	2
Either eggs of chicks disappeared	1
Total	30

ABSTRACT

Red imported fire ants are reported preying on kestrel (sparrow hawk) chicks and pipping eggs in nest boxes in North central Florida. In 1992, Bio-Tac® and Amdro® were used to protect the hatching eggs and chicks. The results were not statistically significant, but the Amdro® test was encouraging. Large-scale tests with Amdro® were initiated in the 1993 breeding season.

INTERPRETIVE SUMMARY

This is the first report of Red imported fire ants, Solenopsis invicta Buren, attacking a bird of prey, specifically the kestrel or sparrow hawk. RIFA were observed preying on kestrel chicks and pipping eggs in nest boxes in North-central Florida. In 1992, Bio-Tac® was applied to the outside-back of the wooden nest boxes, as a barrier to fire ant foraging. The test was terminated after the first breeding season, since the material was difficult to apply and the results were not statistically significant. A preliminary test to determine the effectiveness of Amdro® to protect the hatching eggs and chicks was initiated during the second season period in 1992. The results were not statistically significant, but the Amdro® test was encouraging. Large-scale tests with Amdro® were initiated in the 1993 breeding season.

EFFECT OF IMPORTED FIRE ANT PREDATION ON A POPULATION OF THE LEAST TERN - AN ENDANGERED SPECIES

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ABSTRACT

Populations of Least Tern (Sterna antillarum) hatchlings were compared between a site infested with red imported fire ant (Solenopsis invicta Buren) and a site in which S. invicta had been eliminated by application of fenoxycarb bait. Least Tern hatchlings had a seasonal mean mortality rate 26.7% higher in the infested site than in the control.

INTRODUCTION

Birds nesting on an open beach are faced with many hazards that endanger their nesting success. These threats are commonly associated with avian and mammalian predators, human intrusion and tidal washouts. However, harassment by ants must also be considered as a factor that can influence the reproductive success of ground-nesting birds. Littlefield (1987) suggested that ant harassment was the probable cause of death of a Sand Hill Crane (Grus canadensis tabida) chick at Malheur National Wildlife Refuge in Oregon, as well as the cause of nest abandonment. Jackson and Jackson (1985) reported the abandonment of a Killdeer (Charadrius vociferus) nest in east-central Mississippi due to an infestation by an unknown ant species at the pipping stage. Red imported fire ant (Solenopsis invicta Buren) (RIFA) predation on a number of avian species has been reported (Wilson and Silvy, 1988). As early as 1938, Solenopsis sp. (probably geminata [F.]) were reported killing Bobwhite (Colinus virginianus) (Travis 1938, 1943). Johnson (1961) documented RIFA feeding on the eggs of Bobwhite. Sikes and Arnold (1986) observed predation on Cliff Swallow (Hirundo pyrrhonata) nestlings in east-central Texas. Ridelhuber (1982) found evidence of RIFA predation on the chicks and pipped eggs of the Wood Duck (Aix sponsa) and the Roseate Spoonbill (Ajaia ajaja). Other avian species destroyed include the Barn Swallow (Hirundo rustica) [Kroll et al. 1973], the Mississippi Kite (Ictinia mississippiensis) [Parke 1977] and the Black-bellied Whistling Duck (Dendrocygna autumnalis) [(Delnicki and Bolen 1977].

Ant harassment and potential ant predation was noted in 1988 in a colony of Least Terns (Sterna antillarum) nesting along a large expanse of beach in Gulfport, Harrison County, Mississippi. During the 1988 nesting season, numerous chicks, ranging in developmental stages from hatchlings to fledglings, were observed with ants and or ant stings on their bodies. These ants, though not positively identified at the time, were most likely RIFA. A subsequent survey showed only colonies of RIFA in the immediate area of the nesting grounds. RIFA workers were typically found clinging to the feet of the chicks or to the areas around the eyes. A total of 22 chicks were found with ants on their bodies. Some chicks had as few as one ant on their body while others were completely covered with ants. Sixteen of these chicks were less than 10 days old and nine were less than one week of age. Younger, less mobile chicks would seem to be most susceptible to attack by RIFA workers. Twenty-six chicks were found with ant stings; these wounds usually resulted in swelling of the feet and the area around the eyes. A few chicks had holes through the webs between their toes. In one instance, a chick's foot was so badly damaged by RIFA stings that it was deformed and appeared permanently crippled. Additionally, seven nests were found abandoned (with eggs). Five dead pipped eggs and 18 dead chicks infested with RIFA workers were located. Although nest abandonment and chick mortality were not directly observed, these data suggested the probable culprits were foraging RIFA workers. Previous studies by other researchers have shown similar patterns of predation (Stoddard 1932, Travis 1938, Kroll et al. 1973, Parker 1977, Ridlehuber 1982).

MATERIALS AND METHODS

A single application of fenoxycarb fire ant bait, (Logic® Ciba-Geigy Corp., Greensboro, NC) was made to a 3.83 ha nesting site on 25 September 1990 at a rate of 1.68 kg/ha. Population density surveys of RIFA were carried out prior to treatment within both the treated site and the adjacent untreated (2.65 ha) check site using the method described by Lofgren and Williams (1982). Subsequent surveys were made monthly to determine the efficacy of the treatment (Table 1). During the bird nesting season, surveys were conducted on both the RIFA populations and the populations of 1-3 day old chicks. Chicks were examined for signs of ant predation and mortality factors for dead birds were determined. Beginning the first week in May 1991, visual surveys of the Least Tern population were conducted at both the treated and the untreated site. Counts were made of active nesting sites, numbers of eggs, pipped eggs and chicks and mortality. Percent morality was determined by survey of 1-3 day old chicks observed in or within 0.3 m of a nest along a transect line through the center of the site.

Table 1. Comparative Populations of Red Imported Fire Ants after Treatment with Logic Fire Ant Bait.

Treatment	Mean Pretreatment Pop. index	Percent Change in Pretreatment Population index in months posttreatment (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated	296	-77	-86	-87	-90	-98	-100	-100	-100
Untreated	277	-40	-28	-31	- 1	+28	+40	+36	+22

RESULTS AND DISCUSSION

Although nests were excavated beginning in early April, no eggs were observed until the first week in May. Eggs laid during this early period were heavily destroyed by Fish Crows (Corvus ossifragus). By week 4 in late May, egg numbers had declined precipitously (Fig. 1). Beginning in June (week 5), egg numbers began to increase once again (this also coincided with a substantial increase in growth of beach grasses and forbes perhaps supplying camouflage for the nests). The first chicks began to appear in week 5 as well. No chick mortality was noted until week 7. Comparative mortalities betwixt the treated and untreated sites showed a consistent pattern (Fig. 2). The highest mortality at the treated site occurred in weeks 9 and 10. Two strong storms passed over the area during this time period. Mortality at the untreated site during week 9 was only slightly higher than the previous two weeks. The storms may have restricted the ability of RIFA workers to effectively forage. Mortality levels peaked at week 11 and had begun to drop at week 12 at the untreated site. At the treated site, mortality levels began dropping around week 10.

The significant factor involved in the mortality of Least Tern eggs and chicks are Fish Crows. Mobbing is the normal defensive response of Least Terns to intruders, scavengers and predators. Least Terns will harass an intruder and, through shear numbers, drive the invader from the area. At both study sites, there were far too few adults to successfully defend the nesting areas. During one survey, a Fish Crow was observed entering the nesting area and devouring an egg while being molested by only two adult Least Terns.

Another important factor was the intrusion of man. Even though the areas are clearly marked as Least Tern nesting sites, numerous incursions were made by people throughout the nesting season. On one occasion, 18 separate sets of footprints were observed passing within 10 feet of a 4' x 8' warning sign and into the nesting grounds. During the study, five nests were found trampled; 8 eggs and two chicks were destroyed. Nests that are disturbed frequently are abandoned by the parent birds. Young birds forced from their nests by intruders are often attacked by adult Least Terns.

Fire ants were a third causative agent in Least Tern mortality. Red imported fire ants made a significant impact upon Least Tern chicks (Fig. 2). Overall mean differences in mortality of Least Tern chicks in the control site when compared with the treated site averaged 26.7% higher throughout the nesting season.

Although there is little that can be done to prevent attacks by Rain Crows or other predators, RIFA can be controlled. A judicious application of fenoxycarb (an insect growth regulator) can significantly lower numbers of RIFA eliminating an unneeded and unwanted pressure on the survival of this species.

LITERATURE CITED

Bent, A.C. 1921. Life histories of North American gulls and terns. U.S. Natl. Mus. Bull. 113. 345 p.

Delnicki, D.E. & E.G. Bolen. 1977. Use of Black-bellied Whistling Duck nest sites by other species. Southwest. Nat. 22: 275-277.

Downing, R.L. 1973. A preliminary nesting survey of Least Terns and Black Skimmers in the East. Am. Birds 27: 946-950.

Jackson, B.J.S. & J.A. Jackson. 1985. Killdeer nest abandonment caused by ants. Miss. Kite 15: 5-6.

Jackson, J.A. & B.J.S. Jackson. 1985. Status, dispersion, and population changes of the Least Tern in coastal Mississippi. Colonial Waterbirds 8: 54-62.

Johnson, A.S. 1961. Antagonistic relationships between ants and wildlife, with special reference to imported fire ants and bobwhite quail in the southeast. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 15:88-107.

Kroll, J.C., K.A. Arnold, & R.F. Gotic. 1973. An observation of predation by native fire ants on nestling barn swallows. The Wilson Bull. 85: 478-479.

Littlefield, C.D. 1987. Probable Sand Hill Crane mortality resulting from ant harassment. Murrelet. 66: 107-108.

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

Parker, J.W. 1977. Mortality of nestling Mississippi Kites by ants. The Wilson Bull. 89: 176.

Ridlehuber, K.T. 1982. Fire ant predation on Wood Duck ducklings and pipped eggs. Southwest. Nat. 27: 220.

Stoddard, H.L. 1932-38. Annual reports of the Cooperative Quail Study.

Sikes, P.J. & K.A. Arnold. 1986. Red imported fire ant (Solenopsis invicta) predation on cliff swallow (Hirundo pyrrhonata) nestlings in East-Central Texas. Southwest. Nat. 31: 105-106.

Travis, B.V. 1938. The fire ant (Solenopsis sp.) as a pest of quail. J. Econ. Entomol. 31: 649-652.

Travis, B.V. 1943. Notes on the biology of the fire ant, Solenopsis geminata (F.) in Florida and Georgia. Fla. Entomol. 24: 15-22.

Wilson, D.E. & N. J. Silvy. 1988. Impact of the imported fire ant on birds. IN: Proc. Governor's Conference, The Imported Fire Ant: Assessment and Recommendations, Oct. 24-25. Sportsmen Conservationists of Texas, Austin, TX pp. 70-74.

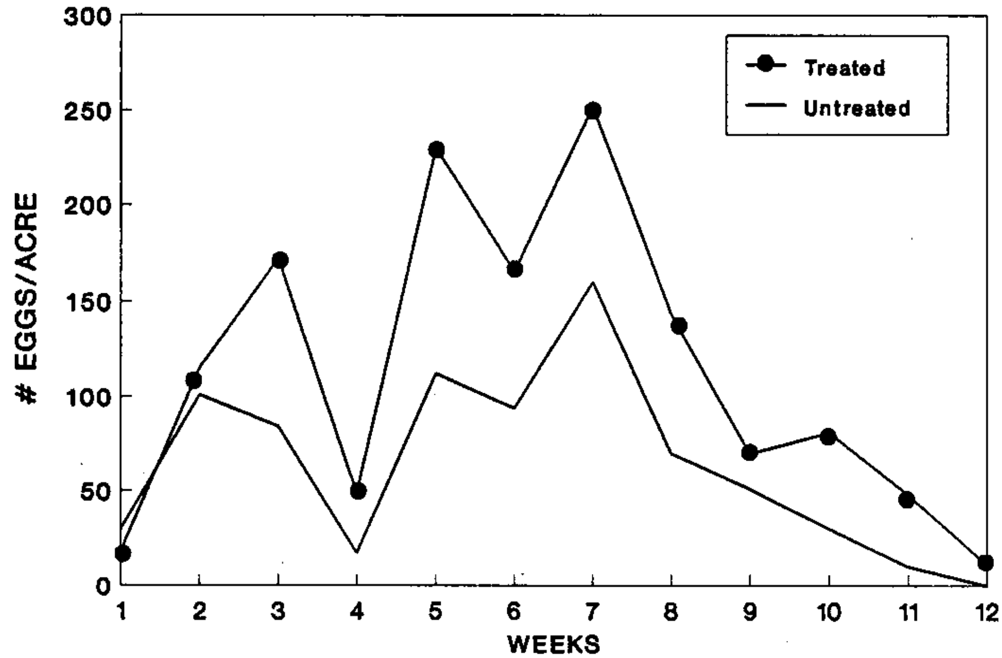

FIG. 1. Number of Least Tern eggs per acre.

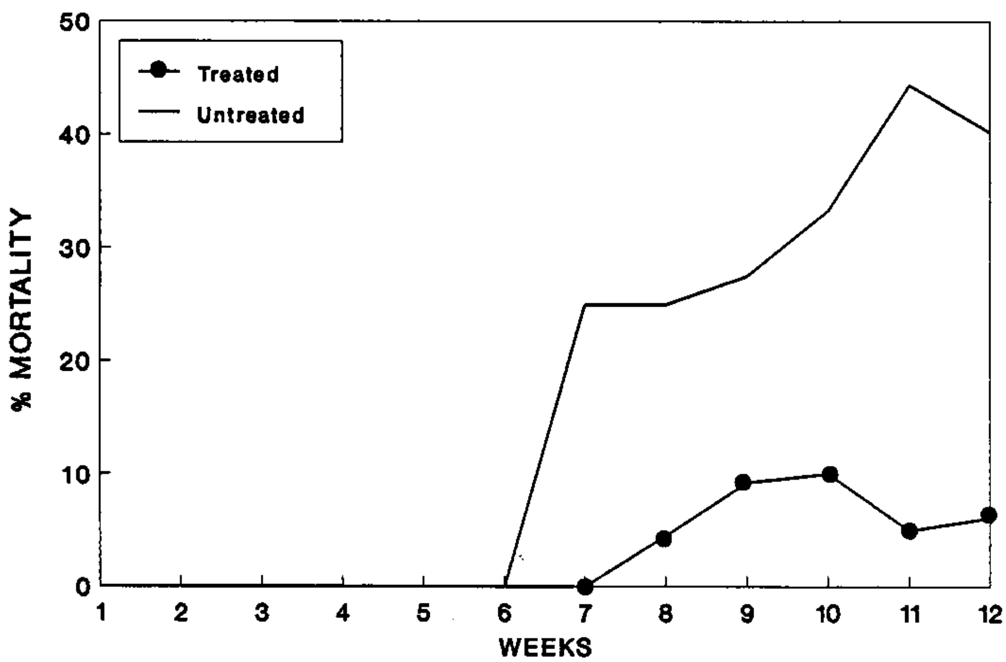

FIG. 2. Comparative percent mortality of 1-3 day old Least Tern chicks

IMPACT OF THE RED IMPORTED FIRE ANT ON SELECT COMPONENTS OF THE TEXAS COASTAL PRAIRIE

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This summary of our on-going studies are focused on the impact of the red imported fire ant, *Solenopsis invicta* Buren, on three basic components of the ecosystem: seeds, insects, and small mammals. First we examined the ants impact on seeds which not only serve as food for insects and small mammals, but their survival and distribution may be affected by ants. The resulting distribution of plants or loss of species which serve as important food resources for insects and small mammals may also be impacted by ants.

The seed study was conducted in the laboratory to determine which seeds were: 1) at risk of being predated on, 2) those that were resistant, and 3) those that were dispersed. Each replication consisted of 25 seeds placed in a dish or depression (3 x 5 cm) and randomly exposed to ants in an area in which an ant colony could forage into via a paper bridge. After 24 hr the number of seeds removed and number of seeds remaining that were damaged, or moved and damaged was determined. Of the 73 species of seeds examined, 53.7% of the species sustained damage (over 50%). Most of the damaged seeds were also moved, often to the nest. Thirty three percent of the species of seed studied rarely sustained more than 2% damage and less than 2% were moved, these were considered resistant (Table 1). Thirteen percent of the species studied were readily moved (over 95% of the individual seeds), but suffered less than 2% damage and were considered to be susceptible to being dispersed (Table 2). Although over 50.7% of the species of seed studied were moved and damaged, only six species (Table 3) or 8.2% suffered damage to over 96% of their seeds and were considered to be very susceptible to fire ant predation. The results of these laboratory studies suggest that the seeds of many plants are susceptible to ant predation, although a few are resistant and a few are readily dispersed.

The second component of our ecosystems study has been an examination of the impact of *S. invicta* on the insect fauna which compete with small mammals for food or may themselves serve as food. Our approach has been to examine the impact of fire ants on insect decomposers for several reasons. One is that the insect population has a beginning and end, there are manageable numbers, and comparisons between fire ant exposed and protected situations can be easily manipulated without the use of pesticides or locating infested or uninfested areas that are otherwise identical.

Two studies have been conducted. The first examined the impact of fire ants on decomposing plant material. Although published (Vinson 1991, Environ. Entomol. 20: 98), it is presented here as a comparison. In this study the decomposing plant material (a peach) was protected from fire ants for 3, 6, or 9 days while in companion studies fire ants were provided access to the decomposing peach for the last three days of the study. As shown in Table 4, when the decomposing material had been exposed to fire ants for three days there was a drastic reduction in the number of decomposers and the diversity compared to the ant protected treatment. The resource was basically taken over by fire ants at the expense of the other species.

More recent studies used carrion (a chicken) as the decomposing resource and the results were slightly different. First, the resource was larger, second it decomposed slower, and third, the organisms involved were different. However, as found with the plant decomposers, the numbers of adults that could be collected were lower on the carrion exposed to fire ants (Table 5). In contrast, the number of larvae collected although lower early, increased after nine days in carrion exposed to fire ants (Table 5). Although the reasons for these differences are not clear, one possibility is resource size which is under study, but other factors may be the different nutritional value of the decomposing resource or differences in the feeding behavior of the insects on the two resources. Overall fire ants appear to negatively impact the population levels and diversity of other insects.

The third area of investigation has focused on small mammals. The first study was conducted during a drought period (1989-1990) in South Texas (Killion, M.S. Thesis, Texas A&M, December 1992), that consisted of 2, 120 x 96 m rectangular adjoined plots. Half of each plot was maintained as a low ant plot by individual mound treatment and careful use of insecticides. Following treatment, fire ant populations were significantly lower on the treated plot. Small mammals were captured, marked, and recaptured every month on a gird of traps placed 10 m apart on treated and untreated plots. In 1989-1990 the major species captured was the Northern pygmy mouse, (Table 6). No significant difference in rodent captures were detected prior to ant removal, but after treatment a significantly greater number of *Baiomys taylori* ($G = 5.584$, $\underline{P} < 0.05$) were captured on the low ant plot. In 1991-1992 the small mammal population increased (Table 6). While more animals were captured on the treated plot, the differences, were not significant.

During the 1989-1990 studies a few nests of the Northern Pygmy mouse were observed and we examined the hypothesis that the recruitment of ants to their burrow entrances were identical to randomly chosen points. Using bait cards, the time to recruit five foragers was determined from June through October at the burrow entrance (5.38 $\pm$ 0.57 minutes), which was significantly slower than recruitment at random locations (4.35 $\pm$ 0.25 minutes).

These results suggested that some small mammals could detect ant activity and locate in areas of low activity. To examine this possibility further, we conducted a more intensive trapping using 20 m^2 subplots (traps were 3.3 meters apart) in both the treated and tje untreated larger plot and we compared the trap catch per unit effort between the treated and untreated plots for both grids. The small plots were placed in the treated plot using a randomly chosen large plot trap site as the center. The small plots in the untreated plot were also similarly chosen, but the center of the plot was moved to the nearest fire ant mound. No difference in the trap catch per unit effort for *B. taylori* on the large plot was found ($t = 0.44$, $df = 12$), but a significant difference was found on the small plot ($t = 3.59$, $df = 4$, $P = 0.023$), fewer animals being trapped on the untreated plot. The results suggest that small mammals may avoid areas of high ant activity which is assumed to occur near a fire ant mound. However, the affect may only be manifested in local areas and impact the population when in stress.

Lastly, we wanted to examine the impact of fire ants on nesting activity of precocial and altricial species. These studies used pregnant female cotton rats, which were placed in nest boxes that were designed so that we could allow fire ants to forage into the nest box and the small mammal could leave to nest in an ant-free identical box. We were only able to examine the precocial hispid cotton rat, *Sigmodon hispidus*. We found that 87% of the and third, the organisms involved were different. However, as found with the plant decomposers, the numbers of adults that could be collected were lower on the carrion exposed to fire ants (Table 5). In contrast, the number of larvae collected although lower early, increased after nine days in carrion exposed to fire ants (Table 5). Although the reasons for these differences are not clear, one possibility is resource size which is under study, but other factors may be the different nutritional value of the decomposing resource or differences in the feeding behavior of the insects on the two resources. Overall fire ants appear to negatively impact the population levels and diversity of other insects.

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The results of these studies suggest that fire ants are impacting the ecosystem in many ways, but the impact is complex. Seeds may be an important component of the diet of fire ants, but only some seeds are readily predated on and others are resistant or dispersed by fire ants. The results suggest ants could alter plant assemblages. Insects which are important food for fire ants are also impacted, but the impact may be influenced by the nature and size of the resource supporting the insect population. Small mammals are also being impacted, but the impact may be greater during nesting periods and may depend on the animal's reproductive strategy. Further, the differences may depend on the distribution of the fire ant's activity and the ability of small mammals to seek areas of low ant activity as a refuge from ant harassment.

It is clear that fire ants are having an impact on the ecosystem, but how the ecosystem will ultimately change to accommodate this species is unknown. It is certainly complex and still evolving.

Table 1. A list of species of seed in which less than 2% were moved or damaged by *Solenopsis invicta* and were considered resistant.

Rhus albida, Sumac (Anacardiaceae)
Ilex cassine, Yaupon (Aquifoliacae)
Spinacia aleracea, Spinach (Chenopodiaceae)
Tagetes erecta, Marigold (Compositae)
Brassica ropa, Turnip (Cruceferae)
Cucurbita pepo, Squash (Cucurbitaceae)
Glycine soja, Soybean (Leguminaceae)
Lupinus texensis, Blue Bonnet (Leguminaceae)
Phaseolus mungo, Mung bean (Legumenaceae)
Vigna sinensis, Pink-eye Low Pea (Legumenaceae)
Vicia crocca, Vetch (Legumenaceae)
Gossypium herbacium, Cotton (Malvaceae)
Rosa woodsii, Wild Rose (Rosaceae)
Petunia mytaginiflora, Petunia (Solanaceae)

Table 2. Species of seed which were readily moved (over 95%) but suffered less than 2% damage by *Solenopsis invita* and were considered dispersed.

Zinnia panciflora, Zinnia (Compositae)
Geranium columbinum, Cranes Bill (Geraniaceae)
Orysa sativa, Rice (Graminae)
Albium cepa, Onion (Liliaceae)
Cassia chamaecrista, Partridge Pea (Leguminaceae)
Solanum plycanthum, Night Shade (Solanacea)

Table 3. Species of seed that were severely damaged by *Solenopsis invita*.

Alyssum maritimum, Alyssum (Cruciferae)
Lepidium virginicum, Pepper Grass (Cruciferae)
Aguilegia canadensis, Columbine (Ranunculaceae)
Eragrostis lehmanii, Lovegrass (Graminae)
Oryanum vulgare, Oregano (Labiatae)
Sesamum orientale, Sesame (Pedaliaceae)

Table 4. Mean number of insects collected from a rotting peach exposed or not to fire ants at three intervals during decomposition.

Insects	IFA Protected			IFA Exposed (last 3 days)		
	3	6	9	3	6	9
Diptera adults	56.0	7.6	0.6	0.2	0.0	0.2
Diptera larvae	173.0	4813.6	923.2	0.0	816.8	80.2
Coleoptera adults	34.0	48.6	38.8	11.8	3.8	10.8
Coleoptera larvae	0.6	2469.6	1561.8	0.0	467.4	192.0
Hymenoptera						
a) Parasitic adults	2.0	7.6	2.8	0.0	0.0	0.0
b) Fire ant workers	0.0	1.4	0.8	1732.4	2175.8	598.0

Adapted from Vinson, J. Econ. Entomol. (1991).

Table 5. The impact of *Solenopsis invicta* on the numbers of insects collected after the colonization of carrion at five intervals over a 15-day period.

Insects	IFA Protected					IFA Exposed				
	3	6	9	12	15	3	6	9	12	15
Adult Diptera	35	50	45	31	19	14	23	12	3	14
Adult Coleoptera	9	10	46	39	33	4	7	4	13	5
Larvae (Diptera + Coleoptera) /100	0	12	83	22	3	0	7	84	57	14

Table 6. Numbers of small mammal collected from *Solenopsis invicta* infested plots compared to plots with significantly reduced fire ant numbers maintained for four years.

Mammal Species	1989-1990		1991-1992	
	PLUS IFA	MINUS IFA	PLUS IFA	MINUS IFA
B. taylori	98	135	411	449
S. hispidus	0	3	37	48
R. fulvescens	10	16	40	51
P. lencopus	4	5	112	105
Total	112	159	600	653

SRIEG–34 (Imported Fire Ants): Should it be –IEG or SERA?

T. J. Helms, Administrative Advisor,
MS Agricultural and Forestry Experiment Station

This brief presentation was scheduled for several reasons. First, I represent the Southern Association of Agricultural Experiment Station Directors, made up by the Agricultural Experiment Station Directors of the 13 contiguous southern states and the territories of Puerto Rico and the Virgin Islands, and includes liaison representatives from the USDA–ARS and –CSRS. Secondly, many, perhaps the majority, of you are unaware that your group exists as an Information Exchange Group (IEG) authorized by this Association under the designation, SRIEG–34 (Imported Fire Ants). Thus, you should understand the "what, why and how" your group originated and gain an understanding that my aim is not to interfere, but to facilitate the functions of this group. Third, except for certain administrative details, an explanation of how an IEG is to function is unnecessary given your obvious success in organizing your annual conferences. However, through no fault of your own, you have not had an opportunity to communicate the results of your efforts with the Association. Finally, it is time to initiate discussion about the future of this IEG.

SRIEG–34 had its origin during the late 1980's from the efforts of some of you and those of a benefactor among the Southern Experiment Station Directors who proposed its establishment following two or more failed attempts to organize a regional research project. Again, because of your vigor and desire to communicate with each other in this symposium or conference setting, a series of very successful annual conferences have been organized since the inception of SRIEG–34. I should also like to add that you deserve only praise for your efforts.

IEG's provide a mechanism for administrative recognition and approval for groups to meet periodically to discuss and coordinate research involving related, but not interdependent activities in individual states or cooperating agencies. (Other type of information exchange groups exist; for example, the Southern Regional Association of Experiment Station and Extension Directors recently established joint SERA–IEG's, that is, Southern Extension and Research Activity– Information Exchange Groups.) As your Administrative Advisor, I am expected to attend your annual conference and serve as your liaison with the Association. In addition, I must distribute an "authorization" for the meeting in advance of the event and your Chairman or Secretary should prepare a brief, one-to-two page annual report for my transmittal to the Association Chairman and the Executive Director.

What lies ahead? SRIEG–34 is scheduled to terminate in 1995. Therefore, it is incumbent upon you to make decisions about your future. ....do you want to maintain your group as currently organized? ... would it be beneficial for your group to be organized as a SERA–IEG? .... if your goal is to conduct research on a regional basis, do you wish to attempt, once again, to establish yourself as a regional project? .... do you want to request continuation as a group under authorization of the Southern Regional Association of Experiment Station Directors? I genuinely want to and will represent your interests, but I must learn from you before January 1994 if, then if so, how you want to be organized.

APPENDIX I

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