Interrelationship of Ants and the Sugarcane Borer in Florida Sugarcane Fields[1,2]

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ABSTRACT

Environ. Entomol. 10: 415–418 (1981)

The interrelationship between 4 species of ants and the sugarcane borer, *Diatrea saccharalis* F., was studied over a 6-month period in Florida. Ants were collected monthly from May to October, and numbers were compared with those of sugarcane borers collected bi-weekly during the same period. The data showed a slight increase in sugarcane borer damage in the fields treated with mirex (dodecacloroctahydro-1,3,4-metheno-1*H*-cyclobuta[*cd*]pentalene) to reduce populations of the red imported fire ant, *Solenopsis invicta* Buren. Pearson's correlation cofficients were positive between the sugarcane borer and the red imported fire ant but negative between the sugarcane borer and *Pheidole dentata* Mayr and *P. floridana* Emery. These data suggest that the reduction of all ant species with mirex bait resulted in increased damage from the sugarcane borer and that a multiple predator ant complex is more effective than one dominated by *S. invicta*.

Carroll (1970) first reported the appearance of the *Solenopsis invicta* Buren (=*Solenopsis saevissima richteri* Forel), in sugarcane fields in Florida. A single colony, located in Glades County, was observed foraging in a field heavily infested with the *Diatrea saccharalis* (F.). Records of the Florida Department of Agriculture's Division of Plant Industry indicate that the first infestation of *S. invicta* in Hendry County was reported from the Devils Garden area on Nov. 18, 1973. The earliest infestation in Palm Beach County was reported on Mar. 20, 1973, from the western fringe of the city of West Palm Beach. From these records it appears that infestation of the sugarcane fields by *S. invicta* progressed east in the direction of the prevailing winds. More recently, Prewitt et al. (1978) reported a massive invasion of Florida sugarcane fields by *S. invicta* and its impact on (human) workers in the fields. Our observations in 1978 (unpublished data) showed that sugarcane fields throughout the western area of Palm Beach County were heavily infested with *S. invicta*. The most heavily infested fields were south and west of US highway 27. The infestation became progressively lighter farther from the highway, although some isolated fields supported very heavy infestations of noncontiguous populations. Some fields infested with *S. invicta* appeared to support only a limited complex of other species of sugarcane-infesting ants.

Charpentier et al. (1967) indicated that *S. invicta* was one of the primary predators of *D. saccharalis* in Louisiana. They reported that a sugarcane field with a history of light *D. saccharalis* infestations (3%) yielded 1259 ants in pitfall traps compared to 611 ants in pitfall traps froma field with a high infestation.

Reagan et al. (1972) reported that infestations of *D. saccharalis* in 2 fields and subsequent damage to sugarcane increased 53% and 69%, respectively, after one application of mirex for reduction of ant populations. They treated experimental plots with mirex bait (0.3%) at the high rate of 6.73 kg/ha. Treatment with mirex at this rate also resulted in a high mortality of arthropod predators and crickets in the treated areas; however, it did not significantly reduce populations of spiders. Statistical analysis of the data indicated significantly greater damage by *D. saccharalis* in plots treated with mirex.

Long et al. (1958) similarly reported a drastic increase in *D. saccharalis* populations and a consequent increase in sugarcane damage after broadcast application of heptachlor granules for control of *S. invicta*. The authors therefore assumed that this treatment suppressed populations of natural enemies of *D. saccharalis* more effectively than it suppressed populations of *D. saccharalis* itself. Carroll (1970) reported that *Pheidole dentata* Mayr and *P. floridana* Emery were the most abundant species of ants in the Florida sugarcane fields and were the most avid predators on the eggs and 1st- and 2nd-instar larvae of *D. saccharalis*.

The purpose of this study was to compare the interrelationship of populations of ants with those of *D. saccharalis* in Florida sugarcane fields that had or had not been treated with mirex bait.

Materials and Methods

The study area consisted of 2 sets of paired fields, owned by the U.S. Sugar Corporation, that varied in size from 5.80 to 6.92 ha. One field of each pair was treated on May 31, 1978 with mirex bait (0.1%) for reduction of *S. invicta* populations. The bait was applied at the rate of ca. 0.27 kg/ha with a modified Gandy® applicator mounted on a tractor.

Twenty-five paired bait index stations for the collection of ants were established in each field with 2 baits (honey-agar and meat) at each station. Pretreatment bait index collections were made on May 25 and June 1 to establish base line data for each field. These collections are listed as June (Table 1). One posttreatment bait index collection was made each month from July through October.

Diatrea saccharalis populations were monitored every other week by personnel of the USDA Sugarcane Research Laboratory, SEA/AR, Canal Point, FL. Ten stalks of sugarcane were examined at each station, and the number of adults, larvae and cast skins of *D. sac-*

[1] Hymenoptera: Formicidae. Lepidoptera: Pyralididae (Phyralididae).
[2] This paper reports the results of research only. Mention of a pesticide in this paper does not constitute a recommendation for use by the USDA nor does it imply registration under FIFRA as amended. Received for publication: June 10, 1980.
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Table 1.—Collections of *Solenopsis invicta*, *S. geminata*, *Pheidole* spp., and *Diatreae saccharalis* trapped in sugarcane fields in Florida.

Species	No. of insects trapped and no. of positive stations ( )				
	June	July	Aug	Sept	Oct
		Untreated fields			
Solenopsis invicta	4396(22)	1445(12)	3759(18)	1571(16)	1097(6)
Solenopsis geminata	3441(20)	1378(6)	1671(4)	1110(4)	3584(9)
Pheidole spp.	1684(31)	4851(38)	3488(35)	3890(36)	1650(32)
Diatreae saccharalis	32(17)	68(15)	29(16)	95(37)	428(35)
		Treated fields[a]			
Solenopsis invicta	6575(21)	851(22)	1333(24)	4376(33)	8162(28)
Solenopsis geminata	4127(21)	21(3)	11(1)	92(3)	114(2)
Pheidole spp.	1808(23)	162(9)	238(20)	1086(21)	853(18)
Diatreae saccharalis	48(21)	62(16)	106(27)	192(42)	880(46)

[a] Treatment applied immediately following June bait index collection.

charalis were tabulated for each stalk. Samples were collected within a 3-m radius of each bait index station. Collections and observations of *D. saccharalis* activity extended from mid-May to late October, 1978. Final observations were made on November 30, 1978; at this time only the percentage damaged joints for each of the 4 fields were noted.

Estimates of correlations between *D. saccharalis* and ant populations were derived with Pearson's parametric correlation analysis. Comparisons were made between populations of *D. saccharalis*, *S. invicta*, *S. geminata*, *P. dentata*, and *P. floridana*. These 4 species of ants represented >98% of the total number of ants collected. For analysis, data for the two pheidolids were treated as an aggregate.

Results

Specimens of ants collected from the bait index stations included representatives of 7 genera and 9 species for an aggregate total of 69,699 ants. Those collected and percentage of collection were as follows: *S. invicta* (47.88%), *S. geminata* (22.37%) *P. floridana* (16.61%), *P. dentata* (11.87%), *Conomyrma flavopecta* (0.05%), *Paratrechina bourbonica* (1.07%), *Strumigenys membranifera* (<0.01%), *Odontomachus haemotodis* (<0.01), and *Diplorhoptrum* sp. (0.13%).

For the purposes of our study, we have considered only the 4 most abundant species, and of these 4, we have combined results of the 2 *Pheidole* spp. The data from the collections are presented in Table 1.

In the fields treated with mirex, populations of all of the species of ants declined dramatically within one month; this decrease ranged from 87% with *S. invicta* to 99% with *S. geminata*. Populations of the latter species remainned low throughout the 4-month posttreatment period; however the *Pheidole* spp. slowly increased in numbers to a level of about 50% of that prior to the mirex tratment. *Solenopsis invicta* showed the greatest capability of resurgence, and by the end of the study period our collections of this species were greater than those prior to the mirex treatment. The same general population trends were noted for the different ant species when only the numbers of bait stations at which ants were collected was considered.

In the untreated fields, *S. invicta* was the most abundant initially; however, the *Pheidole* spp. were collected at the greatest number of bait stations. Subsequent to the initial collections, however, the population of *S. invicta* declined sharply in July but rose again in August. Thereafter, further decline occurred and by the end of the test period the total number of ants collected was about ¼ that of the pretreatment collection. (No explanation for the low collection in July was apparent.) *Solenopsis geminata* collections were very low during the months of July, August, and September as compared to the pretreatment collections; however, in October the total numbers were slightly greater than in the pretreatment collections. At that time, however, this number of ants was collected at only ½ as many bait stations as in the pretreatment collection. The *Pheidole* spp., which were lowest in numbers in the initial collection but highest in number of stations at which they were collected, predominated during the summer months of July, August, and September. While their numbers declined at the final collection period in October, they were collected at over twice as many stations as the 2 *Solenopsis* spp. combined.

Populations of *D. saccharalis* were relatively low in the pretreatment collections and were found at less than half of the collection sites. In the untreated fields, these populations remained relatively low for the first 3 months but began to increase in September, and in the October collection 428 *D. saccharalis* were found at 35 of the 50 collection stations. In contrast, the *D. saccharalis* in the treated fields showed a gradual increase throughout the test with 880 *D. saccharalis* collected at 45 of 50 stations in October. Our final observations on percentage damaged joints confirmed these observations, since the treated fields averaged almost twice as many damaged joints (5.7 vs 3.3%) as the untreated fields. Analysis of variance indicated that these differences were highly significant ($\alpha = < 0.01$).

The statistical analyses of the data (see Tables 2 and 3) showed that in the treated fields *S. invicta* was positively correlated with populations of *D. saccharalis* ($r = 0.54$; $p = < 0.01$). This correlation did not occur in the untreated fields, but instead *S. geminata* showed a positive correlation with *D. saccharalis* ($r = 0.34$;

Table 2.—Pearson product-moment correlation coefficients between ant and *D. saccharalis* populations for untreated fields.[a]

	S. geminata	*Pheidole* spp.	*D. saccharalis*	Sum
Solenopsis invicta	−0.0906	−0.2314	−0.0653	0.6032
	0.2022	0.0010	0.3584	0.0001
	200	200	200	200
Solenopsis geminata		−0.1542	0.3430	0.4328
		0.0293	0.0001	0.0001
		200	200	200
Pheidole spp.			−0.0528	0.2538
			0.4597	0.0003
			200	200
Diatreae saccharalis				0.1115
				0.1159
				200

[a] Each table entry presents (in descending order): correlation coefficient (r), the probability of obtaining a correlation coefficient as large or larger due to chance alone (p), and the number of observations (n). Sum represents the total number of ants for species listed.

Table 3.—Pearson product-moment correlation coefficients between ant and *D. saccharalis* populations for treated fields.[a]

	S. geminata	*Pheidole* spp.	*D. saccharalis*	Sum
Solenopsis invicta	−0.0364	−0.1721	0.5369	0.9198
	0.6094	0.0148	0.0001	0.0001
	200	200	200	200
Solenopsis geminata		−0.3686	0.0583	0.0174
		0.6043	0.4125	0.8073
		200	200	200
Pheidole spp.			0.0200	−0.0012
			0.7782	0.9868
			200	200
Diatreae saccharalis				0.5596
				0.0001
				200

[a] Each table entry presents (in descending order): correlation coefficient (r), the probability of obtaining a correlation coefficient as large or larger due to chance alone (p), and the number of observations (n). Sum represents the total number ants of this species listed.

$p=0.03$). Both *S. invicta* and *S. geminata* were negatively correlated with *Pheidole* spp. in the untreated fields ($r=-0.23$; $p=<0.01$ and $r=-0.15$; $p=0.03$, respectively), but only *S. invicta* was negatively correlated with *Pheidole* spp. in the treated fields ($r=-0.17$; $p=0.01$).

Discussion

Our observations of the *S. invicta* populations in both the treated and untreated fields suggest that they were recent invaders since most of the colonies were very small (<10,000 worker ants). *Solenopsis invicta* was very successful in reestablishing itself after the mirex treatment, apparently because the competitive ant species were also reduced to low numbers. This contrasts with results in the untreated fields in which the *S. invicta* populations actually declined. These results suggest that the more mature *Pheidole* spp. and *S. geminata* colonies in the untreated fields were able to sustain themselves against the immature *S. invicta* colonies, thus providing a greater complex of potential predators for *D. saccharalis*. The rather weak negative correlations between *S. invicta* and *S. geminata* and the 2 *Pheidole* spp. probably represent competition of the species for the ant baits. Both of the *Solenopsis* spp. are capable of producing considerably larger colonies than the *Pheidole* spp. and thus could be expected to locate the baits more readily, as well as prevent feeding of the *Pheidole* spp. on the bait.

The positive correlations between *S. geminata*, *S. invicta*, and *D. saccharalis* are puzzling in that *S. invicta* has been reported as an extremely important predator of sugarcane borers in Louisiana (Reagan et al. 1972). If this is true, then one would expect *D. saccharalis* and *S. invicta* to be negatively correlated. The fact that they are positively correlated suggests either that *S. invicta* and *S. geminata* are not as important as predators on the sugarcane borer in Florida as the *Pheidole* species, or that they are positively correlated because they are in some way attracted to the particular station by the presence of the sugarcane borer. It is also possible that the positive correlation may be the result of the 2 species varying in response to a common factor such as another insect or some microenvironmental effect.

In conclusion, we can say from our data that the application of mirex in the sugarcane fields tended to modify the ant predator complex such that *S. invicta* became the predominant species, and that although the difference in results between treated and untreated fields was not great, the mirex treatment resulted in a slight increase in the occurrence of *D. saccharalis*. Conversely, our results suggest that a multiple predator complex, with no predominant species such as occurred in the untreated fields, is more effective in reducing and controlling *D. saccharalis* populations than the simplified *S. invicta*-dominated complex that was found in the treated fields.

REFERENCES CITED

Carroll, J. F. 1970. Role of ants as predators of the sugarcane borer, *Diatreae saccharalis*. M.S. Thesis. University of Florida. 70 pp.

Charpentier, Leon J., W. J. McCormick, and R. Mathes. 1967. Beneficial arthropods inhabiting sugarcane fields and their effects on borer infestations. Sugar Bull. 45: 276–7.

Long, W. H., E. A. Concienne, E. J. Concienne, R. N. Dopson, and L. D. Newsom. 1958. Fire ant eradication program increases damage by the sugarcane borer. Ibid. 37: 62–3.

Prewitt, J. C., R. Brown, T. L. Carpenter, G. B. Powell, and T. E. Summers. 1978. Known distribution of the imported fire ant, *S. invicta* Buren, in Florida sugarcane fields: Benefit or problems for the future. Sugar Azucar 73: 39 (Abstract).

Reagan, T. E., G. Coburn, and S. D. Hensley. 1972. Effects of mirex on arthropod fauna in a Louisiana sugarcane field. Environ. Entomol. 1: 588–91.

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ENVIRONMENTAL ENTOMOLOGY