The Striped Earwig, and Ant Predators of Sugarcane Rootstock Borer, in Florida Citrus

Earl H. Tryon, Jr.

The Florida Entomologist, Vol. 69, No. 2. (Jun., 1986), pp. 336-343.

Stable URL:
http://links.jstor.org/sici?sici=0015-4040%28198606%2969%3A2%3C336%3ATSEAAP%3E2.0.CO%3B2-Z

The Florida Entomologist is currently published by Florida Entomological Society.

THE STRIPED EARWIG, AND ANT PREDATORS OF SUGARCANE ROOTSTOCK BORER, IN FLORIDA CITRUS

EARL H. TRYON, JR.
Entomology Department
International Rice Research Institute
P.O. Box 933, Manila, Philippines

ABSTRACT

The relative abundance of ant and striped earwig (*Labidura riparia*) (Pallas) (Dermaptera: Libiduridae) populations was assessed in 78 central Florida citrus groves. Ants were predominant in 74 groves while the striped earwig was the dominant predator in 4 groves where ants were absent. Detailed studies were made in Winn and High Acres citrus groves. Winn grove, with residues of cyclodine chlorinated hydrocarbon insecticide in the soil, had a dense population of striped earwigs and no ants. High Acres citrus grove, with no insecticide soil residues, had a dense population of ants (ca. 30 species) and few striped earwigs, typical of the other 74 groves sampled. Without a natural population of ants, the striped earwig became a major nocturnal soil surface predator in the Winn grove.

Striped earwig predation was measured on monitored populations of *Diaprepes abbreviatus* (L.) (Coleoptera: Curculionidae) first instar larvae placed on the soil surface under the citrus tree canopy. These earwigs, quiescent during the day, had a peak predation period of 3 to 4 hours after sunset. Thereafter predation decreased gradually and ceased before sunrise. Seasonal predation activity of the striped earwig was greatest between May and October.

RESUMEN

La abundancia relativa de poblaciones de hormigas y de la tijerata rayada (*Labiduro riparia*) (Pallas) (Dermaptera: Libiduridae) fue evaluada en 78 arboledas de cítricos del centro de la Florida. Las hormigas predominaron en 74 arboledas mientras que la tijereta rayada fue el depredador más dominante en 4 arboledas donde las hormigas estaban ausentes. Se hicieron estudios detallados en arboledas en Winn y High Acres. En la arboleda de Winn, con residuos en la tierra del insecticida ciclodine hidrocarburo clorinado, huvo una densa poblacion de tijeretas rayadas y no de hormigas. La arboleda de cítricos de High Acres, sin residuo de insecticidas en la tierra, tuvo una densa población de hormigas (aprox. 30 especies) y pocas tijeretas rayadas, que fue lo típico de las muestras de las otras arboledas. Sin una población natural de hormigas, la tijereta rayada se convirtió en un importante depredador nocturno en la superficie de la tierra en la arboleda de Winn.

Se midió la depredación de la tijereta rayada en poblaciones chequeadas del primer estadio larval de *Diaprepes abbreviatus* (L.) (Coleoptera: Curculionidae) puesto en la superficie de la tierra debajo del dosel de los arboles cítricos. Estas tijeretas, en reposo durante el día, tuvieron el periodo de depredación más alto e 3 a 4 horas después de la puesta del sol. De aquí en adelante, depredación disminuyó gradualmente y cesó antes de la salida del sol. La actividad estacional depredadora de la tijereta rayada fue mayor de Mayo a Octubre.

The sugarcane rootstalk borer weevil, *Diaprepes abbreviatus* (L.), is an important curculionid pest of sugarcane and citrus in the West Indies. It was first reported attacking citrus near Apopka, Florida, in 1964 (Woodruff 1964). The weevil egg masses are deposited between leaves which are bound together with an adhesive secretion. Jones and Schroeder (1983) reported the freshly hatched (144 to 224 h after oviposition) neonate larvae drop immediately (235 to 248 h after oviposition) to the soil surface under the tree canopy and remained on the soil surface no longer than 3 h, between 1100 and 2400 h before burrowing to feed on the roots. This larval root feeding eventually causes severe host decline and decreases fruit production. An area of about 20,000 ha, including Apopka, Florida is presently under quarantine.

Since the ban on the use of cyclodiene insecticides, effort has been directed toward evaluating alternative control methods. Whitcomb et al. (1982) and Richman et al. (1985) reported that *D. abbreviatus* neonate larvae are vulnerable to soil-surface arthropod predators. They documented the primary soil-surface predators in a Florida citrus grove to be a complex of ant species. Several of these ant species were effective predators when *D. abbreviatus* neonate larvae were placed on the soil surface for observation.

The striped earwig, *Labidura riparia* (Pallas) (Dermaptera: Labiduridae), is also an important predator of insect pests in cultivated fields in California (Schlinger et al. 1959) and several southeastern states (Clements 1968, Whitcomb 1973, Neal 1974, Nguyen & Workman 1975, Walker & Newman 1976, Buschman et al. 1977, Travis 1977, and Reinert 1978). Clements (1968) and Travis (1977) reported that the striped earwig was common in cultivated fields, including groves, in central Florida. Uncultivated fields, pastures, and wooded areas had few striped earwigs (Walker & Newman 1976). Tawfik et al. (1972) reported that "the striped earwig was strictly an animal tissue feeder; in other words a strict predator." Its life history was described by Tawfik et al. (1972) and Shepard et al. (1973).

To identify and evaluate possible biotic factors affecting first instars of sugarcane rootstalk borer larvae, *D. abbreviatus* (Coleoptera: Curculionidae), a survey for soil surface predators was initiated in 78 commercial citrus groves near Orlando, Florida. Two groves were selected to evaluate predation rates on the soil surface.

METHODS

Arthropods were collected and identified from 78 citrus groves in Lake, Orange, and Polk counties in central Florida. Baited traps were placed monthly for a 72-h sampling period in the groves during June and July 1979 and for 12 months in 1980. Moist cat food was used as bait in open 7-dram snap vials. The vials with the bait were placed upright in 50 ml of 70% ethyl alcohol at the bottom of widemouthed 946 ml Mason jars. Alcohol was necessary to prevent the trapped insects from being eaten or decaying. Ten baited Mason jars per grove were randomly buried with the lid at soil surface under the citrus canopy for 72 h. The lids to the Mason jars had six holes (21.5 cm diameter) to allow insect predators to enter but prevent mammals and reptiles from reaching the bait or the trapped insects.

Detailed predation experiments were conducted in 2 commercial citrus groves, High Acres and Winn, located within the *D. abbreviatus* quarantine area northwest of Orlando, Florida. These 2 groves characterized the 2 extremes in soil-surface predator populations. Recommended pesticide practices (fungicides, scalicides, miticides, spray oils, etc.) were used in both groves by the commercial operator. Unlike High Acres, Winn had a history of chlorinated hydrocarbon soil insecticides used to control several weevil species between 1950 and the early 1970s. Since 1968, dieldrin (2/16/73, date sprayed), chlordane (9/15/71), 4/21/70), and heptachlor (5/13/69, 11/20/69) have been used.

Weed species complexes (measured using 10 1-m^2 samples in each grove), relative density of soil surface arthropod predators, and pesticide soil residues present were used to characterize the two groves. Predators were collected and identified from baited traps.

Sampling *L. riparia* is difficult because it is nocturnal. Maximum feeding activity of the striped earwig occurred just after sunset and continued at decreasing levels until all activity ceased before sunrise (Clements 1968, Shepard et al. 1973, Walker & Newman 1976, and Buschman et al. 1977). Striped earwig predation rates were evaluated by using first instars of *D. abbreviatus* larvae as prey in open 55 mm (depth) petri dishes. The *D. abbreviatus* larvae were obtained from USDA laboratory in Apopka, Florida. The open petri dishes were placed into the soil within the citrus tree drip line. This approximated the area of larval drop after hatching from foliar egg masses. Ten petri dishes with 20 weevil larvae each were placed beneath each of 4 randomly selected citrus trees for 20 minutes. This was repeated hourly for 24 h each Monday during the summer and fall of 1980. A camel hair brush was used to keep the crawling weevil larvae inside the dishes. Because of the small size of the weevil larvae (avg 1.2 mm by 0.5 mm) and soil surface debris, petri dishes were necessary for accurate nocturnal observations of larval predation by the striped earwig and other arthropods. Nocturnal observations were made with flashlights covered by transparent red cellophane. The number of larvae missing from each dish after each trial was calculated as predation percentage. The predation source was identified by observation.

RESULTS AND DISCUSSION

STRIPED EARWIG AND ANT POPULATION DENSITY

Preliminary insect pitfall trap data collected during the second week of June 1979 demonstrated that the 2 groves selected for detailed experiments presented an extreme contrast in the relative abundance of insect predators on the soil surface. The striped earwig was the predominant predator (more than 97%) in Winn grove in 1980 (Tables 1 and 2). Few ants (0.2%) were observed or collected in this grove. The striped earwig was the predominant arthropod (avg 98%) in only 4 of the 78 groves sampled for surface predators. High Acres had an ant population, which was more typical of the 74 groves with a large ant population and no *L. riparia* (Table 3). Whitcomb et al. (1982), who surveyed High Acres, reported 30 ant species with 13 species predominating. High Acres was typical of 95% (74 of 78) of the groves sampled. The total number of ants ranged from 92.4% to 100% of the total predators (avg. 98.7%) in these groves. Whitcomb et al. (1982) also reported that of 2,613 first-instar *D. abbreviatus* larvae collected in High Acres, more than 75% were taken by 3 ant species *Pheidole dentata* Mayr (31.1%), *P. floridana* Emery (24.0%), and *Tetramorium simillimum* Roger (20.8%). The striped earwig comprised less than 3% (avg 0.9%) of the arthropod predators in any one grove. Richman et al. (1986) also demonstrated that the ants collected in these groves were the most important predator of the sugarcane rootstock borer neonate larvae.

Baited pitfall traps in Winn grove between 2100 and 2300 h (June 1980) attracted significantly ($P < 0.01$) more striped earwigs than unbaited traps (49.7:18.4 striped earwig/trap/2 h). The most effective baits were moist cat food with a strong odor (Friskies'® tuna and liver, etc.)

TABLE 1. PREDATORY GROVE INSECTS COLLECTED IN 10 PITFALL TRAPS IN WINN CITRUS GROVE (WINN) AND HIGH ACRES CITRUS GROVE (HA) IN CENTRAL FLORIDA (I NSECTS/TRAP).

Predatory Insects	June 8-14, 1979		June 12-18, 1980	
	Winn	HA	Winn	HA
Earwigs				
Labiduria riparia	370.0	0.0	264.8	0.0
Euborella annulipes (Lucas)	13.8	6.8	9.1	6.4
Ants	1.4	81.2	0.0	74.7
Others (Hemiptera, Coleoptera)	0.7	13.7	0.0	9.8

TABLE 2. PREDATORY INSECTS COLLECTED IN 10 PITFALL TRAPS FROM WINN CITRUS GROVE, 1980.

Sampling Dates	Predatory Insects (No./trap)		
	Earwigs *Labidura riparia* (Pallas)	*Euborellia annulipes* (Lucas)	Ants[3]
January 10-16	11.3	0.4	0.0
February 14-20	2.7	0.3	0.0
March 9-15	3.6	0.7	0.0
April 10-16	48.8[1]	4.8	0.3
May 9-15	152.7	4.1	0.1
June 12-18	264.8	9.1	0.0
July 20-26	103.9[2]	12.8	1.4
August 14-20	241.0[1]	8.4	0.3
September 9-15	79.4	2.8	0.1
October 11-17	97.6	3.4	0.0
November 13-19	40.3	1.8	0.0
December 14-20	29./9	2.5	0.0

[1]A large percentage (50%) of the *L. ripaira* trapped were immature.

[2]Consist of adult females observed in nests and not scavenging for food.

[3]The 2.2 ants collected per trap consisted of 0.9 *Pseudomyrmex elongata*, 0.7 *P. brunnea*, 0.4 *Pheidole moerens*, and 0.2 *Camponotus impressus*.

WEEDS

To help explain the two contrasting insect predator populations, weed species and density in Winn and High Acres groves were assessed. Regular cultivation and an annual use of herbicide kept Winn grove much freer of weeds than the seldom-cultivated High Acres grove. In monocultures, population levels of native predators, e.g. ants and earwigs, are directly influenced by weed complexes (Alteiri & Whitcomb 1979). Abundant species exclusive to each grove were hairy signalgrass (*Brachiaria piligera* (F. Meull.) and guineagrass (*Panicum maxumum* Jacq.) in the Winn grove, and crabgrass

TABLE 3. PREDATOR INSECTS COLLECTED IN 10 PITFALL TRAPS IN HIGH ACRES GROVE.

Insect Species	Insects collected (No./trap) 9-15 May	12-18 June	20-26 July	14-20 August
Formicidae[1]				
Pheidole floridana Emery	8.3	6.5	21.2	32.4
Pheidole dentata Mayr	14.9	13.7	28.4	15.1
Tetramorium similimum Roger	15.8	17.6	13.7	19.6
Conomyra edeni Buren	9.2	4.9	2.8	4.0
Pheidole moerens Wheeler	1.6	3.7	8.7	3.7
Solenopsis invicta Buren	3.7	1.8	13.0	4.1
Paratrechina bourboniza (Florel)	0.2	1.1	1.6	3.2
Others	0.1	5.9	2.3	7.0
Total	62.8	55.2	91.7	89.1
Dermaptera				
Labidura riparia (Pallas)	0.0	0.0	0.0	0.0
Euborellia annulipes (Lucas)	4.6	5.3	8.9	6.8
Total	4.6	6.3	8.9	6.8
Coleoptera	7.1	6.7	3.8	5.2
Hemiptera	0.9	2.4	4.9	3.3
Total (insects/trap)	75.4	69.6	109.3	104.4

[1]Identified with the help of Dr. Everett Nikerson, Division of Plant Industry, Gainesville, Florida.

(*Digitaria ciliaris* (Retz.) Koel.), southern sida (*Sida acuta* Burn. f.), two pigweeds (*Amaranthus viridus* L. and *A. hybridus*), and *Bidens alba* (L.) in High Acres.

Amaranthus sp. has served as a reservoir for numerous phytophagous insects and associated predators, including a ground beetle (*Lebia analis* Dej.) and several ant species (Alteiri & Whitcomb 1979). Ants trapped on *Amaranthus* sp. in High Acres included *Conomyrma* sp., *Solenopsis invicta* Buren, and several *Pheidole* sp., *Bidens alba* (L.), also found in High Acres, always had mealybug populations, *Planococcus ficus* (Signoret), at the soil root interface that were tended by the imported fire ant (*S. invita*). Thus, *Amaranthus* sp. and *Bidens alba*, abundant only in High Acres, were beneficial in maintaining ant populations.

SOIL INSECTICIDE RESIDUES

Surface soil from Winn and High Acres groves was analyzed for the presence of all soil insecticide residues by the Pesticide Research Laboratory, Institute of Food and Resources, University of Florida. Trace amounts (0.003 ppm) of DDD and DDE were found in soil from both High Acres and Winn groves. Soil samples from Winn grove also had residues from dieldrin (avg. 0.0009), chlordane (avg 0.100), heptachlor (avg 0.093), endrin (avg 0.039) and two unidentifiable cyclodiene insecticides (ppm between 0.002 and 0.115).

The extensive use of the cyclodiene chlorinated hydrocarbon insecticides and the continued existence of their residues help explain the eradication of soil-surface ant populations and the resulting buildup of striped earwig populations at Winn grove. Stoddard (1962), Workman (1963), and Gross & Spink (1969) reported that the striped earwig may be resistant to the chlorinated hydrocarbons heptachlor and chlordane. Clements (1968) found chlordane did not control the striped earwig. Striped earwig populations were maintained at low density levels by ant predation (Stoddard 1962, Gross & Spink 1969, and Price & Shepard 1977). Observations of earwig egg predation by ants were supported by laboratory studies by Watts and Whitcomb (unpublished). They found several ant species (*Pheidole dentata* Meyr, *Solenopsis invicta* Buren, and *Tetramorium bicarinatum* (Nylander)) each removed 100% of eggs from *L. riparia* egg masses (avg 36.4 eggs/batch) in less than 60 minutes. Dense striped-earwig populations increased in lawns and fields only after ant populations had been eliminated by the use of heptachlor (Stoddard 1962, Gross & Spink 1969).

Striped Earwig Predation

Results from observations of predation by the striped earwig on first-instar *D. abbreviatus* weevil larvae are presented in Figure 1. Earwigs fed on all or none of 20 weevil larvae per trial. One earwig would consume a dish of 20 weevil larvae in less than one minute and only one adult earwig was found inside a petri dish at one time. In an encounter between two earwigs, the smaller earwig usually left instantly or risked being cannibalized. The earwigs remained motionless or hid when white lights were used. This required the use of a flashlight with a dim red light to avoid this interruption during night observations. Once feeding was initiated, however, light, regardless of color, no longer inhibited their activity.

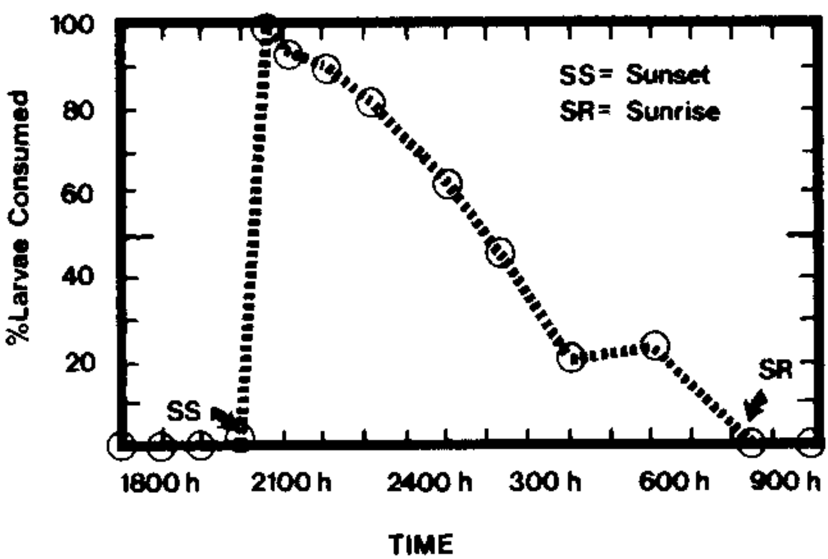

Figure 1. Percentage of *D. abbreviatus* neonate larvae consumed by striped earwig in open petri dishes in Winn citrus grove (12 observation days, 4 trial/h/day, 20 larvae/trial).

Observations of the striped earwig activity confirmed their nocturnal habits. Peak foraging and feeding activity occurred during the first 3 hours after sunset and gradually decreased throughout the night and ceased before sunrise. During the peak feeding period, more than 75% of all weevil larvae placed under the citrus canopy during the summer and fall of 1980 were consumed. The percentage eaten was calculated from the number of weevil larvae taken from an open petri dish during 20-minute intervals (Fig. 1). The amount of the first-instar weevil larvae consumed per night during this 3 hour time period ranged from 100% (June 16) to 64% (July 21). Feeding tests were conducted only from May to November when the weevil neonate larvae were available. Only in late November did earwig feeding activity decrease to less than 30%. This reflected the decrease in *L. riparia* activity in late fall (Table 2).

During daylight hours, striped earwigs were quiescent and hid in shaded resting sites protected by several layers of soil debris. Earwigs were rarely observed foraging during the day (0700-1900 h). However, at dusk (2000-2100 h) feeding activity of the striped earwig began. During the first few hours (2100-2400 h) they were most effective at removing the introduced *D. abbreviatus* larvae from the petri dishes. This was explained by the aggressive foraging and their concentration under the citrus tree canopies in the early evening. Feeding continued during most of the dark hours (2100-0700) but gradually became less effective after midnight as they dispersed and became less active. Before sunrise, they disappeared into protected resting sites.

Periodic decreases in feeding activity by the striped earwig during summer (i.e. 64%, July 21) parallel a lack of feeding activity by several adult females observed in shallow burrows near the feeding trials (Table 2). These females remained in their burrows protecting their brood for several days despite feeding by other striped earwigs. Even minor disturbances with various pointed devices failed to dislodge the female. Caussanel (1968), Tawfik et al. (1972), and Shepard et al. (1973), reported that females did not feed or leave their burrows while brooding eggs for up to 12 days.

Ants and the striped earwig are the predominant arthropod soil surface predators in central Florida citrus groves. However, they may be mutually exclusive. Ants were the predominant soil surface predator in the typical grove. Ant populations or the striped earwig may play a major role in reducing larval populations. Chlorinated hydrocarbon soil insecticide residues remain for years and effectively eliminate many soil-surface predators including Formicidae species. Groves without ant populations were characterized by nocturnal predation by dense populations of the striped earwigs. This unique condition was observed in 4 of 78 surveyed citrus groves in central Florida. Without the various ant species common to the citrus grove soil surface, large populations of striped earwigs become the dominant arthropod predator.

End Note

This is Florida Agricultural Experiments Station Journal Series No. 3402.

References Cited

ALTEIRI, M. A., AND W. H. WHITCOMB. 1979. Manipulation of insect population through seasonal disturbance of weed communities. Protection Ecology. 1: 185-202.

BUSCHMAN, L. L., W. H. WHITCOMB, R. C. HEMENGWAY, D. L. MAYS, RU NGUYEN, N. C. LEPPLA, AND B. J. SMITTLE. 1977. Predators of velvetbean caterpillar eggs in Florida soybeans. Environ. Entomol. 6: 403.

CAUSSANEL, C. 1968. Factors conditionant 7 maintien des soins aux feufs chez *Labidura riparia* (Dermaptera: Labiduridae). Int. Cong. Entomol. Moscow. 13(1): 488.

CLEMENTS, R. H. 1968. Important earwigs, Dermaptera, of central and south Florida and the biology and control of the primary species, *Labidura riparia* (Pallas) under laboratory conditions. MS thesis, Univ. of Florida. 87 pp.

GROSS, H. R., AND W. T. SPINK. 1969. Response of striped earwigs following application of heptachlor and mirex, and predation-prey relationship between imported fire ants and striped earwigs. J. Econ. Entomol. 62(3): 686-689.

JNOES, I. F., AND W. J. SCHROEDER. 1983. Study of first-instar *Diaprepes abbreviatus* (Coleoptera: Curculionidae) activity for control purposes. J. Econ. Entomol. 76(3): 567-569.

NEAL, T. M. 1974. Predaceous arthropods in the Florida soybean agroecosystem. MS thesis, Univ. of Florida. 196 pp.

NGUYEN, RU, AND R. B. WORKMAN. 1975. Biotic agents limiting the cabbage looper in northeast Florida. J. Georgia Entomol. Soc. 13(2): 152-155.

PRICE, J. F., AND MERLE SHEPARD. 1977. Striped earwig. *Labidura riparia* colonization of soybean fields and response to insecticides. Environ. Entomol. 6(5): 679-683.

REINERT, J. A. 1978. Natural enemy complex of the southern chinch bug in Florida. Ann. Entomol. Soc. of America 71(5): 728-731.

RICHMAN, D. B., W. H. WHITMAN, AND W. F. BUREN. 1985. Predation on neonate larvae of *Disprepes abbreviatus* (Coleoptera: Curculionidae) in Florida and Puerto Rico citrus groves. Florida Entomol. (in press).

SCHLINGER, E. I., R. VAN DEN BOSCH, AND E. J. DIETRICK. 1959. Biological notes on the predaceous earwig *Labiduria riparia* (Pallas), a recent immigrant to California (Dermaptera: Labiduridae), J. Econ. Entomol. 52(2): 247-294.

SHEPARD, M., V. WADDILL, AND W. KLOFT. 1973. Biology of the predaceous earwig, *Labidura riparia* (Dermaptera: Labiduridae). Ann. Entomol. Soc. America 66(4): 837-841.

STODDARD, H. J. SR. 1962. Bird casualties at a Leon County, Florida TV Tower, 1955-61. Bull. 1, Tall Timbers Research Station. Tallahassee, Fla. 36-41.

TAWFIK, M. F. S., SALAH ABUL-NASR, AND M. M. EL-HUSSEINI. 1972. The biology of *Labiduria riparia* (Pallas). Bull. Soc. Entomol. 56: 75-92.

TRAVIS, P. A. 1977. Population dynamics of *Labidura riparia* (Pallas) (Dermaptera: Labiduridae). MS thesis, Univ. of Florida. 85 pp.

WALKER, J. T., AND G. G. NEWMAN. 1976. Seasonal abundance, diet periodicity and habitat preference of the striped earwig *Labidura riparia* in the coastal plain of South Carolina. Ann. Entomol. Soc. American 69(4): 571-574.

WHITCOMB, W. H. 1973. Natural populations of entomophagous arthropods and their effect on the agrocosystem. Proc. Miss. Symp. Biol. Control. Univ. of Mississippi pp. 150-169.

WHITCOMB, W. H., T. D. GOWAN, AND W. F. BUREN. 1982. Predators of *Diaprepes abbreviatus* (Coleoptera: Curculionidae) larvae. Florida Entomol. 65: 150-158.

WOODRUFF, R. E. 1964. A Puerto Rican weevil new to the United States (Coleoptera: Curculionidae). Florida Dept. of Agric., Div. Plant Ind., Ent. Cir. 30, 1-2.

WORKMAN, R. B. 1963. Laboratory test for control of earwigs. Florida Entomol. 46: 17-18.