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PREDATORY ARTHROPODS ATTACKING THE EGGS OF  
*DIAPREPES ABBREVIATUS* (L.) (COLEOPTERA: CURCULIONIDAE)  
 IN PUERTO RICO AND FLORIDA<sup>1, 2</sup>

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ABSTRACT

Egg masses of the sugar cane rootstalk borer, *Diaprepes abbreviatus* (L.) attached to citrus and coffee in Puerto Rico and citrus in central Florida were attacked by the ants *Monomorium floricola* (Jerdon) in Puerto Rico and *Crematogaster ashmeadi* Mayr in Florida. Some additional ant species and a few other arthropods were observed preying on the eggs, but these were generally not important in citrus.

Key Words: Weevil, *Diaprepes abbreviatus*, predation, ant, *Monomorium floricola*, *Crematogaster ashmeadi*, citrus, coffee

The curculionid beetle, *Diaprepes abbreviatus* (L.), has been a threat to the citrus, sugar cane and ornamental plant industries since its introduction, apparently from Puerto Rico, into Florida in 1964 (Woodruff 1964, 1968). The weevil has a life cycle that lasts 1-2 years, during which time it is primarily in the larval stage in soil around the roots of its host plant (Woodruff 1968, Whitcomb *et al.* 1982). The eggs are cemented between the leaves of host plants, with the 1st instar larvae dropping and burrowing into the soil. The eggs hatch almost uniformly in seven days (Woodruff 1968). While larval predators have been reported by Whitcomb *et al.* (1982) little is known about the predators attacking the egg stage, although some observations from the island of Guadeloupe were reported by Buren and Whitcomb (1977). In the current study predation on the eggs by various predatory arthropods was observed on citrus at Isabela and Adjuntas, Puerto Rico and at Forest City and Lockhart, Florida. In addition, observations were made on coffee and various secondary growth plants at Mayagüez, Puerto Rico.

#### MATERIALS AND METHODS

Preliminary studies were made in citrus in Puerto Rico in May, 1982 and in coffee and secondary growth in May, 1981. Adult beetles were collected at Isabela and allowed to lay eggs between wax paper strips. This simulated natural oviposition sites and enabled observations to be made of the eggs and predators while the predation was occurring. The 1981 observations in Mayagüez were of egg masses oviposited between citrus leaves and paper toweling by beetles from Isabela and Adjuntas. Most of these had been opened to allow the eggs to be observed during predation. In all cases the egg masses were paper-clipped (Fig. 1) to the leaves of citrus, coffee, or various shrubs and vines. Observations usually were made for two-hr periods during the morning, afternoon and evening. A total of 14 hr of observation at Mayagüez, 24 hr of observation at Isabela and nine hr of observation at Adjuntas were made in Puerto Rico. The 1981 (Mayagüez) observations were made by one observer and the 1982 (Isabela and Adjuntas) observations by three observers watching separate sets of egg masses. All of the sets contained 18 or more egg masses and during the 1982 work 30 masses were set out, five to a tree, for each observer and checked every 10 min during the two-hr period. Because of rain, evening observations were accomplished only in coffee at Mayagüez in 1981. Thirty masses were left for 24 hr at Adjuntas and 72 hr at Isabela and checked for predation rates.

In Florida, observations were made at Forest City, Seminole Co. and at Lockhart, Orange Co. During 1981 a total of 12 hr (all on October 1-2, 1981) of observations was conducted at Forest City and 2 hr at Lockhart. All of these were with eggs on citrus leaves and most were opened to allow direct viewing. Twenty egg masses were used, attached four to a tree on five trees. In 1982 a total of 6 hr of observation on 30 masses per 2-hr period was conducted at Forest City and 2 hr at Lockhart. Thirty egg masses were left on six trees in both Forest City and Lockhart twice for 24 hr. Evening observa-



Fig. 1. — Egg masses paper-clipped to citrus at Isabela, Puerto Rico.

tions were made at Forest City only over 4 hr, during the 1981 period. No evening or morning observations were made at Lockhart. Heavy rains fell in Florida during summer 1982, making evening work difficult because of large amounts of water on the citrus leaves during evening and early morning.

At Isabela and Adjuntas, malathion, dicofol and methomyl were applied to the citrus once a year or when pests built up. Insects and spiders were quite abundant at all locations in Puerto Rico. The Florida groves were sprayed with ethion and oil during the summer and fall and dicofol for mites at various times. The Forest City grove had been treated also with heptachlor as recently as 1975 and with benomyl, wettable sulphur and malathion prior to 1980. Both Florida groves had a high population of ants, especially *Conomyrma flavopecta* (M. R. Smith), on the ground surface. Spiders also were numerous.

The weather at Mayagüez, Isabela and Adjuntas was relatively uniform, with temperatures near 27 C during the day and no cooler than 20 C at night. The humidity was high and rain fell almost every afternoon. At Forest City and Lockhart the temperatures ranged from 16-34 C and the humidity from 60-100%. No rain fell during the 1981 observations but rain fell both before and after one observation period in 1982. In 1981 the Forest City grove was watered often with overhead sprinklers, but the heavy rains in 1982 kept the ground damp at both groves.

The work in Puerto Rico and Florida was scheduled to fit the rise of adult weevil populations and oviposition by females in both areas. Weevils were quite numerous in Puerto Rico in May (but not April) and present in low

numbers in the Florida groves during summer and fall. The rise of weevil populations roughly coincides with the start of the rainy seasons in both areas.

## RESULTS AND DISCUSSION

Seven species of ants [*Brachymyrmex* sp., *Camponotus ustus* Forel, *Cardiocondyla wroughtoni* Forel, *Monomorium ebeninum* Forel, *M. floricola* (Jerdon), *Pseudomyrmex* sp., and *Tetramorium bicarinatum* (Nylander)], one species of cricket, (*Cycloptilum* sp.), and one earwig, [*Doru albipes* (Fab.)], were observed attacking egg masses in Puerto Rico. Only two of these, *Monomorium ebeninum* and *M. floricola*, were seen opening the eggs and only *M. floricola*, which is arboreal, was observed to prey on naturally oviposited eggs as well. At Forest City and Lockhart four species of ants [*Conomyrma flavopecto* (M. R. Smith), *Crematogaster ashmeadi* Mayr, *Pseudomyrmex mexicanus* Roger, and *Xenomyrmex floridanus* Emery], two species of spiders [*Trachelas deceptus* (Banks) and *Aysha velox* (Becker)] and one larval lacewing (*Chrysopa cleveri* Navas) were observed to feed on the eggs. Only the ants *Crematogaster ashmeadi* and *Xenomyrmex floridanus* were observed to enter between the waxpaper or chew through it to the eggs. The other predators either attacked opened egg masses or eggs on the edge of a mass. The data for the more important predators observed are summarized in Table 1.

The predation rate for one 24-hr period at Adjuntas was 50% for eggs between wax paper. At Isabela, 50% of the 30 egg masses were gone after 72 hr. In both cases *Monomorium floricola* probably was a major factor, although at Isabela earwigs may have been important as well. Natural egg masses from Isabela averaged 73.4 eggs/mass ( $N = 9$ , S.D. = 20.4). At Forest City the predation rates for two days (August 10-11 and August 26-27) were 23 and 0%, respectively. In the first case workers of *Crematogaster ashmeadi* were still present at all but two of the eaten masses and workers of this species were attacking four or more masses. A 5th mass was in the process of attack by *Xenomyrmex floridanus*. At Lockhart on the same dates predation rates were 0, but on August 11 one mass was under attack by *Xenomyrmex floridanus*. Both ant species are arboreal. The *Conomyrma* attack on July 15, 1982, was not effective and workers tended to drop the eggs after they had worked them loose from the edge of the mass. The one *Pseudomyrmex mexicanus* seen attacking an egg mass on July 15 at Forest City apparently took only a few eggs. Egg masses from the laboratory colony at Plymouth averaged 75.2 eggs/mass on citrus leaves ( $N = 5$ , S.D. = 50.1) and 65.1 eggs/mass between wax paper ( $N = 20$ , S.D. = 30.8) (Jones and Schroeder USDA data).

The ants of the genus *Monomorium* which were observed feeding on *Diaprepes abbreviatus* eggs in Puerto Rico appear to be the most effective of the predators observed. *M. floricola* was dominant, both in coffee and citrus. *M. ebeninum* was observed in large numbers on lower shrubs and vines of secondary growth near coffee at Mayagüez. It appears that one or both of these species may have been the small black ant that consumed numerous *D. abbreviatus* eggs in a cage set up in Puerto Rico by the USDA (Schroeder and

Table 1. — Arthropods attacking *Diaprepes abbreviatus* egg masses in Puerto Rico (May, 1981, 1982) and central Florida (October, 1981 and July-September, 1982). Individual predators observed twice or less are not included. (See text).

Predator Family & Species	Host/Location	Remarks
Formicidae		
<i>Brachymyrmex</i> sp.	Coffee/Mayag	Not very abundant. Only a few
<i>Brachymyrmex</i> sp.	Coffee/Mayagüez	ants attacking mass.
	Citrus/Adjuntas	
<i>Cardiocondyla wroughtoni</i> Forel	Secondary shrubs/Mayagüez	Very few ants, attacked in afternoon.
<i>Conomyrma flavopecta</i> (M. R. Smith)	Citrus/Forest City	Not effective. Attacked eggs close
		to the ground.
<i>Creमतogaster ashmeadi</i> Mayr	Citrus/Forest City	Attacked masses by biting through
		wax paper. On one occasion destroyed
		all 5 masses in 1 tree.

<i>Monomorium ebeninum</i> Forel	Secondary shrubs/Mayagüez	Large number of ants (to 258) recruited in very short time (10 minutes). Eggs attacked by ants biting through leaves.
<i>Monomorium floricola</i> (Jerdon)	Coffee/Mayagüez; Citrus/Adjuntas, Isabela	Smaller than <i>M. ebeninum</i> . Large numbers of ants (to 60 or more) recruited. The most successful ant predator of <i>D. abbreviatus</i> on citrus in Puerto Rico.
<i>Xenomyrmex floridanus</i> Emery	Citrus/Forest City, Lockhart	The smallest of the ant predators in Florida. At least several dozen ants were observed attacking eggs on two occasions.
Anyphaenidae <i>Aysita velox</i> (Becker)	Citrus/Forest City	Observed 3 times 18:00-midnight attacking open eggs.



Jones, personal observations). Both species were also observed attacking *D. abbreviatus* eggs on the island of Guadeloupe (Buren and Whitcomb 1977). With the exception of *M. ebeninum*, the species of ants attacking the eggs of *D. abbreviatus* in Puerto Rico were arboreal ants, nesting as well as foraging in the trees or bushes. *Camponotus ustus* and the *Brachymyrmex* sp. do not occur in Florida. *Brachymyrmex* sp. may be an undescribed arboreal species of this genus. None of the ants observed in Florida are known to occur in Puerto Rico. *Cardiocondyla wroughtoni* and *Monomorium floricola* occur both in Puerto Rico and Florida but appear to be rare or absent in the Forest City and Lockhart groves. Although *Monomorium ebeninum* has been recorded from south Florida (Creighton 1950), as far as known to the writers, it does not occur in central Florida.

The discovery of two species of spiders attacking opened egg masses in Florida adds to the accumulating evidence that some hunting spiders can locate and recognize insect eggs. This had been shown for the jumping spiders *Metaphidippus galathea* (Walckenaer) and *Pellenes coecatus* (Hentz) (Lincoln *et al.* 1967), and the clubionid *Chiracanthium inclusum* (Hentz) (Bushman *et al.* 1977, Richman *et al.* 1980), but not for the clubionid *Trachelas deceptus* (Banks) or for the anyphaenid *Aysa velox* (Becker). It is likely that some kairomones may be involved in such predation, especially with the relatively poor-sighted clubionid and anyphaenid spiders.

The cricket *Cycloptilum* sp. and the lacewing *Chrysopa claveri* Navas were observed preying on eggs only once or twice and are probably not important predators. However, the earwig *Doru albipes* (Fabricius) seen in Isabela was captured several times between citrus leaves which has traces of *Diaprepes* egg masses and may have caused some significant losses. No solid data were obtained on these species.

While we have not made extensive observations in either Puerto Rico or Florida there seems to be more egg predation in Puerto Rico, probably because there were higher densities of arboreal ants there. In Florida, *Crematogaster ashmeadi* may, under certain conditions as yet unknown, be an important predator. These ants were observed to recruit, but were very slow. Some ants were still near the remains of egg masses attacked 24 hr earlier in at least two cases.

In summary, we have only provided some foundation for future work on egg predators of *D. abbreviatus*. However, we now have some idea as to which predatory arthropods may be important in both Puerto Rico and Florida citrus groves.

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#### NEW RECORDS OF THRIPS IN GEORGIA (THYSANOPTERA: TEREBRANTIA: TUBULIFERA)

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#### ABSTRACT

Eight species of thrips are listed as new State records and the number of species known in Georgia is increased to 153.