Capture of *Diaprepes abbreviatus* (Coleoptera: Curculionidae) in Traps: Effects of Location in a Citrus Tree and Wick Materials for Release of the Attractant[1]

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ABSTRACT In replicated field tests made in Florida in October and November 1982 to develop a survey for *Diaprepes abbreviatus* L., we devised a trap, obtained an attractant from the weevil colony, and then used the trap and attractant to determine the best trap location in a citrus tree as well as to identify a wick material for release of the attractant. Traps were constructed with a cage attached to an inverted funnel. An attractant used in the traps was from a chloroform ext

Diaprepes abbreviatus L., a sugarcane rootstalk borer weevil, is an important pest of sugarcane, citrus, and other crops in the West Indies. The weevil was found in Florida in 1964 (Woodruff 1964). By 1982, the weevil was established on 4,000 ha of citrus (total citrus in Florida, 324,000 ha), but was not found on sugarcane (total sugarcane in Florida, 132,000 ha). The weevil is, however, established in ornamental nurseries in south Florida less than 10 km from the sugarcane areas (S. A. Alfieri, unpublished data). Methods for detecting the weevil's spread have been investigated. Beavers et al. (1979) examined the use of light traps and determined that trap efficiency was not adequate for survey. Schroeder (1981) demonstrated the presence of an attractant that was deposited on the plant by the adult and attracted weevils of the opposite sex. Beavers et al. (1982) used sticky traps to show an in-flight attraction when traps were placed adjacent to plants with adult weevils. A trap and trapping techniques are needed to evaluate weevil populations, to study attractancy, and to determine the spread of *D. abbreviatus* in the United States.

A trap was developed based on observations of adult *D. abbreviatus* behavior (Schroeder and Jones, unpublished data). The trap is an inverted funnel with a cage attached to the top. The design is comparable to that of other insect traps (Leggett and Cross 1971). Subsequently, a highly significant increase in the number of weevils captured occurred when an extract of weevil frass was added to the trap. Therefore, it was possible to initiate field trap studies for *D. abbreviatus* in conjunction with studies of the attractant. The experiments described here were conducted with the trap and attractant to determine the best trap location in a citrus tree, as well as to compare different types of materials for release of the attractant. The results of these experiments, which were conducted in a weevil-infested citrus grove in Central Florida, are reported here.

Materials and Methods

The trap consisted of an inverted wire cloth (2 wires per cm) funnel, 22 cm in diameter by 20 cm high, with a 1.1-cm-diameter opening in the top. A cage (15 cm in diameter by 16 cm high) was affixed to the top of the funnel for retention of live weevils. A wire cloth square, 15 cm on a side, 38 cm long, surface area 4,560 cm^2, was suspended from the bottom funnel opening. A wire attached to the top of the cage was used to hang the trap from a hook in the citrus tree. The hook extended 0.25 m at right angles from a 2.7-cm (O.D.) pipe support attached to the tree. The trap was removed from the support to determine weevil capture.

To obtain the attractant, a colony of ca. 600 male and female (1:1) field-collected adults was maintained in the laboratory on citrus foliage. Cages were wood frame and screen wire construction (61 by 61 by 91 cm), with a 0.32-cm-mesh hardware cloth bottom. A glass plate was placed under the cage to collect frass, leaf bits, and other possible excreta. The material above was collected daily and stored at −20°C until extraction. The attractant used in the traps was a Soxhlet extract of 20 g of weevil material in 225 ml of chloroform.

The citrus grove used for the trap studies was 15 ha, 20 years old, and contained 173 trees per ha (7.6 m between trees and rows). Average tree height was 4 m. The grove had a native weevil population, and all captured weevils were returned to the grove. During the trap study, 27 October through 24 November, weevils were collected, the sex ratio was determined, and the weevils were released. Weevils were collected from trap and adjacent citrus trees after a visual location of the adult. Observations of the field sex ratio were made to determine if trap capture male-female ratio deviated from that of the native field population.

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Table 1. Effect of trap location in citrus trees on the number of *D. abbreviatus* captured in 17 days, three traps per tree in 10 trees, Plymouth, Fla.

Trap location above soil (m)	Weevils/trap[a] ($\bar{x}$ ± SE) ♂	♀	Sex ratio (♂:♀)	Total weevils/ trap per day
Top (4.3)	25.7 ± 14.9a	9.2 ± 3.5b	2.79:1	2.18
Middle (2.8)	10.2 ± 8.3b	3.6 ± 3.1bc	2.83:1	0.86
Low (0.3)	1.4 ± 1.6c	0.5 ± 0.9c	2.80:1	0.12

[a] Numbers in a column or a row followed by the same letter are not significantly different ($P > 0.05$), by Duncan's multiple range test.

Table 2. Effect of different wick materials for release of the attractant on the number of *D. abbreviatus* captured in 16 days in 20 traps, 4 per citrus tree, Plymouth, Fla.

Wick material	Weevils/trap[a] ($\bar{x}$ ± SE) ♂	♀	Sex ratio (♂:♀)	Total weevils/trap per day	Total weevils
Glass wool	17.8 ± 11.6a	9.4 ± 5.0a	1.9:1	1.60	136a
Rubber	8.8 ± 6.6b	6.2 ± 4.0ab	1.4:1	0.88	75b
Cotton	6.8 ± 2.0b	7.2 ± 2.8ab	0.9:1	0.82	70b
Blank	4.2 ± 2.9b	2.2 ± 2.7b	1.9:1	0.38	32c

[a] Numbers in a column followed by the same letter are not significantly different ($P > 0.05$), by Duncan's multiple range test.

Location of the Trap in a Citrus Tree

Traps were hung from a pole in the citrus tree with the bottom of the trap suspended above, but touching, foliage. There were three traps per tree in 10 trees. The trap nearest the ground was under the dripline (0.3 m from soil surface to bottom of funnel). The middle trap was in foliage 2.8 m above ground, and the high trap was in the top of the tree 4.3 m above ground. A cotton wick (dry weight, 0.24 g) suspended in each holding cage was treated with 2 ml of attractant and retreated daily. The test duration was 16 days (18 October through 2 November). Data were analyzed by analysis of variance and Duncan's multiple range test.

Wick Material for Release of the Attractant

Three materials were used for release of the attractant: a cotton dental wick (0.24 g), glass wool (0.30 g), and rubber septa (0.3 g each, two per trap). The test was a randomized complete block with four traps in each of five citrus trees. One trap had no attractant. Traps were 4.3 m above the soil surface and were in contact with citrus foliage. Wicks were treated daily with 2 ml of attractant. Rubber septa were soaked overnight and replaced two per trap. Each septa retained ca. 1.0 ml of attractant.

The test duration was 17 days (8 November through 24 November). Traps in a tree were competing for weevils in the same specific location (4.3 m above ground). Data were analyzed by analysis of variance and Duncan's multiple range test.

Results and Discussion

The trap captured and retained live adult *D. abbreviatus*. Apparently, the escape rate from the trap was ca. 10%, based on field observations. The number of weevils captured was significantly influenced by weather, weevil activity, growth areas in the trap tree, and other factors competing for the native population. The present trap design enabled us to initiate these field trap studies for *D. abbreviatus*. Trap modifications designed to improve capture must be tested and methods to simplify construction are needed to develop a weevil survey trap. The basic trap design used in this study will, however, provide a standard to test trap modifications.

D. abbreviatus flies actively. However, the traps were positioned with the bottom touching foliage to enable weevils to walk or fly to the trap. Therefore, weevil capture was in part chance capture and a response to the attractant through ambulatory or flight behavior.

The male-female sex ratio for the native weevil population during the test period (18 October through 24 November) was 1.1:1 for the 621 individuals collected. The field sex ratio from 18 October through 2 November (test 1) was 1.4:1 (158 weevils), and the sex ratio from 8 November through 24 November (test 2) was 1.0:1 (463 weevils).

Location of the Trap in a Citrus Tree

Location of the trap in the citrus tree significantly ($P < 0.05$) affected weevil capture. The 10 traps located in the top of trees (4.3 m above ground) captured 349 weevils, compared with middle traps (2.7 m above ground) which captured 138 weevils, and low traps (0.3 m above ground) which captured 19 weevils. The traps located in the top also captured significantly more ($P < 0.05$) male than female weevils (Table 1). The traps 2.8 m and 0.3 m from ground captured 102 male, 36 female, and 14 male, 5 female weevils, respectively, but the greater male capture was not significantly different from that of the female.

Trap sex ratio was consistent for the three locations (2.8:1), but deviated from the field sex ratio (1.4:1). Therefore, the male and female weevil populations appear evenly distributed in the tree, with significantly more weevils in the top. Also, the traps captured more male than female weevils; this could, in part, result from differential activity. Males are probably more active, and potentially more easily captured. The different capture rate could also be related to the extract because of a differential extraction by chloroform. Another possible explanation was that females were not responsive because they were probably mated. Schroeder (1981) determined that 97.5% of the females in a field population are mated. Also, the trap design could be a factor; possibly, at least some of the males captured were carried into traps mounted on female weevils.

Wick Material for Release of the Attractant

The presence of the attractant in the trap significantly increased ($P < 0.01$) weevil capture per trap compared with traps with no attractant. There were 18.7 weevils per trap in baited traps, compared with 6.4 weevils per trap in unbaited traps. Glass wool as the wick material, compared with rubber or cotton, significantly increased ($P < 0.05$) male weevil capture in baited traps (Table 2). The male-female trap ratio was 1.5:1, and therefore deviated from the field ratio of 1.0:1. Therefore, as in the trap location experiment, these results suggest that the attractant in the extract exerts the greatest influence on the male in a field population.

It is interesting that the traps with no attractant also captured more male than female weevils (2:1). This indicated that a portion of the trap sex ratio difference was related to activity alone. The increase in female capture was significant only when glass wool was compared to unbaited traps. However, a portion of the significant increase in total weevils captured for baited compared to unbaited traps can be attributed to the increase in numbers of females captured. The block effect in this test was not significant ($P > 0.05$).

Glass wool was better than cotton or rubber for release of the male attractant present in the extract. A possible attractant for females also present in the extract increased capture as determined by weevils per trap per day and total weevils captured. However, use of glass wool did not significantly increase the number of females captured compared with the other wick materials tested.

This study to determine some of the factors that affect trap capture of *D. abbreviatus* in citrus represents an initial step to developing a trap and trapping techniques. By locating traps in the top of trees and with the crude extract on glass wool, it might be possible to initiate a weevil survey. The survey would provide a basis to determine presence of weevils, emergence periods, population levels, and a method to evaluate control techniques. The survey would also provide a basis for developing a better trap, and a method to evaluate the nature of the attractants.

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Effect of Twospotted Sp
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Tidewater Research and Continuing

ABSTRACT Even relatively s
spider mite, *Tetranychus urtica*
large-seeded, Virginia-type pea
occurring midway through the
sprays of the acaricides dicofol,
The systemic insecticide aldicar
(preplant plus early pegging), o
mite populations to increase. T
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Infestations of the twospotted spider
chus urticae Koch, have changed from
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factor in peanut production in recent
ginia-Carolina area. Changes in prod
particularly the widespread use of org
insecticides, and tank mixes, have p
sponsible for the increased frequency
Cagle (1949) outlined the life history
spider mite from collections made in
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reaux and Dosse (1963). The biology,
plants, and chemical control of twosp
on Georgia peanuts were reported b
1979). Campbell et al. (1974) describ
field control of twospotted spider mite
various acaricides and fungicides and
for resistance in the greenhouse. The
interactions in field trials with the mo
insecticides, fungicides, and combina
by Campbell (1978). This report incl
from a 1975 test. The treatments ma
copper sulfate (Fungi-Sperse) + car
+ carbaryl caused severe mite out
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hydroxide (alone) or triphenyltin hyd
Yields were markedly reduced in pl
combination mancozeb + carbary
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ance to twospotted spider mite at
species was described by Johnson
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Because of the severity of attac
frequency of twospotted spider
research was done to compare fol
with soil-applied, systemic insecti
Populations of mites were counte
lation levels. Yield, grade, and va

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