OBSERVATIONS ON THE OVIPOSITION PROCESS OF *DIAPREPES ABBREVIATUS* (COLEOPTERA: CURCULIONIDAE)

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A single adult *Diaprepes abbreviatus* L. was discovered in a citrus nursery in Orange County Florida (Woodruff 1964). *D. abbreviatus* was not collected again until 1968, when larvae were collected at the same nursery and several hundred adults and larvae were subsequently collected in and around Apopka, FL (Woodruff 1968). Since its introduction in 1964, *D. abbreviatus* has spread to 20 counties in Florida, where it currently infests approximately 164,000 acres (66,420 ha) (Anonymous 1997). This area contains approximately 30,000 acres (12,150 ha) of infested commercial citrus and has a limited and localized geographical distribution.

D. abbreviatus is an insidious pest; tree symptoms may not appear until the larvae are well established on the tree roots (Wolcott, 1936). Adults feed on young foliage, females lay egg clusters between leaves, and the larvae feed on the roots of a host (Fennah 1942, Jones 1915, Wolcott 1936, Woodruff 1968). Oviposition by *D. abbreviatus* appears to be restricted to nighttime hours (Jones 1915, Schroeder 1981, Wolcott 1936). Females oviposit approximately 60 egg masses during their lifetime which may contain from 30 to 260 eggs each and an average of about 5,000 eggs over their life span (Wolcott 1936). Wolcott (1933) observed that female *D. abbreviatus* preferred to oviposit between paper strips compared to leaves. Neonate larvae failed to emerge from these strips (Wolcott 1933). Fennah (1942) found that *D. abbreviatus* preferred paper strips over tin foil strips and mature leaves which were both favored over immature leaves for oviposition. Immature leaves are preferred feeding sites (Jones 1915, Wolcott 1936). Adair et al. (1998) reported that freezer paper strips might serve as a potential oviposition trap in citrus.

Adult *D. abbreviatus* were field collected in Vero Beach, Florida and maintained as previously described (Adair et al. 1998). Thirty females and 30 males per cage were held in 30 × 30 × 60 cm aluminum rearing cages (Bioquip Products, Gardena, CA 90248-3602) at 27 ± 2°C, 30% RH and photoperiod of 11:13 (L:D). Five 2.54 cm × 15.24 cm doubled strips of transparency film (polyester, Labelon, Canadaigua, NY 14424) were provided for oviposition sites. At 10:00 PM, transparency film strips containing an ovipositing female were removed to a microscope stage for observation and photographing.

Microscopic observations were conducted with an Olympus S2-6045 zoom stereo microscope with a 100AL 0.5× objective lens, 10× eyepiece and a NFK 2.5 × LD 125 lens and Olympus S2-PT (with L-adapter) adapter for a SLR camera. An Olympus OM 2S camera with automatic shutter speed and f-stop was used with Kodak Kodacolor 400 Gold® film. The transparency film strip with an ovipositing female was placed across an open Petri dish and illuminated above and below with a tungsten halogen lamp (Olympus Highlight 3000) equipped with bifurcating cold fiber optic goose neck

illuminators. Ovipositing females were videotaped with a Sony Color Video camera (CCD-IRIS) top-mounted on the dissecting scope using standard recording mode to record time sequence data. Times were compiled for the following stages:

Ovipositor Extension (Fig. 1-1). Ovipositor moved down toward previously laid row of eggs. This process followed the resting stage. Ovipositor probed along row of eggs previously deposited to find position for next row. Rear legs were aligned in conjunction with ovipositor.

Lower Adhesive Deposition (Fig. 1-2). Timed from start of adhesive material deposition. Ovipositor was now at base of egg mass. Ovipositor moved in dabbing motion. Rear legs squeezed the transparency film thus spreading the adhesive.

Oviposition (Fig. 1-3, 1-4). A row of eggs was laid from bottom to top one by one. Each egg was placed approximately horizontal.

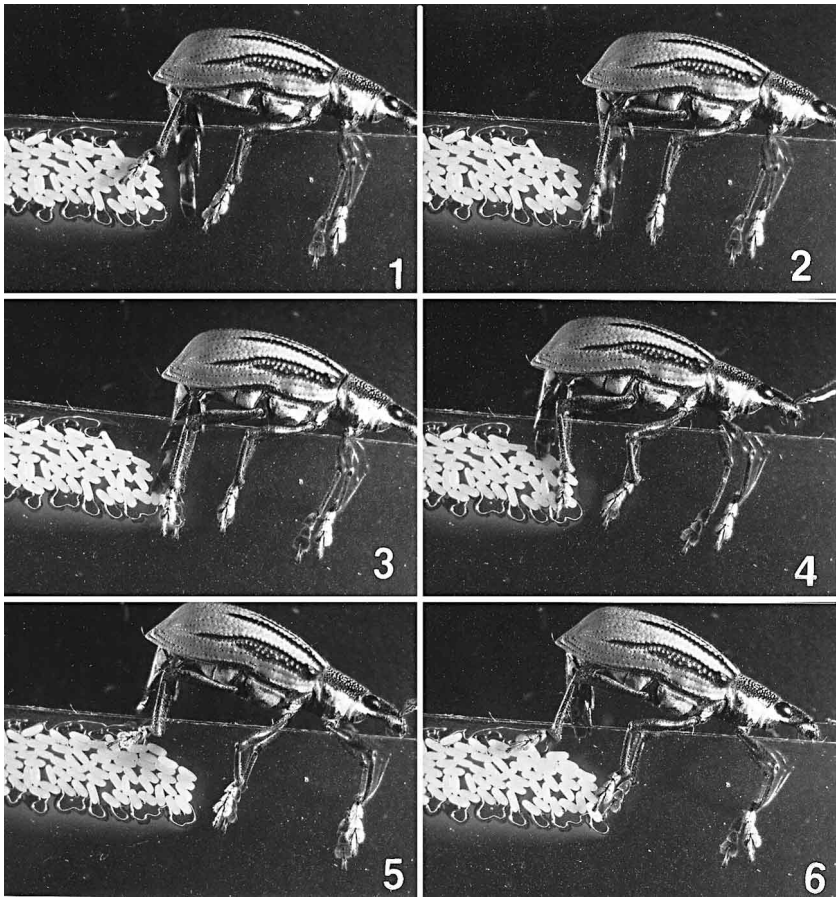

Fig. 1. Oviposition Postures of *Diaprepes abbreviatus*. 1. Ovipositor extension, 2. Deposition of lower egg mass adhesive, 3. Oviposition (lower), 4. Oviposition (upper), 5. Deposition of upper egg mass adhesive, and 6. Resting Posture.

Upper Adhesive Deposition (Fig. 1-5). Timed from start of adhesive deposition along upper surface of egg mass.

Rest (Figs. 1-6). Ovipositor withdrawn from egg mass to the edge of the transparency film and held at approximately 9% angle to horizontal edge of transparency film.

Twenty-one ovipositing females were observed and photographed. However, Fig. 1 is a sequence of photographs from one female. The female in Fig. 1 had laid approximately one-half of the egg mass when moved to the microscope stage. If a female was moved during the onset of oviposition or after the completion of oviposition, it dropped to the cage floor, typical evasive behavior of D. abbreviatus. When fully engaged in oviposition, females were easily moved to the microscope stage and completed production of an egg mass. Eight females were used for the stage time calculations. These females completed the 5 stages (above) 4 or more times (about 5.1 times per female). Forty-one replications were used for the time calculations.

Visual results are presented in the photographs of Fig. 1. The steps for oviposition and their time course (N = 41) in Fig. 1 are: ovipositor extension (30.8 ± 2.9 s mean ± S.D.), deposition of the lower egg mass adhesive (18.9 ± 1.9 s), oviposition (123.3 ± 12.0 s), deposition of the upper egg mass adhesive (22.7 ± 1.5), and rest (84.7 ± 10.7 s). This cycle averaged 4.7 min and was systematically repeated until all eggs in a single mass were deposited; 7-9 eggs were oviposited per cycle. Egg mass deposition time can be estimated by dividing the number of eggs in a mass by 8 and multiplying by 4.7 min (approximately 1.7 eggs/min). For example, a 100 egg mass would take approximately 1 h to deposit. Schroeder (1981) reported 1 h for an egg mass containing 80 + eggs; no data were presented.

After each egg was discharged females probed with the end of the ovipositor to position the next egg directly on top of the previous egg. Similarly, the ovipositor was used to locate the perimeter of the egg mass to deposit the upper and lower portions of the adhesive liquid. All females observed were consistent in applying the adhesive material only to the outer edges of the egg mass and none were observed depositing it inside the egg mass.

Summary

Oviposition by *D. abbreviatus* occurred in a six stage cycle of about 4.7 min. Consequently, a 100 egg egg mass would take about 1 h to complete. The six stages were documented photographically.

Endnote

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