Reproductive Biology of *Fidiobia dominica* (Hymenoptera: Platygastriidae), an Egg Parasitoid of *Diaprepes abbreviatus* (Coleoptera: Curculionidae)

**RITA E. DUNCAN,** **BRYAN J. ULMER,** **JORGE E. PEÑA,** **AND STEPHEN L. LAPOINTE**

**ABSTRACT** The reproductive biology of *Fidiobia dominica* Evans (Hymenoptera: Platygastriidae) was studied in the laboratory (25.6 ± 1°C) using host eggs of *Diaprepes abbreviatus* L. (Coleoptera: Curculionidae). *F. dominica* readily parasitized *D. abbreviatus* eggs on both host plant and wax paper substrates. The number of egg masses parasitized and the number of offspring produced were higher when females were offered more than one host egg mass but did not differ when either two or three egg masses were offered. Female parasitoids that were provided with host eggs and a honey food source lived significantly longer than those that were not provided a food source; however, they did not parasitize more *D. abbreviatus* eggs. Oviposition occurred in host eggs from 0 to 7 d old, and host mortality was relatively consistent for eggs 0–5 d old and lower for eggs 6–7 d old. Successful parasitoid emergence seldom occurred after host eggs were 4 d old, and by 7 d, no adults successfully emerged. Developmental time from egg to adult was 19.3 ± 0.2 d for males, significantly more rapid than the females (20.4 ± 0.1 d). The mean longevity of adult females was 8.0 ± 0.4 d, with a mean oviposition period of 2.7 ± 0.3 d; males survived 8.1 ± 0.4 d. The demographic parameters including intrinsic rate of increase (rm), generation time (T), and net reproduction (R0) were 0.142/d, 22 d, and 22.4 female eggs/d, respectively.

**KEY WORDS** classical biological control, citrus integrated pest management, oviposition, reproduction, nutrition

*Diaprepes abbreviatus* L. (Coleoptera: Curculionidae) was first reported in the United States in Orange County, FL, in 1964 (Woodruff 1964). It is now established across south and central Florida and is a major pest of the citrus industry, where it is estimated to cost producers tens of millions of dollars annually (Stanley 1996); it is also a significant pest for ornamental plants from 59 families (Simpson et al. 1996). Citrus is highly polyphagous and has been associated with root rot organisms including *Phytophthora* spp. (Timmer et al. 2005). Citrus production in infested areas has been heavily impacted, resulting in severe tree decline and loss of production (McCoy et al. 1995). Biological control is a critical element in an ongoing effort to establish an integrated pest management (IPM) system for *D. abbreviatus*. The lack of native parasitoids attacking this pest (Hall et al. 2001) and an earlier failed attempt at classical biological control (Sutton et al. 1972) led to programs aimed at introducing hymenopteran egg parasitoids from the Caribbean. From 1997 to 2000, three species of egg parasitoid were introduced into Florida. *Ceratogramma etiennei* Delvare (Hymenoptera: Trichogrammatidae) was recovered 1 yr after its release but failed to establish (J.E.P., unpublished data). *Quadrastichus hai-tiensis* Gahan and *Aprostocetus vaquitarum* Wolcott (Hymenoptera: Eulophidae) have established in areas

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of south Florida, where they cause significant mortality to D. abbreviatus eggs (Peña et al. 2006). However, neither parasitoid has established in the citrus-producing areas of central Florida (Castillo et al. 2006, Ulmer et al. 2006). D. abbreviatus is established from the southern tip of the peninsula in Miami-Dade County to Marion and Volusia counties in the central portion of the state (Weissling et al. 2004). Consequently, efforts are ongoing to discover an egg parasitoid that will successfully inhabit the range of D. abbreviatus in Florida.

In April 2003, J.E.P. led a survey for citrus weevil egg parasitoids on the island of Dominica. Fidiobia dominica Evans (Hymenoptera: Platygastridae) was discovered attacking Diaprepes abbreviatus (Guérin) and caused ~11% mortality (Evans and Peña 2005). It was subsequently imported to the quarantine facility at the University of Florida, Tropical Research and Education Center (UF-TREC), in Homestead, FL, to be studied as a potential biological control agent for D. abbreviatus. Preliminary studies showed that F. dominica is a primary, solitary endoparasitoid that successfully parasitizes D. abbreviatus eggs (Evans and Peña 2005). In this study, we report on the investigations undertaken to determine the reproductive biology of F. dominica. Various aspects of reproduction were studied under laboratory conditions using D. abbreviatus as a host, including fecundity, developmental time, and the conditions of the host necessary for successful parasitism, as well as the influence of various rearing conditions. The data presented are a critical step toward understanding the basic biology and conditions needed for rearing this previously unstudied insect.

Materials and Methods

Insects. Colonies of D. abbreviatus were obtained by collecting adult weevils from fields of ornamental trees near Homestead, FL (80.2° W, 25.3° N, 1 m alt.). The weevils were placed in 30 by 30 by 30-cm Plexiglas cages (200 adults per cage) with water and foliage of the host plant Conocarpus erectus L. (Myrtales: Combretaceae), which provided a food source and an oviposition substrate. The foliage was in the form of bouquets containing 20–25 terminal branches (each 15–20 cm long and with ~10 leaves) placed in a 500-ml plastic container full of water. Wax paper strips (3 by 10 cm) stapled together were also used as an oviposition substrate as described by Étienne et al. (1990). The oviposition substrate was renewed every 2–3 d. The stock colony of D. abbreviatus was held in a room maintained at 25.6 ± 1°C, 12:12 L:D, and ~65% RH. A colony of F. dominica was initiated at the UF-TREC from material collected in Dominica (Evans and Peña 2005). The stock colony of F. dominica was reared on D. abbreviatus host eggs using wax paper as a substrate (Étienne et al. 1990) and was held in a room maintained at 25.6 ± 1°C, 12:12 L:D, and ~65% RH. Voucher specimens of F. dominica were retained by the U.S. National Museum of Natural History (USNM), Florida Collection of Arthropods (Gainesville, FL), and the Canadian National Collection (Ottawa, Canada).

Assessment of Oviposition Substrates. To establish the oviposition substrate for our assays, F. dominica was offered <2-d-old D. abbreviatus egg masses (49.8 ± 1.9 eggs per egg mass) either concealed between C. erectus leaves as they would occur in nature, exposed on C. erectus leaves by separating the leaves of an egg mass, or exposed on wax paper strips. One naive female (<2 d old) was placed into a 10-ml test tube with a single egg mass. A smear of honey was provided on the inner surface of each test tube as a food source, and the open end of the tube was covered with a double ply Kimwipe (Kimwipes EX-L; Kimberly-Clarke, Rosswell, GA) secured with rubber tubing. Twenty-one F. dominica females were tested on each of the three treatments in a no-choice situation for a total of 63 insects. Host and parasitoid survival were recorded on each substrate; survival was considered neonate emergence for D. abbreviatus and adult emergence for F. dominica. In addition, a second set of test tubes was used to assess survival of D. abbreviatus eggs on each substrate without F. dominica (n = 20). Total number of eggs and neonate emergence were recorded on each substrate.

Host Availability. To determine the number of host egg masses needed to maximize fecundity, an excess number of host eggs were provided to F. dominica. Treatments consisted of a female F. dominica (0–3 d old) provided with one, two, or three egg masses (<2 d old) of D. abbreviatus in 10-ml test tubes as above. Host egg masses on wax paper were offered to each female for 24 h. The number of egg masses parasitized by each female, number of progeny produced by each female, and the number of host eggs available were recorded once all F. dominica adults and D. abbreviatus neonates emerged. The experiment was repeated 30 times for each treatment. Females that did not oviposit during the 24-h period were not included in the analysis.

Parasitoid Nutrition. To determine the effect of nutrition on female longevity, females were held under one of four conditions: water only; honey only; host eggs and water; or host eggs, water, and honey. Females (<24 h old) were placed in 10-ml glass test tubes (as above). The host egg treatments consisted of two D. abbreviatus egg masses (<2 d old) laid on wax paper. Those treatments that did not need host eggs received wax paper blanks with no eggs. Host eggs were removed and replaced daily. Exposed host egg masses were removed and placed in 10-ml glass test tubes (as above) until adult emergence. Emerging parasitoids were counted and sexed. Honey was provided in the form of a smear created with the pointed end of a needle on the inner surface of the test tube. Water was provided by wetting the double ply Kimwipe that covered the open end of the test tube. Females were checked twice daily for survival. The experiment was repeated with 28–30 females for each treatment.

Influence of Host Egg Age on Parasitism. A no-choice test was conducted to study F. dominica host
egg age preference. *D. abbreviatus* egg masses 1–7 d old were exposed to *F. dominica* females on wax paper. Host eggs were held in a 10-ml glass test tube (as above) before exposure to *F. dominica*. When eggs reached the appropriate age (1–7 d old), a single *D. abbreviatus* egg mass (58.1 ± 4.2 eggs) was offered to a naïve mated female (0–2 d old) for 24 h. After 24 h, the female was removed, and the egg mass was held in a 10-ml test tube until all *F. dominica* adults and *D. abbreviatus* neonates had emerged. The number of host eggs per egg mass, the number and sex of the emerging parasitoids, and the number of dead *D. abbreviatus* eggs were recorded. The experiment was replicated 29 times with host eggs aged 1, 2, 3, 4, 5, and 6 d and 22 times for 7-d-old eggs.

**Developmental Time.** Developmental time of male and female *F. dominica* was determined by offering two host egg masses (<2 d old) on wax paper to individual females (*n* = 25) held in 10-ml test tubes as above. Host egg masses were exposed to the females for 24 h; egg masses were individually transferred to 10-ml test tubes. Each egg mass was inspected daily for parasitoid emergence. Emerging parasitoids were recorded daily and removed and sexed at the time of emergence.

**Fecundity, Adult Longevity, and Demographic Parameters.** To determine daily and overall fecundity of *F. dominica*, presumably mated females <2 h old were placed in 10-ml test tubes (as above) with two host egg masses (<2 d old) on wax paper. Host egg masses were replaced by new ones daily until the female died. Host eggs were held until all *F. dominica* adults and host neonates emerged. These results were combined with developmental times and the sex ratio obtained in the earlier experiments to construct a life table for *F. dominica* and to calculate its intrinsic rate of increase (*r* <sub>m</sub>), generation time (T), and net reproduction (*R* <sub>n</sub>) (Birch 1948, Southwood and Henderson 2000). The following equations were used: *R* <sub>n</sub> = Σlxmx, T = ΣΣlxmx/*R* <sub>n</sub>, *r* <sub>m</sub> estimation = Σexp(Σlxmx(−*r* <sub>m</sub>x)), where *x* is the survivorship of the original cohort at age *x*, and nx is the number of female offspring produced per surviving female in each age interval.

**Experimental Conditions and Statistical Analysis.** All experiments were conducted in a room maintained at 25.6 ± 1°C, 12:12 L:D, and 56% RH. For assessment of oviposition substrates, parasitoid nutrition, and host availability, means were compared by Tukey’s honestly significant differences (HSD) test after a significant analysis of variance (ANOVA; *P* < 0.05). To examine the effect of host egg age on parasitoid emergence and host mortality and detect significant differences between the means (*P* < 0.05), data were subjected to a Kruskal-Wallis ANOVA. A one-way ANOVA was performed to determine differences in developmental time and adult longevity between the sexes of *F. dominica* (Statistix 8; Analytical Software 2003). 

### Results

**Assessment of Oviposition Substrates.** The initial number of *D. abbreviatus* eggs offered on the three oviposition substrates was not significantly different (*F* <sub>2,60</sub> = 2.16, *P* = 0.12; Table 1). The number of *D. abbreviatus* eggs that died from causes other than parasitism was also not significantly different (*F* <sub>2,60</sub> = 1.45, *P* = 0.24). *F. dominica* females parasitized substantially more host eggs on open wax paper and open *C. erectus* than they did on closed *C. erectus*. Significantly more progeny were produced (*F* <sub>2,60</sub> = 6.12, *P* = 0.004) and more host eggs were killed without adult emergence (*F* <sub>2,60</sub> = 3.72, *P* = 0.03) on wax paper and open *C. erectus* than on closed *C. erectus*. Consequently, more neonate *D. abbreviatus* emerged from closed *C. erectus* than from the other oviposition substrates (*F* <sub>2,60</sub> = 6.49, *P* = 0.003). In the control where eggs were not exposed to *F. dominica* females, there was no difference in mean egg mortality on wax paper (2.5 ± 1.4 SE), open (1.3 ± 1.1), or closed (0.3 ± 0.1) *C. erectus* (*F* <sub>2,37</sub> = 1.11, *P* = 0.34).

**Host Availability.** The mean number of egg masses parasitized was significantly higher when females were offered more than one egg mass, and the mean number of egg masses parasitized did not differ for females offered either two or three host egg masses (*F* <sub>2,83</sub> = 24.6, *P* < 0.001; Table 2). Ninety-seven percent of the tested females oviposited; females that did not oviposit were not included in the analysis. The mean number of eggs parasitized by *F. dominica* was significantly higher when offered more than one host egg mass, but there was no significant difference between those females offered two or three egg masses (*F* <sub>2,20</sub> = 4.0, *P* = 0.02). Females produced 15% more offspring when offered more than one egg mass. Females parasitized 74% of host eggs when offered a single egg mass. This proportion was significantly reduced when the number of egg masses was increased (*F* <sub>2,83</sub> = 39.0, *P* < 0.001; Table 2).

**Parasitoid Nutrition.** Female longevity was significantly affected by an oviposition substrate and a source of nutrition. Females that were provided with

### Table 1. Mean number (±SE) of total *D. abbreviatus* eggs, neonates, dead eggs, *F. dominica* adults, and parasitized eggs that did not produce adult *F. dominica* on three different oviposition substrates including wax paper, open *C. erectus*, and closed *C. erectus*.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Total Da eggs</th>
<th><em>D. abbreviatus</em> neonates</th>
<th><em>D. abbreviatus</em> eggs dead</th>
<th>Dead parasitized eggs</th>
<th><em>F. dominica</em> adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wax paper</td>
<td>58.1 (4.2) a</td>
<td>29.7 (5.2) ab</td>
<td>2.7 (1.8) a</td>
<td>7.5 (2.9) ab</td>
<td>18.3 (3.5) a</td>
</tr>
<tr>
<td>Open <em>C. erectus</em></td>
<td>46.3 (4.2) a</td>
<td>17.3 (3.3) b</td>
<td>3.6 (1.7) a</td>
<td>9.6 (2.8) a</td>
<td>15.8 (3.4) a</td>
</tr>
<tr>
<td>Closed <em>C. erectus</em></td>
<td>47.4 (4.9) a</td>
<td>41.1 (5.3) a</td>
<td>0.2 (0.2) a</td>
<td>1.1 (0.4) b</td>
<td>5.0 (1.9) b</td>
</tr>
</tbody>
</table>

Means within each column followed by the same letter are not significantly different (*P* = 0.05).
only host eggs and water died earlier than those provided host eggs or honey or honey and no host eggs ($F_{1,110} = 20.1, P < 0.001$; Table 3). Females provided only honey had the longest adult lives, which were approximately four times longer than those provided eggs and water. The presence of water did not affect longevity when females were provided with honey. Although females lived longer when provided a honey food source, they did not parasitize significantly more D. abbreviatus eggs than females that were not provided a food source ($F_{1,56} = 1.13, P = 0.29$). The number of adult offspring produced was also not significantly different between the treatments ($F_{1,56} = 0.56, P = 0.45$); the sex ratio of the offspring was comparable on the two treatments (Table 3).

**Table 2. Mean number (±SE) of egg masses and individual eggs parasitized by F. dominica when offered one, two, or three host D. abbreviatus host egg masses**

<table>
<thead>
<tr>
<th>Number of egg masses offered</th>
<th>$n$</th>
<th>Host egg masses parasitized per female</th>
<th>Host eggs parasitized per female</th>
<th>Proportion of host eggs parasitized</th>
<th>Percent of host egg masses parasitized</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29</td>
<td>1.00 ± 0.00 b</td>
<td>31.14 ± 2.11 b</td>
<td>0.74 ± 0.04 a</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>29</td>
<td>1.72 ± 0.08 a</td>
<td>36.14 ± 1.19 a</td>
<td>0.46 ± 0.03 b</td>
<td>86.2</td>
</tr>
<tr>
<td>3</td>
<td>28</td>
<td>1.79 ± 0.13 a</td>
<td>37.14 ± 1.36 a</td>
<td>0.34 ± 0.02 c</td>
<td>39.5</td>
</tr>
</tbody>
</table>

Means within each column followed by the same letter are not significantly different ($P = 0.05$). The mean number of host eggs per egg mass included in this study was 40.85 ± 1.36.

Developmental Time. A total of 41 male and 362 female F. dominica offspring emerged from the egg masses offered to 25 ovipositing females. Male developmental time from egg to adult was significantly shorter than that of females ($F_{1,401} = 35.0, P = <0.001$). Males emerged 19.3 ± 0.2 d after oviposition, 1 d earlier than females, which emerged 20.4 ± 0.1 d after oviposition.

**Table 3. Mean number of days adult females survived with and without host eggs and sources of nutrition and water**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Longevity (d)</th>
<th>Adult offspring</th>
<th>Total parasitism</th>
<th>Proportion female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggs/water</td>
<td>2.6 (0.2) b</td>
<td>13.2 (2.4) a</td>
<td>25.1 (2.5) a</td>
<td>0.76</td>
</tr>
<tr>
<td>Eggs/honey/water</td>
<td>7.7 (0.7) a</td>
<td>15.8 (2.4) a</td>
<td>28.7 (2.3) a</td>
<td>0.79</td>
</tr>
<tr>
<td>Honey/water</td>
<td>8.6 (0.7) a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Honey</td>
<td>10.3 (1.1) a</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Means within each column followed by the same letter are not significantly different ($P = 0.05$). Mean number of host eggs parasitized, total offspring produced, and proportion female offspring when females were provided host eggs with and without a nutrition source.


dized eggs did not successfully emerge, and many of those did not even reach puation. Host eggs that were 7 d old did not seem to support parasitoid development past the egg or early instars. There was no significant difference in the number of host eggs that were offered to females for the different host age groups ($F_{6,189} = 1.88, P = 0.09$). The sex ratio of F. dominica emerging from host eggs of different ages was relatively consistent across all host egg ages.

**Table 4. Mean number of days adult females survived with and without host eggs and sources of nutrition and water**

- **Treatment**
  - Eggs/water
  - Eggs/honey/water
  - Honey/water
  - Honey

- **Longevity (d)**
  - 2.6 (0.2) b
  - 13.2 (2.4) a
  - 8.6 (0.7) a
  - 10.3 (1.1) a

- **Adult offspring**
  - 13.2 (2.4) a
  - 15.8 (2.4) a
  - 8.6 (0.7) a
  - 10.3 (1.1) a

- **Total parasitism**
  - 25.1 (2.5) a
  - 28.7 (2.3) a
  -
  -

- **Proportion female**
  - 0.76
  - 0.79

Means within each column followed by the same letter are not significantly different ($P = 0.05$). Mean number of host eggs parasitized, total offspring produced, and proportion female offspring when females were provided host eggs with and without a nutrition source.


discussion

Fidiobia dominica was reared effectively on D. abbreviatus host eggs. This parasitoid was discovered on the island of Dominica attacking Diaprepes doublieti (Evans and Penia 2005); however, it thrived on D. abbreviatus host eggs in the laboratory and seems to be a viable biological control agent against this pest. Females oviposited under all conditions tested, but laboratory parasitism rates and adult production were higher when the host egg masses were opened and exposed to the parasitoid. Host eggs exposed on plant material and wax paper strips (Etienne et al. 1990) produced approximately the same amount of F. do-
minica offspring. Given that rearing this insect with wax paper was much less labor intensive, it was the preferred method for colony production and assay design. To maximize F. dominica production, the number of host egg masses offered should be approximately two per female each of the first 2–3 d of adult life; however, production does not increase by offering females more than two host egg masses of average size. It is noteworthy that, when females were presented with more than one host egg mass, they would often attack eggs from additional egg masses without parasitizing 100% of the eggs in any one egg mass. A carbohydrate source of nutrition has been shown to increase adult longevity, and often reproductive parameters, for many hymenopteran parasitoids (Heimpel et al. 1997, Baggen and Gurr 1998, Wackers 2001, Olson et al. 2005, Williams et al. 2005). Fidiobia dominica females that were fed honey lived longer than those without; however, honey did not increase fecundity under laboratory conditions. Oviposition in both treatments was limited almost entirely to the first 2 d. It seems that F. dominica females have a finite number of eggs, and given the minimal effort needed to locate hosts under laboratory conditions, they were able to oviposit these eggs within the first 2–3 d after emergence, regardless of the food resource provided. Leatemia et al. (1995) reported that, although lifetime offspring production of Trichogramma minutum Riley (Hymenoptera: Trichogrammatidae) was significantly higher when offered a honey food source, offspring production in the first 2 d was not significantly different for females provided honey compared with those that were unfed. Although a food source may not be vital for colony production, it may be much more important under field conditions where females would be required to forage and expend much more energy and time to locate host eggs. Some host eggs were killed with no parasitoid development in each treatment, but it was not clear if these eggs were fed on by female F. dominica. Host feeding by females has been observed in other parasitoids and is assumed to provide female wasps with resources that can be used during host searching or for egg maturation (Jervis and Kidd 1986, Godfray 1994).

Fidiobia dominica attacked host eggs from 0 to 7 d old; however, successful development to the adult stage dropped significantly when host eggs reached an age of 4–5 d. Although parasitoid development was generally not successful on host eggs that were >4 d old, the host egg was killed, resulting in substantial D. abbreviatus mortality among all ages of host eggs exposed to this parasitoid. Development of D. abbreviatus seemed to cease when parasitoid oviposition occurred, but it was not clear if the host was killed by the ovipositing female or the developing parasitoid. The relationship between host age and parasitoid oviposition and development observed for F. dominica was very similar to that observed for two other D. abbreviatus egg parasitoids: A. vaquitarum and Q. haitiensis (Jacas et al. 2005, Castillo et al. 2006). These eulophid parasitoids attacked host eggs up to 6 and 7 d old, respectively, but, as with F. dominica, successful development to the pupal and adult stage dropped significantly after host eggs reached 4 d of age.

Fidiobia dominica females were most productive during the first 2 d of adult life. After 2 d, they laid very few eggs, and no eggs were laid after the first week. This is in contrast to the eulophid egg parasitoids A. vaquitarum and Q. haitiensis, both of which laid a substantial number of eggs the first week of adult life and continued at low levels of oviposition for 2 wk at the same temperature (Jacas

<table>
<thead>
<tr>
<th>Host egg age (d)</th>
<th>n</th>
<th>Fd adults emerged</th>
<th>Fd females</th>
<th>Fd males</th>
<th>Dead Da eggs</th>
<th>Total Da eggs</th>
<th>No. of Da mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>29</td>
<td>18.8 (2.4) a</td>
<td>16.1 (2.3) a</td>
<td>2.7 (0.8) a</td>
<td>9.6 (2.1) a</td>
<td>28.5 (1.8) a</td>
<td>41.5 (1.9) a</td>
</tr>
<tr>
<td>1-2</td>
<td>29</td>
<td>11.3 (2.2) ab</td>
<td>10.1 (2.0) ab</td>
<td>1.2 (0.3) ab</td>
<td>14.3 (1.9) ab</td>
<td>25.6 (1.7) a</td>
<td>40.4 (2.7) a</td>
</tr>
<tr>
<td>2-3</td>
<td>29</td>
<td>12.7 (2.1) ab</td>
<td>8.3 (1.9) ab</td>
<td>3.4 (1.2) ab</td>
<td>9.9 (1.7) a</td>
<td>22.6 (2.1) a</td>
<td>36.5 (1.9) a</td>
</tr>
<tr>
<td>3-4</td>
<td>29</td>
<td>8.4 (1.9) ab</td>
<td>7.4 (1.7) ab</td>
<td>1.0 (0.3) abc</td>
<td>18.6 (2.5) ab</td>
<td>27.1 (2.7) a</td>
<td>41.4 (1.9) a</td>
</tr>
<tr>
<td>4-5</td>
<td>29</td>
<td>3.8 (1.9) bc</td>
<td>3.4 (1.2) bc</td>
<td>0.4 (0.2) bc</td>
<td>22.5 (2.4) b</td>
<td>26.3 (2.4) a</td>
<td>43.2 (1.4) a</td>
</tr>
<tr>
<td>5-6</td>
<td>29</td>
<td>0.1 (0.1) c</td>
<td>0.1 (0.1) c</td>
<td>0.0 (0.0) c</td>
<td>9.2 (2.0) a</td>
<td>9.2 (2.0) b</td>
<td>42.6 (2.0) a</td>
</tr>
<tr>
<td>6-7</td>
<td>22</td>
<td>0.0 (0.0) c</td>
<td>0.0 (0.0) c</td>
<td>0.0 (0.0) c</td>
<td>9.2 (2.0) a</td>
<td>9.2 (2.0) b</td>
<td>42.6 (2.0) a</td>
</tr>
</tbody>
</table>

Means within each column followed by the same letter are not significantly different (P = 0.05).

Fig. 1. Mean survival and mean (±SE) number of progeny (emergent adults) produced by female F. dominica on each day of adult life when provided honey and an excess of host eggs.

Table 5. Demographic parameters of F. dominica reared in the laboratory on D. abbreviatus

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Rm</th>
<th>T</th>
<th>rm</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.5°C</td>
<td>22.4</td>
<td>22.0</td>
<td>0.142</td>
</tr>
</tbody>
</table>

Net reproductive rate (Rm = female replacement), mean generation time (T, d), and intrinsic rate of increase (rm, d⁻¹).
et al. 2005, Castillo et al. 2006). Female longevity was also substantially lower for *F. dominica* (8.0 d) than was reported for either *A. vaquitarum* (15.2 d) or *Q. haitiensis* (14.5 d). Given the relatively brief life span and oviposition period of *F. dominica*, host availability, in time and space, may be more crucial for the establishment of this parasitoid. However, the demographic parameters for *F. dominica* are comparable with those of *A. vaquitarum* and *Q. haitiensis* (Jacas et al. 2005, Castillo et al. 2006), which have been successful egg parasites of *D. abbreviatus* in south Florida (Peña et al. 2006).

Overall, the demographic parameters for *F. dominica* reared on *D. abbreviatus* in the laboratory and its affinity for this host make it a promising candidate for biological control of this invasive pest. The development of a colony production protocol and the success of this parasitoid in the laboratory is also encouraging and bodes well for the planned release of *F. dominica* in Florida. Further research is needed to understand the effect of environmental factors, such as temperature and humidity, on population establishment and dispersal in the field.

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