ANTHONOMUS FLAVUS (COLEOPTERA: CURCULIONIDAE)
A FRUIT-INFESTING WEEVIL OF THE
BARBADOS CHERRY, MALPIGHIA GLABRA
(MALPIGHIACEAE), NEW TO NORTH AMERICA\(^1\)

CARL E. STEGMAIER, JR.\(^2\) AND HORACE R. BURKE\(^3\)

ABSTRACT

*Anthonomus flavus* Boheman, a fruit-infesting weevil, was first collected in the United States on 25 July 1972, at Hialeah, Florida by Carl Stegmaier. *A. flavus* infests the fruit of the Barbados cherry shrub, *Malpighia glabra* L. One to 20 larvae sometimes develop in a single fruit. The larvae pupate in a cavity formed by their feeding. During the period 25 July 1972 through 16 July 1973, 473 adult weevils were swept from the foliage of *Malpighia* spp., 4 adults were reared, and 144 larvae and 10 pupae were dissected from the fruit of *M. glabra* in Dade County. *A. flavus* is known to occur in the United States only in Dade County, Florida. Data on the life history, habits, hosts, and taxonomy of the species are presented. The pupal stage is described for the first time.

The purpose of this paper is to present the first published record of *Anthonomus flavus* Boheman from the United States and to contribute to the knowledge of the life history, habits, hosts, and taxonomy of the species. On 25-27 July 1972 the senior author collected 21 adult specimens of a small weevil from a Barbados cherry shrub, *Malpighia glabra* L., at Hialeah, Florida. These specimens were submitted to Rose Ella Warner (Systematic Entomology Laboratory, USDA) who determined them as *Anthonomus flavus* Boheman and (Pers. comm., 4 Aug. 1972) stated that this constituted a new record for the species from the United States. Previously *A. flavus* had been known to occur in Puerto Rico; St. Croix, St. Thomas, and St. John Islands; and Guadeloupe.

Since relatively little is known about *A. flavus*, its discovery in Florida afforded Stegmaier an excellent opportunity to pursue biological studies on the species. The contribution of the junior author is mainly that of presenting some preliminary information on the taxonomy of the species and describing the pupal stage.

LIFE HISTORY

The first biological data recorded under the name "*Anthonomus flavus* Boheman" were presented by Wolcott (1950) on the basis of observations made in Puerto Rico. Wolcott described the injury caused by the weevil on fruit of *Malpighia* as being similar to that of the plum curculio, consisting of a

\(^1\) Contribution No. 290, Bureau of Entomology, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, Florida 32601.

\(^2\) Research Associate, Florida State Collection of Arthropods, Division of Plant Industry, Florida Department of Agriculture and Consumer Services.

\(^3\) Texas Agricultural Experiment Station, Department of Entomology, Texas A&M University, College Station, Texas 77843.
crescentic scar on the skin of the fruit and puckering of the flesh. According to Wolcott’s account, the larva confines its feeding to one area and pupates in the fruit near a seed. Wolcott later (1955) stated that on Malpighia puniceifolia L. (now considered by some to be a synonym of M. glabra) in Puerto Rico the eggs are deposited either in the ovary of a flower or in tender young fruit. An earlier record which probably refers to A. flavus also was made by Wolcott (1936). He stated that “Anthonomus flavipes Boheman” had been reared from the fruit of Malpighia glabra at Mayaguez, Puerto Rico. We have been unable to determine that a species by this name has been described in the genus. Furthermore, judging from the host data given and the fact that Wolcott stated that the type was from Guadeloupe (the type locality of A. flavus Boheman), this appears likely to be an error in the spelling of the name; Wolcott’s statement probably refers to A. flavus.

Our first encounter with the immature stages of this weevil came on the evening of 18 May 1973, when 22 larvae and 1 pupa were dissected from 6 malformed Barbados cherry fruit in Hialeah, Florida. Most of the larvae (Fig. 6) were found immediately beneath the skin of the fruit; however, some individuals occurred within the flesh near the seeds. The single pupa was found in a pupal chamber composed of seed fragments possibly cemented together with fecal material on the exterior of a seed. One of the fruit examined contained 10 larvae. It was noted also that the Caribbean fruitfly, Anastrepha suspensa (Loew), coexisted with some of the larvae of A. flavus.

On 19 May, 6 fruit were examined and found infested with 11 larvae of A. flavus at the Stegmaier residence. Moreover, a single rotten fruit found on the ground contained 4 live larvae. An infested fruit showing a crescentic scar of the type mentioned by Wolcott (1950) is illustrated in Fig. 7. The infestations cited above were found at the end of the fruiting period of M. glabra.

Mr. Robert J. Reasoner who resides in the neighborhood of 83rd Avenue and S. W. 4th Street, Miami, collected 7 infested fruit of Malpighia glabra on 24 May; this fruit contained 39 larvae, 4 pupae, and a single teneral adult which emerged while dissections were being made. A subsequent collection of 12 infested fruit taken by Mr. Reasoner from his neighborhood on 29 May contained 61 larvae dissected from 10 fruit; however, 1 of the fruit was infested with 20 larvae. Mr. Reasoner informed Stegmaier that the fruiting season for Malpighia glabra was over at that time. The senior author tried to induce pupation of larvae in the 2 remaining fruit collected by Mr. Reasoner and was surprised to discover 4 pupae in 1 of the 3 seeds in the fruit.

Mr. Edward R. Bartley of Kendall, Florida, provided 20 fruit collected on 30 May 1973; however, upon examination these proved not to be infested. The senior author and Mr. George Avery opened some 50 fruit at the Fairchild Tropical Garden on 31 May 1973, and the findings were also negative. Sweeping the foliage of 3 species of Malpighia on the same day proved to be successful, as 92 adults were taken in this manner at the Fairchild Tropical Garden. One plant known as Singapore Holly, Malpighia coccigera L., used for ornamental purposes, about 14 in. high with spiny leaves was without fruit but bore flowers and buds; 21 adult weevils were swept from this plant. It should be noted here that Burke and Ahmad (1967), from their biological studies on the genus Anthothonomus, stated “Larvae of most species of Anthothonomus for which biological data are available develop either in the flower buds, or in the flower heads or in a few cases as inquilines in various types of galls. At least some of the few species which feed as larvae in fruits
may do so secondarily, as they are also known to develop in flower buds." A. flavus probably develops in flower buds in Florida also, as it has been reported to do so in Puerto Rico by Wolcott (1955).

On 31 May 1973, Dr. Robert Knight escorted the senior author through the U. S. Plant Introduction Station (located 27 blocks south of the Fairchild Tropical Garden) in an effort to establish other potential hosts for A. flavus and distribution of the weevil. The search for the weevil was negative on this date despite extensive sweeping of foliage of well established Malpighia varieties and examinations of mature fruit. A return trip was made to the "Station" on 7 June, and 96 fruit were collected from a variety of Malpighia glabra, bearing the Plant Introduction No. 98866; this variety was imported from Surinam, South America, in 1932. An examination of all of the fruit present resulted in finding 3 larvae at the Station, and to date no further records are available from this site.

Wolcott (1955) reported larvae of A. flavus feeding in the flower buds and newly developing fruits of the West Indian cherry, M. puniceifolia. Dr. Robert Knight informed Stegmaier that "puniceifolia" is considered by several subtropical horticulturists to be a synonym of "glabra."

The single Barbados cherry shrub in Stegmaier's backyard is 20 years old, and during the past 6 years it has been examined frequently to determine its various insect associates. No weevils were recorded from the shrub until 25 May 1972, and even though R. E. Warner had indicated (Pers. comm., 4 Aug. 1972) that the weevil was new to North America, no further action was taken until the senior author's wife brought him the aforementioned 6 malformed, infested fruit on 18 May 1973. To date in Dade Co., Florida 473 adults have been swept from Malpighia shrubs, 144 larvae and 10 pupae were dissected from 199 fruit obtained from 3 localities, and 4 adults were reared from 2 collections.

Malpighia glabra, a glabrous shrub, grows to 10 ft. high (Bailey 1949). It is native to northern South America northward to south Texas and occurs in Florida and the West Indies.

No one knows for certain how A. flavus managed to become established in Dade County. It is possible that some individual with a taste for exotic fruit smuggled some infested Barbados cherry fruit from the Caribbean area into Florida. Another possibility is that the weevil managed to reach Florida as a hitchhiker aboard an aircraft. It is also quite possible that undetected weevil infestations in varieties of Malpighia glabra, such as the B-17 variety, being imported into Florida by nurseries, harbored A. flavus within the flower buds or young fruit.

The preferred host for Anthonomus flavus probably is M. glabra; however, more extensive research should be conducted by horticultural entomologists stationed in south Florida to determine the extent of infestations on this and other possible hosts.

**Taxonomy**

Taxonomic Relationships—Anthonomus flavus was first described from Guadeloupe by Boheman (1843). The species was not further treated taxonomically until Hustache (1929) redescribed and keyed it in a publication on curculionids of Guadeloupe. A. flavus is allied with a group of tropical species referred to collectively by Champion (1903) as the A. venustus Group.
### TABLE 1. Collection Records of *Anthonomus flavus* from Dade County, Florida

<table>
<thead>
<tr>
<th>Dates Collected</th>
<th>Host</th>
<th>Number of Fruit Examined</th>
<th>Larvae</th>
<th>Pupae</th>
<th>Swept Adults</th>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-VII-72</td>
<td><em>M. glabra</em></td>
<td>14</td>
<td></td>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>27-VII-72</td>
<td></td>
<td>7</td>
<td></td>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>18-V-73</td>
<td></td>
<td>6</td>
<td>22</td>
<td>1</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>19-V-73</td>
<td></td>
<td>6</td>
<td>11</td>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>20-V-73</td>
<td></td>
<td>6</td>
<td></td>
<td>20</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>21-V-73</td>
<td></td>
<td>4</td>
<td></td>
<td>49</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>22-V-73</td>
<td></td>
<td>6</td>
<td></td>
<td>14</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>24-V-73</td>
<td></td>
<td>7</td>
<td>39</td>
<td>4</td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>26-V-73</td>
<td></td>
<td>6</td>
<td></td>
<td>16</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>29-V-73</td>
<td></td>
<td>12</td>
<td>62</td>
<td>3</td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>31-V-73</td>
<td><em>M. cocigera</em> L.</td>
<td>21</td>
<td></td>
<td></td>
<td>e</td>
<td></td>
</tr>
<tr>
<td>3-VI-73</td>
<td><em>M. sp.</em> (a)</td>
<td>25</td>
<td></td>
<td></td>
<td>e</td>
<td></td>
</tr>
<tr>
<td>9-VI-73</td>
<td><em>M. glabra</em></td>
<td>33</td>
<td></td>
<td></td>
<td>e</td>
<td></td>
</tr>
<tr>
<td>10-VI-73</td>
<td><em>M. glabra</em></td>
<td>38</td>
<td></td>
<td></td>
<td>e</td>
<td></td>
</tr>
<tr>
<td>13-VI-73</td>
<td></td>
<td>52</td>
<td>3</td>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>19-VI-73</td>
<td></td>
<td>26</td>
<td>3</td>
<td></td>
<td>f</td>
<td></td>
</tr>
<tr>
<td>30-VI-73</td>
<td></td>
<td>22</td>
<td>7</td>
<td>2</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>25-VI-73</td>
<td><em>M. glabra</em></td>
<td>16</td>
<td></td>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>26-VI-73</td>
<td></td>
<td>12</td>
<td></td>
<td>25</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>16-VII-73</td>
<td></td>
<td>41</td>
<td></td>
<td></td>
<td>c</td>
<td></td>
</tr>
</tbody>
</table>

**TOTALS**: 199 144 10 473

---

a. Fairchild Tropical Garden. Acc. No. X-12-104. Believed to be a wild strain of *Malpighia glabra*.
b. U. S. Plant Introduction Station. Plant Introduction No. 98866, introduced from Surinam, S. A., in 1932. This introduction is a variety of *Malpighia glabra*.
c. C. Stegmaier's residence. 11335 N. W. 69th Avenue, Hialeah, Florida.
d. R. J. Reasoner's neighborhood. 83rd Avenue and S. W. 4th Street, Miami, Florida.
e. Fairchild Tropical Garden. 109th Street and Old Cutler Road.
f. U. S. Plant Introduction Station. 139th Street and Old Cutler Road, Miami, Florida.

Champion originally placed 5 species in this group, including *Anthonomus venustus* Champion (Guatemala), *Anthonomus cinerus* Champion (Mexico), *Anthonomus melanostictus* Champion (Panama), *Anthonomus calvecens* Champion (Guatemala), and *Anthonomus v-notatus* Champion (Panama). The latter 2 species obviously do not belong in the same taxonomic group as the other 3 and are herein removed from the group. They are replaced in the *A. venustus* Group by *A. flavus* and *Anthonomus tridens* Fall which are associated with the group for the first time in the present paper. *A. tridens* was described originally from Baja, California (Fall 1909), but it is now known to...
be more widely distributed in Mexico. Some species from the West Indies probably fall into this group also. A careful taxonomic revision of the group is needed to determine the relationships and status of the various species included.

The A. venustus Group is characterized by: the small size (2.2-3.3 mm); relatively dense dorsal covering of small, elongate scales; color pattern of elytra usually with an oblique light-colored line extending from humerus to suture at middle forming a v-shaped pattern; profemora greatly enlarged, maximum width about 1.6 X that of mesofemur; each profemur bearing 2 or 3 femoral teeth; protibiae strongly curved; middle and hind legs tending to be testaceous in color and contrasting sharply with darker fore legs; eyes strongly rounded; third elytral interval elevated at base.

It is also possible that the group may be further characterized on the basis of host data. A. flavus develops in flower buds and fruit of Malpighia spp. A. melanostictus has been collected on Malpighia sp. in Mexico, and an undescribed species of the group has been taken on Malpighia mexicana Juss. in Mexico. Two species from St. Vincent which probably belong to this group have been associated with Malpighia according to data from the (U. S.) National Museum of Natural History provided by R. E. Warner (Pers. comm., 24 July 1973). Although hosts are not known for the remaining species, it seems safe to assume on the basis of their similarity to A. flavus and A. melanostictus that these species also utilize plants of the family Malpighiaceae as hosts. Other such well defined species groups in the genus Anthonomus are confined to either a single plant genus or to closely related genera as hosts.

In addition to A. flavus from Florida, 2 other species of the A. venustus Group occur in the United States. A few specimens of an undetermined species (near A. tridens Fall) have been collected in the vicinity of Brownsville, Texas. Malpighia glabra occurs in the Brownsville area, but we have not had an opportunity to collect on the plant there. A single specimen of an apparently undescribed species has been examined from the Patagonia Mts., Santa Cruz Co., Arizona. No species of Malpighia is known to occur in this area in Arizona, but 2 other genera (Janusia and Aspicarpa) of Malpighiaceae are found there (Kearney and Peebles 1969). A. flavus (Fig. 3, 4, 5) may be readily separated from other species of the A. venustus Group examined by the fact that it does not have a distinct metafemoral tooth.

Anthonomus unipustulatus Champion also develops in the fruit of Malpighia spp. (Ahmad and Burke 1972; Berry 1959) in Mexico and Central America. Ahmad and Burke (1972) cited collection data indicating that the species also has been taken from the fruit of Malpighia glabra. The junior author of the present paper has collected A. melanostictus and A. unipustulatus from the same Malpighia tree in Mexico. However, the occurrence of A. unipustulatus on Malpighia should not cause taxonomic confusion as it is not closely related to any members of the A. venustus Group. A. unipustulatus has the profemur only slightly larger than the mesofemur, and, in addition, has a short stout rostrum and a single profemoral tooth.

DESCRIPTION OF PUPA—Terminology follows that of Burke (1968)

Length: 3.0-3.7 mm. (av. 3.2). Color: Whitish, turning darker with age; prothoracic setae and process of 9th abdominal segment brown. Rostrum (Fig. 2): One pair of distirostral setae located just before middle of rostrum; each borne on slight prominence; length of each seta equal to about 1/5 width of
Fig. 1 and 2. Pupa of *Anthonomus flavus*. (1) Dorsal view with enlargement of laterotergal seta 2. (2) Ventral view.

Rostrum; a pair of shorter, finer setae borne immediately distad of distirostrals. One pair of straight to slightly curved basirostral setae, each borne on a small tubercle, distance between setae equal to about 3/4 width of rostrum at base. **Head:** A pair of frontal setae, separated by approximately same distance as that separating basirostrals; stouter than basirostral setae. Supraorbital setae present. **Pronotum** (Fig. 1): All pronotal setae associated with tubercles; setae on anterior portion of pronotum stouter than those on posterior portion. Three pairs of anterolateral setae, each borne on summit of low rounded to subconical tubercle. Anteromedian setae each borne at apex on anterior face of a tall conical to subconical tubercle; tubercles separated by distance approximately equal to width of base of a tubercle. Posterior median setae much finer than anteromedians, located at middle to slightly behind middle of pronotum, each borne on top of a low tubercle or on side of short, tooth-like tubercle; tubercles separated by distance equal to about 3 X the width of one of the tubercles at base. Three pairs of postero-lateral setae, each of which is borne at or near base of spinelike tubercle. **Mesonotum:** Three pairs of fine, straight mesonotal setae, setae of 2 outer pairs each located at base of a toothlike tubercle. Inner seta may be located either at base of a small
Fig. 3, 4, 5. Adult of *Anthonomus flavus* collected at Miami, Fla. (3) Lateral View. (4) Anterior portion of body showing enlarged profemora and strongly curved protibiae. (5) Dorsal view showing color pattern of scales.

toothlike tubercle or on top of a small rounded one. *Metanotum*. Three pairs of metanotal setae, like mesonotals except more widely separated. *Abdomen*: Three pairs of discotergal setae on each of terga 18; setae fine, usually slightly curved, each shorter than 1/2 length of tergum on which it is borne; DsT₁ borne on summit of a small rounded to subconical tubercle; DsT₂ and DsT₃ each borne near base of a spine-like tubercle except on tergum 8 where it is located on summit of small tubercle; some tubercles with a small secondary spine at apex. Laterotergal setae 1 short, each little if any longer than tubercle on which it is borne; tubercles subconical, with a crown of 2 or more spines at apex. Laterotergal seta 2 fine, attenuate, slightly curved; each borne on end of a subconical or cylindrical tubercle bearing 3 short spines at apex (Fig. 1). Segment 9 not bearing setae; terminated by a single process which is forked at apex; extreme tip of each fork flattened. Laterosternal setae absent. *Legs*: Hind femora each with a distinct projection on inner margin at apex; femoral setae absent.
Fig. 6. Larvae of Anthonomus flavus feeding in the flesh of Malpighia glabra fruit immediately under the skin. Fig. 7. Deformed Barbados cherry fruit infested by larvae of Anthonomus flavus.


Diagnosis: The pupa of A. flavus is easily distinguished from pupae of the approximately 50 species of the tribe Anthonomini for which this stage is known. The prolonged inner apical angle of the metafemur and the peculiar laterotergal tubercles (each bearing a crown of 2 or 3 teeth) separate A. flavus from all other known pupae of the tribe. The single posterior process of the 9th abdominal segment with the bifid apex is shared only with Anthonomus albopilosus Dietz and Pseudanthonomus validus Dietz. A few other species have a single process, but it is not forked at the apex.

Larva—The larva of A. flavus was described and keyed by Ahmad and Burke (1972), and little additional information on this developmental stage can be offered here. The large number of larvae available during the present study did make it possible to determine the number of larval instars. There are apparently 3 instars (as in all other species of Anthonomus for which this information is available) with head capsule widths being as follows: first instar, 0.34-0.38 mm (9 specimens, av. 0.36 mm); second instar, 0.47 mm (1 specimen); third instar, 0.51-0.62 (40 specimens, av. 0.55 mm).

Disposition of Specimens

For reference purposes adults and larvae of Anthonomus flavus have been deposited in the following collections: Systematic Entomology Laboratory, U.
S. Department of Agriculture; Florida State Collection of Arthropods, Division of Plant Industry, Gainesville, Florida A&M University; Plant Protection and Quarantine Programs, USDA, APHIS, Miami; University of Florida, Subtropical Experiment Station, Homestead; U. S. Plant Introduction Station, Miami; Texas A&M University; University of California, Riverside; Carnegie Museum, Section of Insects and Spiders, Pittsburgh.

Acknowledgements

Thanks are due the following persons who helped to make this paper possible: R. E. Warner (Systematic Entomology Laboratory, USDA) for determination of the weevil, *Anthonomus flavus*, and for various other assistance; Dr. Robert Knight (research horticulturist, U. S. Plant Introduction Station) for the translation of Wolcott’s (1955) paper and for his assistance in locating specimens of *Malpighia* species at the “Station”; Dr. John Popenoe (Director, Fairchild Tropical Garden) for giving C. Stegmaier permission to collect specimens of fruit and weevils in the “Garden”; George Avery (botanist, Fairchild Tropical Garden Research Center) for his help in locating specimens of the various species of *Malpighia*; Robert J. Reasoner and Edward Bartley (Plant Protection and Quarantine Programs, USDA, APHIS, Miami) for their collections of Barbados cherry fruit cited in this paper.

Literature Cited


BIOLUMINESCENT COMMUNICATION BETWEEN FUNGI AND INSECTS—(Note) While on the 1969 Alpha Helix Expedition to New Guinea (N.S.F. supported through the Scripps Institution of Oceanography) I encountered a number of luminescent mushrooms. Dramatic to a night visitor to a rainforest, some are exceedingly conspicuous as they glow brightly against pitch black. Since the luminescent chemical reaction uses energy, and natural selection promotes efficiency, one is prompted to speculate on the adaptive significance of this phenomenon. The fungal light may attract insects that perform some service for the fungi. The fungivorous progeny of an attracted insect might consume but a small portion of the fruiting body but at the same time excrete chemicals that are essential for plant nutrition. (This hypothesis does not seem as far fetched as the reality of a venus flytrap or sundew capturing insects for their chemicals.) The attracted insects might disperse the spores of the fungi. If spores matured after the luminescence had ceased, and hence were not ready at the time of visitation, they might be carried away by the maturing progeny of an oviposition visitant. Or, as in the relationship between stinkhorn fungi and blow flies in European forests, an attracted insect might eat nonripe spores that complete their maturation in its gut and are later deposited elsewhere in the feces (W. Wickler, Mimicry, 1968, p. 155). Even the weak hyphal luminescence of the nearctic Omphalotus illudens might be attractive to soil or litter arthropods, where background light was absent.

The interactions in these hypotheses can be considered communication in the strict sense, since natural selection would enhance both signal and receiver components in the context of information transfer. J. E. Lloyd, University of Florida, Gainesville 32611.