CAPS Datasheets provide pest-specific information to support planning and completing early detection surveys.

Gymnandrosoma aurantianum

Figure 1. *Gymnandrosoma aurantianum* adult female. Photo credit: John W. Brown, National Museum of Natural History, Washington, DC.

Scientific Name

Gymnandrosoma aurantianum Lima, 1927

Synonym(s):

Ecdytolopha aurantianum (Lima, 1927)
Argyroploce torticornis Meyrick, 1931
Ecdytolopha torticornis Powell et al., 1995

Common Name

Citrus fruit borer, orange fruit borer, macadamia nut borer

Type of Pest

Moth, borer

Taxonomic Position

Class: Insecta, **Order:** Lepidoptera, **Family:** Tortricidae

Notes on taxonomy and nomenclature:

Gymnandrosoma aurantianum is a species complex consisting of several morphologically similar tortricid moths from Brazil to Mexico (Gilligan, 2025; Hayden et al., 2025). This datasheet covers any species published under the name *G. aurantianum* and known synonyms.

Pest Recognition

This section describes characteristics of the organism and symptoms that will help surveyors recognize possible infestations/infections in the field, select survey sites, and collect symptomatic material. For descriptions of diagnostic features, see the Identification/Diagnostic resources on the AMPS pest page on the CAPS Resource and Collaboration website.

Pest Description

Adults:

Adults are predominantly brown with indistinct reddish brown and black markings (Figs. 1 & 2) (Noboa et al., 2018). They have a wingspan ranging from ~$^{1}/_{2}$–$^{3}/_{4}$ inches and a body length of ~$^{3}/_{8}$ inches (Adamski and Brown, 2001; Bento et al., 2001b; Blanco-Metzler, 1994; White and Tuck, 1993). The forewings have a conspicuous white dot on the distal one-third of the forewing (Fig. 2) (Noboa et al., 2018). Male antennae are flattened at the base and have a characteristic notch (Fig. 3) (Adamski and Brown, 2001; Noboa et al., 2018). Adults rest on the trunk and inner branches in the lower, middle, or upper third of the tree canopy during the day. During dusk and twilight, the moths flies to the top of the canopy for mating (Bento et al., 2001a; Blanco-Metzler, 1994; Lima, 1945).

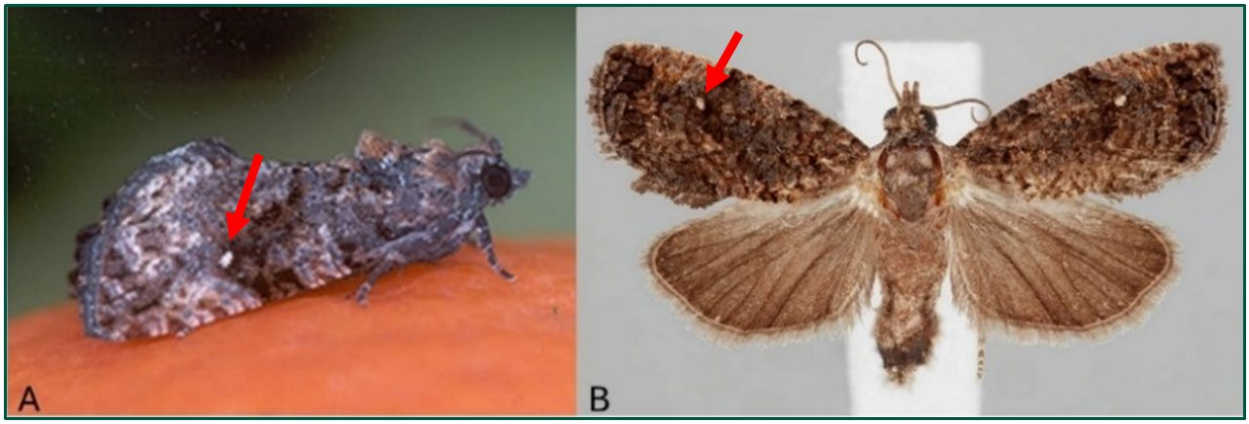

Figure 2. *Gymnandrosoma aurantianum* adults: when wings are folded (**A**) and when mounted (**B**). Red arrow indicates characteristic white dot on forewings. Photo credits: (A) Haroldo Volpe, Fundecitrus; (B) John W. Brown, National Museum of Natural History, Washington, DC.

Figure 3. Antenna of *G. aurantianum* male, showing characteristic notch. Photo credit: Julieta Brambila, USDA-APHIS-PPQ.

Eggs:

Newly laid eggs are pale white and flattened, circular to ovoid in shape, and small (less than $^{1}/_{16}$ in long) (Fig. 4A) (Blanco-Metzler, 1994; Lopez-Guillen et al., 2021). Eggs turn yellowish in the center and later darken to a reddish brown or pink as they mature (Blanco-Metzler, 1994; Lopez-Guillen et al., 2021). Eggs are commonly found on mature citrus fruit around the middle third of the tree canopy, or on immature macadamia fruit in the lower and middle parts of the tree canopy (Bento et al., 2001a; Blanco-Metzler et al., 1993; Blanco-Metzler et al., 2001; Parra et al., 2004).

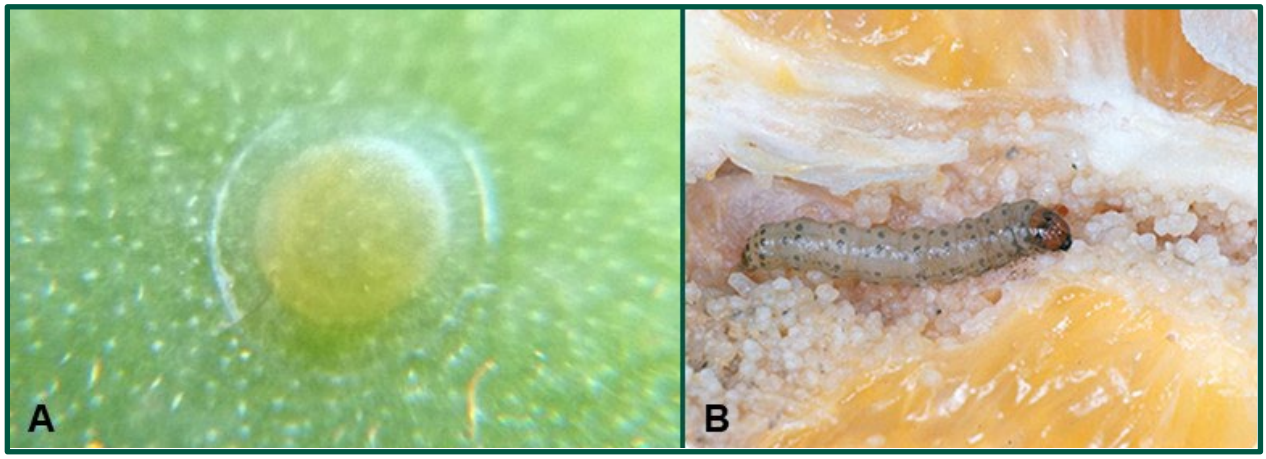

Figure 4. *Gymnandrosoma aurantianum* egg **(A)** and *Gymnandrosoma aurantianum* larva **(B)**. Photo credits: (A) Guillermo Lopez-Guillen, Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias, Mexico and (B) Haroldo Volpe, Fundecitrus.

Larvae:

Larvae are creamy white with brown patches; the head is pale yellow to pale orange, and then brown in the final instar (Fig. 4B) (Adamski and Brown, 2001; Noboa et al., 2018; Orellana et al., 2008). Last instar larvae are approximately ¾ inches long (Lopez-Guillen et al., 2021; Noboa et al., 2018). Larvae may be found inside fruits or nuts, feeding on the pulp or endosperm (Blanco-Metzler, 1994; Lima, 1945).

Pupae:

Newly formed pupae are brown and later turn dark brown, measuring approximately ¼ inches long (Adamski and Brown, 2001; Blanco-Metzler, 1994; Noboa et al., 2018). They are fusiform (spindle-like) in shape, tapering at both ends (Adamski and Brown, 2001). In citrus, pupae may be found in the soil and occasionally inside the fruit (Parra et al., 2004; White and Tuck, 1993). In macadamia, pupae may be found in nuts or on trees attached to lichens and moss (Blanco-Metzler, 1994; Blanco-Metzler et al., 1993).

Symptoms

Though most descriptions of damage are in *Citrus* × *aurantium var. sinensis* (orange) (Garcia, 1998; White and Tuck, 1993), *G. aurantianum* is known to infest several other citrus species, including *C*. *reticulata* (mandarin), *C*. x *paradisi* (grapefruit), and *C. limon* (lemon), (Adamski and Brown, 2001; Lima, 1945; Noboa et al., 2018; White and Tuck, 1993).

In citrus, a brown necrotic area surrounds the site of larval entry; the rind yellows, ripening prematurely (Fig. 6A, B, C) (White, 1999; White and Tuck, 1993). Frass will be visible near the larval entry point on the rind (Fig. 6A) (Bento et al., 2019; White, 1999). Most infested fruits drop prematurely (Bento et al., 2019; Carvalho et al., 2015), but both fruits that are penetrated when ripe and fruits that do not drop prematurely become a shade of orange that is distinct from healthy fruits (White and Tuck, 1993).

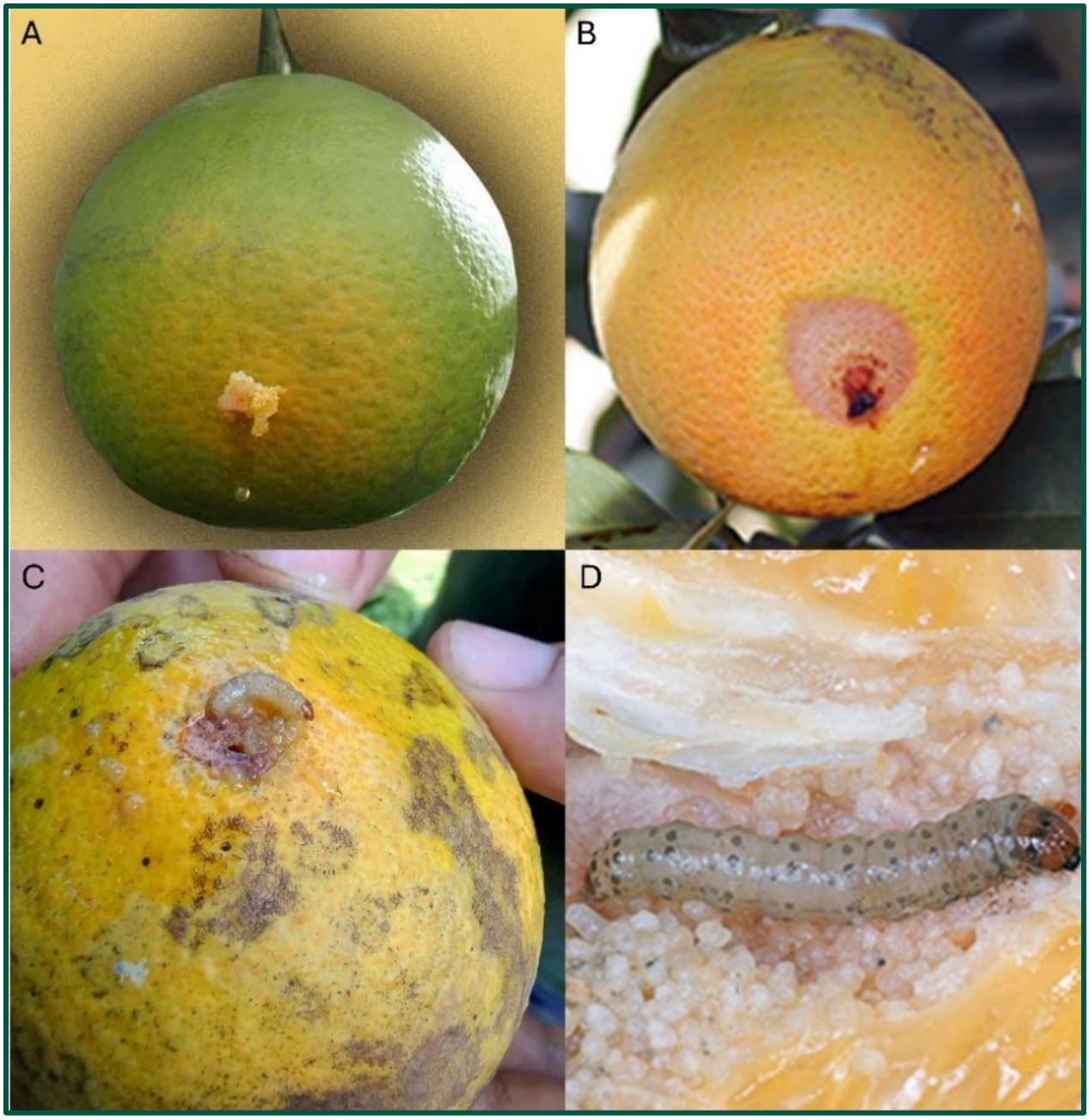

Figure 6. Feeding damage of citrus fruit borer on citrus: frass accumulation on the rind (**A**), sunken and necrotic area on the rind (**B**), a larva on the surface of the fruit (**C**), a larva inside the fruit (**D**). Photo credits: Haroldo Volpe, Fundecitrus.

In macadamia, the signs of infestation may not be readily visible because entry holes are initially small (Blanco-Metzler et al., 1993). As the larvae grow, the entry hole enlarges and frass accumulates in and around the entrance (Fig. 7) (Blanco-Metzler et al., 1993).

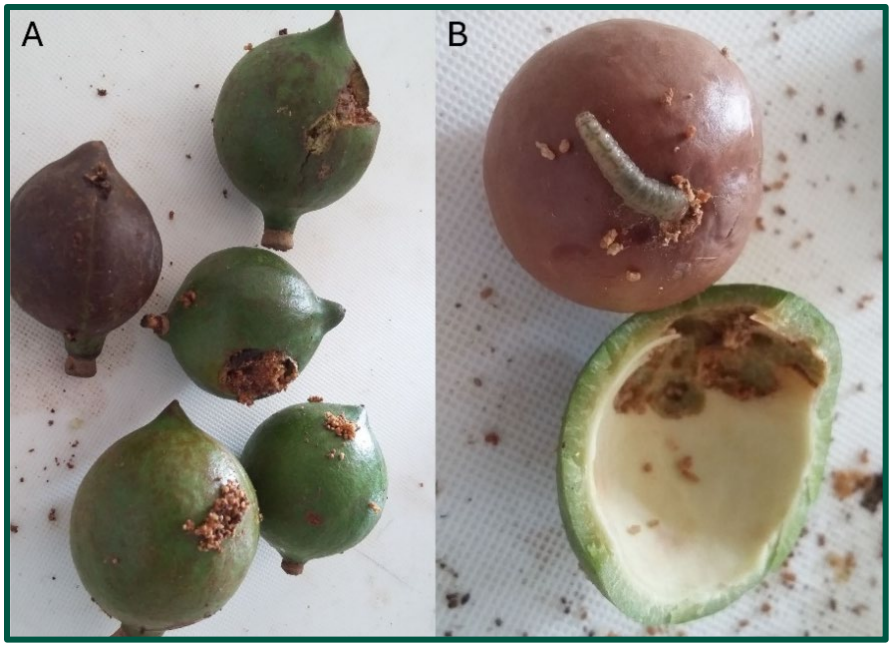

Figure 7. Feeding damage of the citrus fruit borer on macadamia nuts: larval feeding damage on the husk and frass accumulation (**A**) and internal damage on the shell of a macadamia nut (**B**). Photo credits: Guillermo Lopez-Guillen, Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias, Mexico.

In pecan, larvae excavate the husk and create frass-filled galleries between the husk and endosperm (Nava et al., 2020). Symptoms for other hosts are not included here, as they have not been as well described.

Easily Mistaken Species

In general, larvae and adults of the genera *Gymnandrosoma*, *Cryptophlebia*, and *Ecdytolopha* can look similar (Adamski and Brown, 2001). These moths are indistinguishable by eye and will require a taxonomic expert to identify to species by dissection and examination of the genitalia (Adamski and Brown, 2001; Cabrera-Asencio et al., 2012).

In macadamia growing areas, citrus fruit borer adults can be confused with members of the genus *Cryptophlebia* (Adamski and Brown, 2001; Blanco-Metzler, 1994). *Cryptophlebia illepida and C. ombrodelta* are present in Hawaii and are commonly found in macadamia nuts (Fig. 8A,B) (Jones, 1994; Namba, 1956).

Gymnandrosoma leucothorax and *G. trachycerus* are reported from Puerto Rico (Cabrera-Asencio et al., 2012), while *G. punctidiscanum* is found throughout the eastern United States and is commonly caught in CAPS survey traps for citrus fruit borer in Florida (Fig. 8C) (Brambila, 2023; Gilligan and Epstein, 2014). These species share some larval hosts with *G. aurantianum*, including *Citrus* spp. (*G. trachycerus*) and *Psidium guajava* (*G. leucothorax*) (Adamski and Brown, 2001). *Gymnandrosoma desotanum* and *G. orarum*, which both occur in Florida and are associated with

Rhizophora mangle, are occasionally caught in CAPS survey traps for citrus fruit borer (Adamski and Brown, 2001; Brambila, 2023; Hayden et al., 2025).

Other closely related moths which may be occasionally caught in CAPS survey traps include *Ecdytolopha mana* (Fig. 8D), *E. palmetum*, and *Cydia erotella* (Brambila, 2023). *Ecdytolopha mana* occurs in the southern United States from Arizona to Alabama and north to Maryland, and *E. palmetum* occurs in Florida (Adamski and Brown, 2001; Hayden et al., 2025). The range for *C. erotella* is poorly defined, but scattered populations have been reported in the eastern United States (Hall et al., 2025).

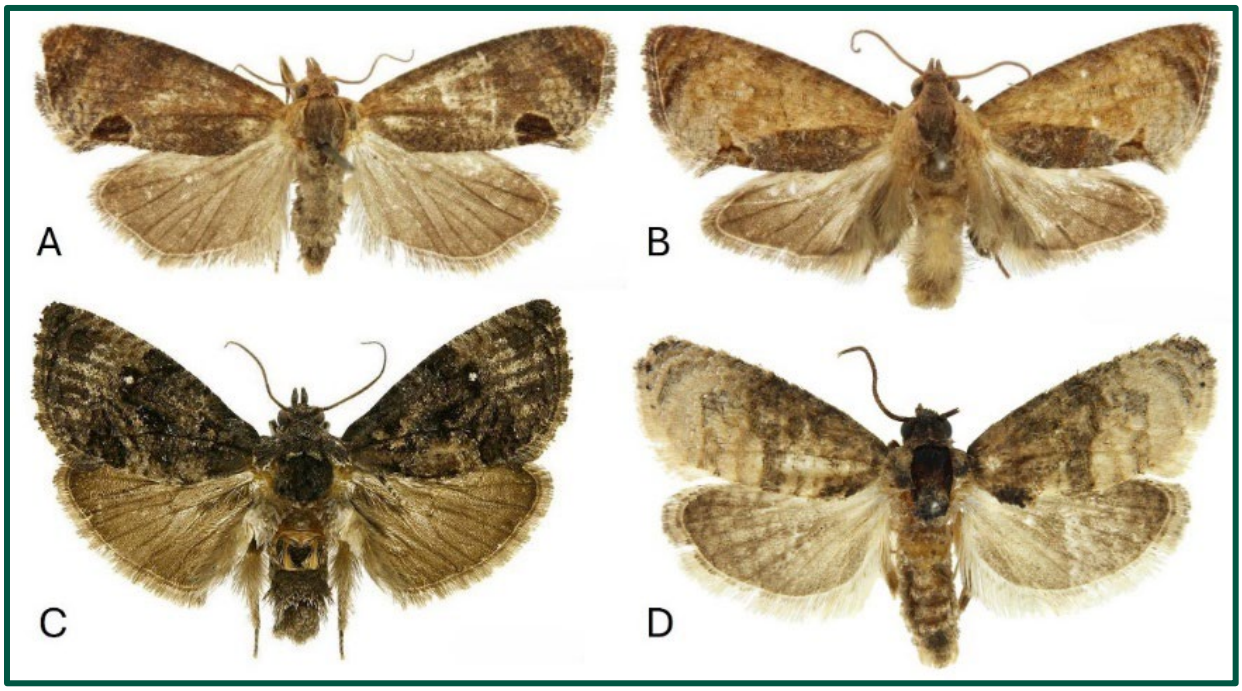

Figure 8. Moth pests that resemble citrus fruit borer: *Cryptophlebia illepida* (**A**), *C. ombrodelta* (**B**), *Gymnandrosoma punctidiscanum* (**C**), and *Ecdytolopha mana* (**D**). Photo credits: Todd M. Gilligan and Marc E. Epstein, TortAI: Tortricids of Agricultural Importance, USDA APHIS PPQ, Bugwood.org; all images CC BY-NC 3.0 US.

Commonly Encountered Non-targets

The CAPS approved survey method for this species is trapping with large plastic delta traps loaded with *Gymnandrosoma aurantianum* pheromone-based lure. In addition to members of *Gymnandrosoma*, *Cryptophlebia*, and *Ecdytolopha,* various other Lepidoptera that occur in the United States may be captured in traps designed for *G. aurantianum* due to their attraction to the components of the lure. These include: *Cnephasia asseclana, Esperia sulphurella, Hedya spp., Hypsopygia costalis* (clover hayworm), *Opogona sacchari, O. arizonensis*, and *O. floridensis* (CDFA, 2016; Covell Jr. and Gibson, 2008; Davis, 1978; El-Sayed, 2025; Gilligan et al., 2011; Lam et al., 2011; Powell, 1968; Rings, 1992; Yard and Garden, 2016).

Biology and Ecology

Citrus fruit borer has multiple generations per year; the number of generations depends on environmental conditions and host plant phenology. In tropical parts of Brazil and Costa Rica, the moth is active year-round and is estimated to have 7–10 generations per year (Bento et al., 2001b; Blanco-Metzler, 1994; Garcia, 1998; Parra et al., 2004).

Eggs are laid individually, with females rarely laying up to eight eggs laid on a single fruit (Blanco-Metzler et al., 1993; White, 1999). In citrus, eggs are preferentially laid on the rind of mature fruits when populations are low, but when populations are high, the eggs are laid on mature and immature fruits indiscriminately (Arthur et al., 2016; Parra et al., 2004). Egg laying generally occurs near the middle third of the citrus tree canopy (Bento et al., 2001b). In macadamia, eggs are laid on immature fruits in the lower and middle parts of the tree canopy (Blanco-Metzler et al., 1993; Blanco-Metzler et al., 2001). Similar egg-laying behavior is observed on *Plukenetia volubilis* (sacha inchi) (Leandro, 2012) and is likely similar on other hosts. Under laboratory conditions (64–90°F), eggs hatch in 3–11 days (Garcia, 1998; Garcia and Parra, 1999; Parra et al., 2004).

Larvae bore into the rind or husk of fruits and nuts and feed on the pulp or endosperm if the shells are not hardened (Blanco-Metzler, 1994; Lima, 1945). Generally one larva develops per fruit or nut, but when moth populations are high, up to three to four larvae can be present (Blanco-Metzler, 1994; Leandro, 2012; White and Tuck, 1993), and larvae may move between fruits in a cluster (Orellana et al., 2008). Larvae develop through four instars (Blanco-Metzler, 1994; Garcia and Parra, 1999; Leandro, 2012) and may create silken webs or cocoons as they near pupation, using debris or attaching two or more fruits in a cluster (Blanco-Metzler, 1994). Under laboratory conditions (64–90 °F), the larval period lasts 12–49 days (Garcia, 1998; Garcia and Parra, 1999; Parra et al., 2004).

To pupate, larvae exit the fruit or nut and disperse to the ground on silk threads or by crawling down trees, where they may build cocoons of silk with frass or other debris attached (Blanco-Metzler, 1994; Lima, 1945; White and Tuck, 1993). Pupation sites vary based on the host. In citrus, pupation generally occurs in the soil, but some may pupate inside the fruit (Parra et al., 2004; White and Tuck, 1993). In macadamia, pupation can occur in nuts or on trees attached to lichens and moss (Blanco-Metzler, 1994; Blanco-Metzler et al., 1993). Under laboratory conditions (64–90 °F), the pupal period lasts 7–25 days (Garcia, 1998; Garcia and Parra, 1999; Parra et al., 2004).

Adults are most active during dawn and dusk and fly short distances inside and over the host tree canopy (Aranda-Arguello et al., 2024; Bento et al., 2001a; Blanco-Metzler, 1994). During the day, adults usually rest on the trunk and inner branches in the lower, middle, or upper third of the tree canopy and are difficult to spot due to camouflage (Bento et al., 2001a; Blanco-Metzler, 1994; Lima, 1945). During dusk and twilight, adults move to the upper canopies of host trees for mating (Bento et al., 2001a). Females produce sex pheromones to attract males (Leal et al., 2001), and mating occurs three to four days after emergence (Aranda-Arguello et al., 2024; Bento et al., 2001a). Moths start laying eggs two days after mating (Blanco-Metzler, 1994). Under laboratory

conditions and depending on host and temperature, females lay between 37 and 200 eggs on average (Blanco-Metzler, 1994; Garcia, 1998; Parra et al., 2004), up to a maximum of 281 eggs in their lifetime on some host fruits (White, 1999). Under laboratory conditions, adult moths typically live 10–26 days (Blanco-Metzler, 1994; Leandro, 2012; Parra et al., 2004; White, 1999).

Flight activity varies by location and host and generally coincides with the fruiting season. Peak flight occurs from spring through early winter in South American citrus-growing areas (Bento et al., 2019; Bento et al., 2001b; Lima, 1945; SSPA, 1957). The moths are found year-round in Central American macadamia orchards because of continuous fruiting (Blanco-Metzler, 1994). The moth has three population peaks in the Caribbean during *Sapindus saponaria* (soapberry) fruiting season (White, 1999).

In laboratory conditions, depending on temperature and host, *G. aurantianum* requires 21–100 days to complete development (Bento et al., 2019; Garcia, 1998; Leandro, 2012; Parra et al., 2004). Development is fastest between 80–86°F and is estimated to stop below 50°F (Garcia, 1998). Cold tolerance has not been studied in this species, but studies of related species (*Cryptophlebia peltastica* and *Thaumatotibia leucotreta*) suggest citrus fruit borer is unlikely to survive freezing or near-freezing temperatures for extended periods (Moore et al., 2018; Stotter and Terblanche, 2009). Neither diapause nor overwintering has been reported for any stage of this pest.

Known Hosts

Citrus spp. and *Macadamia integrifolia* (macadamia nut) are the major hosts of *G. aurantianum* (Adamski and Brown, 2001; Carvalho et al., 2015; Noboa et al., 2018; White and Tuck, 1993; Yamamoto et al., 2006). Though most descriptions of damage are in *Citrus ×aurantium var. sinensis* (orange) (Garcia, 1998; SSPA, 1957; White and Tuck, 1993), it is known to infest other citrus species, including *C. reticulata* (mandarin), *C. limon* (lemon), and to a lesser extent *C.* x *paradisi* (grapefruit) (Adamski and Brown, 2001; Lima, 1945; Noboa et al., 2018; White and Tuck, 1993).

Gymnandrosoma aurantianum has many minor hosts, including *Annona cherimola* (cherimoya), *A. squamosa* (sugar apple), *Averrhoa carambola* (starfruit), *Carya illinoinensis* (pecan), *Cojoba arborea, Cupania vernalis, Eriobotrya japonica* (loquat), *Litchi chinensis* (lychee), *Melicoccus bijugatus* (Spanish lime), *Pithecellobium dulce* (Madras thorn), *Plukenetia volubilis* (sacha inchi), *Prunus persica* (peach), *Psidium guajava* (guava), *Punica granatum* (pomegranate), *Punica* spp., *Sapindus saponaria* (soapberry), *Simarouba amara*, and *Theobroma cacao* (cacao) (Adamski and Brown, 2001; Bento et al., 2001a; Brown et al., 2008; Cabrera-Asencio et al., 2012; White and Tuck, 1993).

Although banana is listed as a host in the literature, the original source material indicates that the specimens were actually reared from cacao. Banana as a host is likely an error that has been perpetuated from the original source (Adamski and Brown, 2001).

The host list below includes cultivated and wild plants that 1) are infected or infested by the pest under natural conditions, 2) are frequently described as major, primary, or preferred hosts, and 3) have primary evidence for feeding and damage documented in the literature. Plants are highlighted in bold if they are commercially produced and the pest causes economically significant damage.

Table 1. Preferred hosts of *Gymnandrosoma aurantianum*.

Scientific Name	Common Name	Presence in the US*	Type/Use	Reference
Citrus ×aurantium var. sinensis	**Orange**	**Present**	**Cultivated**	**Faria et al. (1998)**
Citrus reticulata	**Mandarin**	**Present**	**Cultivated**	**Noboa et al. (2018)**
***Citrus* spp.**	**Citrus**	**Present**	**Cultivated**	**Cabrera-Asencio et al. (2012)**
Citrus ×aurantium var. racemosa	**Grapefruit**	**Present**	**Cultivated**	**White and Tuck (1993)**
Macadamia integrifolia	**Macadamia**	**Present**	**Cultivated**	**de Matos et al. (2019)**

*Presence in the U.S. confirmed by NASS (2025)

Pest Importance

Gymnandrosoma aurantianum is a serious pest of citrus and macadamia in Central and South America (Blanco-Metzler, 1994; Carvalho et al., 2015). For citrus, this pest has caused fruit damage of up to 34% in Brazil and losses up to 40% in Costa Rica and Trinidad (Garcia, 1998; Parra et al., 2004; White, 1999; White and Tuck, 1993). In Costa Rica, up to 39% nut damage has been reported in macadamia (Blanco-Metzler, 1994).

Gymnandrosoma aurantianum is listed on the EPPO A1 list (EPPO, 2024). It is also listed as a harmful organism by Chile, Guatemala, Morocco, Panama, Paraguay, and Venezuela (USDA, 2025). If *G. aurantianum* becomes established in the United States, there may be trade implications with these countries.

Pathogens or Associated Organisms Vectored

This species is not known to be associated with pathogens or other organisms. Secondary infection from bacteria, fungi, and other insects can occur (White and Tuck, 1993).

Known Distribution

Gymnandrosoma aurantianum is present in North America (Mexico), the Caribbean, Central America, and South America (Table 2) (Adamski and Brown, 2001).

Table 2. Countries where *Gymnandrosoma aurantianum* is known to occur.

Region/Continent	Country	Reference
North America	Mexico	(Adamski and Brown, 2001)
Central America	Costa Rica	(Adamski and Brown, 2001)
Central America	El Salvador	(Orellana et al., 2008)
Central America	Guatemala	(Aranda-Arguello et al., 2022)
Central America	Honduras	(Adamski and Brown, 2001)
Central America	Nicaragua	(Adamski and Brown, 2001)
Central America	Panama	(Adamski and Brown, 2001)
Caribbean	Barbados	(Adamski and Brown, 2001)
Caribbean	Cuba	(Adamski and Brown, 2001)
Caribbean	Dominican Republic	(Razowski, 1999)
Caribbean	Puerto Rico	(Cabrera-Asencio et al., 2012)
Caribbean	Trinidad and Tobago	(Adamski and Brown, 2001)
South America	Argentina	(Adamski and Brown, 2001)
South America	Bolivia	(Razowski and Wojtusiak, 2013)
South America	Brazil	(Adamski and Brown, 2001)
South America	Colombia	(Adamski and Brown, 2001)
South America	Ecuador	(Adamski and Brown, 2001)
South America	French Guiana	(Adamski and Brown, 2001)
South America	Peru	(Adamski and Brown, 2001)
South America	Suriname	(Adamski and Brown, 2001)
South America	Uruguay	(Bentancourt and Scatoni, 1992)
South America	Venezuela	(Adamski and Brown, 2001)

Status of infestation in the United States (August 2025)

Within the United States and outlying territories, *G. aurantianum* is present in Puerto Rico (Cabrera-Asencio et al., 2012) and was recently detected in Texas with no evidence of an established population (Hayden and Danner, 2025).

Pathway

This pest is an internal feeder (de Matos et al., 2019; Nava et al., 2020), and likely disperses via the movement and trade of infested fruits and nuts. Larvae of *Gymnandrosoma* spp., including those of citrus fruit borer, are frequently intercepted at ports of entry, primarily from host fruits in passenger baggage originating from countries where this pest is known to occur (ARM, 2025).

Adult moths fly short distances around host trees during dawn and dusk and are not active fliers (Bento et al., 2001a; Blanco-Metzler, 1994). Quantitative estimates of dispersal distances are not available for this pest. Long-distance dispersal of adults has

not been documented. Adults of a similar tortricid, *Thaumatotibia leucotreta*, are estimated to disperse <1 mile per year (EFSA et al., 2020).

Use the **Agricultural Commodity Import Requirements(ACIR) manual** to determine 1) if host plants or material are allowed to enter the United States from countries where the organism is present and 2) what phytosanitary measures (e.g., inspections, phytosanitary certificates, post entry quarantines, mandatory treatments) are in use. These requirements are updated regularly.

Potential Distribution within the United States

A likelihood of establishment map has been developed for *G. aurantianum* (SAFARIS, 2024). Based on this map, the entire continental United States, except for areas of high elevation in the Mountain West, as well as Hawaii and Puerto Rico, have suitable conditions for the establishment of *G. aurantianum* (SAFARIS, 2024). Further, portions of Alaska may have suitable conditions in some years. However, this pest will only be able to establish where its hosts occur. The endangered area for this pest includes the primary citrus and macadamia-producing states, including Arizona, California, Florida, Hawaii, and Texas (NASS, 2025). Other minor hosts are more broadly distributed: *C. illinoinensis* (pecan) is native to much of the eastern United States, *E. japonica* (loquat) is present in California and parts of the South, *S. saponaria* (wingleaf soapberry) is native to the South, *P. granatum* (pomegranate) is present in the southern half of the United States, and *P. persica* (peach) is grown in most of the United States (NRCS, 2025). If *G. aurantianum* becomes established in the United States, there is a risk of spread on minor hosts to new areas with major hosts.

Survey and Key Diagnostics

Approved Methods for Pest Surveillance*:

For the current approved methods and guidance for survey and identification, see Approved Methods for Pest Surveillance (AMPS) pest page on the CAPS Resource and Collaboration website.

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Versions

September 2018: Datasheet completed (Version 1)

November 2025: Datasheet revised (Version 2)

- Added **Pest Recognition** section
- Added **Easily Mistaken Species** section
- Added **Commonly Encountered Non-targets** section
- Removed **Damage** section
- Updated **Scientific Name**
- Updated **Synonyms**
- Updated **Type of Pest**
- Updated **Taxonomic Position**
- Updated **Common Name**
- Updated **Pest Recognition** section
- Updated **Biology & Ecology** section
- Updated **Known Hosts** section
- Updated **Pest Importance** section
- Updated **Known Vectors** section
- Updated **Known Distribution** section
- Updated **Pathway** section
- Updated **Potential Distribution within the United States** section
- Updated guidance for **Approved Methods** section

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