

Erythrina moths *Terastia meticulosalis* Guenée and *Agathodes designalis* Guenée ¹

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Introduction

Although little known, the Erythrina moths *Terastia meticulosalis* Guenée and *Agathodes designalis* Guenée represent a remarkable case of niche partitioning (Sourakov 2011). In Florida, throughout the southern United States, and from Mexico to Argentina, these two species feed on plants of the genus *Erythrina* (Fabaceae). This genus, while mostly known as attractive ornamentals, has medicinal and other uses (Powell and Westley 1993). The descriptions of the moths' life histories below are based on north-central Florida populations that use the coral bean, *Erythrina herbacea*, as a hostplant. This plant is not only native to the region, but is also frequently used as an ornamental.

Synonymy

There are four other species within the genus *Terastia*. In the past, *T. subjectalis* (found in Australia and throughout Asia) had been considered a synonym of *T. meticulosalis*, but now is listed in modern literature as a separate species. The taxonomic status of *T. meticulosalis* populations in Africa, where it is listed from Kenya, South Africa, Uganda, and Sierra Leone, is unclear.

There are nine other species of *Agathodes* described. For example, *Agathodes ostentalis*, similar to *A. designalis*, is found throughout Asia and Australia. Larvae of *A. ostentalis* also feed on *Erythrina*, but are different in appearance from those of *A. designalis*.



Figure 1. An adult Erythrina stem-borer, *Terastia meticulosalis* Guenée. Photographed in Gainesville, Florida Credits: Andrei Sourakov, University of Florida

In Florida, and throughout the North American populations, *A. designalis* is represented by the subspecies *A. designalis monstrialis*, while *A. designalis designalis* was originally described from South America. Additional work on the genus, including new methods such as the DNA barcoding, is likely to change current classification of the genus (Dan Janzen, pers. com.). For instance, larvae of *A. designalis* in Costa Rica are different from those in Florida, perhaps emphasizing the underlying taxonomic differences (Janzen & Hallwachs 2011; Sourakov 2011).

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Figure 2. An adult *Erythrina* leaf-roller, *Agathodes designalis* Guenée. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida

Distribution

Both species are found from South Carolina to Florida in the eastern United States, west to Arizona, and then south to Argentina.

Description

In Florida and throughout the southeastern United States, both species are quite distinct, but in collections they can be confused with members of the same genera, which are distributed world-wide.

Terastia meticulosalis Guenée - *Erythrina* stem-borer

ADULTS

In *T. meticulosalis*, size depends on the generation and locality and, therefore, the diet, of the caterpillars. For instance, in Florida, the Spring generation that feeds on seeds was shown to be larger than the Summer and Fall generations that feed inside the stem. The wing span for Spring generations was ~1.4 inches (3.7 cm) versus ~1.2 inches (3.0 cm) for Summer generations, and as small as ~1.0 inches (2.5 cm) in Fall generations (Sourakov 2011). Collection specimens from South America are notably larger (~1.8 inches or 4.6 cm).

The marbled-brown forewings of *T. meticulosalis* make this species cryptic when at rest. However, its hind wings are white, as seen above.



Figure 3. An adult *Erythrina* stem-borer, *Terastia meticulosalis* Guenée. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida

EGGS

The oviposition of *T. meticulosalis* has not been described.

LARVAE

Larvae: The young larvae of *T. meticulosalis* are found inside the stems of *Erythrina herbacea*, where their feeding produces a characteristic dying-off of the tip of the host plant. The infestation rate by *T. meticulosalis* can be relatively high. As the availability of undamaged shoots of *E. herbacea* declines, neonate larvae bore and feed inside the leaf stalks and later make their way inside the stems.



Figure 4. *Erythrina herbacea* in July, showing a characteristic dying off of the stem as the larva of *Terastia meticulosalis* Guenée burrows downwards. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida

In younger larvae, the dorsal prothoracic plate and the head are black and heavily sclerotized. In older larvae, the

prothoracic plate becomes cream-colored, slightly darker than the rest of the body, which is otherwise translucent and cream-colored.

In the Spring, young larvae of *T. meticulosalis* infest the tips of the stem and gradually kill off the upper part of the plant, from where they move into the pods to feed on seeds.

Prior to pupation, last instar larvae are able to consume large numbers of seeds and move from one pod to another. Larvae of *T. meticulosalis* sometimes accumulate red pigments prior to exiting pods to pupate on the forest floor. However, this was only observed in the Spring generation that feeds on seeds (Sourakov 2011).

The larvae of Summer and Fall generations of *T. meticulosalis* feed inside the stems until pupation (the seeds become hard and pods splits open during this time). Hence, the Summer/Fall larvae look paler than Spring ones.



Figure 7. Prepupa of *Terastia meticulosalis* Guenée. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida



Figure 5. Second instar larva of *Terastia meticulosalis* Guenée. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida



Figure 8. Mature larva of *Terastia meticulosalis* Guenée, hollowing the stem of *Erythrina herbacea*, Summer/Fall generations. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida



Figure 6. Third instar larva of *Terastia meticulosalis* Guenée, Spring generation. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida



Figure 9. Mature larva of *Terastia meticulosalis* Guenée, Summer/Fall generations. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida



Figure 10. Head and thorax of mature larva of *Terastia meticulosalis* Guenée, Summer/Fall generations. Photographed in Gainesville, Florida. Credits: Andrei Sourakov, University of Florida



Figure 11. The larva of *Terastia meticulosalis* Guenée purges the hollow stem of *Erythrina herbacea* from frass by crawling backwards to the entrance when defecating. Photographed in Gainesville, Florida. Credits: Andrei Sourakov, University of Florida

PUPAE

Terastia meticulosalis makes loose double-layered cocoons. The pupa is cream-colored at first and then becomes light brown with the proboscis extending far into the abdominal segments.



Figure 12. The pupa of *Terastia meticulosalis* Guenée inside its cocoon. Photographed in Gainesville, Florida. Credits: Andrei Sourakov, University of Florida



Figure 13. The pupa of *Terastia meticulosalis* Guenée, lateral view. Photographed in Gainesville, Florida. Credits: Andrei Sourakov, University of Florida



Figure 14. The pupa of *Terastia meticulosalis* Guenée, ventral view. Photographed in Gainesville, Florida. Credits: Andrei Sourakov, University of Florida

***Agathodes designalis* Guenée - Erythrina leaf-roller**

ADULTS

Agathodes designalis specimens reared in Florida and Costa Rica are ~1.2 inches (3.0 cm) in wing span, but specimens from South America found in collections can be larger.

The purple-and-green marbled forewings of *A. designalis* are colorful, while the hind wings are beige. The abdomen is held in an up-right position, which gave the moth an unofficial common name of “sky-pointing moth.” Males have a pair of hair-pencils that are extended during “female calling,” for the release of pheromones.



Figure 15. An adult *Erythrina* leaf-roller, *Agathodes designalis* Guenée. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida



Figure 17. Fourth instar larva, Spring generation, of *Agathodes designalis* Guenée feeding on the inflorescence of *Erythrina herbacea*. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida



Figure 16. Webbing of the first and second instar larvae, Spring generation, of *Agathodes designalis* Guenée over the inflorescence of *Erythrina herbacea*. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida

EGGS

Eggs of *A. designalis* are laid singly on the ventral side of the leaf (Bourquin 1945).

LARVAE

Young larvae of *A. designalis* are translucent and orange with six rows of short, black-sclerotized tubercles, and are cryptic.



Figure 18. Mature larva, Spring generation, of *Agathodes designalis* Guenée feeding on the inflorescence of *Erythrina herbacea*. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida

The later instar larvae and prepupae appear aposematic. They develop cream-colored longitudinal stripes, and the black tubercles become more prominent on the orange background, while the head is bright red.



Figure 19. Mature larva, Spring generation, of *Agathodes designalis* Guenée suspends itself by a silk thread after falling off the host plant, *Erythrina herbacea*. Photographed in Gainesville, Florida. Credits: Andrei Sourakov, University of Florida



Figure 21. Prepupa, Spring generation, of *Agathodes designalis* Guenée changes color after feeding on the inflorescence of *Erythrina herbacea*. Photographed in Gainesville, Florida. Credits: Andrei Sourakov, University of Florida



Figure 22. Mature larva, Summer generation, of *Agathodes designalis* Guenée inside a shelter made from the leaves of *Erythrina herbacea*. Photographed in Gainesville, Florida. Credits: Andrei Sourakov, University of Florida



Figure 20. Mature larva, Spring generation, of *Agathodes designalis* Guenée feeding on the inflorescence of *Erythrina herbacea*. Photographed in Gainesville, Florida. Credits: Andrei Sourakov, University of Florida



Figure 23. Dorsal view of a mature larva, Summer generation, of *Agathodes designalis* Guenée feeding on leaves of *Erythrina herbacea*. Photographed in Gainesville, Florida. Credits: Andrei Sourakov, University of Florida

Summer and Fall generations of *A. designalis* feed on leaves and develop slower than the Spring generation that feeds on flowers, which indicates the higher nutritional value of their Spring diet.

In the Spring generation that feeds on flowers, the prepupa can become red. The prepupae of Summer and Fall generations are cream-colored.



Figure 24. Lateral view of a mature larva, Summer generation, of *Agathodes designalis* Guenée feeding on leaves of *Erythrina herbacea*. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida



Figure 25. Frontal view of a mature larva, Summer generation, of *Agathodes designalis* Guenée feeding on leaves of *Erythrina herbacea*. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida

There are four generations of *A. designalis* between May and September in north-central Florida. Larvae of *A. designalis* collected in Gainesville, Florida, in September completed their feeding by mid-October and diapaused in a prepupal stage inside cocoons (Sourakov 2011). The diapause might not be present in the warmer parts of the moth's range or might occur in different seasons.



Figure 26. Prepupa, Fall generation, of *Agathodes designalis* Guenée on *Erythrina herbacea*. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida

PUPAE

Agathodes designalis makes loose double-layered cocoons similar to these of *T. meticulosalis*, and the pupa, though it appears more glossy and more uniformly colored brown, is otherwise similar to that of *T. meticulosalis*.



Figure 27. Lateral view of pupa of *Agathodes designalis* Guenée. Photographed in Gainesville, Florida.
Credits: Andrei Sourakov, University of Florida

Host

See *Terasita meticulosalis* table and *Agathodes designalis* table.



Figure 28. Coral bean, *Erythrina herbacea*, a host plant of *Terastia meticulosalis* Guenée and *Agathodes designalis* Guenée. Photographed in April at Gainesville, Florida. Credits: Andrei Sourakov, University of Florida



Figure 29. Coral bean, *Erythrina herbacea*, a host plant of *Terastia meticulosalis* Guenée and *Agathodes designalis* Guenée. Photographed during May at Gainesville, Florida. Credits: Andrei Sourakov, University of Florida



Figure 30. Coral bean, *Erythrina herbacea*, plant in late Spring (June) following an infestation, with pods hollowed by larvae of *Terastia meticulosalis* Guenée. Photographed in Gainesville, Florida. Credits: Andrei Sourakov, University of Florida



Figure 31. Coral bean, *Erythrina herbacea*, a hostplant of *Terastia meticulosalis* Guenée, as seen in August with pods open and seeds exposed. Photographed in Gainesville, Florida. Credits: Andrei Sourakov, University of Florida

Economic Importance

Terastia meticulosalis is a serious pest of naturally-occurring and commercially grown *Erythrina*, a genus valued for its many uses from agricultural and ornamental to medicinal and pest control (Powell & Westley 1993). Raven (1974) suggested that *T. meticulosalis* makes the cultivation of *Erythrina* in southern Florida almost impossible.

Despite its small size, *T. meticulosalis* requires a substantial amount of plant material to develop to the adult stage, including seeds. Plants can be substantially damaged by larvae boring into the center of the stem, killing parts of the plant above. As a result, the health of host plants can be severely affected and the whole plant or at least its reproductive organs are often destroyed.

Agathodes designalis has a marginal impact on *E. herbacea*, though it can destroy flowers, making coral bean less attractive as an ornamental.

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Terastia meticulosalis.

Host Plant Species	Locality	Reference	Remarks
<i>Erythrina sandwicensis</i>	Hawaii	Swezey 1923	This population is likely extinct (Zimmerman 1958)
<i>Erythrina variegata</i>	Sri Lanka	Hutson 1920	Moth population now considered as <i>T. subjectalis</i>
<i>Erythrina variegata</i>	Great Nicobar, India	Bhattacharya & Mandal 1976	Moth population now considered as <i>T. subjectalis</i>
<i>Erythrina caffra</i>	South Africa	Taylor 1951	Moth taxonomy unclear
<i>Erythrina herbacea</i>	SE United States	Dyar 1901, Sourakov 2011	
<i>Erythrina fusca</i>	Florida	Heppner 2003	Pantropical <i>E. fusca</i> is the most basal of all <i>Erythrina</i>
<i>Erythrina</i> * <i>bidwillii</i>	N Florida	Eric Anderson pers. com.	This host is a hybrid: <i>E. herbacea</i> * <i>E. crista-galli</i> , and is a commercially sold ornamental
<i>Erythrina crista-galli</i>	N Florida	Eric Anderson pers. com.	In Florida is sold by nurseries as an ornamental

Agathodes designalis.

Host Plant Species	Locality of Record	Reference
<i>Erythrina crista-galli</i>	Argentina N Florida	Bourquin 1932 Eric Anderson pers. com.
<i>Erythrina herbacea</i>	Florida	Dyar 1901
<i>Erythrina flabeliformis</i>	Arizona	Powell & Opler 2009
<i>Erythrina fusca</i>	Florida	Heppner 2003
<i>Erythrina variegata</i>	Florida	Heppner 2003
<i>Inga vera</i>	Florida	Heppner 2003
<i>Erythrina</i> * <i>bidwillii</i>	N Florida	Eric Anderson pers. com.
<i>Citharexylum berlandieri</i>	Florida	Heppner 2003
<i>Citharexylum spinosum</i>	Florida	Heppner 2003
<i>Kigelia africana</i>	Florida	Heppner 2003
<i>Nerium oleander</i>	Florida	Heppner 2003
<i>Erythrina costaricensis</i>	Costa Rica, ACG	Janzen & Hallwachs 2011
<i>Erythrina lanceolata</i>	Costa Rica, ACG	Janzen & Hallwachs 2011
<i>Erythrina berterioana</i>	Costa Rica, ACG	Janzen & Hallwachs 2011
<i>Triumfetta lappula</i>	Costa Rica, ACG	Janzen & Hallwachs 2011