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Tropical Sod Webworm (Lepidoptera: Crambidae): a Pest of Warm Season Turfgrasses

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ABSTRACT. Larvae of *Herpetogramma* species (commonly called webworms, sod webworms, or grass webworms) are widely distributed throughout North America, Eurasia, Australia, New Zealand, Central and South America. Tropical sod webworm, *Herpetogramma phaeopteralis* (Guenée), larvae are among the most destructive pests of warm-season turfgrasses in the southeastern United States, Caribbean, and central America, especially on sod farms and newly established sod, lawns, athletic fields, and golf courses. Larval feeding affects the esthetics, vigour, photosynthesis, and density of turfgrass. Symptoms of infestation appear as notched and ragged grass blades with damaged areas in lawn appearing as small brown patches of closely mowed grass. Heavy infestations allow the ingress of weeds. Current control recommendations against tropical sod webworm include several cultural methods (including dethatching and cultivar selection) and the foliar application of chemical insecticides against larval stages. We summarize the seasonal biology, taxonomy, and IPM options of this important pest.

Key Words: *Herpetogramma phaeopteralis*, St. Augustinegrass, *Crambus* sp., lawn pest

Various species of native sod-feeding webworms in the family Crambidae (crambid snout-nosed moths) occur in North America. Species commonly found on cool-season turfgrasses include the bluegrass webworm, *Parapediasia teterrellus* (Zincken), which is distributed over the eastern United States from Massachusetts and Connecticut west into Colorado and through mid-Texas and eastward but most abundant in the limestone districts of Kentucky and Tennessee where Kentucky bluegrass (*Poa pratensis*) is dominant; the western lawn moth, *Tehama bonifatella* (Hults), which is found west of the Rocky Mountains and along the Pacific Coast, western Canada into Alaska; the striped sod webworm or changeable grass-veneer, *Fissicrambus mutabilis* (Clemens), which is found from New York to Florida, west to Illinois to Texas and north to Ontario; and the larger sod webworm, *Pediasia trisecta* (Walker), which ranges from southern Canada south into North Carolina and west into Tennessee, Texas, New Mexico, Colorado, and north to Washington State (Global Biodiversity Information Facility database; North American Moth Photographers Group; Heppner 2003, Brandenburg and Freeman 2012).

The tropical sod webworm, *Herpetogramma phaeopteralis* (Guenée), occurs exclusively in warm-season turfgrasses. This species occurs from South Carolina to Florida and the Caribbean, and west to Texas, and south through central America (Fig. 1). A related species, the grass webworm, *Herpetogramma licarsisalis* (Walker), occurs as an important pest of turf and some other grass crops in Hawaii, Australasia, and Southeast Asia (Tashiro 1976, Grant 1982, Barrion and Litsinger 1987). As an easy diagnostic characteristic, these *Herpetogramma* webworms hold their wings out flat when at rest, whereas all other North American webworms partially fold their wings around their body, giving them a tube-like appearance (Fig. 2). Eggs of tropical sod webworm are flattened and laid in small clusters on leaf surfaces, whereas other webworms drop ridged, barrel-shaped eggs at random as they fly over the grass; larvae may generally be distinguished by the different patterns of plates (panicula) on their thoracic segments (Kerr 1955).

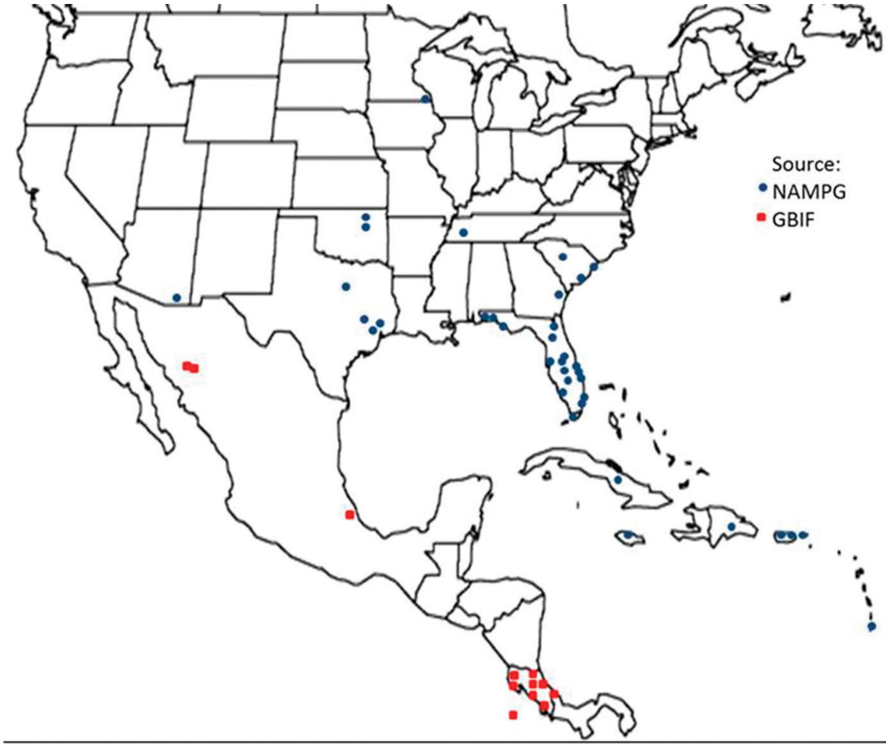
Currently, relatively little published information exists for many of these webworm species, although they collectively comprise an important pest complex of turf. Here we present an overview of the tropical sod webworm ecology and field identification and discuss integrated pest management (IPM) approaches for this species in warm-season turfgrass. This report collates existing fragmented literature and our experiences working with this insect in Florida.

Tropical Sod Webworm

Taxonomy. Nine species of *Herpetogramma* occur in North America. These small, brownish moths are frequently collected at light traps. However, some species are highly variable in wing pattern shading, and possess conservative genital structures in both sexes. This led to many species being independently described multiple times (Solis 2010). Tropical sod webworm was formerly classified in the family Pyralidae along with other sod webworms in the genus, *Crambus*. According to a recent systematic revision, this species was moved to the subfamily, Spilomelinae, and family, Crambidae (Solis 2010). Synonymies associated with *H. phaeopteralis* in the literature include *Botys phaeopteralis* (Guenée), *Botys vecordalis* (Guenée), *Botys vestalis* (Walker), *Botys additalis* (Walker), *Botys plebejalis* (Lederer), *Botys cellatalis* (Walker), *Botys communalis* (Snellen), *Botys intricatalis* (Möschler); *Acharana descripta* (Warren) is designated as a new synonym of *H. phaeopteralis*.

Pest Status. The tropical sod webworm is among the most common caterpillar species causing economic impact to turf through direct damage and control costs in the southeastern United States. It normally occurs in a pest complex that includes the fall armyworm, *Spodoptera frugiperda* (J. E. Smith), striped grass looper, *Mocis* spp., and fiery skipper, *Hylephila phyleus* (Drury) (Fig. 3; Brandenburg and Freeman 2012). Tropical sod webworm is most damaging in newly established turf with higher fertility levels (Trenholm and Unruh 2004). Stakeholders impacted by this pest in the southeastern United States include sod producers, lawn care professionals, golf course superintendents, and athletic field managers. These industries are well represented with economic impacts of over US$3 billion in Florida alone (Haydu et al. 2006). However, to our knowledge, the specific economic impact of tropical sod webworm has not been calculated.

Life History. Adult tropical sod webworm communicate via sex pheromones with virgin females lacking an obvious calling posture and mating occurs 3–4 h before sunrise (Meagher et al. 2007). We have observed tympanic and associated chordotonal organs in moths, which suggest ultrasonic courtship behavior. However, we have not confirmed the release of acoustic signals from males of this species as



State	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Alabama						x	x	x	x	x	x	
Arizona								x				
Florida	x	x	x	x	x	x	x	x	x	x	x	x
Georgia									x	x		
Minnesota										x		
Oklahoma								x	x	x		
S. Carolina									x	x		
Tennessee										x		
Texas									x	x	x	

Fig. 1. Distribution and seasonal occurrence of tropical sod webworm, *Herpetogramma phaeopteralis*, based on reports of adult specimens. Source: North American Moth Photographers Group (NAMPG; mothphotographersgroup.msstate.edu) and the Global Biodiversity Information Facility database (gbif.org).

has been noted among other Crambidae (Nakano et al. 2008, Takanashi et al. 2010). Adults live for 10–14 d when provided 5% vol:vol honey water in greenhouse cages and likely nectar-feed on flowering plants. Sourakov (2008) noted this species feeding on extra floral nectaries of passion vines, *Passiflora incarnate* (L.). The presence of both flowers and extra floral nectaries on plants with such structures, such as *Ipomoea* (Convolvulaceae), will support the flight ability, longevity, and fecundity of the adult moth as well as some of its natural enemies (Rudgers 2004, Wäckers et al. 2007).

We have observed that adults have a high preference to reside in tall grass (Cherry and Wilson 2005) and shrubs during the day and are most active at dusk. Females deposit eggs on grass blades in the evening and eggs hatch in 4 d at 25°C. Tropical sod webworms develop through six larval instars and the pupal stage lasts from 21 to 47 d, depending on temperature. The lower, upper, and optimum thermal thresholds for egg–pupae were 15, 35, and 30°C, respectively (Tofangsazi et al. 2012).

Multiple generations of this species may occur in a year; the authors have observed four or more generations per year in southern Florida. In southern Florida, tropical sod webworm adults are present year round, with significantly higher numbers in the fall (September through November; Cherry and Wilson 2005). Populations decline over the winter and increase slightly March through May. In central Florida, the authors have observed adults from May through November. In more northern regions of Florida (Gainesville), the peak of flight activity was reported in October and November (Kerr 1955) and August through October (John Capinera, personal communication). Indications are that this species does not survive the winter in the northern part of the state (Kerr 1955). Based on the observed patterns of abundance, we speculate that some gradual seasonal migration of this species may occur from southern into northern Florida during the late spring and early summer.

Description of Life Stages

Eggs. Adult females deposit clusters of 10–35 creamy-white eggs on the upper surface of grass blades (Fig. 4). Eggs are flattened, overlapping, slightly oval, and measure 0.7 mm (length), 0.5 mm (width), and 0.1 mm (height). Eggs are pale white when laid and become brownish-red as they mature. The duration of the egg stage is variable with temperature, ranging from 29.6 d at 15°C to 3.2 d at 30°C (Tofangsazi et al. 2012).

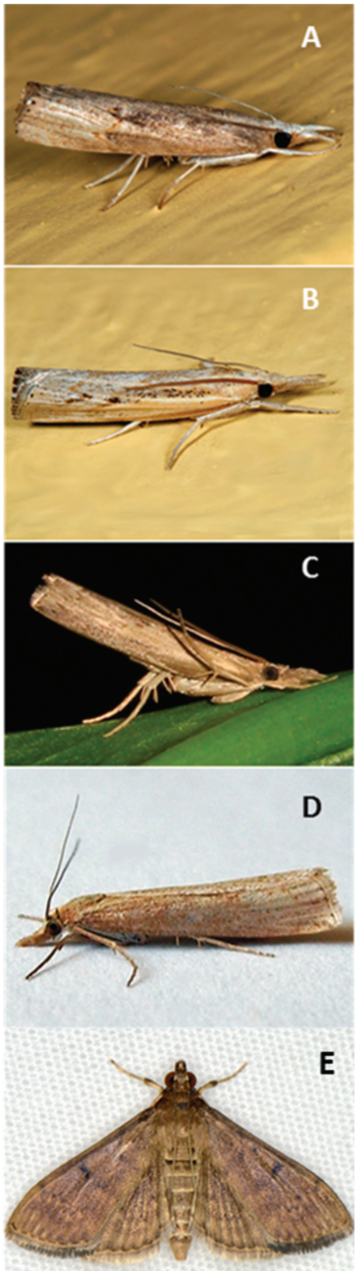


Fig. 2. Common webworms of cool-season grasses; bluegrass webworm (A), larger sod webworm (B), striped sod webworm (C), western lawn moth (D); tropical sod webworm (E). Photo credits Tom Murray (A and B), Anita Gould (C), Jim Moore (D), and Gary J. Goss (E).

Larvae. Young tropical sod webworm larvae are cream colored, turning more greenish in late instars, with a dark, yellowish-brown head. They can be distinguished from other warm-season turf caterpillars by their size and markings (Fig. 5). Tropical sod webworm has two pairs of brown spots on each body segment; larval head capsules at maximum width measure 0.008, 0.01, 0.02, 0.03, 0.04, and 0.05 inch (0.23, 0.34, 0.49, 0.68, 0.94, and 1.27 mm) in instars 1–6, respectively, and mature larvae range from 0.7 to 1 inch (18–25 mm; Kerr 1955). In contrast, mature fall armyworm larvae reach ≈1.5 inches (38 mm) long and have an inverted, light-colored "Y" on the head. Mature striped grass loopers larvae reach ≈1.4 inches (35 mm) long and have several narrow stripes on the head, sides, and back. Mature fiery skipper larvae reach ≈1 inch (25 mm) long and have a distinctive "neck" that is constricted behind the black head. When disturbed, tropical sod webworm larvae may adopt a defensive C-shape pose and can move rapidly forward and backward.

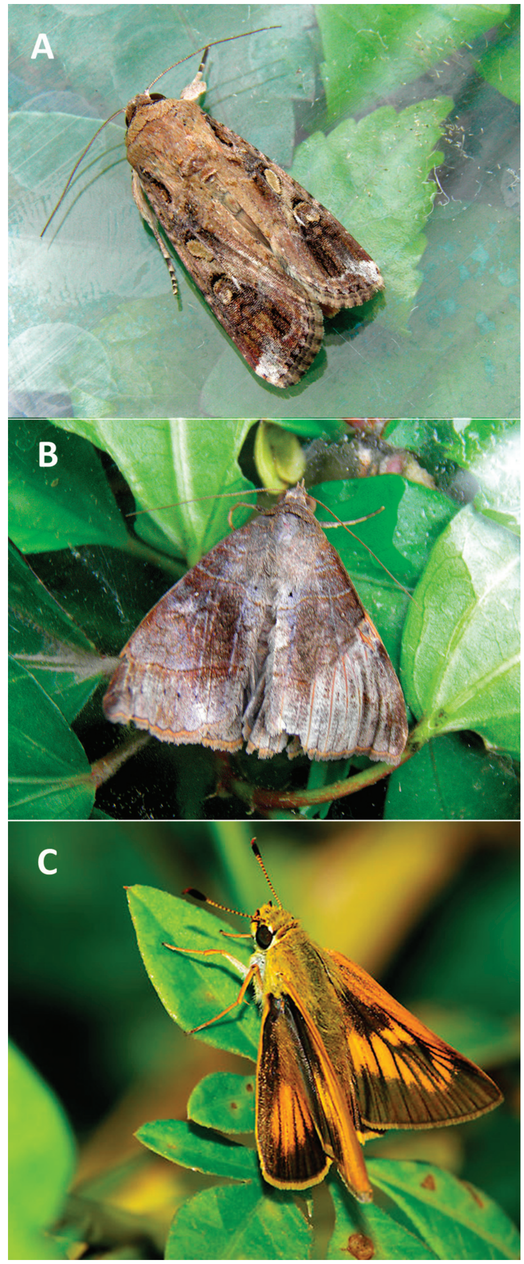


Fig. 3. Moths found in association with tropical sod webworm: fall armyworm (A), striped grass looper (B), and fiery skipper (C). Photo credits Bernardo Navarrete (A, B), Tim Lethbridge (C).

Pupae. The reddish-brown pupae are ≈0.35 inch (9 mm) long and 0.1 inch (2.5 mm) wide. The pupae may be exposed or buried in thatch (Fig. 6).

Adults. Moths of tropical sod webworm are dingy brown and their wing spread is ≈0.8 inch (20 mm; Fig. 2E). Adult males have six abdominal segments, whereas females have five (Kerr 1955). At rest, wings are held horizontally in a triangular shape. The terminal segment in males has a slim extension, while the anal segment of the female has a large fusiform opening.

Hosts and Damage Symptoms

Tropical sod webworm feed on the majority of warm-season grasses, preferring St. Augustinegrass, *Stenotaphrum secundatum* (Walter) Kuntze, and Bermuda grass, *Cynodon* spp. (Trenholm and Unruh 2004). Other major warm-season turfgrasses subject to an-

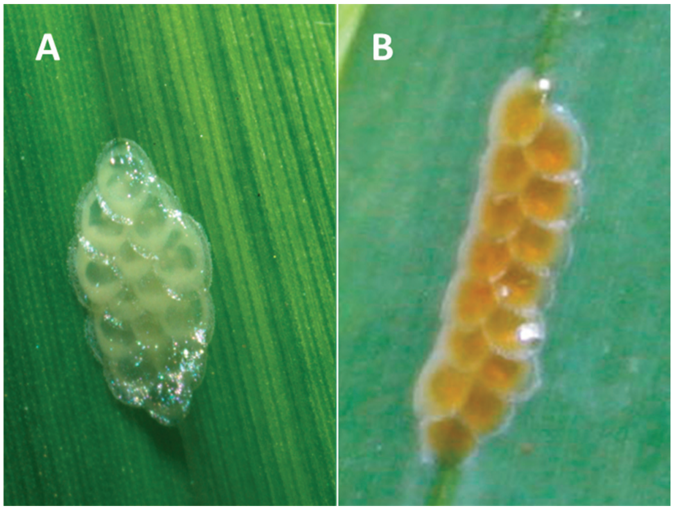


Fig. 4. Newly laid pale white eggs (A) and mature brownish-red eggs (B) of tropical sod webworm. Photo credit: Nastaran Tofangsazi.

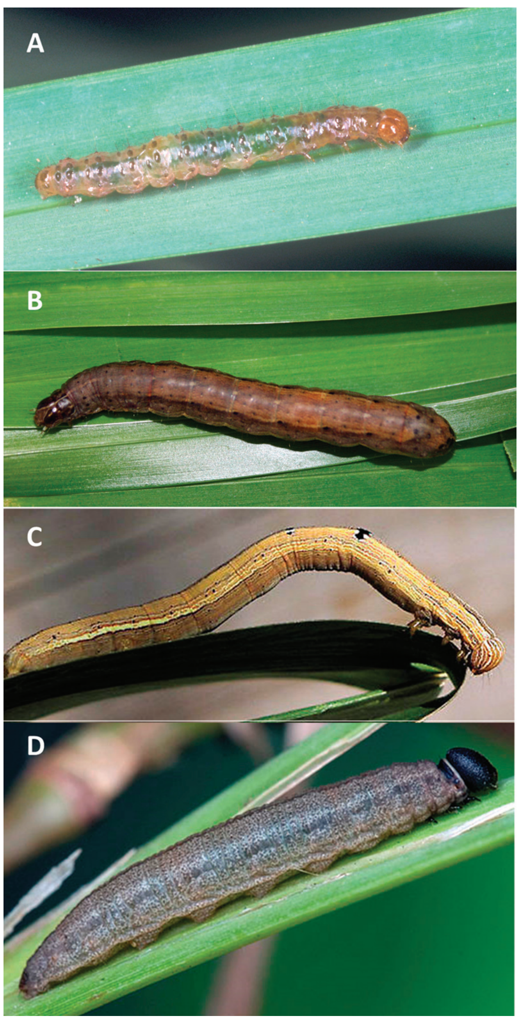


Fig. 5. Larvae of tropical sod webworm (A), fall armyworm (B), striped grass loopers (C), fiery skipper (D). Photo credits Lyle Buss (A), Nastaran Tofangsazi (B), Karen Anthonisen Finch (C), and Alan Chin-Lee (D).

Fig. 6. Tropical sod webworm pupa and larvae in thatch. Photo credit Steven Arthurs.

Fig. 7. Tropical sod webworm damage in St. Augustinegrass. Window feeding damage of younger instars (A) and close-cropped grass from large infestation in a residential lawn; lawn to left was treated with insecticide (B). Photo credits Nastaran Tofangsazi.

nual infestation are centipedegrass, *Eremochloa ophiuroides* (Munro), seashore paspalum, *Paspalum vaginitium* (Swartz), carpetgrass, *Axonopus* spp., zoysiagrass, *Zoysia japonica* (Steudel), *Zoysia matrella* (L.), and bahiagrass, *Paspalum notatum* (Flugge) (Kerr 1955).

Symptoms depend on the stage of infestation (Fig. 7). The first four larval stages (instars) are "window feeders," i.e., they only feed on the upper surface of grass blades, and so the injury they cause is often overlooked. Fifth and sixth instars can severely damage grass by chewing entire sections off the leaf blade. At this stage, infested turf often initially takes on a "ragged" appearance as mid-sized larvae begin to feed on the edges of the grass blades; larger larvae consume the entire grass blades down to the thatch. Areas damaged by late-instar larvae show as patches with exposed brown thatch that become progressively larger. However, roots, stolons, and meristems are generally unaffected. Like armyworms and cutworms, most sod webworms feed at night and larvae hide in the thatch and possibly aerification holes during the day. Larvae prefer dry and hot grass areas. Grass may recover if infestations are not too severe, but extensive feeding damage often encourages the ingress of weeds that need additional control methods (N. T., personal observations). Most severe damage occurs during late fall when tropical sod webworm are most abundant and the rate of grass growth has declined so that damage is not repaired as readily. Tropical sod webworm have been particularly damaging in recent years in metropolitan areas of central and southwest Florida (S.P.A. and N. T., personal observation) and the upper coastal region of Texas (Anonymous 2014).

IPM of Tropical Sod Webworm

Sampling. Monitoring every 7 d during spring, summer, and fall, especially in "hot spot" areas where damage tends to reappear, is important to detect early infestations (Trenholm and Unruh 2004). Larvae can be found in infested sod by parting grass in the periphery of poorly grown turf areas and looking for chewing damage and greenish larval frass in the thatch layer. Larvae can be found curled in a C-shape near the soil surface. Larvae feed at night and leave silk trails as they move from one grass blade to another. These trails are easily seen in the morning if dew is present. Larvae can be agitated during the day using soap flushes (i.e., 1 tablespoon of dishwashing soap in a gallon of water applied in a 1 m^2 area of turf). Detection is enhanced by movement of larvae climbing up grass blades within 5 min of application of the soapy water flush.

Moths hiding in shrubs and bushes fly low to the ground when disturbed. We have observed that moths can be captured in sweep nets held vertically over vegetation where they are hiding. Once in place, tapping the vegetation encourages moths to fly upwards into the nets. This initial presence of adults indicates that oviposition and later feeding damage may be expected. Adults are attracted to porch lights (personal observation) and can be captured using black-light traps (Cherry and Wilson 2005). Light traps are useful for sampling and collecting adults; however, the cost of traps and the presence of many other insects attracted to the light are considerable disadvantages (Muirhead-Thompson 1991). Sex pheromones that allow specific capture of turf pests such as fall armyworm currently are not available for this species. However, we have recently identified several candidate pheromone compounds: C14-acetate and C16-acetate with single or double bonds and an unsaturated hydrocarbon that elicit an electroantennogram (EAG) response in the laboratory (N. T., unpublished data).

Economic Threshold. Economic threshold depends on turf vigor, maintenance practice, other biotic and abiotic factors, and tolerance of homeowners or turfgrass managers for turf damage. On golf courses, damage in roughs is less noticeable than damage in fairways, and damage on tees and greens may not be tolerated at all (Anonymous 2008). Esthetic thresholds are thus variable, although a threshold of 5–10 webworms/m^2 may warrant a control treatment in high-quality turf in dry and sunny areas (Anonymous 2008). Additional damage to turf may occur from mammals and birds digging holes in search of larvae (Potter 1998).

Chemical Control. Insecticides are frequently used against damaging populations of tropical sod webworm. Insecticide application 10–12 d after observing flying moths may control smaller larvae that are generally easier to control than larger larvae (Watschke et al. 1995). When the damaged area is small and early infestations are detected, spot treatments may be applied. Monitoring is recommended to confirm the efficacy of insecticide treatments.

Several products are registered for sod webworms for homeowner and professional use (Table 1). With contact materials, irrigation should not be applied within 24 h to allow the insects to consume the foliage and make contact with treated surfaces. Granular formulations may be less effective against sod webworms, as insecticidal activity on the leaf blades where larvae feed may be insufficient. With systemic materials, posttreatment irrigation should be applied if rainfall is not expected within 24 h to move the material to the root zone (Potter 1998). In our tests, among the newer registered materials, chlorantraniliprole provided over 5 wk of residual control of tropical sod webworm larvae under field conditions, compared with clothianidin and bifenthrin with 1–3 wk of control (Tofangsazi et al. unpublished data). Based on the developmental rate of tropical sod webworm (Tofangsazi et al. 2012), the residual activity of chlorantraniliprole may extend to the subsequent tropical sod webworm generation, and reduce the required frequency of insecticide applications.

Other lawn chemicals may impact tropical sod webworm populations. Cherry et al. (2010) reported that the herbicide "Clear Choice"

Table 1. Current insecticides registered for use against turf caterpillars in North America

Active ingredient	Chemical subgroup	IRAC[a] class	Trade name(s)	Home owner products
Carbaryl	Carbamate	1A	Sevin	
Bifenthrin	Pyrethroid	3A	Talstar, Onyx	Ortho-bug-b-gon max insect killer for lawns
Cyfluthrin	Pyrethroid	3A	Tempo	Bayer advanced complete insect killer
Deltamethrin	Pyrethroid	3A	DeltaGard	Hi-yield turf ranger insect control granules
Lambda/gamma-cyhalothrin	Pyrethroid	3A	Scimitar, Demand	Triazicide insect killer for lawns
Clothianidin	Neonicotinoid	4A	Arena, Aloft	
Imidacloprid	Neonicotinoid	4A	Merit	Hi-yield grub free zone iii, Bayer advanced complete insect killer
Spinosad	Spinosyns	5	Conserve	Natural guard spinosad landscape and garden insecticide
Bacillus thuringiensis subsp. *aizawai* and *kurstaki*	Bacterial derived	11B	Dipel	Safer brand caterpillar killer II with B.t.
Halofenozide	Diacylhydrazine	18	Mach 2	Hi-yield kill-A-Grub
Indoxacarb	Indoxacarb	22A	Provaunt	
Chlorantraniliprole	Anthranilic Diamide	28	Acelepryn, GrubEx	
Azadirachtin	Azadirachtin	UN	Azatrol, Neemix	
Steinernema carpocapsae	Microbial		Millenium	
S. feltiae	Microbial		NemAttack	
Heterorhabditis bacteriophora	Microbial		B-Green	
H. indica	Microbial			
Beauveria bassiana	Microbial		Botanigard	

[a] Insecticide Resistance Action Committee.

(84% isoparaffinic oil, 0.5% 2,4-D, 0.3% mecoprop, 0.090% dicamba, plus emulsifiers) reduced survival of small and medium-sized tropical sod webworm larvae. Mortality was caused by a feeding response (starvation or toxicity via ingestion) rather than direct contact or volatilization. Research has shown that silicon can enhance plant resistance to some turf pests (Saigusa et al.1999). However, Korndorfer et al. (2004) tested applications of calcium silicate to turfgrass, but did not observe any differences in subsequent feeding and development of *H. phaeopteralis* compared with control plants.

Microbial Control. Hazards associated with the overuse of insecticides in turf include insecticide resistance, negative impacts on beneficial and other nontarget species, and contamination of groundwater (Racke 2000, Potter 2005). These issues along with public concerns have stimulated interest in application of microbial insecticides as part of integrated management of turfgrass insect pests (Grewal 1999, Racke 2000). Microbial insecticides are generally specific to their target pest(s), considered nontoxic to humans, and can be applied with standard pesticide equipment such as pressurized sprayers, mist blowers, and electrostatic sprayers (Koppenhöfer 2007). However, biopesticides have had limited market success and sales of microbial insecticides constituted $<0.1\%$ of the estimated US$500 million U.S. turfgrass insecticide market in 1998 (Koppenhöfer 2007).

Recently, Tofangsazi et al. (2014) investigated the potential of five different commercially available entomopathogenic nematode products against tropical sod webworm. Results revealed that the label rate of "Millenium" formulation of *Steinernema carpocapsae* (applied at 10^6 infective juveniles per liter and 2500 liters per ha) reduced webworm populations by 83–93% and was as effective as clothianidin against larger larvae. Because nematodes are sensitive to desiccation and temperature extremes, it will be necessary to keep turf moist for several hours post application and preferably apply during early morning or evening hours (Shapiro-Ilan et al. 2002). Other insect pathogens and microbial derivatives that may help control sod webworms include entomopathogenic fungi (esp. *Beauveria bassiana*; Fig. 8), entomopathogenic bacteria (*Bacillus thuringiensis* variety *kurstaki* and *aizawai*), and spinosad (*Saccharopolyspora spinosa* byproduct). However, we are unaware of any published research comparing the activity of these materials against *H. phaeopteralis*.

Cultural Control. Maintenance practices can influence turfgrass susceptibility to tropical sod webworm. Excessive fertilization and improper watering and mowing may result in a layer of thatch (i.e., accumulated dead and living stems located above the soil surface; Trenholm and Unruh 2004). It is recommended to avoid conditions that favor thatch buildup and dethatch to reduce insect habitat and minimize pesticide applications (Potter 1998). Close mowing stresses grass and encourages webworm damage. In Florida, grass should be mowed to a recommended height of 3.5–4 inches (9–10 cm) for St. Augustinegrass, 2.5–3 inches (6–8 cm) for dwarf St. Augustinegrass, 3–4 inches (8–10 cm) for bahiagrass, 1–3 inches (3–8 cm) for zoysiagrass, 0.75–1.5 inches (2–4 cm) for Bermuda grass, and 1.5–2 inches (4–5 cm) for centipedegrass (Trenholm and Unruh 2004). It might be helpful to remove grass clippings while adults are present, as this would remove webworm eggs that are laid at that time. Irrigation should be applied as needed, which can be determined by observing blue-gray color of grass blades and visible human footprints on the grass. Irrigation needs depend on grass species and location. In Florida, irrigation systems should be calibrated to deliver 0.75 inch (2 cm) of water with frequency timed for local water restrictions. Trenholm and Unruh (2004) suggest a yearly fertilization program for Florida turfgrasses, which includes a combination of one or two applications of multiple nutrient fertilizations and several supplemental applications of nitrogen fertilizer. No more than 1 pound of slow-release nitrogen fertilizer per 1,000 square feet of lawn is recommended (Trenholm and Unruh 2004).

Using pest-resistant turfgrass varieties is one potential tool for managing turf pests. But, turfgrass breeding programs usually place emphasis on esthetic traits and abiotic factors, such as drought, heat, cold, and other physiological stresses, rather than developing cultivars with pest resistance (Reinert et al. 2009). Nevertheless, Reinert and Busey (1983) reported that fewer larvae completed development and less damage was observed on two clonal selections, 'PI–289922' and 'PI–289912', and two commercial cultivars, 'Common' and 'FB–119', of Bermuda grass (*C. dactylon*). More recently, Reinert et al. (2004) and Reinert (2008) reported that the cultivars of St. Augustinegrass, 'Amerishade', 'Floratine', 'FX–10', 'NUF-76', 'Winchester', and zoysiagrass cultivars, 'Cavalier', 'DALZ8501', and 'JZ–1', were less preferred for adult oviposition and larval development compared with other cultivars. While planting "less preferred" cultivars may reduce tropical sod webworm populations on an individual site, such practices will not reduce tropical sod webworm populations on a regional scale unless these cultivars become widely marketed and used by the sod industry.

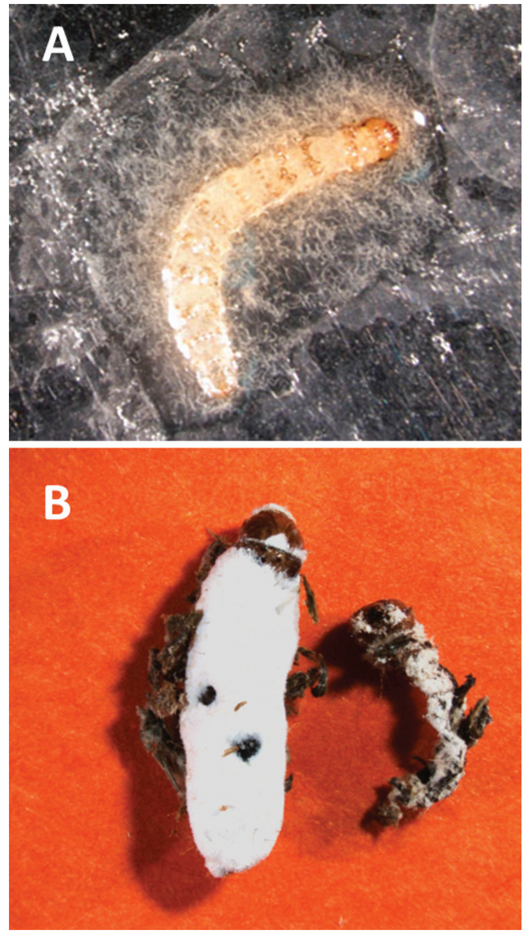


Fig. 8. Tropical sod webworm larvae killed by the nematode, *Steinernema carpocapsae* (A) and the fungus, *Beauveria bassiana* (B). Photo credits Nastaran Tofangsazi.

Natural Enemies. Beneficial arthropods observed attacking tropical sod webworm include several generalist predators, i.e., spiders, ants (i.e., *Lasius neoniger* Emery and *Solenopsis molesta* Say), lady beetles, big-eyed bugs (*Geocoris* spp.), syrphid flies, ground and tiger beetles, rove beetles, and a variety of parasitoids, mostly *Trichogramma* spp., braconids, encyrtids, scelionids, and an ichneumonid wasp (*Horogenes* sp.; Kerr 1955). We observed the egg parasitoid, *Trichogramma fuentesi* (Torre), parasitizing $>80\%$ of tropical sod webworm eggs in our colony (Fig. 9) (N. T., personal observation). However, the impact of biological control agents on tropical sod webworm has not been documented under field conditions.

Insecticide applications against insect pest populations in yards and landscapes can harm beneficial insects and insectivorous birds, and

Fig. 9. Tropical sod webworm eggs parasitized by *Trichogramma fuentesi* (R) and larvae emerging from unparasitized eggs (L). Photo credit Nastaran Tofangsazi.

ultimately cause more severe insect pest outbreaks in subsequent generations (Hostetler et al. 2002). Preserving natural enemies by using low-toxicity insecticides may help limit outbreaks of tropical sod webworm. Theoretically, beneficial insect populations can be increased by providing flowering plants throughout the season as pollen and nectar sources and by manipulating natural enemy activity through landscape design (Braman et al. 2002). Increasing vertical layering in yards and landscapes by planting a variety of plants with different sizes and heights will provide more cover and feeding opportunities for beneficial insects. However, the use of such strategies would first require knowledge of specific natural enemies that are important locally, as well as the selection of specific plants on which they are adapted to feed.

Summary

Tropical sod webworm has become an economically injurious pest of warm-season turfgrass in the southeastern United States and elsewhere, although this insect remains relatively unstudied. There is no single solution to manage this pest; however, the application of best management practices in IPM programs should minimize producer costs and insecticide inputs in residential settings. In Florida, current control methods are primarily limited to applications of conventional insecticides. Future research is necessary to establish reliable economic thresholds under different scenarios and evaluate the impact of alternative controls including mechanical, cultural, and biological strategies for management of this important pest. The elucidation of seasonal migration of this species is also needed.

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