Insect Pest Management on Turfgrass[1]

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Turfgrass is grown in many environments and for different uses, including home lawns, parks, athletic fields, cemeteries, golf courses, sod farms, pastures, and right-of-ways. The intensity of turfgrass insect management largely depends on the turf species, variety, and its intended use.

Several insects and mites live and feed in grass. Many are harmless, some are beneficial, and some are pests. Only a few cause significant damage and need immediate control. It is important to remember that insects are only one of many potential causes of thin, brown, or dead grass. Disease, nematodes, drought, and nutritional deficiencies can also be damaging. Proper identification is the first step of an integrated approach to managing insect pests of turfgrass, which can save money and prevent unnecessary pesticide applications. For more information on turfgrass integrated pest management (IPM) see *Landscape Integrated Pest Management*, http://edis.ifas.ufl.edu/in109.

This publication describes the biology and management of the most important pests of turfgrass in Florida. A list of pesticides labeled for insect control in turfgrass can be found in Table 1 along with their formulation information. In general, healthy turf is less vulnerable to pests and can recover faster from a pest infestation. Avoid unnecessary applications of soluble nitrogen fertilizers, mow at the correct height for the grass species, minimize thatch, and avoid over-watering. During active seasons, check every seven to ten days for pest activity, especially in "hot spots" where damage tends to reoccur.

Armyworms

The fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae), is the most common armyworm species in Florida.

The caterpillar (damaging life stage) (Figure 1) is green to brown in color when small, dark brown when mature, and can reach up to 4 cm (1.5 inches) in length. It has a light colored stripe along the middle of its backside, with darker bands along each side. There are four dark dots on the dorsal side of each abdominal segment. Its head is dark and marked with a light colored, inverted "Y." Pupation occurs in the soil for 10 to 14 days depending on temperature and precipitation. Adult moths are brown with white on the tips of each forewing and have a wingspan up to 4 cm (1.5 in). Eggs are circular, light green when deposited, and darken with age; they are dusted with gray, fuzzy scales (Figure 2) from the female's body. Females produce approximately 1000 eggs in clusters of 50 to several hundred, which are deposited on tips of leaf blades or light-colored objects adjacent to turf.

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Figure 1. Fall armyworm caterpillar.
Credits: L. Buss

Figure 2. Fall armyworm egg cluster.
Credits: J. L. Castner

Despite its name, the fall armyworm can damage turfgrass in the spring and fall in Florida. They overwinter as pupae in the Gulf Coast region of the United States. The moths migrate northward each spring, reaching the northern states in the fall (hence the "fall" in their name). Larvae feed any time during the day or night, but are most active early in the morning or late in the evening. Larval feeding occurs uniformly in groups over larger areas, rather than in patches. Caterpillars first skeletonize the grass blades and later create bare spots in the lawn.

Monitor for fall armyworms by mixing one tablespoon of liquid dishwashing soap in one gallon of water. Pour the solution onto a four-square-foot area near the damage. Insects will crawl to the surface if present. Examine several suspected areas. Areas under lights can be monitored for adults because the adults fly to lights at night. Also, check light colored surfaces near turfgrass for egg clusters.

Some resistant turfgrass cultivars have been developed for cool-season varieties (Reinert and Read 2008), but fewer resistant cultivars exist for warm-season turf varieties.

Several natural enemies, including wasps and predatory bugs, attack fall armyworm caterpillars (Held et al. 2008; Joseph and Braman 2009). It is important to remember that cultural practices and pesticide applications can affect the abundance and efficacy of natural enemies. Caterpillars tend to become a problem in newly established turf, especially if the turf was fertilized heavily in late summer. Treat at the first sign of damage for best results. Insecticides are more effective against younger caterpillars.

For more information on the biology and management of armyworms, see https://edis.ifas.ufl.edu/topic_armyworms.

Bermudagrass Mite

The bermudagrass mite, *Eriophyes cynodoniensis* (Acari: Eriophyidae), is an under-recognized pest of turfgrass, and its damage is often misdiagnosed for other pests.

These eriophyid mites (Figure 3) are tiny, about 0.2 mm (1/125-inch) long, and just visible with a 15 to 20x magnification hand lens. They are creamy white in color, somewhat carrot-like in shape, and have two pairs of legs, which is unique among mites. One generation develops in five to ten days. The eggs are deposited under the leaf sheath and after hatching, the mites molt twice before reaching adulthood. All life stages (eggs, nymphs, and adults) live under the leaf sheath and hundreds of them can be found under a single leaf. Mites may disperse by wind, other insects, or grass clippings.

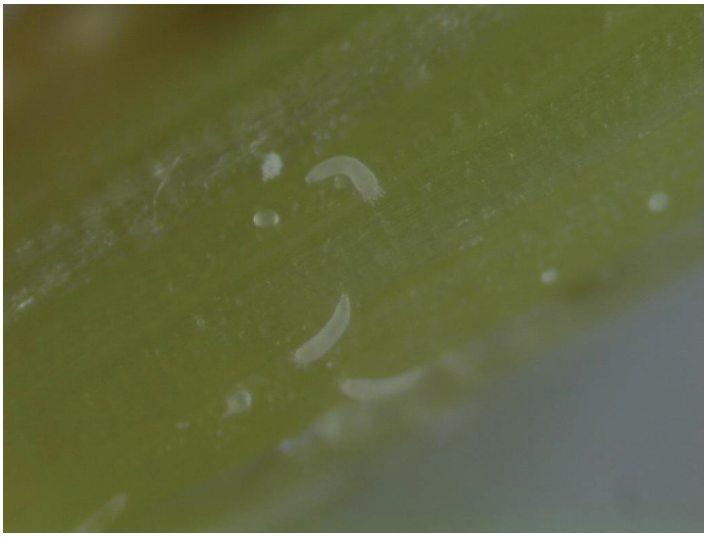

Figure 3. Bermudagrass mites.
Credits: L. Buss

Bermudagrass is the only host for this mite species. The mite causes damage characteristic of eriophyid mites: grass blade tips turn light green to yellow and curl abnormally. The internodes shorten, tissues swell, and the grass becomes tufted (called "witches broom") so that small clumps

appear (Figure 4). Large areas of grass may die and become infested with weeds. Damage is worse during hot, dry weather and when the grass is stressed.

Figure 4. Bermudagrass mite damage.
Credits: E. Buss

Bermudagrass cultivars 'Tifsport' and 'Tifway' both exhibit resistance to bermudagrass mite feeding (Reinert et al. 2008). However, 'Tifway' has previously shown susceptibility to feeding damage, so damage may occur in some instances (Reinert et al. 1978). Infestations usually develop in taller grass (rough areas, around sand traps, along canals, fence rows, etc.). Mow as close as practical (i.e., scalp the infested turf) and collect and destroy grass clippings from heavily infested areas. Chemical control is limited for mites, so implementing cultural and mechanical strategies may provide the best success. For more information on integrating these strategies see *Landscape Integrated Pest Management*, http://edis.ifas.ufl.edu/in109.

Cutworms

Several species of cutworms (e.g., black or granulate cutworms) (Lepidoptera: Noctuidae) occur in Florida, but seldom are serious pests in turfgrass.

Larvae (Figure 5) are mostly hairless and have three pairs of true legs and five pairs of fleshy prolegs on the abdomen. Cutworms tend to curl up when disturbed. Adults (Figure 6) are generally dull-colored with wingspans up to 4 cm (1.5 in). At rest, wings are folded flat over the abdomen. Eggs are round, laid randomly on leaf blades, and hatch within ten days. Three to seven generations may occur each year. Cutworms remain active all year in southern Florida and are active from early spring to late fall in central Florida.

Both adults and larvae are active at night. Larvae usually dig a burrow in the ground or thatch (or use an aeration hole) and emerge at night to chew off grass blades and shoots. Damage may appear as circular spots of dead grass or depressed spots that look like ball marks on golf greens.

Figure 5. Granulate cutworm larva.
Credits: L. Buss

Figure 6. Granulate cutworm moth.
Credits: L. Buss

Cutworms have been more problematic in close-cut turf on golf courses, primarily on greens, tees, and occasionally fairways. Lawns rarely have problems with cutworm infestations. Monitor for cutworms by mixing one tablespoon of liquid dishwashing soap in one gallon of water. Pour the solution onto a four-square-foot area near the damage. Insects will crawl to the surface if present. Examine several suspected areas. Areas under lights can be monitored for adults because the adults fly to lights at night. Promote healthy turf with proper cultural management. Mechanical removal of clippings during mowing can effectively reduce populations by removing eggs deposited on grass tips (Williamson and Potter 1997).

Treat at the first sign of damage for best results. Insecticides are more effective against younger caterpillars. Caterpillars tend to become a problem in newly established turf or in early fall, especially if the turf was fertilized heavily in late summer.

For more detailed information on the biology and management of cutworms, see http://entnemdept.ufl.edu/creatures/veg/black_cutworm.htm.

Fire Ants

Imported fire ants, *Solenopsis* spp. (Hymenoptera: Formicidae), are small, aggressive ants that build rounded nests or mounds (Figure 7) that can be as large as two or three feet across. However, in sandy soils, the mound does not maintain its shape. Imported fire ants occur throughout Florida, infesting over 30 million acres. Their mounds can disrupt mowing or harvesting and damage electrical equipment.

Figure 7. Red imported fire ant mound.
Credits: L. Buss

Imported fire ants are 3 to 6 mm (0.1–0.25 in) long and are reddish-brown to black. They are social insects and can have a single queen (up to 240,000 individuals per colony) or multiple queen colonies (up to 500,000 individuals per colony). Colonies have at least one queen ant, winged males and females (virgin queens), workers, and a brood (eggs, larvae, and pupae). In heavily infested areas, single queen colonies may have 40–150 nests per acre, and multiple queen colonies may have 200–800 nests per acre.

There are two species of imported fire ants, both accidentally introduced at port in Mobile, AL. The black imported fire ant, *Solenopsis richteri*, was imported to the United States in 1918 or earlier. This ant now occupies only small areas in northern Alabama, northern Mississippi, Tennessee, Oklahoma, and Texas. The red imported fire ant, *Solenopsis invicta* (Figure 8), was introduced in the early 1930s and since that time has spread widely. This aggressive ant presently infests more than 340 million acres in Alabama, Arkansas, California, Florida, Georgia, Louisiana, Mississippi, New Mexico, North Carolina, South Carolina, Tennessee, Oklahoma, and Texas.

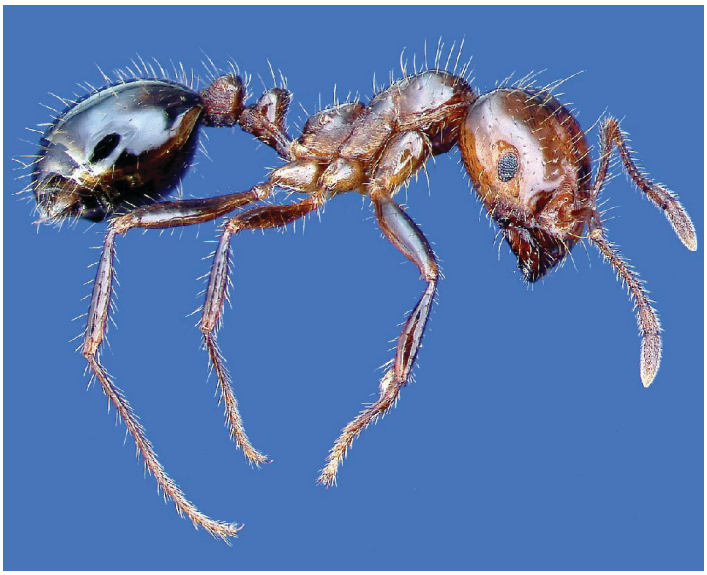

Figure 8. Red imported fire ant.
Credits: Almquist

Imported fire ants do not inflict direct feeding damage on turfgrass, but their mounds are an aesthetic issue, public health concern, and can indirectly cause turf to yellow and die. The red imported fire ant aggressively defends its colony and inflicts painful bites and stings to people, pets, livestock, and wildlife. Like many other ant species, fire ants may facilitate other pest problems by protecting scale insects, aphids, or other honeydew-secreting insect pests of nearby plants.

To treat fire ant mounds, scatter granules around the edge of the nest. Ants take the bait into the colony and feed the insecticide-treated oils to each other, which results in colony death.

For more information on fire ant biology and management, see *Managing Imported Fire Ants in Urban Areas*, http://edis.ifas.ufl.edu /LH059.

Ground Pearls

Ground pearls, *Margarodes* sp. and *Eumargarodes* sp. (Hemiptera: Margarodidae), are a type of scale insect that feeds on the sap from plant roots.

Clusters of pinkish-white eggs, covered in a white waxy sac, are deposited in the soil from March to June. Small nymphs (called crawlers) emerge from eggs approximately 9–15 days later, attach to the roots, and enclose themselves in a hard, yellow-brown, globular shell. These "pearls" (also called cysts) (Figure 9) range in size from about 0.5 to 1.5 mm (0.02 to 0.06 in). They may occur as deep as ten inches in the soil. Ground pearls overwinter in the cyst stage and females reach maturity in late spring. The adult female

is wingless, 1.5 mm (0.06 in) long, pink in color, with well-developed forelegs and claws (Figure 10). Females can reproduce without mating. Adult males are not commonly seen, but have wings and are gnat-like. One generation may last from one to two years.

Figure 9. Ground pearls or cysts.
Credits: J.L. Castner

Figure 10. Mature female ground pearl.
Credits: L. Buss

Ground pearls feed on the roots of bermudagrass, St. Augustinegrass, and zoysiagrass, but prefer centipedegrass. They occur throughout Florida, Georgia, Alabama, South Carolina, and North Carolina. Ground pearl feeding causes irregular patches of yellow, brown, or dying grass. Damage is most commonly noticed during spring green-up, especially during hot, dry weather. Grass rarely recovers in damaged areas, and weeds often invade the damaged areas.

No management strategies, including insecticides, are currently available for ground pearls. Use best management practices (BMP) to minimize plant stress and maintain proper fertility and soil moisture to help grass tolerate the damage.

For more information on ground pearl biology and management, see *Ground Pearls*, https://edis.ifas.ufl.edu/lh073.

Hunting Billbug

The hunting billbug, *Sphenophorus venatus vestitus* (Coleoptera: Curculionidae) (Figure 11), is an underappreciated pest of turfgrass, and its damage is often misdiagnosed.

Adult beetles are about 1 cm (0.4 in) long and weevil-like in appearance with a short, fairly broad, downward-curved snout (Figure 11). They are gray to black but are often coated with soil. Several billbug species occur in Florida, but they can be distinguished by the pattern on their pronotum. The most problematic, the hunting billbug, has a Y-shaped marking, with a parenthesis-shape on either side (Figure 12). The larvae are also 1 cm (0.4 in) long in their final stage and legless (Figure 11). The body is white with a tan head capsule.

Figure 11. Hunting billbug adult and larva.
Credits: J.L. Castner

Figure 12. Hunting billbug adult.
Credits: L. Buss

Adult billbugs chew small holes in grass stems near the crown and deposit eggs in some of the stems. Larvae hatch in eight to ten days and feed inside the grass stem and crown area. Eventually, larvae go into the soil and feed on the roots. Because larvae do not move far, small, irregular areas of dead grass develop that resemble dollar spot disease. The larvae and pupae occur 2.5 to 7.5 cm (1–3 in) deep in the soil, among roots and runners. One generation develops in 8 to 10 weeks and multiple generations occur per year throughout Florida.

Zoysiagrass and bermudagrass are preferred hosts, but bahiagrass, St. Augustinegrass, and centipedegrass are also attacked. Injury is more pronounced during extended periods of heat and drought. Adults cause the most damage, which is often noticed in the spring as dead patches or areas that are slow to green-up. Billbug damage is often mistaken for drought stress, chinch bug or white grub damage, or disease. Billbug feeding in sod may prevent it from holding together when cut.

Monitor turfgrass root zones to determine if billbugs are responsible for damage. Turfgrasses containing fungal endophytes have enhanced tolerance and resistance to stress and feeding from certain insects. Overseeding with an endophytic ryegrass in the fall can reduce hunting billbug infestations (Huang and Buss 2013). There are also resistant and tolerant varieties of bermudagrass and zoysiagrass available. 'Diamond' and 'Pristine Flora' zoysiagrass are recommended to reduce hunting billbug damage (Huang et al. 2014). As always, proper irrigation and fertility management can increase the plant's natural defense and tolerance to pest damage.

For more information on the biology and management of hunting billbug, see *Hunting Billbug*, https://edis.ifas.ufl.edu/in364.

Mole Crickets

Three exotic mole cricket species—tawny (Figure 13), southern, and shortwinged (*Scapteriscus* spp.) (Orthoptera: Gryllotalpidae)—were introduced from South America around 1900 and are significant pests of turfgrass in Florida. The native northern mole cricket, *Neocurtilla hexadactyla*, is rarely a pest.

The front legs of mole crickets are flattened and adapted for digging. Tawny and southern mole cricket adults grow to be 4 cm (1.5 in) long, whereas the shortwinged mole cricket adults only reach 2.5 cm (1 in). The tawny mole cricket is a light, creamy brown color and the southern is gray to dark brown with four distinct light spots on its prothorax (the area immediately behind the head). Tawny and southern mole crickets can also be distinguished by their dactyls (digging claws): the southern has a U-shaped space between them, while the tawny has a V-shaped space. The shortwinged mole cricket also has a U-shaped dactyl space.

Figure 13. Tawny mole cricket.
Credits: L. Buss

In northern and central Florida, egg laying begins in March with a peak in May. Eggs hatch in 20 to 25 days, and emergence is mostly complete by late June. Nymphs feed through the summer, molting five to eight times before becoming adults in the fall. Tawny mole crickets overwinter mostly as adults, and southern mole crickets overwinter mostly as late instar nymphs. There is only one generation of both species per year in northern and central Florida.

In southern Florida, tawny mole cricket oviposition and egg hatch occur a few weeks earlier than in central or northern Florida. The southern mole cricket has two generations a year in southern Florida. Egg laying occurs in early spring and again in summer. Generations of shortwinged mole crickets overlap, and egg laying occurs year-round, with a peak in late spring or summer and a smaller peak in winter.

Bermudagrass, bahiagrass, and centipedegrass are most often attacked by mole crickets. Tawny and shortwinged mole crickets are herbivorous and consume all parts of the grass plant. The southern mole cricket is a predator and scavenger. All three species tunnel through the surface layer of the soil (Figure 14), causing considerable damage to the grass roots. The tunneling also loosens the soil so that the grass is often uprooted and dries out. Most mole cricket tunneling occurs at night, a few hours after dusk, and again just before dawn.

Monitor for mole crickets using a soap flush early in the day. For a demonstration of how to do a soap flush, visit https://www.youtube.com/watch?v=sx_o4EMXsCo.

Southern and tawny mole cricket adults are also attracted to lights, especially in the spring. Warm, moist weather and soil conditions increase mole cricket activity. Mole cricket management depends on the condition, use, and demand of the turf as well as the life stage of the insect. Extensive research has been conducted on biological control of mole crickets in Florida with varying success. Nematodes, especially *Steinernema scapterisci*, can reduce mole cricket populations as well as the parasitoid wasp, *Larra bicolor,* and parasitoid fly, *Ormia depleta*. Unfortunately, none of these biological controls are commercially produced.

Figure 14. Mole cricket damage.
Credits: J.L. Castner

It is important to get insecticides into the soil, either by slit-injection, pre- or post-treatment irrigation, or by using a wetting agent in the spray solution. Apply insecticides as late in the day as possible because mole crickets are deeper in the soil during the day and closer to the soil surface at night. Baits are most effective later in the summer, when older nymphs come onto the soil surface at night. Do not get baits wet.

For more detailed information about the life history and management of mole crickets, see http://ipm.ifas.ufl.edu/Agricultural_IPM/Mole_Cricket_project.html or http://entnemdept.ifas.ufl.edu/creatures/orn/turf/pest_mole_crickets.htm.

Scales/Mealybugs

Three types of leaf-feeding scale insects or mealybug pests of turfgrass occur in Florida: Rhodesgrass mealybug (*Antonina graminis*), Bermudagrass scale (*Odonaspis ruthae*), and a white armored scale, *Duplachionaspis divergens*. None are very common, but they can occasionally cause damage.

The Rhodesgrass mealybug, *A. graminis* (Hemiptera: Pseudococcidae) (Figure 15), is a round, dark brown insect covered with a white, cottony secretion that appears as tufts of cotton on the grass. It prefers Rhodesgrass, Johnsongrass, bermudagrass, and St. Augustinegrass. Rhodesgrass mealybug infests the crown, nodes, or leaf axils, but not the leaves. Females reproduce without mating and deposit 300–600 eggs in a cottony ovisac. There are no males. The nymphs (called crawlers) disperse and begin feeding under a leaf sheath at a node. A white, spherical, waxy sac is secreted around them. After settling, the insects will not move again. Mealybugs secrete honeydew as their waste, which facilitates the growth of black sooty mold on plant surfaces. Infested grass slowly loses vitality and shows symptoms similar to drought stress. Damage is most severe during extended hot, dry periods. The life cycle of Rhodesgrass mealybug ranges from 60 to 70 days. In northern Florida, there are five generations per year and continuous generations in southern Florida.

Figure 15. Rhodesgrass mealybugs.
Credits: L. Buss

The adult female of the Bermudagrass scale, *Odonaspis ruthae* (Hemiptera: Diaspididae) (Figure 16), is oval, white, and approximately 1.6 mm (0.06 in) in diameter. This scale insect prefers taller grass and areas that are heavily thatched or shaded. Bermudagrass scale is more commonly found in golf course roughs, around sand traps, or along fencerows. The life cycle of a Bermudagrass scale ranges from 60 to 70 days, with five generations per year in northern Florida and continuous generations in southern Florida.

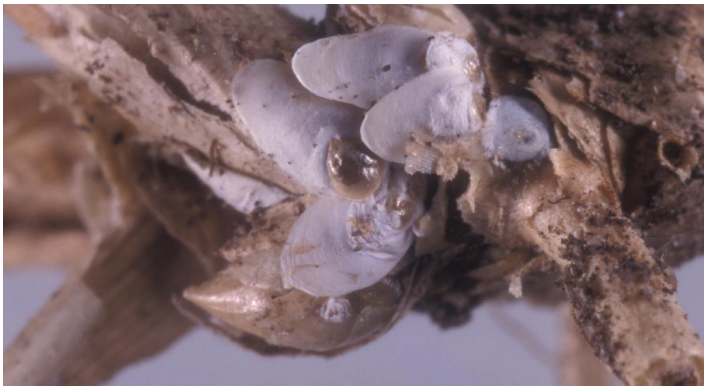

Figure 16. Bermudagrass scale on bahiagrass rhizome.
Credits: L. Buss

A more recently introduced scale insect pest, *Duplachionaspis divergens* (Hemiptera: Diaspididae) (Figure 17), has become established and common in Florida. This pest was first detected in North America, in Florida, in 2002 and has been intercepted in Alabama and Texas. Adult females lay on average 130 eggs each, and there may be nine generations per year. The potential economic impact of this pest is uncertain, but it has been detected on several species of grasses, including *Miscanthus* spp., St. Augustinegrass, bahiagrass, and zoysiagrass. Infested grass clippings should be collected and destroyed.

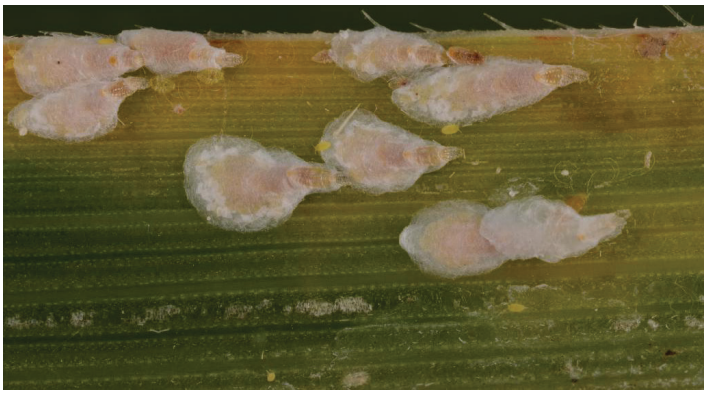

Figure 17. *Duplachionaspis divergens* on sugarcane.
Credits: L. Buss

Southern Chinch Bug

The southern chinch bug (SCB), *Blissus insularis* (Hemiptera: Blissidae), is the most important pest of St. Augustinegrass, the most commonly planted turfgrass species for Florida lawns.

Chinch bug adults (Figure 18) are about 5 mm (0.2 in) long and black with white patches on their wings, which are folded over the back. Young nymphs (Figure 19) are reddish-orange with a white band across the back. Body color darkens and becomes black as nymphs become adults.

Figure 18. SCB adult.
Credits: L. Buss

Figure 19. SCB nymph.
Credits: L. Buss

Activity is reduced during the winter in northern Florida, but all stages are present year-round in most of the state. Eggs are laid in leaf sheaths or crevices and cracks in nodes and other protected places. Each female chinch bug lays an average of 300 eggs during her lifetime. Adults can live up to two months. In the summer months, the eggs hatch in seven to ten days. The nymphs pass through five nymphal instars, requiring four to five weeks to reach adulthood. Chinch bugs have at least three generations a year in northern Florida and seven to ten in southern Florida.

Chinch bugs feed on sap from within St. Augustinegrass at the crown or stem, near the soil surface. The pests often feed in aggregations, so damage tends to be concentrated and spread outward. Injured plants look stunted, yellowed, wilted, or dead. Yellow to burnt-brown patches are often first noticed along sidewalks, in poorly irrigated areas, or sun-exposed locations.

To monitor for chinch bugs, part the yellowing or declining grass to look for insects crawling on plants and within the thatch. Insert an open-ended cylinder or metal can with both ends cut out near damaged turf. Some companies sell cylinders specifically for this purpose. Fill the can with water and wait five minutes for chinch bugs to float to the top. Examine at least three or four places. Another monitoring option is to sample areas of declining turfgrass using a battery-powered, handheld vacuum. Push the opening of the vacuum down into the thatch in several areas, then empty the filter and look for chinch bugs.

Cultural controls include reducing the amount of water-soluble nitrogen fertilizer used, mowing at the recommended height for St. Augustinegrass, minimizing thatch buildup, and monitoring and spot treating the damaged area and a five foot area surrounding it, if necessary. Chinch bug-resistant St. Augustinegrass cultivars should be used when available, although previously resistant varieties like

'Floratam' have become susceptible. Currently, 'NUF-76' is the only commercially available resistant St. Augustine variety. *Geocoris* spp. (big-eyed bugs) prey upon chinch bugs but do not always provide adequate control (Carstens et al. 2008). See *St. Augustinegrass for Florida Lawns*, http://edis.ifas.ufl.edu/lh010 for more information on proper management.

Some chinch bug populations have become resistant to several insecticide chemical classes including pyrethroids (Cherry and Negata 2005). Use a high rate of insecticide with a wetting agent to penetrate thatch. Avoid using low rates and rotate modes of action to prevent resistance development. Combination products may also help reduce resistant populations.

For more information about the biology and management of the southern chinch bug, visit https://edis.ifas.ufl.edu/topic_southern_chinch_bug.

Twolined Spittlebugs

The twolined spittlebug, *Prosapia bicinta* (Hemiptera: Cercopidae), is occasionally an important pest of warm-season turfgrasses including bermudagrass, St. Augustinegrass, centipedegrass, bahiagrass, and orchard grasses. It also feeds on many crops, ornamental plants, and weeds. Spittlebugs are present throughout the entire state, but are most abundant in northern and northwestern Florida.

Spittlebug nymphs may be yellow, orange, or white. The bugs, themselves, are less noticeable than the frothy spittle (Figure 20) that covers them. Adults are about 6 to 12 mm (0.25 to 0.5 in) long, black with dark red eyes and two orange lines across the wings (Figure 21).

Figure 20. Spittlebug spittle mass.
Credits: J.L. Castner

Figure 21. Two-lined spittlebug adult.
Credits: J.L. Castner

The first generation adult population begins to emerge in June. Adults deposit eggs at the base of the grass in the thatch, in hollow grass stems, or behind the leaf sheaths. There are five nymphal instars and usually two generations per year. The first generation develops in about 2.5 months. Second-generation adults peak in early August to September. Eggs laid by second-generation adults overwinter and, depending upon temperature and precipitation, hatch from March to April.

Nymphs and adults both extract plant juices through their straw-like mouthparts. Infested turf wilts, purple-colored streaks develop on grass blades, sometimes the turf turns yellow and eventually brown, and the blades curl. Heavy infestations may kill, wither, or reduce turfgrass growth.

Most of the spittle masses are usually located near the soil surface or in the thatch. Spittlebugs damage is often associated with an overdeveloped thatch layer, which provides high-humidity conditions optimal for insect development. Over-fertilization can also increase spittlebug populations and subsequent damage. Follow approved practices regarding mowing, fertilizing, and irrigating to reduce thatch buildup. If a thatch problem exists, dethatching or verticutting will reduce spittlebug problems. Shortman et al. (2002) evaluated over 50 turfgrass genotypes for spittlebug resistance and found that none were resistant, but 'Emerald' zoysiagrass, 'Tifway' bermudagrass, and 'Sea Isle 2000' paspalum were most tolerant to feeding damage.

For more information on the biology and management of two-lined spittlebug, see *Twolined Spittlebugs in Turfgrass*, https://edis.ifas.ufl.edu/lh077.

Tropical Sod Webworm

Tropical sod webworm (TSW0, *Herpetogramma phaeopteralis* (Lepidoptera: Crambidae), is a sporadically damaging caterpillar pest of most warm season turfgrasses, including the following: Zoysiagrass, bermudagrass, bahiagrass, centipedegrass, St. Augustinegrass, and seashore paspalum. It can also feed on some cool season turfgrasses such as creeping bentgrass.

Larvae (Figure 22) are gray-green, have brown spots on each segment, and a light brown head. Mature larvae can be about 19 to 25 mm (0.75–1 in) in length. Larvae progress through seven or eight instars before becoming adults. Sod webworms form cocoons in the soil or thatch made from plant debris and soil particles. Approximately seven days after pupation, adults emerge. Sod webworm adults (Figure 23) are small, tan to gray moths with a wingspan of 19 to 25 mm (0.75–1 in). Moths hide in shrubs and other sheltered areas during the day and begin flying at dusk. The adults do not cause damage, but deposit small clusters of 6 to 15 round, flat eggs on grass blades at nighttime, which take about one week to hatch. The life cycle from egg to adult requires five to six weeks at 78°F and 12 weeks at 72°F.

Figure 22. TSW larva.
Credits: L. Buss

Figure 23. TSW adult.
Credits: L. Buss

Newly hatched larvae skeletonize the grass blades, while older larvae chew on grass blades near the soil surface. They remain curled up in the soil during the day and feed at night. Damage begins in small patches of brown, short-clipped grass, about 2.5 to 7.5 mm (0.1–0.3 in.) in diameter. Small, green frass (droppings) can be seen on the ground surface. Larvae chew notches in the leaves, causing the grass to look ragged or irregularly shaped. Larger larvae build silken tubes through the thatch or on the ground surface. Sod webworms can be especially damaging to close-cut turf, but rarely cause lasting damage to high-cut turf.

This pest is most active from April through November, but may occur year-round in southern Florida. Three generations occur in northern Florida and four generations in southern Florida.

Most tropical sod webworm problems are associated with turfgrass cultivated under high maintenance or drought conditions. Larger populations can attract birds, which may cause additional damage because the birds will tear up the turf in search of caterpillars. Monitor for damaging populations with soapy water flushes. Endophyte-enhanced grasses are toxic to sod webworms and should be implemented when available. Treat at the first sign of damage for best results. Insecticides are more effective against younger caterpillars. Caterpillars tend to become a problem in newly established turf or in early fall, especially if the turf was fertilized heavily in late summer.

Tofangsuzi et al. (2014) provide a nice overview of this insect in a recently published review of the ecology and management of tropical sod webworm in the southeastern United States.

For more detailed information, see http://entnemdept.ufl.edu/creatures/ORN/TURF/Tropical_sod_webworm.htm.

White Grubs

White grubs (larvae of scarab beetles) (Coleoptera: Scarabaeidae) are sporadic problems of turfgrass in Florida. However, certain species can be very damaging in coastal regions. At least five common genera occur in Florida. The masked chafers, *Cyclocephala* spp. (Figure 24), are most frequently encountered, and *Tomarus* spp. (Figure 25) are the second most common. Populations of *Strategus antaeus* (the ox beetle), *Phyllophaga* spp. (May/June beetles), *Euphoria sepulcralis* (a day-flying flower beetle), and *Ataenius* spp. are less common.

Figure 24. Masked chafer adult (left) and larva (right).
Credits: J.L. Castner

Figure 25. *Tomarus subtropicus* adult (L) and larva (R).
Credits: L. Buss

The larvae are plump-looking grubs that rest in a C-shaped position (Figure 24, 25). They are white in color with dark areas at the rear, three pairs of legs, and a tan to reddish-brown head. The adults are scarab beetles. Depending on the species, the larvae range from 1 to 5 cm (0.4–2 in) long in their final stage. Billbug larva can look similar; however, billbug larvae do not have legs.

Development through one generation may take six months to one year in Florida. As an example, the southern masked chafer, *Cyclocephala lurida*, has two generations per year in central Florida. Eggs are laid 2.5 to 5 cm (1–2 in) below the surface of the soil usually during April or May. The grubs feed on the grass roots until mid- to late summer, and pupate in the soil in August and September. Adults emerge September through October, mate, and lay eggs. The larvae then hatch, feed during the winter months, and pupate in early spring. *Tomarus* spp. have a one-year life cycle. *Phyllophaga* spp. have one to two generations each year and tend to be pests in ornamental plant beds or on tree roots. *Ataenius* spp. have at least two generations per year. Development times for some of these pests take longer in cooler, northern climates.

White grubs feed on the roots of all turfgrass species. They occur at or just below the soil-thatch interface. Mild damage may make the turf yellow, which could be misdiagnosed as a nutrient deficiency or disease. Severe damage results in large areas of dead turf due to a lack of roots. Damage can be masked if the turf is frequently irrigated, but if drought or another stress affects the infested turf, the grass will quickly die (Potter 1982). Damage from mature grubs is most pronounced during late summer and early fall.

To monitor for adults, watch for scarab beetles flying at night near lights. To monitor white grub populations, cut three sides of a one-foot square piece of sod about 5 cm (2 in) deep at the edge of one of the off-color areas and pull the sod back. See if the grass roots are chewed off and sift through the soil and thatch looking for grubs. Check several places in symptomatic turf. When turf is easily pulled from the soil with little evidence of roots snapping and some grubs are present, it is likely that white grubs are responsible.

For more detailed information about white grub biology and management, see *White Grub Management in Turf*, https://edis.ifas.ufl.edu/lh037.

Additional Information

For more information on insect and mite pests of turfgrass, please refer to these UF/IFAS Extension publications:

- *Ants* (ENY-203), http://edis.ifas.ufl.edu/ig080
- *Chiggers* (ENY-212), http://edis.ifas.ufl.edu/ig085
- *Fleas* (ENY-205), http://edis.ifas.ufl.edu/ig087
- *Pillbugs, Sowbugs, Centipedes, Millipedes, and Earwigs* (ENY-221), http://edis.ifas.ufl.edu/ig087
- *Ticks (Family Ixoididae)* (ENY-206), http://edis.ifas.ufl.edu/ig088
- *Insecticides Used in the Urban Environment: Mode of Action* (ENY-282), http://edis.ifas.ufl.edu/in077
- *Pests in and around the Southern Home,* http://ifasbooks.ifas.ufl.edu/p-1222-pests-in-and-around-the-southern-home.aspx

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Table 1. Insecticides registered for use on turfgrass in Florida.

Active Ingredient	Trade Names	Chemical Class	IRAC Classification	Mode of Action	Notes
Bermudagrass Mite					
Abamectin	Divanem	Avermectins, Milbemycins	6	Glutamate-gated chloride channel allosteric modulator	Golf courses only
Azadirachtin	Azatrol, Neemix, Turplex	Azadirachtin	18B	Ecdysone agonist / molting disruptor	
Bifenthrin	Talstar, Menace	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Chlorpyrifos	Dursban, Chlorpyrifos SPC	Organophosphates	1B	Acetylcholine esterase inhibitor	For use on sod farms
Deltamethrin	Deltagard G	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Dicofol	Dicofol 4E, Kelthane	Organochlorine	2A	GABA-gated chloride channel blockers	Sod farms and non-residential only.
Lambda-cyhalothrin	Battle, Demand, Scimitar, Cyonara	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Zeta-cypermethrin + Bifenthrin +Imidacloprid	Triple Crown Golf, T&O	Pyrethroids, Neonicotinoids	3, 4A	Sodium channel modulators, Nicotinic acetylcholine, receptor agonists/antagonists	
Cutworms					
Acephate*	Orthene, Acephate	Organophosphates	1B	Acetylcholine esterase inhibitor	Use on sod farms and golf courses only. Water in after application.
Azadirachtin	Neemix, Turplex	Azadirachtin	18B	Ecdysone agonists/molting disruptors	
Bifenthrin F, GC, G	Talstar, Menace	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
B.t. products	Several names	*B. t.* subspecies *kurstaki*	11B2	Microbial disruptors of insect gut membranes	
Carbaryl 80 WSP and baits	Sevin	Carbamate	1A	Acetylcholine esterase inhibitor	Late afternoon. Do not mow 1–3 days after application.
Chlorantraniliprole	Acelepryn	Anthranilic diamide	28	Depletes calcium from insect muscles, disrupting normal contraction	
Chlorpyrifos 4 E, 2 ES, 50 WP, Pro	Dursban, Chlorpyrifos SPC	Organophosphates	1B	Acetylcholine esterase inhibitor	For use on sod farms.
Clothianidin 0.5G, 50 WDG	Arena	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/antagonists	
Clothianidin + Bifenthrin	Aloft	Neonicotinoids; Pyrethroids, Pyrethrins	3, 4A	Nicotinic acetylcholine receptor agonists/antagonists; sodium channel modulators	
Cyfluthrin	Tempo 2, Tempo Ultra	Pyrethroids, Pyrethrins	3	Sodium channel modulators	

Active Ingredient	Trade Names	Chemical Class	IRAC Classification	Mode of Action	Notes
Deltamethrin G	Deltagard	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Dinotefuran	Zylam	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/antagonists	
Entomopathogenic nematodes	Various names				Effective against early instar stages.
Indoxacarb SC	Provaunt	Oxadiazine	22	Voltage-dependent sodium channel blockers	Not labeled for use on sod farms.
Lambda-cyhalothrin	Battle, Scimitar, Cyonara	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Spinosad	Conserve	Spinosyns	5	Nicotinic acetylcholine receptor agonists (allosteric)—not group 4	
Zeta-cypermethrin + Bifenthrin + Imidacloprid	Triple Crown Golf, T&O	Pyrethroids, Neonicotinoids	3, 4A	Sodium channel modulators, Nicotinic acetylcholine, receptor agonists/antagonists	
Fall Armyworm					
Acephate*	Orthene, Acephate	Organophosphates	1B	Acetylcholine esterase inhibitor	Use on sod farms and golf courses only. Water in after application.
Bifenthrin	Talstar, Menace	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
B.t. variety kurstaki	Several names	*B. t.* subspecies *kurstaki*	11B2	Microbial disruptors of insect gut membranes	
Chlorantraniliprole	Acelepryn	Anthranilic diamide	28	Depletes calcium from insect muscles, disrupting normal contraction	
Chlorpyrifos	Dursban, Chlorpyrifos SPC	Organophosphates	1B	Acetylcholine esterase inhibitor	For use on sod farms.
Cyfluthrin	Tempo 2, Tempo Ultra	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Deltamethrin	Deltagard	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Diflubenzuron	Dimilin 2L	Insect Growth Regulator	15	Chitin biosynthesis inhibitor	
Dinotefuran	Zylam	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/antagonists	
Indoxacarb SC	Provaunt	Oxadiazine	22	Voltage-dependent sodium channel blockers	Not labeled for use on sod farms.
Lambda-cyhalothrin	Battle, Scimitar, Cyonara	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Spinosad	Conserve	Spinosyns	5	Nicotinic acetylcholine receptor agonists (allosteric)—not group 4	
Zeta-cypermethrin + Bifenthrin + Imidacloprid	Triple Crown Golf, T&O	Pyrethroids, Neonicotinoids	3, 4A	Sodium channel modulators, Nicotinic acetylcholine receptor agonists/antagonists	

Active Ingredient	Trade Names	Chemical Class	IRAC Classification	Mode of Action	Notes
Fire Ants					
Acephate*	Lesco-Fate, Orthene	Organophosphates	1B	Acetylcholine esterase inhibitor	Uniform distribution. Apply early morning or late afternoon.
Hydramethylnon 0.88% bait	Amdro, Maxforce G	Hydramethylnon	20A	Mitochondrial complex III electron transport inhibitors (coupling site II)	Uniform distribution. Do not exceed 1.5lb/acre.
Avermectin 0.011% bait	Affirm	Avermectins	6	Chloride channel activators	Uniform distribution 3–4 ft around base of mounds
Bifenthrin F, G	Talstar, Menace	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Chlorpyrifos 4 E	Dursban	Organophosphates	1B	Acetylcholine esterase inhibitor	For use on sod farms.
Clothianidin + Bifenthrin	Aloft	Neonicotinoids; Pyrethroids, Pyrethrins	3, 4A	Nicotinic acetylcholine receptor agonists/antagonists; sodium channel modulators	Multiple formulations.
Deltamethrin G	Deltagard	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Fenoxycard 1 B	Award	Fenoxycarb	7B	Juvenile hormone mimics	Single mound treatment.
Spinosad bait	Justice	Spinosyns	5	Nicotinic acetylcholine receptor agonists (allosteric)—not group 4	
Fipronil 0.0143	Topchoice, Fipronil	Phenylpyrazoles	2B	GABA-gated chloride channel antagonists	Broadcast.
Imidacloprid + Bifenthrin	Allectus, Atera	Neonicotinoids; Pyrethroids, Pyrethrins	3, 4A	Nicotinic acetylcholine receptor agonists/antagonists; sodium channel modulators	Site-specific rates.
Indoxacarb bait	Advion	Oxadiazine	22	Voltage-dependent sodium channel blockers	
Lambda-Cyhalothrin	Battle, Scimitar, Cyonara	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Metaflumizone bait	Siesta				No more than 4 applications in one year.
Methoprene 0.5% bait	Extinguish	Juvenile hormone analogs	7A	Juvenile hormone mimics	
Methoprene + Hydramethylnon	Extinguish Plus	Juvenile hormone analogs	7A	Juvenile hormone mimics	
Pyriproxyfen bait	Distance Fire Ant Bait	Pyriproxyfen	7C	Juvenile hormone mimics	
Zeta-cypermethrin + Bifenthrin + Imidacloprid	Triple Crown Golf, T&O	Pyrethroids, Neonicotinoids	3, 4A	Sodium channel modulators, Nicotinic acetylcholine receptor agonists/antagonists	
Ground Pearls					
					No effective chemical control—use best management practices.

Active Ingredient	Trade Names	Chemical Class	IRAC Classification	Mode of Action	Notes
White Grubs					
Carbaryl	Sevin	Carbamate	1A	Acetylcholine esterase inhibitor	Curative treatment
Chlorantraniliprole	Acelepryn	Anthranilic diamide	28	Depletes calcium from insect muscles, disrupting normal contraction	Preventive. Apply at egg hatch. Use higher rates late in season.
Clothianidin	Arena	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	Preventive.
Clothianidin + Bifenthrin	Aloft	Neonicotinoids; Pyrethroids, Pyrethrins	3, 4A	Nicotinic acetylcholine receptor agonists/ antagonists; sodium channel modulators	
Dinotefuran	Zylam	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	Preventive. Apply at egg hatch.
Imidacloprid	Merit, Mallet	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	Preventive. Apply prior to egg hatch.
Imidacloprid + Bifenthrin	Allectus, Atera	Neonicotinoids; Pyrethroids, Pyrethrins	3, 4A	Nicotinic acetylcholine receptor agonists/ antagonists; sodium channel modulators	Check label for site-specific rates.
Thiamethoxam	Meridian	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	Preventive. Optimal control when applied from adult activity to egg hatch.
Hunting Billbug					
Bifenthrin F, GC, G	Menace, Talstar	Pyrethroids, Pyrethrins	3	Sodium channel modulators	GC formulation for golf courses.
Chlorantraniliprole	Acelepryn	Anthranilic diamide	28	Depletes calcium from insect muscles, disrupting normal contraction	
Chlorpyrifos 50 WSP, Pro	Dursban	Organophosphates	1B	Acetylcholine esterase inhibitor	For use on sod farms.
Clothianidin 0.5G, 50 WDG	Arena	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	
Clothianidin + Bifenthrin	Aloft	Neonicotinoids; Pyrethroids, Pyrethrins	3, 4A	Nicotinic acetylcholine receptor agonists/ antagonists; sodium channel modulators	
Deltamethrin G	Deltagard	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Imidacloprid 75 WSP, 0.5G	Merit, Mallet	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	Apply prior to egg hatch.
Imidacloprid + Bifenthrin	Allectus, Atera	Neonicotinoids; Pyrethroids, Pyrethrins	3, 4A	Nicotinic acetylcholine receptor agonists/ antagonists; sodium channel modulators	Check label for site-specific formulation.
Lambda-Cyhalothrin	Battle, Scimitar, Cyonara	Pyrethroids, Pyrethrins	3	Sodium channel modulators	Label restrictions near water.
Propoxur 1.5 fl oz	Baygon				Mow before treatment.
Thiamethoxam 0.33G, 25 WG		Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	Apply from peak adult activity to egg hatch.

Active Ingredient	Trade Names	Chemical Class	IRAC Classification	Mode of Action	Notes
Zeta-cypermethrin + Bifenthrin + Imidacloprid	Triple Crown Golf, T&O	Pyrethroids, Neonicotinoids	3, 4A	Sodium channel modulators, Nicotinic acetylcholine receptor agonists/antagonists	
Mole Crickets					
Acephate*	Orthene, Lesco-Fate	Organophosphates	1B	Acetylcholine esterase inhibitor	Use on sod farms and golf courses only. Water soil before application.
Bifenthrin F, GC, G	Talstar, Menace	Pyrethroids, Pyrethrins	3	Sodium channel modulators	GC formulation on golf courses.
Carbaryl bait	Sevin	Carbamate	1A	Acetylcholine esterase inhibitor	
Chlorpyrifos B	Dursban	Organophosphates	1B	Acetylcholine esterase inhibitor	For use on sod farms.
Cyfluthrin	Tempo 2, Tempo Ultra	Pyrethroids, Pyrethrins	3	Sodium channel modulators	Home lawn only.
Deltamethrin G	Deltagard	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Dinotefuran 20SG	Zylam	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	Apply at egg hatch.
Fipronil	Chipco Choice 0.1G; Top Choice, Fipronil 0.0143	Phenylpyrazoles	2B	GABA-gated chloride channel antagonists	Broadcast.
Imidacloprid 75 WP, 0.5G	Merit, Mallet	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	Target early instar crickets.
Imidacloprid + Bifenthrin	Allectus, Atera	Neonicotinoids; Pyrethroids, Pyrethrins	3, 4A	Nicotinic acetylcholine receptor agonists/ antagonists; sodium channel modulators	Site-specific formulations.
Indoxacarb Insect G	Advion	Oxadiazine	22	Voltage-dependent sodium channel blockers	Not for use on sod farms.
Indoxacarb	Provaunt	Oxadiazine	22	Voltage-dependent sodium channel blockers	Possession of supplemental label at time of application required.
Lambda-Cyhalothrin	Battle, Scimitar, Cyonara	Pyrethroids, Pyrethrins	3	Sodium channel modulators	Check label reentry period and nearby water restrictions.
Propoxur B	Baygon				
Zeta-cypermethrin + Bifenthrin + Imidacloprid	Triple Crown Golf, T&O	Pyrethroids, Neonicotinoids	3, 4A	Sodium channel modulators, Nicotinic acetylcholine receptor agonists/antagonists	
Scales/Mealybugs					
Bifenthrin	Talstar, Menace	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Clothianidin	Arena	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	
Deltamethrin	Deltagard	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Imidacloprid	Merit	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	

Active Ingredient	Trade Names	Chemical Class	IRAC Classification	Mode of Action	Notes
Thiamethoxam	Meridian	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	
Zeta-cypermethrin + Bifenthrin + Imidacloprid	Triple Crown Golf, T&O	Pyrethroids, Neonicotinoids	3, 4A	Sodium channel modulators, Nicotinic acetylcholine receptor agonists/antagonists	
Southern Chinch Bug					
Acephate*	Orthene	Organophosphates	1B	Acetylcholine esterase inhibitor	Use on sod farms and golf courses only
Beauveria bassiana	Botanigard, Naturalis-T	Unknown		Fungal spores attach to insect, germinate, and penetrate cuticle	
Chlorantraniliprole	Acelepryn	Anthranilic diamide	28	Depletes calcium from insect muscles, disrupting normal contraction	Suppression.
Bifenthrin F, GC, G	Talstar, Menace	Pyrethroids, Pyrethrins	3	Sodium channel modulators	GC formulation on golf courses.
Carbaryl 80 WSP	Sevin	Carbamate	1A	Acetylcholine esterase inhibitor	
Clothianidin 0.5G, 50 WDG	Arena	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	
Clothianidin + Bifenthrin	Aloft	Neonicotinoids; Pyrethroids, Pyrethrins	3, 4A	Nicotinic acetylcholine receptor agonists/ antagonists; sodium channel modulators	
Cypermethrin TC	Demon	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Chlorpyrifos 2E, 4E, 50 WP, Pro	Dursban	Organophosphates	1B	Acetylcholine esterase inhibitor	For use on sod farms only.
Cyfluthrin	Tempo 2	Pyrethroids, Pyrethrins	3	Sodium channel modulators	For use on home lawns.
Deltamethrin G	Deltagard	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Dinotefuran 20SG	Zylam	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	Suppression.
Imidacloprid + Bifenthrin	Allectus, Atera	Neonicotinoids; Pyrethroids, Pyrethrins	3, 4A	Nicotinic acetylcholine receptor agonists/ antagonists; sodium channel modulators	See label for site specific formulations.
Lambda-Cyhalothrin	Battle, Scimitar, Cyonara	Pyrethroids, Pyrethrins	3	Sodium channel modulators	See label for reentry period and water restrictions.
Permethrin	Astro	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Zeta-cypermethrin + Bifenthrin + Imidacloprid	Triple Crown Golf, T&O	Pyrethroids, Neonicotinoids	3, 4A	Sodium channel modulators, Nicotinic acetylcholine receptor agonists/antagonists	

Active Ingredient	Trade Names	Chemical Class	IRAC Classification	Mode of Action	Notes
Twolined Spittlebug					
Acephate	Orthene	Organophosphates	1B	Acetylcholine esterase inhibitor	Use on sod farms and golf courses only.
Bifenthrin F, GC, G	Talstar, Menace	Pyrethroids, Pyrethrins	3	Sodium channel modulators	Use GC formulation on golf courses.
Carbaryl 80 WSP	Sevin	Carbamate	1A	Acetylcholine esterase inhibitor	
Chlorpyrifos 4E, 50WSP, Pro	Dursban	Organophosphates	1B	Acetylcholine esterase inhibitor	For use on sod farms.
Deltamethrin G	Deltagard	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Tropical Sod Webworm					
Acephate	Lesco-Fate, Orthene T, T&O, Precise 4G	Organophosphates	1B	Acetylcholine esterase inhibitor	Usse on sod farms and golf courses only.
Azadirachtin	Azatrol, Neemix, Turplex	Azadirachtin	18B	Ecdysone agonists/molting disruptors	
Bacillus thuringiensis	Various names	*B. t.* subspecies *kurstaki*	11B2	Microbial disruptors of insect gut membranes	
Bifenthrin F, GC, G	Talstar, Menace	Pyrethroids, Pyrethrins	3	Sodium channel modulators	Use GC formulation for golf courses.
Carbaryl 80 WSP	Sevin	Carbamate	1A	Acetylcholine esterase inhibitor	
Chlorantraniliprole	Acelepryn	Anthranilic diamide	28	Depletes calcium from insect muscles, disrupting normal contraction	
Chlorpyrifos 4E, 2E, 5G, Pro	Dursban	Organophosphates	1B	Acetylcholine esterase inhibitor	For use on sod farms.
Clothianidin 0.5G, 50 WDG	Arena	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	
Clothianidid + Bifenthrin	Aloft	Neonicotinoids; Pyrethroids, Pyrethrins	3, 4A	Nicotinic acetylcholine receptor agonists/ antagonists; sodium channel modulators	
Cyfluthrin	Tempo 2, Tempo Ultra	Pyrethroids, Pyrethrins	3	Sodium channel modulators	Irrigate after application. Do not apply to bentgrass.
Deltamethrin G	Deltagard	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Diflubenzuron	Dimilin 2L	Insect Growth Regulator	15	Chitin biosynthesis inhibitor	
Dinotefuran 20SG	Zylam	Neonicotinoids	4A	Nicotinic acetylcholine receptor agonists/ antagonists	
Imidacloprid + Bifenthrin	Allectus, Atera	Neonicotinoids; Pyrethroids, Pyrethrins	3, 4A	Nicotinic acetylcholine receptor agonists/ antagonists; sodium channel modulators	See label for site specific formulation.

Active Ingredient	Trade Names	Chemical Class	IRAC Classification	Mode of Action	Notes
Indoxacarb SC	Provaunt	Oxadiazine	22	Voltage-dependent sodium channel blockers	Not labeled for sod farms.
Lambda-Cyhalothrin	Battle, Scimitar, Cyonara	Pyrethroids, Pyrethrins	3	Sodium channel modulators	See label for reentry period and water restrictions.
Methomyl 90 SP	LannateH				
Permethrin	Astro	Pyrethroids, Pyrethrins	3	Sodium channel modulators	
Spinosad A and D SC	Conserve	Spinosyns	5	Nicotinic acetylcholine receptor agonists (allosteric)—not group 4	
Zeta-cypermethrin + Bifenthrin + Imidacloprid	Triple Crown Golf, T&O	Pyrethroids, Neonicotinoids	3, 4A	Sodium channel modulators, Nicotinic acetylcholine receptor agonists/antagonists	
Acephate*	Water in after application. When using acephate, check pH of spray water and adjust to 5.5–6.0 when pH is above 7.0. Acephate is not labeled for use on residential turf except as a fire ant mound treatment. Acephate is registered for turf on golf courses and sod farms.				
Many other trade names are available. No endorsement of products is intended, nor is criticism of unnamed products implied. ***Read container label carefully for use directions, application techniques, irrigation requirements, worker protection information, and precautions.*** Be sure the formulation of pesticide you use is labeled for use on turfgrass.					