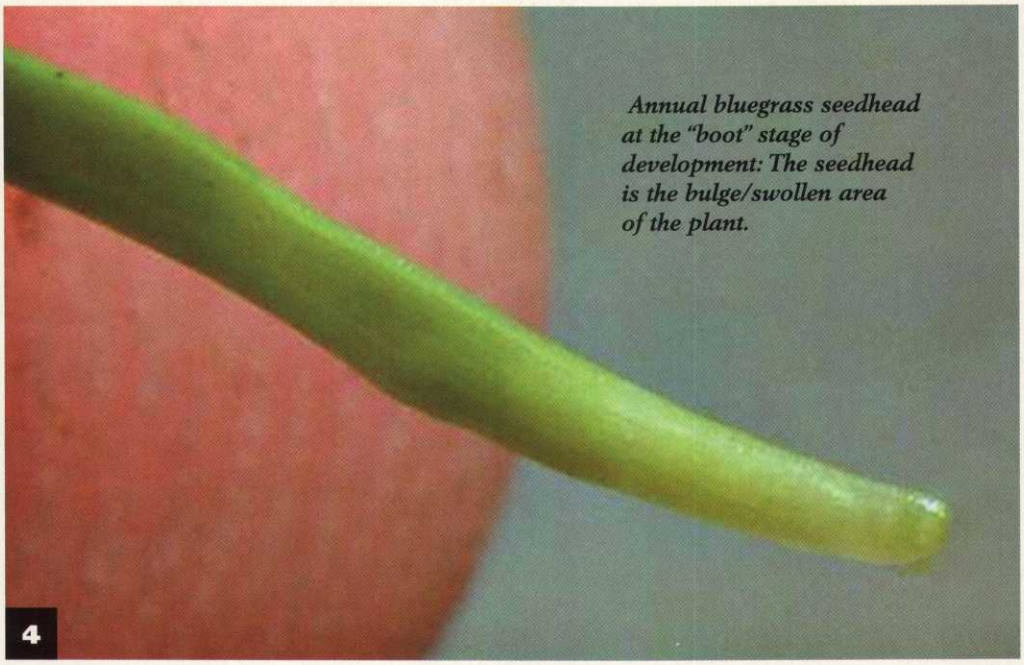

Annual bluegrass seedhead at the "boot" stage of development: The seedhead is the bulge/swollen area of the plant.

4

West Coast, acceptable seedhead suppression has been documented when Proxy is used but it appears less effective when used on the East Coast. Proxy is a "class E" PGR. This class of PGRs acts hormonally in the plant to prevent growth.

Primo Maxx (trinexapac-ethyl) provides little annual bluegrass seedhead suppression. Primo Maxx is a "class A" PGR. This class of PGRs blocks

An annual bluegrass seedhead at a greens' mowing height.

the production of gibberellic acid late in the production pathway in order to encumber the 1103-elongation of plant cells to reduce plant growth. Seedhead production is primarily driven by cell division, not cell elongation.

However, when Proxy and Primo Maxx are tanked mixed, annual bluegrass seedheads can be suppressed on putting greens.

In a two-year study at Penn State, this PGR combination has consistently provided more than 85-percent suppression of the annual bluegrass seedheads on putting greens with only slight phytotoxicity. In this study, multiple applications of the Proxy/Primo Maxx tank mixed combination, applied three weeks apart, provided greater than 90 percent seedhead suppression. Additionally, when MacroSorb Foliar (an L-amino acid bio-stimulant) was added to the tank mixture, the small amount of phytotoxicity was reduced even further while annual bluegrass seedhead suppression remained constant.

Turfgrass managers who choose to cultivate the annual bluegrass populations on putting greens can use PGRs to suppress the seedheads. This tactic will improve the overall annual bluegrass plant health and provide the golfer with a higher-quality playing surface.

Borger is a research support technician at Pennsylvania State University. Watschke is a professor of turfgrass science at Penn State and undergraduate coordinator for the turfgrass science major. Soika is a research support technologist in the Department of Plant Pathology at Penn State.

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Root-feeding insects have unseen effects on turfgrass quality

By Doug Richmond

PHOTO BY DOUG RICHMOND

Adult tawny mole cricket with front legs equipped for digging.

Managing soil-dwelling insects is one of the most challenging tasks any turfgrass professional can undertake. Soil insects are difficult to monitor and difficult to control, but the damage they cause can be devastating and may in fact lead to a host of related long-term problems that can influence overall turf quality. However, armed with knowledge about the biology and ecology of these subterranean pests, most turfgrass managers can devise practical and effective schemes for effectively controlling them.

This article will provide turfgrass managers a basic understanding of the biology and ecology of the most common soil-dwelling insect pests of turfgrass in hopes of promoting more accurate diagnosis and effective use of management tools. Furthermore, it will clarify how proper management of soil insects can improve overall turfgrass quality by demonstrating important but often overlooked links between these pests and other turfgrass management concerns.

There are basically three groups of soil-dwelling, root-feeding insects that commonly cause problems in turfgrass. These three groups are white grubs, billbugs and mole crickets, and each comes with its own behavioral and life history habits that provide specific management challenges and opportunities.

Mole crickets

Although there are about seven species of mole crickets found in turfgrass in the United States, only four of these species are considered pests — the northern mole cricket *(Neocurtilla hexadactyla)*, the southern mole cricket (*Scapteriscus borellii)*, the tawny mole cricket *(Scapteriscus vicinus)* and the short-winged mole cricket (*Scapteriscus abbreviatus)*.

All three *Scapteriscus* species were introduced into the United States from South America during the late 19th and early 20th centuries. In the United States, the southern and tawny mole crickets are distributed throughout the coastal states of the South and Southeast whereas the short-winged mole cricket can be found in parts of southern Florida (Sarasota, Fort Myers, Tampa). The northern mole cricket is distributed from New England south to Florida and west to Texas and the Central Plains.

Mole crickets are easily identifiable due to the characteristic front legs which are stout and modified for digging. Depending on the particular species, mole crickets may range in color from a dark chestnut brown to a golden or grayish brown, and the adults of all species are covered with a dense coat of fine hairs.

Mole crickets can be identified to species based on the configuration of the digging legs and, to some degree, by characteristic pronotal patterns (the pronotum is the shield-shaped area just behind the head).

The seasonal life cycle of mole crickets varies depending on the species. The northern mole cricket takes one year to complete development in the southern portions of its range and two

Continued on page 84

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To evaluate mower pick-up, the morning after application we mowed both sides of the same green to see if there would be any visible pickup in the mower hoppers. Again, there was no mower pickup on the Contec DG side, yet significant mower pick-up on the competitor product side.

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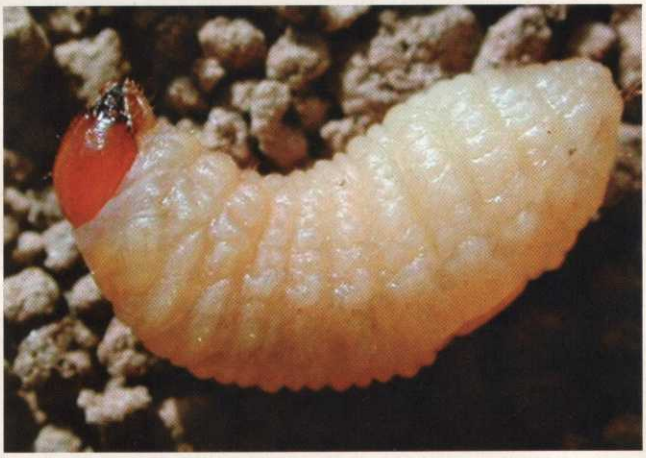
Continued from page 82

years in more northern areas. Both the southern and tawny mole crickets produce one generation per year, with the exception of southern Florida where the southern mole cricket is capable of two generations per year. The short-winged mole cricket likely breeds continuously because all developmental stages can be found in the field at any given time.

In general, mating and dispersal flights take place during spring and usually occur around dusk. Short-winged mole crickets do not fly but disperse by tunneling or crawling instead. Egg laying occurs shortly after mating, and eggs may take up to 30 days to hatch. The larvae then spend the summer feeding on plant roots (short-winged and tawny) or other insects (southern and northern). Development to the adult stage may be completed by fall or may continue into the following spring.



Fully grown bluegrass billbug larva. Notice that the larva is legless.

PHOTOS BY DOUG RICHMOND

Fully grown masked chafer larva. Note the C-shaped body and the presence of three pairs of legs.

As their common name implies, mole crickets damage turf by tunneling through the soil, pushing up soil mounds and feeding on plant roots. Tunneling is destructive because it loosens the soil around plant roots, leaving plants vulnerable to desiccation. With the three imported *Scapteriscus* species, the trails left by tunneling activity are unsightly and sometimes interfere with play on golf course greens and fairways. The adults of these three species can cause considerable damage by pushing up mounds of soil around their burrows during mating and overwintering. More extensive damage may occur during the summer when nymphs (immature stages) are most actively feeding on turfgrass roots.

Although the native northern mole cricket seldom damages turfgrass, it can sometimes be a problem in areas adjacent to streams, ponds or wetlands where it prefers to live.

White grubs

There are several widely distributed species of economically important white grubs in the United States and Canada, and a few species that are more localized in distribution. Several species, including the Japanese beetle (*Popillia japonica*), European chafer (*Rhizotrogus majalis*), Asiatic garden beetle (*Maladera castanea*), and Oriental beetle (*Exomala orientalis*) have been accidentally introduced into the northeastern United States and are a major concern for turfgrass managers along the St. Lawrence-Great Lakes corridor.

The Japanese beetle has spread as far south as Georgia and west to the Mississippi. Other exotic species have been introduced into peninsular Florida, but their biology and capacity for causing problems on turfgrass is not well understood. Several native species including the green June beetle (*Cotinus nitida*), black turfgrass ataenius (*Ataenius spretulus*), northern masked chafer (*Cyclocephala borealis*), southern masked chafer (*Cyclocephala lurida*), southwestern masked chafer (*Cyclocephala pasadenae*) and a variety of June beetle species (*Phyllophaga spp.*)

can also cause serious damage to turf and are more widespread in distribution.

White grubs are the larvae of scarab beetles. Although the adults of these beetles vary somewhat in appearance, the larvae look very similar. White grubs are typically C-shaped in appearance with a soft, fleshy, white body, light brown or chestnut-colored head capsule; and three obvious pairs of legs. Species can be determined based on the pattern of hairs on the lower end of the underside of the abdomen (raster), but a magnifying glass is usually needed for this.

White grubs can be classified into three major groups based on the time required to complete their life cycle (one year or less, one year or more than 1 year). The black turfgrass ataenius has one (Michigan and upper New England) or two (Ohio and South) generations per year depending on the location. This species typically overwinters in the adult stage and begins laying eggs in the spring.

In Ohio, larvae may be present as early as May, with the first generation peaking by mid-June. First generation adults can be present as early as mid-July, with second generation larvae peaking in early September. In northern New York, the single generation of larvae usually peaks by the end of July.

About 25 species of May/June beetles (*Phyllophaga*) have been found in turfgrass in North America, although only four species are known to cause damage to turfgrass. Depending on the species and location, these beetles may take from one to four years to complete development. In species requiring more than one year to complete development, the majority of time is spent in the last larval stage.

The life cycle of all other white grub species typically takes only one year. Although there is some variability between these species, adult beetles typically emerge from the soil during June or July, and young larvae are sometimes present by the beginning of August. Large larvae are usually present by the beginning of October, and this is usually the overwintering stage.

White grubs feed below ground primarily on decaying organic matter, but damage to turfgrass results from incidental root feeding. Damage results in patches of wilted, dead or dying turfgrass during spring or fall. Wilted turf resulting from white grub damage does not respond well to irrigation. Severe secondary damage often occurs in heavily infested areas as a result of skunks, raccoons and other mammals that tear up the turf searching the grubs. This secondary damage is sometimes the first noticeable indication that white grubs are present, but unfortunately they are considerably more difficult to control at this late stage.

Billbugs

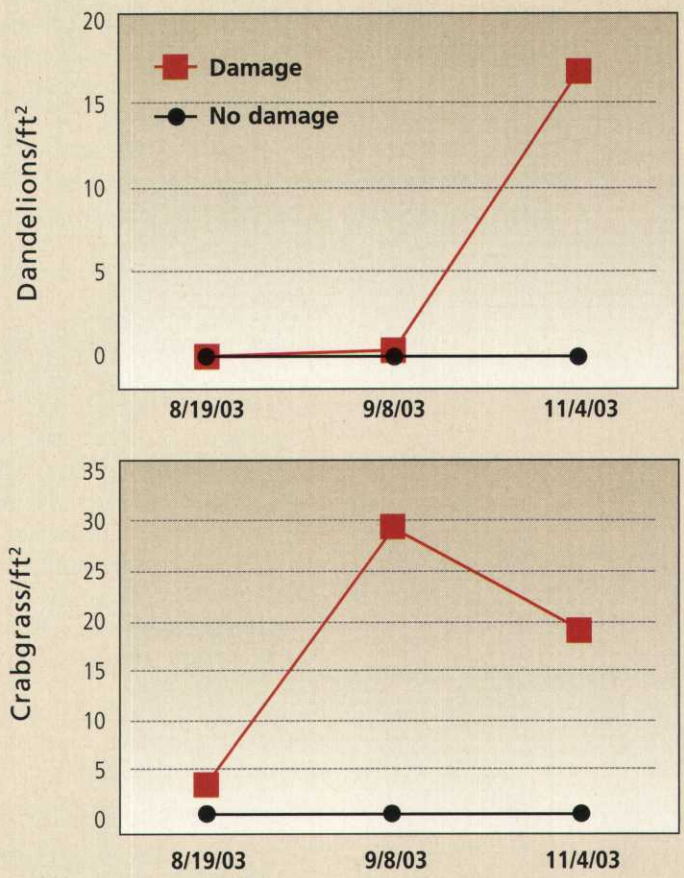
There are five species of billbugs that are known to infest turfgrass in North America. These species include the bluegrass billbug (*Sphenophorus parvulus*), the lesser billbug (*Sphenophorus minimus*), the hunting billbug (*Sphenophorus venatus*), the Denver or Rocky Mountain billbug (*Sphenophorus cicatristriatus*) and the Phoenician or Phoenix billbug (*Sphenophorus phoeniciencsis*).

Although all of these species are native to

Continued on page 86

FIGURE 1

Dandelion and crabgrass density in Kentucky bluegrass damaged or undamaged by bluegrass billbug.



Continued from page 85

North America, their geographical ranges differ significantly. The bluegrass and lesser billbugs are found primarily in cool-season turfgrasses in the Northeast and Midwest, whereas the hunting billbug is most common in the transition zone and southern regions of the United States.

The Denver billbug is confined to the Rocky Mountain and upper Great Plains regions, whereas the Phoenician billbug is more common in Southern California and Arizona.

Billbugs are weevils, and the adults are easily identifiable by their long snout. The larvae are small, white, soft-bodied, legless insects with a brown- or chestnut-colored head capsule. Although adults feed on turfgrass, their damage is insignificant. However, the larvae can cause significant damage while feeding on the roots, stolons, stems and crowns of turfgrass plants.

Damage by larval billbugs is often misdiagnosed as drought stress or dormancy because it often coincides with the onset of dry weather (affecting cool-season turfgrasses) or winter dormancy (affecting warm-season turfgrasses). However, turfgrass damaged by billbugs does not recover when suitable growth conditions return. Billbug damage can be quickly determined using the "tug test." To perform the test, select a few of the dead looking tillers and try to pull them out of the ground. Turfgrass damaged by billbugs will break off easily, and the bottom ends of the tillers are often packed with frass which resembles fine sawdust.

The bluegrass billbug and lesser billbug generally produce one generation per year, although a partial second generation may occur in some areas. In April and early May, adult bluegrass billbugs move from their overwintering sites into stands of turfgrass where they feed, mate and begin to lay eggs. The eggs generally hatch within two weeks and the resulting larvae tunnel inside grass stems. When the larvae have depleted the stem or become too large to be contained within, they move to the crown of the plant where they can inflict significant damage.

The hunting, Denver and Phoenician billbugs have only one generation per year but adults and larvae may be present at any given time. These billbugs usually overwinter as larvae and do not finish development until the following spring. Spring adults feed, mate and lay eggs over an extended period of time.

Richmond is a post-doctoral researcher in the Department of Entomology at Ohio State University.

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No News Is Good News

Word on the street is that there aren't new chemistries poised to join the pre-emergent herbicide market – but that may just mean what's out there is doing the job

BY FRANK H. ANDORKA JR., MANAGING EDITOR

The sounds of silence are pervading the halls of basic chemical manufacturers — at least when it comes to bringing a new pre-emergent herbicide chemistry to market.

There is no single explanation for the lack of new formulations. Some attribute it to changing maintenance practices. Others say there's little impetus to create new chemistries because superintendents seem satisfied with the products currently available. Still others insist that the costs of bringing new chemistries to such a small market are prohibitive. But that doesn't mean there aren't niche markets and small improvements that can be made to current pre-emergent herbicides during the next few years, experts say.

"I'd be hard-pressed to say there's anything new on the horizon on the pre-emergent herbicide front," says Joe DiPaola, golf market manager for Syngenta Professional Products.

More superintendents are shifting from pre-emergent to postemergent weed control because of cost and environmental concerns.

Changing practices

Dave Fearis, turf and ornamental products specialist for PBI Gordon, says smaller maintenance budgets are forcing more superintendents to move from pre-emergent broadcast herbicide applications to postemergent spot treatments instead. He's not sure the practice is widespread yet, but believes it's more prevalent than some may think.

"When you go with a pre-emergent application, it tends to be over a large area," Fearis says. "That costs more money than going out after the weeds emerge and spot treating those areas. There's a cost factor involved that influences some decisions superintendents have to make."

In fact, George Raymond, business manager for herbicides and plant growth regulators for Bayer Environmental Sciences, believes superintendents are making a slow, willful decision to reduce the number of pre-emergent herbicides they use. After all, that's what happened in the agricultural market. Farmers discovered that they could get by with putting down less material if they used postemergent products, he says.

"You're seeing a slow, steady movement in that direction in turf as well," Raymond

Continued on page 92