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ENTOMOLOGY

Black Turfgrass Ataenius

Small Pest of Increasing Importance on Highly Managed Turfgrass

By Nikki L. Rothwell, University of Massachusetts

Ataenius spretulus, otherwise known as the black turfgrass ataenius (BTA), is a scarab beetle native to North America. It was first reported damaging golf course turf in Minnesota in 1932. It was identified next in New York state in 1969, then in Ohio in 1973. Prior to the 1970s, this insect was considered only an incidental pest but, in the last 25 years, this insect has caused damage on golf courses throughout the Northeastern and Midwestern portions of the United States, as well as in California and Ontario, Canada. It has now been reported in 41 of the 48 contiguous states, though most of the severe damage appears in the Midwestern regions of the U.S.

The BTA can be easily confused with another, relatively new turfgrass pest, *Aphodius granarius*, which is also commonly found in areas where BTA is a continuous problem. Although BTA and the aphodius beetle are quite similar, they can be differentiated by the

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appearance of the hind leg of the adult beetle. Aphodius has a stair-stepped tibia, while BTA's hind leg is smooth.

BTA characteristics

The female ataenius beetle lays clusters of 10 to 15 eggs in a small cavity in the top inch of soil. The round, cream-colored eggs are extremely small — less than 0.05 inches — but can be seen without the use of a hand lens against the dark soil. The eggs hatch within two weeks into typical scarab larvae. The larvae are white, C-shaped grubs with a brown head and three pairs of easily identifiable legs. The BTA larvae have three molts or instars, with the third and final instar reaching lengths of 0.3 inch.

While the grubs of the BTA resemble other scarab pests, such as the Japanese beetle or the European chafer, BTA larvae are much smaller in comparison. Due to their small size, BTA grubs take on a grayish appearance when feeding in the soil. In addition to their small size, BTA larvae can also be identified from early instars of other scarab pests by a pair of distinct padlike forms on the tip of the abdomen.

BTA larvae have no unique raster pattern (the pattern of hairs that appears on the abdomen tip). The 45 hairs appear to be randomly placed over the abdomen end. In comparison, the other small scarab larvae, the aphodius beetle, has a raster pattern with hairs arranged in a small V.

Other than size, the pupa or resting stage (following the larval stage) of BTA resembles a Japanese beetle pupa, with both the legs and wings visible, but tucked closely against the body. Pupa coloration ranges from a creamy white in new pupa to a tan for those pupa about to pupate into adults. BTA pupa are located near the soil surface, just below the thatch line.

The BTA adult stage is a fairly small black beetle, approximately 0.1 to 0.2 inch long and 0.05 inch wide. It has a shiny appearance with definite striations that run the length of its wing covers.

BTA biology and phenology

The BTA can have multiple generations per growing season, depending on the region of the country. It has two generations per year in sectors below the southern part of Ohio and one generation per year in areas north of Ohio. A partial second generation has been observed in warmer years in areas as far north as lower Michigan. BTA may have at least three generations per year in California.

Adult beetles overwinter in wooded sites near the golf course. Many of the adults that move into hibernation survive the winter (90% to 96% survival rate). These beetles emerge from the overwintering sites in late March through early May onto greening golf course turf and bury themselves into the grass. On sunny spring days, these shiny black beetles can be seen crawling over golf course greens or flying in large numbers through the air.

Although little is known of BTA mating habits, prior observations have noted that adult females are inseminated throughout most of the summer months. In areas where only one generation occurs, egg laying may begin as early as May 1 and continue into the second week of June.

The eggs hatch and the first instar larvae immediately begin to feed on the turfgrass roots, causing only a little damage due to their small size. The larvae continue to feed and molt through June and the early part of July until reaching the third instar, the most damaging stage of BTA. These third instar larvae can cause considerable damage to the turf when turf is already under summer stress, especially in late July and early August. The larvae eventually move deeper into the soil (1 to 3 inches), where they pupate.

The adults that emerge from these pupa will move to overwintering sites, in areas where only one generation is noted, or begin to lay eggs, in locations with two generations. The second generation larvae hatch and begin to feed, although the time between molts is much shorter due to rising summer temperatures in July and August. The evidence of feeding activity from second-generation, third-instar larvae usually occurs in late August or early September and can be as damaging as the first generation larvae. The second generation pupates in September and these new adults move to overwintering sites in late September or early October.

The BTA has been closely associated with the blooming behaviors of many indicator plants, especially in the Midwestern portions of the U.S. The first generation overwintering females lay their eggs around the time of full bloom of spirea and horse chestnut, and the earliest bloom of black locust depending on location (first half of May in southern Ohio and early June for New York). First generation larvae begin to show up at the same time multiflora rose is in full bloom and second generation eggs are laid when the Rose of Sharon is in full bloom. Many superintendents in the Midwest use these plants as indicators for timing of BTA activity.

Hosts

BTA feeds principally on golf course turf, appearing most commonly on fairways and tees, with an occasionally problem on greens. However, in California, BTA has shown itself to be a constant pest of golf course greens. BTA larvae feed just below the turf surface on the roots of Kentucky bluegrass, bentgrasses, annual bluegrass and perennial ryegrass, showing no preference for one type of grass over another.

Injury from BTA grub feeding begins to appear during the initial heat/moisture stress periods of the growing season, usually late June through July in the Midwest.

Damaged turf first appears as wilted areas that do not respond to water. This wilted appearance is most visible when looking toward the turf in the direction of the sun. After the initial wilting occurs, the turf begins to thin, even under irrigation. Small irregular thinning patches of turf begin to develop usually in areas that have a history of early moisture stress. If left untreated, larval feeding activity can lead to large areas of dead or damaged turf.

The grubs feed in the typical scarab manner, eating the turf roots and root hairs, resulting in a severely depleted and inadequate root system that is unable to supply the above ground portion of the plant with sufficient moisture to sustain itself. As the heat or moisture stress continues, the plant sloughs leaf tissue causing the aforementioned initial thinning. If the feeding activity has removed enough root tissue the plant will wither and die. This weakened or nonexistent root system allows the turf to rolled back like a carpet.

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Long Island, NY, and several regions of Ohio, have reported scattered incidental BTA infestations on home lawns, but with minimal damage to the turf. Most recent studies have shown that BTA prefers to feed on fairway mown turf rather than grass in the rough of a golf course, even if the grass type remains the same. Both adult and larval populations of BTA are more prevalent in fairway turf. Speculation exists to why this phenomenon occurs, but no concrete conclusions have been drawn. Recent research at Cornell has shown that other scarab turf pests show a preference for turf mowed at certain heights.

Natural enemies of BTA

Many studies have shown predatory or beneficial insects dwell in turf. The predatory insects mostly commonly found on golf courses include ants (*Formicidae*), rove beetles (*Staphylinidae*), spiders, hister beetles (*Histeridae*) and ground beetles (*Carabidae*). In laboratory studies, many of these insects have been observed feeding on eggs or larvae of turfgrass pests. Studies have also shown that low-maintenance turf that has few applications of chemicals has fewer turf pest outbreaks than turf under high maintenance conditions. It is believed that turf pests are held in check by natural insect enemies when the natural enemies are not dis-

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Distribution and Estimated Generations of BTA Per Year

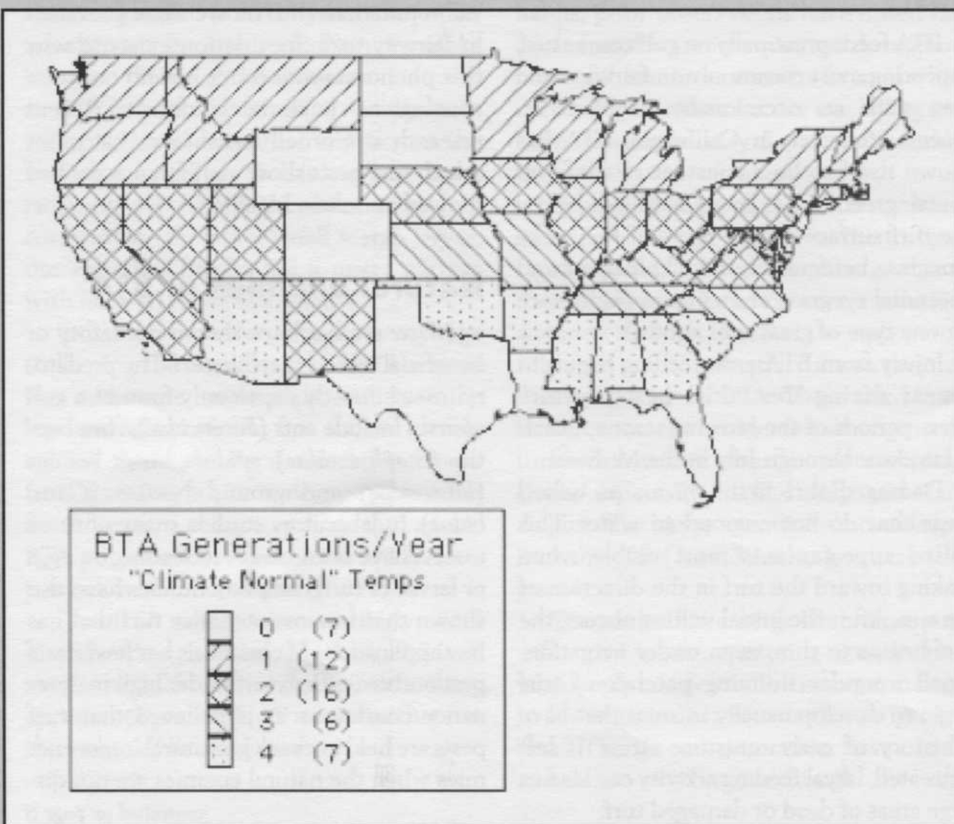
By Christopher Sann, Pest Forecasting Group Inc.

Unlike other soil dwelling and damaging insects of turfgrass, black turfgrass ataenius (BTA) can have several generations per year. In fact, the relatively small number of accumulated degree-days required between full generations are much more akin to several of the surface dwelling insect pests of turf — armyworms, chinch-bugs and cutworms.

This relatively small number of accumulated degree-days (~1100 @ base 50) means that multiple generations of BTA may be more of a problem to turfgrass managers than they realize during an average year and much more of a problem in the warmer years that we have recently been experiencing in the 1990s.

In northern areas of BTA's traditional distribution (the Northeast and Midwest) this can mean one to two full or partial generations per year during a climatologically normal year. In a warm year, the number of generations can increase to a second or third partial or full generation. This added generation, combined with the moisture stress that often accompanies these warmer years, can lead to substantially increased levels of damage, particularly at sites with irrigation.

In southern areas of BTA's distribution, managers need to be familiar with the probable number of generations that will occur under normal or average climate



conditions. It is not inconceivable that in warmer, slightly dryer years, the three to four partial or full generations per year normally found in these areas could increase to as many as five to six partial or full generations.

The concept of increasing multiple partial or full generations per year is very important to understand for all turfgrass managers and especially those in newly identified distribution areas. In cooler regions, an additional partial or full generation may increase late season danger from actively feeding grub populations by a factor of two, depending the site characteristics. But the danger in more southern zones, from exploding late season BTA grub populations in warmer years, could increase by a factor of four or more. Keep in mind an additional partial generation can pose as much or more current year risk as a full generation, which will likely pose added risk in the following year.

Based on an analysis of the estimated number of generations per year per NOAA Climatological District (CD), the potential variation in estimated generations year can differ considerably within a state. The difference between assuming two generations a year and actually having four is significant. Managers in states with a wide variance in climate, should consider the table below.

POSSIBLE VARIENCE IN NUMBER OF BTA GENERATIONS*

State	NOAA CD #	Area Name	Generations/yr.
Alabama	01	Northern Valley	4.0
	08	Gulf	5.5
Arizona	02	Northwest	2.2
	05	Southeast	7.2
California	03	Northeast Basin	1.2
	07	Southeast Desert Basin	5.3
Georgia	03	Northeast	3.6
	09	Southeast	5.4
Maryland	02	Central Eastern Shore	3.4
	08	Allegheny Plateau	1.9
Nevada	01	Northwest	1.9
	04	Extreme Southern	5.3
New York	03	Northern Plateau	1.3
	04	Long Island	2.6
North Carolina	01	Southern Mountains	2.9
	06	Southern Coastal Plain	4.2
Oklahoma	01	Panhandle	3.6
	08	South Central	4.7
Oregon	05	High Plateau	0.8
	09	Southeast	2.0
South Carolina	01	Mountain	3.4
	07	Southern	5.0
Utah	02	Dixie	3.0
	05	Northern Mountains	1.3
Virginia	01	Tidewater	3.6
	06	Southwestern Mountains	2.3
Washington	01	West Olympic Coastal	1.0
	08	Central Basin	2.3
Wyoming	02	Snake River Drainage	0.6
	07	Cheyene Drainage	1.9

* States where the difference in the number of BTA generations in the different regions was equal to or less than 1.0 are not included on this list.

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turbed by abundant chemical applications.

Beneficial insects are also found in association with BTA. Recent studies have shown that higher populations of BTA larvae are found in locales where beneficial enemies are at low numbers. In areas where these natural enemies are in high populations, BTA larvae seem to be in low numbers. These observations suggest that beneficial insects play a large role in the location of BTA outbreaks on golf course turf. However, more research must be done to verify these new findings.

Observations suggest that beneficial insects play a large role in the location of BTA outbreaks on golf course turf.

The only pathogen reported on BTA is known as milky disease, caused by *Bacillus popillae*. Milky spore disease is a bacteria that infects many of the scarab pests found in golf course turf. The spores of the bacteria live in the soil. The grub ingests these spores as it is feeding on the turf roots. The spores multiply in the blood (hemolymph) of the grub and build up to such a high population in the body that the grub has a milky white appearance. Eventually, the spores of the bacteria will build up to such high numbers, they will kill the grub. The milky disease that infects BTA is specific to only BTA; it does not infect any other scarab turfgrass pest and is not available commercially.

The incidence of milky disease found in BTA has a variable incident rate in all areas where BTA has been found. In a study done in Rochester, NY, in 1969, approximately 70% of the BTA sampled contained milky disease. Many BTA grubs in other regions have shown some evidence of the milky disease infection, but little information is known about the level of infection rate that actually kills the grub.

In Michigan, BTA larvae were collected from both the fairway and rough areas of the golf course. The grubs collected from the rough had a 67.7% infection rate of milky disease compared to only a 34.4% infection rate of grubs collected from the fairway turf.

This experiment may be a precursor to future studies to discover why BTA grubs are infected with milky spore disease more often in longer turf, which in turn may help milky spore disease become a more effective agent against damaging BTA populations.

Thresholds

Adult BTA can be monitored with black light traps placed on the golf course in April and May to capture beetles emerging from overwintering sites. A soapy flush (one to two gallons of water with one or two tablespoons of lemon scented dish detergent over a one to two foot turf area) poured onto a green can bring up the buried adult beetles. However, monitoring adult activity is not directly correlated with high populations of BTA larvae on golf course turf. Monitoring adults may give the superintendent an idea of the populations present in the area, but the presence of adults is not a guaranteed indicator of larval activity.

The most effective way to scout for larval activity is to sample the turf with a typical golf course cup cutter (a 4.25-inch diameter cup cutter is about 0.1 square feet). Collect two-inch-depth cup cutter cores in areas that appear to be under stress. Break up each turf core, examining the turf, thatch and soil layers for the small white grubs.

Economic thresholds for BTA have not been established for golf course turf, but observational thresholds exist. Also, it is difficult to determine economic thresholds for turfgrass infested with BTA because of the many factors affecting the vigor of the turf: water, desiccation, fertilization, compaction, other insect problems, disease and mowing height. However, non-stressed turf usually can tolerate approximately 50 BTA grubs per square foot or five grubs per cup cutter sample. If the turf is under any type of stress, this threshold level will decrease to approximately 30 grubs per square foot or three grubs per cup cutter, depending on the level of turf stress. Also, turf may have a lower threshold for second generation grubs because of the summer heat stress on the turf in August.

Control Methods

Standard insecticides known to be effective against Japanese beetle and other white grub pests have also been shown to be effective for black turfgrass ataenius. The traditional method of pesticide application has been to apply insecticide shortly after the female beetles have laid their eggs. Spray for BTA larvae around the time of horse chestnut or Van Houtte spirea in full bloom, around the first of June in the Midwest.

These applications of insecticides should be watered in heavily to be most effective at controlling BTA, with at least 0.25 to 0.5 inches of water immediately after in-secticide applications.

Bendiocarb should be applied for BTA at 2 to 3 pounds of active ingredient (AI) per acre. Isofenphos is applied at 2 pounds of AI/acre, but this material should only be applied once per year for any grubs targeted. Trichlofon penetrates the thatch layer more readily than the other traditional insecticides; therefore, it is the optimal material for spot treating for BTA, after grubs have been observed. This insecticide should be administered at 8 pounds of AI/acre. However, state regulations vary, so check the labels before applying any chemicals to the turf.

The two new chemicals currently on the market for white grub control, halofenozide and imidacloprid, have also been shown to be effective at controlling populations of BTA. However, these materials should only be applied to the turf once per season. Halofenozide should be applied the turf at the rate of 1.5 pounds of AI/acre, usually in late May. (The data for halofenozide is inconclusive at this time.)

Imidacloprid is applied at a much lower rate, only 0.3 pounds of AI/acre.Imidacloprid should be applied in late April or early May in the Midwest, or about the time of BTA egg laying in other regions. This material is only effective when applied to the turfgrass before the larvae are present. Also, imidacloprid is not effective when used to spot treat areas where third instar larvae are causing considerable damage.

Another approach to control BTA infestations was developed at The Ohio State University in the late 1970s. This approach targets the adult male and female beetle populations upon emerging from overwintering, before the fertilized female beetles have the opportunity to lay eggs.

The traditional method of pesticide application has been to apply insecticide shortly after the female laid their eggs.

The insecticide is applied to the turf and remains bound in the thatch where the adults reside during most of the spring. Chlorpyrifos used in this manner has been shown to be effective in the control of adult BTA populations. It should be applied in two applications. The first application should be made approximately at the time between forsythia full bloom and dogwood full bloom. A second application is then made two weeks later. The applications are made with a reduced rate of chlorpyrifos, 1 to 2 pounds of AI/acre, and they should be watered in lightly.

This approach should only be used in locales where BTA populations have been high in recent years. The reason for caution for this control approach is because large populations of adult beetles do not always lead to large damaging populations of BTA grubs. Conceivably, this approach could lead to wasted chemical applications and unnecessary labor and equipment expenditures if the preliminary information on BTA activity from recent growing seasons is not known for a site.

Biological control methods for BTA have been under investigation for years, but to date have not lead to overwhelming success in any area. Field trials at the University of Rhode Island have shown that the entomopathogenic nematode, *Steinernema carpocapsae*, can suppress BTA larval populations, but at a rate of nematodes 10 times the recommended and commercially viable rate. Although expensive, nematodes may possibly be a viable option for biological control against white grub pests, such as BTA. However, currently the nematodes continue to yield mixed results when used in field applications.

Natural pathogen infestations of milky disease, *B. popillae*, have shown to be effective in suppressing BTA populations after the disease has been established in an area for three to four years. Work at Michigan State University has also shown milky disease to be higher in BTA larvae that reside in longer mowed turfgrass than larvae in shorter cut turf. Hopefully, work will continue for BTA grub control to make milky spore disease a feasible option in the future.

The beetles are extremely unpredictable in their duration in an area. They will show up at a golf course for three years in a row, but on the fourth year, BTA populations will be no where in sight.

Although considerable research has been conducted on the black turfgrass ataenius in the last five years, much more still needs to be discovered. Black turfgrass ataenius research is now needed more than ever as we see an increase in damaging BTA populations across the Midwest, Northeast and Mid-Atlantic regions of the U.S.

Because little is known of the insect's basic biology and because it is a relatively new pest to turfgrass, much mystery still surrounds BTA. The beetles are extremely unpredictable in their duration in an area. For instance, they will show up at a golf course for three years in a row, but on the fourth year, BTA populations will be no where in sight. They also show no discrimination for a particular type of turfgrass nor do they appear in proximity to certain overwintering sites or appear to be widespread in affecting all golf courses in a particular area.

Although the black turfgrass ataenius is an enigma, research will continue to piece the BTA puzzle together to aid superintendents in combating this turfgrass pest.

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