ENTOMOLOGY RESEARCH: CAUSES OF BLACK TURFGRASS ATAENIUS AND APHODIUS OUTBREAKS ON GOLF COURSES (1992-96)

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Introduction

The black turfgrass ataenius, *Ataenius spretulus* (Haldeman), is present at low levels in turf throughout most of the United States and Canada. Populations are so low in home lawns that turf injury is almost unheard of. The first report of ataenius as a turf pest came from Minnesota in 1932, where large numbers of ataenius larvae were found in damaged portions of a golf course green (Hoffman 1935). Over the next 35 years ataenius damage to turf was not mentioned in scientific journals (Tashiro 1987). However, after 1970, ataenius was regularly reported as a sporadic pest of golf courses in most of the midwest and northeast United States and Ontario, occasionally causing extensive damage to fairways (Cartwright 1974, Kawanishi et al. 1974, Weaver and Hacker 1978, Wegner and Niemczyk 1979, Wegner and Niemczyk 1981).

Ataenius overwinters as an adult (Niemczyk and Dunbar 1976). Wegner and Niemczyk (1981) collected adults from September through March from the top 5 cm of soil along the edge of golf course woodlots where they found as many as 264 adults per m^2. On golf courses in Ohio, ataenius completes 2 generations per year. Eggs are deposited in May, and larvae reach a peak density in June that may surpass 500 larvae per 0.1 m^2 (Niemczyk and Dunbar 1976, Wegner and Niemczyk 1981). A second generation of adults emerge in July. Eggs can be found again in July and August, and larvae reach a second peak of activity in August. Nearly all of the larvae have pupated by early October (Wegner and Niemczyk 1981). Ataenius completes at least 2 generations per year in regions south of central Ohio, and 1 generation per year, sometimes followed by a partial second generation in areas north of Ohio (Wegner and Niemczyk 1981, Vittum 1995, Smitley 1994).

Aphodius granarius (L.), a native of Europe, is widely distributed in the United States, but has only recently been known to damage golf course fairways and greens in Colorado, Michigan and Ontario (Jerath 1960, Sears 1979, Tashiro 1987, Smitley 1994). Aphodius adults and larvae are very similar in appearance to ataenius and the 2 are frequently confused by golf course superintendents in Michigan. With a microscope, adult aphodius can be distinguished from ataenius by observing the hind tibia, and the larvae can be distinguished from each other by the pattern of hairs on the underside of the last abdominal segment (Tashiro 1987).

In Michigan, the larvae do not occur at the same time (Smitley 1994). Aphodius adults become active in May, and larvae are present in June, while ataenius adults become active in late May and the larvae are present in July and early August (Smitley 1994, Smitley et al. 1998). Aphodius was believed to have 2 generations per year, based on spring and fall peaks of adult activity in Ontario and Ohio (Sears 1979, Tashiro 1987). However, only 1 generation of larvae was observed in Michigan (Smitley 1994).

Michigan Research. At the request of golf course superintendents in Michigan we began investigating ataenius in 1992. We started with the question of "why do ataenius larvae cause damage at some golf courses, while they are scarce at other golf courses and in home lawns?" We began our investigation with 3 golf courses in the Detroit area; Franklin Hills, Orchard Lake and Oakland Hills. At one golf course ataenius was the most abundant, at the second course aphodius was most abundant, and at the third course aphodius and ataenius were equally abundant. At all three golf courses, ataenius and aphodius larvae were 5 to 10-fold more abundant in fairways compared with adjacent roughs (Table 1, Smitley et al. 1998).

The observed difference in grub activity between the fairway and rough raised more questions. Irrigation coverage was similar in our fairway and rough plots at all 3 courses, ruling out irrigation as a factor. One of the students working on the project noticed that we caught more ground beetles and rove beetles in the rough. These beetles are known to be predators of other insects. Are rove beetles and ground beetles important predators of ataenius? What else could explain why ataenius larvae are much more abundant in the fairway? While deciding on the type of experiments to conduct the following year we listed other factors that may differ between fairway and rough: pesticide use, grass species composition, milky spore disease of ataenius, fertility, and mowing practices.

In 1995 we decided to find out exactly how ataenius larvae, rove beetles and ground beetles were distributed in the fairway and rough within 10 m (30') of the fairway/rough border. In 1995 we traveled to Spring Lake Country Club in western Michigan to sample a fairway where no insecticides had been used for 2 years. Pitfall traps were placed along replicated transects running into the fairway and rough, and a golf course cup-cutter was used to remove soil cores along the same transects for counting ataenius larvae (Figure 1). A total of 112 pitfall traps were changed weekly from early May to early July. A total of 341 aphodius 1,131 ataenius 4,703 ants, 2,693 ground beetles, and 2,304 rove beetles were captured in pitfall traps. Ataenius adults were again more abundant in the fairway, and the numbers of predatory insects captured in pitfall traps declined sharply when crossing from the rough into the fairway (Figure 2). As the numbers of predators caught in pitfall traps increased, the number of ataenius adults decreased, suggesting that rove beetles, ground beetles and ants are important predators. When irrigation coverage thinned-out, some 15 to 20' into the rough from the fairway border, the number of predators began to decrease.

In 1996 a similar experiment was conducted at Cattails Golf Club where they have perennial ryegrass throughout the fairway and rough. Also, no pesticides have ever been used on the fairway where our plots were located. Pitfall traps were placed in lines running from the fairway into the rough in a design similar to the one used at Spring Lake in the previous year (Figure 1). The type of insects found in pitfall traps was similar to what was found at Spring Lake the previous year, but the number of rove beetles and ground beetles was much less (3-fold fewer) at Cattails, demonstrating that predator activity may vary considerably from one golf course to another. Even with the grass species being the same in the fairway and rough, and with no history of pesticide use in the fairway, we still found 2 to 3-fold more predators in the rough compared with the fairway, and ataenius adults and larvae were 5-fold more abundant in the fairway (Figure 3).

Conclusions From Michigan Research

1. Ataenius adults and larvae are at least 4-fold more abundant in golf course fairways compared with roughs.
2. Rove beetles, ground beetles and ants are 2 to 10-fold more abundant in the rough.
3. The abundance of ataenius adults and larvae is inversely correlated to abundance of surface predators.
4. Experiments at the Cattails Golf Course have eliminated grass species and irrigation as potential causes of outbreaks of ataenius in fairways.
5. Even when there is no history of pesticide use in the fairway, predators may be more abundant in the rough, although the differences between predator activity in the fairway and rough may be even greater when pesticides are used in the fairway.
6. The abundance of predators may vary 3-fold from one golf course to another.

Summary and Future Research So far we have shown that ataenius adults and larvae are consistently more abundant in fairways compared with rough, while predatory insects are more abundant in the rough. At this point we believe that the standard use of pesticides in the fairway but not the rough only partially explains why this happens. The impact of fairway and rough mowing practices on predatory insects needs to explored further. Also we need to know if fungicides have any impact on insect predators or on the milky spore disease that may infect as much as 70% of the ataenius larvae.

References Cited

Cartwright, O. L. 1974. *Ataenius, Aphotaenius* and *Psuedataenius* of the United States and Canada (Coleoptera: Scarabaeidae: Aphidiinae). Smithsonian Contrib. Zool.154: 1-106.

Hoffman, C. H. 1935. Biological notes on *Ataenius cognatus* (Lec.) a new pest of golf greens in Minnesota (Scarabaeidae-Coleoptera). J. Econ. Entomol. 28: 666-667.

Jerath, M. L. 1960. Notes on larvae of nine genera of Aphodiinae in the United States (Coleoptera: Scarabaeidae). Proc. U.S. Nat. Mus. 111: 43-94.

Kawanishi, C. Y., C. M. Splittstoesser, H. Tashiro, and K. H. Steinkraus. 1974. *Ataenius spretulus*, a potentially important turf pest, and its associated milky disease bacterium. Environ. Entomol. 3: 177-181.

Niemczyk, H. D., and D. M. Dunbar. 1976. Field observations, chemical control, and contact toxicity experiments on *Ataenius spretulus*, a grub pest of turf grass. J. Econ. Entomol. 69: 345-348.

Sears, M. K. 1979. Damage to golf course fairways by *Aphodius granarius* (L.) (Coleoptera: Scarabaeidae). Proc. Entomol. Soc. Ontario. 109:48.

Smitley, D. R. 1994. Entomology research, pp. 27—34. *In* 64th Annual Michigan Turfgrass Conference Proceedings, January 18-20, 1994, Lansing, Michigan.

Smitley, D. R., Davis, T. W. and N. L. Rothwell. 1998. Spatial distribution of *Ataenius spretulus*, *Aphodius granarius* (Coleoptera: scarabaeidae), and predaceoius insects across golf course fairways and roughs. Environ. Entomol. 27: 000-000.

Tashiro, H. 1987. Turfgrass insects of the United States and Canada. Cornell University Press, Ithaca NY and London. 391pp.

Vittum, P. J. 1995. Black turfgrass ataenius, pp. 35-37. *In* R. L. Brandenburg and M. G. Villani [eds.], Handbook of turfgrass insect pests. Ent. Soc. America, Lanham, Maryland.

Weaver, J. E., and J. D. Hacker. 1978. Bionomical observations and control of *Ataenius spretulus* in West Virginia. W.V. Univ. Agric. For. Exp. Stn. Curr. Rep. 72. 16 pp.

Wegner, G. S., and H. D. Niemczyk. 1979. The *Ataenius* of Ohio. Ohio J. Sci. 79: 249-255.

Wegner, G. S., and H. D. Niemczyk. 1981. Bionomics and phenology of *Ataenius spretulus*. Ann. Entomol. Soc. Am. 74: 374-384.

Table 1. Ataenius and Aphodius larvae in the fairway and adjacent irrigated rough of 3 golf courses in 1992 and 1993. Data are means ± SD larvae per 5 cup-cutter soil cores taken at the time of peak larval density

		--------Ataenius larvae--------			--------Aphodius larvae--------		
Location	**Year**	**Date**	**Fairway**	**Rough**	**Date**	**Fairway**	**Rough**
Oakland Hills	1992	20 July	12.6 ± 1.8 **	4.8 ± 4.6	22 June	14.2 ± 7.2 **	2.8 ± 3.3
Orchard Lake	1992	20 July	13.2 ± 13.5	0.8 ± 1.1		—	—
Franklin Hills	1992	27 July	2.2 ± 1.6 *	0.4 ± 0.5		—	—
Oakland Hills	1993	19 July	1.6 ± 1.7	0.0 ± 0.0	14 June	11.2 ± 9.5	2.4 ± 2.5
Orchard Lake	1993	26 July	3.8 ± 3.0 *	0.0 ± 0.0	26 July	3.2 ± 2.8 *	0.0 ± 0.0
Franklin Hills	1993	26 July	6.6 ± 2.9 **	0.0 ± 0.0		—	—

Fairway means ± SD followed by 1 or 2 asterisks are different from corresponding rough means (ANOVA) at the P=0.05 or P=0.01 level, respectively.

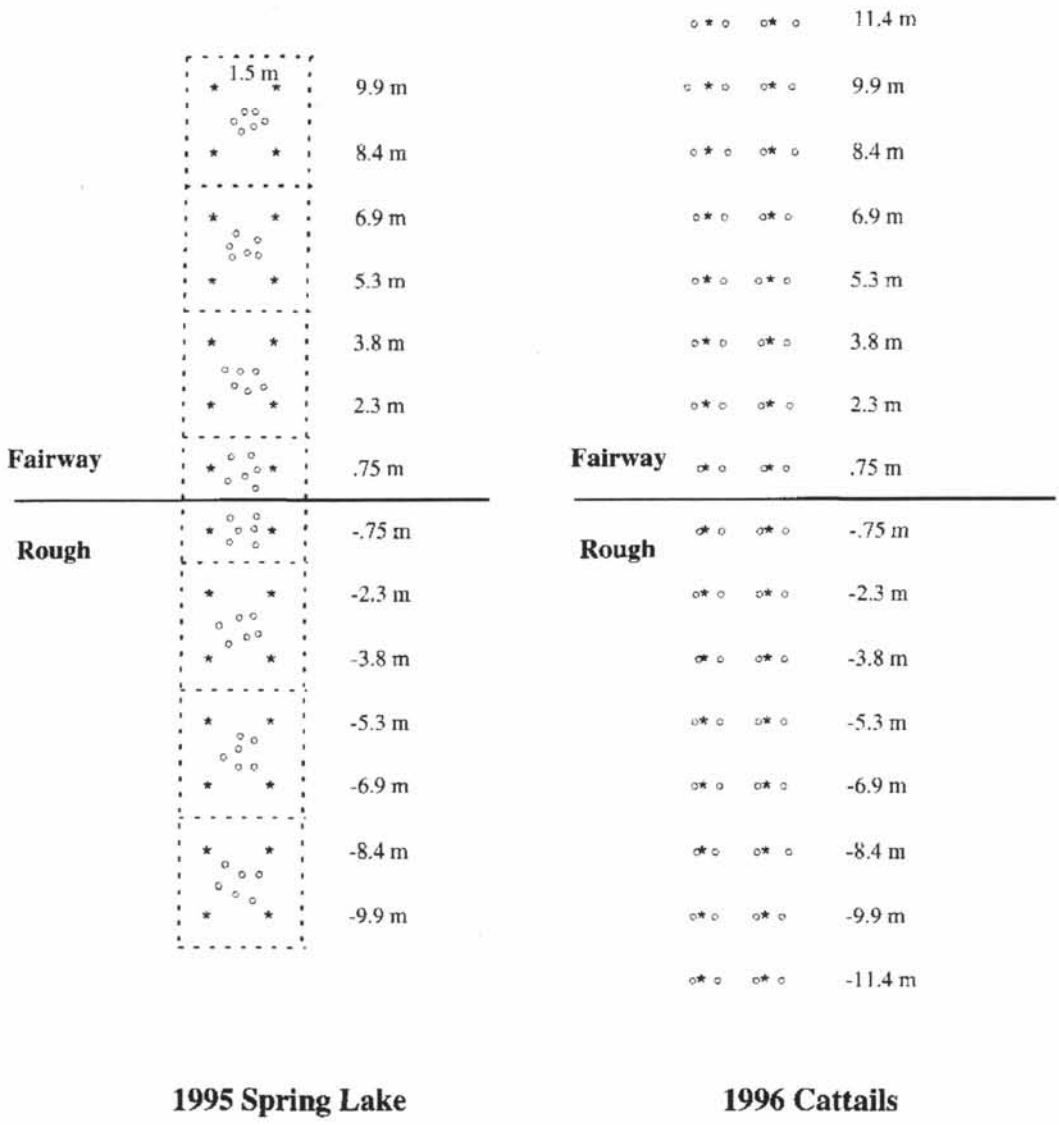

Figure. 1. *Diagram of 1 of 4 replicate plots at Spring Lake (1995) and at Cattails (1996). The locations of pitfall traps (*) and soil core samples (o) are shown.*

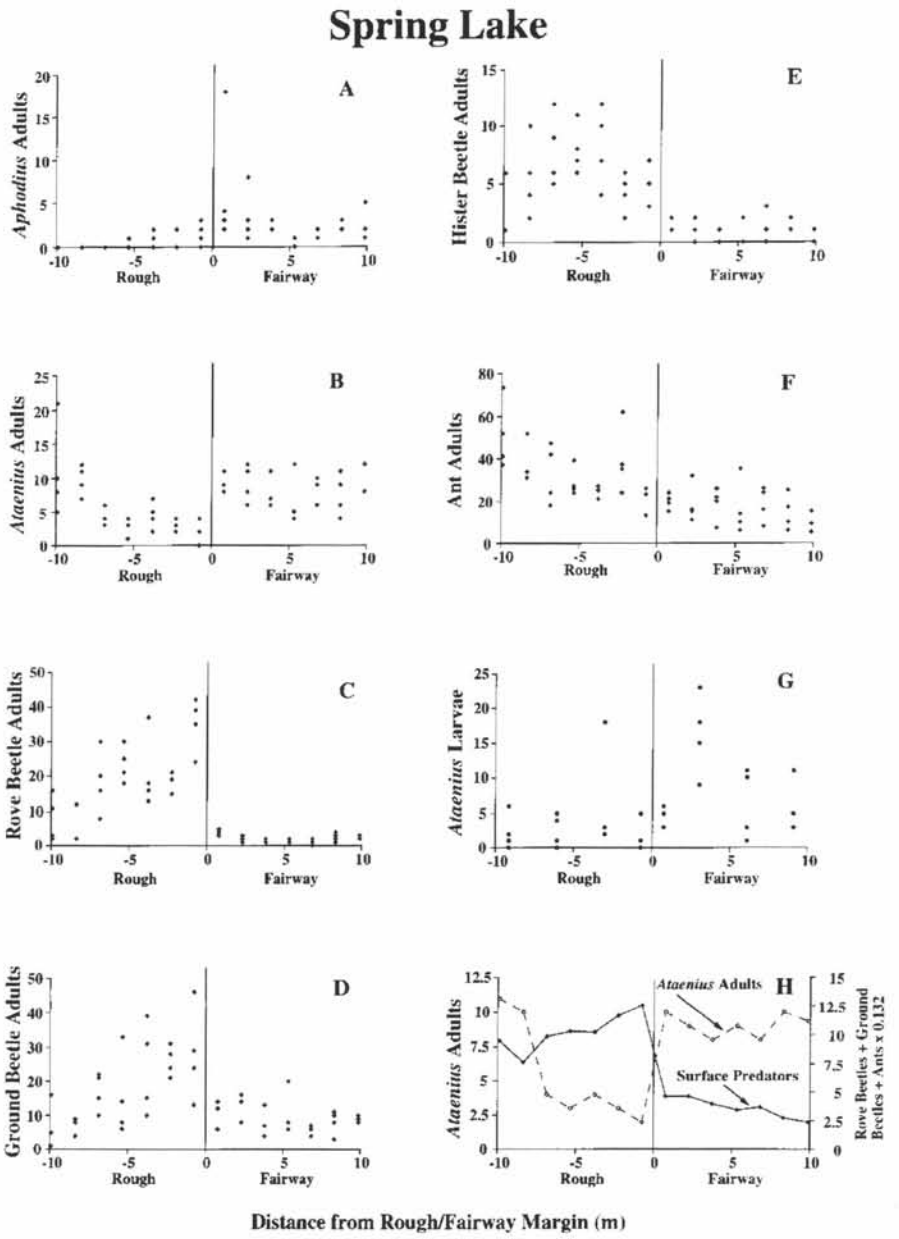

Figure. 2. *Spring Lake Country Club: the distribution of aphodius adults (A), ataenius adults (B), rove beetles (C), ground beetles (D), hister beetles (E), ants (F), ataenius larvae (G), and the sum of all rove beetle, ground beetles and ants (H) in the fairway and rough. The scale used for the right axis in H was chosen so that the largest number of surface predators found in any location was similar to the largest number of ataenius adults.*

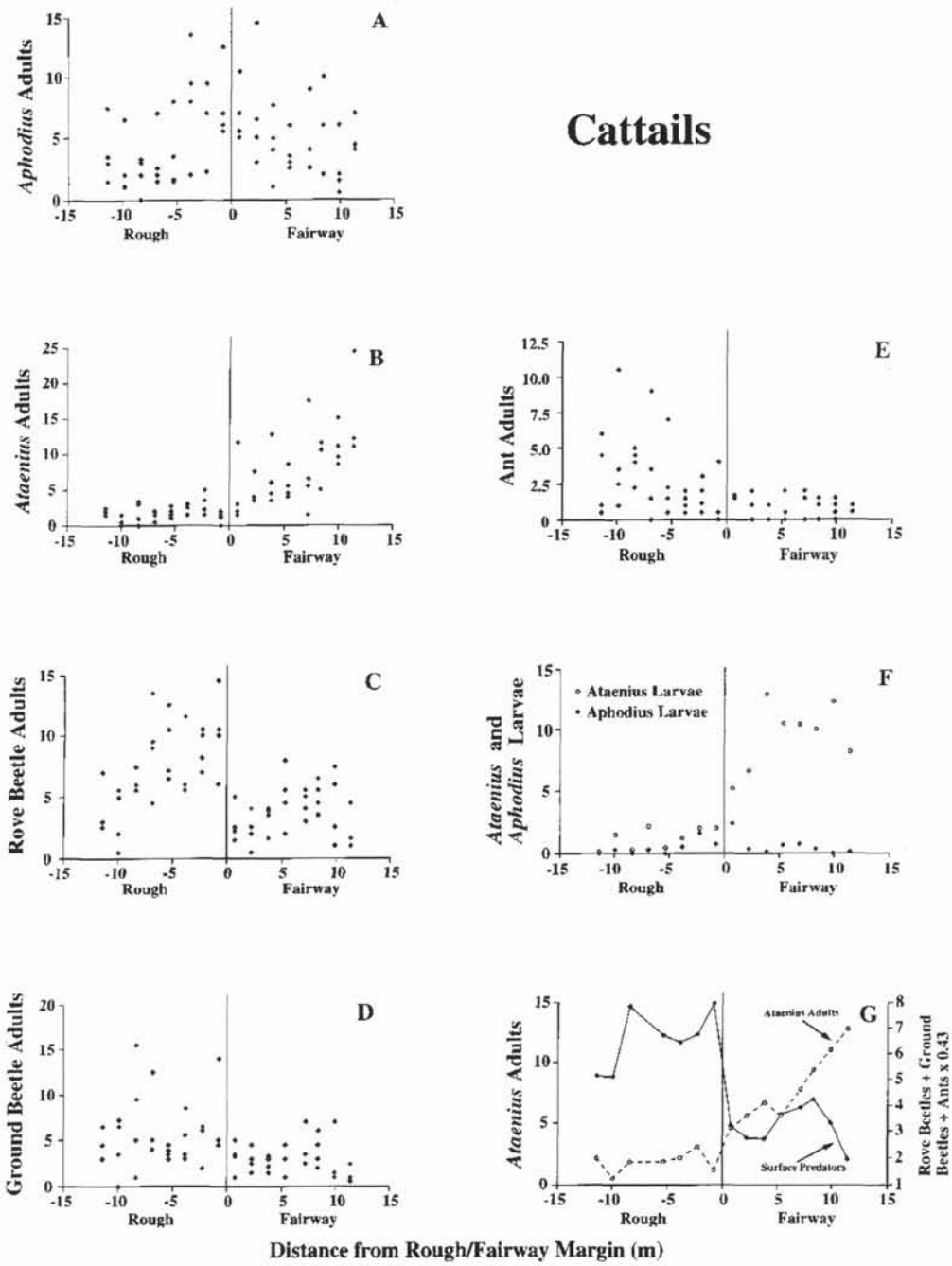

Figure. 3. *Cattails Golf Course: the distribution of aphodius adults (A), ataenius adults (B), rove beetles (C), ground beetles (D), ants (E), aphodius and ataenius larvae (F), and the sum of all rove beetles, ground beetles and ants (G) in the fairway and rough. The scale used for the right axis in H was chosen so that the largest number of surface predators found in any location would plot at a peak similar to the peak for ataenius adults.*