

INTERACTIONS OF GRUBS, PREDATORS, AND PESTICIDES

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In the last two years we found that golf courses in Michigan are plagued by two species of small black beetles: *Ataenius spretulus* and *Aphodius granarius*. *Aphodius* grubs are active in June while *Ataenius* grubs are active in late July. Some courses may have both *Ataenius* and *Aphodius*. I have attempted to identify the reasons for outbreaks of *Ataenius* and *Aphodius* beetles on golf course, where sometimes more than 500 grubs are found per square foot, compared with 5 or less per square foot in a typical home lawn. In 1992 and 1993 we found a large proportion (10-75%) of *Ataenius* and *Aphodius* grubs were infected with milky spore disease (*Bacillus popilliae*). Also in 1993, my students observed more ant activity in the irrigated rough than in the fairway. They suggested that I put more energy into investigating predator activity. With those thoughts in mind we created a new set of research plots at Oakland Hills and Franklin Hills to investigate how pesticides affect the natural incidence of milky spore disease in grubs, and how pesticides affect predators. At the same time we continued to explore how the irrigated rough differed from fairways as a habitat for grubs and predators.

In 1994 we placed small glass vials filled with ethylene glycol into the soil so that the tops of the vials were flush with the soil surface, to trap predators crawling on the soil surface. Two groups of predators dominated the trap catches: staphylinid beetles and ants. Staphylinids are a family of small (1/4 to 1/2 inch long) beetles that are mostly predators as adults and larvae. Staphylinids are also referred to as rove beetles. There are about 3,200 species of rove beetles in North America. Pesticides seemed to have little affect on the number of rove beetles caught in our traps in the fairway. The most interesting result was that we caught 10-fold more rove beetles in the irrigated rough than in the fairway (Table 1). We found a similar situation for ants. Traps located in the irrigated rough had 3 to 10-fold more ants than traps located in the fairway (Table 2). Although ants and rove beetles probably feed on beetle eggs and small beetle grubs, we did not find a strong correlation between predators and grubs. When the number of ants and rove beetles were added together they explained 30% of the variation in the number of *Ataenius* grubs at Franklin Hills (Figure 1). The negative correlation is highly significant but other factors such as interplot movement of predators or the dependence of predators on the density of prey must also be important because the number of grubs per plot varied from 5 to 15 where no predators were found and from 0 to 5 where the most predators were found.

Dursban sprays reduced the number of *Ataenius* grubs found at Franklin Hills but caused an increase in the number of *Aphodius* grubs found at Oakland Hills (Table 3). Apparently the *Aphodius* grubs at Oakland Hills are somewhat resistant to Dursban. Predator activity may account for lower number of grubs in the control plots compared with the Dursban plots. The different response of predators and grubs at one golf course compared with another is most likely due to differences in the level of grub resistance to pesticides. At both golf courses the highest number of grubs were in the plots treated with Daconil. In an insecticide trial on the same fairway at Oakland Hills we also found low numbers of grubs in the control plots and much higher number of grubs in one insecticide treatment. We found a total of 21 *Aphodius* grubs in six plots treated with Oftanol, compared with 5 grubs in six control plots (Table 4). Apparently, predators were active in control plots but not in the Oftanol plots.

After our 1994 field research we believe that predators are playing an important role in keeping populations of *Ataenius* and *Aphodius* grubs under control at golf courses. At this point it appears that the most likely cause of outbreaks of grubs in fairways is reduced predator activity. The role that various pesticides play in suppressing predators and pathogens is not clear. We will continue to investigate the importance of predators on golf courses and how pesticides affect the balance between predators and grubs in 1995.

Figure 1. The number of *Ataenius* grubs found in fairway plotted against the number of ants and rove beetles caught in pitfall traps.

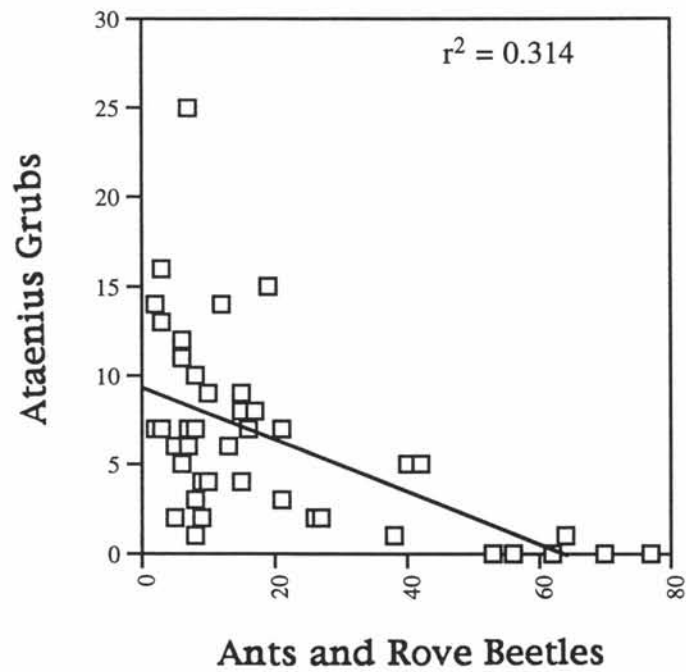


Table 1. Impact of pesticides on staphylinid beetles in the fairway and adjacent irrigated turf.

Treatment	Franklin Hills Staphylinids	Oakland Hills Staphylinids
Dursban once	1.3	3.0
Fairway control	1.7	2.0
Banner	1.7	1.8
Rubigan	1.7	1.8
Dursban twice	1.8	2.3
Curalin	2.2	1.2
Bayleton	2.7	2.0
Daconil	3.3	2.2
Rough Control	19.8	7.7

Table 2. Affect of fungicide and insecticide treatments on the activity of ants in fairway plots.

Treatment	Franklin Hills Ants	Oakland Hills Ants
Daconil	3.2	6.5
Bayleton	3.2	16.3
Curalin	6.5	5.3
Fairway Control	8.0	4.3
Banner	12.0	12.2
Dursban once	8.3	4.3
Dursban twice	9.2	5.2
Rubigan	19.0	2.7
Rough Control	24.0	41.5

Table 3. Dursban and Daconil affects on Ataenius and Aphodius grubs at two golf courses.

Treatment	Franklin Hills Ataenius grubs	Oakland Hills Aphodius grubs
Dursban once	1.3	4.0
Dursban twice	0.3	2.3
Daconil	9.7	5.0
Fairway control	8.0	1.8
Rough control	0.2	2.5

Table 4. Aphodius larval response to insecticide treatments at Oakland Hills, 1994.

Company	Treatment	Rate	/5 liters	# of Aphodius grubs on 20 June	
				Mean	Total
Rhone Poulenc	Mocap 10G	5.0 lb ai/acre	23.15 gr/plot	0.67a	4
Rhone Poulenc	Sevin 80WSP	8.0 lb ai/acre	34.3 gr	0.50 a	3
Rohm & Haas	RH-0345 2F	1.0 lb ai/A	14.3 ml	0.17 a	1
Rohm & Haas	RH-0345 2F	2.0 lbs ai/A	28.6 ml	0.00 a	0
Rohm & Haas	RH-0345 2F	3.0 lbs ai/A	42.9 ml	0.00 a	0
Miles	Merit 1G	0.3 lbs ai/A	15.42 gr/plot	0.00 a	0
Standard	Oftanol 2I	3 fl oz/1000 ft ²	29.2 ml	3.50 b	21
Control				0.83 a	5

Means followed by the same letter are not significantly different ($P < 0.05$ ANOVA/Fisher's Protected LSD). Data were transformed using $\log_{10}(X+1)$ prior to ANOVA. Untransformed data are presented.