BIOLOGICAL CONTROL OF ATAENIUS AND APHODIUS ON GOLF COURSES

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Summary

We made good progress this year in our effort to determine what causes outbreaks of Ataenius and Aphodius beetles on golf courses. Analysis of our data from a series of plots running the width of a fairway and adjacent rough showed a clear pattern of predator suppression in the fairways. Predators were 5 to 10 times more abundant in the rough than in the fairway. Levels of Ataenius were highly correlated (inversely) with levels of predators, and a turf fungicide, Daconil, was found to suppress predator populations by 50%. A survey conducted by Nikki Rothwell indicated that Daconil is the most popular turf fungicide, and that golf courses make an average of 12 fungicide applications per year to fairways.

In a separate study, the new insecticide, Merit, was most effective for Japanese beetle and European chafer when applied in early July.

Introduction

Ataenius spretulus, a small black scarab beetle native to North America, was first reported to damage fairway turf in Minnesota in 1927 (Tashiro 1987). Although Ataenius was present throughout the century it was rarely reported as a turf pest until after 1970 (Weaver & Hacker 1978). The dramatic increase in the number of golf courses reporting damage from Ataenius after 1970 has been attributed to the development of resistance to chlordane, dieldrin, and perhaps other insecticides (Niemczyk & Dunbar 1976, Niemczyk & Wegner 1982). Investigations in Ohio and West Virginia indicate that Ataenius beetles in those states undergo two generations per year, with grubs causing the most damage in June and August. In northern New York, Ontario, Michigan, and other parts of the country north of Ohio, Ataenius may have only one generation per year. In some locations Aphodius granarius, another small scarab grub about the same size as Ataenius, has been found along with Ataenius grubs (Tashiro 1987). At one golf course in Ontario where turf damage was extensive, 97% of the grubs were identified as Aphodius granarius (Sears 1979). Overall, Ataenius spretulus has been reported to injure turf far more often than Aphodius granarius, although many superintendents probably do not realize that they have Aphodius. The number of Ataenius grubs necessary to injure turf (the damage threshold) is controversial. In most cases damage to fairway turf has been associated with counts of over 100 grubs per square foot, or 10 grubs per cup-cutter. However, Tashiro (1987) found little or no damage on fairways with 10 grubs per cup-cutter, and suggested that densities of 25 per cup-cutter are more likely to cause damage. A consistent thread running through the literature is the presence of milky spore disease, caused by Bacillus popillae. The strain of B. popillae causing milky spore disease in Ataenius and Aphodius grubs is different from the strain of B. popillae that infects Japanese beetle. The strain infecting Ataenius and Aphodius occurs naturally in the soil and does not infect Japanese beetle, European chafer or masked chafer (Splittstoesser & Tashiro 1977). The milky spore bacteria are ubiquitous in golf course soils, always causing some infection and death of Ataenius grubs (Kawanishi et al. 1974). In some cases more than 79% of the Ataenius grubs were found to be infected with B. popillae (Wegner & Niemczyk 1981).

Experimental Procedure

An extensive set of research plots were established at Spring Lake Country Club near Grand Haven, Michigan. Sixty-four plots were sampled weekly from late May until late July to evaluate the activity of predators in 16 different treatments (Fig. 1 and 2). Plots were located along transects starting 35 feet into the irrigated rough and extending across the fairway border 35 feet into the fairway. Predators were sampled by sinking 8-dram glass vials into the ground so that the top of the vial was flush with the soil surface. Ten ml of ethylene glycol was added to each vial as a preservative for insects falling into the traps. Four vials were placed in each plot for a total of 144 vials. The glass vials were changed weekly by capping and removing one vial and replacing it with another clean vial with ethylene glycol. The removed vials were labeled and returned to the laboratory for counting and identifying Ataenius adults, Aphodius adults, and predators. Cup-cutter samples were taken once in June and once in July at the time of peak activity for Ataenius and Aphodius larvae.

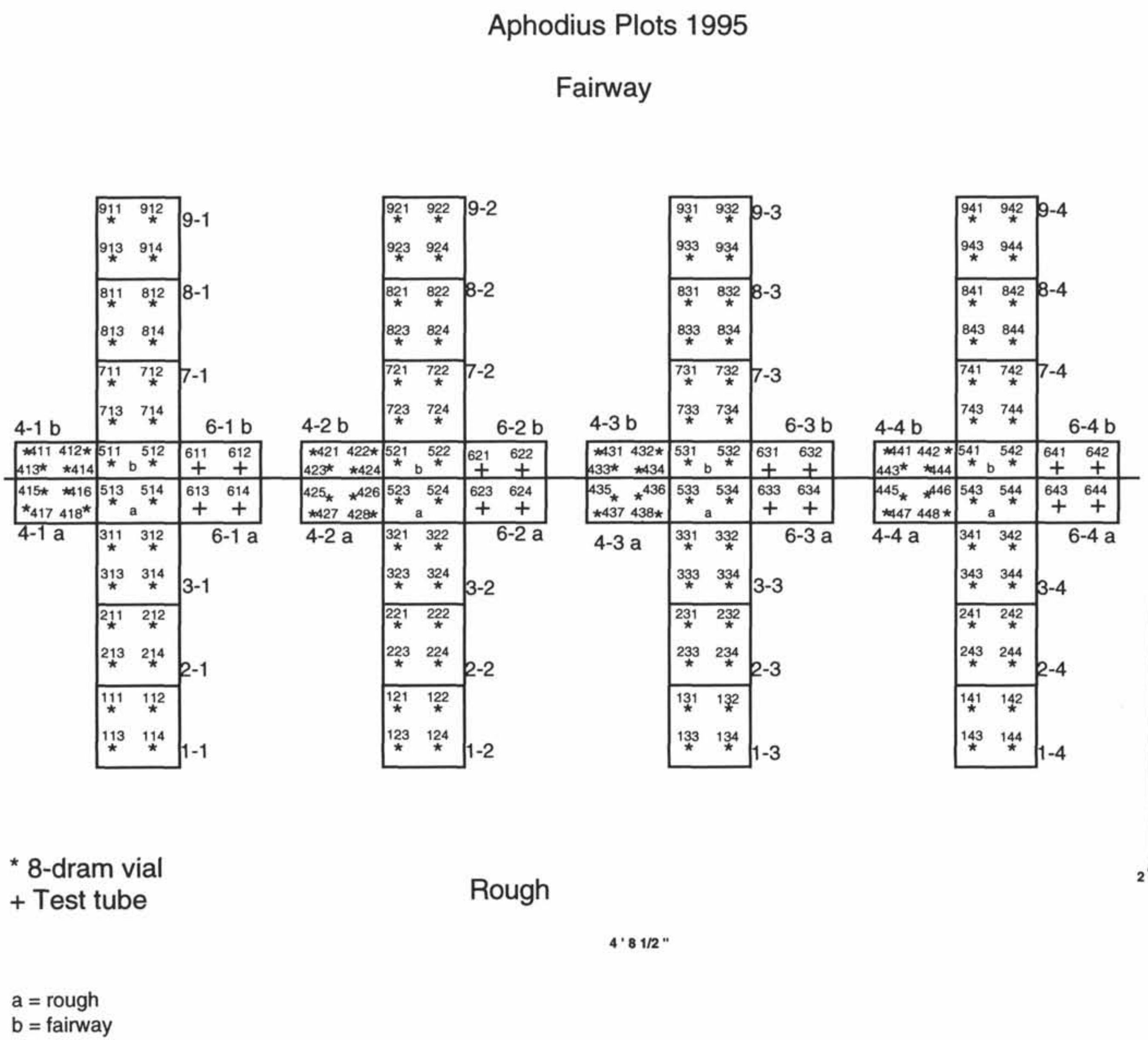
Results

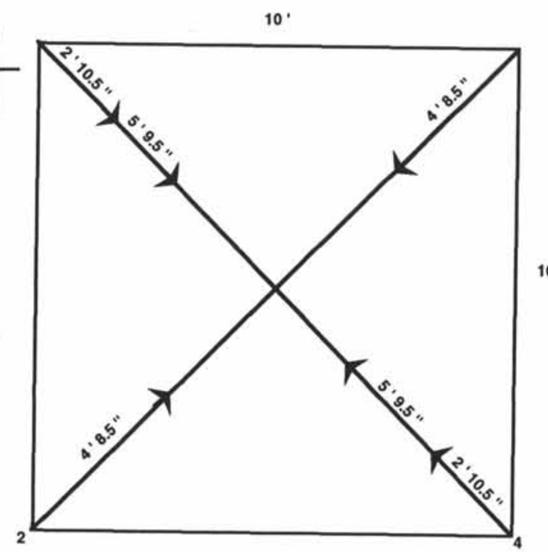
The glass vials worked extremely well as pitfall traps for Ataenius and Aphodius adult beetles and for certain predators. We caught large numbers of 4 types of predators: ground beetles, rove beetles, hister beetles, and ants. Ants were most abundant in the far rough and decreased in numbers gradually as plots extended further into the fairway (Fig. 3). Ground beetles were most abundant in the irrigated rough and declined in numbers gradually as the plots extended further into the rough away from the irrigation, and abruptly in the fairway. Three or four times as many ground beetles were found in the irrigated rough compared with the fairway (Figure 4). A similar pattern was found for rove beetles and hister beetles, also potential predators of Aphodius and Ataenius (Fig. 5 and 6).

The pattern of Ataenius adults appears to be inverse to the number of predators caught in pitfall traps. The largest number of Ataenius adults were found in the fairway with an abrupt decline as the border into the rough was crossed. The pattern of Ataenius grubs in the fairway and rough seems to reflect the effects of the adult beetle distribution and the abundance of predators. Two to three times as many grubs were found in the fairway compared with the irrigated rough, less of a difference than observed at Oakland Hills, Franklin Hills, and Orchard Lake, where 5 to 10 times more grubs were found in the fairway. The smaller difference between the number of grubs in the fairway and rough may be due to the overall lower population of Ataenius and Aphodius at Spring Lake in 1995. If the population of Ataenius had been greater, the numbers of grubs in fairway may have been 5 to 10 greater than in the rough.

All groups of predators were suppressed by a single application of Daconil at the recommended rate. The average level of reduction was 50%. A similar effect was observed in the fairway and rough.

Figures 1 and 2.





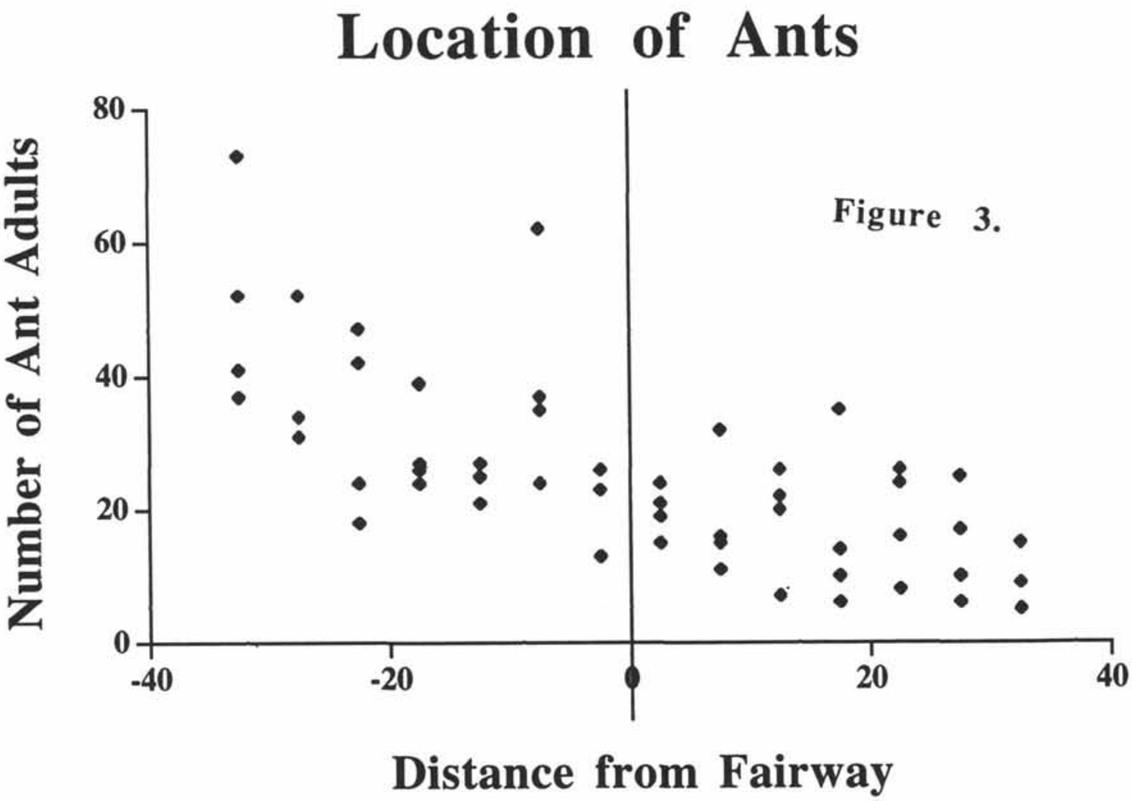


Figure 3.

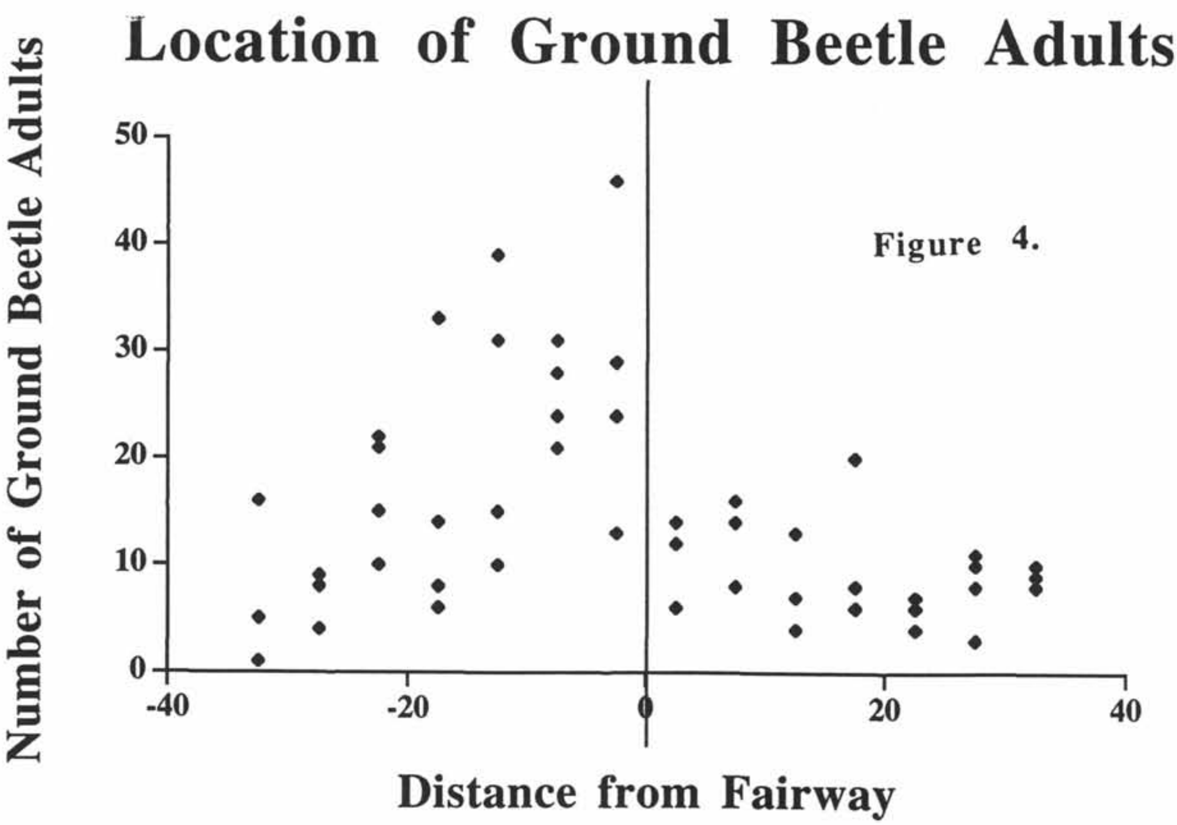


Figure 4.

Figure 5.

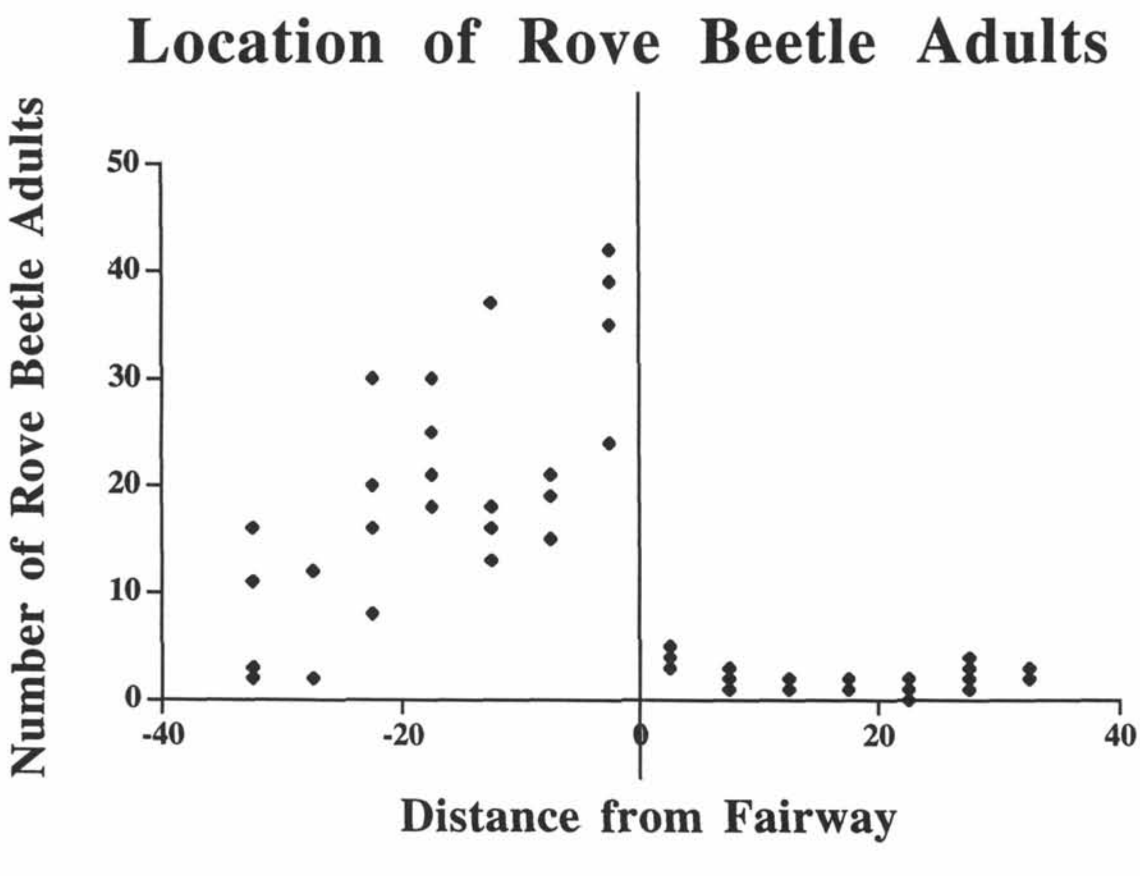
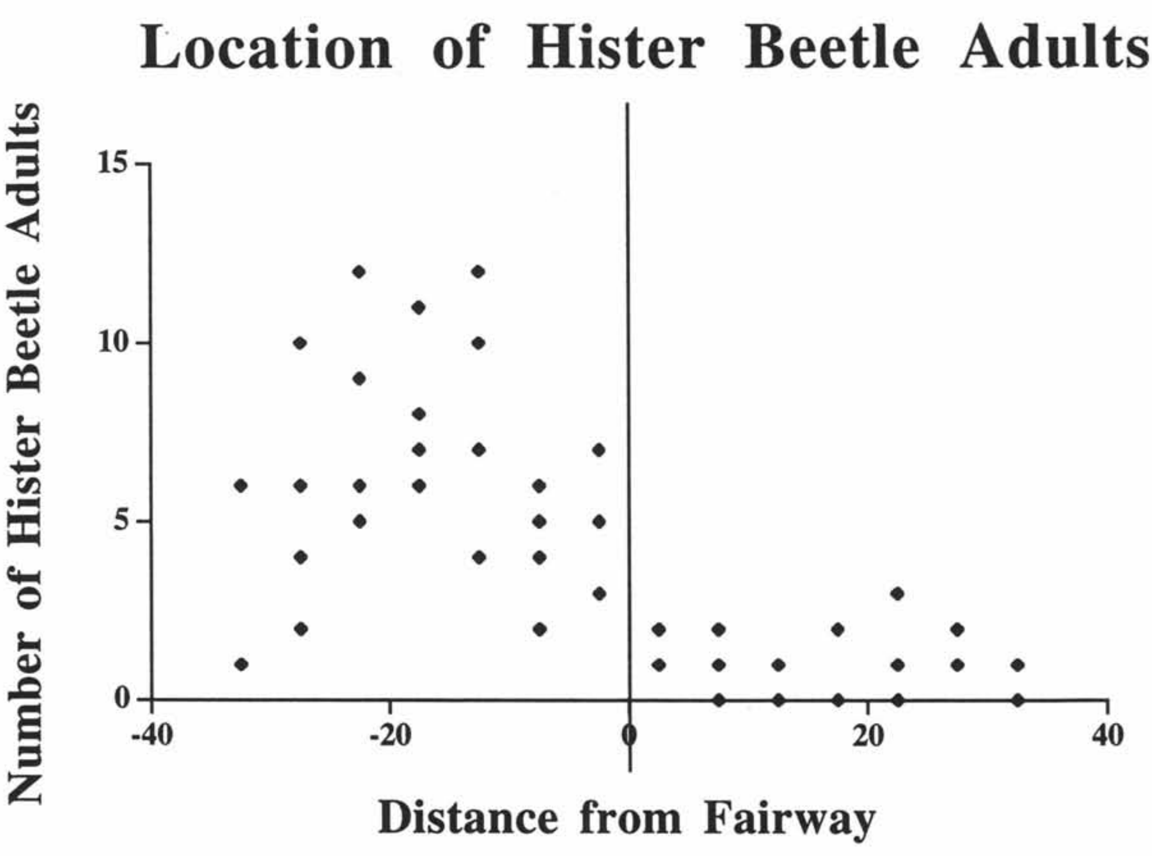

Location of Rove Beetle Adults
Number of Rove Beetle Adults
50
40
30
20
10
0
-40
-20
0
20
40
Distance from Fairway

Figure 6.


Location of Hister Beetle Adults
Number of Hister Beetle Adults
15
10
5
0
-40
-20
0
20
40
Distance from Fairway

Conclusions

Predators are far more abundant in the irrigated rough than in the fairway. The distribution of predators changes dramatically right at the border between fairway and rough. If a single application of Daconil suppresses predators by 50%, multiple applications may be devastating. This study leaves little doubt that predators play an important role in suppressing Ataenius and Aphodius beetles, and that the use of Daconil, and perhaps other pesticides could suppress predators and contribute to an outbreak of Ataenius or Aphodius. If Ataenius or Aphodius develops resistance to an insecticide, like what happened at Oakland Hills when we found that Oftanol did not kill Aphodius grubs, a single application of that insecticide could suppress predators and cause an outbreak of grubs.

Literature Cited

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Table 1. Effect of Daconil on Predators in the Rough.

	Number of Predators	
Type of Predator	Control	Daconil
Ground beetles	16.3	9.5
Rove beetles	20.9	15.6
Ants	30.8	25.6
Hister beetles	8.0	2.8

Table 2. Effect of Daconil on Predators in the Fairway.

	Number of Predators	
Type of Predator	Control	Daconil
Ground beetles	8.1	2.5
Rove beetles	1.0	1.0
Ants	17.4	8.5
Hister beetles	0.6	0.3

Table 3. Ataenius Larvae After Treatment with Daconil or Dursban

Treatment	Ataenius larvae[1] per fairway plot on July 1
Daconil	11.0 ± 6.2
Dursban	0.5 ± 0.5
Control	6.3 ± 2.5

[1]Mean ± SE of 4 replications.

Table 4. European Chafer Insecticide Test, County Club of Jackson, 1995

Treatment	Rate	Treatment Date	Grubs per 2.0 ft^2 on Sep 30
RH-0345	1.0 lb AI/acre	May 24	9.2 a
RH-0345	1.0 lb AI/acre	July 12	1.8 a
RH-0345	1.0 lb AI/acre	Aug 18	3.8 a
Merit 75WP	6.4 oz form/acre	May 24	9.8 a
Merit 75WP	6.4 oz form/acre	July 12	2.6 a
Merit 75WP	6.4 oz form/acre	Aug 15	6.2 a
Control	-	-	7.6 a