Cultural Control, Risk Assessment, and Environmentally Responsible Management of White Grubs and Cutworms

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Goals:

- *Determine factors that affect the distribution and abundance of white grubs and cutworms on golf courses.*
- *Reduce the use of insecticides by identifying methods to reduce white grub and cutworm insects through modified cultural practices.*
- *Provide better information on the effects of pesticides on natural enemies of turf-grass pests and other beneficial species that live in golf course turf.*

Cooperators:

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This research seeks better understanding of the causes of insect outbreaks on golf courses. We are also evaluating means by which superintendents can manage white grubs and cutworms with reduced use of broad-spectrum insecticides.

Field studies showed that withholding irrigation during peak flight of beetles, raising cutting height, and light application of aluminum sulfate in spring may help to reduce severity of subsequent infestations of Japanese beetle and masked chafer grubs. Grub densities were not affected by spring applications of lime or urea, but use of organic fertilizers (composted cow manure or activated sewage sludge) may increase problems with green June beetle grubs. Use of a heavy roller was not effective for curative grub control. Soil moisture seems to be the overriding factor determining distributions of root-feeding grubs in turf.

On creeping bentgrass putting greens, black cutworm (BCW) moths laid similar numbers of eggs regardless of cutting height. Nearly all eggs are laid singly, on tips of leaf blades. We found that most (75-97%) of the eggs are removed with clippings each time that greens are mowed; however, many eggs survive passage through the mower blades and will later hatch. Clippings therefore should be discarded well away from greens and tees. BCW also lay eggs in fairways and roughs, but here, most eggs are laid lower down on grass plants where they are not removed by mowing. Thus, reservoir populations may develop in high grass surrounding greens

and tees. *Our work shows that cutworms may crawl as far as 70 feet in a single night, and that they often invade greens from peripheral areas.* Thus, when treating for cutworms, a 30 foot buffer zone around the putting green also should be treated.

BCW thrived when fed creeping bentgrass, perennial ryegrass, or tall fescue, but Kentucky bluegrass was highly unsuitable as food (Figure 4). Endophyte-infected cultivars did *not* provide significant resistance. Putting greens surrounded by creeping bentgrass, tall fescue, or perennial ryegrass may be at greatest risk from invasion from peripheral areas. Unfortunately, none of the 14 cultivars of creeping bentgrass that we tested showed much resistance to BCW.

BCW are most active on putting greens between midnight and just before dawn. Treatments therefore are best applied toward evening. Young cutworms feed mainly by "grazing" on the surface, whereas larger ones feed mainly from aerification holes or self-made burrows. Contrary to expectation, BCW were not attracted to aerified bentgrass, although they tend to occupy aerification holes when they are available. Sand top dressing may partially deter cutworms. Mowing at night, or an hour or so before dawn may provide substantial control by shredding.

Grubs of northern and southern masked chafers are important pests of golf courses throughout the United States. Females of both species produce a potent sex pheromone that attracts males. Interestingly, the two species are cross-attractive. In a pilot study, we tested whether grub "hot-spots" on golf courses could be located by trapping males using crude extracts of virgin female beetles. Because the beetle flights are localized, we reasoned that areas with heavy mating flights would be at highest risk from grubs. The results were promising, but the difficulty of getting virgin female beetle extract prohibits practical application. A synthetic lure is needed before this system can be fully tested on golf courses. Thus, we are collaborating with chemists at Cornell University to identify and synthesize the masked chafer sex attractant. The active chemical peak was pinpointed by gas chromatography and electro-antennogram behavioral analysis, and the compound was characterized by mass spectroscopy. A putative molecular formula has been worked out. Identification and synthesis of this potent attractant will allow its use for survey, risk assessment, and improved timing of control actions on golf courses.

Insecticides applied to golf courses can adversely affect beneficial or non-target invertebrates such as predators and earthworms. This sometimes can aggravate pest outbreaks or thatch buildup. We therefore are studying environmental side effects of two novel soil insecticides, imidacloprid (Merit®) and halofenozide (Mach 2®) as compared to conventional soil insecticides. Our work shows that both Merit and Mach 2 provide excellent control of white grubs, with low impact on beneficial and non-target species. These findings were requested by the US-EPA in support of final registration of Mach 2 for use on turf.

Finally, we initiated studies on the biodiversity and importance of predatory invertebrates in golf course habitats. The

most abundant predators on Kentucky golf courses were ants, together with various mites, spiders, ground beetles, and rove beetles. More than 99 percent of the ant mounds on putting greens were made by one species, *Lasius neoniger*. When naturally deposited cutworm eggs were exposed on putting greens or aprons, 92 to 95 percent were eliminated in one night by *Lasius* workers. When cutworm or Japanese beetle eggs were exposed in fairways or roughs, predation was much higher in roughs than on fairways on both golf courses (Figure 5). Predation on eggs was closely correlated with abundance of ants. This study will reveal ant species that are most likely to cause damage to putting greens, and those that are highly beneficial predators. Ongoing work will seek ways of managing pest ants while conserving those species that are important in buffering golf courses against pest outbreaks.

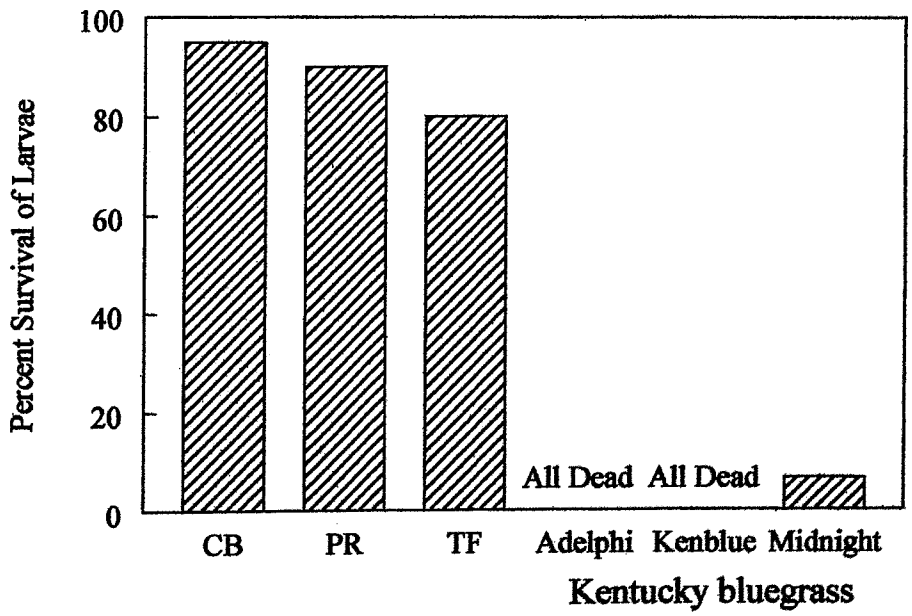
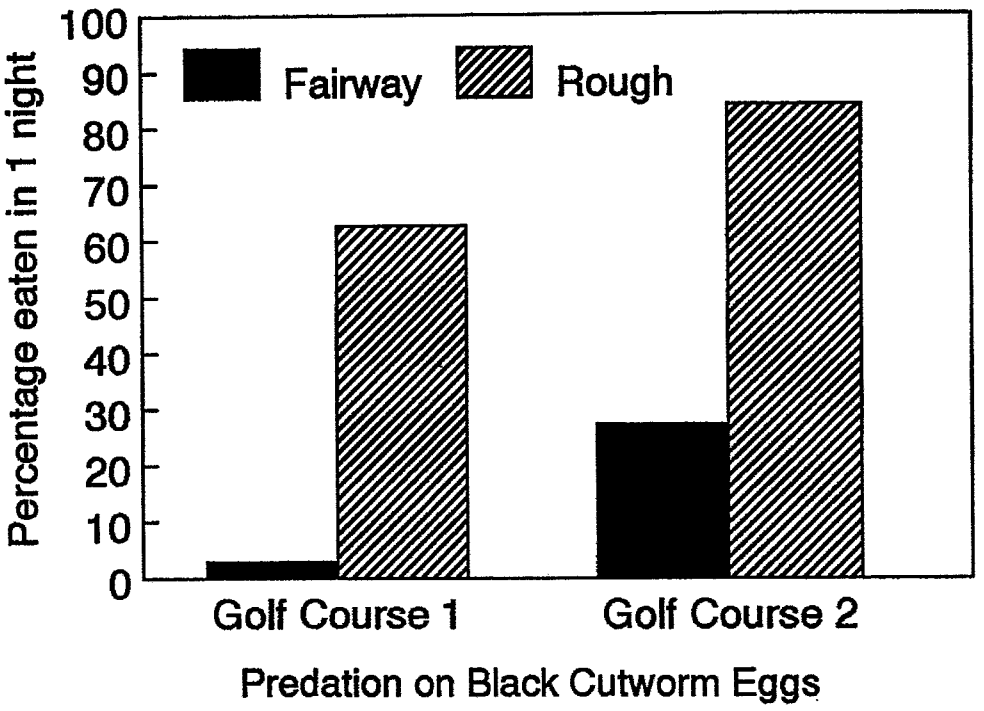


Figure 4. (last year) High survival of black cutworms reared on creeping bentgrass (CB), perennial ryegrass (PR) and tall fescue (TF), and lack of suitability of three diverse cultivars of Kentucky bluegrass.



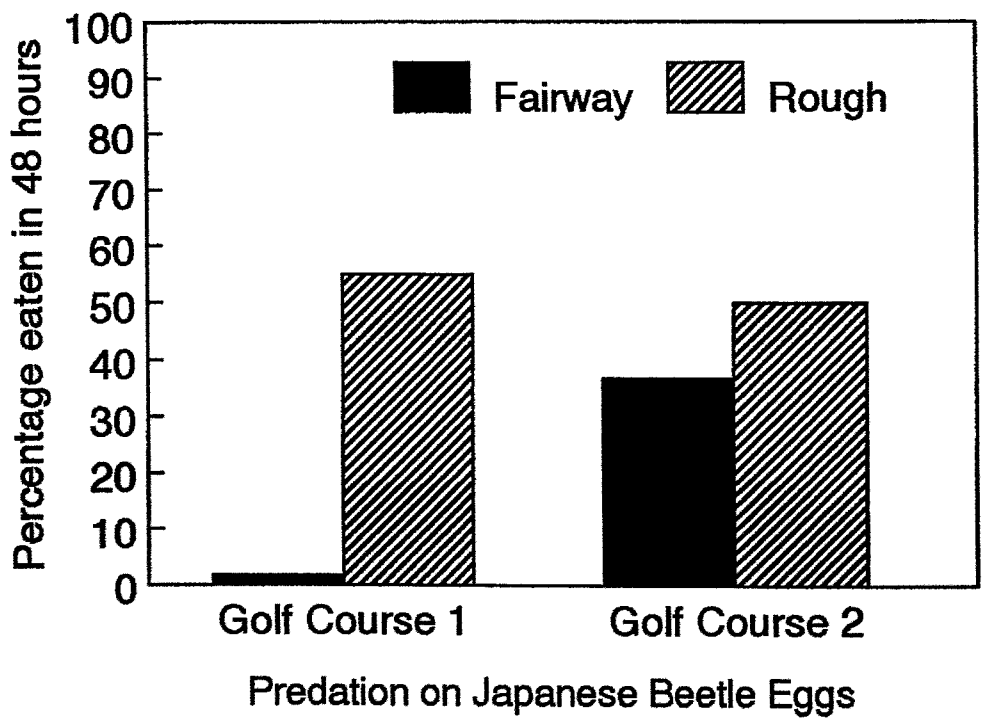


Figure 5. Natural predation on eggs of black cutworm or Japanese beetle exposed on golf courses for one night or two days, respectively. Note high rates of predation in untreated roughs, where predators were abundant, as compared to fairways. Ants were the most important predators on eggs.