PROGRESS REPORT
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DAMAGE THRESHOLDS, RISK ASSESSMENT, AND ENVIRONMENTALLY COMPATIBLE MANAGEMENT TACTICS FOR WHITE GRUB PESTS OF TURFGRASS

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Executive Summary:

Root-feeding white grubs are the most damaging insect pests of golf courses in the U.S. The goal of this project is to develop effective, ecologically-sound tactics for managing white grubs in golf course turf, and to identify pesticides that are least harmful to beneficial invertebrates such as earthworms and predators. Specific objectives are to: 1) clarify feeding preferences and establish damage thresholds for white grubs on cool-season turfgrasses, 2) evaluate compatibility of turfgrass pesticides with beneficial organisms, 3) field test a pheromone-based system for predicting white grub densities, and 4) evaluate the potential for managing white grubs by non-chemical, cultural manipulations.

Tall fescue and creeping bentgrass were found to be relatively tolerant of grub feeding injury; Kentucky bluegrass and hard fescue are less forgiving. Healthy turf will tolerate at least 10 grubs/ft^2 without significant damage. Damage thresholds vary with turf species and vigor. Remedial irrigation and fertilization masks grub injury and accelerates recovery. Tall fescue endophyte does not provide significant resistance to grubs. Japanese beetle grubs prefer perennial ryegrass, while masked chafer (MC) grubs do not discriminate among grasses. Grubs will eat roots of lawn weeds and do not suffer ill effects from weeds in turf.

Earthworm activity breaks down thatch, enriches soil, alleviates compaction, and enhances air and water infiltration. Field evaluations with >40 turfgrass pesticides showed that most products used on golf courses are not harmful to earthworms. The fungicides benomyl and thiophanate-methyl, and the insecticides bendiocarb, carbaryl, ethoprop, and fonofos are especially toxic to worms. Predatory insects were shown to consume large numbers of turfgrass pests. Improperly timed insecticide treatments may interfere with this process and result in higher survival of white grubs. Green June beetle grubs pose a potential environmental hazard when treated because the contaminated grubs die on the turf surface and are attractive to birds. A strategy was developed which allows selective treatment during the beetle flight to eliminate this problem.

Pilot studies were run to determine if captures of adult MC in pheromone traps could be used to predict subsequent densities of white grubs at particular sites. Results were promising, but further testing was limited by availability of crude female extract to use as bait. Efforts in 1993 were directed at identifying and synthesizing the sex pheromone. Presence of the attractant was discovered in the grubs themselves, a phenomenon not previously known for any insect. Studies were initiated to determine if a parasitic wasp, *Tiphia* sp., uses the pheromone to locate grubs underground. If so, baits might be used to attract the parasite to grub "hot spots" on golf courses.

Cultural practices were evaluated to determine how they may affect the distribution and abundance of white grubs on golf courses, or if they can be modified to reduce grub populations. Standard fertilization, aerification, liming, or use of a heavy roller had no effect on grub densities, but populations were somewhat reduced in high-mown, or sulfur-treated turf. Soil moisture was the most important factor; grub densities were 2-4 times higher in irrigated turf. Use of organic fertilizers, e.g., composted cow manure or Milorganite, resulted in 2-4 fold increases in GJB grubs.

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OVERALL GOALS:

The primary goal of this project is to increase understanding of the biology and behavior of root-feeding white grubs, the most important insect pests of cool-season turfgrasses in the U.S. We also seek to develop ecologically sound methods for managing grubs on golf courses and other turfgrass sites. Because they feed underground, white grubs are difficult to observe and study. Many important aspects of their biology remain poorly known. We know little about the relative resistance or tolerance of different grass species, the relationship between grub density and damage to the turf, or how management tactics affect the expression of injury. This information is important for establishing damage thresholds or other decision-making guidelines, especially now that more golf superintendents are practicing integrated pest management (IPM). Better methods of risk assessment are necessary to allow superintendents to identify and target areas with high grub densities, while reducing the need for preventative or blanket applications of insecticides. We seek to identify the factors that make a site attractive to or unsuitable for white grubs, because this may reveal ways that the turf system can be manipulated to minimize insect problems. Finally, we seek to understand the role of beneficial organisms in buffering the turf against pest outbreaks or agronomic problems such as thatch accumulation or soil compaction. Our goal is help the golf industry to identify pesticides and other tactics that provide the best compromise between efficacy and minimal negative impact on the environment.

OBJECTIVE 1. Objective 1 is to quantify relationships between grub density, damage, and tolerance of different cool-season turfgrasses so as to establish thresholds or guidelines for use in IPM. We also seek to clarify feeding preferences of different grub species for different grasses.

Progress and Present Status: A series of 10 greenhouse experiments was run during 1993 to clarify the feeding preferences of Japanese beetle (JB) and southern masked chafer (MC) grubs, and to compare the relative tolerance and growth of the turfgrasses in response to varying degrees of root-feeding injury. Greenhouse flats containing tillers of six different cool season grasses were infested with Japanese beetle or masked chafer grubs, and effects on foliage yield, root loss, and grub survival were measured. In companion studies, pots seeded with the different grasses were infested with varying levels of grubs in either spring or fall. Irrigation and/or fertilization were manipulated to determine how these factors affect expression of injury. Preference tests were conducted with each grub species to learn if grubs will orient toward and selectively feed on particular grasses over others. Finally, we evaluated the response of grubs to common lawn weeds. Until now, it was unknown whether grubs will feed upon roots of weeds, or if certain weed species might have toxic, or allelopathic effects on the grubs.

Tall fescue, creeping bentgrass, and perennial ryegrass are relatively tolerant of white grub damage, sustaining significant root losses without significant loss of foliar growth or yield.