lates of both nematodes and bacteria will be obtained in the future, and the effectiveness of all isolates against white grubs will be established.

Dr. Michael Klein
Dr. Randy Gaugler
Dr. Harry Kaya

University of Kentucky

Damaged Thresholds, Risk Assessment, and Environmentally Compatible Management Tactics for White Grub Pests of Turfgrass

The objectives of this project are to: 1) field test a pheromone-based risk assessment system for predicting white grub densities, 2) evaluate the compatibility of turfgrass insecticides with beneficial predators, and 3) establish damage thresholds for white grubs on cool-season turfgrasses.

For the first objective, an inexpensive trap system, which could be easily used by golf course superintendents, was developed and field tested. Female masked chafers produce a volatile sex pheromone that is highly attractive to night-flying males. In 1990, we placed sticky traps at 30 sites in the roughs surrounding three fairways at the Lexington Country Club, Lexington, KY. The traps were baited with 3 female-equivalents of the pheromone extract, and set out on the turf surface to capture beetles. We repeated this procedure on two nights, July 3 and July 9. In early August, we returned to the golf course and took 12 turf core samples at each site. Grubs were returned to the laboratory where they were identified and counted. We plotted and analyzed the data to determine if there was a predictive relationship between the trap captures of adults and subsequent grub populations.

While we had hoped for a strong correlation between the number of adult beetles caught and the subsequent grub density, no such relationship was evident in the golf course test. We could not predict the local grub population based on pheromone trap captures. Our efforts on this project will now be mainly directed at identifying the chemical sex pheromone. This would enable large quantities of synthetic pheromone to be produced at relatively low cost. The pheromone could be formulated in dispensers which discharge it slowly over a period of several weeks, making extended trapping more practical.

The second objective of the project is to determine the importance of predators in reducing populations of pest insects in turf, and to identify those turfgrass insecticides that are least disruptive to this process. Improper timing of insecticide applications, or use of certain insecticides that are particularly harsh on predators, could result in peak resurgences because of interference with natural predation on eggs and other life stages of pest species. Large plots (0.25 acre) of Kentucky bluegrass were treated in June 1991 with either carbaryl, isazofos, cyfluthrin, or left untreated. Impact of the insecticides on predators was monitored with pitfall traps for up to 10 weeks post-treatment. Eggs of the Japanese beetle and pupae of the fall armyworm were implanted into the treated plots at 1 and 3 weeks after treatment, and the incidence of natural predation that occurred in 48 hours was determined. Last fall, grub populations were sampled in treated and untreated plots to determine if the June treatments could indirectly affect grub populations by eliminating predators.

Preliminary counts suggest that all of the insecticides resulted in significant reductions in predator abundance. Their effects, however, were not equally severe, and analysis of the full data set is expected to reveal significant differences in impact on beneficial insects. Initial results document the high rate of predation in the control plots (more than 50%) and is the first experimental verification that predators are important in natural regulation. There were high rates of predation on fall armyworm pupae in all plots, including those treated with insecticides. Perhaps the most striking and significant result from these 1991 studies was the finding that fall grub populations were significantly higher in some pesticide treated plots than in untreated control plots.

The third objective is to quantify relationships between grub density, root damage, foliar growth, and aesthetic quality of different cool-season turfgrasses to establish damage thresholds for making management decisions. Interactions between grass species, grub species, and management tactics on the expression of grub feeding injury will be measured. Large, replicated plots of Kentucky bluegrass, creeping bentgrass, hard fescue, perennial ryegrass, and endophyte-infected and endophyte-free tall fescue were established in 1989. In spring 1991, we implanted 12 galvanized steel enclosures (1 $ft.^2$)into each plot. In addition, 204 wooden rooting boxes, each consisting of a 1 $ft.^2$ wooden frame with a nylon screen bottom, were implanted into a Kentucky bluegrass turf. These were divided among two studies, one to measure effects of irrigation and fertilization on expression of grub damage, and the other to consider grass species effects.

Because white grubs do the most damage during late summer and fall, the above experiments were run until mid-October, and harvesting was completed just one week before this report was written. We have begun the time-consuming task of separating the formerly living (green) and dead (brown) grass tissue before weighing the hundreds of samples.

Dr. Daniel A. Potter
Dr. Andrew Powell