ENTOMOLOGY RESEARCH 1999

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Investigating the causes of outbreaks of white grubs on golf course fairways (Nikki Rothwell, Terry Davis, Breanna Simmons, Young-Ki Jo).

We have been using the black turfgrass ataenius, *Ataenius spretulus*, to investigate why white grubs are so abundant in golf course fairways. The factors causing outbreaks of ataenius may also cause problems with Japanese beetle grubs and other insects in golf course fairways. We have come to the following conclusions from our turf research:

1. *A. spretulus* adults and larvae are at least 4-fold more abundant in the fairway compared with the rough.
2.
3. Rove beetles (predators) are 3 to 10-fold more abundant in the rough. Ground beetles, and ants (predators) are 2-fold more abundant in the rough.

3. Milky disease of *A. spretulus* larvae, caused by *Bacillus popilliae*, infects more larvae in the rough (50%) than the fairway (25%).

4. The density of surface predators is inversely correlated to the density of*A. spretulus* adults and larvae.

5. Experiments at the Cattails Golf Course have eliminated grass species, irrigation and fertilizer use as potential causes of outbreaks of *A. spretulus* in fairways.

6. The increased density of *A. spretulus* adults and larvae in fairways compared with roughs still occurs when pesticide use and the history of pesticide use are eliminated experimentally. However, the suppression of predators and the intensity of the *A. spretulus* outbreaksmay be even greater when pesticides are used.

7. Mowing practices alone (and the resulting changes in turf structure) are responsible for a 3-fold increase in *A. spretulus* adults and larvae in the fairway compared with the rough.

8. Overall, outbreaks of *A. spretulus* in golf course fairways are most likely due to the suppression of predators and milky disease in the fairway, caused by mowing practices, and perhaps exacerbated by pesticide use.

A Model Explaining Outbreaks of Insect Pests in Fairways:

Previous research has demonstrated that more predatory insects are found in the rough while ataenius grubs are more abundant in fairways. We have developed the following model to explain the relative abundance of ataenius grubs in the fairway and predators in the rough:

Turf mowed at rough height is much taller above ground (50 mm vs 12 mm) and has a much larger root system below ground than turf in the fairway. The enlarged structure of turf in the rough compared with the fairway supports a greater abundance and diversity of small arthropods that consequently supports more predatory insects. The abundance of predators (spiders, rove beetles, ground beetles and ants) that feed on small arthropods (mites and springtails) in the rough keep Ataenius, Aphodius and other turf insect pests under control, while the relative paucity of predators in the fairway allows turf pests to escape with little affect from predation.

Research in 1999 was planned to support the above model. The following questions were addressed:

Question 1: What is the relative level of predator feeding activity in the fairway compared with the rough? Young-Ki Jo

Question 2: How does the structure of the insect and mite communities differ between fairway and rough? Breanna Simmons

Question 3: (An alternative to the model) Do ataenius adults prefer to lay their eggs in the fairway compared with the rough?

Progress in 1999.

Young-Ki Jo and Breanna Simmonds have both proven to be outstanding students, and good progress has been made in 1999. Breanna found major differences between soil arthropod communities in the fairway and rough at Groesbeck Golf Course in Lansing. Soil cores were pulled once per week and processed as described in the proposal. The most abundant soil insect, springtails, were more than twice as abundant in the rough compared with the fairway. A total of 1,364 were collected from cup-cutters in the fairway compared with 3,078 in the rough. Mites were more than 3-fold more abundant in the rough (3,636) compared with the fairway (1,156). These results support our model that predators are more abundant in the rough because the rough supports a larger community of insects and mites.

Young-Ki Jo worked-out experimental methods for studying the relative rate of predation in the fairway and rough. He placed western corn rootworm eggs inside sections of plastic straws (10 per straw) and put them in the fairway and rough at several golf courses. In at least one experiment more eggs were consumed in the rough compared with the fairway. In some of the tests, no differences were found. He is now working on improving the design of his "egg holders" to make them more accessible to predators. Young-Ki also put *Ataenius* larvae out at the Hancock Center in fairway and rough plots. More larvae were consumed in plots mowed at rough height. In a third experiment he tested the preference of *Ataenius* for fairway or rough turf by putting adults in containers with half fairway and half rough turf. Similar numbers of Ataenius adults and larvae were found in rough and fairway turf, but fewer were found where the turf began to dry-out. Young-Ki then devised an experiment to determine if the *Ataenius* beetles preferred moist or dry turf. Clearly, the beetles preferred the moist turf. Finally, Ataenius larvae or eggs were confined in small cages with individual rove beetles or ground beetles (a total of 7 cages with 1 rove or ground beetle per cage). Small rove beetles ate *Ataenius* eggs and larger rove beetles and ground beetles ate the *Ataenius* larvae.

All of the experiments will be repeated again in 2000 to confirm the preliminary results obtained in 1999. At the end of next year we should have very solid support for our model of how outbreaks of white grubs occur on golf course fairways. This model will also help explain outbreaks of black cutworms, Japanese beetle and other insect pests on golf course fairways.

Biological Control of Japanese Beetle in Michigan and the North Central United States: From Project GREEEN (David Cappaert)

Introduction

Japanese beetle (*Popillia japonica* Newman) is a costly pest for the nursery, landscape, turf, blueberry and grape industries in Michigan. It is particularly damaging to nursery growers because a federal quarantine prevents shipment of nursery stock from infested states to non-infested states unless it is certified as free of Japanese beetle. The finding of a single Japanese beetle larva can result in restriction of a nursery field, or the presence of a single adult beetle in blueberries can jeopardize the entire shipment to a processor. For landscapers and arborists, adult Japanese beetles may be the most serious tree and shrub pest in southern Michigan, frequently defoliating lindens, sycamores, Japanese maple, birch, chestnut, horsechestnut, black walnut, sassafras, hibiscus, crabapple, ornamental cherries, roses, mountain ash, pussy willow, American elm, and Virginia creeper. In heavily infested areas, insecticide applications must be repeated frequently to maintain foliage on susceptible plants. Japanese beetle larvae are also the most damaging pests of golf courses in Michigan. Adults are attracted to moist turf where they prefer to lay their eggs. The larvae feed on turf roots, sometimes causing extensive damage. Costly insecticides are applied to prevent turf injury. Japanese beetle larvae also damage recreational turf, industrial turf, and

home lawns and sod farms.

Project Goal

Reduce the pest status of Japanese beetle in Michigan, and ultimately in the North Central United States through introduction of natural enemies.

Summary

- 40 potential study sites including parks, rest areas, blueberry farms, industrial lawns and golf courses were surveyed. 12 sites with the highest density of Japanese beetle larvae were selected (10 golf courses and 2 industrial lawns) and grouped into 6 pairs based on location and density of larvae.
- Japanese beetle parasites known to be active in Massachusetts and Connecticut were absent in Michigan.
- *Ovavesicula*, a protozoan pathogen known to infect approximately 25% of Japanese beetle larvae in Connecticut was absent in Michigan larvae.
- A Gregarine (protozoan) digestive system parasite found in 70% of Japanese beetle larvae in Connecticut was only found in 2 of 10 locations in Michigan (an overall infection rate of 2.5% for Michigan larvae at all locations).
- The parasitic fly, *Istocheta*, and the pathogen, *Ovavesicula*, were introduced at 5 study sites in Michigan.
- Two entomopathogenic nematodes and the milky disease bacterial pathogen were applied at 5 sites to evaluate their persistence and long-term impact on Japanese beetle larvae.