

# Villani's Impact on Entomological Research

## Insect Behavior

Mike's lab pioneered radiography to follow soil insect behavior. This technique has significant practical impact on understanding white grub behavior, and how behavior determines the interaction between the larvae and either insecticides or potential biological control agents. Examples: (a) watering to move insecticide downwards also can be expected to bring larvae upwards, (b) *Metarhizium anisopliae* as a repellent to white grub larvae makes this product ineffective.

## Toxicology and Insect Pathology

Selectivity of control agents in their interaction with the species complex of white grubs. Different species (and stages of each species) of white grub differ in their sensitivity to various control agents, including insecticides, and various biological control agents. These interactions are further complicated by variation in the performance of these agents in soils with different chemical/physical properties. These interactions are tremendously important to the users of insecticides currently sold for the control of white grubs. For example, while product labels broadly include all white grubs for control by the insecticide halofenozide (Mach 2, GrubEx), we found in Mike's lab that Asiatic garden beetle is insensitive to this chemistry. In my field trials, Asiatic garden beetle larval survival actually improved as the rate of halofenozide ap-

plication increased, further indicating that the label claims for control of this species are inappropriate. As a practical matter, turf managers (including homeowners) need exactly the kind of basic data that Mike was able to provide, to have a complete understanding of the strengths and weaknesses of the tools available to them.

## Basic Ecology and Behavior of Adults

Scarab beetles determine where their larvae develop through their ovipositional behavior. Mike's lab worked at understanding the population distribution of white grub infestations, which then reflects the underlying oviposition behavior. These studies impinge on the important practical issue of determining where treatment may be needed, and for developing sampling guidelines for management.

## Principles of IPM

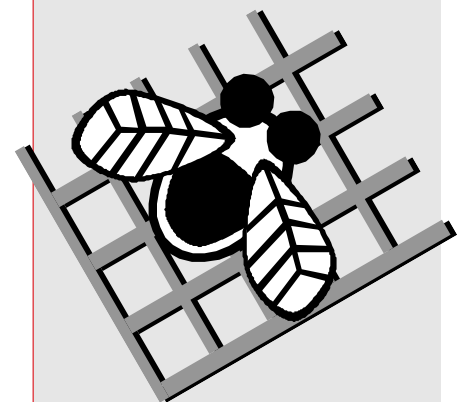
Mike was a leader among turf entomologists in criticizing the prevailing preventive timing in the use of imidacloprid (Merit) for white grub management. Although this method has been a tremendous commercial success, the ramifications of broad scale, injudicious application of imidacloprid to turf involves an abandonment of one of the basic tenets of IPM: that insecticides should only be applied when and where their use is justified by evidence that the developing insect population would otherwise cause economic damage.

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## Mike's Research

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**Figure 1**

