Turfgrass Pesticides and Biological Disease Control: Are They Compatible?

In the past few years, biological strategies of pest control have been attracting considerable attention among turfgrass scientists as well as golf course superintendents. These biological approaches are being viewed as an attractive means of reducing the superintendent's dependency on chemical pesticides. Our work over the past 11 years has focused on the development of biological disease control strategies for turfgrasses that employ the use of compost amendments or microbial inoculants. Regardless of the biological strategy followed, the level of control is dependent on the elevated activity of native or introduced soil microorganisms.

Despite the positive results with microbial inoculants and compost amendments, golf course superintendents have been reluctant to place more reliance on these disease control tactics. One of the more commonly-asked questions of biological disease control strategies in general is how other management practices affect the efficacy of biological controls. Of particular concern is the impact chemical pesticides may have on disease control efficacy. It should be realized that no single control strategy is used alone on golf course turf. A wide variety of chemical agents are employed, and no biological agent will replace these immediately. Furthermore, no turf disease control product is always effective, and we would be naive indeed to believe that biological controls were exceptional in this regard. Therefore, information on the compatibility of biological control strategies with existing chemical products, particularly fungicides, insecticides, and herbicides, is critical for the greater adoption of reduced chemical disease management strategies.

In 1997, a trial was established to examine the impacts of high label rates of various chemical pesticides on the efficacy of compost-amended topdressings for the suppression of Brown Patch and Dollar Spot diseases on creeping bentgrass putting greens. Composts that were evaluated included brewery sludge compost, municipal biosolids compost, and Sustane (turkey litter compost). Applications were made at monthly intervals at rates of 10 lb/1000 ft^2. Superimposed over these treatments were applications of various pesticides that included the following products: Merit and Dursban (Insecticides), Trimec [2,4-D, MCPP, and Dicamba] and Pre-M (Herbicides), and Heritage (Fungicide).

Although none of the pesticides tested reduced or enhanced the suppression of Dollar Spot or Brown Patch by compost amendments, the pesticides themselves had dramatic effects on disease development as shown in Table 1.

Interestingly, each of the insecticides and herbicides tested significantly enhanced Brown Patch disease. Heritage effectively controlled the disease. On the other hand, Pre-M and Dursban significantly suppressed Dollar spot disease whereas Heritage significantly enhanced disease severity. The other pesticides had not effect on Dollar spot severity. We know from laboratory studies that none of these pesticides (with the exception of Heritage) is directly toxic to the fungal organisms that cause Brown Patch or Dollar Spot. We have also learned from other laboratory studies that several different microbial inoculants are relatively unaffected by pesticide applications. We can only conclude that the reason we see enhanced or suppressed disease development is because of changes either to the physiology of the turfgrass plant or because of alterations in soil microbial communities that affect the activities of turfgrass pathogens. We plan to investigate this in more detail in coming years. These results do indicate the potential adverse affects different pesticides may have on the severity of turfgrass diseases.

Although our results have not demonstrated any adverse affects on the suppressiveness of compost amendments, our study was small and contained an extremely limited number of treatments. These results can therefore be considered only preliminary. We plan to expand these studies this coming season to investigate the compatibilty of these combinations. The use of biological approaches to turfgrass management is likely to increase as the emphasis in nonchemical and environmentally-friendly production practices increases.

This research not only will identify promising biological products for use in golf course management, but also will identify compatible combinations of biological products with conventional chemical pesticides. It is likely that we will discover synergistic combinations of biological and chemical pesticides as well as identify potentially detrimental interactions between biological and chemical products. This research will be important in the development of IPM strategies for golf course turf and the under-

continued on page 8

Research Update

No single control strategy is used alone on golf course turf. A wide variety of chemical agents are employed, and no biological agent will replace these immediately.

Table 1. Effect of various pesticides on Brown Patch severity on a creeping bentgrass putting green.

	% Plot Area Symptomatic	
Pesticide	Brown Patch	Dollar Spot
Untreated	11.9 c	35.0 b
Trimec (herbicide)	31.3 a	30.9 bc
Merit (insecticide)	20.0 b	39.1 b
Pre-M (herbicide)	29.1 a	25.3 cd
Dursban (insecticide)	34.1 a	17.2 d
Heritage (fungicide)	0.0 d	74.4 a

Different letters within a column indicate significant differences among treatments.

These results do indicate the potential adverse affects different pesticides may have on the severity of turfgrass diseases.

Pesticides & Biocontrols

continued from page 7

This research not only will identify promising biological products for use in golf course management, but also will identify compatible combinations of biological products with conventional chemical pesticides.

standing of these interactions will be essential to the long-term health and sustainability of turf quality on the golf course.

Purpose of the Project

The goal of this project is to determine whether biological control strategies are compatible with standard applications of chemical pesticides commonly used in the management of golf course turf. Specifically, we are interested in any potentially positive as well as any negative combinations of pesticides with microbial inoculants or disease suppressive composts. Our objectives are to:

1) determine the direct toxicity of selected herbicides, insecticides, and fungicides to various turfgrass pathogens so that laboratory and field results may be properly interpreted.

2) examine, in laboratory studies, the impacts of high label rates of various chemical pesticides on the efficacy of various microbial inoculants and compost amendments for the suppression of *Pythium* damping-off and root rot caused by *Pythium graminicola*, Brown Patch caused by *Rhizoctonia solani*, and Dollar Spot caused by *Sclerotinia homoeocarpa.*

3) evaluate, on turfgrass research plots as well as on golf course fairways, the efficacy of selected compost amendments and microbial inoculants when oversprayed with selected chemical pesticides.

Table 2. Pesticides used for toxicity testing with target turfgrass pathogens.

Fungicides	Insecticides	Herbicides
chlorothalonil (Daconil)	bendiocarb (Turcam)	2,4-D
cyproconazole (Sentinel)	chlorpyriphos (Dursban)	DCPA (Dachthal)
etridiazole (Koban)	isophenphos (Oftanol)	dicamba (Banvel)
flutolanil (Prostar)	imidacloprid (Merit)	dithiopyr (Dimension)
fosetyl Al (Aliette)	trichlorfon (Dylox)	fenoxaprop (Acclaim)
iprodione (Chipco 26019)	mecoprop (MCPP)	
propiconazole (Banner)	pendimethalin (Pre-M)	
thiophanate methyl (Fungo)	prodiamine (Barricade)	
propamocarb (Banol)		
mefanoxam (Subdue)		
triadimefon (Bayleton)		
azoxystrobin (Heritage)		

Table 3. Biological treatments tested in combination with selected pesticides.

Microbial Inoculants	Compost Amendments
Actinovate *(Streptomyces spp.)*	Sustane
Companion *(Bacillus subtilis GB03)*	AllGro Biosolids
Green Releaf, Bio-B Plus *(Bacillus spp.)*	Endicott Yard Waste
Pf-5 *(Pseudomonas fluorescens)*	Port Bay Gold
EcCT-501 *(Enterobacter cloacae)*	Nutri-Brew
TX-1 *(Pseudomonas aureofaciens)*	
Turf Tech Bio (various microbes)	
BioStart 2000G (various microbes)	
BioTrek 22G *(Trichoderma harzianum)*	

Objective 1: Direct Toxicity of Pesticides

Results of compatibility testing such as that described here have traditionally been difficult to interpret because of the unknown direct toxicity of various chemical pesticides to turfgrass pathogens. This is particularly true for work with fungicides since many of the fungicides tested for compatibility with biological treatments also have activity against the target pathogen. The use of *Pythium* species as models in fungicide compatibility studies has avoided some of these problems since few registered fungicides have activity against *Pythium* species. However, it is not clear, what toxicity might exist with insecticides and herbicides against *Pythium* and other fungal turfgrass pathogens. Therefore, in order to be able to interpret our field studies properly, we must first establish any known toxicity of the pesticides being tested with target turfgrass pathogens. We will choose pesticides from those listed in Table 2.

These materials will be tested for toxicity to *Sclerotinia homoeocarpa, Rhizoctonia solani,* and *Pythium graminicola,* three of the more common and important pathogens of golf course turf. A range of concentrations will be tested so that relative toxicity (EC50 values) can be determined. Those materials least toxic to the target pathogens will be tested further in laboratory and field trials.

Objective 2: Pesticide Impact on Microbial Inoculant and Compost Amendment Efficacy

In initial screenings, each of the pesticides tested to satisfy the first objective (see Table 2) also will be tested in combination with the biological treatments listed in Table 3.

Microbial inoculants will be amended to sand according to label rates or, with the case of several bacterial strains, will be drenched into sand at cell concentrations of ~108 cells/ml. Immediately after inoculation, cylinders will be drenched with appropriate concentrations of the test pesticide. Concentrations used will depend on specific label rates of each pesticide. Seedling stands will then be evaluated 6, 7, and 8 days after inoculation. The following types of treatments will be included in these experiments: 1) untreated, uninoculated; 2) untreated, inoculated; 3) pesticide treated, uninoculated; and 4) pesticide-treated, inoculated. From these experiments, those pesticide/biocontrol combinations showing either enhancements or reductions in efficacy over the biological control treatment alone will be tested in field studies outlined below. Those pesticides showing any phytotoxicity to seedlings will be tested further in mature turf in greenhouse experiments.

Objective 3: Field Tests

One set of plots will be established on bentgrass turf at the Cornell University Turfgrass Research Field Facility. Biocontrol treatments will be randomized within a set of four replicate blocks receiving a pesticide application. Control plots will consist of untreated turf (no biocontrol treatment) within each pesticide block. Among the pesticide treatments, one set of biocontrol treatments will receive no pesticide application and serve as an additional control. Individual biocontrol will be applied to 3 ft x 3 ft plots. Unless stated otherwise on the label, microbial inoculants will be applied at weekly intervals according to label rates whereas compost applications will be made at monthly intervals at rates of 10 lb/1000 ft^2. Pesticides will be applied according to label instructions. The efficacy of disease suppression in pesticide/biocontrol combination plots will be compared with plots receiving only the biocontrol treatment alone.

Funding Sources

We are grateful for the funding support of the New York State IPM program, the New York State Turfgrass Association and the GCSAA.

Eric B. Nelson, Cheryl M. Craft, David Hicks
Cornell UniversityTurfgrass Team
F. Dan Dinelli
North Shore Country Club, Glenview, IL

Short Cutts

continued from page 2

Citation of Merit for Delhi Leader Morales

The New York State Turfgrass Association (NYSTA) bestowed one of its highest honors on Dominic Morales, Turfgrass Program Leader at SUNY Delhi, awarding him the 1997 Citation of Merit. Dominic has distinguished himself over the years with his willingness to contribute to educational programs throughout the state and region as well as his tenacious promotion and development of the Turfgrass Program at Delhi.

Dominic's expertise as an educator was recognized in the past few years by the SUNY system with the Chancellor's Award for Excellence in Teaching. These two awards demonstrate Dominic's dedication to turfgrass education, his active involvement in industry activities, and the admiration of his colleagues. Recently, he spearheaded the construction of a second nine holes at the Delhi Golf Course and new Turfgrass Education Facility. This activity has brought national attention to the Delhi program.

Dominic received his degrees from SUNY Farmingdale, University of New Hampshire, and the University of Connecticut. He lives in the Delhi area with his wife and lovely children.

The Short Course Returns to Long Island

For the second consecutive year, the Cornell Turfgrass Team in partnership with the Nassau-Suffolk Landscape Gardeners, the New York State Turfgrass Association, and Cornell Cooperative Extension Associations are bringing the Turfgrass Management Short Course to Long Island.

This is the same course that has been offered in Ithaca for 13 years, inspiring over 1000 turfgrass professionals. In 1997, the course conducted on Long Island met with overwhelming support and demonstrated the highly successful nature of this educational opportunity.

This year the course will be held for two weeks at the Holiday Inn Ronkonkoma in West Islip from February 16 to 20, then 23 to 27, 1998. The short course is designed to provide basic information on the art and science of turfgrass management. Many of our short course alumni have improved the profitability in their businesses as a result of this course. In addition, with its emphasis on both fundamental concepts, it serves as a foundation for individuals who do not have formal training in turfgrass science.

Topics covered include turfgrass soil management, selecting and establishing turfgrass stands, understanding soil tests for proper fertilizing, and of course half day sessions with hands-on labs for grass, weed, insect and disease identification.

If you'd like more information please contact our short course assistant Kelly Woodhouse at (607) 255-3090.

This year the "Short Course" will be held for two weeks at the Holiday Inn Ronkonkoma in West Islip from February 16 to 20, then 23 to 27, 1998.