A Disease Management Program to Reduce Pesticide Use on Bentgrass Greens

North Carolina State University

Jack Bailey

Start Date: 1998
Number of Years: 3
Total Funding: $74,752

Objectives:

1. *Verify the utility of using microclimate information for scheduling the use of fans, irrigation and fungicides for disease management.*
2. *Develop the system, hardware and software, to monitor and analyze the microenvironment on golf courses.*
3. *Determine if unnecessary fungicide applications can be reduced by using microclimate-based information for disease management.*

Specially-designed weather stations will be used to monitor the microenvironment and analyze the data regarding the likelihood of disease outbreaks. This information will be constantly updated and displayed on a personal computer. Analyses will be automated using the most current research information on the relationship of the environment and disease. Results of these *disease advisories* will be used to alter the times and duration of fan and irrigation usage to minimize the rate of disease progress. Weather-based thresholds also will be used to time fungicide applications to minimize the unnecessary use of fungicides while maintaining turf quality.

Standard ANOVA and regression statistics will be used to describe the relationship between air speed, total rain/irrigation, and hours of disease favorable conditions. Fungicides applied on *standard* and advisory-based schedules will be compared regarding disease incidence, turf quality and cost of maintenance.

Weather-based disease advisory models can be utilized to minimize the unnecessary use of fungicides while minimizing the risks to turfgrass quality associated with reduced pesticide input. Golf course fans and irrigation can have positive and negative impacts on turf quality. This work would create an objective method of determining when and how long fans and irrigation systems should operate to maximize their efficiency while reducing the likelihood of disease outbreaks.

Progress to Date. Funds were issued this spring and a thorough search was made to find a graduate student candidate that had expertise both in agriculture and engineering sciences. Jasson Latta was selected and trained during the summer on soft money (non-USGA funds) to familiarize him with the turfgrass research being conducted by Paul Lyford. Jasson started his MS program this fall in the Mechanical and Aerospace Engineering (MAE) Program at NCSU. Dr. Bailey will serve as his principal advisor in the Department of Plant Pathology, with Dr. Chuck Hall serving as a co-advisor in MAE. In addition to his engineering training, Jasson will be taking his second plant pathology course this spring in preparation for collecting the biological information necessary for this work.

Jasson has built a seven-foot wingspan, electric, radio-controlled airplane to be used in this work. A camera has been mounted in the body of the aircraft to remotely sense turf stress, quality, and foliage moisture patterns. Work is underway to locate the digital analysis hardware and software to be used in evaluating the images collected in this manner. This device will be used for data collection on fan design and to assess the success of each fan design on experiment stations and golf courses. The airplane is necessary to obtain images at right angles without the use of heavy machinery (i.e. cherry pickers) normally used for these types of studies.

The Importance of Carbon Balance and Root Activity in Creeping Bentgrass Tolerance to Summer Stresses

Kansas State University

Bingru Huang

Start Date: 1998
Number of Years: 3
Total Funding: $75,000

Objectives:

Investigate the physiological factors that cause summer bentgrass decline, and specifically, examine how carbohydrate metabolism influences the decline in creeping bentgrass root activity and turf quality under low mowing and high temperatures.

It was proposed that imbalanced photosynthesis and respiration process and carbohydrate depletion could be the primary physiological factors contributing to bentgrass quality decline under high temperature and close mowing conditions. The overall objective of the project was to test this hypothesis in creeping bentgrass cultivars grown under close mowing and high temperature stresses. This project involved two studies, in which responses of turf quality, root growth, viability, and carbohydrate metabolic activities for four creeping bentgrass cultivars to high temperatures and close mowing conditions were examined in controlled environment growth chambers.

The first study investigated effects of differential shoot/root temperatures and mowing frequency on turf and root growth and carbohydrate metabolic activities to determine whether turf quality and carbon balance could be improved by modifying root temperatures. In this study, two widely grown bentgrass cultivars *CRENSHAW* and *PENNCROSS*, and two relatively new cultivars with promising summer performance under close mowing, *L-93* and *PENN A-4*, were examined. Grasses were exposed to differential shoot/root temperatures, including low shoot/root (20/20 C; control), low shoot/high root (20/35 C), high shoot/low root (35/20 C), or high shoot/root (35/35 C) conditions. Grasses were mowed at a 3 to 4 mm height daily or on alternate days.

It was found that turf quality and root activity were much lower at high root (20/35 C) or high shoot/root (35/35 C) temperatures than those of their respective controls for all four cultivars. Reducing root temperature to 20 C while maintaining shoots at 35 C improved turf quality and root growth to levels similar to those of the control treatment. High shoot/root temperatures reduced canopy photosynthetic rate and caused an imbalance between photosynthesis and respiration (carbon deficit) whereas reducing root temperatures reversed, to some extent, the adverse effects of high shoot/root temperature on carbon balance. The decline in turf quality was more severe for *PENNCROSS* than *CRENSHAW, L-93* and *PENN A-4* under high root or shoot/root temperatures. Similarly, daily carbon consumption to production ratio was higher for *PENNCROSS* than other cultivars under high root or shoot/root temperatures when grasses were closely mowed daily. Extending mowing frequency from daily to every other day improved turf quality and root growth, especially under high root or shoot/root temperatures, which was accompanied by enhanced photosynthetic rate and reduced carbon consumption to production ratio.

The second study examined whether declines in shoot and root growth with increasing temperatures (20, 24, 30, 34, and 38 C) were related to changes in carbohydrate metabolisms in *PENNCROSS* under close mowing conditions. Turf quality, root growth and viability of *PENNCROSS* declined significantly with increasing temperature to 30 C and higher. The imbalance between photosynthesis and respiration, carbon deficit, and reduced carbohydrate availability occurred as temperatures exceeded 30 C.

Results from both studies clearly demonstrated that first, carbohydrate depletion was a major physiological cause of summer bentgrass decline under high temperatures and close mowing. This was related to the imbalance between photosynthesis and respiration, which was caused by severe decline in photosynthesis capacity under high temperatures and low mowing. Second, roots played an important role in the regulation of creeping bentgrass tolerance to high temperature stress. Therefore, reducing root-zone temperature improved turf quality.

Two manuscripts describing the results of the project are currently being prepared for submission to Crop Science by the end of 1998. ◆

The Basic Biology and Etiology of Sclerotinia Homoeocarpa, The Causal Agent of Dollar Spot

Cornell University

Gary E. Harman

Start Date: 1998
Number of Years: 3
Total Funding: $75,000

Objectives:

1. *Examine the development, including possible apothetical production, of the pathogen in creeping bentgrass greens and fairways when present in leaf tissue, in root tissue or as isolated stroma and to determine the length of survival of the pathogen in infected tissue or as stroma.*
2. *Measure the genotypic variation of the pathogen from similar and diverse geographical locations using RAPD analysis and anastomosis groupings.*

A summary of observations and tentative conclusions from the first field season are provided below together with action plans for the upcoming months.

1. Small (2 x 4 cm) porous nylon bags were prepared, inoculum of *S. homoeocarpa,* in the form of infected grass or grown on sterile wheat, was placed in the bags, the bags were heat-sealed and they were buried vertically in bentgrass greens. The upper edge of the bags was even with soil line.
2. The bags containing the wheat-based inoculum caused low levels of disease shortly after burial. Conversely, the bags with the turf-based inoculum rarely, if ever, caused disease. Disease was attributed to the bags since the natural epiphytotic had not occurred yet in this area.
3. At the time of the natural epiphytotic in August and September, no disease from the bags occurred from either inoculum type.
4. Re-isolation of *S. homoeocarpa* from the internal region of the bags resulted in slow-growing colonies that were almost overlooked due to the great difference in the growth patterns and morphologies of the laboratory culture.
5. *S. homoeocarpa's* normal growth type is rapid and floccose. This morphotype occurs in laboratory-adapted cultures and is obtained if the pathogen is isolated from infected turf. The slow-growing phase of the organism and the rapid-growing phase are very different.
6. After a week of incubation, the slow-growing, *S. homoeocarpa* colonies from the buried inoculum suddenly began to grow rapidly and become indistinguishable from the rapid-growing phase. The sudden explosive development is the only way that we could recognize the pathogen on the plates. We are still attempting to isolate