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In Cooperation with
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# 2007 RUTGERS TURFGRASS PROCEEDINGS

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The Rutgers Turfgrass Proceedings is published yearly by the Rutgers Center for Turfgrass Science, Rutgers Cooperative Extension, and the New Jersey Agricultural Experiment Station, School of Environmental and Biological Sciences, Rutgers, The State University of New Jersey in cooperation with the New Jersey Turfgrass Association. The purpose of this document is to provide a forum for the dissemination of information and the exchange of ideas and knowledge. The proceedings provide turfgrass managers, research scientists, extension specialists, and industry personnel with opportunities to communicate with co-workers. Through this forum, these professionals also reach a more general audience, which includes the public.

This publication includes lecture notes of papers presented at the 2007 New Jersey Turfgrass Expo. Publication of these lectures provides a readily available source of information covering a wide range of topics and includes technical and popular presentations of importance to the turfgrass industry.

This proceedings also includes research papers that contain original research findings and reviews of selected subjects in turfgrass science. These papers are presented primarily to facilitate the timely dissemination of original turfgrass research for use by the turfgrass industry.

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Dr. Ann Brooks Gould, Editor
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# CULTURAL MANAGEMENT AND DISEASE CONTROL ON GOLF COURSES

**Paul Vincelli**[1]

Turfgrass diseases can create many headaches for golf course superintendents, and it is tempting to rely on "magic bullet" solutions like fungicides. However, cultural practices are really the foundation of a turfgrass disease control program. Think about the disease triangle, the three components that must be in place in order for plant disease to develop: a susceptible host, a pathogen (cause of the disease), and an environment suitable for disease development (Figure 1).

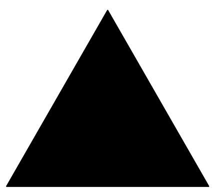


Figure 1. The **Disease Triangle**, the components that must be in place for disease to develop.

As golf course superintendents, you are managers of perennial plantings. Therefore, your options for manipulating the ***host*** corner of the disease triangle are limited, and typically, pathogens of turfgrass plants are nearly impossible to keep out of any turfgrass environment. Many pathogens of turfgrass are widespread and common inhabitants of turfgrass soils, and others are readily disseminated as airborne spores. Thus, you have very little direct influence over the ***pathogen*** corner of the disease triangle. About all you have substantial control over is the turfgrass growing ***environment***. The way you grow the grass can have a major influence on disease development.


Figure 2. Enhanced dollar spot by Cleary 3336 (thiophanate methyl). The fungicide didn't control dollar spot because the fungus is resistant to thiophanate-methyl. Thiophanate-methyl probably suppressed soilborne fungi which are naturally antagonistic to dollar spot.

Cultural management of turfgrass diseases offers several advantages, including reducing:

1. one's dependence on commercial fungicides
2. the risk of fungicide resistance
3. negative consequences of fungicides; these can include phytotoxicity, disease enhancement (Figure 2), and disease resurgence (Figure 3).

## VARIETY SELECTION

If you are seeding or re-seeding, selecting a variety resistant to important turfgrass diseases is among your most potent tools for reducing disease pressure.

Consider Figure 4. If one managed a variety highly susceptible to the patch diseases pictured there, one could likely never use enough fungicide to completely control these soilborne diseases.

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Cyproconazole Untreated

Figure 3. Disease resurgence 8 weeks after an effective fungicide (cyproconazole) was sprayed. The cyproconazole probably disrupted natural antagonists in the soil, resulting in more severe dollar spot than in areas where nothing had been applied.

However, by choosing a variety with a high level of resistance, you can see you would be able to avoid the use of fungicides for patch diseases.

It is sometimes tempting to ignore disease resistance when selecting varieties. For example, some practitioners are unconcerned about the high susceptibility to dollar spot in creeping bentgrass varieties like Crenshaw, Independence, and others, pointing out that fungicides can be used to control this disease. But not only does this lock you into a fungicide dependency, it increases the risk of fungicide resistance by increasing overall pathogen activity, possibly creating a situation where fungicides become less and less useful for the very disease against which you counted on them.

The Rutgers turf variety development program is second to none, and you also have access to excellent information on disease reactions of varieties through the National Turfgrass Evaluation Program (http://www.ntep.org/).

Figure 4. Differences in susceptibility to summer patch and necrotic ringspot among Kentucky bluegrass cultivars.

## LEAF WETNESS MANAGEMENT

With few exceptions, fungi need a film of moisture in order to penetrate and infect plant tissues. Fungi that infect from spores need that moisture in order to germinate, just like a plant seed does. Fungi that infect through mycelial growth (like those that cause dollar spot or brown patch) need that moisture so that mycelial strands can grow across air spaces between leaf blades and infect neighboring leaves. Thus, any practice that reduces the duration of leaf wetness periods also reduces pressure from foliar diseases. Mowing at sunrise is a highly effective practice for breaking up leaf wetness as well as for disrupting fungal mycelium. Other useful techniques include dragging the turf using coupled hoses, syringing at sunrise, or poling. The foliar application of surfactants could be useful, but in our research, these need to be applied too often to achieve disease control.

Timing of irrigation can have a substantial impact on disease development. In a study at the University of Kentucky, irrigation at sunrise substantially reduced disease pressure as compared to applying the same amount of irrigation during the evening (Figure 5). Morning irrigation results in shorter leaf wetness periods than evening irrigation. This is because irrigation at sunrise knocks off guttation droplets and condensation off of leaf blades (Figure 6), permitting faster drying. (Guttation droplets are those that form from water that was taken up by roots and passes through the plant, emerging at leaf tips.) In contrast, evening irrigation creates leaf surface wetness that doesn't have time to dry by nightfall, resulting in long leaf wetness periods.

## FERTILITY

Nitrogen fertility can have a substantial impact on disease development. Overfertilization with nitrogen is known to favor Pythium blight, brown patch, and gray leaf spot, whereas underfertilization favors dollar spot, leaf rusts, anthracnose, and red thread.

The form of nitrogen supplied to the plant's roots can also affect disease development. The best example of this is seen with summer patch and take all. These diseases are less severe in turf regularly fertilized with ammonium forms of nitrogen, whereas they are made worse where turf is regularly fertilized with nitrate forms of nitrogen. The benefit of the ammonium form is that, over time, it causes an increase in acidity around the root (called the rhizosphere),

Daily irrigation in evening

Daily irrigation in early morning

Figure 5. Identical amounts of daily irrigation were applied to these plots of fairway-height creeping bentgrass.

which seems to increase the turf's resistance to infection by the fungi that cause these diseases. In contrast, nitrate-nitrogen reduces acidity in the rhizosphere, making roots more susceptible to infection. The benefit from ammonium is not due to the acidity being poisonous to the fungi; they grow quite well under reasonably acid conditions. But somehow, the increase in pH increases plant resistance to infection.

Other plant nutrients have relatively modest effects on disease development, although they should always be supplied at levels that provide for optimal turf growth.

Figure 6. Guttation droplet at tip of blade, and condensation on mycelial strands (Courtesy David Williams).

## MOWING PRACTICES

Shorter mowing heights are commonly associated with increased disease pressure, especially from root-infecting fungi. Turfgrass plants respond to shorter mowing heights by producing shorter root systems, which leaves them more vulnerable to root infections. Given an equal amount of root infection on two swards, the sward with the higher mowing height is less likely to show foliar symptoms, because the plants are more tolerant to the root infection and resulting root rot. Even differences of a few thousandths of an inch can help a putting green limp through a root rot situation or a period of stressful weather.

## ORGANIC MATTER MANAGEMENT

A thick thatch or soil zone of high organic matter favors disease development. A thick thatch layer holds moisture, favoring fungal activity. It also may limit rooting depth, leaving the turf more vulnerable to root infections. A buried thatch layer (Figure 7) develops when thatch is covered by repeated topdressing which is not thoroughly incorporated into the thatch layer through verticutting and aerification/filling with sand. A buried thatch layer creates a "ponding" effect in the root zone with every irrigation or rainfall, since water will not percolate uniformly through these soil layers of differing textural class. A problem like this must be corrected in order to reduce activity of fungal pathogens in the root zone.

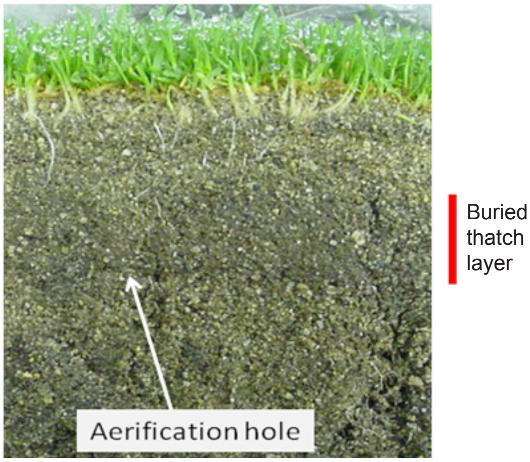


Figure 7. Buried thatch layer in a sand-based putting green.

## TURF GROWTH REGULATORS

Trimmet (paclobutrazole) and Cutless (flurprimidol) are both are well-known growth regulators, but they are also weak fungicides. Apply these products to turf and you can often see some weak but measurable reduction in dollar spot pressure. Since these growth regulators have identical modes of action to DMI fungicides, one has to be cautious about applying heavy rates of DMI fungicides as well as these growth regulators on putting green turf during stressful periods in summer.

Primo has no known fungicidal activity but, in work conducted by John Inguagiato and Bruce Clarke at Rutgers University, it has been shown to sometimes slightly reduce pressure from anthracnose on *Poa annua*, possibly by reducing mowing stresses. In the same studies, the Rutgers scientists found that Embark alone can increase anthracnose pressure, possibly due to carbohydrate depletion as the turf comes out of growth regulation. However, putting Primo in the program seemed to eliminate that effect.

## BIOLOGICAL CONTROL

It may surprise you to learn that natural biological control of turfgrass diseases is actually the norm in turfgrass ecosystems (Figures 2 and 3). The problem is that this natural biological control is usually insufficient for complete disease control, so turfgrass managers have still to contend with disease outbreaks. Maybe as we learn more about the complex world of natural biological control, we'll be able to recommend ways to enhance that consistently and naturally, so we are not so dependent upon fungicides.

The use of biological disease control products is increasing in turfgrass management. This is a wonderful development, but research shows that the efficacy of the current generation of biological control products is typically not as consistent as inert fungicides. Therefore, expect variability in performance from site to site and from year to year. Furthermore, don't expect good results under high disease pressure. And finally, be skeptical of exciting claims of disease control. Rely on cultural practices and resistant varieties as the foundation of your disease control program, and don't expect the application of biological control products to substitute for good agronomics.