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Nutrient Monitoring for Turfgrass Disease Management

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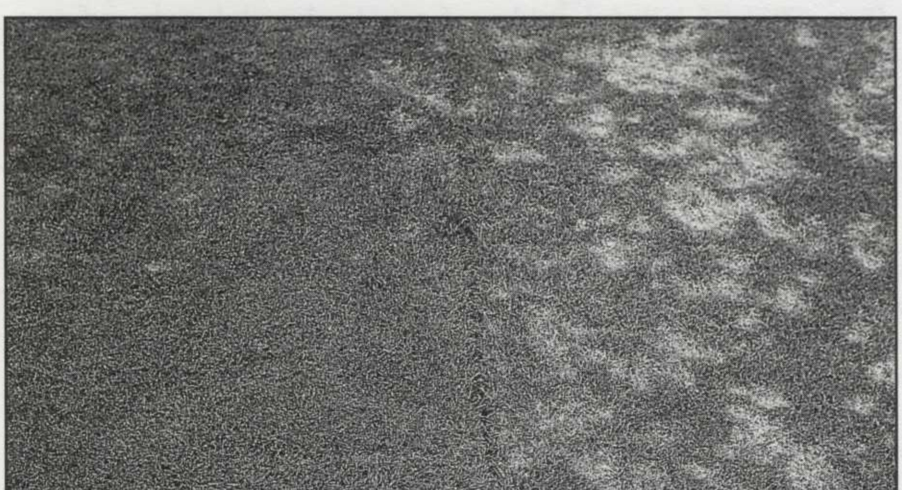
Before today's multitude of turfgrass fungicides was available, turf managers relied on cultural practices and tolerated levels of disease that would be unacceptable today. Still, cultural practices are the mainstay of good turf management and always will be. Most disease textbooks even group diseases according to the effects of cultural practices and environmental factors. For example, all foliar diseases can be reduced by minimizing the time leaf blades are wet. Many diseases can be reduced by raising mowing height above the stress-inducing levels common today. Different diseases predominate at different temperatures and are commonly grouped as cool, warm and hot weather problems.

Diseases are also often grouped as "high nitrogen" or "low nitrogen" diseases. Some fungi will more easily invade the soft succulent growth that follows



Dollar spot (on right) is attributed to low nitrogen while large brown patch (on left) was caused by high nitrogen. Photo by Gail L. Schumann.

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applications of quick-release nitrogen. Disease severity can increase when "excess" applications are made. Diseases commonly included in this group are brown patch, leaf spot, Pythium blight and snow molds.

Other fungi invade plants whose growth is compromised by stress factors such as low fertility, and especially low nitrogen availability.

A well-fertilized sward of turfgrass is likely to outgrow invasion by such fungi before disease reaches an unacceptable level.

If low fertility is combined with other stress factors, such as compaction, low mowing height, wear and insufficient irrigation, disease may reach unacceptable levels. This can be exacerbated by weather conditions that produce heavy dew and prolonged leaf wetness which gives the fungal pathogen an additional advantage over the stressed, slow-growing plants. Diseases commonly included in this group are anthracnose, dollar spot, and rust.

The November, 1996 issue of *TurfGrass TRENDS* included articles that summarized the effects of nitrogen fertilization on turfgrass disease injury and important information on nitrogen use and requirements in turfgrass.

Turfgrass disease research in Nebraska confirmed that dollar spot and rust are more severe at low nitrogen fertility levels and brown patch is more severe at higher levels is various turfgrass species. However, monthly applications of nitrogen fertilizers maintained adequate supplies for disease recovery following brown patch outbreaks.

Control Problems With Dollar Spot

Records of fungicide use indicate that turf managers apply significant portions of their disease control products for brown patch, a classic high-nitrogen disease, and for dollar spot, a classic low-nitrogen disease. Dollar spot, in particular, can be costly to control using fungicides because of its relatively long season of activity in many areas.

Repeated use of some fungicides has resulted in documented cases of fungicide resistance in certain populations of the causal agent, *Sclerotinia homoeocarpa*. The chemical groups include the benzimidazoles (e.g. thiophanate-methyl), the dicarboximides (e.g. iprodione, vinclozolin) and the sterol-inhibitors or DMI fungicides. Two important new fungicides, flutolanil (ProstarTM) and azoxystrobin (HeritageTM) offer excellent control of some turfgrass diseases, but not dollar spot. Such chemical control problems, coupled with environmental concerns about the overuse of fungicides, have led many turf managers to focus their attention on cultural management and the use of fungicides only when cultural management is insufficient.

What alternatives exist for dollar spot management? Several different research groups have investigated environmental models to predict dollar spot outbreaks for improved timing and mimimal application of fungicides. Unfortunately, there is considerable genetic variability of the fungus (or fungi) responsible for this disease which has made accurate forecasting unreliable.

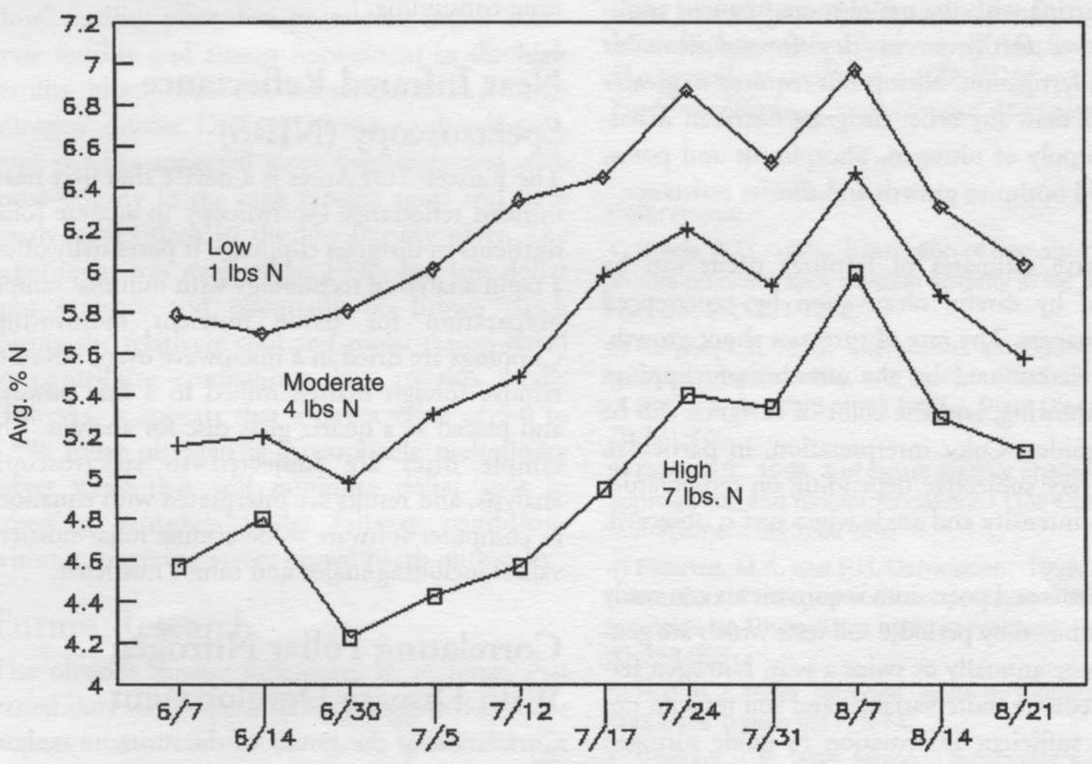
Disease Severity Related to Nitrogen Fertility	
More Severe Under High Fertility	*More Severe Under Low Fertility*
brown patch	anthracnose
Pythium blight	dollar spot
leaf spots and melting out	rust
powdery mildew	
snow molds	

Some new biocontrol options, a strain of the fungus *Trichoderma harzianum* (BiotrekTM) and a strain of the bacterium *Pseudomonas aureofaceans* (BioJectTM) are commercially available, but much remains to be learned about timing, application rates and reliability of these products.

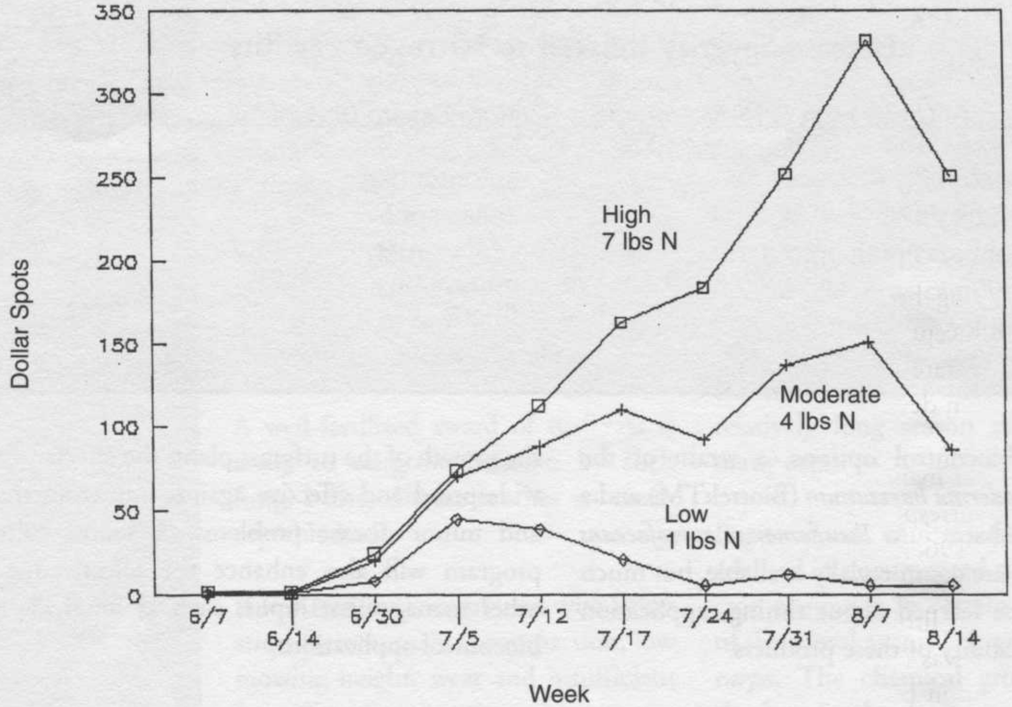
One of the major advantages to focusing on cultural management of diseases is that it is less important which specific disease is potentially causing a problem. If the focus is on optimizing the growth of the turfgrass plant, the effects will be widespread and effective against numerous major and minor disease problems. A sound cultural program will also enhance the effectiveness of other management inputs such as fungicide and biocontrol applications.

Precise Use of Fertilizers

Many golf course superintendents are relying on computer-based water monitoring for more precise



Average Percent Foliar Nitrogen. Foliar nitrogen levels as determined by NIRS in experimental plots of creeping bentgrass maintained under fairway conditions.



Average Number of Dollar Spots. Dollar spots in experimental plots of creeping bentgrass maintained under fairway conditions.

irrigation. Similar advances in nutrient monitoring are occurring with the use of more frequent applications of fertilizers in dry formulations or through fertigation. Nitrogen is required in greater amounts than any other turfgrass nutrient. A balanced supply of nitrogen, phosphorus and potassium will optimize growth and disease resistance.

Qualitative estimates of fertilizer needs can be obtained by careful observation by experienced turf managers. The rate of turfgrass shoot growth, usually determined by the amount of clippings during mowing, and the color of turfgrass can be useful guides. Color interpretation, in particular, can be very subjective depending on temperature and sun intensity and angle when turf is observed.

Phosphorus and potassium requirements can easily be determined by periodic soil tests which are generally done annually or twice a year. Nitrogen fertility needs are more variable, and soil tests do not provide sufficient information to guide nitrogen needs. Laboratory tissue tests of foliar nitrogen can determine both the mineral and protein levels of nitrogen to guide turf managers in their fertilizer applications, but these tests can be expensive and time-consuming.

Near Infrared Reflectance Spectroscopy (NIRS)

The Karsten Turf Anser is a device that uses near-infrared reflectance spectroscopy to analyze foliar nutrients in turfgrass clippings. It potentially offers a rapid analytical technology with minimal sample preparation for tissue nutrient monitoring. Clippings are dried in a microwave oven, sieved to remove foreign matter, milled to a fine powder, and placed in a quartz glass disc for analysis. The sample discs are subjected to spectroscopic analysis, and results are interpreted with equations in computer software to determine foliar nutrient values including major and minor nutrients.

Correlating Foliar Nitrogen With Disease Development

Correlation of the results of the nutrient analyses with standard laboratory methods is complex and requires many tests. A study at the University of Massachusetts by the author and graduate student, John Bresnahan, was designed to determine target values for foliar nitrogen levels that would minimize turfgrass diseases. The study gave special attention to dollar spot.

Experimental creeping bentgrass plots (*Agrostis palustris* cv. 'Penncross') were maintained under conditions similar to golf course fairways with a 0.5 inch mowing height (1.3 cm) and uniform maintenance except for the addition of weekly ammonium nitrate fertilizer according to the results of Karsten device results.

The goal was to maintain plots at three different fertility levels corresponding to 1, 4 and 7 lb N per 1000 sq ft (49, 196, and 343 kg N ha-1). Fertilizer was added weekly except during stressful weather conditions when little growth occurred. At these times, fertilizer was not applied in order to maintain the separation between the foliar N levels of the clipping samples.

Disease was allowed to develop throughout the season with no fungicide applications. Dollar spot, a "low nitrogen disease, was quite severe in the "low" fertility plots, less prominent under moderate fertility and almost nonexistent in the high fertility plots. However, brown patch is a "high nitrogen" disease. During a brown patch outbreak, large patches appeared more frequently and with more severity in the high fertility plots and were nearly nonexistent in the low fertility plots. The experiment was repeated in 1996, but low dollar spot pressure and essentially no brown patch during the relatively cool and moist season failed to contribute confirming data to this study. However, it appears that a target value of 5.0 to 5.5% foliar nitrogen is a reasonable preliminary target value that will minimize dollar spot in creeping bentgrass under fairway conditions without triggering severe brown patch outbreaks.

Future Research

The obvious disease differences in turfgrass that varied only its nitrogen fertility suggest that foliar nutrient monitoring has great potential for improved cultural management of diseases and turfgrass management in general. Scientists have long speculated on interactions between nutrient levels and the effects of these interactions on stress tolerance, cold tolerance, and tolerance to various diseases. More precise nutrient management might allow turf managers to optimize turfgrass growth even under the demanding conditions of increased play and low mowing heights.

Although it is likely that various species will react similarly to fertilizers, the specific target values are likely to vary between species and even between cultivars. The target values are also likely to vary depending on the soil type, sand-based turf culture, and in different climatic regions. Clearly, we are only beginning to understand the important and more subtle interactions that can affect turfgrass stress tolerance and health. These technologies offer the tools to manage turfgrass more precisely than ever before, but we still need considerable new research information to make the best use of these technologies. Nutrient monitoring can help a turfgrass manager understand exactly what mineral nutrients the turf needs and when it needs it.

Dr. Gail L. Schumann is an associate professor of plant pathology in the Department of Microbiology at the University of Massachusetts. She recently co-authored a CD-ROM entitled, Turfgrass Diseases:Diagnosis and Management.

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