Nitrogen fertility and anthracnose basal rot in putting greens

Disease severity may be reduced with an adequate nitrogen rate and an appropriate source.

Environmental Institute for Golf

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Wakar Uddin, Ph.D.
Michael Soika
David Livingston

Basal rot anthracnose is a destructive disease of annual bluegrass (*Poa annua* L.) and creeping bentgrass (*Agrostis stolonifera* L.) in North America and Western Europe. The causal agent of the disease recently has been reassigned to *Colletotrichum cereale* (formerly *C. graminicola*) (3). Anthracnose in turfgrass had been previously classified as a *senectopathic* problem, meaning that the pathogen infects aging tissue that is already near death (2). However, incidence and severity of the disease in putting greens have dramatically increased in recent years (5,9,10). The reason for the increased problem in greens is unclear. Certain cultural practices and changes in pathogen population may have, at least in part, contributed to the problem.

The disease

Two phases of the disease are commonly recognized: foliar blight and basal rot (13). The foliar blight phase develops during warm periods in the summer, and the basal rot phase may occur at anytime of the year. In close-cut annual bluegrass, the foliar phase of the disease begins with development of small spots on foliage that cause leaves to turn yellow or orange in winter or spring; subsequent infection of basal stem and crown tissue by the fungus causes the plants to die. Infected plants later develop a large number of acervuli and melanized setae, which may be found on the crown and stem tissues or between the sheaths of aerial shoots. Nutritional deficiencies and environmental stresses are also important factors influencing development of the disease.

Effects of fertility

Nitrogen application rate significantly influences the development of various turfgrass diseases. Some diseases are influenced by too much nitrogen, whereas others are affected by too little. Dollar spot and red thread diseases are more severe in underfertilized turf, and brown patch, Pythium foliar blight and gray leaf spot diseases are enhanced by excessive amounts of nitrogen (8,13,15).

In golf turf management, different rates of nitrogen — often less than 3 pounds/1,000 square feet/year (146.4 kilograms/hectare) — are used annually on putting greens to minimize foliar growth and maximize ball roll speed (11, 12). Such rates apparently remain at the lower range of the normal amount of nitrogen required for plants during the growing season with the usual recommended rate of 4 to 6 pounds/1,000 square feet/year for annual bluegrass putting greens (16).

Studies have shown that increased severity of anthracnose basal rot disease in annual bluegrass

Development of basal rot anthracnose in mixed annual bluegrass and creeping bentgrass putting greens. **Photos by W. Uddin** putting greens is associated with reduced rates or frequency of nitrogen fertilization (1,4,7,14). However, lower anthracnose severity also has been reported in an annual bluegrass green that received a moderate amount of nitrogen annually compared to a similar green that received a higher amount of nitrogen annually (6).

This study was undertaken to determine the effects of rate and source of nitrogen application on the severity of anthracnose basal rot on a mixed creeping bentgrass and annual bluegrass green.

Materials and methods

Application of field treatments

The experiment was conducted in 2005 and 2006 on two different sites at the Joseph Valentine Turfgrass Research Center, Pennsylvania State University, University Park. The turf was a mixed sward of Penncross creeping bentgrass (*Agrostis palustris* Huds.) and annual bluegrass (*Poa annua* L.) maintained as a green mowed at a 0.125-inch (3.2-millimeter) height six times per week. The soil was Hagerstown silt-loam with a pH of 6.9. The experimental area was not fertilized at any point during the growing season before the study was started. No herbicides, fungicides or insecticides were applied before or during the test period. Irrigation was applied as needed to prevent drought stress.

2005 study

In this experiment, we used three sources of nitrogen: urea (46-0-0), methylene urea (26-0-0) and IBDU (30-0-0). Each nitrogen source was applied at 0.1, 0.3 and 0.5 pound actual nitrogen/1,000 square feet (0.5, 1.5 and 2.4 grams/square meter) on a 14-day schedule from April 27 through July 6. No fertilizer was applied in the untreated control plots. All treatments were applied six times during that period. Treatment plots 3 feet × 6 feet (0.9 meter × 1.8 meter) were arranged in a randomized complete block design with three replications. Treatments were applied with a CO_2-powered sprayer equipped with a TeeJet 11008E nozzle at 40 psi (275.8 kilopascals) in water equivalent to 2 gallons/1,000 square feet (81.5 milliliters/square meter). Prior to application of the treatments in each plot, the spray bottles were vigorously shaken to dissolve or disperse the fertilizer particles effectively in the water.

The turf in the experimental area was inoculated with *Colletotricum cereale*, which was originally isolated from symptomatic annual bluegrass turf at the Valentine Turfgrass Research Center in 2003. A spore suspension of *C. cereale* (10^4 conidia per milliliter aqueous suspension) was applied to the turf with a hand-held sprayer. Inoculation was conducted in the late afternoon (before sunset), and the turf was covered with a 6-mil plastic sheet for three consecutive nights; the cover was removed each morning. A total of seven assessments of anthracnose basal rot severity (using an index of 0-10, where 0 is asymptomatic turf and 10 is more than 90% symptomatic turf) were made on May 24, 27 and 30, June 2, 5 and 8 and July 14. Symptomatic plants were randomly collected from the plots and evaluated for the presence of acervuli, conidia and setae on the affected tissues.

Deterioration of annual bluegrass plants due to severe infection of crown, roots and stem tissue by *Colletotrichum cereale* (**top**) and profuse production of acervuli on the stem (**bottom**).

Nitrogen vs. anthracnose

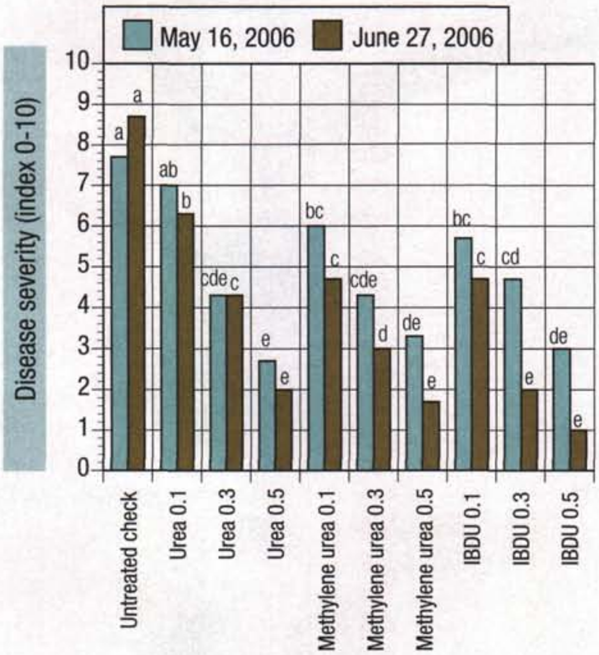

Figure 1. The effects of nitrogen rate (0.1, 0.3 or 0.5 pound/1,000 square feet) and source on severity of anthracnose basal rot. Bars with same letters (within the same color) are not significantly different. The disease severity index ranges from 0 to 10, where 0 is asymptomatic turf and 10 indicates that 90% or more of the turf shows symptoms of disease.

Leaf tissue nitrogen

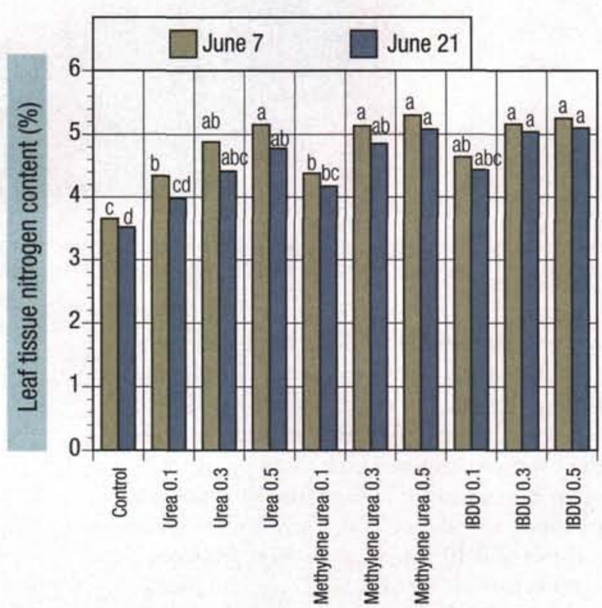

Figure 2. Nitrogen contents in leaf tissue collected from turf plots that received different rates (0.1, 0.3 or 0.5 pound/1,000 square feet) and sources of nitrogen. Bars with same letters (within the same color) are not significantly different.

2006 study

The study was repeated in 2006 on a mixed sward of Penncross creeping bentgrass and annual bluegrass adjacent to the area used for the 2005 study. The same procedures were followed in both years.

A total of seven assessments of anthracnose basal rot severity were made on May 16, 23 and 30 and June 6, 13, 20 and 27. Data for two assessment dates, May 16 and June 27, are presented (Figure 1). Foliar tissue samples were also collected from each plot on June 7 and 21 for analysis of tissue nitrogen levels (Figure 2). Four subsamples were collected from each plot in all replications.

Results and conclusion

Studies in 2005 and 2006 provided similar results. The results indicate that source of nitrogen and application rate are important factors influencing anthracnose basal rot development. In first disease assessment, the effects of nitrogen source and application rate on disease severity were significant. Application of the low rate (0.1 pound) of urea did not significantly reduce anthracnose basal rot. However, application of the low rate (0.1 pound) of methylene urea and IBDU significantly reduced the disease, and disease severity in these plots was not significantly different. Disease severity in plots treated with the medium rate (0.3 pound) of all three sources of nitrogen was significantly lower than that of the plots treated with the low rate of all three sources. However, disease severity did not differ among the plots treated with the medium rate of the three sources of nitrogen. Application of the high rate (0.5 pound) of nitrogen, regardless of the source, provided the most effective control of anthracnose basal rot. Disease severity on those plots ranged from 27% to 33% compared to 77% in the untreated control.

The first disease assessment was made 25 days after the first application and 10 days after the second application of nitrogen treatments. Results of the first disease assessment indicated that effect of rate among the sources was not clearly evident during the early part of the study. However, the effects of rate became more pronounced in several of the subsequent disease assessments. Much greater suppression of the disease was recorded during the later part of the study, where disease severity in plots treated with the high rate of nitrogen of the two controlled-release sources ranged from 10% to 20% compared to 87% in untreated control plots. Analysis of soil and plant tissue indicated that nitrogen accumulation in the foliar tissue of plants increased as nitrogen fertility increased (Figure 2).

The role of stress

It has been reported in the literature that several turfgrass pathogens effectively infect plant hosts grown under stresses such as drought, wounding and fertility. *Colletotrichum cereale* is a stress pathogen that appears to have infected host plants maintained under low levels of quick-release nitrogen. Although it has become apparent in recent years that the fungus can also infect plants that are not under stress, the nitrogen fertility factor appears to be critical during the infection process. Our study revealed the significance of nitrogen fertility as part of the cultural management practices in anthracnose basal rot development. These results will be instrumental in providing disease management recommendations to superintendents.

Conclusion

In this study we have shown that development of basal rot anthracnose in annual bluegrass in a mixed annual bluegrass and creeping bentgrass green is influenced by nitrogen rate and source. *Colletrotrichum cereale* is historically a stress pathogen, and it appears from our study that nutritional stress resulting from low nitrogen fertility may have predisposed plants to infection by the pathogen. Nitrogen source also appears to influence anthracnose basal rot development; however, the disease is more pronounced at the lower rate than at the medium or higher rate of nitrogen application.

When managing anthracnose with fertility, the most practical approach may be to maintain an adequate amount of nitrogen throughout the season using controlled-release nitrogen. Employing a fertility program with a sustained level of nitrogen content in plant tissue during the season will be instrumental in developing an integrated basal rot anthracnose management strategy.

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Wakar Uddin (wxu2@psu.edu) is an associate professor in the department of plant pathology and David Livingston is a research support associate in the department of crop and soil sciences at Pennsylvania State University, University Park; Michael Soika is a research specialist in the department of plant pathology, North Carolina State University, Raleigh.

The research says

→A higher rate of nitrogen fertilization significantly reduces anthracnose development in annual bluegrass in a mixed annual bluegrass and creeping bentgrass green.

→Controlled-release type nitrogen provides greater suppression of the disease than the quick-release type.

→Maintaining an adequate level of nitrogen in plants throughout the season is an important component of an integrated anthracnose management strategy.