Cultural Management of Anthracnose Disease on Annual Bluegrass

Nitrogen fertility and growth regulators can have positive impacts on management of this potentially devastating disease.

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Anthracnose is a disease on many turfgrass species throughout the world, but is particularly severe on weakened or senescent annual bluegrass (*Poa annua* L.) turf. Anthracnose is caused by the fungus *Colletotrichum cereale* (Manns, Crouch, Clarke, and Hillman), which persists in turf as a saprophyte in thatch or infected plant material. Typically, the fungus can become pathogenic and infect leaf, stem, or root tissue when an environment of high humidity or extended leaf wetness coincides with plant stress. Symptoms can be observed throughout the year, but they are most intense between June and September in temperate and transitional climatic zones.

Annual bluegrass grown on golf course putting greens is a weak perennial species that is known for its prolific production of seedheads, particularly between mid-April and June. Seedheads are unsightly, but more importantly, they also decrease the playability (smoothness and uniformity) of a putting green and deplete the carbohydrate (food) reserves of the plant by early summer. Consequently, carbohydrate-starved annual bluegrass plants are thought to be more susceptible to anthracnose once summer conditions become more stressful (e.g., hot, humid, and/or droughty weather).

The incidence and severity of anthracnose on annual bluegrass turf has increased in recent years throughout the United States, particularly along the East Coast and in Midwestern states. In many cases, epidemics were so severe that fungicides have been unable to effectively control the disease when used at label rates and application intervals, resulting in extensive turf damage and major disruption to play, especially on putting greens. It is thought that changes in fungicide use patterns as well as management practices commonly employed on golf courses may be predisposing turf to anthracnose.

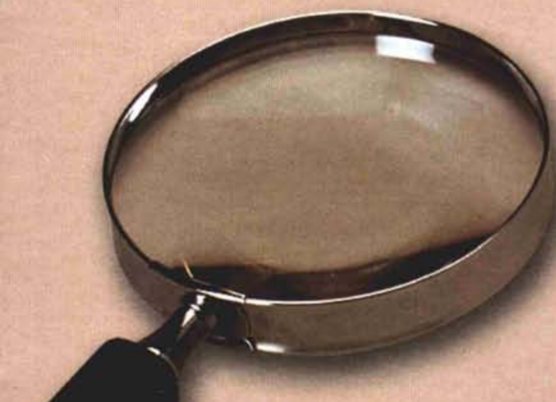
It is probable that more than one or various combinations of management factors may be enhancing the severity of this disease and making it more difficult to control. Common management practices thought to affect anthracnose severity include N fertilization, mowing, rolling, chemical plant growth regulation, verticutting, topdressing, and irrigation. Our research program at Rutgers University has and is currently evaluating various aspects of these important cultural practices. The overall goal of our research is to develop a set of best management practices (BMPs) for the control of anthracnose disease on annual bluegrass putting green turf. This article summarizes findings from a trial that evaluated the impact of N fertilization, two chemical growth regulators, verticutting, and the potential interactions of these factors on anthracnose of an annual bluegrass putting green.

GENERAL RESEARCH METHODS

The trial was conducted on annual bluegrass turf grown on a Nixon sandy loam and maintained as a putting green. Plots were mowed 10 to 14 times per week with a triplex mower bench-set at 0.125 in. Turf was topdressed lightly with medium sand every 14 days and brushed with a cocoa mat. Water was applied uniformly to the plot area by hand-held hose or sprinkler irrigation to avoid severe drought, yet maintain firm, dry surface conditions consistent with industry playing standards. Preventative disease control (fungicides) that did not affect anthracnose was applied for dollar spot and brown patch diseases.

NITROGEN FERTILIZATION

Of the 17 essential nutrients required for plant growth, nitrogen (N) is often the fertilizer nutrient that can be most effectively used by a turf manager to impact plant vigor and health. Plant



Anthracnose Up Close and Personal

Anthracnose first appears on annual bluegrass as ¼- to ½-inch-diameter spots of yellow to orange-brown turf (top photo), which can progress to large, irregularly shaped areas on infected putting greens, tees, or fairways. Infection often first occurs on older or senescing leaves of plants, causing yellow leaf lesions (middle photo). "Basal stem rot" refers to the stage when the pathogen attacks leaf sheaths, stems, and the crown. Lesions on these plant parts initially appear water-soaked, but quickly turn black as tissue is destroyed. At this point, damaged shoots are easily pulled from the infected crown and the entire plant may die. Upon close examination with a magnifying glass or 10x hand lens, affected foliage and stems are often covered with small, black reproductive structures called *acervuli* (diagnostic feature). As acervuli mature, long black spines (setae) are produced (bottom photo). Each acervulus contains dozens of one-celled, crescent-shaped, asexual spores called *conidia*. The conidia are readily moved by wind, water, or other mechanical means to uninfected turf and cause infection.

growth and maintenance require relatively large amounts of N, and N deficiency can inhibit growth and reduce tolerance to environmental stress (Orcutt and Nilsen, 2000). In the Northeast, N is commonly applied at less than 3 lbs. per 1,000 sq. ft. annually on putting greens to limit leaf growth and reduce the frictional resistance to ball roll (Radko, 1985; Zontek, 2004). This may result in N deficiency during the growing season since recommendations for N fertilization of annual bluegrass putting greens typically range from 2.7 to 6.3 lbs. per 1,000 sq. ft. per year (Beard et al., 1978; Vargas and Turgeon, 2004). Turf maintained below optimal N levels can enhance the severity of diseases such as dollar spot and red thread (Smiley et al., 2005). The practice of occasionally spoon feeding turf with N at 0.05 to 0.125 lb. per 1,000 sq. ft. when plants are low in vigor may not be sufficient to maintain a healthy, disease-free playing surface.

We evaluated soluble N applied at 0.1 lb. per 1,000 sq. ft. (as an NH_4NO_3 solution) every 7 or 28 days beginning in mid-May and through the summers of 2003, 2004, and 2005. Our findings clearly indicate that low-rate soluble N fertilization every 7 days had the greatest reduction in anthracnose severity throughout this study; increasing N by 0.3 lb. per 1,000 sq. ft. per month during the summer reduced damage 25% to 73% (Table 1). More research is needed to determine the optimum frequency of low-rate liquid N fertilization; that is, fertilization every 14 or 21 days may be as effective as every 7 days at reducing severity of anthracnose.

Superintendents have frequently asked about the potential role, if any, of late- and early-season granular N fertilization in suppressing anthracnose of annual bluegrass turf. Some superintendents have reduced or abandoned the practice of applying granular N (¾ to 1¼ lbs. per 1,000 sq. ft.) on greens in the fall or spring, thus further reducing the supply of this important nutrient. Previous research on annual bluegrass fairway turf has found greater disease when most N was applied during April and May rather than November; also, N applied at 6 lbs. per 1,000 sq. ft. per year increased anthracnose foliar blight compared to 3 lbs. per 1,000 sq. ft. per year (Danneberger et al., 1983). Similar research is needed to define the possible role of late- or early-season granular N fertilization on anthracnose of putting green turf. Furthermore, the influence of the seasonal effect of granular N fertilization on the optimum frequency of low-rate liquid N fertilization during the growing season needs to be determined. Such research would provide insight into the feasibility of using foliar (liquid) fertilization to reduce and possibly eliminate higher-rate granular N fertilization with respect to disease management.

Table 1
Anthracnose disease response to N fertilization of annual bluegrass turf mowed at 0.125 in. in North Brunswick, N.J., during 2003. Data are representative of disease response in 2004 and 2005.

	Turf Area Infested			
	18 June	30 June	25 July	22 August
	%			
Nitrogen (N) †				
28-d	14.2a‡	36.8a	49.9a	39.8a
7-d	5.7b	12.8b	31.4b	35.9a

† Nitrogen was applied as an NH_4NO_3 solution containing 0.1 lb. per 1,000 sq. ft. of N from 12 May to 22 September 2003.

‡ Numbers in columns followed by a different letter are statistically different based on an *F*-test at the 0.05 probability level.

CHEMICAL GROWTH REGULATION

Chemical plant growth regulation has become an integral component of putting green management on many golf courses (Dernoeden, 2002; Danneberger, 2003). We evaluated two plant growth regulators (PGRs) for possible effects on anthracnose severity. Mefluidide (Embark® 0.2L) is applied to suppress seedhead formation in annual bluegrass putting green turf, which improves uniformity and smoothness of the playing surface. Trinexapac-ethyl (Primo MAXX™ 1ME) can also improve the vigor and playability of putting greens by reducing vertical shoot growth and increasing stand density and uniformity (McCullough et al., 2005). The Embark levels studied were either none or a split application of Embark at 0.69 fl. oz. per 1,000 sq. ft. two weeks apart in April 2003, 2004, and 2005. The levels of Primo studied were either none or Primo applied at 0.125 fl. oz. per 1,000 sq. ft. every 14 days starting at the same time Embark was applied, except on plots treated with Embark when Primo treatments were initiated on the last date of Embark treatment.

Our findings indicate that chemical growth regulation generally improved turfgrass quality, but the greatest benefits (i.e., reduced seedheads, better turf quality and reduced anthracnose) occurred when Embark and Primo were used sequentially. Disease reduction from growth regulation was not as consistent and generally not as dramatic as that observed with 7-day soluble N fertilization. The effect of either growth regulator used alone was inconsistent, but neither product greatly aggravated disease symptoms. At later stages of disease outbreaks, the greatest reduction in anthracnose occurred on

Table 2

Anthracnose disease response to N fertilization, Embark (mefluidide), and Primo (trinexapac-ethyl) application on annual bluegrass turf mowed at 0.125 in. during later stages of disease progression in 2004 and 2005.

			Turf Area Infested	
			2004	2005
Nitrogen†	Embark‡	Primo§	30 August	30 July
Interval (d)	fl. oz. per 1,000 sq. ft.		------------- % -------------	
28	0	0	65.0	84.9
28	0	0.125	51.3	86.5
28	0.69	0	57.4	82.0
28	0.69	0.125	50.3	85.3
7	0	0	48.9	66.6
7	0	0.125	43.0	67.6
7	0.69	0	50.0	69.0
7	0.69	0.125	25.1	45.9
	LSD		*6.8*	*9.4*

† Nitrogen was applied as an NH_4NO_3 solution containing 0.1 lb. per 1,000 sq. ft. of N from 7 May to 9 October 2004 and 21 May to 3 August 2005.

‡ Embark 0.2L was applied as a split application of 0.69 fl. oz. per 1,000 sq. ft. on 7 and 21 April 2004 and 6 and 20 April 2005.

§ Primo MAXX 1ME was applied every 14-d from 7 April to 22 September 2004 and 6 April to 10 August 2005. Initial Primo application was delayed on turf previously treated with Embark until 21 April in 2004 and 20 April on 2005.

plots treated with Embark and sequential applications of Primo under the 7-day N fertilization schedule (Table 2).

The combination of these PGRs presumably improved physiological and morphological characteristics of the turf, thereby reducing susceptibility to anthracnose, a disease that is known to be more severe on stressed turf (Smiley et al., 2005). Embark reduces seedhead production of annual bluegrass, and several studies have reported that regulation with Embark reallocates photosynthate away from shoots and seedheads to root and crown tissues (Cooper et al., 1987; Cooper et al., 1988; Hanson and Branham, 1987). Stress tolerance of turf improves with increased rooting; thus the reallocation of photosynthate to roots and crowns probably improved the vigor of annual bluegrass turf. Additionally, Primo applications can improve physiological characteristics (Ervin and Koski, 2001b; Zhang and Schmidt, 2000; McCann and Huang, 2007) as well as reduce internode elongation of turfgrass (Ervin and Koski, 1998; Ervin and Koski, 2001a). A slower growing, more compact turf would increase the proportion of the leaf blade remaining after mowing. Since leaf blades have greater photosynthetic efficiency than sheaths (Thorne, 1959), stress associated with routine low mowing would be reduced with the use of Primo.

Because plant growth regulation has become so prevalent, a better understanding of the impact of these materials on anthracnose is needed before more comprehensive BMPs can be developed to combat this devastating disease. Our current research is evaluating chemical regulation strategies that reduce seedhead formation in the spring, suppress vegetative growth throughout the season, or combine both forms of suppression. Various application timings, rates, and frequencies of Primo, Embark, and ethephon (Proxy®) are being studied for their effects on anthracnose.

VERTICUTTING

Anthracnose is reputed to be enhanced by wounding of host plant tissue. Verticutting is commonly used to reduce irregular shoot growth, puffiness, excessive thatch, and non-uniform shoot density of putting green turf with the goal of improving turfgrass quality and increasing ball roll distance. An initial report indicated that verticutting to a 0.2 in. depth increased the severity of anthracnose on a mixed annual bluegrass-creeping bentgrass turf compared to a 0.12 in. depth or no verticutting (Uddin and Soika, 2003).

We have evaluated verticutting to a 0.12 in. depth with 0.04 in. wide blades spaced 0.5 in. apart every 14 days from May to August 2003, 2004, and 2005. Contrary to expectations, verticutting to a shallow depth (0.12 in.) did not have a substantial effect on anthracnose. Verticutting in our study only cut leaf blades and did not remove organic matter from the thatch layer. Thus, verticutting at depths great enough to cut crowns and stolons or remove thatch may enhance plant stress and increase anthracnose, whereas verticutting to groom the leaf canopy does not appear to affect disease.

SUMMARY

Management of annual bluegrass putting green turf with soluble N applied every 7 days at a low rate (0.1 lb. per 1,000 sq. ft.) from late spring through summer provided the most consistent reduction in anthracnose severity. The growth regulators Embark and Primo used in sequence to suppress seedheads and vegetative growth also reduced anthracnose severity but not as consistently as weekly low-rate N fertilization. At advanced stages of disease, the combination of 7-day N fertilization and Embark and Primo applications provided the greatest reduction in disease severity. Use of Embark or Primo alone had infrequent and inconsistent effects on anthracnose but should not greatly aggravate disease severity.

Rutgers graduate student John Inguagiato discusses his anthracnose management research at Field Day.

Shallow verticutting of the upper leaf canopy (grooming) every two weeks during the growing season had little effect on anthracnose severity.

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Disease activity typically starts first in high-stress areas such as the perimeter of greens that were recently expanded or within the mower cleanup pass.

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