Developing Best Management Practices for Anthracnose Control on Annual Bluegrass Putting Greens: Summarizing Four Years of Field Research

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Anthracnose is a destructive disease of weakened or senescent turf caused by the fungus *Colletotrichum cereale*. The disease occurs throughout the world on almost all turfgrass species but is particularly severe on annual bluegrass (*Poa annua* L.). It has been suggested that management practices commonly employed on golf courses may be enhancing abiotic stress and thus 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. The objective of this project is to determine the influence of management practices on the incidence and severity of anthracnose on annual bluegrass putting green turf. Our approach has been to develop comprehensive studies that assess commonly employed management practices in factorial arrangements. This provides an assessment of not only individual factors (main effects), but also the potential for management practices to interact. Two field studies have been completed and four projects were initiated in 2006. All studies were conducted on annual bluegrass turf maintained as putting greens at the Rutgers Turf Research Farm in North Brunswick, NJ. Ultimately, results from this work will be used to formulate a comprehensive set of best management practices for the control of anthracnose on golf courses.

Nitrogen Fertility, Plant Growth Regulators and Verticutting

Our initial study was established in 2003 to evaluate the impact of recent trends in putting green management including decreased nitrogen fertilization (i.e., <1.5 lb/1,000 ft^2/yr), increased use of plant growth regulators (PGRs) to suppress seedheads (i.e., mefluidide) and vegetative growth (i.e., trinexapac-ethyl), and routine verticutting on anthracnose. After three years of observation, it was evident that maintaining adequate nitrogen fertilization (~ 3.0 lb/1,000 ft^2/yr) is critical to reducing anthracnose severity on annual bluegrass putting greens. Weekly N applications of 0.1 lb/1,000 ft^2/yr during summer months reduced disease 25 – 73% compared to the same rate applied monthly. Mefluidide (ME) initially increased anthracnose incidence when symptoms first appeared in June 2003 and 2004; but had little effect later in the summer. Repeat applications of trinexapac-ethyl (TE) typically had either no effect or slightly reduced the severity of anthracnose during this study. The sequential use of ME and TE had the greatest impact on anthracnose in 2004 and 2005, reducing the disease more than 27% compared to ME and TE alone in 2004, and 43-54% compared to TE alone in 2005. Wounding associated with verticutting had little effect on anthracnose severity.

Mowing and Rolling Practices

Prior to our research, ultra-low mowing (<0.125 in), increased mowing frequency, and lightweight rolling were thought to increase anthracnose severity. We examined the effect of these practices on anthracnose and ball roll distance (an important measure of putting green quality) in 2004 and 2005. A 0.015-in increase in mowing height (0.110- to 0.125-in or 0.125- to 0.141-in) resulted in a meaningful reduction in anthracnose. Contrary to expectations, increased

mowing frequency did not increase anthracnose severity. However, changing mowing frequency from a single- to double-cut was as effective at increasing ball roll distance as lowering the mowing height from 0.141 to 0.110 inches. Lightweight vibratory rolling every other day slightly reduced anthracnose under moderate disease pressure. Double-cutting and lightweight rolling slightly increased soil bulk density and surface hardness, but the increases measured were ameliorated by aerification and freezing and thawing. Acceptable ball roll distance (9.5 to 10.5 feet) was obtained at a 0.125-to 0.141-in mowing height when combined with either double-cutting everyday and/or vibratory rolling every other day without increasing (and in many cases reducing) anthracnose severity.

Seedhead Suppression and Vegetative Growth Regulation Strategies

Further examination of seedhead suppression and vegetative growth regulation with PGRs began in 2005. This ongoing study is examining a range of TE rates (0.1 - 0.2 fl oz/1,000 ft^2), decreased TE application intervals (7- vs. 14-d), and combinations of TE with and without ME or ethephon (ET), both commonly used seedhead regulators. TE did not affect anthracnose in 2005, but reduced the disease 29 - 60% in 2006 compared to untreated turf. Anthracnose severity declined linearly with increasing rate of TE in 2006. More frequent applications of TE were more effective in reducing disease in July 2006 at both 0.125- and 0.2-fl oz/1,000ft^2. However, TE at higher rates and shorter intervals of application reduced turf quality from April to July 2006. The combination of ME and TE regulation programs decreased disease by as much as 71% and 42% relative to ME- or TE-alone, respectively, over both years. The average ET treatment effect reduced anthracnose 24 – 77% relative to untreated turf in both years of the study. And the combination of ET and TE regulation programs reduced disease in July of 2005 and 2006 more than either growth regulator used alone. The average ET treatment had less disease than turf treated with ME in 2006.

Topdressing Practices

Despite documented agronomic advantages of sand topdressing, the abrasive nature of this practice has raised concerns that it may contribute to anthracnose epidemics. A study was initiated in May 2006 to determine if rate and frequency of sand topdressing influenced disease development. Light topdressing (i.e., 1.0 ft^3/1,000 ft^2) initially enhanced anthracnose. However by early August, topdressing every 7- or 14-d at 1.0- or 2.0-ft^3/1,000 ft^2 reduced disease compared to non-topdressed plots. Infrequent sand topdressing every 21- or 42-d at a higher rate (4.0 ft^3/1,000 ft^2) also reduced disease by August. During recovery phase of the disease (late August), anthracnose damage decreased most rapidly in turf topdressed with sand regardless of rate or frequency. Contrary to the initial hypothesis, this first year of data indicated that sand topdressing had a cumulative beneficial effect and that light-frequent applications provided the most rapid and substantial reduction of anthracnose

A companion study was also initiated in 2006 to ascertain whether different methods of sand incorporation and sand particle shape (i.e., round *vs* sub-angular) affect the disease. The incorporation methods evaluated in this study (i.e., stiff-, soft-bristled brush, vibratory rolling or none) had no effect on anthracnose. Both sand types at first enhanced disease in July, but continued topdressing reduced disease severity in August and September compared to non-

topdressed turf. Results from this study corroborate the findings of the previous study; sand topdressing reduced anthracnose severity and brushing did not enhance disease.

Irrigation Management

Proper irrigation management is critical to maintaining plant health and the playability of putting green turf. Over-watering increases the potential for traffic stress such as mower scalp and may increase susceptibility to anthracnose, whereas maintaining putting greens at extremely low soil water availability can weaken and possibly predispose plants to this disease. In 2006, a study was established to determine whether irrigation regime (i.e., 100, 80, 60, and 40% evapotranspiration replacement) influences this disease. Anthracnose severity was greater in plots maintained with 40% or 60% evapotranspiration (ET) than turf receiving 80 or 100% ET replacement on 28 July. By 25-August, turf watered at 100% ET had as much anthracnose as turf receiving 40% ET replacement; moderate irrigation levels of 60 and 80% had the least disease on this date. These data illustrate that both over- and under- watering turf can increase anthracnose.

Lightweight Rollers and Equipment Traffic Stress

Traffic stress from maneuvering mowing and rolling equipment on the edge of putting greens has been suggested as a potential cause of enhanced anthracnose on putting greens. A study was initiated in 2006 to determine if routine mowing and rolling operations can affect anthracnose depending on the location of the equipment traffic on a putting green, that is, perimeter (edge) or center. Only three observation dates of disease incidence were obtained in 2006. Anthracnose was greater in plots treated as the center of a putting green on 18-August. However, disease was greater in perimeter plots than center plots on the last two rating dates. Both forms of rolling increased disease on 11-September compared to non-rolled turf. More data is required before any definitive conclusions can be drawn from this study.

Working Outline of Best Management Practices for Anthracnose Control

Our current findings indicate that nitrogen fertilization and mowing height are the most influential cultural practices affecting anthracnose severity in annual bluegrass putting green turf. Other practices that we have studied such as the application of plant growth regulators, irrigation, and topdressing can also affect this disease.

Nitrogen

- Nitrogen should be applied to maintain vigor of the putting green turf without overfertilizing. An annual nitrogen program of approximately 3.0 lb/1,000 ft^2/yr that includes frequent (two or more per month) low rate applications during summer months will reduce anthracnose incidence and severity.

Mowing and Rolling

- Mowing below 0.125-in should be avoided. If feasible, raise the cutting height as high as 0.141-in for greater suppression of anthracnose. Slight increases in mowing height (0.015 in) can significantly reduce the severity of this disease.

- Roll and/or increase mowing frequency to maintain ball roll distances at higher mowing heights. Rolling and double-cutting increase ball roll, but typically will not enhance the disease. However, management of the additional equipment traffic particularly at the perimeter of putting greens will need to be considered.

Plant Growth Regulators

- Routine trinexapac-ethyl use even at high rates and short intervals reduces anthracnose severity by improving turf tolerance to low mowing and enhancing plant health.
- Mefluidide and ethephon can be used to suppress seedhead formation in annual bluegrass turfs without increasing anthracnose.
- Mefluidide or ethephon applied in March or April at label rates with subsequent applications of trinexapac-ethyl throughout the growing season will provide the best turf quality and will reduce anthracnose.

Irrigation

- Limited data; not feasible at this time to describe a BMP.

Topdressing

- Preliminary data suggests that frequent, light sand topdressing reduces anthracnose although a slight stimulation of the disease may occur initially. Moreover, sand topdressing dramatically improves the recovery of annual bluegrass turf from anthracnose damage.