Best management practices for anthracnose on annual bluegrass

Using the correct cultural practices can lessen the severity of anthracnose disease on annual bluegrass.

Anthracnose (caused by *Colletotrichum cereale*) is a destructive fungal disease that can destroy weakened turf and is particularly severe on annual bluegrass (*Poa annua*). It occurs throughout the United States, Canada and Western Europe (19) as well as Australia and Japan (2). Outbreaks of anthracnose on golf course putting greens started to increase in frequency and intensity during the mid-1990s (4,5,10,11). Since then researchers have determined that the severity of anthracnose is influenced by many of the management practices used by superintendents.

Scientists within the NE-1025 multi-state turf research project have reported their initial findings of how annual bluegrass management practices affect anthracnose disease (16). That report addressed the effects of nitrogen fertility, chemical growth regulation, mowing, rolling, topdressing, verticutting and irrigation on anthracnose of annual bluegrass putting green turf. This report updates our conclusions on these practices since 2008. These results are being used to revise a comprehensive set of best management practices for the control of anthracnose disease on golf courses.

**Nitrogen fertility**

**Soluble nitrogen**

Management of nitrogen fertility is crucial to maintaining the health and vigor of the turf, which, in turn, affects playability ("speed" and smoothness of ball roll) on putting greens. Initial research clearly indicated that applying soluble nitrogen (0.1 pound/1,000 square feet [4.9 kilograms/hectare]) on a seven-day schedule from late spring through summer reduces anthracnose severity up to 24% compared to applying the same nitrogen rate every 28 days (5).

The exact reason(s) for reduced anthracnose severity in plants receiving greater nitrogen nutrition are not known, but improved plant vigor has been proposed (23). More recently, researchers have discovered that frequent soluble nitrogen fertilization reduces anthracnose severity as the nitrogen rate increases up to the equivalent Nitrogen fertility 

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Anthracnose on annual bluegrass (basal rot and black acervuli on lower stem, left, and severe thinning associated with the disease on a golf course putting green, right). Photos by J. Roberts
of 0.2 pound/1,000 square feet/week (9.8 kilograms/hectare/week) (15). In fact, short-term use of nitrogen at rates of 0.4-0.5 pound/1,000 square feet/week (19.5-24.4 kilograms/hectare/week) applied before disease symptoms become severe are very effective at reducing anthracnose severity. However, if these high rates are continued into the summer, disease severity increases dramatically (14,15).

A recent trial conducted to assess the effect of soluble nitrogen source on anthracnose severity of annual bluegrass putting green turf showed that potassium nitrate reduced disease severity, whereas weekly applications of ammonium sulfate increased anthracnose compared to urea, ammonium nitrate and calcium nitrate (15). Follow-up trials were initiated in 2011 to specifically assess the effect of potassium fertilization and soil pH on anthracnose. Further research is needed to confirm and clarify the first-year observations in these trials, but it appears that potassium deficiency may increase the severity of this disease. Greater soil acidity reduced the vigor of annual bluegrass, but it was not clear how much impact it had on anthracnose severity.

Granular nitrogen

Similar to previous results with soluble nitrogen, research on granular nitrogen (slow-release) has shown that applying higher rates of nitrogen in spring before anthracnose becomes severe reduces anthracnose severity. Interestingly, while slow-release granular nitrogen applied in the fall can reduce disease severity the next growing season, this tactic requires considerably more nitrogen (1.5 pounds or more per 1,000 square feet [≥73.2 kilograms/hectare]) than spring applications (13,14). Thus, superintendents with a history of anthracnose on their putting greens need to re-evaluate the common practice of late-season nitrogen fertilization because it is not an efficient or cost-effective tactic for managing anthracnose disease on annual bluegrass turf. Superintendents should strongly consider shifting more of their granular nitrogen from the fall to the spring if their program is currently weighted toward the fall.

Scientists have further observed that, despite the positive effects of spring fertilization with granular nitrogen, frequent soluble nitrogen applications are also needed through the summer to adequately suppress late-summer symptoms of anthracnose. Thus, best management practices for nitrogen fertilization include an emphasis on granular nitrogen fertilization from early to mid-spring (1-2 pounds/1,000 square feet [48.8-97.6 kilograms/hectare], possibly more under severe disease pressure), and frequent low-rate soluble nitrogen from late spring through summer (up to 0.2 pound/1,000 square feet every seven days).

Topdressing practices

Initial speculation frequently suggested that sand topdressing would contribute to anthracnose epidemics on putting greens. Although researchers have observed that sand topdressing may slightly increase disease when applications
Routine applications of sand topdressing at appropriate rates can significantly reduce anthracnose severity. Photo by R. Wang

Research has consistently confirmed that aggressive programs involving frequent, moderate-rate topdressing (100 or 200 pounds/1,000 square feet [4.9-9.8 metric tons/hectare]) every seven or 14 days) substantially reduce anthracnose during the growing season (9,12). Moreover, the beneficial effect of sand topdressing has been proved to hold true under conditions of intense foot traffic (that is, the equivalent of 200 rounds per day) with golf shoes fitted with soft spikes (12).

A study examining the method of sand incorporation (stiff- vs. soft-bristled brush, vibratory rolling or none) showed no effect on anthracnose. Moreover, sand particle shape (round vs. sub-angular) had little effect on disease severity, but, when a difference was observed, disease severity was lower in plots topdressed with sub-angular sand (unpublished data).

Summer sand topdressing has proved to be very successful at reducing anthracnose severity, yet superintendents have substantial challenges that limit the implementation of an aggressive topdressing program during mid-season. As a result, researchers have more recently examined the impact of spring and fall topdressing programs on anthracnose (15). Findings from this research indicate that fall and spring applications are also effective at reducing anthracnose severity, with spring being the most beneficial time of application. Therefore, it would be best for superintendents to implement an aggressive topdressing program (for example, 400-800 pounds/1,000 square feet [19.5-39 metric tons/hectare]) in spring, especially if it is not feasible to make frequent, moderate-rate topdressing applications during the summer. This research also indicates that superintendents should not forgo spring topdressing even if they implement an aggressive fall topdressing program. Although fall topdressing is beneficial, its positive effects on anthracnose do not last as long into the summer as those of spring topdressing, especially when summer topdressing is limited.

**Irrigation management**

Turf growing in saturated soil caused by poor surface drainage and slow internal drainage is more susceptible to anthracnose than turf that is not overwatered (20,22). In addition, research conducted in a growth chamber indicates that annual bluegrass plants subjected to drought stress before inoculation exhibit greater anthracnose disease (3). Field research has now confirmed that drought stress increases anthracnose severity on annual bluegrass (18). Specifically, irrigation regimes that subject turf to frequent wilt stress during warm, dry weather (that is, less than 60% ETo) will increase anthracnose disease. Moreover, overwatering turf (100% ETo) often results in increased anthracnose severity by the end of the summer. Superintendents should manage irrigation to minimize drought stress (that is, irrigating at 60%-80% ETo) while implementing practices that prevent saturated soil conditions to reduce anthracnose on putting greens.

**Verticutting**

Verticutting is used on putting greens to minimize puffiness (improve surface playability) and other problems associated with thatch accumulation. Although verticutting has been reputed to enhance anthracnose by wounding host plant tissue (4,10,19), research has not confirmed such speculation (5). Recent detailed studies examining the potential impact of mechanical injury (verticutting, coring and solid tining) on anthracnose while the disease was active indicate that wounding of leaves, crowns or stolons does not increase anthracnose severity on annual bluegrass putting greens (15). Thus, superintendents should not be overly concerned about cultivation (verticutting, coring and solid tining) programs contributing to anthracnose disease problems. In fact, a well-designed and properly implemented cultivation
program should benefit an anthracnose management plan by creating an environment that supports healthy turf growth.

**Mowing and rolling**

Research has shown that low cutting height has a greater effect on anthracnose severity on putting greens than any other part of a mowing and rolling program. Low cutting heights will increase anthracnose severity (1,19), whereas more frequent mowing (double cutting) has no effect on this disease (6). It was formerly speculated that double cutting would intensify anthracnose by wounding leaf tissue but, as discussed above, recent mechanical injury studies have not supported this theory. Similarly, lightweight rolling, used to smooth the turf canopy and improve ball roll, was thought to increase stress and susceptibility to anthracnose on putting greens, but research (either with a vibratory or sidewinder unit performed every other day) indicates this practice either has no effect or slightly reduces the severity of this disease (6,13,14,17).

A study assessing the impact of additional traffic caused by the change of direction from rolling equipment and clean-up mowing along the perimeter of putting greens showed no intensification of anthracnose (12,17). Thus, any incidence of greater anthracnose severity at the perimeter of putting green is likely due to other factors.

To improve anthracnose management, superintendents should favor a mowing and rolling program that avoids reducing the mowing height (for example, not less than 0.125 inch [3.2 millimeters]) and adopts the practices of either double cutting and/or rolling to improve playability (ball roll).

**Plant growth regulators**

Many superintendents use plant growth regulators (PGRs) to manage golf course turfgrass. Growth regulators commonly used to enhance annual bluegrass turf include Embark (mefluidide, PBI/Gordon) and Proxy (ethephon, Bayer), to regulate seedhead development, and Primo Maxx (trinexapac-ethyl, Syngenta) to improve shoot density and reduce shoot elongation. As stated in our previous *GCM* article, studies have not demonstrated any consistent effects of these PGRs on anthracnose disease (16).

Two recent studies examining the use of these PGRs alone or in combination indicate that, although they do not intensify anthracnose as was previously speculated, they can reduce disease severity in some cases (7,8). In fact, research suggests that PGR use may contribute to anthracnose suppression by enhancing nitrogen nutrition (8). However, more research on the interaction of PGRs and nitrogen nutrition is needed to gain better insight into this matter. Superintendents should continue to use PGRs to enhance turf quality and playability of annual bluegrass turf without concern that they might enhance anthracnose severity.

**Summary**

Best management practices for the control of anthracnose disease on annual bluegrass turf include adequate nitrogen fertilization in early spring followed by a frequent low-rate nitrogen fertility program initiated in late spring and continued through summer. Granular nitrogen rates of 1 to 2 pounds/1,000 square feet in early to mid-spring combined with frequent, soluble nitrogen applied at 0.1 to 0.2 pound/1,000 square feet/week in late spring and summer will be helpful in reducing anthracnose severity.

An aggressive topdressing program during the spring is particularly important if it is not feasible to implement a frequent program of moderate topdressing during the summer. Although fall topdressing can be important for other reasons, superintendents need to realize that its positive effects on anthracnose will not last as long into
BMPs for anthracnose on annual bluegrass greens

**Nitrogen**
- Apply nitrogen to maintain vigor of the putting green turf without overfertilizing.
- Apply granular nitrogen fertilization at rates of 1-2 pounds/1,000 square feet (48.8-97.6 kilograms/hectare) in spring (rather than fall) to reduce disease severity. Nitrogen rates up to 3.0 pounds/1,000 square feet (146.5 kilograms/hectare) in spring effectively suppress anthracnose but are recommended only if the historical disease pressure has been severe. At higher rates, include slow-release nitrogen as part of the fertilizer to extend the response and avoid a surge in growth.
- Begin summer nitrogen programs earlier in the year to allow nitrogen buildup in the turf, which will decrease anthracnose severity. In summer, apply a cumulative soluble nitrogen rate of 1.5-3.0 pounds nitrogen/1,000 square feet (73.2-146.5 kilograms/hectare) to reduce anthracnose severity. A program using a higher rate over summer will likely need less nitrogen in the spring; a higher spring rate is recommended if anthracnose is historically a problem in mid- to late spring.

**Topdressing**
- Sand topdressing applied every 7 days at 100 pounds/1,000 square feet or every 14 days at 200 pounds/1,000 square feet (4.9 or 9.8 metric tons/hectare) provides a protective layer of sand around the crown, slightly raising the effective height of cut and thus reducing anthracnose.
- Anthracnose is not affected by sand incorporation techniques; select methods that best incorporate sand yet minimize turf injury and wear on mowing equipment.
- Foot traffic on turf topdressed with sand reduces disease severity. Areas that receive daily foot traffic and sand topdressing will have better wear tolerance and decreased disease.
- Implement an aggressive topdressing program (for example, 400-800 pounds/1,000 square feet [19.5-39 metric tons/hectare]) in spring; apply rates at the higher end of this range if summer topdressing is not feasible. Spring topdressing is more effective at reducing anthracnose severity than fall topdressing.

**Irrigation**
- Increased anthracnose can result when annual bluegrass is consistently subjected to wilt stress or excessively wet conditions.
- Irrigating to replace 60%-80% of reference evapotranspiration and hand watering as needed to avoid wilt stress will provide high-quality playing conditions and reduce conditions favorable for anthracnose.

**Mowing and rolling**
- Mowing below 0.125 inch (3.2 millimeters) should be avoided whenever possible. If feasible, raise the cutting height as high as 0.141 inch (3.6 millimeters) for greater suppression of anthracnose. Slight increases in mowing height can significantly reduce disease severity.
- To maintain acceptable ball roll distances (~10 feet [3 meters]) at higher mowing heights, roll and/or increase mowing frequency. Rolling, regardless of roller type, and double cutting increase ball roll but will not enhance the disease.
- Rolling every other day may slightly reduce anthracnose severity.

**Plant growth regulators**
- Routine Primo Maxx (trinexapac-ethyl) use even at high rates and short intervals does not increase anthracnose severity. Benefits of improved turf tolerance to low mowing and enhanced plant health may help reduce disease in some cases.
- Embark (mefluidide) and Proxy (ethephon) can be used to suppress seedhead formation in annual bluegrass without increasing anthracnose.
- Embark or Proxy applied in March or April at label rates with subsequent applications of Primo Maxx at 0.125 fluid ounce/1,000 square feet (0.40 liter/hectare) every seven to 14 days, or 0.1 fluid ounce/1,000 square feet (0.32 liter/hectare) every seven days will provide the best turf quality and may reduce anthracnose.

Table 1. Best management practices for anthracnose disease on annual bluegrass putting green turf.

<table>
<thead>
<tr>
<th>Practice</th>
<th>Details</th>
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<tbody>
<tr>
<td>Nitrogen Application</td>
<td>In spring and summer, apply at rates of 1.5-3.0 pounds nitrogen/1,000 square feet (73.2-146.5 kilograms/hectare) to reduce anthracnose severity. A higher rate over summer may be needed.</td>
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<td>Irrigation</td>
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<td>Mowing</td>
<td>Mow below 0.125 inch (3.2 millimeters) whenever possible, and raise cutting height to 0.141 inch (3.6 millimeters) for greater suppression.</td>
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<td>Rolling</td>
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<tr>
<td>Plant Growth Regulators</td>
<td>Use Embark or Proxy, and Primo Maxx for improved turf tolerance and plant health.</td>
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The research says

- Provide adequate nitrogen fertilization in early spring, initiate frequent low-rate nitrogen fertility in mid- to late spring and continue through summer.
- If frequent moderate topdressing is not feasible in summer, aggressive topdressing in spring is essential.
- Fall topdressing will not replace spring topdressing for anthracnose control.
- Deficit irrigation must avoid subjecting the turf to frequent episodes of wilt stress.
- Use double cutting and/or rolling to improve playability, avoid reducing the mowing height to improve anthracnose management.
- Chemical growth regulation with Embark, Proxy and Primo Maxx should not intensify disease severity and may reduce it.

References


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