Vertical mowing and mowing height affect anthracnose basal rot

Minimizing plant injury significantly reduces disease severity.

Environmental Institute for Golf

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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 has been recently reassigned to *Colletotrichum cereale* (formerly *C. graminicola*) (2). Anthracnose in turfgrass had been previously classified as a *senectopathic* problem, meaning that the pathogen infects aging tissue that is already near death (1). However, incidence and severity of the disease in golf course putting greens have dramatically increased in recent years (3,4,6,7). The reason for the increased problem in greens is unclear. It is likely that certain cultural practices and changes in pathogen population may have, at least in part, contributed to the problem.

Two phases of the disease are commonly recognized — foliar blight and basal rot (9). The foliar blight phase develops during warm periods in summer, and the basal rot phase may occur at any time of the year. In close-cut annual bluegrass, the foliar phase of the disease begins with development of small spots on foliage that result in discoloration of leaves to yellow or orange in winter or spring. Subsequent infection of the basal stem and crown tissue by the fungus causes the plants to die. Infected plants 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 anthracnose basal rot development.

Turfgrass cultural practices that cause mechanical injury to plant tissue, particularly crown, stolon and stem tissue, provide efficient pathways for

Development of basal rot anthracnose in mixed-annual bluegrass and creeping bentgrass putting greens in the summer (**left**) and winter (**right**). **Photos by W. Uddin**

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infection by the anthracnose pathogen. Vertical mowing is common on greens to reduce grain, puffiness, excessive thatch and nonuniform shoot density of the turf and thereby produce faster green speeds (10). Vertical mowing can injure crowns, roots and stems, depending on the intensity of the operation.

Maintaining a proper mowing height also is important in putting green management. Superintendents usually maintain a relatively low mowing height to achieve ideal green speed (8). However, low mowing heights also may contribute to significant plant injury that is likely to provide a greater number of infection pathways for the pathogen. Injury can be much more severe if the green is scalped. Therefore, vertical mowing and low mowing height are potentially serious factors affecting basal rot anthracnose development.

This study was undertaken to determine the effects of vertical mowing and mowing height on the severity of anthracnose basal rot in a mixed stand of creeping bentgrass and annual bluegrass.

Deterioration of annual bluegrass plants caused by severe infection of crown, roots and stem tissue by *Colletotrichum cereale*.

Materials and methods

Field plot maintenance

Before the experiment, the experimental turf site was maintained as a putting green, mowed six times per week with a triplex greens mower at a mowing height of 0.125 inch (3.2 millimeters). Clippings were collected from all mowing activities. Dimension 1EC (dithiopyr, Dow AgroSciences) was applied in early May for pre-emergence control of crabgrass (*Digitaria* species). Trimec Bentgrass Formula (19.84% dimethylamine salt of propionic acid, 6.12% dimethylamine salt of 2, 4-dichlorophenoxyacetic acid, 2.53% dimethylamine salt of dicamba; PBI/Gordon) was applied in late May for control of broadleaf weeds. Nitrogen fertility was kept to a minimum to reduce top growth and maintain faster green speeds.

Field treatments

Two cultural practices common on putting greens, mowing and vertical mowing, were evaluated for their impact on the development of anthracnose basal rot disease on putting greens in 2002 and 2003. The experimental design was a factorial with a strip-plot design with four replications of treatments.

A Toro GM-3 unit was used for vertical mowing. The cutting component, a carbide-tip blade, was set at three depths: deep (0.20 inch [5.1 millimeters]), shallow (0.13 inch [3.3 millimeters]) and none (control). Vertical mowing was conducted once per week for four weeks. The mowing heights were high (0.17 inch or 4.3 millimeters), medium (0.12 inch [3.0 millimeters]) and low (0.08 inch [2.0 millimeters]) under low-nitrogen fertilization (a single 0.25-pound [0.113 kilogram] application in May). Light irrigation was applied to maintain low soil moisture.

Inoculation of turf and disease assessment

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 at Pennsylvania State University in 2003. A spore suspension of *C. cereale* (10^4 conidia/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 during the night for three consecutive nights; the cover was removed each morning.

Severity of anthracnose basal rot (measured using an index of 0-10, where 0 is asymptomatic turf and 10 is more than 90% symptomatic turf) was assessed twice. Symptomatic plants were randomly collected from the plots and evaluated for presence of acervuli, conidia and setae on the affected tissues. Disease severity data were analyzed, and the effects of vertical mowing and mowing height were determined.

Results and discussion

An assessment of basal rot anthracnose three

Effects of vertical mowing

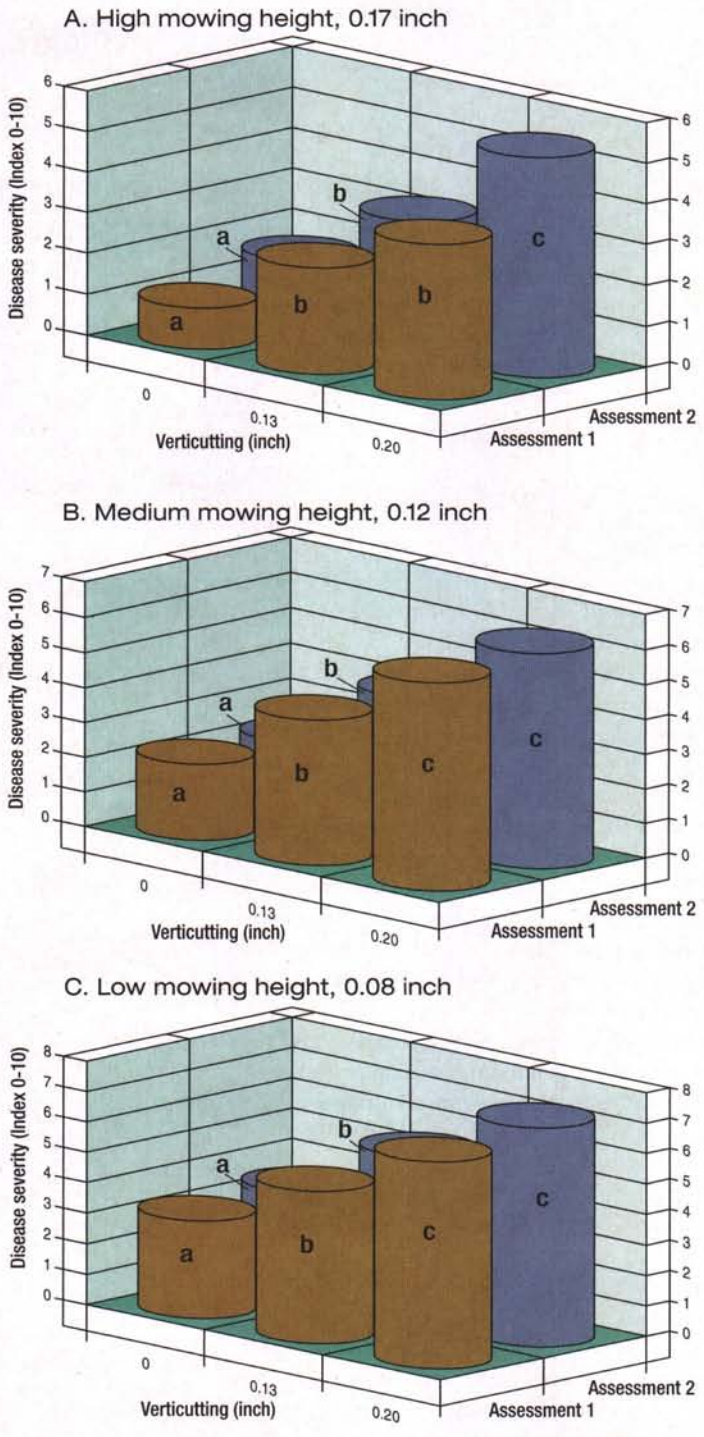

Figure 1. Effects of three vertical mowing depths (0 [none], 0.13 inch [shallow], 0.20 inch [deep]) on basal rot anthracnose severity in annual bluegrass maintained under high (0.17 inch) (A), medium (0.12 inch) (B) and low (0.08 inch) (C) mowing heights. In each figure, cyclinders that are the same color but have different letters are significantly different from one another.

weeks after inoculation indicated that mowing height and vertical mowing both influenced the development of basal rot anthracnose in annual bluegrass.

First assessment of disease severity

In the first disease assessment, the effects of mowing height and vertical mowing on disease severity were significant; however, there was no interaction between mowing height and vertical mowing.

When the turf was mowed at the highest cutting height (0.17 inch [4.3 millimeters]), basal rot anthracnose was least severe (Index 1) in plots that were not vertically mowed (Figure 1A). This rating was significantly lower than disease severity in plots that were vertically mowed at 0.13 inch (3.3 millimeters) or at 0.20 inch (5.1 millimeters). Disease severity in plots that were not vertically mowed was 74% less than disease severity in plots that were vertically mowed at the greatest depth (0.20 inch [5.1 millimeters]). There was no significant difference in disease severity in plots that were vertically mowed at 0.13 inch (3.3 millimeters) and 0.20 inch (5.1 millimeters).

A similar effect of vertical mowing on disease severity was observed when the mowing height was reduced to the medium (0.12 inch [3.0 millimeters]) (Figure 1B) or low (0.08 inch or 2.0 millimeters) height of cut (Figure 1C). However, disease was more severe under the lowest mowing height at all vertical mowing depths (deep, shallow and none) (Figure 1C).

Second disease severity assessment

Effects of vertical mowing and mowing height on disease severity in the second disease assessment showed a pattern similar to that in the first assessment. Overall, basal rot anthracnose severity increased slightly over the two-week period. In the second assessment, there were significant differences in disease severity among the three vertical mowing depths at all three mowing heights.

Colletotrichum *population*

The experimental turf area in this study originally contained a local population of moderately virulent *Colletotrichum cereale* isolates. Inoculation of turf with *C. cereale* originally isolated from this site provided fairly uniform distribution of basal rot anthracnose in the annual bluegrass population. Inoculating plants soon after applying the treatments appeared to have accelerated the infection process as indicated by relatively high basal rot anthracnose disease severity in the experimental turf area compared to adjacent areas.

It has been established in the literature that *C. cereale* is a stress pathogen that effectively infects the host plants through mechanical injury (6,9). Although it has become apparent in recent years that the fungus also can effectively infect plants that are growing under conditions that are not stressful, the injury factor appears to remain critical during the infection process. This was shown by increased disease severity in plots that were vertically mowed and also mowed at reduced mowing heights.

Depth of vertical mowing also appeared to play an important role in basal rot anthracnose development. A Rutgers University study (5) on the effects of nitrogen fertility, growth regulators and vertical mowing on the basal rot anthracnose pathosystem found no substantial effect of vertical mowing on basal rot anthracnose severity, possibly because of the shallow depth of the vertical mowing in the study. However, our study indicates that deep vertical mowing may have caused relatively greater injury to crown, stem and root tissue and therefore caused more severe disease. An extremely low mowing height also removes a considerable amount of photosynthates, provides greater exposure of crown tissue to the pathogen and contributes to summer stress, all of which are conducive to infection and disease development (4,9,10). Effects of close mowing in this study clearly demonstrated such effects on basal rot anthracnose severity in annual bluegrass.

Conclusion

In this study, we have shown that decreased mowing height and increased depth of vertical mowing increased the development of basal rot anthracnose in annual bluegrass in a mixed-annual bluegrass and creeping bentgrass green. Mowing and verticutting caused significant mechanical injury and thus increased disease severity. A turfgrass management strategy focusing on proper timing of cultural practices that minimize plant injury is desirable.

The most practical approach may be to exercise caution in both mowing and verticutting. Vertical mowing may be performed at reduced depths while disease is least active, and the desired mowing height may be formulated by making a compromise between disease management and appropriate green speed. Employing cultural practices that minimize mechanical injury and reduce disease severity will be instrumental in developing an integrated basal rot anthracnose management strategy.

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The research says

→ Low mowing heights and increased depth of vertical mowing increased basal rot anthracnose development in annual bluegrass in a mixed annual bluegrass and creeping bentgrass green.

→ Mowing and verticutting caused significant mechanical injury and thus increased disease severity.

→ Increasing turfgrass mowing height and reducing vertical mowing depths may reduce severity of basal rot anthracnose.