TURFGRASS TRENDS

NEW BACTERIAL DISEASE

A New Bacterial Disease Problem on Creeping Bentgrass Putting Greens

By Paul Giordano and Joe Vargas, Ph.D.

Summer stress and extreme weather conditions have made managing creeping bentgrass (*Agrostis stolonifera*) in many regions of the country quite challenging. Along with the myriad fungal pathogens golf course superintendents must deal with daily, a pathogenic bacterium has recently been isolated from symptomatic creeping bentgrass putting greens around the country. This newly described turfgrass pathogen has been found to be associated with the accelerated growth (etiolation), yellowing and eventual thinning/necrosis of creeping bentgrass on putting greens during summer heat stress.

The bacterium, identified as *Acidovorax avenae* subsp. *avenae* (*Aaa*), was initially isolated from a creeping bentgrass putting green on a championship golf course in the transition zone. Numerous greens exhibited recurring symptoms of etiolation and bentgrass decline/thinning over a number of years. The unique symptoms were similar to those exhibited by annual bluegrass (*Poa annua* L.) infected by the bacterial pathogen *Xanthomonas translucens pv poae*, but they were more localized in irregularly shaped areas (Figure 1). Researchers were initially baffled by the "mystery syndrome" that seemed to be plaguing various cultivars of creeping bentgrass in putting greens in similar climatic regions. The distinct symptoms and lack of fungal pathogens prompted researchers to investigate other potential causes. Cut ends of etiolating leaves and stems were found to exhibit heavy bacterial streaming; a diagnostic sign of plant bacterial infection (Figure 2). Consistent observation of heavy bacterial streaming from symptomatic tissues led to the isolation of the bacterium for further analysis. The infection potential of the bacterium was tested by inoculating healthy creeping bentgrass. When inoculated plants were incubated at temperatures similar to those in the region where the bacterial disease was first observed (90° F, 75 percent relative humidity), the bacterium was capable of causing severe leaf necrosis and thinning (Figure 3).

After confirmation of pathogenicity (ability to cause disease), molecular analy-

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Editor's note: While much remains to be learned about the new bacterial disease discussed in this article, we felt it was important that superintendents have the most current information and thinking on the disease to guide their decision making. We look forward to publishing additional information on the bacterial disease as it becomes available.

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FIGURE 1

***Yellow, etiolated, irregular-shaped areas on a Penn G-2 creeping bentgrass putting green affected with* A. avenae *subsp.* avenae (Aaa).**

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sis identified the bacterium as *Acidovorax avenae* subsp. *avenae*. This particular genera of bacteria contains known plant pathogens that cause a variety of diseases on plants such as corn, sorghum, rice, sugarcane, watermelon and orchids. Throughout the summers of 2010 and 2011, there were many reported cases of the disease around the United States, particularly in the eastern U.S. and in the transition zone. Many of the diagnoses have been met with skepticism due to the lack of a robust diagnostic technique and obsolete methodology.

Bacterial streaming from tissues is a useful diagnostic tool, but in order to confirm that the pathogenic bacterium *Aaa* is indeed present, isolation and identification must be performed. These procedures currently take time and resources that many diagnostic labs do not have. In addition, superintendent impatience has frequently led to unwarranted panic and ineffective treatment action. For these reasons, researchers are currently attempting to develop accurate and reliable molecular tests that would substantially speed up the diagnostic process. Currently, molecular identification of the bacterium by Michigan State University researchers has confirmed *Aaa* on 12 sites around the United States while other university collaborators have identified the bacterium on numerous additional sites as well.

Preliminary growth chamber and field research has produced some interesting results. However, field inoculations with the bacterium at the MSU Hancock Turfgrass Research Center in 2011 did not produce disease symptoms. One of the major factors contributing to the lack of disease is the cool mid-Michigan summer temperatures, particularly at night. The pathogen has been found to be most aggressive and virulent in growth chamber studies at sustained high temperatures (90°F during the day, 78°F at night.) Additionally, poor air movement and environmental stresses have been a commonality among many of the courses that have confirmed *Aaa* infection.

On-site golf course field research has

been undertaken by university collaborators with variable results. Many of the treatments thought to inhibit the disease or its symptoms are anecdotal, originating with superintendents who have battled the disease season after season. Fungicide combinations, growth regulators, bactericidal antibiotics, biofungicides, and fertilizers have all been proposed as potential treatments for this problem. Lab testing of products against the bacterium *Aaa* has identified some candidates that are capable of directly inhibiting the growth of the pathogen. The antibiotic oxytetracycline, when applied prior to inoculation to plants at 200 parts per million, did suppress symptom development (compared to the untreated control) on plants inoculated with *Aaa* and incubated for 14 days in the growth chamber (Figure 4.)

While this result is promising, oxytetracycline is not currently labeled for this use on turfgrass. We also do not know if there will be injury to the turf from applications made in the field during hot weather periods. Further field research must confirm the efficacy of oxytetracycline and other products before recommendations can be made to golf course personnel dealing with this problem. Growth chamber research is only the first step in evaluating products that have the potential to control a natural disease outbreak on the golf course. There are currently no proven chemical control options for this disease in the field.

While *Aaa* was initially isolated from Penn G-2 creeping bentgrass, growth chamber inoculations, as well as isolations from golf course samples, have shown a variety of *Agrostis stolonifera* cultivars to be susceptible to *Aaa* infection. These cultivars include, but are not limited to: Penn A-4, Penn A-1, L-93, Tyee, Declaration, Bengal, 007, and Penncross. Our initial research has indicated some minor variations in susceptibility in growth chamber inoculations; however, all cultivars tested thus far have been susceptible to infection by *Aaa*, to some extent. It is likely that the bacterium is ubiquitous in many turfgrass environments, and only

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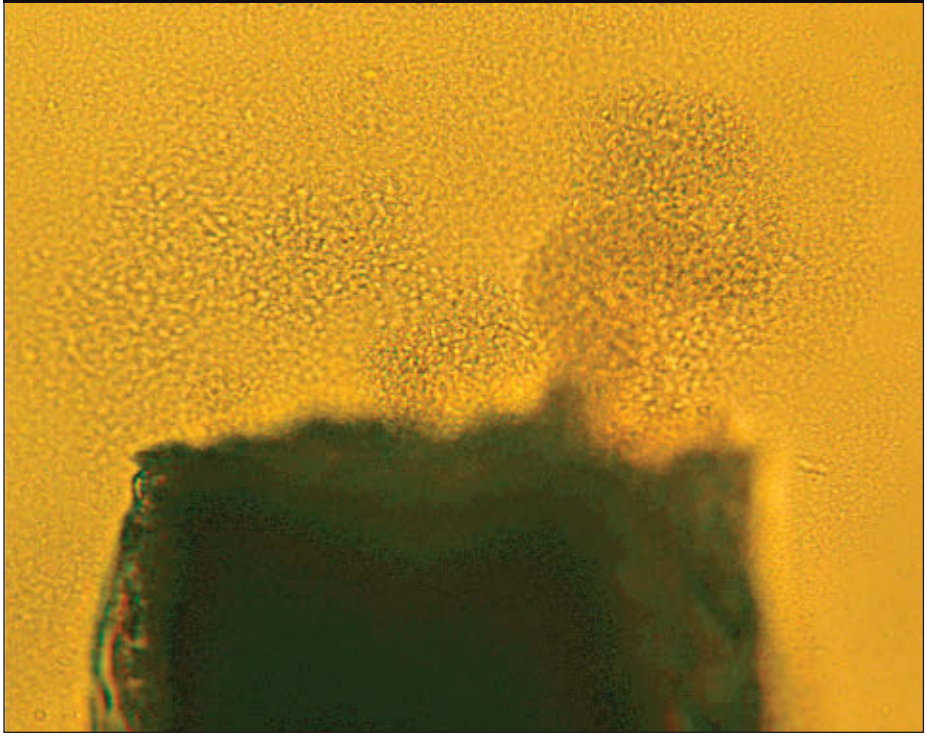
FIGURE 2

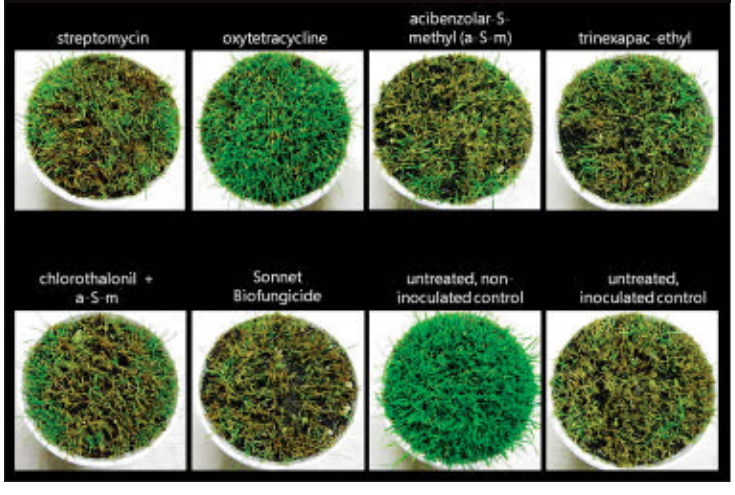


Cells of the bacterium* Aaa *streaming out of the cut end of an infected creeping bentgrass plant.

FIGURE 3

Inoculated (left) vs. non-inoculated (right) Penn A-4 creeping bentgrass cups incubated for 7 days at 32 C, after being cut with scissors dipped in a suspension of **Aaa.**

FIGURE 4



Creeping bentgrass pots pre-treated with various chemicals and challenged with **Aaa.** ***Note the suppression of symptoms with the antibiotic oxytetracycline, resembling the non-inoculated control.***

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becomes a problematic plant invader under certain environmental conditions. Researchers are working to identify molecular techniques that will enable quantification of *Aaa* in environmental samples, so that infected areas can be compared with uninfected areas in order to get a relative indication of bacterial population levels among sites, cultivars, treatments, etc. This type of technique should be useful in developing disease thresholds, making risk assessments, comparing cultivar susceptibility, and determining treatment efficacy.

Most bacterial diseases require a predisposition of the plant in order for infection to take place. Highly maintained turfgrasses such as the newer varieties of creeping bentgrass provide the perfect conditions for would-be bacterial pathogens in the surrounding environment. Unlike fungi, bacteria enter the plant passively, such as through cut ends of leaves from mowing, wounds made during sand top dressing, or natural openings. Frequent mowing, aggressive cultivation, traffic and increasingly stressful management practices (i.e., low mowing heights), likely all serve to increase the severity of the disease. In extended periods of high heat and humidity, creeping bentgrass putting greens already under stress from these demanding maintenance practices seem to be more vulnerable to this bacterial invasion.

At this time, it is not thought that the bacterium can be effectively transported from course-to-course via shoes or machinery. Therefore, no recommendations are being made with regard to quarantines. Some current recommendations for golf course superintendents battling this problem are:

1. Alleviate stress during summer months.
2. Increase air movement.
3. Raise mowing height during stressful periods.
4. Avoid aggressive cultivation practices such as aerification and topdressing during peak outbreak times.
5. Avoid morning mowing, if possible, in order to reduce the further spread of bacteria in morning dew and guttation water.

Our knowledge regarding this pathogen and the associated disease symptoms is still limited, and much research is required to better understand this controversial problem. This will require effective collaboration among university researchers, industry associations and golf course superintendents in order to find the best management practices to solve the problem. Until further research is conducted into disease management in the field, it is difficult to make recommendations regarding product usage and symptom suppression. Stay in contact with your local university for current research findings and management information on this emerging disease.

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