

# Investigations into the Cause and Management of Etiolation on Creeping Bentgrass Putting Greens



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## Objectives:

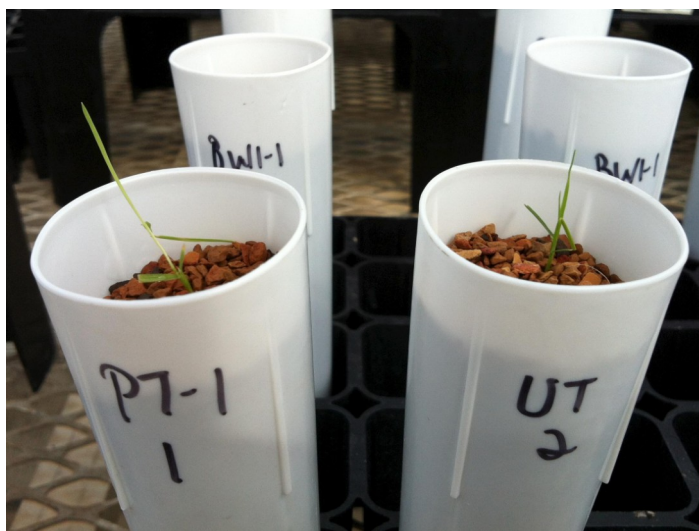
1. Isolate and identify bacteria and other microorganisms associated with etiolated creeping bentgrass.
2. Determine if bacteria associated with etiolated bentgrass produce gibberellic acid or modulate its production by turf plants.
3. Investigate the influence of biostimulant and growth regulator programs on bentgrass etiolation.

Yellowing and elongation of grass tillers, called etiolation, has been a widespread problem for many years on multiple turfgrass species increasing within the past decade. Many causes have been implicated including fungi, bacteria, viruses, phytoplasmas, or nutrient deficiencies. In most cases, symptoms are transient, often associated with the prevailing weather conditions. In other locations, it has progressed to a chronic problem leading to gradual turf thinning and death during stressful summer periods.

In 2009, Giordano et al. (2010) isolated the bacteria *Acidovorax avenae* from etiolated 'G-2' creeping bentgrass in Charlotte, NC causing a surge of interest and speculation citing bacteria as a potential cause. However, isolation of bacteria from etiolated bentgrass did not always identify *A. avenae*. Additionally, research has associated other bacteria with etiolated bentgrass. Research is needed to confirm if *A. avenae* and/or other bacteria are the primary cause of this problem or merely secondary invaders that colonize declining turf during stressful conditions.

Due to the critical nature of bentgrass etiolation, we initiated a comprehensive research program to determine the cause and develop programs for its management. Laboratory and greenhouse experiments have aided in the identification of additional bacteria capable of infecting creeping bentgrass. Since 2011, 156 isolates have been isolated from turf exhibiting symptoms of etiolation, chlorosis, or general decline. Preliminary identification, using the 16S and ITS

Figure 1. Etiolation is the elongation and yellowing of turfgrass leaves and shoots. The bentgrass shoot on the left is showing signs of etiolation. Many causes have been implicated and research is needed to determine the cause of these symptoms.



rDNA sequences, has successfully identified bacteria representing 16 genera including several species of *Pseudomonas*, *Pantoea*, *Microbacterium*, *Bacillus*, and *Acidovorax*. Inoculations have shown additional bacteria to cause etiolation and/or decline of creeping bentgrass. Further research to examine other potential bacteria is ongoing. Additionally, research is needed to determine whether bacteria are causing etiolation by producing plant hormone

analogues or modulating plant host production. Individual bacteria capable of causing etiolation will be evaluated in culture and in planta to determine possible production of gibberellins, a plant hormone that induces stem elongation.

**Figure 2. An *Acidovorax avenae* inoculated bentgrass plot encouraged uniform etiolation. Out of all of the biostimulants tested, Astron typically had the most etiolation.**



A field study was initiated in 2011 to determine the influence of biostimulants and plant growth regulators. The trial was arranged in a factorial design with 5 biostimulant treatments (Knife Plus, CytoGro, Astron, Nitrozyme, and Untreated) applied alone and in combination with weekly or biweekly applications of trinexapac-ethyl (0.125 fl oz 1000 ft<sup>-2</sup>). Biostimulants showed no effect on etiolation during the fall of 2011 when etiolation developed naturally. Trinexapac-ethyl reduced etiolation regardless of application frequency, however, biweekly applications tended to break down by the end of the 2-week period.

During summer 2012, the entire plot area was inoculated with *A. avenae* to encourage uniform etiolation. Out of all biostimulants tested, plots treated with Astron typically had the most etiolation. Additionally, trinexapac-ethyl enhanced etiolation when compared to the untreated check, regardless of biostimulant treatment and weekly applications were often more etiolated than biweekly. Etiolation symptoms have not been observed during the fall of 2012.

#### Summary Points

- Multiple species of bacteria have been associated with etiolation and or general decline of creeping bentgrass putting green turf.
- Research is needed to determine whether bacteria cause etiolation through direct production of plant hormone analogues or by modulating plant host synthesis.
- Biostimulants showed no effect on etiolation in fall 2011, but Astron enhanced etiolation on multiple dates during summer 2012.
- Trinexapac-ethyl can increase and decrease etiolation depending on weather conditions, turfgrass physiological state, or other unknown factors. Further research is needed to determine how trinexapac-ethyl can be used to maintain acceptable turf quality while reducing etiolation.