





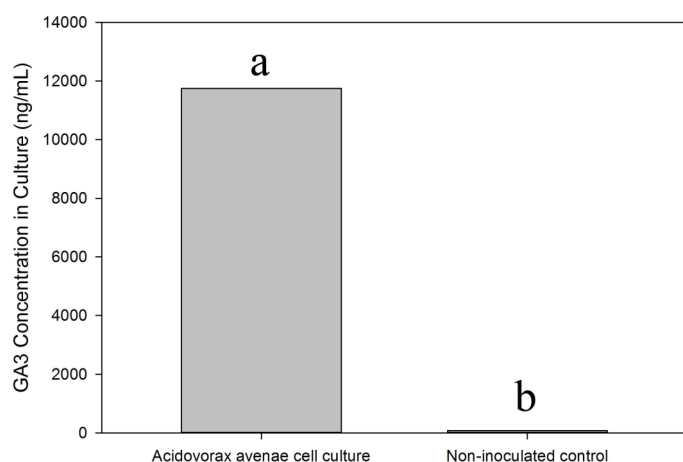
Field observations of bacterial etiolation have suggested that biostimulant and plant growth regulator applications could exacerbate symptom development. While our research showed biostimulants to have little effect, frequent applications of trinexapac-ethyl (PrimoMaxx at 0.125 fl oz. 1000 ft-2 every 7 d) increased etiolation caused by *A. avenae*. In 2013, an additional field study was initiated to evaluate the impact of plant growth regulators (trinexapac-ethyl, flurprimidol, and paclobutrazol) on bacterial etiolation caused by *A. avenae*. Results from the 2-yr trial were similar to previous trials in that trinexapac-ethyl increased symptoms compared to the non-treated control; however, multiple rates of flurprimidol (Cutless EC at 0.069 oz. or 0.138 oz. 1000 ft-2 every 14 d) and paclobutrazol (Trimmit SC at 0.092 fl oz. or 0.184 fl oz. 1000 ft-2 every 14 d) decreased etiolation symptoms compared to trinexapac-ethyl (0.125 fl oz. 1000 ft-2 every 7 d) applications (Figure 3). Trinexapac-ethyl applications still resulted in the highest turf quality, as bacterial decline did not occur as a result of *A. avenae* inoculations. High rates of flurprimidol and paclobutrazol did cause phytotoxicity during periods of low nighttime temperatures, but turf eventually recovered. Based on this research, altering plant growth regulator programs with either chemistry can maintain competitive playing



**Figure 5. Close-up of bacterial etiolation caused by *Acidovorax avenae*.**

conditions while limiting potential increases in bacterial etiolation.

The nature of bacterial etiolation symptoms and the response observed with varying plant growth regulator applications has suggested the involvement of phytohormones (i.e., increased gibberellins that result in elongated plants). Recent research to evaluate bacteria with an enzyme linked immunosorbent assay (ELISA) has shown production of gibberellic acid (GA3) by *A. avenae* in the laboratory (Figure 4). Future research utilizing chemical analysis through chromatography methods will improve our knowledge of phytohormone production by all bacteria capable of causing etiolation symptoms.



**Figure 4. RR<sub>50</sub>-values (LD<sub>50</sub> resistant/ LD<sub>50</sub> susceptible) obtained in the different types of bioassays: Petri dishes assay (PDA), greenhouse assay (GHA) and topical assay (TA).**

**Summary Points:**

- Diverse bacteria have been isolated from creeping bentgrass putting green samples exhibiting symptoms of bacterial etiolation and/or decline
- While previous research has shown *Acidovorax avenae* and *Xanthomonas translucens* to cause bacterial etiolation, additional screening has shown that some *Pantoea* sp. can cause chlorosis and tip dieback.
- If etiolation is problematic, reducing the frequency of trinexapac-ethyl applications or altering plant growth regulator programs with flurprimidol or paclobutrazol can maintain competitive playing conditions while limiting etiolation.
- *Acidovorax avenae* has been shown to produce gibberellic acid in culture, which is a possible cause of etiolation symptoms. Further research is necessary to evaluate phytohormone production in bacteria capable of inducing bacterial etiolation symptoms.