Rhizobacteria Inoculation and Colonization for Promoting Plant Growth in Cool Season Turfgrass

William Errickson, Bingru Huang, and Ning Zhang
Department of Plant Biology and Pathology, Rutgers University, New Brunswick, NJ 08901

RUTGERS
School of Environmental and Biological Sciences

SARE Sustainable Agriculture Research & Education

Leave Empty

This space will be automatically filled with a QR code and number for easy sharing

Introduction

Cool season grasses, such as creeping bentgrass (*Agrostis stolonifera*) experience drought induced reductions in growth and turf quality during the summer months. Drought stress causes an increase in the phytohormone, ethylene, which induces leaf senescence and thinning of the turf canopy. Plant growth promoting rhizobacteria (PGPR) that possess the ACC deaminase enzyme (ACCd) can form associations with the roots of plants and reduce the levels of ethylene that are produced by the plant, thus improving abiotic stress tolerance. These PGPR may provide a sustainable, biological option to mitigate drought stress in creeping bentgrass and to facilitate rapid recovery upon re-watering. However, challenges exist when attempting to inoculate plants in the field, where native soil organisms and weather fluctuations can interfere with successful root colonization by PGPR.

Objectives

1. To determine whether inoculation of roots with ACCd bacteria can improve drought tolerance and post-drought recovery for creeping bentgrass in field conditions.
2. To evaluate phenotypic traits of creeping bentgrass regulated by ACCd bacteria in association with drought tolerance and rapid recovery upon re-watering.

Materials and Methods

Plant materials and growth conditions: Creeping bentgrass (*Agrostis stolonifera cv. Penncross*) plots (1mx1.3m) were established in field soil and maintained at a height of 1.2cm. Plants were inoculated twice before the start of drought stress and once again upon re-watering using a soil drench method. A rainout shelter was used to cover the plots to simulate drought stress.

Bacteria Inoculation Treatments:

1. Non-inoculated control (0.01% humic acid)
2. ACCdR23+14 (novel combination of PGPR strains + 0.01% humic acid)
3. Quantum Growth (commercially available inoculant)

Deficit Irrigation Treatments:

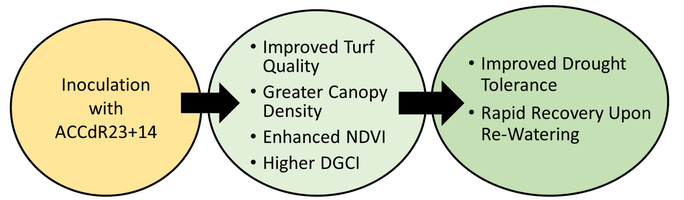
- Well-Watered Control: Plants were irrigated(100% ET)
- Drought Stress: Deficit Irrigation (60% ET) for 49 days
- Recovery: Drought-stressed plants were re-watered for 28 days

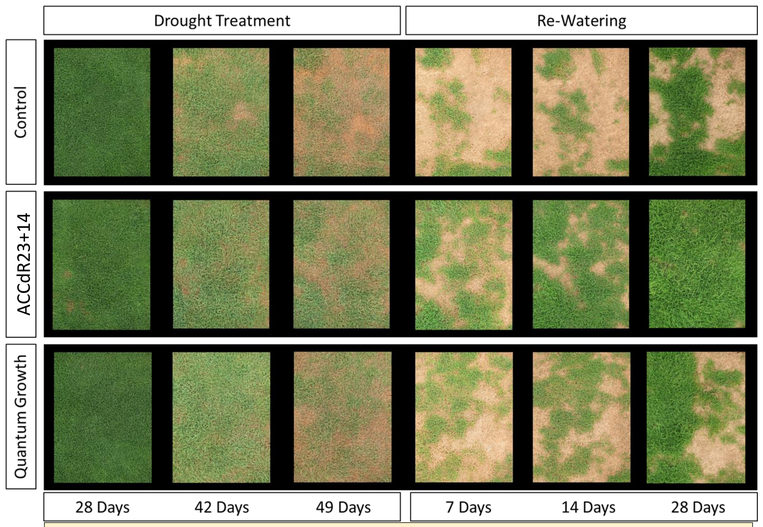
Measurements

- Turf Visual Quality (1-9)
- Normalized Difference Vegetation Index (NDVI)
- Lightbox Digital Images
- Percent Cover
- Dark Green Color Index (DGCI)

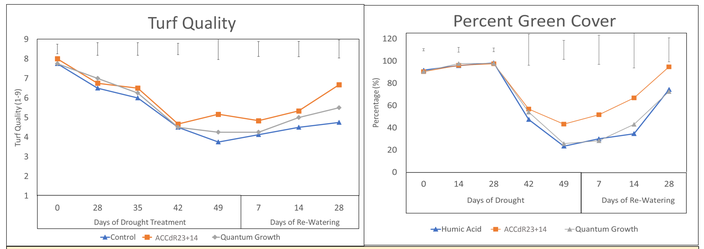
Results

- ACCd bacteria improved drought tolerance and recovery by promoting turf canopy density, NDVI, and DGCI.
- Inoculation with ACCdR23+14 provided longer-lasting drought tolerance and more rapid recovery in creeping bentgrass than non-inoculated controls or a commercially available bacterial inoculant.

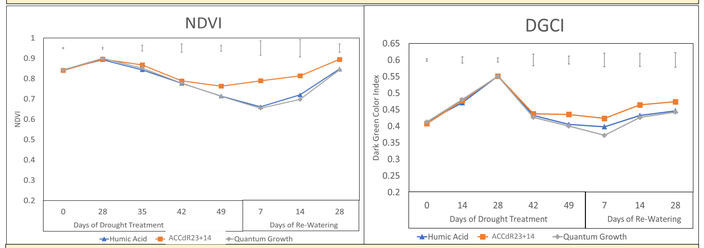




Light box images taken from the same location each week depict the progression of drought stress and recovery in creeping bentgrass inoculated with growth promoting rhizobacteria.



Inoculated plants retained higher turf quality and percent cover through drought stress and saw greater increases in these parameters upon re-watering.



NDVI and DGCI remained higher during the drought stress period recovery periods for plants inoculated with ACCdR23+14

Conclusions and Discussion

- A novel combination of rhizobacteria strains ACCdR23+14 effectively improved drought tolerance and post-drought recovery upon re-watering for creeping bentgrass in field conditions via soil drench application.
- ACCd activity of ACCdR23+14 was the likely mechanism for improving turf quality during drought stress.
- ACCdR23+14 bacteria strains have potential for development as a novel biofertilizer for reducing water use.