

BACTERIAL POPULATIONS AND DIVERSITY WITHIN NEW USGA PUTTING GREENS

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EXECUTIVE SUMMARY

Conducted in cooperation with Clemson University (H.D. Skipper) and the University of Florida (M.L. Elliott) this study evaluates bacterial species and their population fluxes in the soil and rhizosphere during the establishment and maintenance of putting greens. Treatments in this study include grass type (bent or bermuda), organic construction material (sphagnum vs. reed sedge), fumigants (methyl bromide, metam sodium or dazomet) and N fertility regimes (x vs 2x normal). At Auburn University treatments are N rate (1x or 2x normal rate) and construction materials (pure sand putting green or 80/20 sand/peat mix). Sixteen containerized greens were constructed at the Auburn University Turfgrass Research Unit, four replications of each fertility/soil mix combination. Greens were sodded in January 1997 with washed bentgrass sod (cv 'Crenshaw'). Greens are 1 m long x 0.5 m wide, and each drains to an individual collection chamber. Total leachate from each green is collected as needed, volume recorded and a subsample is analyzed for $\text{NO}_3\text{-N}$ and $\text{NH}_4\text{-N}$ concentration. In February, May, August and November of each year root and soil samples (0-4 inch depth) are collected from each green. These samples are shipped to the Univ. of Florida, where they are subject to dilution plating and identification. Selected isolates are returned to Auburn University, where identification at the species level is conducted via GC FAME analysis. Nitrogen rates applied at the Auburn University site were originally 1 or 2 lbs N/1000 ft²/month (granular fertilizer source). Excessive loss of N through leachate and burning of turf at application resulted in a shift of application times and amounts to 1/5 or 1/10 lb N/1000 ft²/week applied via a CO₂ backpack sprayer. These N application rates were initiated on 25 August, 1997 and will likely continue for the rest of the study unless grass health indicates a need for more N.

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INTRODUCTION

Standards for building putting greens have been developed by the USGA such that greens throughout the country will have similar physical, and, to a lesser extent, similar chemical characteristics at the time they are constructed and planted. Rhizosphere microbiology is an exciting, complex area for scientific investigation. However, no research has examined the microbial characteristics associated with the construction materials of putting greens or examined the flux in microbial population and diversity on turfgrass roots after the greens have been planted. To protect environmental quality and to attain sustainable turfgrass growth and production, information must be obtained on this critical aspect of putting greens. This USGA-funded project examines the interrelationships between microorganisms as influenced by their biotic (living organisms) and abiotic (construction materials) environment in new putting greens. Conducted as a cooperative effort with Clemson University and the University of Florida, this project examines the effect of a variety of factors on microbial populations.

OBJECTIVES

The overall objective is to develop baseline data concerning bacterial composition (population and diversity) of new USGA putting greens, both during and after construction. Specific objectives include:

1. Determine bacterial populations associated with putting green root-zone mix materials (AL, SC and FL)
2. Determine bacterial populations of the root-zone mixes before and after fumigation (FL)
3. Compare bacterial populations on two different turfgrasses, bentgrass and bermudagrass, grown in two different root-zone mixes (AL, SC and FL)
4. Compare thatch development, rooting and bacterial population of bentgrass in relation to root-zone mix and N fertilization (AL)
5. Document rhizosphere bacterial population dynamics on bentgrass and bermudagrass putting greens over a four year time period.

METHODS AND MATERIALS

Auburn University

Sixteen containerized greens were built at the Auburn University Turfgrass Research Center, each designed to drain completely into an individual collection chamber. Greens are 1 m long x 0.5 m wide, and were sodded with washed bentgrass sod (cv 'Crenshaw') in January of 1997. Treatments consist of four replications of two greens mixes (sand or an 80/20 sand/peat mix) and two rates of N fertilizer application (1/5 or 1/10 lb N/1000 ft²/week). Nitrogen is applied as a solution via a CO₂ backpack sprayer. Additional fertility (P, K, Ca, Mg, micros) is surface applied as a granular material approximately monthly. All plots are irrigated uniformly and pesticide and fungicide applications are also applied uniformly to all plots. Greens are mowed 6 days of 7 at a 5/32 inch mowing height. Topdressing and aerification are applied on an as-needed basis, with topdressing applied at least monthly and aerification (core) performed at least three times per year.

Leachate from each green is collected whenever necessary, and total volume of leachate is measured. A subsample is collected, filtered and frozen until analyses for NO₃-N and NH₄-N can be performed. Four times per year (February, May, August, November) 0-4 inch soil and root samples are collected from each plot. These samples are shipped to the University of Florida, where dilution plating is performed to identify general families of microorganisms. One isolates have been identified they are returned to Auburn University, where species identification is performed via GC FAME techniques.

RESULTS AND FURTHER STUDIES

Initial nitrate and ammonium analyses from the original N rate treatments (1 and 2 lbs N/1000 ft²/month) indicated that excessive N was leaching through the profile of the greens. This was especially true with the 2 lb N, 100% sand treatment. This excessive leaching, coupled with the feeling that we were not reproducing 'real golf course' conditions caused a shift in the N treatment structure. Thus, on August 25 1997 N treatments were shifted to applying 1/5 or 1/10 lb N/1000 ft²/week, applied as an N solution (urea). These treatments will be continued throughout the length of the study.

To date, three sets of soil/root samples have been collected from GC FAME analysis. Analysis of these soil sets is not yet completed. N leachate is collected approximately weekly, and analysis of nitrate and ammonium in the leachate proceeds as we collect. The micro-plots are working well, and with an active fungicide-spray program we have not had an major set-backs or problems with turf quality. Additional data collection will include thatch depth, monthly color and quality records, and depth of rooting in each plot.