BACTERIAL POPULATIONS AND DIVERSITY WITHIN NEW USGA PUTTING GREENS

E.A. Guertal and J. Kloepper
Departments of Agronomy and Soils
and Plant Pathology
Auburn University

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 NO_3-N and NH_4-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 ft^2/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 ft^2/week applied via a CO_2 backpack sprayer. Year 1 analysis of nitrate and ammonium leachate indicated that both N rate and mix type affected NO_3-N and NH_4-N concentration in leachate, and there was rarely a significant N rate x mix type interaction. During Year 1 leaching of NH_4-N was greater in the sand green than USGA-type green. Leaching of NO_3-N from the USGA green was greater than that from the sand green, but only in the first few months after construction (January - April).

BACTERIAL POPULATIONS AND DIVERSITY WITHIN NEW USGA PUTTING GREENS

E.A. Guertal and J. Kloepper
Departments of Agronomy and Soils
and Plant Pathology
Auburn University

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 ft^2/week). Nitrogen is applied as a solution via a CO_2 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 NO_3-N and NH_4-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.

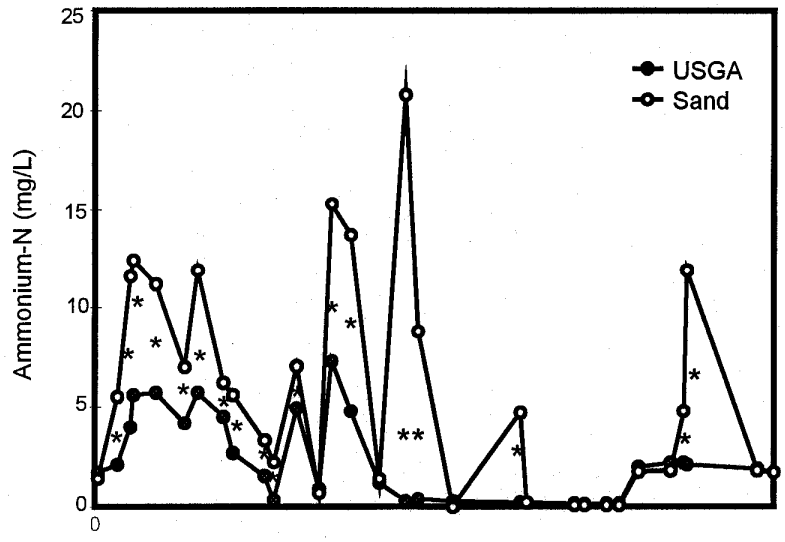
RESULTS AND FURTHER STUDIES

Initial nitrate and ammonium analyses from the original N rate treatments (1 and 2 lbs N/1000 ft^2/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 ft^2/week, applied as an N solution (urea). These treatments will be continued throughout the length of the study.

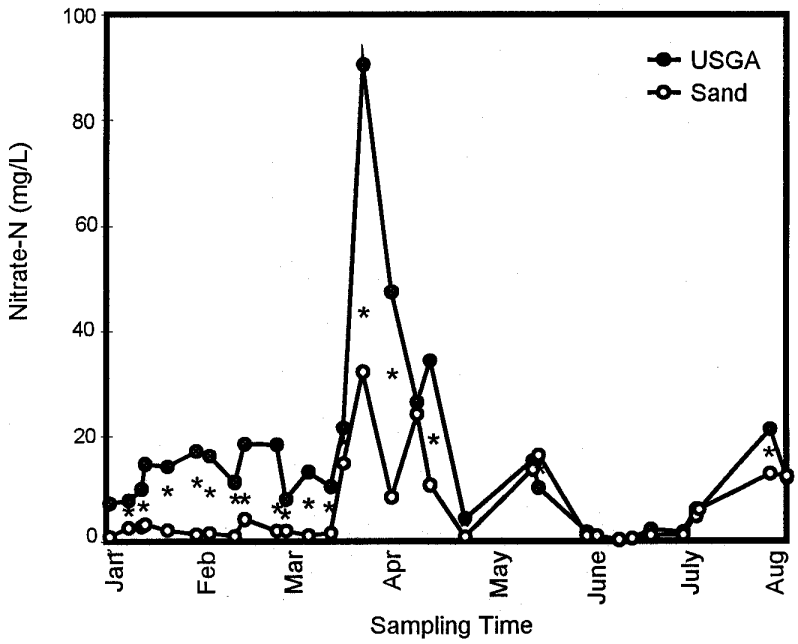
To date, five sets of soil/root samples have been collected from GC FAME analysis. Analysis of these soil sets is not yet completed. N leachate is collected approximately weekly, and analysis of nitrate and ammonium in the leachate proceeds as we collect. To date, Year 1 leachate collection has been analyzed, and results are presented in Figure 1, attached. Laboratory analysis of Year 2 data (after switching to lower, more frequent N application) has been completed, but that data has not yet been analyzed.

Year 1 analysis of nitrate and ammonium leachate indicated that, at most collection dates, concentrations of nitrate and ammonium in leachate were affected by both N rate amd mix type (sand or 80/20). There was rarely a significant N rate x mix type interaction. For results of the microbial population evaluations please see the reports of Skipper et al., and Elliott et al.

Ammonium leaching as affected by putting green mix, Jan - Aug, 1997



Nitrate leaching as affected by putting green mix, Jan - Aug, 1997



*At each collection date, significantly different at alpha = 0.05.

Figure 1.