The Effects of Turfgrass Root Architecture on Nitrate Leaching and Nitrogen Use Efficiency

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Objectives:

1. *Extend our current column lysimeter study comparing six different warm-season turfgrasses for NO_3 leaching and nitrogen efficiency.*
2. *Measure root architecture (depth, density, dynamics) and other root characteristics (cation exchange capacity, carbohydrate release, microbial association, viability) for the six species.*
3. *Measure the kinetic parameters of nitrogenuptake for each species.*
4. *Determine whether root architecture or uptake kinetics explains the differences between the species.*
5. *Use a state-of-the-art-flow-through nutrient solution culture system to screen germplasm for nitrogen uptake efficiency and to simultaneously determine rooting depth of the genotypes.*
6. *Use genotypes identified in objective five to validate the conclusions regarding rooting architecture vs.uptake kinetics as a primary determinant of nitrogen efficiency.*

Large column lysimeters have been constructed and installed at the NCSU Phytotron. Each is equipped with sampling hardware to permit recovery of all leachate. A preliminary study to evaluate lysimeter performance demonstrated that nitrate leaching could be reduced during turf establishment by supplementing the fertilizer with sugar, thus stimulating microbial immobilization of the fertilizer. Ammonium nitrate (AN) was applied monthly at 49 kg N ha^{-1}. Mass emission of N from the controls amounted to 23%, 28%, 9% and 7% of the applied N for months one through four, respectively. The reduction over time corresponds to root development. Sucrose addition reduced both $N0_3$ concentration and mass emission 40 to 65% compared to controls, suggesting significant increases in microbial immobilization. Sucrose addition did not affect root distribution, which also supports the role of microbial activity in reducing leaching. These data indicate the need to better understand turfgrass soil microbiology, especially regarding nitrogen nutrition.

A second experiment was conducted to investigate the effects of (Primo) on nitrate leaching potential and N budget in 'Tifway' bermudagrass. The turf was established in column lysimeters filled with sand. Trinexapac-ethyl (TE) was applied twice at four-week intervals at 0.11 kg a.i. ha^{-1}, and AN was applied at 49 kg N ha-1 two weeks after each TE application, and again six weeks after the second TE application. Separate sets of columns received ^{15}N-labeled AN for each of the first two N applications. TE reduced clipping production by 30 to 40% compared to the control. There was no effect of TE on nitrate leaching following the first two N applications. Following the third AN application, however, approximately 50% less nitrate leached from the TE treated columns compared to the control, even though growth effects from TE had mostly disappeared. There were no differences in root mass between treatments. It is possible that the post inhibition growth response increased demand for N during this period, resulting in less N being available in the rootzone for leaching. Data on tissue allocation of N are currently being analyzed. The results indicate that growth regulators can be used without increasing the potential for nitrate leaching.

We have been able to hire Dr. Chunhua Liu to conduct this project's research. He is presently setting up experiments to examine nitrate leaching as a function of root development and to characterize nutrient uptake kinetics in several warmseason grasses.