An Evaluation of Nitrogen Leaching in Three Golf Course Putting Greens During Establishment

by

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The fate of nitrogen (N) applied to turfgrass is a concern of both turfgrass professionals and surrounding communities in Florida. This is primarily because of the unique combination of climate, hydrology, soils, mobility of soluble N, and management conditions when turfgrasses (particularly sports turfgrass) are grown in Florida. For a number of years we have been investigating the fate of N and other agrichemicals applied under an array of controlled management conditions in Florida and have developed "Best Management Practices" to minimize any potential adverse impacts (Cisar et al., 1989). Practical N management techniques such as the use of controlled-release fertilizers, fertigation, and irrigation management have been shown to provide quality turfgrass with little N leaching (Snyder et al., 1980; Snyder et al., 1984; Snyder, et al., 1989). Most recently, we have participated in a national research program investigating environmental impacts from managing turfgrass systems sponsored by the United States Golf Association (USGA). As an off-shoot of our project on the persistence and mobility of agrichemcials applied to a USGA green, we installed a leachate collection system in re-constructed USGA type greens at an existing golf course in south Florida during a renovation of the course to assess agrichemical mobility under "real-life" play and management conditions.

The initial objective of this study was to monitor the mobility of the major agrichemical used during grow-in, N, during the establishment/maturation phase of newly sprigged bermudagrass greens and to illustrate the usefulness of these monitoring systems for assessing agrichemical and water management of golf course putting greens.

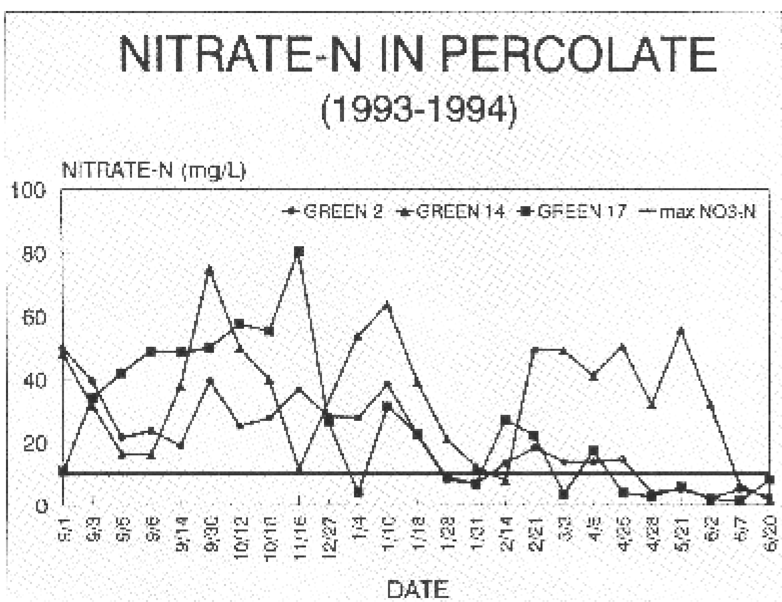
Materials and Methods

Based on experience with stainless-steel lysimeters for collecting percolate from a USGA green at the Ft. Lauderdale Research and Education Center (Cisar and Snyder, 1993), we installed a modified version of that lysimeter into greens on a golf course in south Florida that was undergoing some course layout modifications during the summer of 1993.

Lysimeters were installed while greens 2, 14, and 17 were being constructed. The lysimeters were fitted with bottom drain lines to permit passive drainage from the bottom of the collection chamber to a percolate-collection station on the back or side slope of each green. The "rooting mix over gravel" greens-construction combination in use at each location was reproduced in each lysimeter, thereby preserving the hydrological integrity of the percolate-collecting system. Lysimeter installation was completed in July 1993 and did not cause any serious disruption of the commercial greens installation. The lysimeters have no adverse impact on the management or use of the greens. Collection of percolate water by golf course personnel was initiated in September 1993 during grow-in and continued through July 1994 when the greens were in play and receiving routine management. The water samples were analyzed for NH_4-N, NO_3-N, P and K. Data for NO_3-N is reported herein.

Results and Discussion

In Florida, there is often a very narrow window of time for completing golf course reconstruction. This is due to member/player expectations, the economic considerations of the loss of greens fee revenues, and of course, the uncertainty of weather. Thus, superintendents are often under extreme pressure to get their respective courses back in play. It is a well-recognized practice to facilitate grow-in of bermudagrass through the use of frequent and/or large application of soluble N initially after sprigging. However, soluble N applied to sand soils is prone to leaching especially when the turfgrass does not have complete cover with extensive rooting for nutrient retrieval. Therefore it was not surprising to see relatively high concentrations of nitrate-N being found in the percolate from each green early on during the study when soluble N was applied to immature bermudagrass.



During the establishment phase, the concentration of N in percolate was high and above the current drinking water standard. With the onset of 1994, there was a switch to slow-release N sources and, as the greens matured, there was greater nutrient retrieval capacity. By late January 1994, the nitrate-N levels began to approach and dip below 10 mg L^{-1} in all three greens and stayed consistently below the current 10 mg L^{-1} standard as normal greens fertility maintenance was adopted. However, nitrate-N levels began to rise in green 14. Any ideas why?

The answer turned out to be a rather simple one. The superintendent decided to overseed green 14 due to concerns over poor bermudagrass growth during the winter on that particular green as a result of excessive shade.. And what do you do to encourage overseeding? Fertilize and water plentifully to ensure germination of the overseeding which accounted for the spike in nitrate-N in percolate. However, as the overseeding period ended and a change over to routine fertilization in May 1994, the drop in nitrate-N concentrations in percolate fell off sharply and below the 10 mg L^{-1} standard for green 14 as well.

Conclusions

Several concluding points can be drawn from this field monitoring study. First, leaching of N with percolate can occur during establishment period. While the superintendent's main concern during this period will be for the well-being of the grass, N leaching should be considered as well, and can be reduced by the inclusion of prudent management such as the use of slow release fertilizers and efficient irrigation.

Secondly, the use of conservative strategies of slow release N fertilizers under routine management, effectively reduced N leaching in actual golf course management conditions. These field observations verified the many years of research on ways to minimize N leaching from turfgrass and the development of BMP's by the University of Florida turfgrass faculty.

Finally, this study demonstrated the usefulness of the field monitoring system as an additional tool for management decisions for both nitrogen fertilization and irrigation. Managers could use the data from these lysimeters to evaluate the environmental effect of fertilziation rates and methods, and make modifications where appropriate. In addition, just knowing the amount of percolate collected can be very useful. Such measurements can be used to determine whether irrigation is excessive. Clearly, there would be no N losses when no percolate is observed. Obviously, with Florida rains and irrigation inefficiencies, a situation of no percolate is unrealistic. However it is realistic to avoid over-irrigation and a waste of valuable nutrient elements. It's also economically and environmentally friendly.

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