

# *Gaseous Losses and Long-Term Fate of Nitrogen Applied to Kentucky Bluegrass Turf*

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## **Objectives:**

1. Determine the quantity and form of gaseous nitrogen losses from turf.
2. Develop long-term (20+ years) field plots examining the fate of nitrogen applied to a mature turf.

**Start Date:** 1998

**Project Duration:** 5 years

**Total Funding:** \$124,270

This research project seeks to build on previous research on the fate of nitrogen applied to turfgrass. Specifically, we wished to add to the relatively sparse literature on denitrification from turf. It is our hypothesis that the historically poor recovery of labeled fertilizer nitrogen (LFN) in studies designed to determine the fate of applied nitrogen was due to denitrification losses. Finally, we wish to examine the fate of nitrogen applied to mature, well-established turfgrasses.

Historically, many of the studies on fertilizer fate have been conducted on relatively new turf. All of these studies found very low levels of nitrate leaching; however, we wish to determine if this response holds true for mature turf as well.

Several studies were completed in 2000. Two studies examining denitrification in the field found that denitrification, the anaerobic reduction of nitrate to nitrogen gas, occurs frequently in turf. Previous research in turf indicated that denitrification does not occur except when soils are near saturation. Our research indicates that denitrification occurs routinely after



*Brian Horvath, a graduate student at the University of Illinois, explains how air samples are taken from Kentucky bluegrass turf. The study determined the amount of nitrogen volatilization that occurs from turf.*

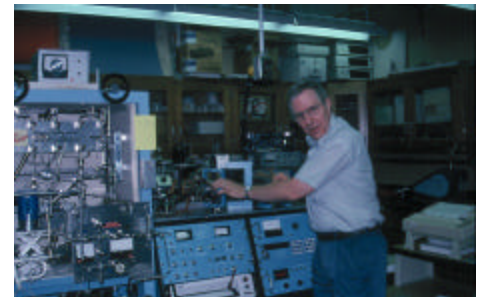
rainfall or irrigation events and in large quantities following fertilizer applications.

Denitrification appears to be a significant loss mechanism in turf because even though the loss rates are generally small, losses occur frequently throughout the growing season. Denitrification losses accounted for 5-15% of applied LFN. However, even with the ability to account for denitrification losses, our total recovery of LFN in soil, plant, and atmosphere averaged 61.2 to 68.4%. This suggests that increased estimates of denitrification are not the complete answer for the incomplete recovery of LFN applied to turf. We believe other loss mechanisms must be occurring that account for the lack of complete recovery of LFN.

In 2000, we monitored denitrification under field conditions. During the course of the study, rainfall or irrigation fell on the plots 24 times and denitrification losses were measured 16 times. Even relatively light irrigation or rain events can result in some denitrification loss because small pockets within the soil can become anaerobic.

Research at Michigan State University monitored nitrate leaching from turf that has been maintained under two different fertility levels for the last two years. One area is fertilized at an annual rate of 2 lbs. N/1000 ft<sup>2</sup>/yr. The other area is maintained at 6 lbs. N/1000 ft<sup>2</sup>/year.

Lysimeters are one square meter in surface area and 1.2 m deep and have been continuously monitored for the last two years for the concentration of nitrate in the drainage water. Earlier research has indicated that nitrate leaching from turf is negligible. In this study, however, the 6 lbs. N/1000 ft<sup>2</sup>/yr treatment has shown steadily increasing rates of nitrate leach-



*At University of Illinois, Dr. Richard Mulvaney has developed a specialized mass spectrometer to measure NO<sub>2</sub> gas volatilized from labeled nitrogen fertilizer.*

ing with levels reaching 10-20 mg/L nitrate from October, 1999, through May, of 2000. These levels are above the national drinking water standard.

However, the 2 lbs. N/1000 ft<sup>2</sup>/yr, a more modest rate of nitrogen fertilization, continues to show low levels of nitrate leaching usually between 1-3 mg/L. This research emphasizes that turf is a perennial species and that the long-term view of its characteristics must be taken.

The final study of this project was begun in the late fall of 2000 and will determine the fate of nitrogen on a mature turf at two different rates of annual nitrogen fertilization.

## **Summary Points**

- Denitrification accounted for 5-15% of the applied labeled fertilizer nitrogen. This amount is higher than previously reported.
- Denitrification occurs routinely after rainfall or irrigation events and in large quantities following soluble nitrogen fertilizer applications.
- Two pounds of N/1000 ft<sup>2</sup>/yr showed low levels of nitrate leaching (usually between 1-3 mg/L), but this value is higher than previously reported.
- While turf is a good system, unnecessary high levels of N fertilization can cause unacceptable levels of nitrate leaching.