Long Term Nutrient Fate Research

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Objectives:

1. *Determine nitrate–nitrogen and phosphorus leaching from a turfgrass stand that has been continually fertilized for 22 years.*
2. *Continue data collection from the Long Term Nutrient Fate Research Area at MSU, currently we have data collection for 14 years consecutively.*

The USGA initially funded research at Michigan State University to determine nitrogen fate and leaching from a Kentucky bluegrass turf in 1991. Similar to previous research, the initial research at MSU conducted from 1991 through 1993 indicated that there was minimal risk of nitrate–nitrogen leaching from Kentucky bluegrass (*Poa pratensis* L.) turfgrass. Since the summer of 1998 percolate samples have been collected from the same monolith lysimeters and analyzed for nitrate–nitrogen (NO_3–N). As of 2013, the turfgrass area has now been under continual fertilization practices for 23 years with percolate collection for the last 15 years consecutively.

Figure 1. The white circle in the foreground marks the top of a large lysimeter used to measure the amount of nitrogen and phosphorous that leaches through a 22–year old turf. The raised hatch allows researchers to collect samples at the base of the lysimeter.

From July 1998 through 2002, lysimeters were treated annually with urea at a low N rate 98 kg N ha^{-1} (24.5 kg N ha^{-1} $application^{-1}$) and a high N rate of 245 kg N ha^{-1} (49 kg N ha^{-1} $application^{-1}$). From 1998–2002 for the high N rate there was a dramatic increase in NO_3–N leaching from 5 mg L^{-1} in 1998 to 25 mg L^{-1} in 2002. During the same time frame there was a modest increase in NO_3–N leaching from 3 mg L^{-1} in 1998 to 5 mg L^{-1} in 2002. In 2003 the N rate was reduced to 196 kg N ha^{-1} for the high N rate while the low N rate remained at 98 kg N ha^{-1}.

In 2003, the concentration of NO_3–N leaching from the high N rate treatment did not decline from the previous years. The average NO_3–N concentration leached from the low and high N rate treatments was 6.3 and 31.6 mg L^{-1}. In 2004, the concentration of NO_3–N leaching from the high N rate treatment declined by 23.1 mg L^{-1} to 8.5 mg L^{-1}. For the low N rate the average concentration of NO3–N in leachate for the low N rate

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Figure 2. Water leachate is collected on a regular basis to measure the amount of nitrogen and phosphorous that leaches through a Kentucky bluegrass turf maintained at rough height.

was 1.2 mg L^{-1}. Since 2004, there has been a steady decrease in the average concentration of NO_3–N in leachate for the high N rate. In the last 5 years the mean NO_3–N concentration in leachate for the high N rate was 2.1 mg L^{-1} and for the low N rate less than 1 mg L^{-1}.

Over the 15 years of collecting leachate samples we have observed high NO_3–N leaching from the 245 kg N ha^{-1} rate and a subsequent decrease in NO_3–N leaching when the rate was decreased to 196 kg N ha^{-1}. This research has demonstrated the importance of long–term nutrient fate studies and improved our understanding of changes in nutrient fate due to the age of turfgrass site and annual nitrogen rate.

Summary Points

- Since 2003 when the high N rate was decreased to 196 kg N ha^{-1}, the annual mean $N0_3$–N concentration has been less than 10 mg L^{-1} for 8 of 11 years since 2004.
- For the high N rate, $N0_3$–N concentrations have fallen in the last 5 years to levels less than 3 mg L^{-1}.
- For the low N rate, the mean $N0_3$–N concentration has been 5 mg L^{-1} or less for every year since 1998 except one (2003).

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