Long-Term Nutrient Fate Research

Kevin W. Frank
Michigan State University

Objectives:

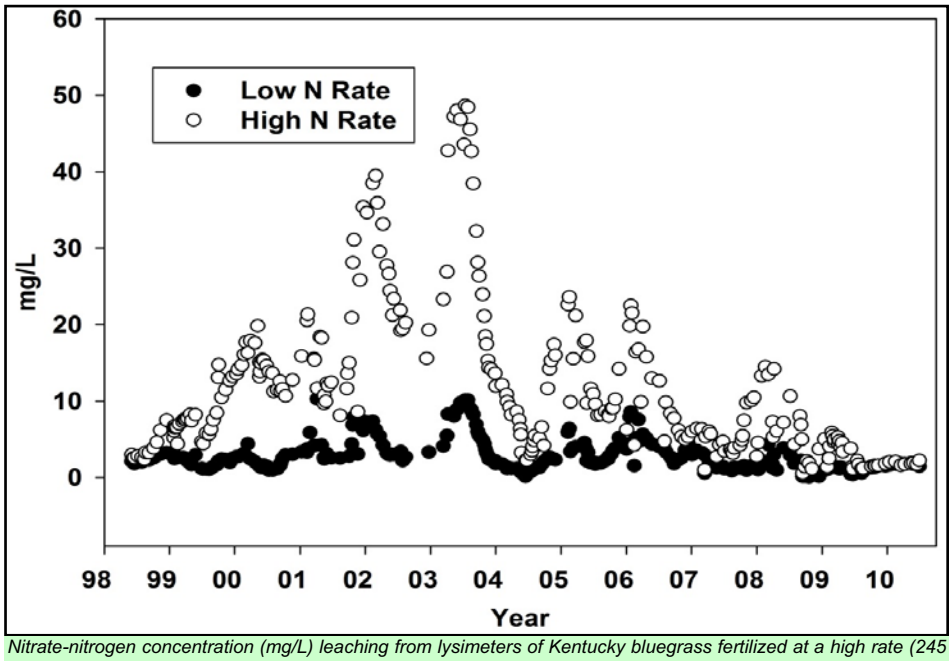
1. Determine nitrate-nitrogen and phosphorus leaching from a turfgrass stand that has been continually fertilized for 20 years.
2. Continue data collection from the Long-Term Nutrient Fate Research Area at MSU; currently we have data collection for 12 consecutive years.

Start Date: 2003
Project Duration: 12 years
Total Funding:
2008-2010: $34,800
2003-2007: $68,886
2000-2002: $64,612

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 2011, the turfgrass area has now been under continual fertilization practices for 21 years with percolate collection for the last 13 years consecutively.

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}). 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}. Since 2003, phosphorus from triple superphosphate (20% P) has been applied at two rates, 49 and 98 kg P ha^{-1} split over two applications. The phosphorus application dates coincide with nitrogen application dates in the spring and autumn.



Nitrate-nitrogen concentration (mg/L) leaching from lysimeters of Kentucky bluegrass fertilized at a high rate (245 kg N ha^{-1} yr^{-1}) and low rate (98 kg N ha^{-1} yr^{-1}) from 1998 through 2010.

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 drastically from previous years. The average concentration of NO_3-N in leachate for the high N rate was 8.5 mg L^{-1}. This was a decrease in NO_3-N concentration of 23.1 mg L^{-1} from 2003. For the low N rate the average concentration of NO_3-N in leachate for the low N rate was 1.2 mg L^{-1}.

The average concentration of NO_3-N in leachate for the high N rate from 2004 through 2010 was 7.5 mg L^{-1}. In 2009 the mean NO_3-N concentration in leachate for the high N rate was 3.2 mg L^{-1} and in 2010 the mean NO_3-N concentration declined even further to 1.8 mg L^{-1}. In 2010, the mean NO_3-N concentration in leachate for the low N rate was 1.4 mg L^{-1}.

The concentration of phosphorus detected in leachate remains very low regardless of treatment. The mean concentration of phosphorus detected in leachate since initiating phosphorus treatments in 2003 has been less than 0.02 mg L^{-1}. This research indicates that leaching potential from continually fertilized turfgrass sites changes due to the age of turfgrass and annual nitrogen rate.

Summary Points

- For the high N rate, the annual mean $N0_3$-N concentration has been less than 10 mg L^{-1} for 5 of 7 years since 2004.
- For the high N rate, most of the sampling dates that had elevated $N0_3$-N concentrations were during late fall or winter when the turfgrass was dormant but the soil was not frozen.
- For the low N rate, the mean $N0_3$-N concentration has been 5 mg L^{-1} or less for every year except one (2003).