Trenholm, Laurie E. 2012. Nitrate Leaching Studies. Florida Turf Digest 29 :2(12-18).

In 2005, research began in 3 locations statewide to quantify nitrate-N and phosphorus leaching under a variety of circumstances. The research has been completely funded by the Florida Department of Environmental Protection. Sites and researchers include Dr. John Cisar at the Ft. Lauderdale Research and Education Center, Dr. Jerry Sartain (phosphorus) and Dr. Laurie Trenholm (nitrate-N) at the Plant Science Research and Education Unit in Citra, and Dr. Bryan Unruh at the West Florida Research and Education Center in Jay.

The research is broken down into various projects, most of which were conducted at 2 or 3 of the sites. Each project was conducted for a period from 2-4 years per site. Here is a brief synopsis of results from some of the main projects in Gainesville.

General Methodology

Drainage lysimeters were installed in the center of each experimental plot at a depth of 4" below ground. The lysimeters were 22" in diameter and 42" tall (Figure 1). Tubing was fitted to the base of each unit, running to above ground boxes. A vacuum was applied to the tubing to evacuate the lysimeters weekly. Samples were sent to the Analytical Research Lab for analysis of nitrate-N. Data from all projects are expressed in units of kg ha^{-1}, which is a measurement of the nitrate-N loading that occurred based on nitrate-N concentration and volume of leachate.

Nitrate-N leaching from newly planted turfgrass

'Empire' zoysiagrass and 'Floratam' St. Augustinegrass were sodded and N treatments were applied the same day at rates of 0.5, 1.0, 1.5, or 2.0 lbs N 1,000 ft^{-2}. Nitrogen was applied as soluble urea. Half of the plots received the same treatments 30 days later.

Nitrate-N leaching from both grasses over all years was considerably greater than from the established grass studies, regardless of N rate. The percent of applied N that leached from St. Augustinegrass in 2006 was 73.4% of what was applied the same day as planting in 2006. Leaching from the plots that received a second treatment 30 days later was reduced to 56.4% of the applied N. Similar results were seen in all years.

Newly planted turf, whether sodded, seeded, sprigged, or plugged, should not be fertilized with N for at least 30 to 60 days after planting, due to the potential for large nutrient losses before a root and/or shoot system has been established. This is now a Best Management Practices (BMP) recommendation.

Nitrate-N leaching from established turfgrass

Nitrogen was applied to Empire zoysiagrass and Floratam St. Augustinegrass over a 3-year study. Annual N rates were 1, 4, 7, or 10 lbs N 1,000 ft^{-2} applied every 60 days throughout the growing season. Nitrogen was applied as soluble urea. Leaching data are presented for 2006 and 2007 for each of the four Fertilizer Cycles (the 60-day interval between each fertilizer application). Fertilizer cycles are presented as Spring (April-May), Early Summer (June-July), Late Summer (Aug-Sept), and Fall (Oct-Nov).

There were few statistical differences in nitrate-N leached due to N rate in St. Augustinegrass (Figure 2). Where there were differences (primarily Fall 2007), greatest nitrate-N load occurred at the highest N rate. During this study, the St. Augustinegrass was in good health and had good growth and cover. The dense root and shoot system provided the grass the ability to take up nitrogen at the excessively high rates applied to some of the plots (7 and 10 lbs 1,000 ft^{-2} yr^{-1}, which far exceeds the current recommendations for fertilizing St. Augustinegrass in north central Florida). Nitrate leached did not exceed 1.4% of the applied N in any fertilizer cycle and was generally below 1% of that applied N. Increased leaching occurred in the fall of 2007 at the 10 lb N rate in response to increased disease and associated injury due to the high N rates, which reduced the cover and density of the grass, resulting in higher leaching.

Zoysiagrass showed a greater tendency to leach more nitrate-N as N rate increased (Figure 3), but it is important to remember that many zoysiagrass cultivars stay green and healthy with less N. Plots that received the high N rates in this study had large patch disease and poor cover by the 3rd year. This resulted in less ability to take up the N and greater leaching. By late summer, the disease was suppressed and the grass had resumed active growth, slowing the high leaching losses down. When N is applied at the recommended rates for zoysiagrass, leaching is minimized as with St. Augustinegrass.

Results of this study clearly indicate that maintenance of a healthy grass that provides dense cover will minimize nitrate-N losses when N is applied at the recommended range of rates. All practices that help to maintain a healthy turfgrass, including proper irrigation and mowing contribute to a healthy turf. When fertilized within the range of N rates recommended by UF/IFAS, nitrate-N leaching was minimized from these two grass species.

Winter Fertilization

This study was conducted in Citra and Jay to determine the impact of fertilizing dormant or semi-dormant turfgrass through the winter months. Floratam St. Augustinegrass and 'UltimateFlora' zoysiagrass were sodded in the fall of 2006. Nitrogen rate treatments were applied monthly as soluble urea. Rates applied were 0, 0.13, 0.25, 0.5, 1.0 and 2.0 lbs N 1,000 ft^{-2} mo^{-1}.

Total nitrate-N leaching losses for the season differed due to an interaction of N rate and grass in years 1 and 2. In both of these cases, St. Augustinegrass had no differences in leaching between control and up to 1 lb N 1,000 ft^{-2}, while zoysiagrass had greatest leaching from either the 1 or 2 lb N rate (Figure 4).

Nitrate-N leaching was compared between months (Table 2). In years 2 and 3, after the grass was well established, greatest leaching generally occurred in the winter and early spring months as compared to the fall months. More N was able to be taken up in the fall when the grass still had a root system when compared to Jan-March, when the grass was in deeper dormancy and a large portion of the roots had sloughed off. While N fertilization is not recommended for home lawns during the winter months in north Florida, there is less potential for nitrate-N leaching from late fall fertilization than from fertilization during Jan-March. These results are based on north Florida conditions and do not apply to south Florida.

N Source Study

This study ran from 2008 through 2011 on Floratam St. Augustinegrass and Empire zoysiagrass. Treatments are listed in Table 1 and were applied as granular treatments at 1 lb N 1,000 ft^{-2} every 60 days, unless noted otherwise. In 2008, this project began in July and therefore only two treatment applications were applied.

In 2008, St. Augustinegrass had no differences in total nitrate-N loading (Figure 5) Zoysiagrass had significantly greater leaching from ammonium nitrate than from any of the other N fertilizers, with no differences between the other products. In 2009, there were no differences in leaching due to either grass or N source. Similar results were seen in subsequent years.

Many think that slow-release N sources are less likely to leach, these results indicate that there are no differences in nitrate-N leaching from either soluble or slow release sources when they are applied to healthy turfgrass. Healthy turf that provides good ground cover is able to take up the fertilizer that is applied to it, as long as the fertilizer is properly applied.

Closing Thoughts

All of the research results from the 3 locations show similar results, indicating that a healthy turfgrass cover mitigates nitrate-N leaching when fertilizer is applied correctly. Maintaining a healthy turfgrass cover includes proper irrigation, mowing, fertilization, and pest control. Following the BMP recommendations for all turf cultural practices can reduce nutrient leaching and potential nonpoint source pollution.

Table 1. N Source Study Treatments

	N Rate (lb N 1,000 ft^{-2} per application)	Frequency of Application
Control	0	0
Ammonium nitrate	1	60 days
Urea	1	60 days
30% SRN	1	60 days
50% SRN	1	60 days
32.8% PCN	1	60 days
32.8% PCN	2	120 days
Milorganite	1	60 days