Nitrate Leaching From Turf Fertilization- A Summary of FDEP-Funded Research

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Lysimeters
As nitrate percolates downward through the column, it collects in reservoir filled with gravel. At bottom of lysimeter is a portal for tubing that runs to collection device aboveground. To collect leachate, a vacuum pump is attached to the tubing and water evacuated from base. A sub-sample is collected for analysis.
Research Projects

1. Nitrate Leaching from Newly Sodded Turf
2. Nitrate Leaching Due to N Rate
3. Nitrate Leaching Due to N Source
4. Nitrate Leaching in Winter Months
5. Phosphorus Leaching
6. Nitrate Leaching Due to Mowing Height
7. Nitrate Leaching Due to Clipping Management
Nitrate Leaching from Newly Sodded Turf

- Floratam St. Augustine turfgrass and Empire zoysiagrass were planted as sod and nitrogen treatments applied same day
- Half of the plots received 2nd nitrogen application 30 days after planting
- N applied as non-coated, quick-release urea granules
- 3 N rates: 0.5, 1.0, 2.0 lbs 1,000 ft\(^{-2}\)
- 2 irrigation regimes
NO$_3$-N Leached From Newly Sodded Floratam

Nitrate-N Leached (kg ha$^{-1}$)

- F1 N 0.5
- F1 N 1.0
- F1 N 2.0
- F2 N 0.5
- F2 N 1.0
- F2 N 2.0

Dates:
- 5/18/2006
- 5/25/2006
- 6/1/2006
- 6/8/2006
- 6/15/2006
- 6/22/2006
Cumulative Nitrate Leaching From Newly Sodded Floratam

![Graph showing cumulative nitrate leaching from newly sodded Floratam. The graph displays the amount of NO3-N leached (kg ha⁻¹) for different N rates (lbs 1,000 ft⁻²) and time points (FT DOP and FT 30 DAP).]
Percent of Applied N Leached From Newly Sodded Floratam

![Bar chart showing the percent of applied N leached from newly sodded Floratam.](chart)

- **NO3-N Leached (kg ha⁻¹)**
- **N Rate (lbs 1,000 ft⁻²)**

- **DOP**
- **30 DAP**
NO₃-N Leached From Newly Sodded Empire

Nitrate-N Leached (kg ha⁻¹)

2005

2008

Turfgrass Science
Conclusions

• Important to note that these rates of leaching are MUCH higher than from established turf
• Do not fertilize newly planted sod for 30-60 days after planting
• Without an established root system, more N likely to leach
• Turf quality and establishment time generally not compromised by lack of fertilization
• While not compared statistically, leaching load was similar between both grasses for the 60-day period following sodding
Nitrate Leaching Due to N Rate

• 3-yr study 2005-2007
• Established Floratam and Empire
• N applied in 4 applications throughout the year at rates of 1, 4, 7, or 10 lbs N 1,000 ft\(^{-2}\)
• Actual rates per application: 0.25, 1, 1.75, 2.5 N 1,000 ft\(^{-2}\)
• Currently recommended N rate for QRN is no more than 0.5 lbs N 1,000 ft\(^{-2}\)
• N applied as quick-release urea dissolved in water and applied through sprayer
<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Cumulative NO$_3$-N Leached (kg ha$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2005</td>
</tr>
<tr>
<td>NR</td>
<td>NS</td>
</tr>
<tr>
<td>Grass</td>
<td>NS</td>
</tr>
<tr>
<td>IR</td>
<td>NS</td>
</tr>
<tr>
<td>NR*Grass</td>
<td>NS</td>
</tr>
<tr>
<td>NR*IR</td>
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<tr>
<td>Grass*IR</td>
<td>NS</td>
</tr>
<tr>
<td>NR<em>Grass</em>IR</td>
<td>NS</td>
</tr>
</tbody>
</table>
Nitrogen Rate Study - Nitrate-N Leaching from Floratam

Nitrogen applied as 100% soluble urea

Trenholm et al. 2009
Nitrogen Rate Study- Nitrate-N Leaching from Empire

Nitrogen applied as 100% soluble urea

Trenholm et al. 2009
Conclusions

• As SA matured after first year, nitrate leaching was minimized, regardless of N rate

• Zoysia more prone to increased leaching as applied N increased
  – Greater disease at higher N rates
  – Lack of healthy turf cover, especially early in season

• Highest tendency for increased leaching occurred in spring and fall, not in summer

• Importance of healthy turf in reducing leaching load
Nitrate Leaching Due to Nitrogen Source

- 8 nitrogen sources applied @ 1 lb N 1,000 ft⁻² 4x yr (consistent with currently recommended rates)
- Established Floratam and Empire
- Study on going through this year
## NO$_3$-N Leaching Due to Nitrogen Source

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Total Cumulative NO$_3$-N Leached (kg N ha$^{-1}$)</th>
<th>Cumulative % Applied N Leached</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen Source (N)</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Grass (G)</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>N x G</td>
<td>***</td>
<td>***</td>
</tr>
</tbody>
</table>
Nitrogen Source Leaching Study - Annual Load from Floratam 2008

![Bar chart showing NO₃- leached (kg ha⁻¹) for different nitrogen sources and methods.]

- Control
- AN
- Urea
- 30% SRN
- 50% SRN
- 30% PCU
- 30% PCU 2 lbs/120
- Mil
Nitrogen Source Leaching Study-Annual Load from Floratam 2009

![Graph showing annual load of NO₃-N leached from Floratam 2009 with different treatments compared to controls.](image)

- **NO₃-N Leached (kg ha⁻¹)**
  - **Control**
  - **AN**
  - **Urea**
  - **30% SRN**
  - **50% SRN**
  - **30% PCU**
  - **30% PCU 2 lbs/120**
  - **Mii**
Nitrogen Source Leaching Study - Annual Load from Empire 2008

![Bar chart showing nitrate leaching load from different nitrogen sources in Empire 2008.](image-url)
Nitrogen Source Leaching Study

Annual Load from Empire 2009

**NO₃-N Leached (kg N ha⁻¹)**

- Control
- AN
- Urea
- 30% SRN
- 50% SRN
- 30% PCU
- 30% PCU 2 lbs/120
- Mil

Legend:
- a
- ------ab-----
- b
Conclusions

• No differences between N sources in Floratam at the rates applied

• Differences in zoysia:
  – AN higher than other sources in 08
  – AN higher than control and 30% PCU in 09

• N source not a key factor in NO₃-N loading from results of this research
Nitrate Leaching in Winter Months

- Apply N at different rates monthly throughout winter to Floratam and Ultimate zoysiagrass
- Control, .125, .25, .50, 1.0 and 2.0 lbs N 1,000 ft\(^{-2}\) mo.
- N applied as non-coated, quick-release urea
Nitrate Leaching in Winter Months

<table>
<thead>
<tr>
<th></th>
<th>Cumulative NO3-N Leached</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2006-07</td>
</tr>
<tr>
<td><strong>Nitrogen Rate</strong></td>
<td>***</td>
</tr>
<tr>
<td><strong>Grass</strong></td>
<td>***</td>
</tr>
<tr>
<td><strong>NR x Grass</strong></td>
<td>***</td>
</tr>
</tbody>
</table>
Cumulative Nitrate Leaching in Winter Months

N Rate, lbs. 1,000 ft^{-2}

2006-07
Cumulative Nitrate Leaching in Winter Months

N Rate, lbs. 1,000 ft\(^{-2}\)

2007-08
Winter Leaching By Month from St. Augustinegrass

Winter leaching from St. Augustinegrass was measured from 2006-07 to 2007-08. The graphs show the leaching for different months and treatments. The leaching was highest in February and March for both years. The control and other treatments showed varying levels of leaching with 6.1, 12.2, 24.5, 49, and 98 treatments.
Conclusions

• While there were few differences in leaching at the lower N rates, NO$_3$-N leached far exceeded leaching that which occurs during the growing season.

• We should not fertilize dormant grass in north Florida – what about central Florida?

• Greatest leaching load occurred in winter/spring vs. fall months.
Overall Conclusions

• Importance of healthy turf to provide cover
• Leaching from SA in particular not affected by N rate or N source when turf is healthy
• Zoysia more affected by higher N rates, but at the recommended N rates for this grass (less than for SA), leaching load minimized
• Timing bans would be better focused on winter/early spring fertilization than summer to reduce potential N loading
We thank the Florida Department of Environmental Protection for funding this research