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

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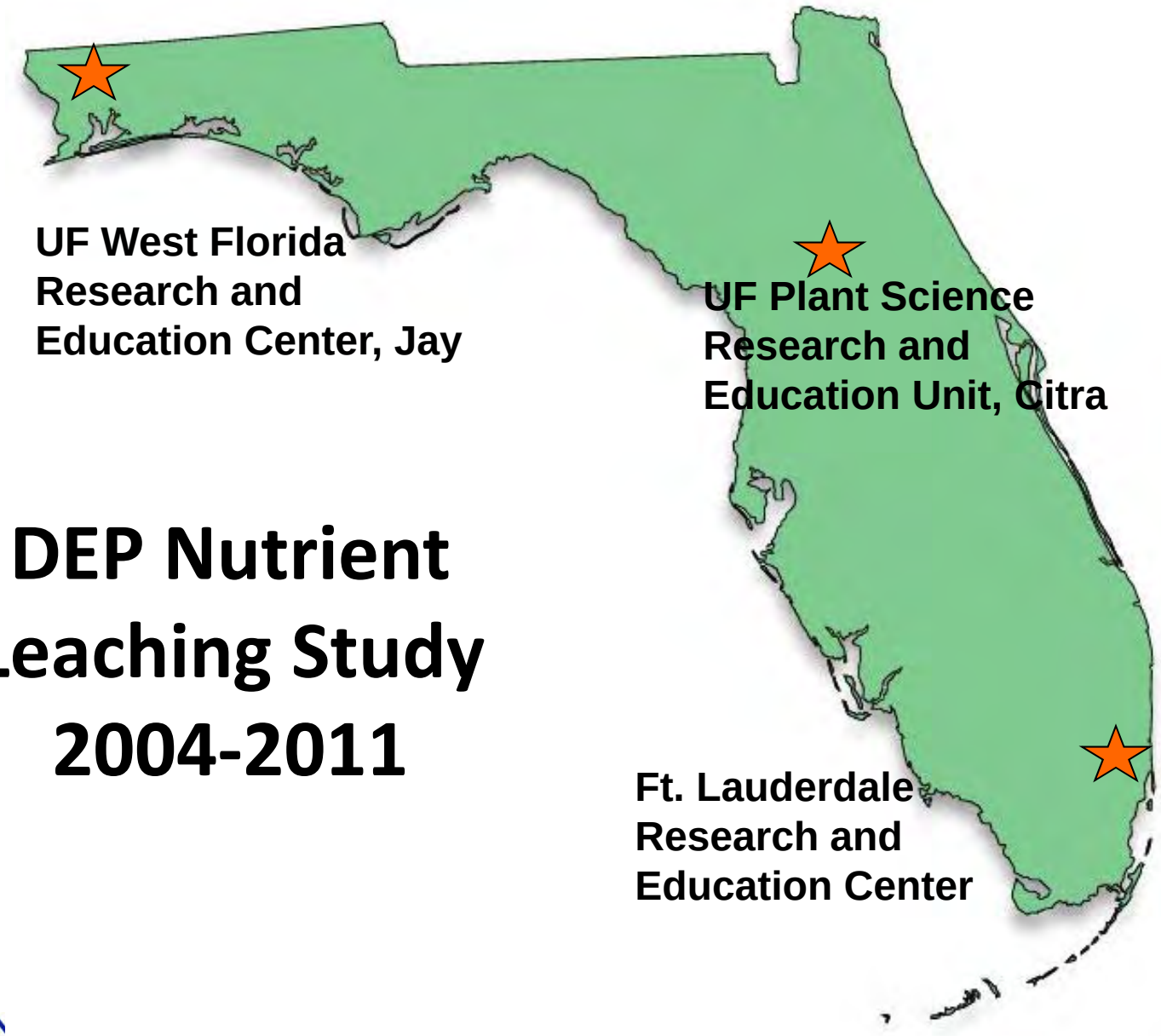

DEP Nutrient Leaching Study 2004-2011

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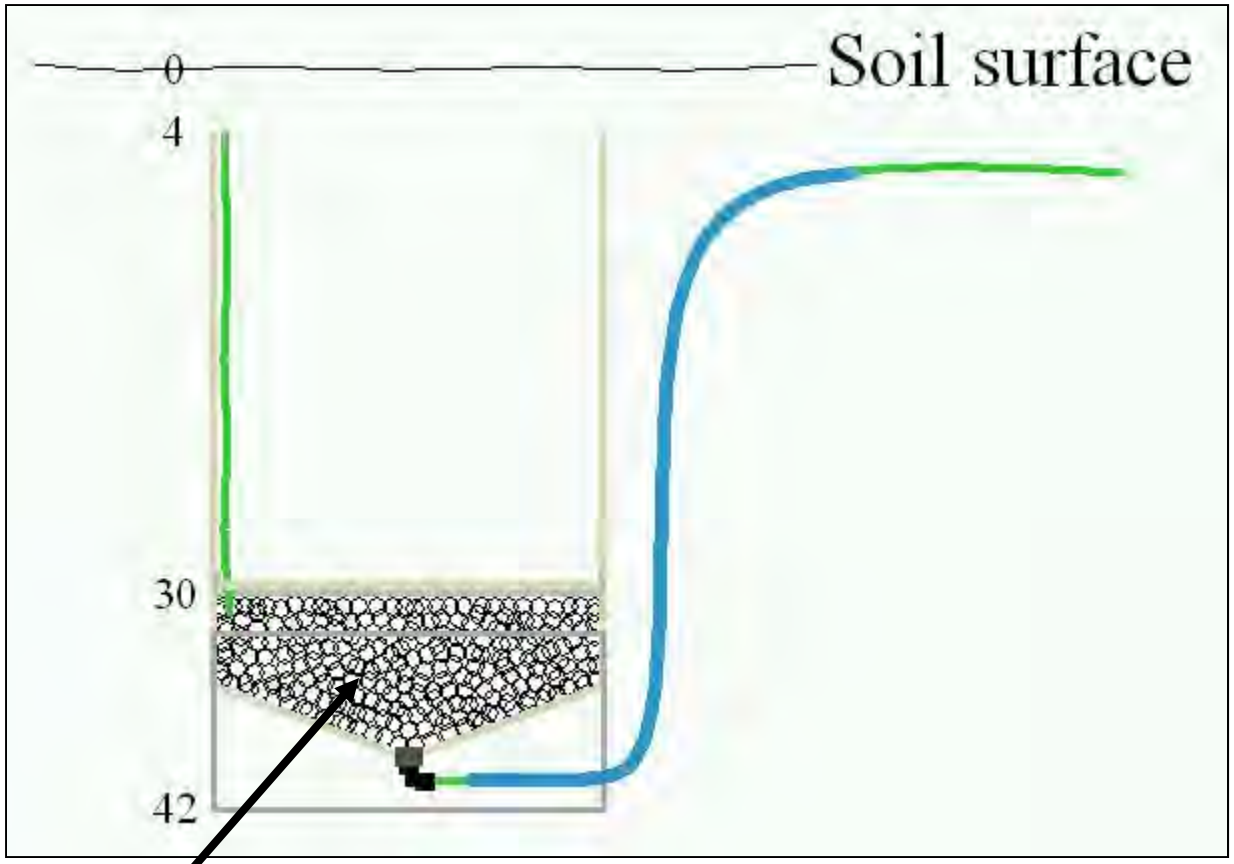
DEP Research – Nutrient Leaching

- Part of a FDEP $4.5 million grant to study nutrient leaching in lawn grasses
- Statewide project
- Apply nitrogen and phosphorus to lawngrasses under a wide variety of circumstances
- Measure visual quality, physiological responses, and nitrate and phosphate concentration in leachate

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 the 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 and Empire 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 water soluble urea 2 irrigation regimes

Treatments

N Rate	Frequency
1. 0.5 lb N	DOP
2. 1.0 lb N	DOP
3. 2.0 lb N	DOP
4. 0.5 lb N	DOP + 30 DAP
5. 1.0 lb N	DOP + 30 DAP
6. 2.0 lb N	DOP + 30 DAP

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Nitrate-N Leached Over 60 Day Study Period

	Total NO_3-N Leached (kg N ha-^{1})			
	Empire		Floratam	
Source of Variation	Yr 1	Yr 2	Yr 1	Yr 2
Nitrogen Treatment (NT)	NS	NS	**	NS
Irrigation (IR)	NS	NS	NS	NS
NT * IR	NS	NS	NS	NS

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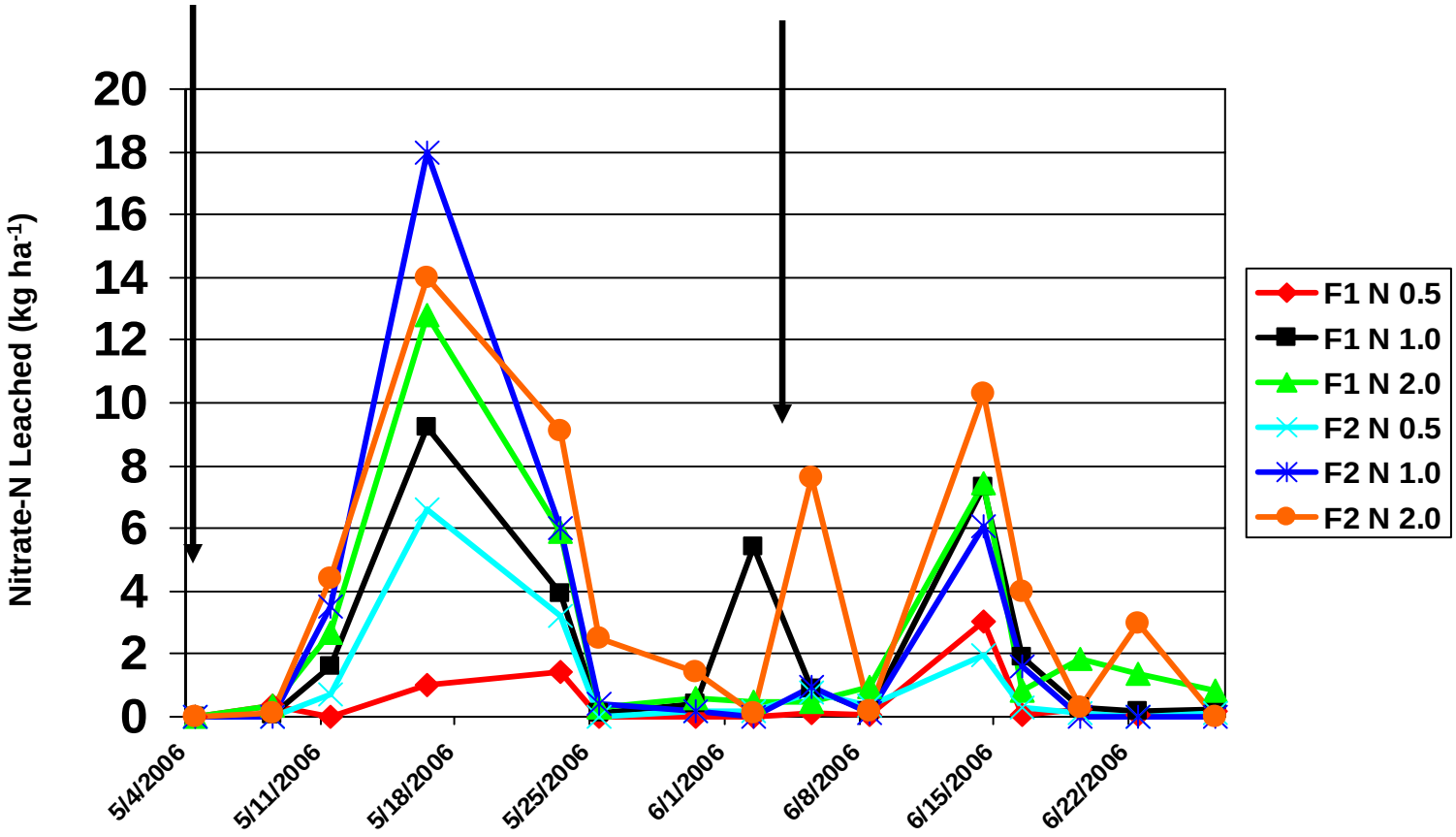
NO_3-N Leached From Newly Sodded Floratam



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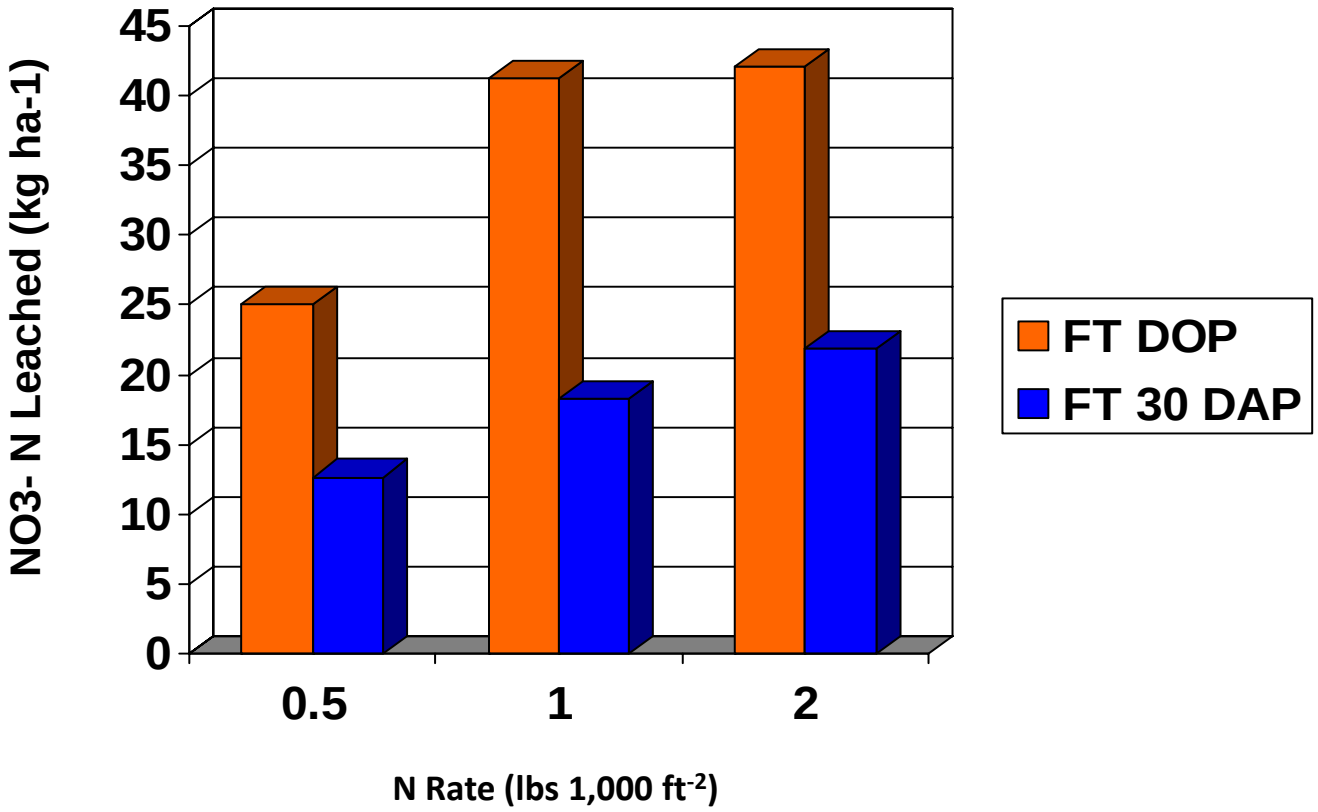
Nitrate Leaching From Newly Sodded Floratam



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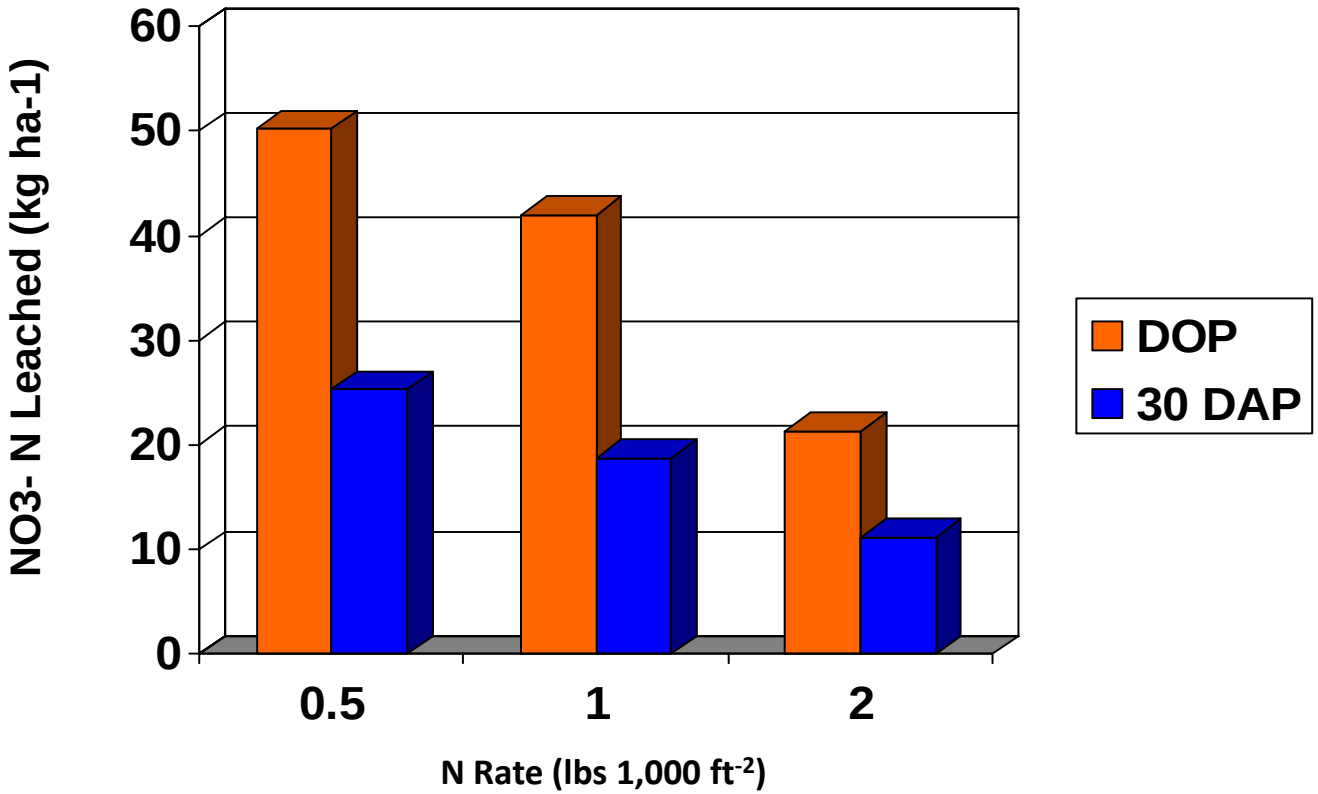
Percent of Applied N Leached From Newly Sodded Floratam



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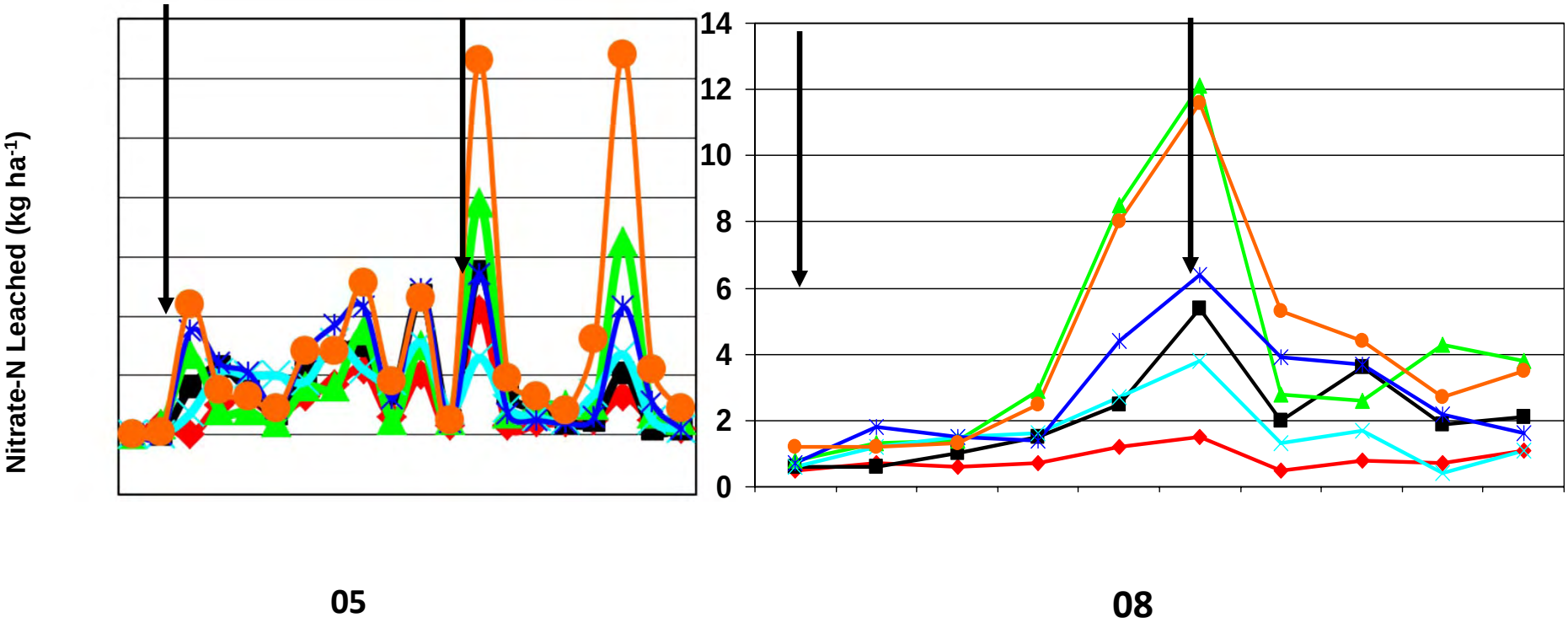
NO_3-N Leached From Empire



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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
- No pre-plant fertilizer incorporation, even with biosolid products
- Without an established root system, more N likely to leach
- Turf quality and establishment time not compromised by lack of fertilization

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}
- N applied as water soluble urea
- 2 irrigation regimes (1” @ 1x wkly, 0.5” @ 2x wkly)

Source of Variation	Cumulative NO_3-N Leached	Cumulative NO_3-N Leached
	kg ha^{-1}	kg ha^{-1}
	2006	2007
NR	**	***
Grass	***	***
IR	NS	*
NR*Grass	NS	***
NR*IR	*	***
Grass*IR	NS	NS
NR*Grass*IR	NS	*

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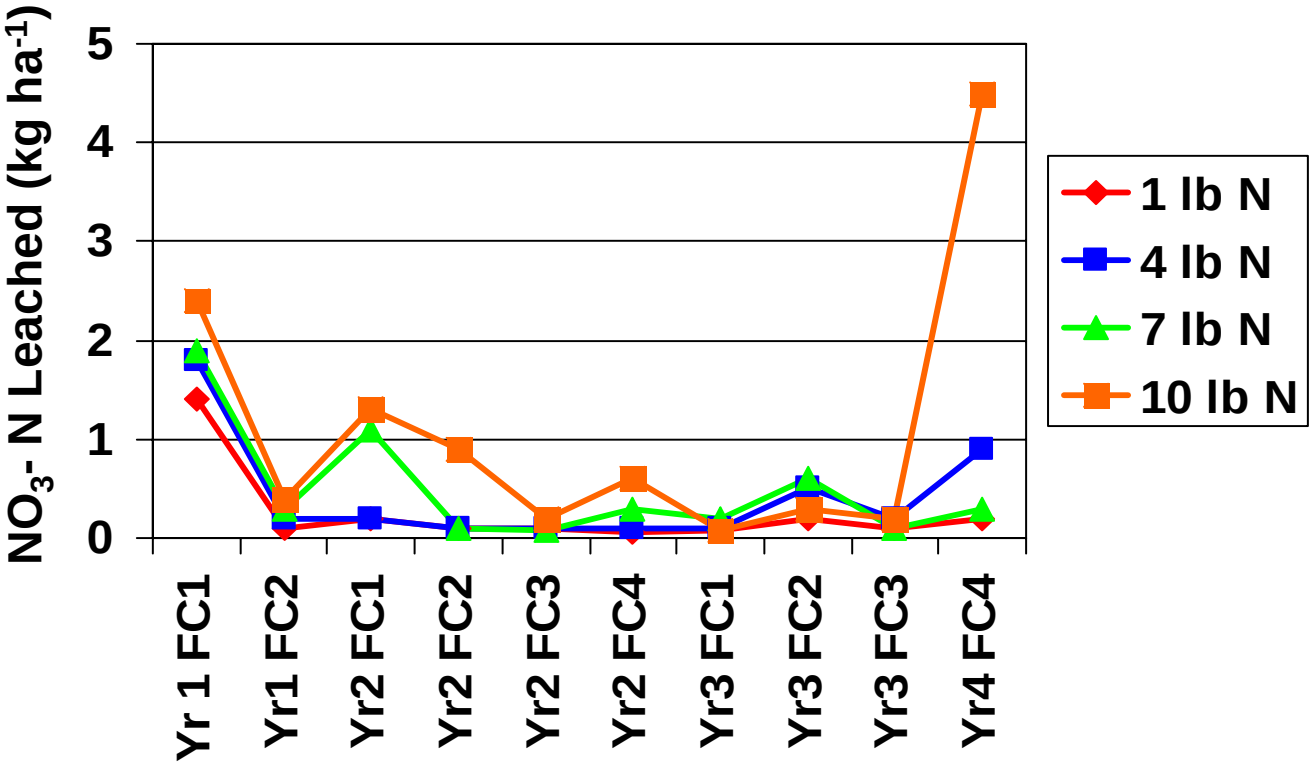
Nitrogen Rate Study - Nitrate-N Leaching from Floratam



Nitrogen applied as 100% soluble urea

Trenholm et al. 2009

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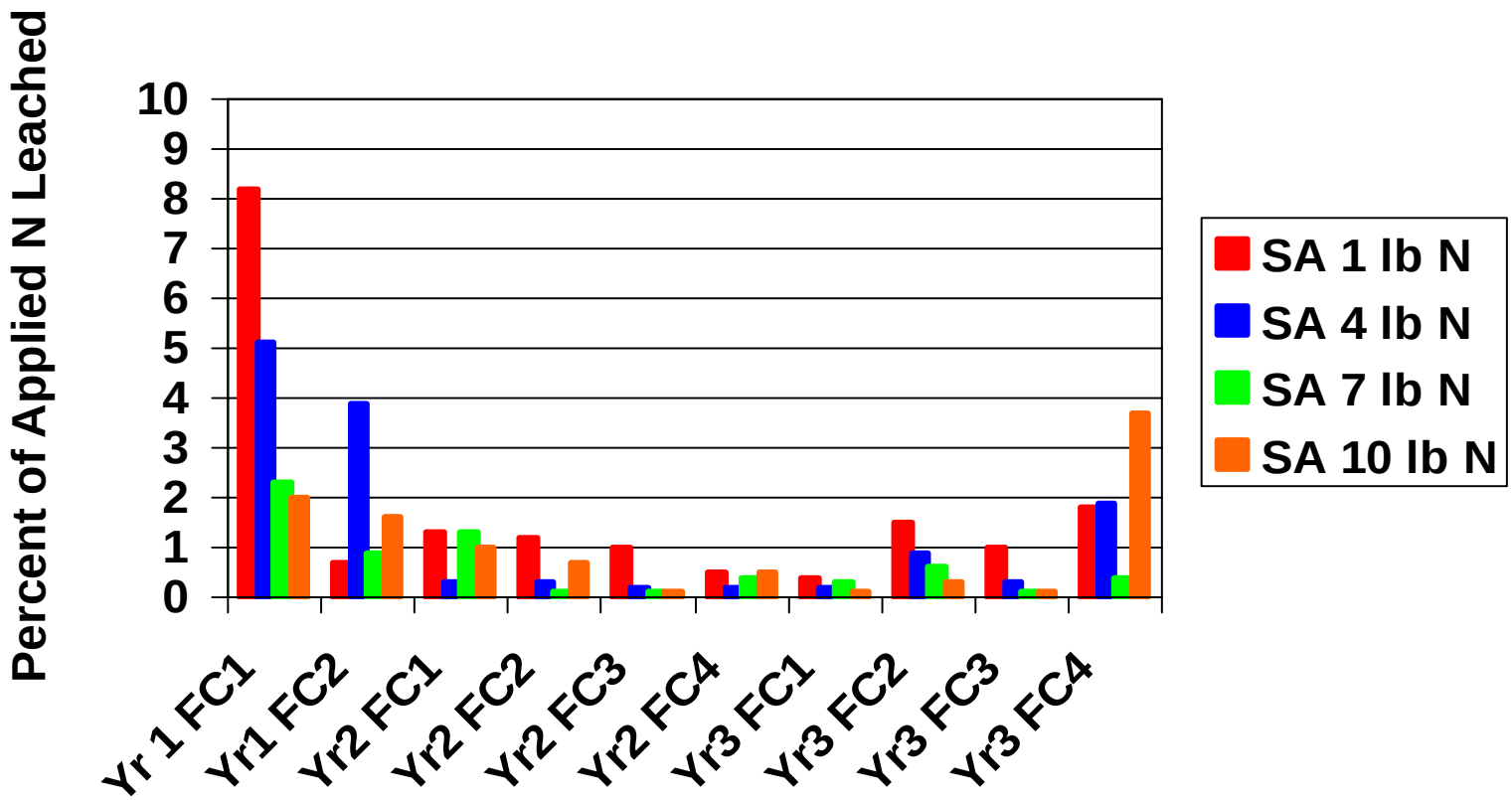
Nitrogen Rate Study -Percent of Applied N Leached from Floratam



Nitrogen applied as 100% soluble urea

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Trenholm et al. 2009

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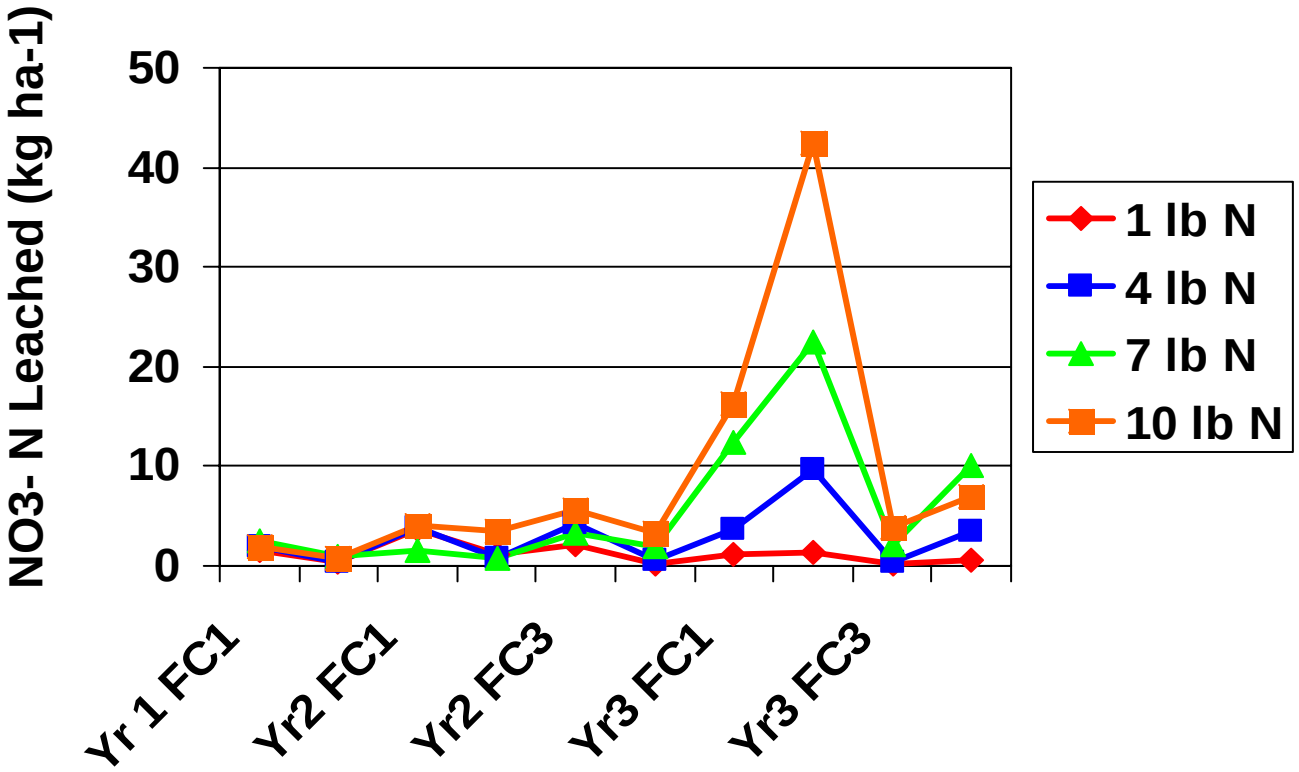
Nitrogen Rate Study- Nitrate-N Leaching from Empire



Nitrogen applied as 100% soluble urea

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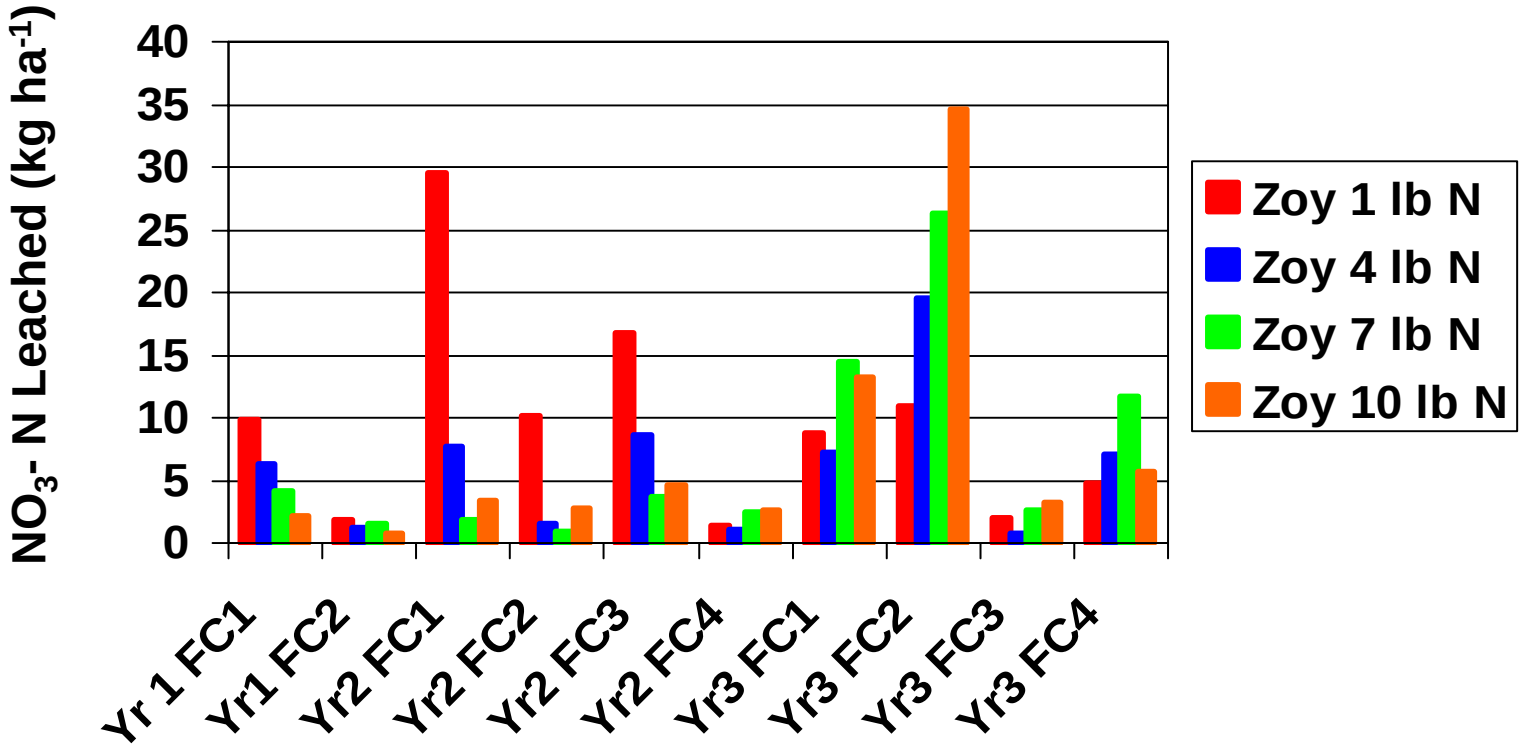
Nitrogen Rate Study - Percent of Applied N Leached from Empire



Nitrogen applied as 100% soluble urea

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Trenholm et al. 2009

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Conclusions

- A healthy turf cover mitigated N leaching loads
- Importance of BMPs in maintaining a healthy turf cover (fertilization, mowing, irrigation)
- As SA matured after first year, nitrate leaching was minimized, regardless of N rate
- When turf cover was eroded, N leaching losses increased
- Current N recommendations for SA are good

Conclusions

- Zoysia more prone to increased leaching as applied N increased
  - Greater disease at higher N rates
- Zoysia N recommendations being revised downwards to reduce disease and potential for greater N losses
- Empire needs for N lower than in SA – quality and color good with less N
- Highest tendency for increased leaching occurred in spring and fall, not in summer

Nitrate Leaching Due to Nitrogen Source

- 8 nitrogen sources applied @ 1 lb N 1,000 ft^{-2} 4x yr
- Established Floratam and Empire
- 4 yr study

Figure 1 - Leaching columns experiment aspects

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Nitrogen Sources

N Sources –applied at 1 lb N every 60 days

1. Control
2. Water soluble ammonium nitrate
3. Water soluble urea
4. 30% Sulfur coated urea
5. 50% Sulfur coated urea
6. Polymer sulfur coated urea (Duration)
7. Polymer sulfur coated urea applied at 2 lbs N every 120 days
8. Milorganite

NO_3-N Leaching Due to Nitrogen Source

Source of Variation	2008	2009	2010	2011
Grass	NS	NS	NS	NS
Nitrogen Source (NS)	***	NS	NS	*
G * NS	***	NS	NS	NS

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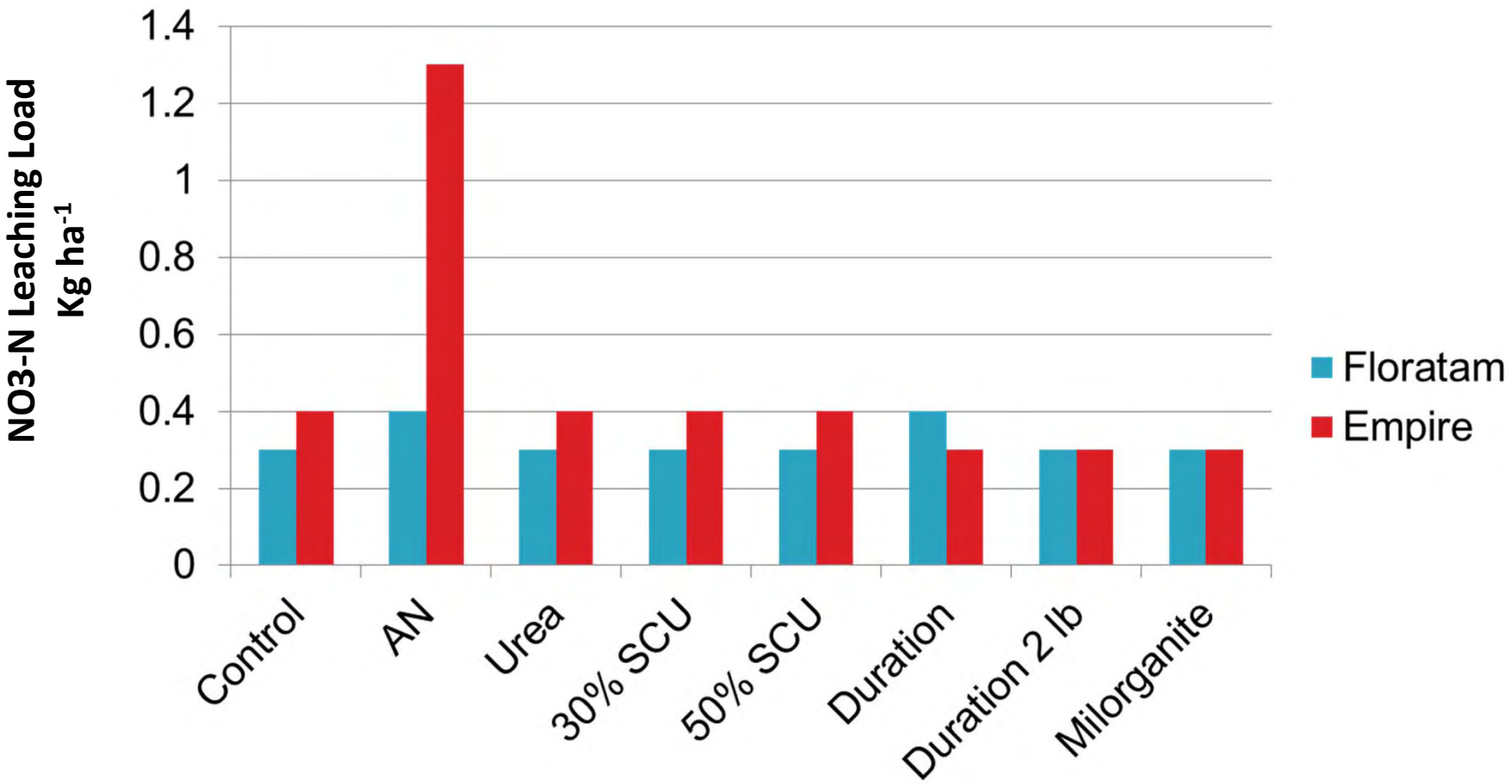
NO_3-N Loads 2008



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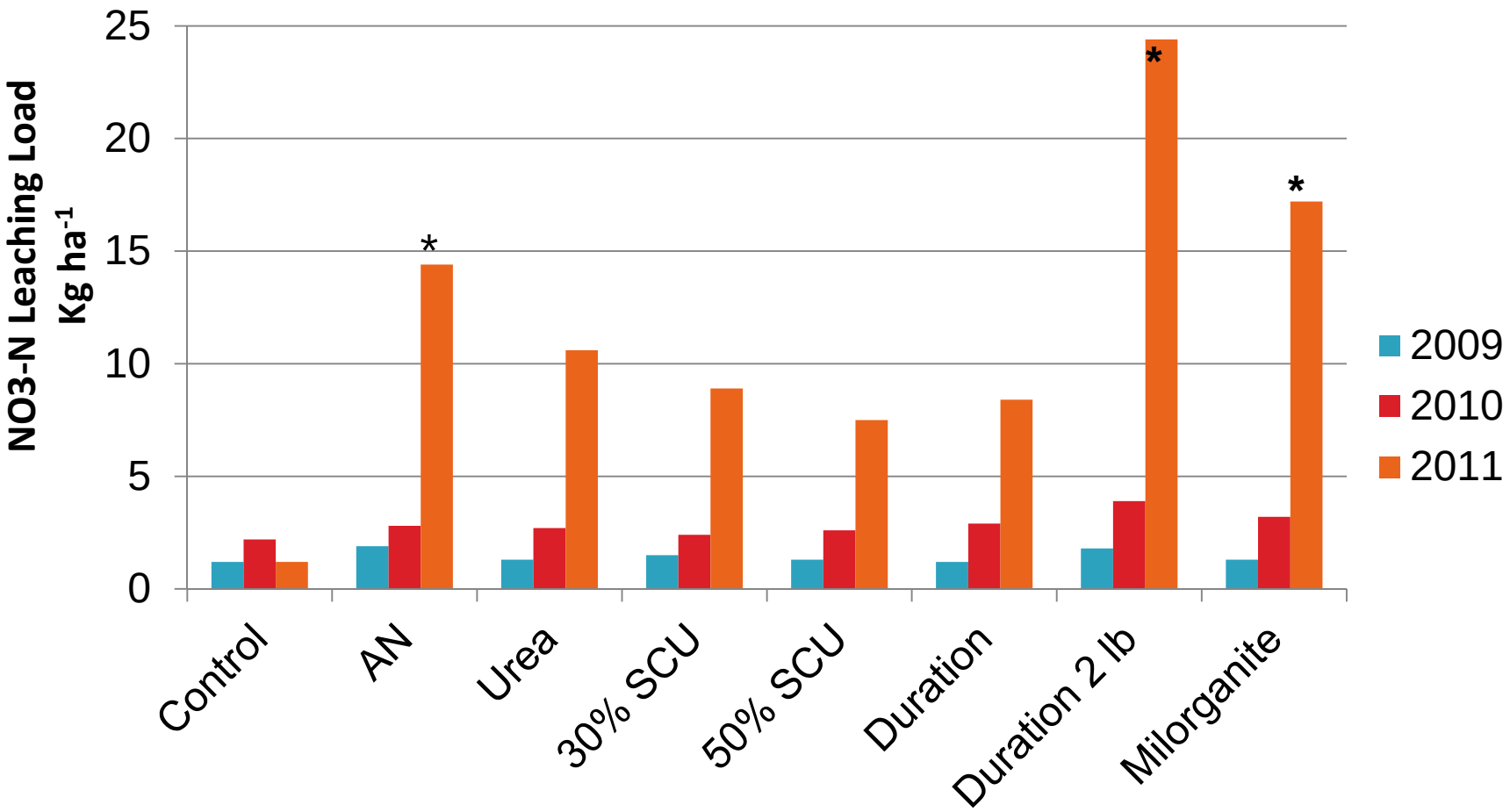
NO_3-N Loads 2009-2011



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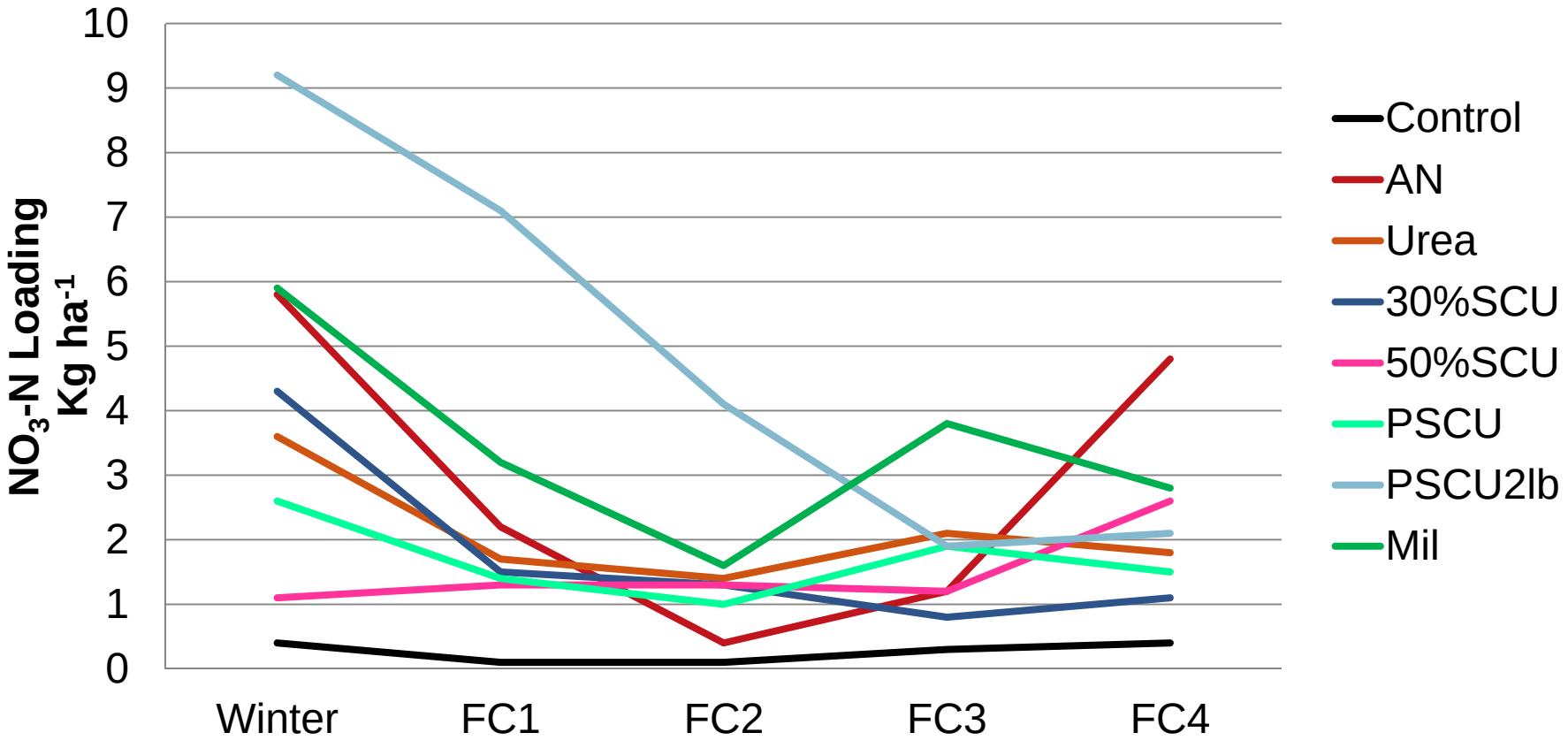
NO_3-N Loading By Fertilizer Cycle, 2011



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Conclusions

- No significant differences in NO3-N loading between grasses
- Differences due to N source in 2 of 4 yrs
- Where differences occurred, greatest loading from AN (2008) and AN, PSCU at 2 lb twice a year, and Milorganite (2011)
- What about ordinances banning use of water soluble N sources?
- Should DACS allow Fertilizer Label Rule to change to allow application of 2 lb PSCU products?
- Should DACS allow Fertilizer Label Rule to change to allow application of up to 1 lb water soluble N?

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 water soluble urea

Nitrate Leaching in Winter Months

	Cumulative NO3-N Leached		
	2006-07	2007-08	2008-09
Nitrogen Rate	**	*	*
Grass	***	***	***
NR x Grass	**	NS	**

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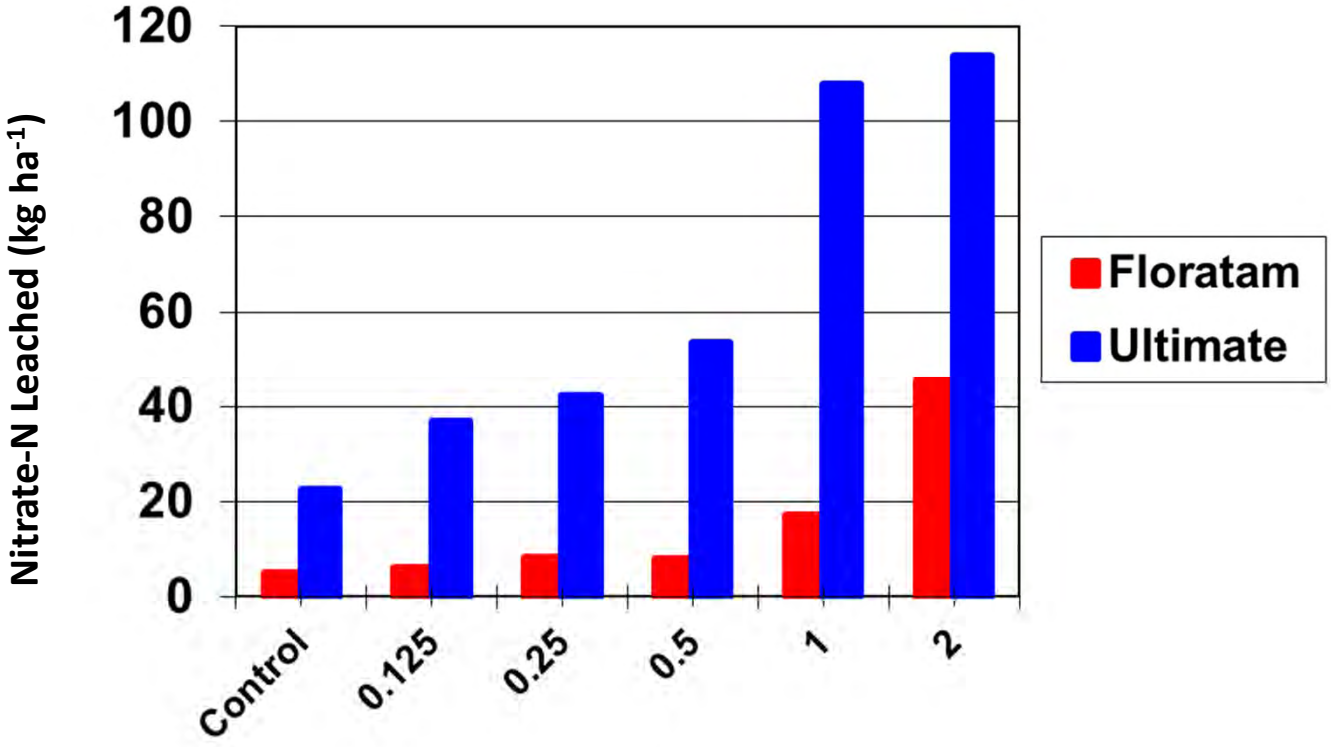
Nitrate Leaching in Winter Months (Yr 1 Nov-March Cumulative)



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

2006-07

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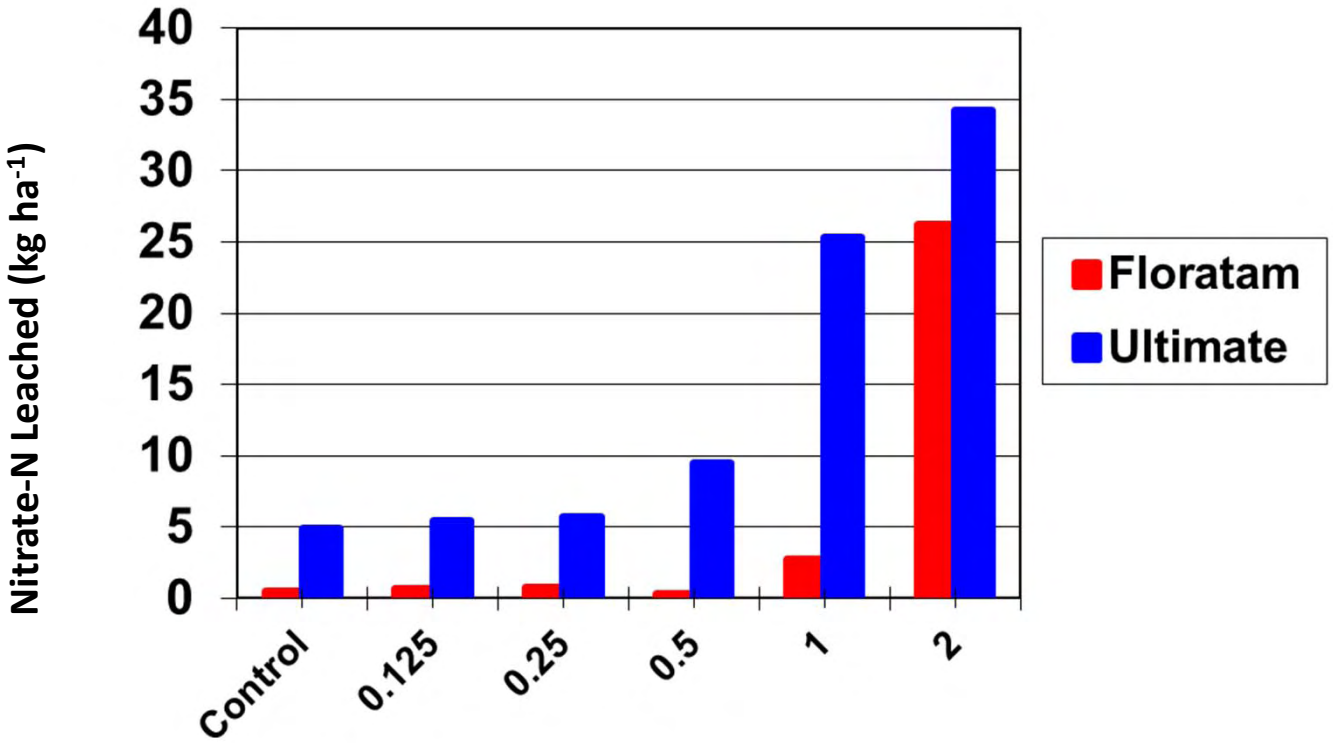
Nitrate Leaching in Winter Months
Yr 2 (Dec-Mar Cumulative)



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

2007-08

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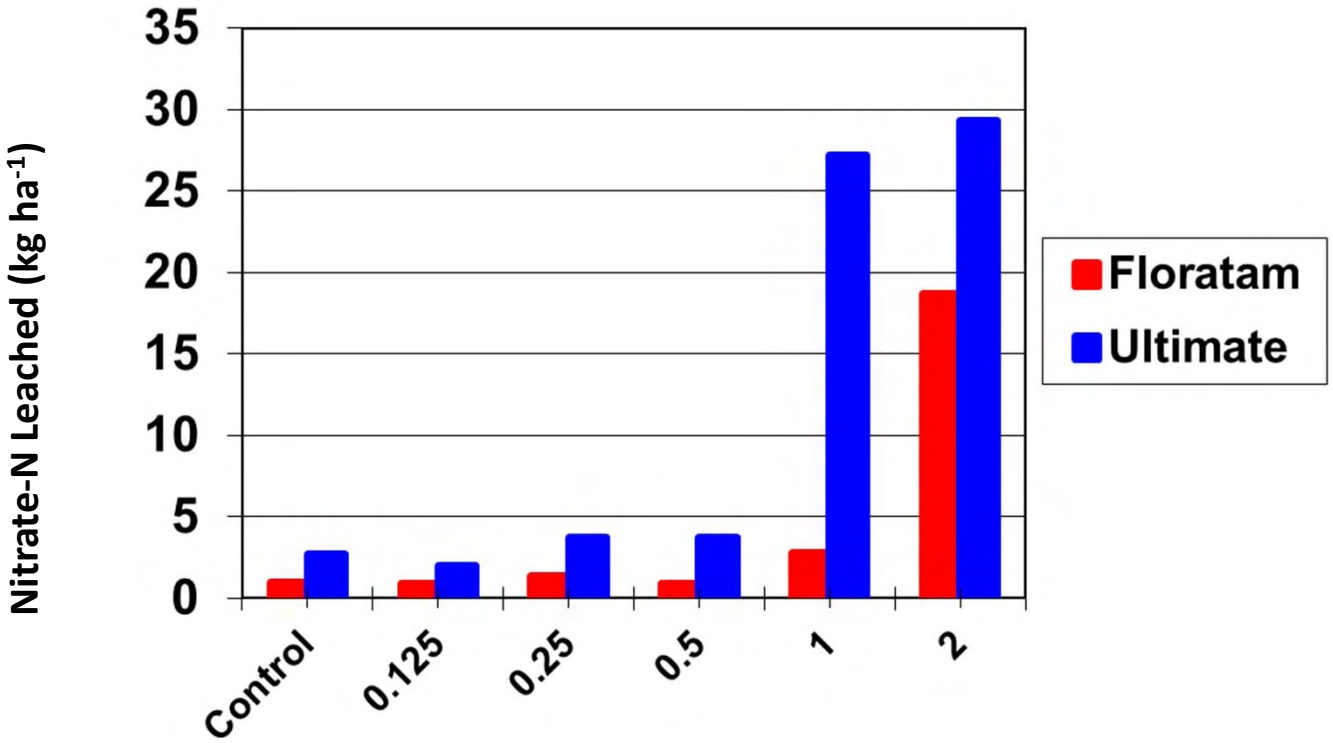
Nitrate Leaching in Winter Months Yr 3 (Nov-March Cumulative)



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

2008-09

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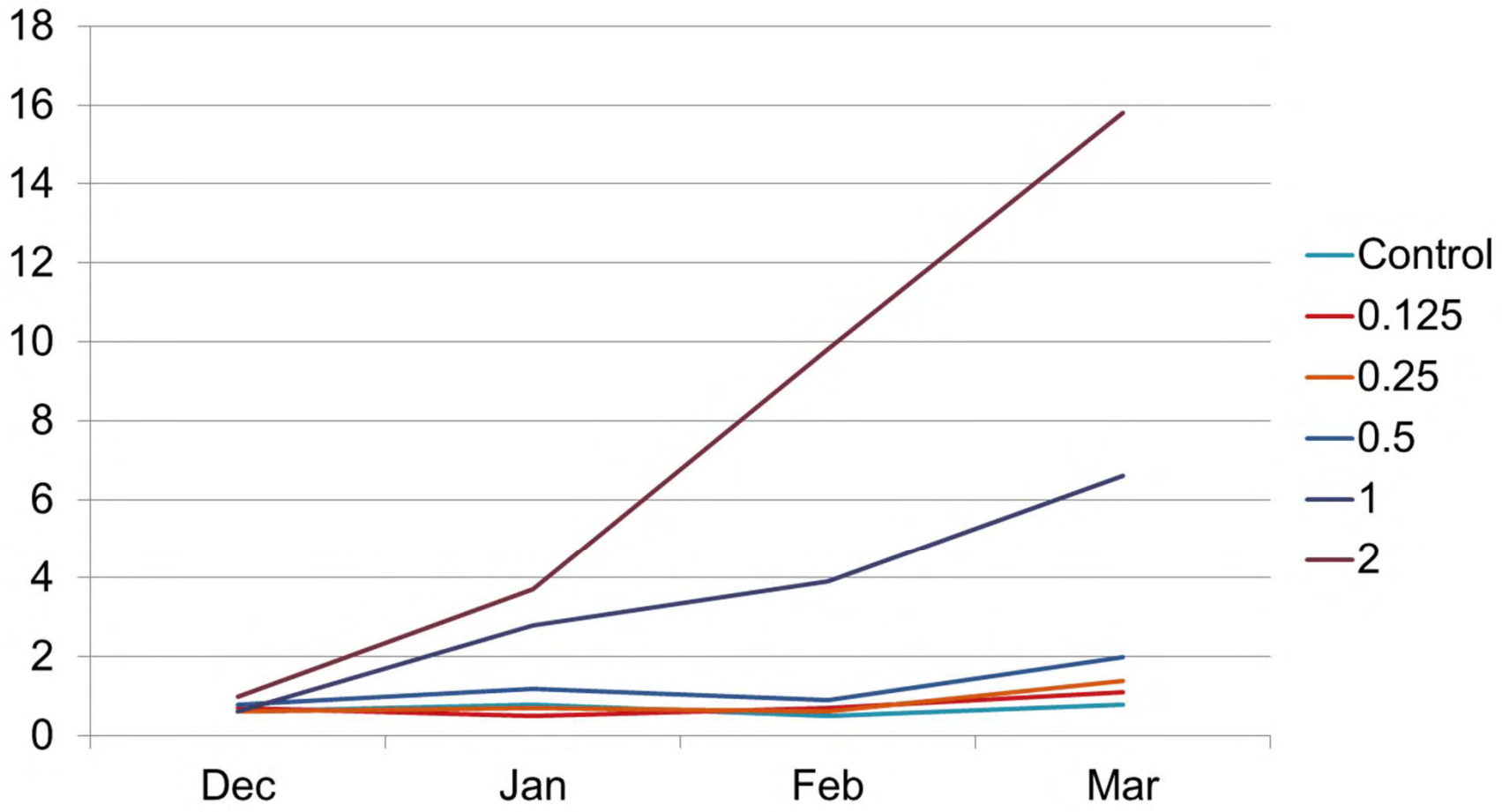
Analysis of Variance by Month

ANOVA by Month	Yr 1	Yr 2	Yr 3
Grass (G)	**	*	*
Nitrogen (N)	***	***	***
Month (M)	***	***	***
G*N	**	NS	**
G*M	***	NS	**
N*M	***	***	***
G*N*M	***	NS	**

NO3-N Loading By N Rate and Month Yr 2



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Conclusions

- While there were few differences in leaching at the lower N rates, these loading rates exceed what occurs during the growing season
- Leaching higher in zoysia and at two highest N rates
- Turf quality/color not improved by fertilization
- Trend towards greater leaching in winter/spring than in fall months
- If additional N applications to be done due to summer bans or contractual obligations, they should be done in fall rather than spring

UF-IFAS Recommended Annual N Rates (South Florida)

St. Augustinegrass: 4-6 lbs N 1,000 ft^{-2} yr^{-1}

Zoysiagrass*: 4-6 lbs N 1,000 ft^{-2} yr^{-1}

Bahiagrass: 2-4 lbs N 1,000 ft^{-2} yr^{-1}

*Empire zoysiagrass needs lower N rates than this to reduce disease and enhance health

**Athletic turf requirements (bermudagrass, paspalum) are greater

Are all turf fertilization events potential pollution events?

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Other Factors to Reduce Nutrient Movement

- Do not apply nitrogen fertilizer at excessive rates – stick to the UF-IFAS recommendations
- Remove fertilizer granules from impervious surfaces
- Remove leaf clippings from impervious surfaces
- Use deflector shields around water bodies
- Maintain a buffer zone around water bodies
- All of these will likely have more impact on reducing pollution than nitrogen source used

We thank the Florida Department of Environmental Protection for funding this research

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