Nitrogen exports from turfgrasses: effects of water conservation practices

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Turfgrass

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Stillwater, OK

U.S. Drought Monitor

November 1, 2011
Valid 7 a.m. EST

South

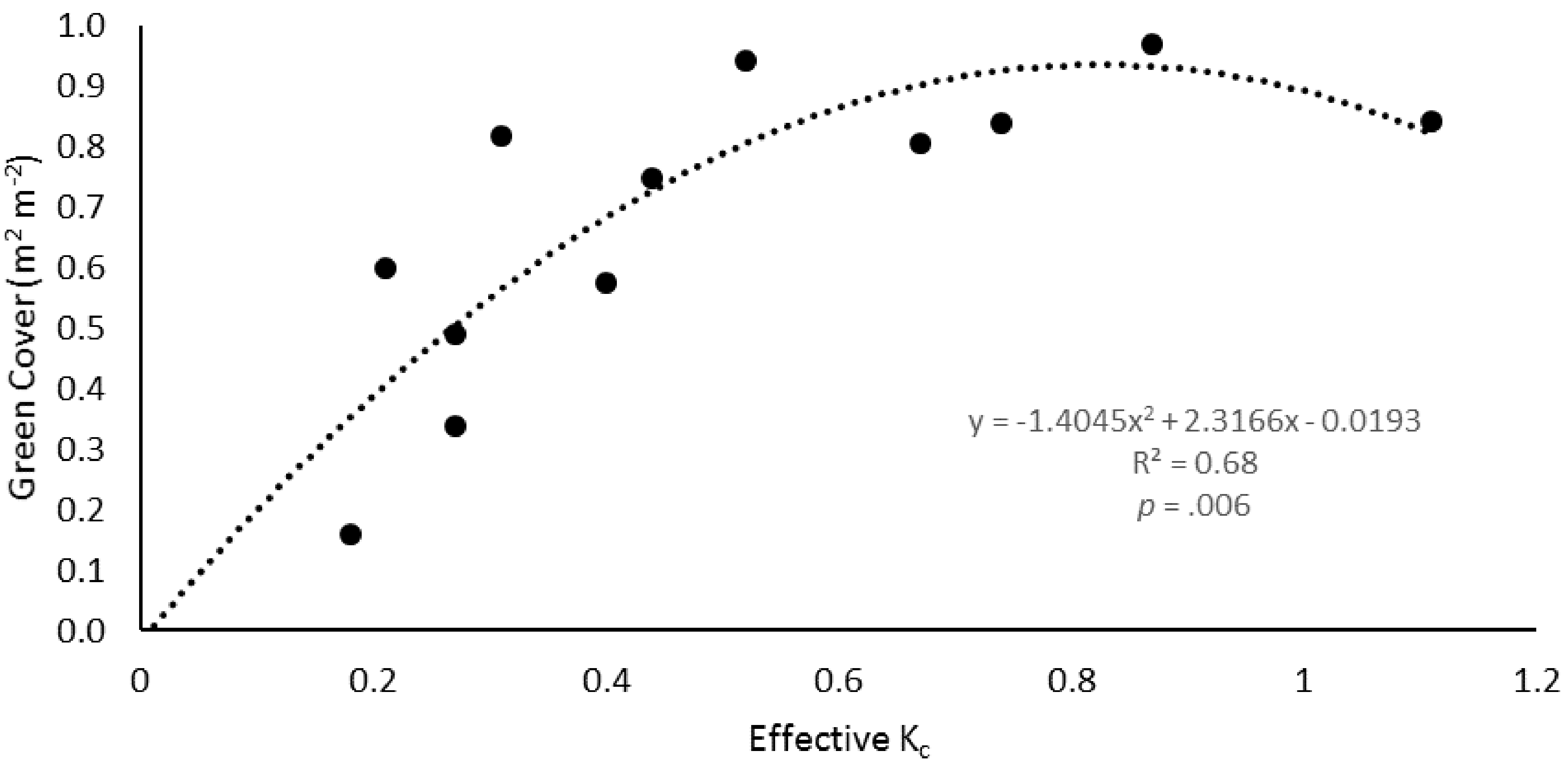
Drought C

	None	D0-D4
Current	11.84	88.16
Last Week (10/25/2011 map)	13.04	86.96
3 Months Ago (08/02/2011 map)	8.30	91.70
Start of Calendar Year (12/28/2010 map)	8.86	91.14
Start of Water Year (09/27/2011 map)	18.34	81.66
One Year Ago (10/26/2010 map)	43.50	56.50

Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe


NO PARKING FIRE LANE



1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Green Cover (m^2 m^{-2})
y = -1.4045x² + 2.3166x - 0.0193
R² = 0.68
p = .006
0
0.2
0.4
0.6
0.8
1
1.2
Effective K_c

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- What happens to Runoff from these types of sites?
  - Dry soil
  - Low plant density
  - Senescing plant tissue

  - Water <u>quantity</u> v <u>quality</u>

Nitrogen Pollution

- Nitrate-N is most often of interest
  - Drinking water standards
  - Bioavailable
  - Highly mobile
  - proxy for total N
- Other forms of interest
  - Ammonium-N
  - DON

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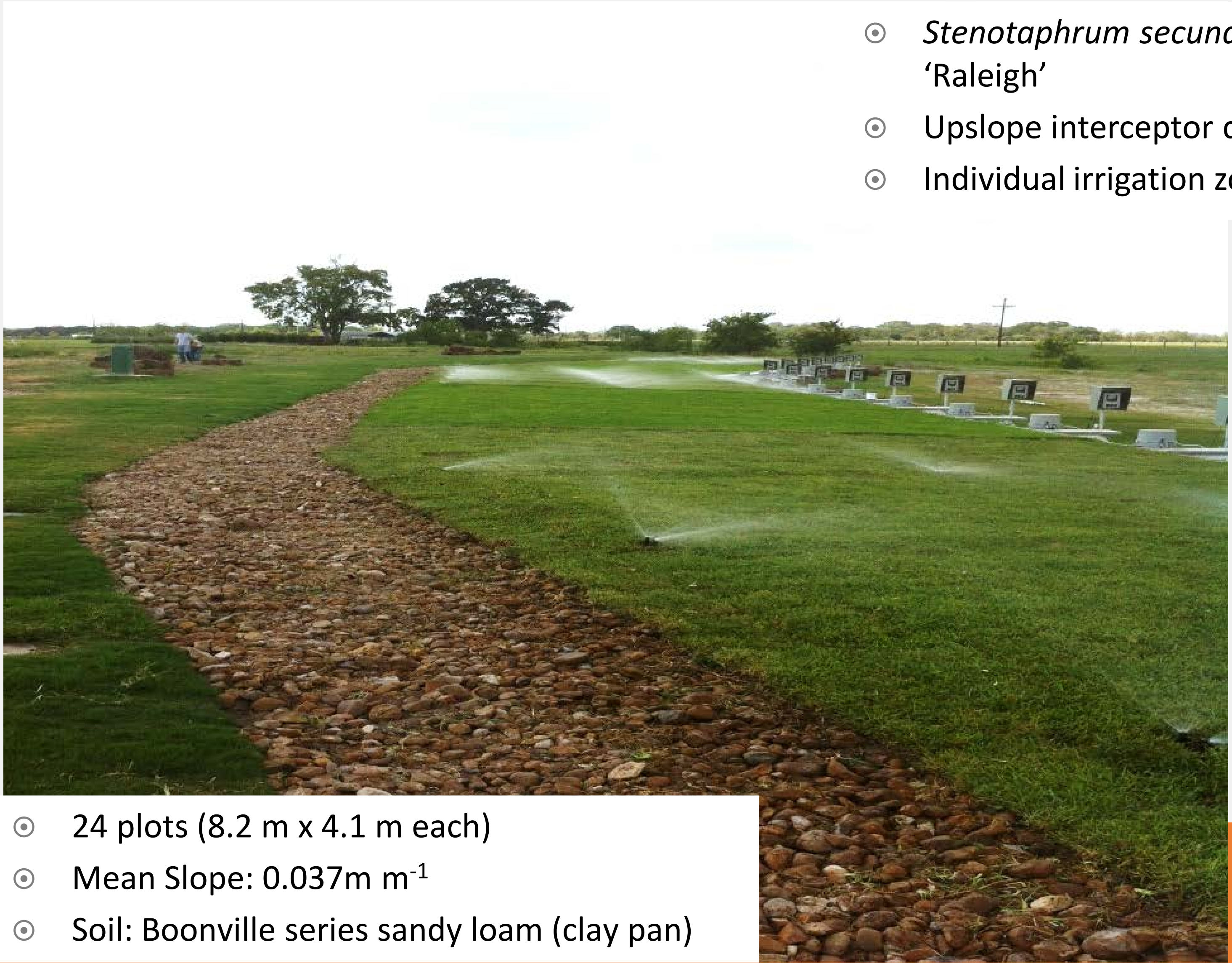
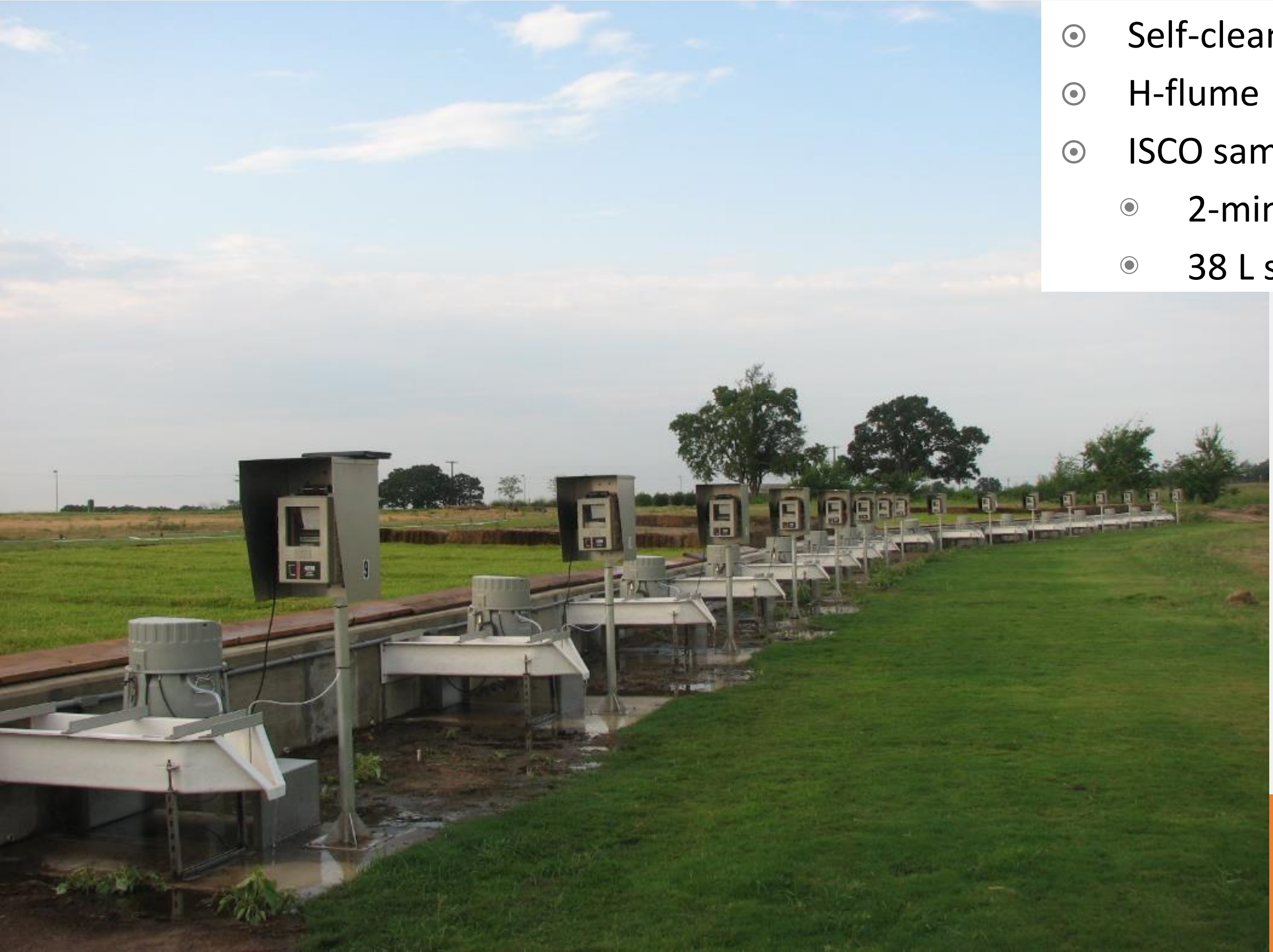
Study Site in College Station, TX

- *Stenotaphrum secundatum* Walt. Kuntz 'Raleigh'
- Upslope interceptor drain
- Individual irrigation zones per plot



- 24 plots (8.2 m x 4.1 m each)
- Mean Slope: 0.037m m^{-1}
- Soil: Boonville series sandy loam (clay pan)

Methods: Runoff capture



- Self-cleaning gutters
- H-flume
- ISCO samplers and bubbler flow meters
  - 2-minute temporal resolution
  - 38 L sampler pacing

Experiment

- Objectives:
  - Investigate the effects of deficit irrigation and N fertilizer rate on N exports in surface runoff from simulated lawns.

- Hypotheses:
  - Deficit irrigation will reduce runoff volume
  - Deficit irrigation will increase Nitrate-N concentration

Treatments

- Tues / Friday Irrigation Schedule
  - 50, 75, or 100% of Estimated Turf Water requirements
  - 4 cycles per morning to reduce irrigation runoff

- Fertilizer Treatments
  - 0, 2, or 4 applications per year
  - N Rate of 40 kg ha^{-1} per app
    - (0.9 lb 1000 ft^{-2})

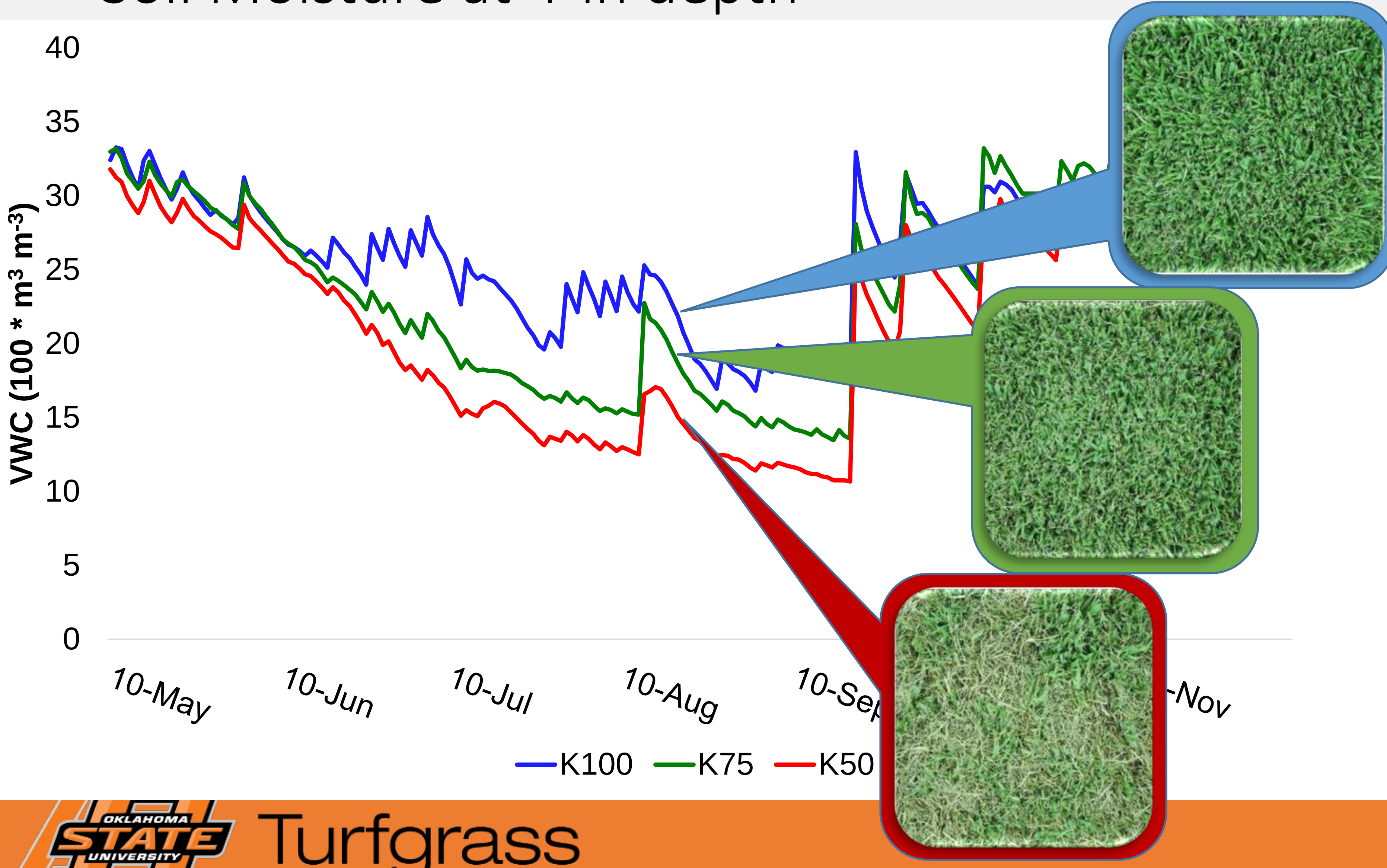
Sampling and chemical analysis

- Samples were vacuum-filtered through ashed Whatman GF/F filters (0.7 micron nominal pore size).
- Nitrate-N was analyzed using Cd–Cu reduction (USEPA method 353.3).
- Ammonium-N was quantified using the phenate hypochlorite method with sodium nitroprusside enhancement (USEPA method 350.1)
- TDN was measured using high temperature Pt-catalyzed combustion with a Shimadzu TOC-V_{CSH} and Shimadzu total measuring unit TNM-1

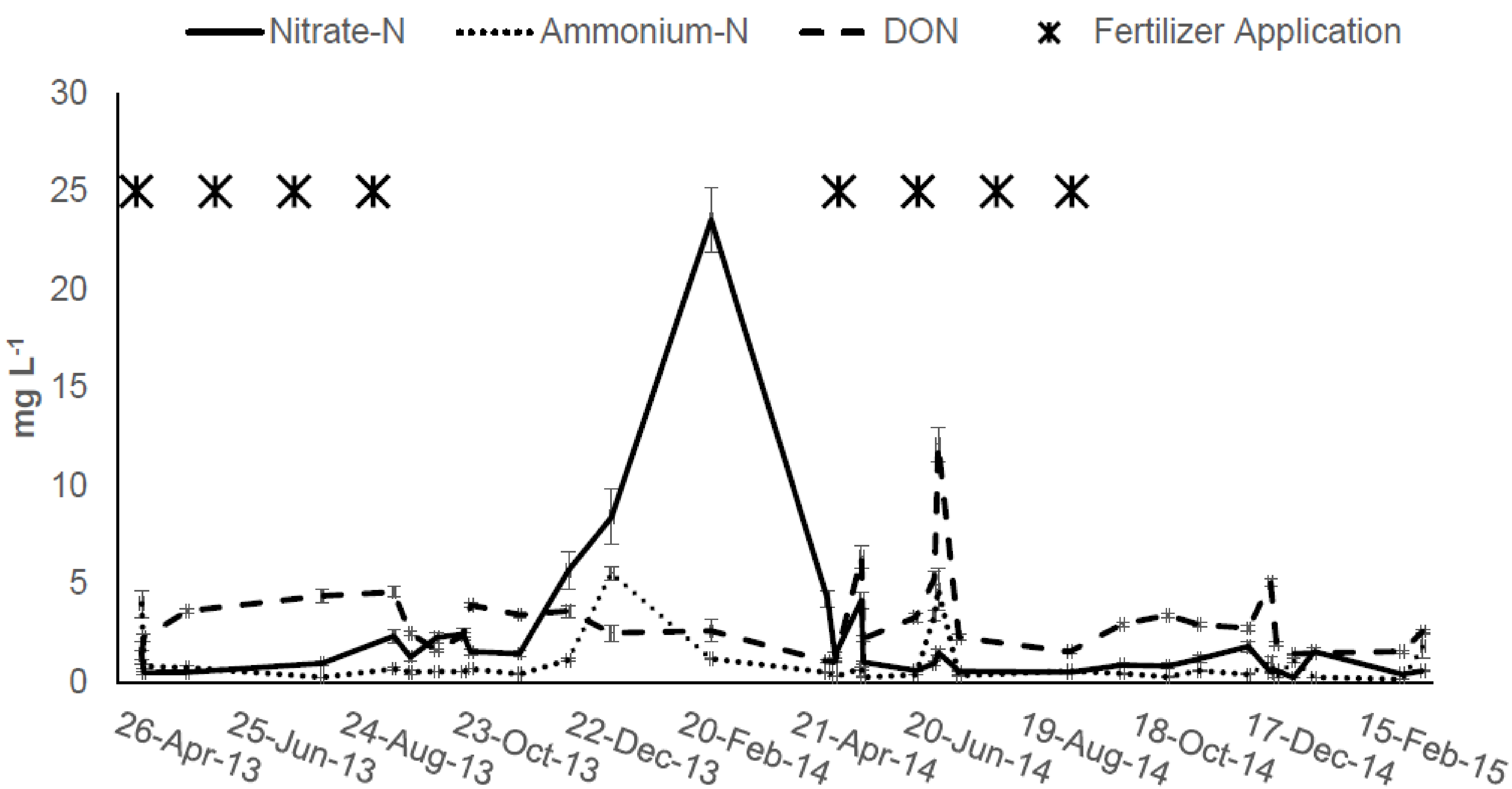
Data Analysis

- Total runoff volume and nutrient concentration in runoff
- Used to calculate nutrient exports (kg ha^{-1})

Soil Moisture at 4-in depth



N species preferences



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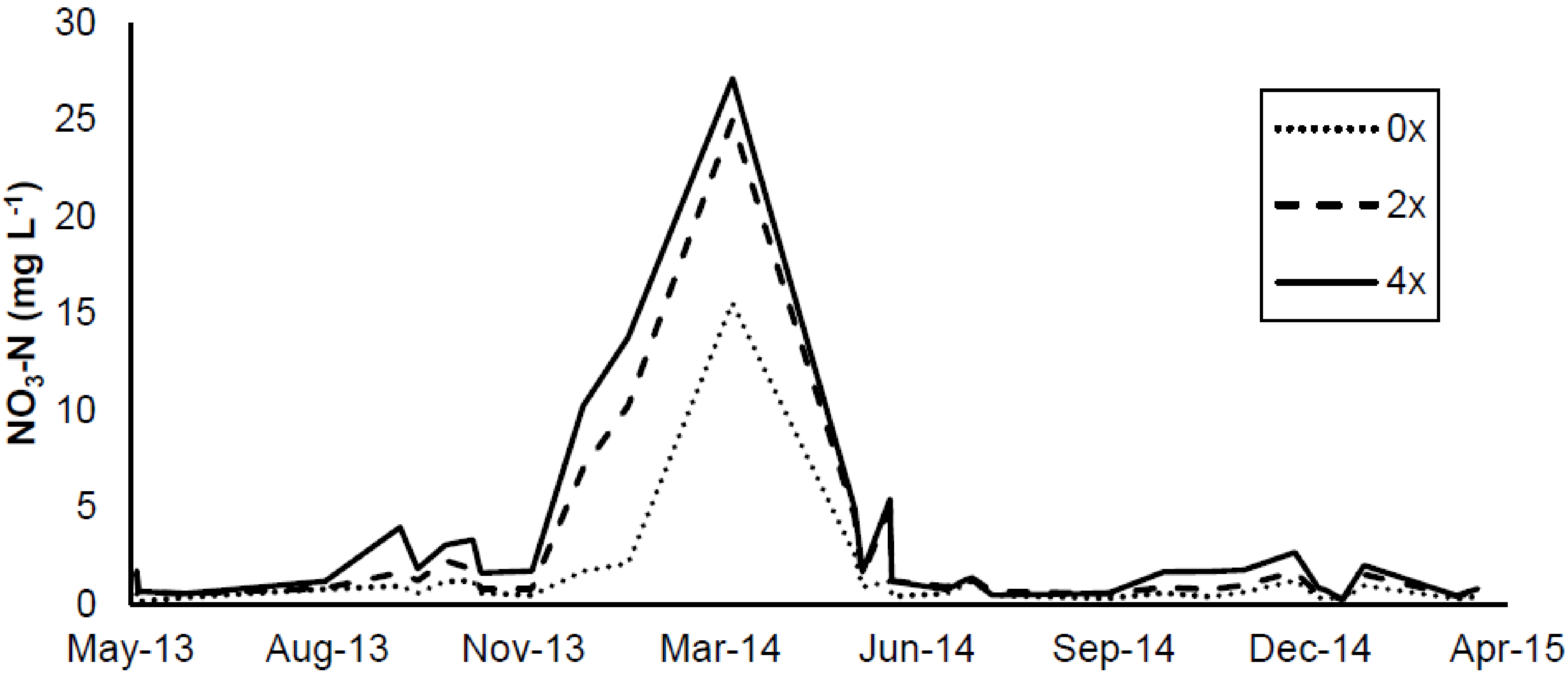
Nitrate-N Concentration and Fertilizer effect



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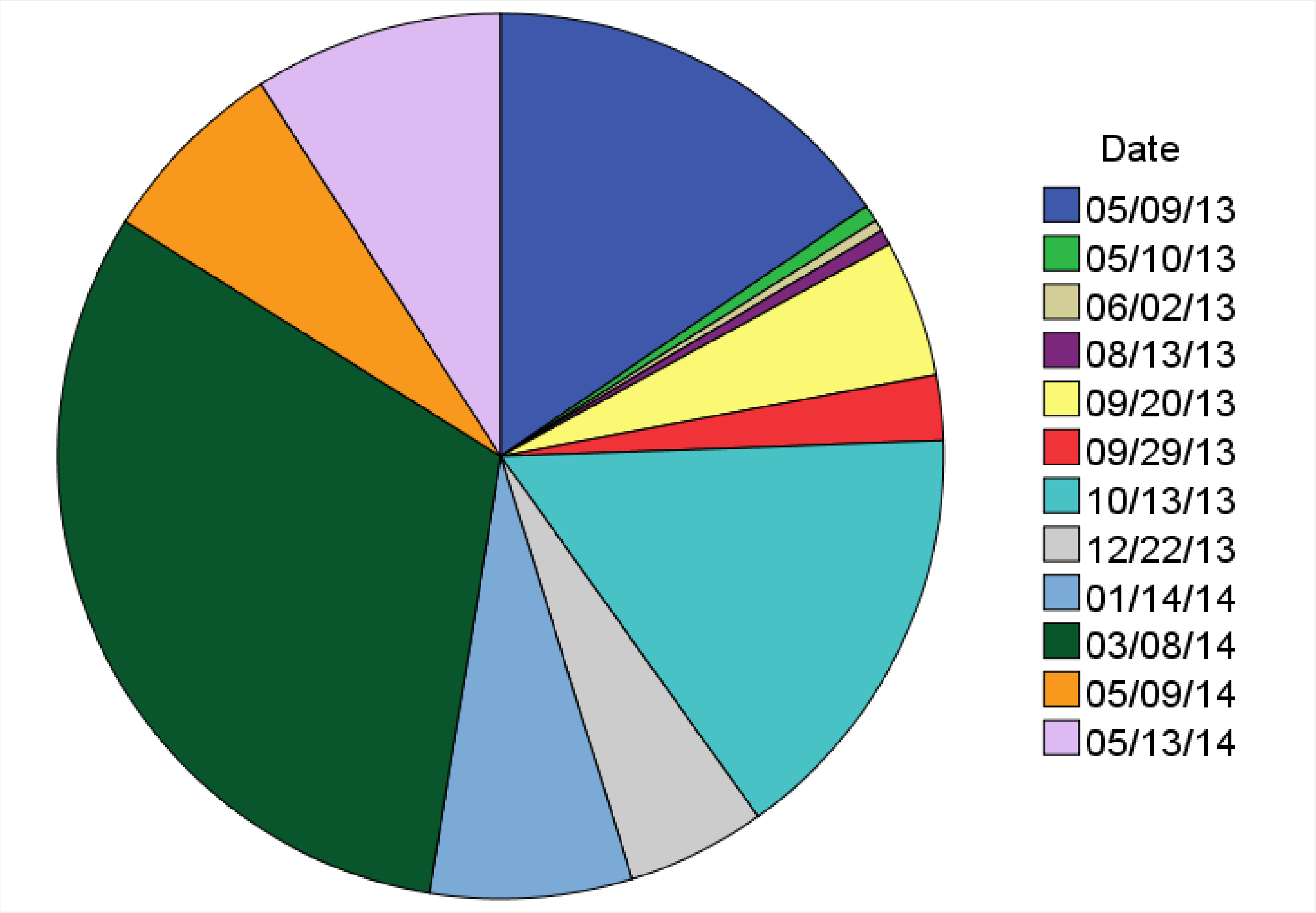
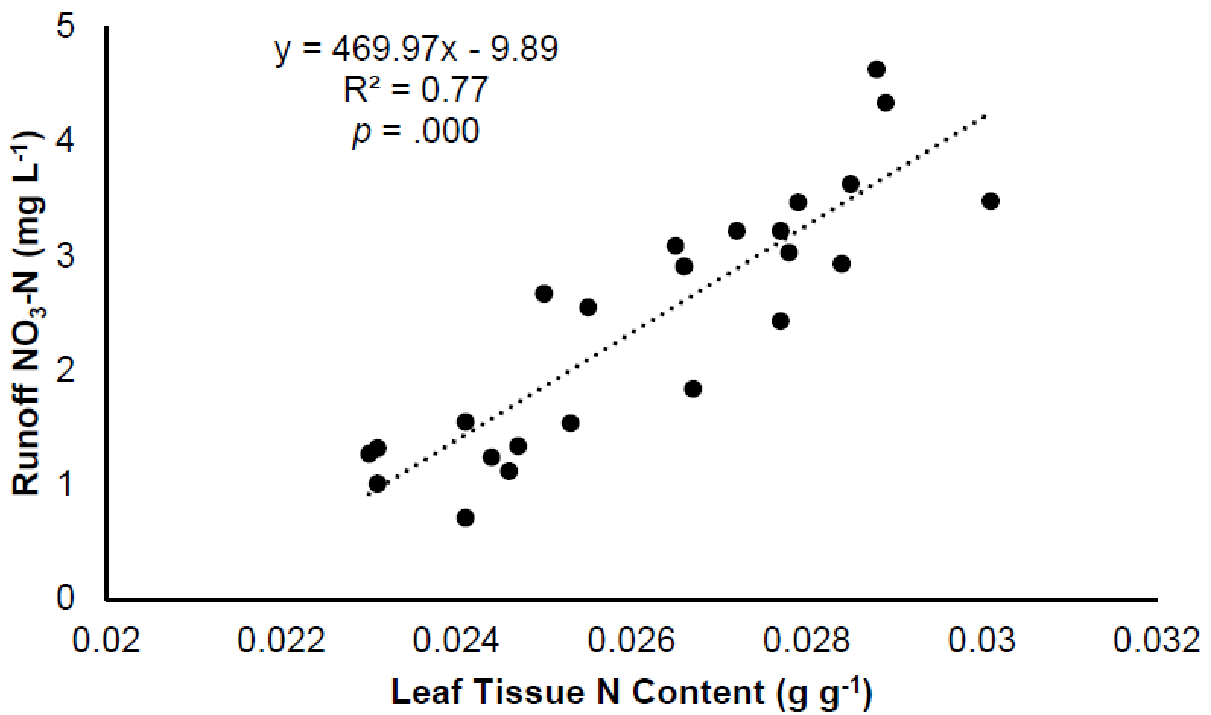
N Exports

	Fertility (F) †	--------0x--------		------------2x------------			------------4x------------			
	Irrigation (I) ‡	*K75*	*K100*	*K50*	*K75*	*K100*	*K50*	*K75*	*K100*	**Mean**
Year	Season§	------kg ha^{-1}------								
2013	Spring	0.18	0.30	0.57	0.38	1.37	0.86	0.82	0.74	0.65
	Summer	0.06	0.34	0.18	0.17	0.45	0.25	0.32	0.67	0.31
	Fall	0.23	0.73	0.65	0.70	1.57	0.91	1.21	1.18	0.90
	Winter	0.70	1.78	2.18	1.96	2.38	2.97	3.14	1.33	2.05
2014	Spring	0.66	0.71	1.60	0.86	2.07	2.42	1.43	1.35	1.39
	Summer	0.49	0.58	0.87	0.83	0.60	0.91	0.66	0.56	0.69
	Fall	0.01	0.01	0.01	0.00	0.01	0.03	0.01	0.03	0.01
	Winter	0.60	0.93	0.89	0.84	0.98	1.47	1.82	0.91	1.05
Total		2.92	5.37	6.95	5.75	9.42	9.81	9.41	6.76	7.05

Nitrate-N Exports



Where does the N come from?



Conclusions

- Deficit irrigation can reduce runoff volumes and therefore NO_3-N exports, But…..
- The benefits are short-lived if N fertility is not adjusted downward.
  - greater N retention in year 1 led to N saturation in year 2.
- Winter and Early Spring Losses can be significant in some years, presumably due to mineralization processes and reduced plant activity.

What's next?

- Seasonal nutrient cycling
  - Cool v warm-season turfgrasses
- Dryland v well-watered
  - worst-case scenario
- Other nutrients?

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Questions

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