

# **Fertilizer Leachate Study at the Wildflower Center Data Report: Data from the Fall of 2006**

## **City of Austin Watershed Protection Department**

**2007      DR-07-03**

### **Summary of Nitrate Leachate Results and Turf Health Rates**

1. Blocks have significantly different nitrate leachate. Blocks A and B, which have different soils, have high nitrate leachate levels.
2. Treatment NO<sub>3</sub> leachate means within blocks do not have a recognizable pattern. Fertilizers applied at higher rates do not necessarily have higher nitrate leachate.
3. Treatment leachate NO<sub>3</sub> means are not significantly different, and for blocks C and D are below 1 mg/L.

#### **• Sources**

1. All means are low enough that we would consider all of them acceptable.
2. Blocks, Treatments and the interaction between blocks and treatments are all significant. Thus the interpretation is difficult and uncertain.
3. Amonium sulfate and urea have higher means than the slow release fertilizers and the natural organic fertilizer. The control had the lowest mean.

#### **• Products**

1. Products are not significantly different from each other.
2. Turf Builder has the highest mean and the control has the lowest mean.

#### **• Native Grass**

1. No leachate was collected beneath the native grass in Block J. Only one sample was collected from Block A. The soil in blocks A and J were significantly different.
2. The leachate from Block A was high, reflecting the soil, not a fertilizer, as no fertilizer was applied.

#### **• Turf Health and Nutrient Levels**

1. Turf health was good for all plots.
2. Tissue phosphorus levels were either good or high; nitrate levels were either low or good. Remember that these levels are designed for crop production, not for appearance. Turf appearance was good for all studies and treatments.

3. Blocks have significantly different turf nutrients. This is probably related to soil levels.
4. Treatments within studies are not significantly different, except for phosphorus levels in the product study where Control and Polyon41 levels were slightly higher than the levels for Turf Builder and Exalt.
5. Native grass had significantly lower phosphorus levels than the other three studies which had equivalent levels.

## **Introduction**

### **Study objective(s) for the Fall of 2006**

- To find fertilizers that we can recommend to the Austin area homeowner which
  1. Have nitrate and phosphorus leachate concentrations low enough to prevent further degradation to our environmentally sensitive karst aquifer (<3.5 mg/L?)
  2. Could be formulated to be easily spread at our recommend rate of ½ lb. per 1000 sq. ft. (possibly > 1/2 lb. per 1000 sq. ft. if N is really slow release)
  3. Do not result in unsustainable levels of phosphorus in area soils
- Determine if there really is a slow release inorganic fertilizer for Texas

### **Site description:**

80 plots at the Wildflower Research Center. Research areas are composed of raised bed blocks with limestone edging 16' wide by 16', 20', or 24' long with right triangles with 4' legs removed from the corners. Thus they are somewhat hexagonal in shape. Treatment blocks are divided in treatment plots by metal dividers which extend from just below the grass surface to the bottom of the raised bed. This is below the top of the lysimeter. Blocks contain 8, 10 or 12 treatment plots. Each treatment plot is approximately 4' by 8' with the exception of the corner plots which are 4' wide and 4' long on one side and 8' long on the other side. Plot surface is sloped slightly so that water will not pond in the raised bed blocks during rainfall.

### **Rates**

Objectives:

- Comparison of slow release N sources applied at rates bracketing the typical rate of 1 lb/1000 sq. ft. twice per year to determine variation in potential leaching losses from different application rates.
- Comparison of turf health in terms of color and clipping nutrient levels to minimally acceptable standards.

There are four fertilizer treatments, two rates and four replicates. Fertilizers are

- Sulfur Coated Urea: 42-0-0
- MU: urea:formaldehyde ratio of 1.7:1 – Nutralene (NuGro) 40-0-0
- MU: urea:formaldehyde ratio of 1.3:1 – like MethX 40-0-0 ( get from Lebanon)
- Polyon: 43-0-0 (get from Purcell)

Rates: 1/2 lb per 1000 sq. ft. and 2 lbs. per 1000 sq. ft.

Hypotheses:

- Leaching losses for the high rate will be above levels potentially harmful to aquatic life even for slow release sources (Sulfur coated urea, Methylene Urea, Polyon coated urea)
- Turf health in terms of color and grass nutrient levels will be acceptable for the lowest application rate, even for slow release fertilizers

## Sources

Objective: Comparison of N sources to determine variation in potential leaching losses from individual fertilizer applications. There are eight nitrogen sources and 4 replicates. Urea and ammonium sulfate are quick release fertilizers, the remainder are slow release.

Fertilizers

- None - control
- Urea: 46-0-0 (available at Howard's)
- Ammonium sulfate: 21-0-0 (available at Howard's)
- Sulfur Coated Urea: 42-0-0
- MU: urea:formaldehyde ratio of 1.7:1 – Nutralene (NuGro) 40-0-0
- MU: urea:formaldehyde ratio of 1.3:1 – MethX 40-0-0 ( get from Lebanon)
- Polyon: 43-0-0 (get from Purcell)
- Natural organic: 8-2-4; N source is poultry litter (get from Lady Bug)

Rates: 1 lb/1000 sq. ft. twice per year: late spring – May 18, early fall – September 7.

Hypotheses:

- Leaching losses will remain below levels potentially harmful to aquatic life for slow release sources (Sulfur coated urea, Methylene Urea, Polyon coated urea, poultry litter)

## Products

Objectives:

- Comparison of commercially available slow release N sources applied at manufacturer recommended rates to determine variation in potential leaching losses.
- Comparison of turf health in terms of color and clipping nutrient levels to minimally acceptable standards.

There are four fertilizers and three replicates.

- Purcell's Polyon 41-0-0 (applied once in spring at 2 lb/1000 sq.ft.- manufacturer's recommended rate)
- Scotts Turf Builder 26-2-13 applied at 1 lb/1000 sq. ft. twice per year: late spring – May 18, early fall – September 7.
- Lebanon's Exalt 25-0-12 applied at 1 lb/1000 sq. ft. twice per year: late spring – May 18, early fall – September 7.
- None – Control

Hypotheses:

- Leaching losses will be below levels potentially harmful to aquatic life for all fertilizers
- Turf health in terms of color and grass nutrient levels will be acceptable for the all fertilizers

## Native Grass

Objectives:

- Comparison of leachate from native grass vs. St Augustine with no fertilizer.
- Comparison of turf appearance in terms of color and homogeneity (cover of live canopy)

Native grass with no fertilizer with three replicates vs. St. Augustine with no fertilizer with two replicates.

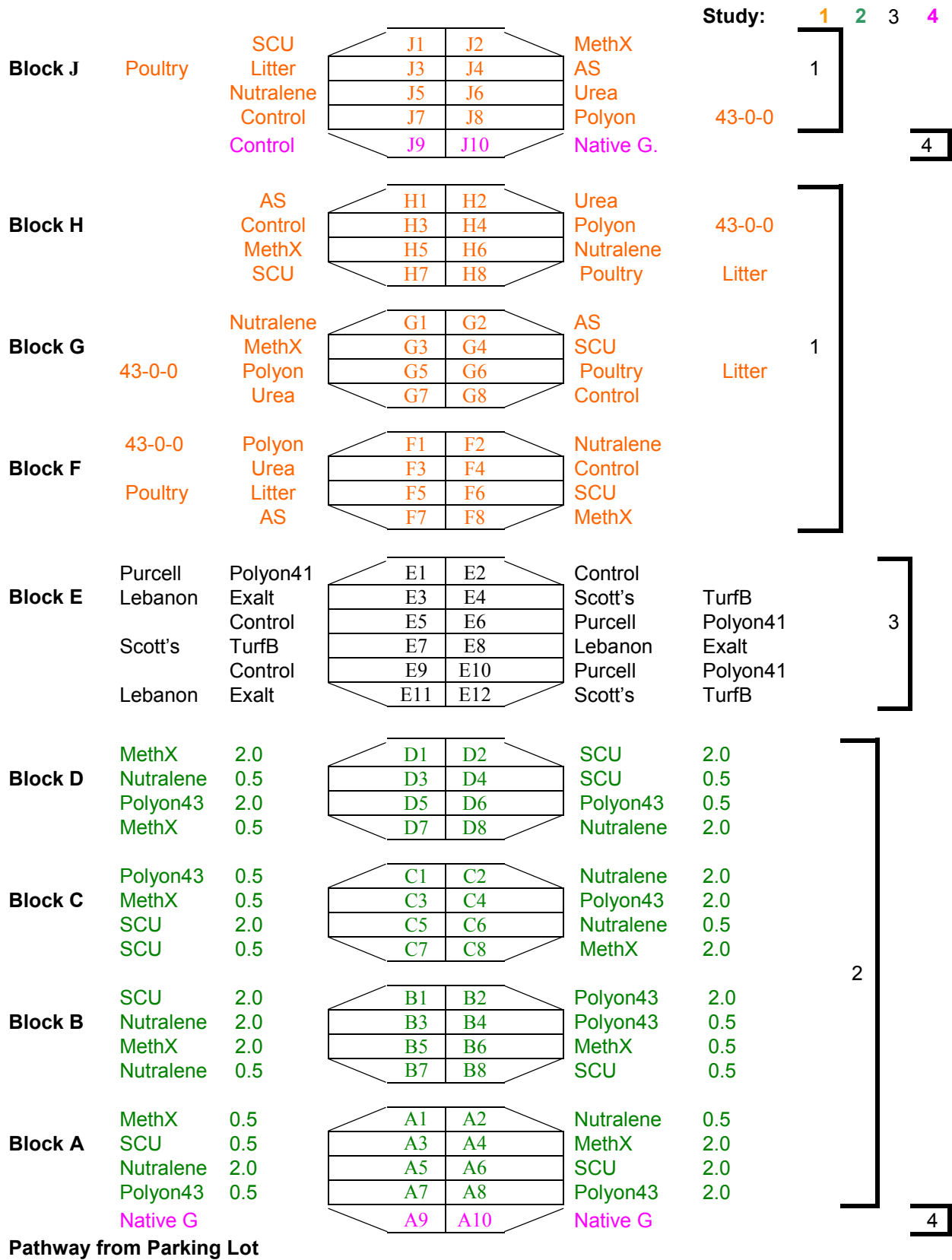
Hypotheses:

- Leaching losses will be below levels potentially harmful to aquatic life for both grasses
- Native grasses will have better turf health than St. Augustine.

**Table 1. Data Collected in the Fall of 2006**

	Fertilize	Leachate	Grass Tissue	Soil	Turf appearance
8/31/06				X	
9/6/06		X			X
9/7/06	X				
9/13/06		X			
9/14/06			X		X
9/20/06		X			
9/24/06					
9/27/06		X			
10/11/06		X			
10/24/06					X
10/26/06		X			
11/29/06		X			

# Plot Identification



## Rates - lbs/100ft<sup>2</sup> in Blocks A, B, C, and D

**Blocks have significantly different nitrate leachate (mg/L).** Blocks A and B had different soil and their leachate levels are very high. The volume of water in the the lysimeters in Block A was insufficient for testing most of the time.

Duncan Grouping	Mean	N	Block
A	52.167	3	A
B	11.227	26	B
C	0.672	29	C
C	0.311	17	D

**Treatment means within blocks do not have a recognizable pattern.** For the plots printed in orange, the plots fertilized at the ½ pound rate have higher leachate than those fertilized at the 2 pound rate.

Level of Treatment	Level of Block	N	-----VALUE-----	
			Mean	Std Dev
MethX_2	A	1	13.6000000	.
Nutralene_2	A	1	90.9000000	.
SCU_1/2	A	1	52.0000000	.
MethX_1/2	B	4	12.2375000	11.1770252
MethX_2	B	5	12.5120000	8.5115991
Nutralene_1/2	B	2	9.4200000	12.2753737
Nutralene_2	B	5	6.2640000	4.7208082
Polygon43_1/2	B	4	22.1025000	21.0896979
Polygon43_2	B	1	0.7200000	.
SCU_1/2	B	1	12.0000000	.
SCU_2	B	4	7.2750000	3.1159215
MethX_1/2	C	2	1.2650000	1.1808683
MethX_2	C	2	1.5450000	1.4071425
Nutralene_1/2	C	4	0.8275000	0.6329494
Nutralene_2	C	4	1.1250000	1.1692020
Polygon43_1/2	C	4	0.9525000	0.6279796
Polygon43_2	C	5	0.1020000	0.0725948
SCU_1/2	C	4	0.3400000	0.2401388
SCU_2	C	4	0.0975000	0.1132475
MethX_1/2	D	1	0.0100000	.
MethX_2	D	4	0.2085000	0.2313922
Nutralene_1/2	D	4	0.0710000	0.1132137
Nutralene_2	D	3	0.5000000	0.6392965
SCU_1/2	D	4	0.0735000	0.1115153
SCU_2	D	1	2.3600000	.

**Nitrate treatment means for blocks C and D are not significantly different and all means are below 1.0 mg/L in the leachate.**

----- Study=Rates -----

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	0.9525	4	Polyon43_1/2
A	0.8571	7	Nutralene_2
A	0.8467	3	MethX_1/2
A	0.6540	6	MethX_2
A	0.5500	5	SCU_2
A	0.4493	8	Nutralene_1/2
A	0.2068	8	SCU_1/2
A	0.1020	5	Polyon43_2

**The fertilizers were applied at the 1 pound rate in blocks F, G, H, and J. However due to block differences they can not be compared to the rates in blocks A-D. See Figures 1a and 1b.**

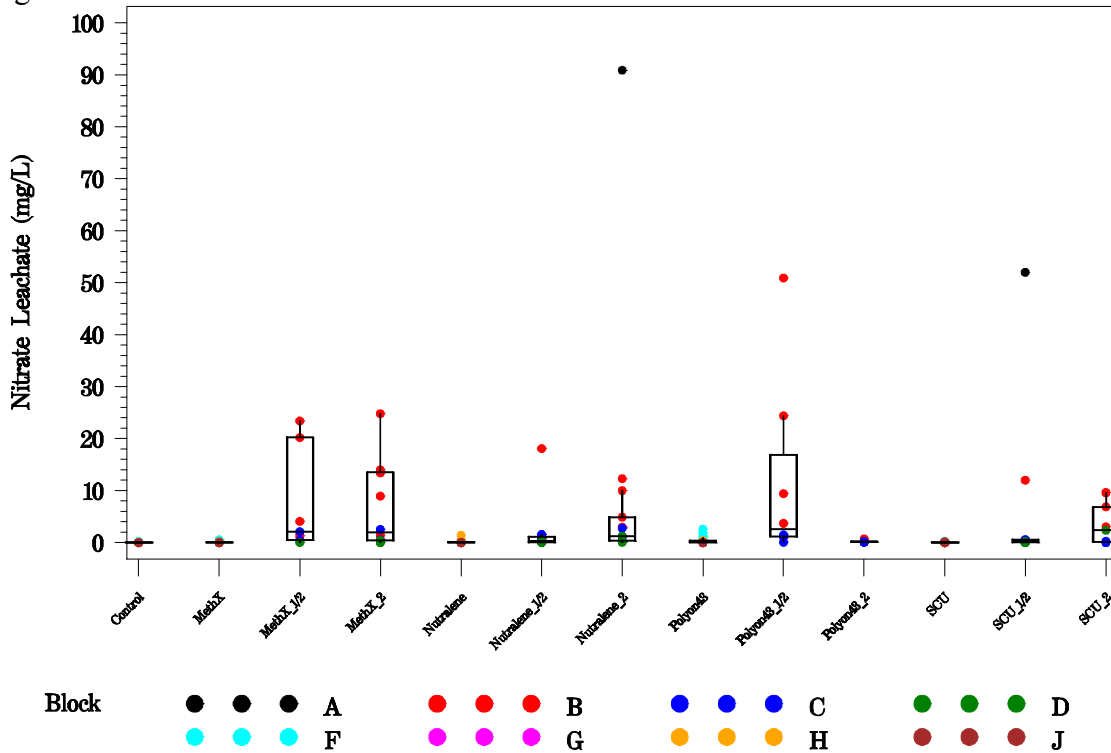


Figure 1a. Nitrate leachate for 4 fertilizers in 8 blocks.

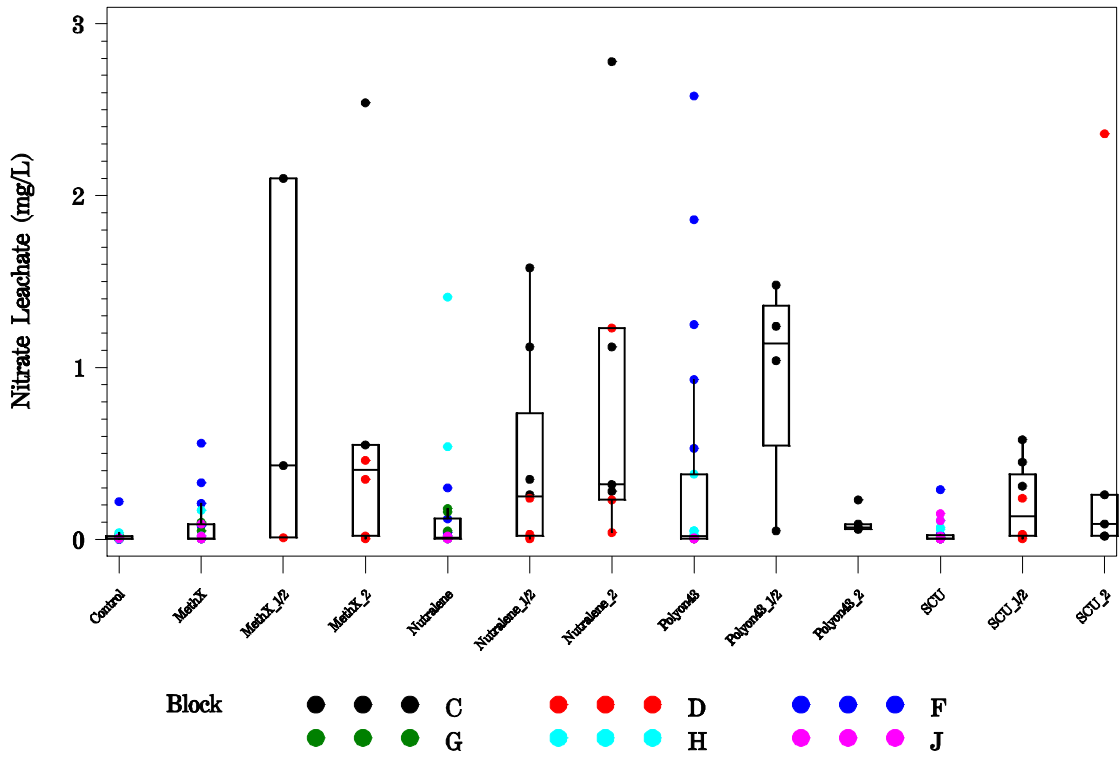
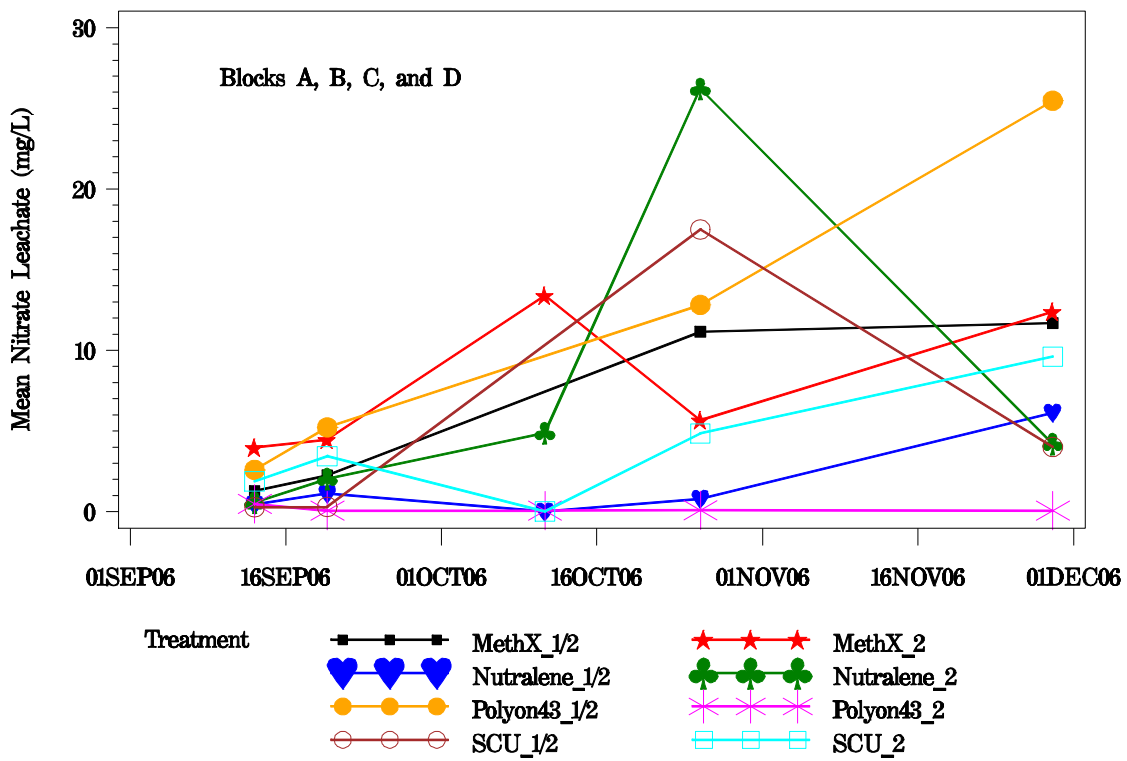
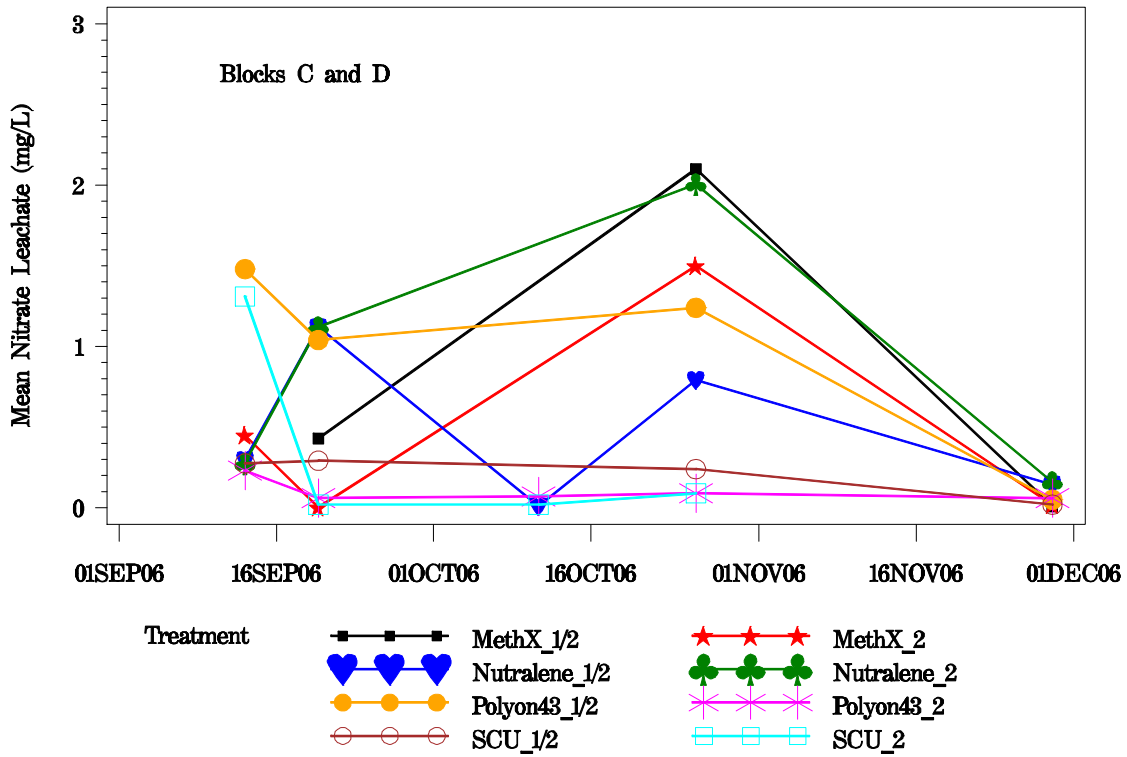


Figure 1b. Nitrate leachate for 4 fertilizers in 6 blocks.

The time series for the rates are shown below.





Try using soil or water volume as a covariate!!!!!!!!!!!!!!

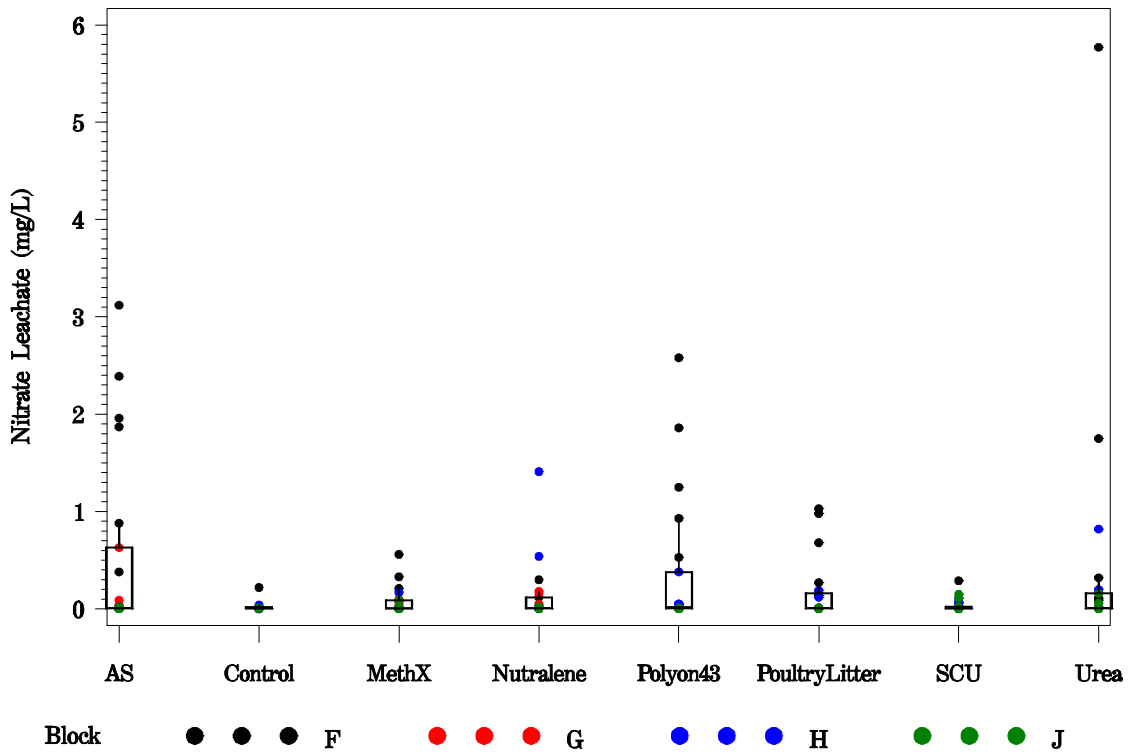
## Sources in Blocks F, G, H, and J

**Blocks, Treatments and the interaction between blocks and treatments are all significant.** Thus the interpretation is difficult and uncertain. At least the control had the lowest mean. Also all means are low enough that we would consider all of them acceptable.

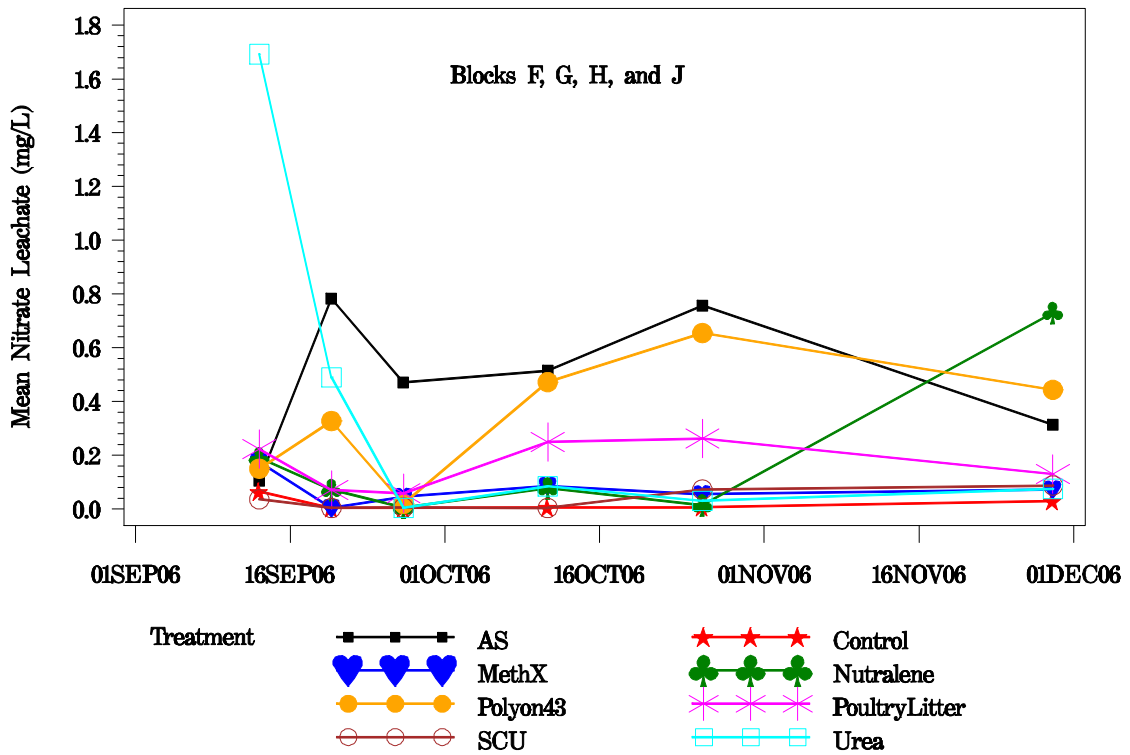
Duncan Grouping	Mean	N	Block
A	0.7119	44	F
B	0.1005	45	H
B			
B	0.0351	44	G
B			
B	0.0180	46	J

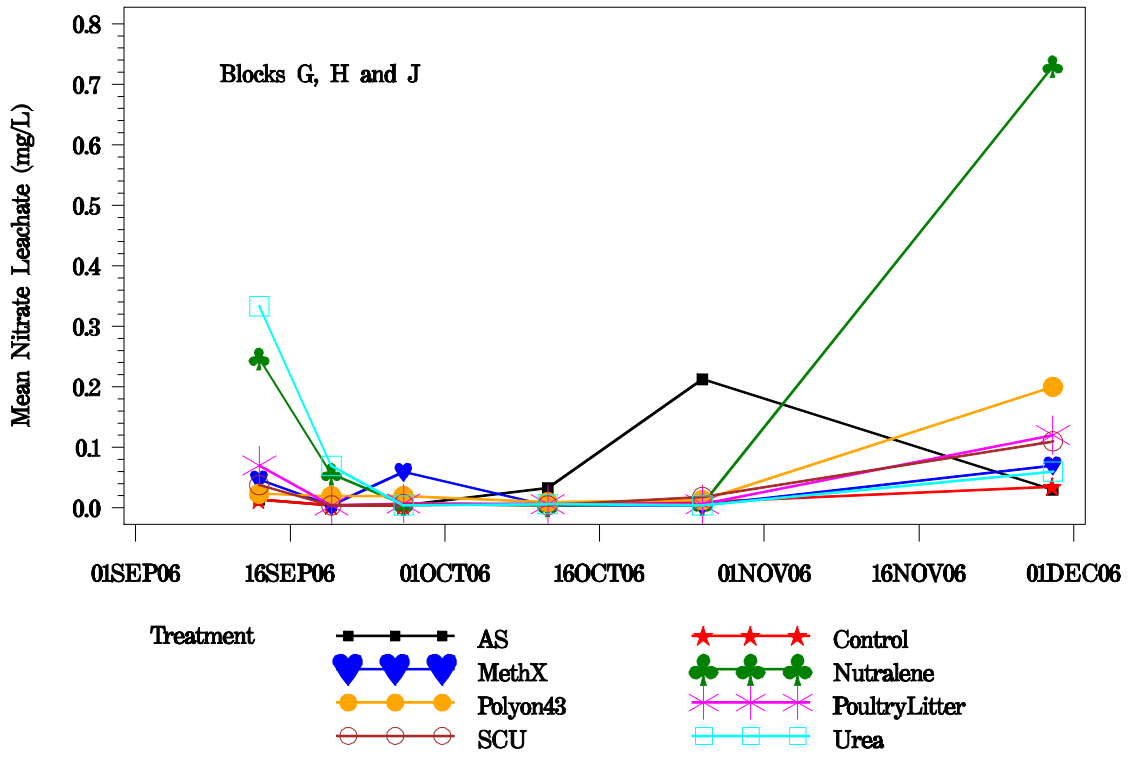
Duncan Grouping	Mean	N	Treatment
A	0.4983	23	AS
A			
B A	0.4452	21	Urea
B A			
B A C	0.3546	22	Polyon43
B C			
B D C	0.1739	21	PoultryLitter
B D C			
B D C	0.1379	21	Nutralene
D C			
D C	0.0731	23	MethX
D C			
D C	0.0341	28	SCU
D			
D	0.0210	20	Control

!!!DO CONTRASTS TO COMPARE QUICK RELEASE TO SLOW RELEASE



The time series for the sources are shown below.



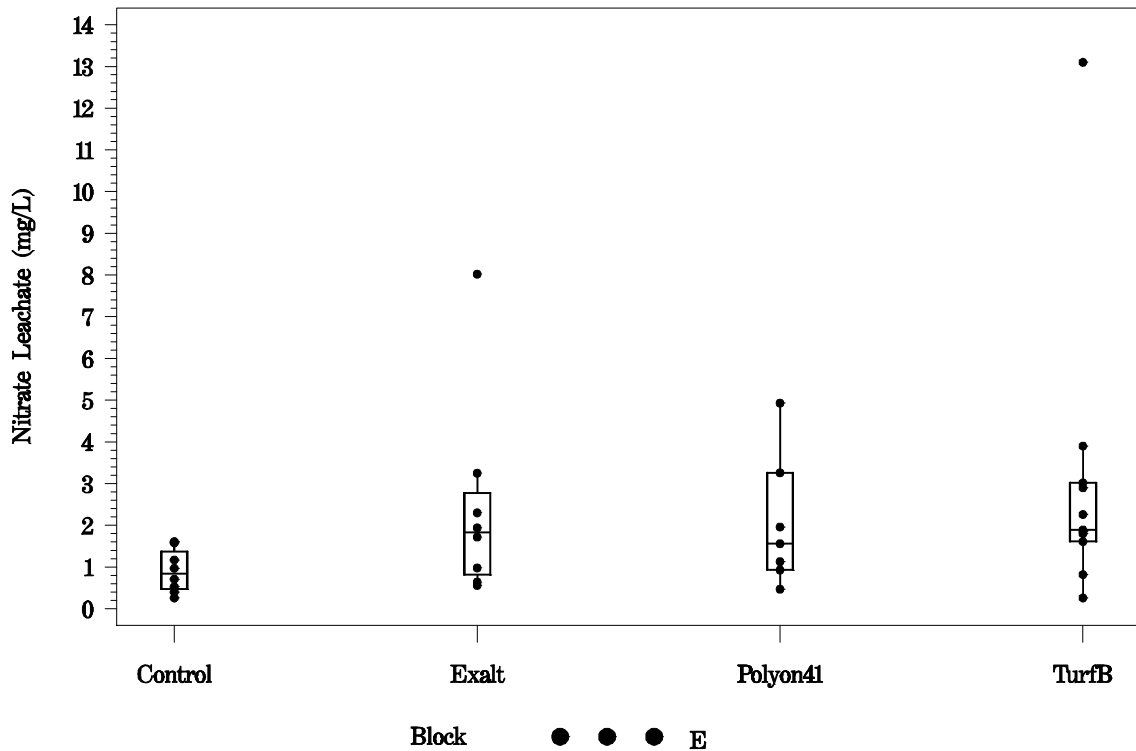


## Products

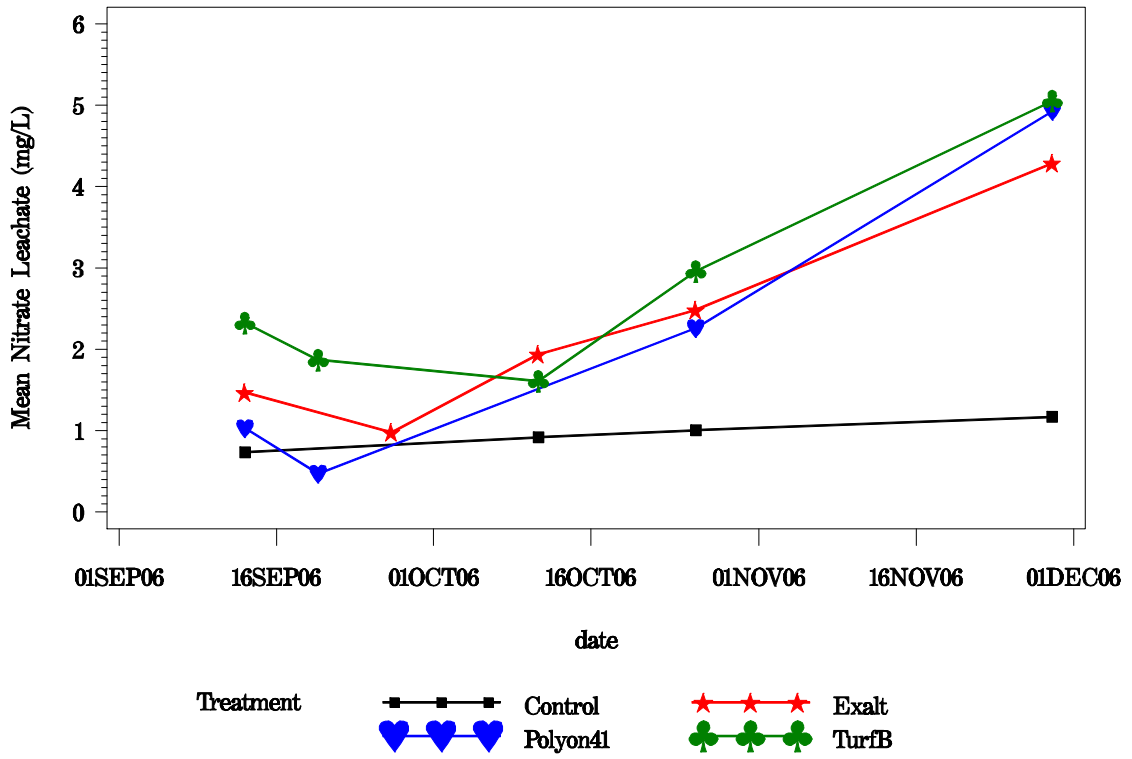
**Products are not significantly different.** The control has the lowest mean.

----- Study=Products -----

Duncan Grouping	Mean	N	Treatment
A	3.037	11	TurfB
A	2.426	8	Exalt
A	2.034	7	Polyon41
A	0.904	8	Control

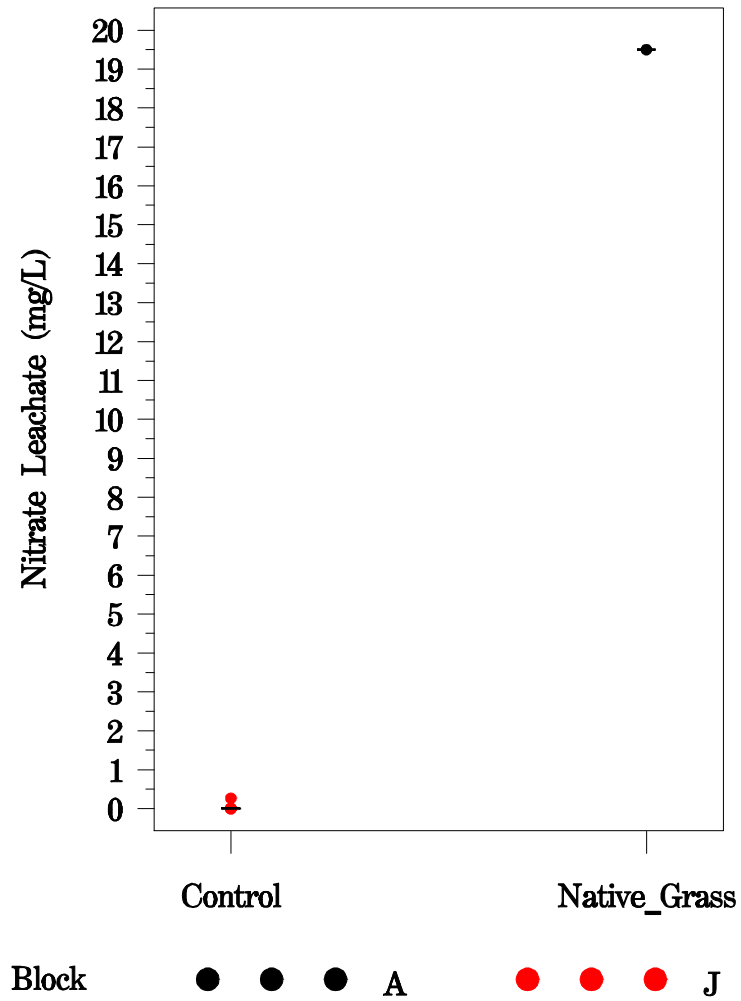


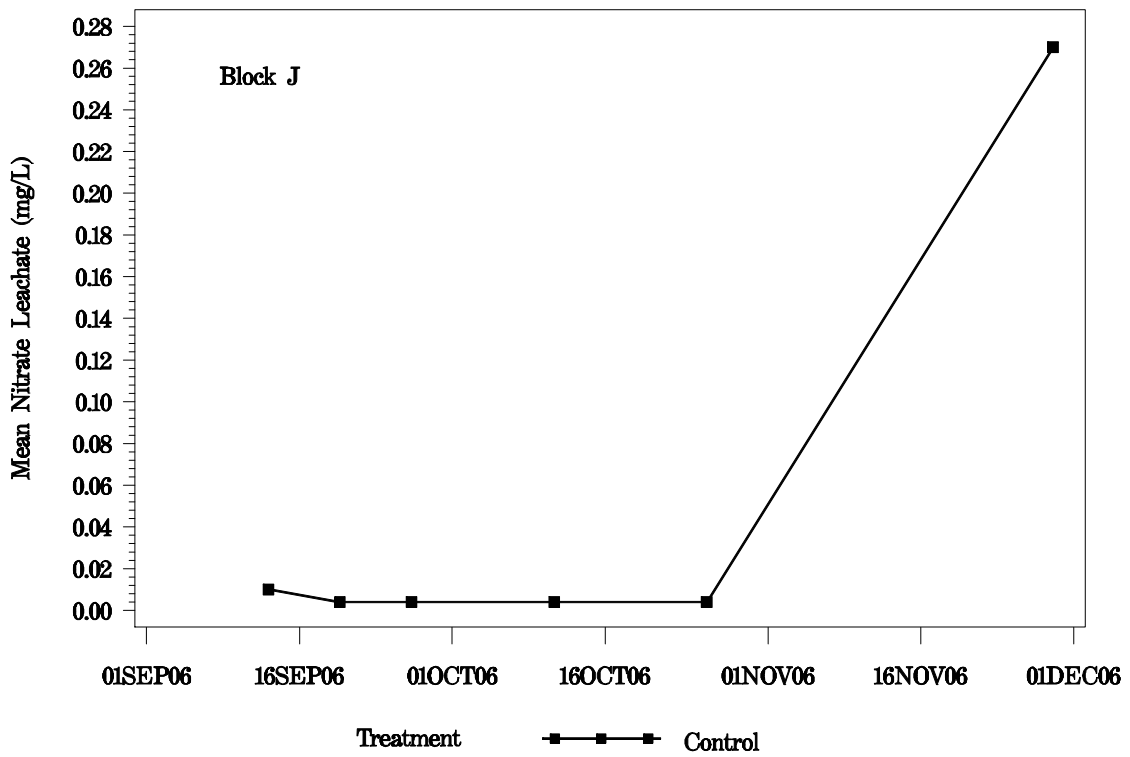
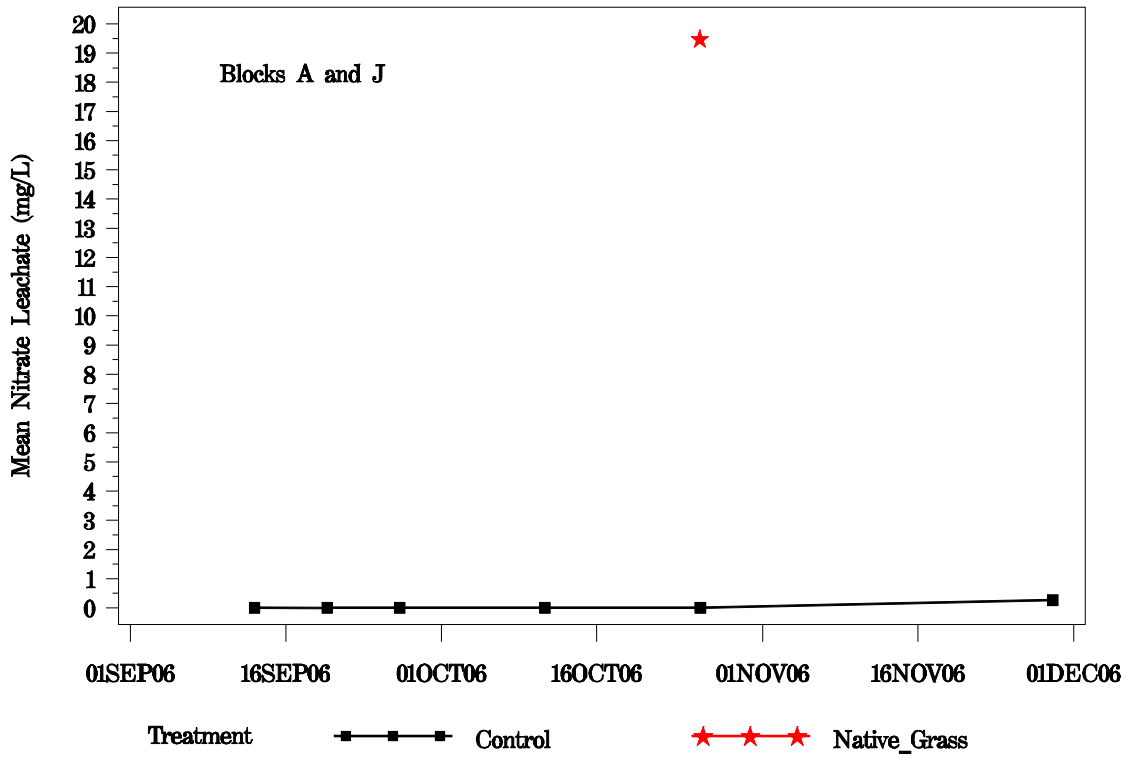
**The leachate from the products is still increasing after 2 ½ months.**



## Native Grass

No leachate was collected beneath the native grass in Block J. Only one sample was collected from Block A. The leachate from Block A reflects the soil, not fertilizer on the grass, as no fertilizer was applied.





## Grass Tissue Levels

Blocks have significantly different grass tissue levels

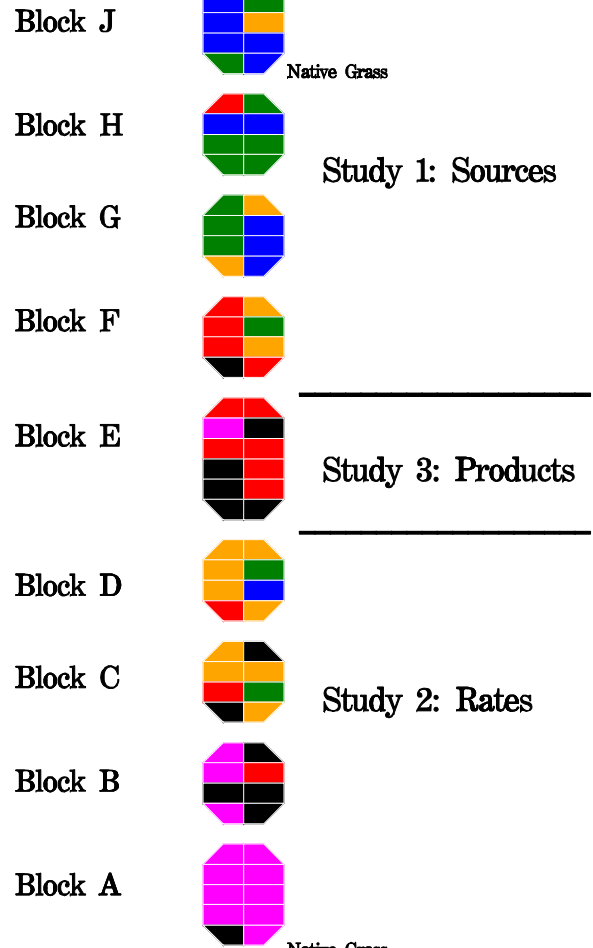
### Nitrate Percent:

Duncan Grouping	Mean	N	Block
A	3.37491	10	A
B	3.16010	8	B
B	3.01363	12	E
C	2.66140	8	F
C	2.61295	8	C
D	2.41076	8	D
E	2.21063	8	H
E	2.18510	8	G
E	2.09255	10	J

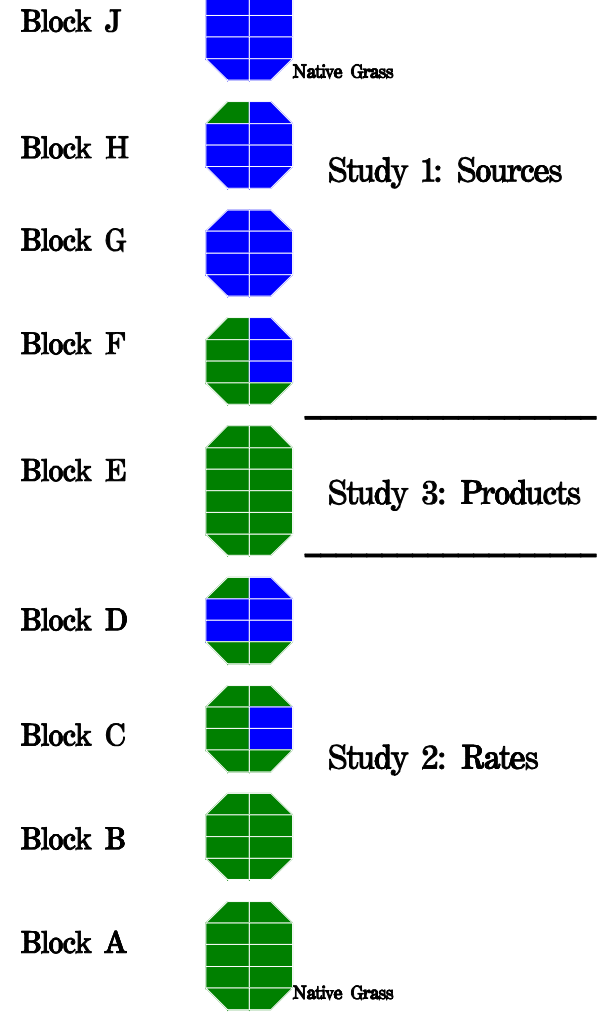
### Phosphorus Percent:

Duncan Grouping	Mean	N	Block
A	0.66750	8	F
B	0.56375	8	G
B	0.55875	8	H
B	0.54500	8	C
B	0.52917	12	E
B	0.51125	8	D
C	0.45500	10	J
C	0.43375	8	B
D	0.35700	10	A

9/14/06 Grass Tissue Nitri



9/14/06 Grass Tissue Nitri



9/14/06

Grass Tissue Phosph

Block J



Native Grass

Block H



Study 1: Sources

Block G



Block F



Block E



Study 3: Products

Block D



Block C

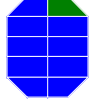


Study 2: Rates

Block B



Block A



Native Grass



9/14/06

Grass Tissue Phosph

Block J



Native Grass

Block H



Study 1: Sources

Block G



Block F



Block E



Study 3: Products

Block D



Block C

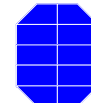


Study 2: Rates

Block B



Block A



Native Grass



