# Turfgrass Response to Surface-applied Gypsum

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Turfgrass Nutrition & Soil Fertility

PENNSTATE

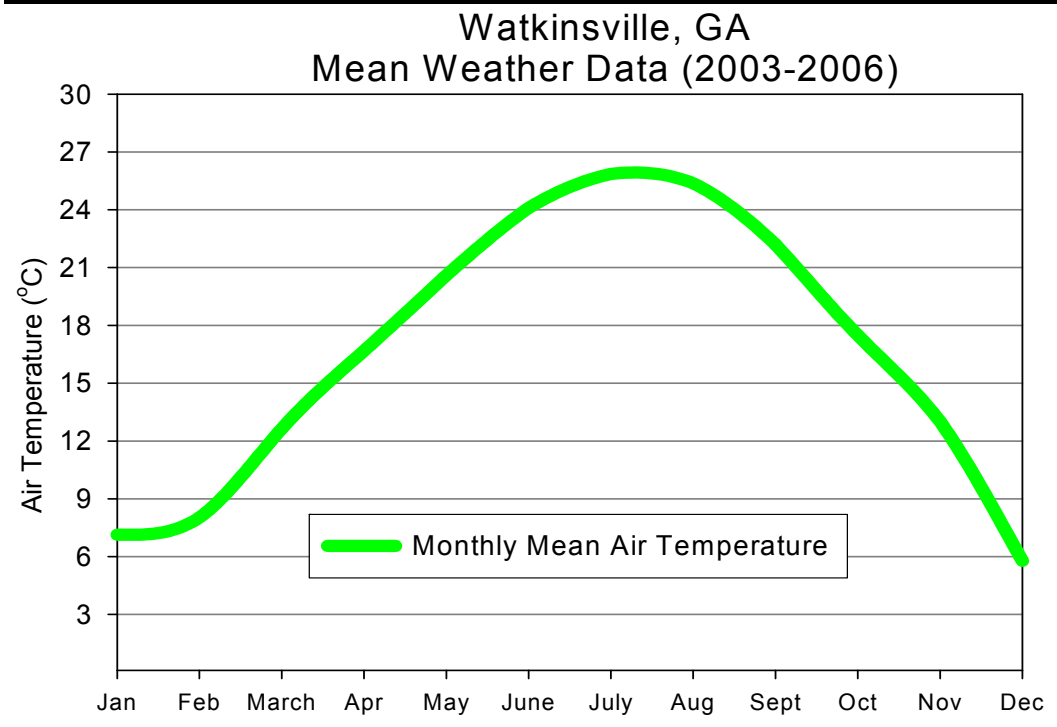
1855

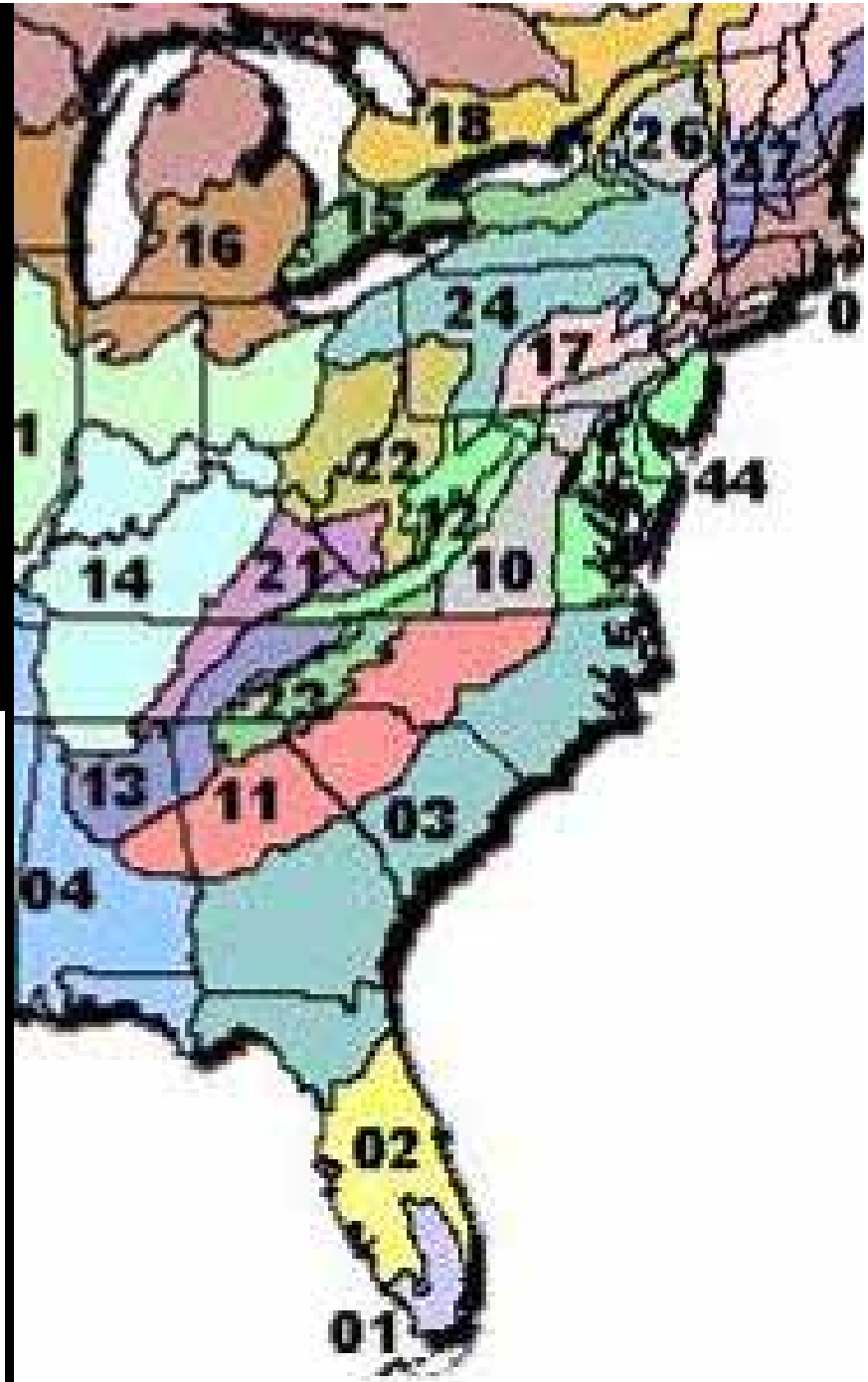
# US Southern Piedmont Physiographic Region #11

13 x $10^6$ ha

Highly dissected, 60-400 m elevations

Mesic-Thermic soil temp regime




http://www.blm.gov/wildlife/pifplans.htm

# US Southern Piedmont Physiographic Region

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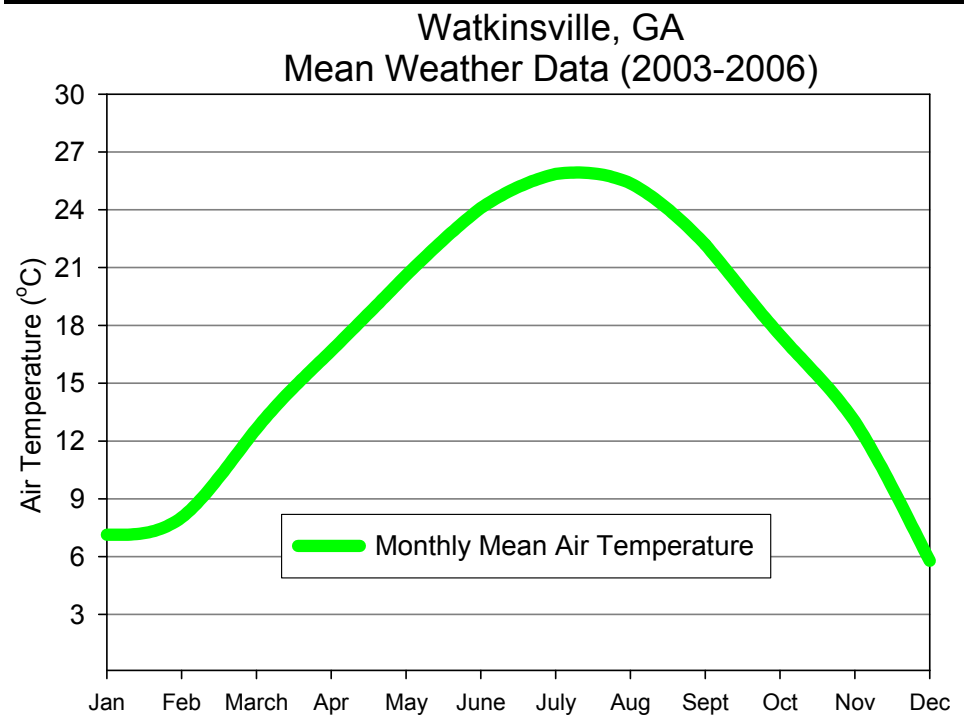
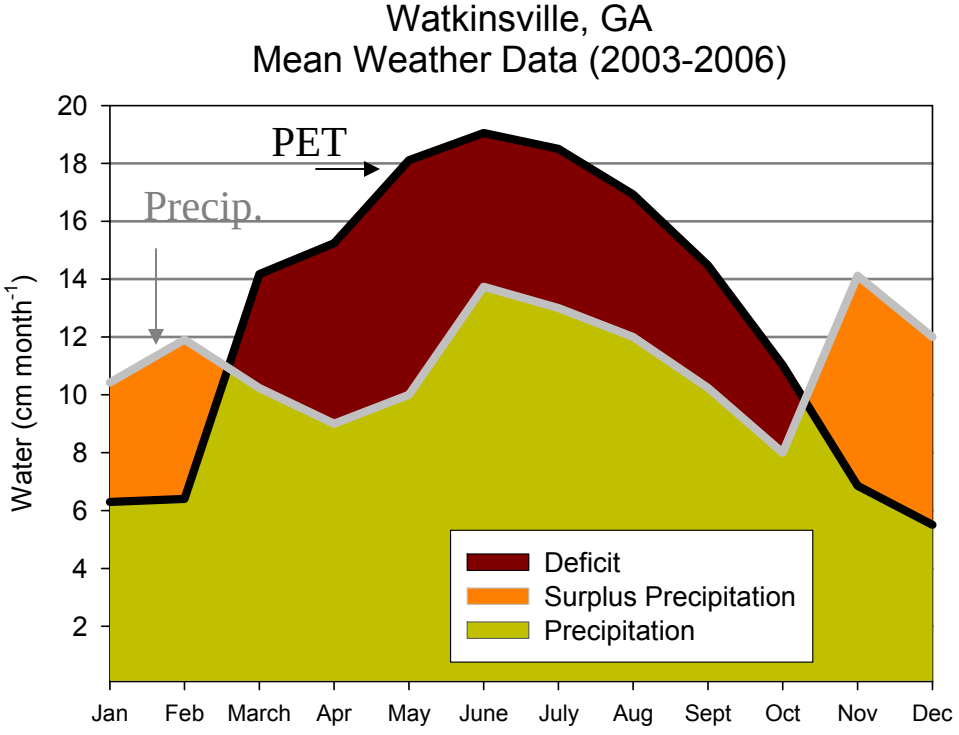
Typic Udic soil moisture regime



## US Southern Piedmont Physiographic Region

13 x $10^6$ ha

Mesic-Thermic soil temp regime

Typic Udic soil moisture regime

Thus, most upland soils are old, deep, fairly well-structured, highly leached, strongly acidic—

**Ultisols (with very little OM)**

# Turfgrass and the SE US

Bermudagrass & Tall Fescue are popular turfgrass selections in the landscape of the US Southern Piedmont (GA, AL, and the Carolinas)

# Treatment Options???

- Lime
  - Agricultural grade limestone is an effective ameliorant of soil acidity
  - Commonly incorporated at establishment for production of cotton, soybean, corn, wheat, etc.
  - INCORPORATE is the key word, effective lime treatment of soil acidity requires tillage into the soil profile

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So how can managers ameliorate the effects of surface and subsoil acidity without plowing the lawn?

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Many attributes:

- More soluble than agricultural lime
- Doesn't require tillage
- Doesn't raise pH of the surface soil
  - This can cause soil structure and turf disease problems
- Provides sulfate ($SO_4$), the plant essential nutrient form of sulfur

# Experimental Objective

Determine the suitability of surface-applied gypsum as an ameliorant of acid subsoil-impaired turfgrass systems in the Southern US Piedmont

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Determine the suitability of surface-applied gypsum as an ameliorant of acid subsoil-impaired turfgrass systems in the Southern US Piedmont:

- monitoring Ca and Al soil transport rates
- turfgrass drought resistance ($H_2O$ use)
- turfgrass vegetative growth ($1^o$ & lateral)
- nutrient sufficiency of turfgrass tissue
- resulting turfgrass root proliferation

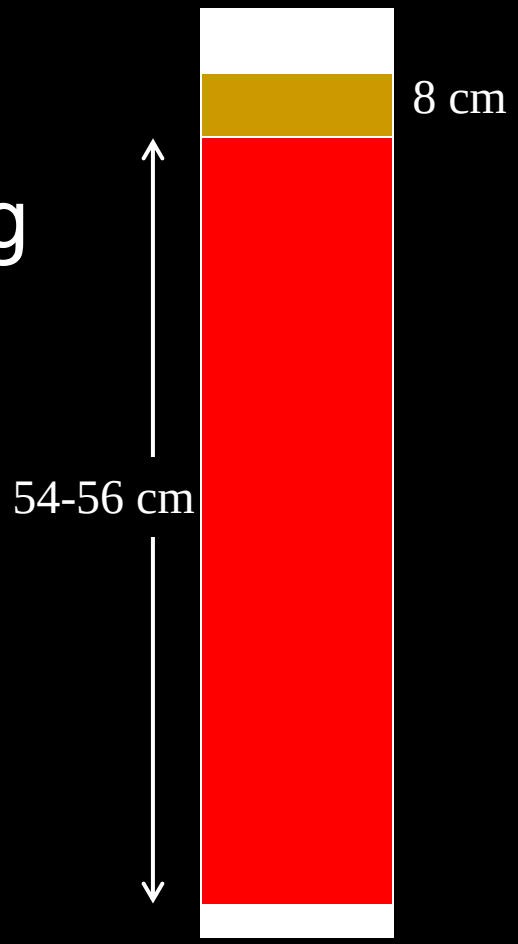
# Experimental Design

## Acidic B Horizon Clay

| | |
|---|---|
| pHw(1:1) | 4.9 |
| Exch. Acid | 3.9 meq/100g |

Mehlich III (M3) exchangeable:

| | |
|---|---|
| Phosphorus (P) | 2.0 lbs/A |
| Potassium (K) | 0.04 meq |
| Magnesium (Mg) | 0.25 meq |
| Calcium (Ca) | 0.65 meq |
| Total CEC: | 4.84 meq |



# Experimental Design

Treatments (5):

- Synthetic Gypsum (Southern Co. FGDG)
- Tech. Grade Gypsum ($CaSO_4 \cdot 2H_2O$)
- Calcium Chloride ($CaCl_2 \cdot 2H_2O$)
- Calcitic Lime (100% CCE)
- Control

**90** columns: Bermudagrass ('Princess' or 'Sultan'; 30 each), or a turf-type Tall Fescue blend (30)

Half of each instrumented to provide real-time soil moisture data (3 of 6 replications)

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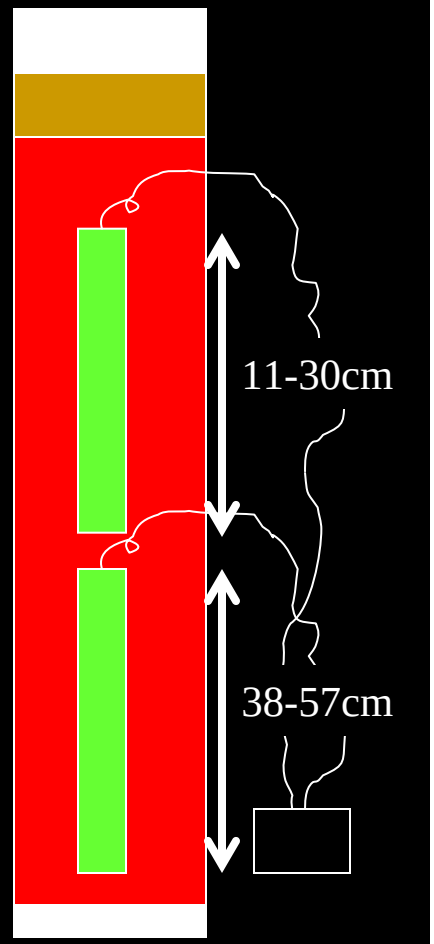
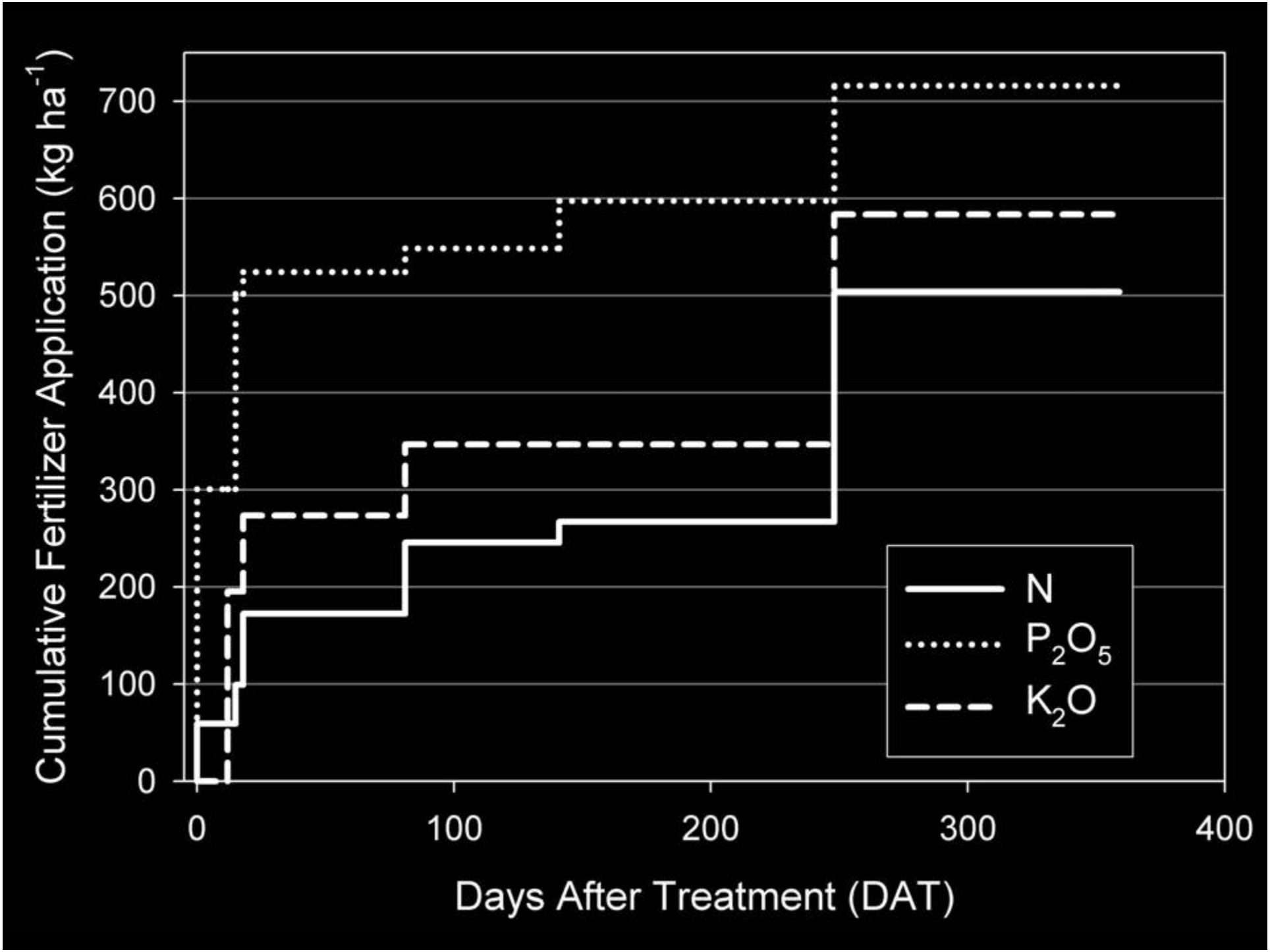


# Experimental Design

The Southern Co. SynGyp is 23.3% Ca by mass (+/- 0.65), and has a calcium carbonate equivalency of 2.7% (+/- 0.14). Trace element and heavy metal analysis show few impurities

| Treatment | Application Rates lbs/Acre (Ca) |
|---|---|
| Lime | 4,332 (1,735) |
| FGD and TG Gypsum | 13,796 (3,224) |
| $CaCl_2$ | 11,825 (3,224) |


Cumulative Fertilizer Application (kg ha-1)
700
600
500
400
300
200
100
0
0
100
200
300
400
Days After Treatment (DAT)
N
P2O5
K2O

# TF Cultural Methods

- Columns mowed every 9±3 d @ 3” height
- No signs/symptoms of pest activity observed (tall fescue is good like that)
- When >half the TF columns showed stunted growth & leaf firing, all were irrigated with 4” in 1” pulses over 36 hours (every 20-35 d)
- Post-estab: 11 lbs N & $K_2O$ / acre•month

# Berm. Cultural Methods

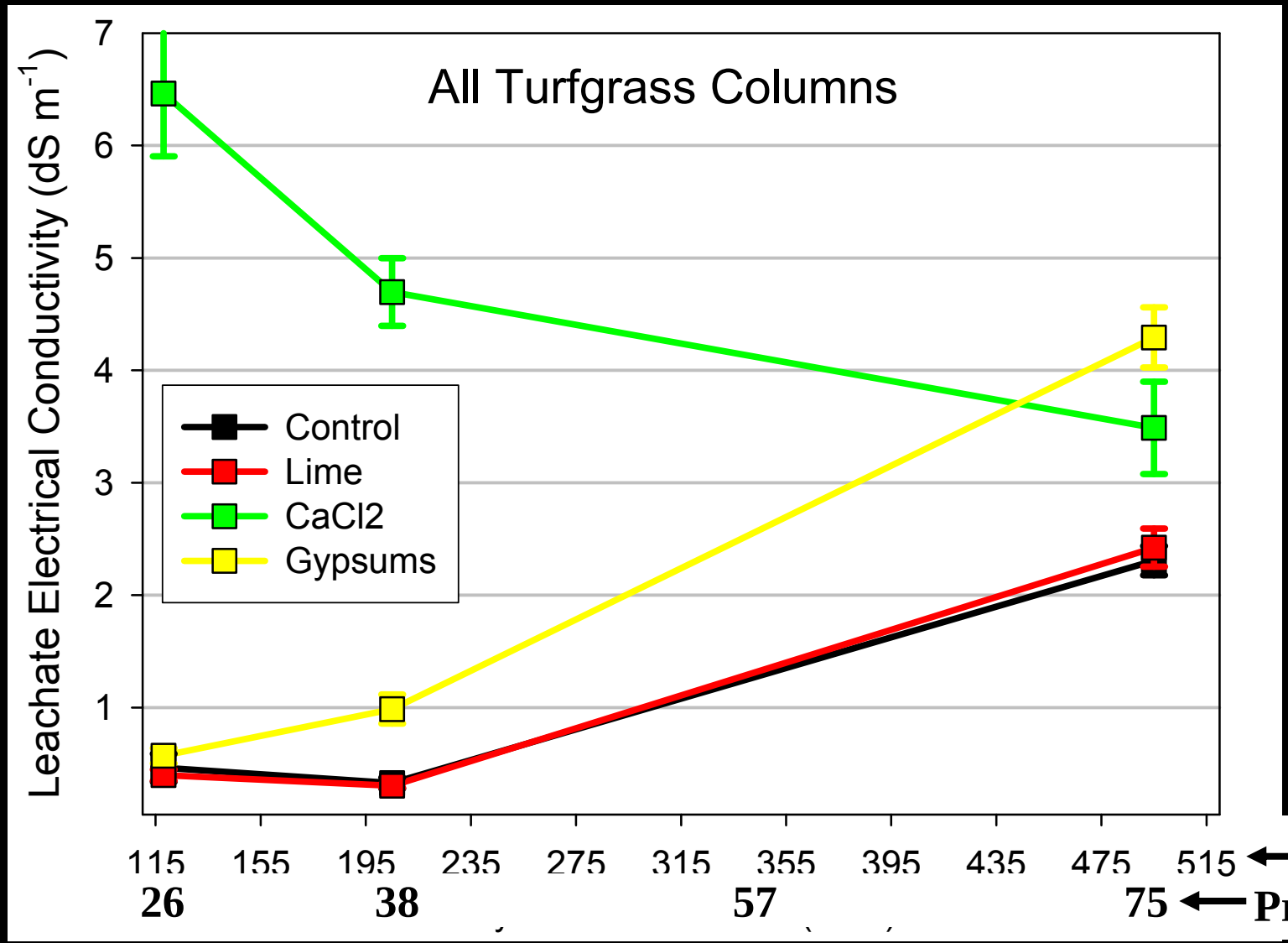
- Columns mowed every 7±2 d @ 1.4” height
- Insect pests controlled when necessary
- When >half the bermudagrass columns showed stunted growth/dormancy, all were irrigated with 4” in 1” pulses over 36 hours (every 30-50 d)
- Post-estab: 32 lbs N & $K_2O$ / acre•month

# Data Collection

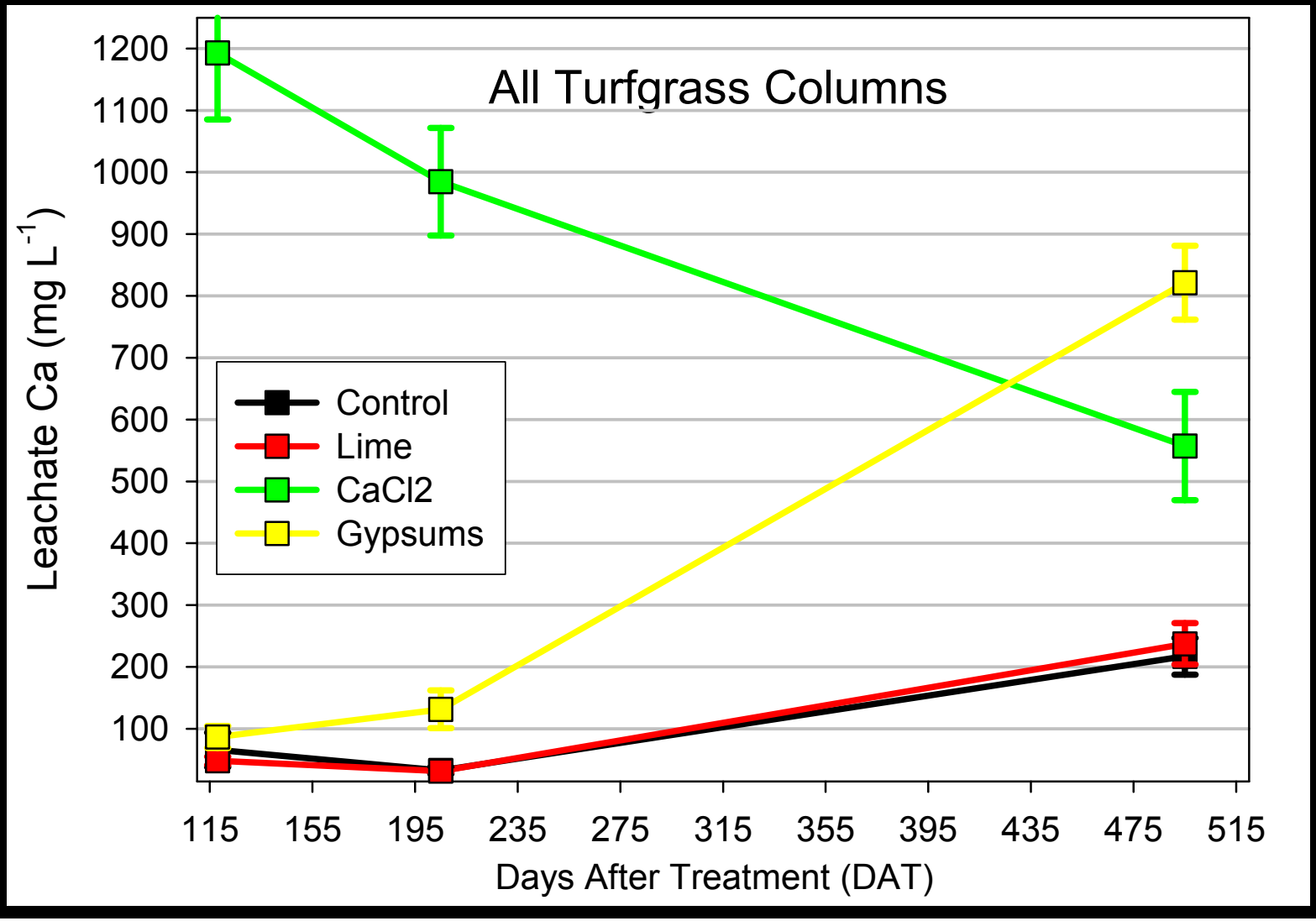
- Column leachate 4, 7, and 15 MAT
  - pH & EC immed., filtered & acidified for ICP
- Dry & weighed clippings of alt. mows (45 events)
- Acid digested shoot clippings for nutrient analysis (150, 260, 380, and 590 DAT)
- Soil $H_2O$, greenhouse environment 3X per day
- Percent vegetative cover (20 events; 70-794 DAT)
- Extractable Al, Ca, Mg, K (1 M $NH_4Cl$) & Sulfur (Mehlich 3), soil pH & EC by soil depth (10 cm)
- RLD, SRL, & architecture by depth (winRhizo)

# Leachate chemistry and composition

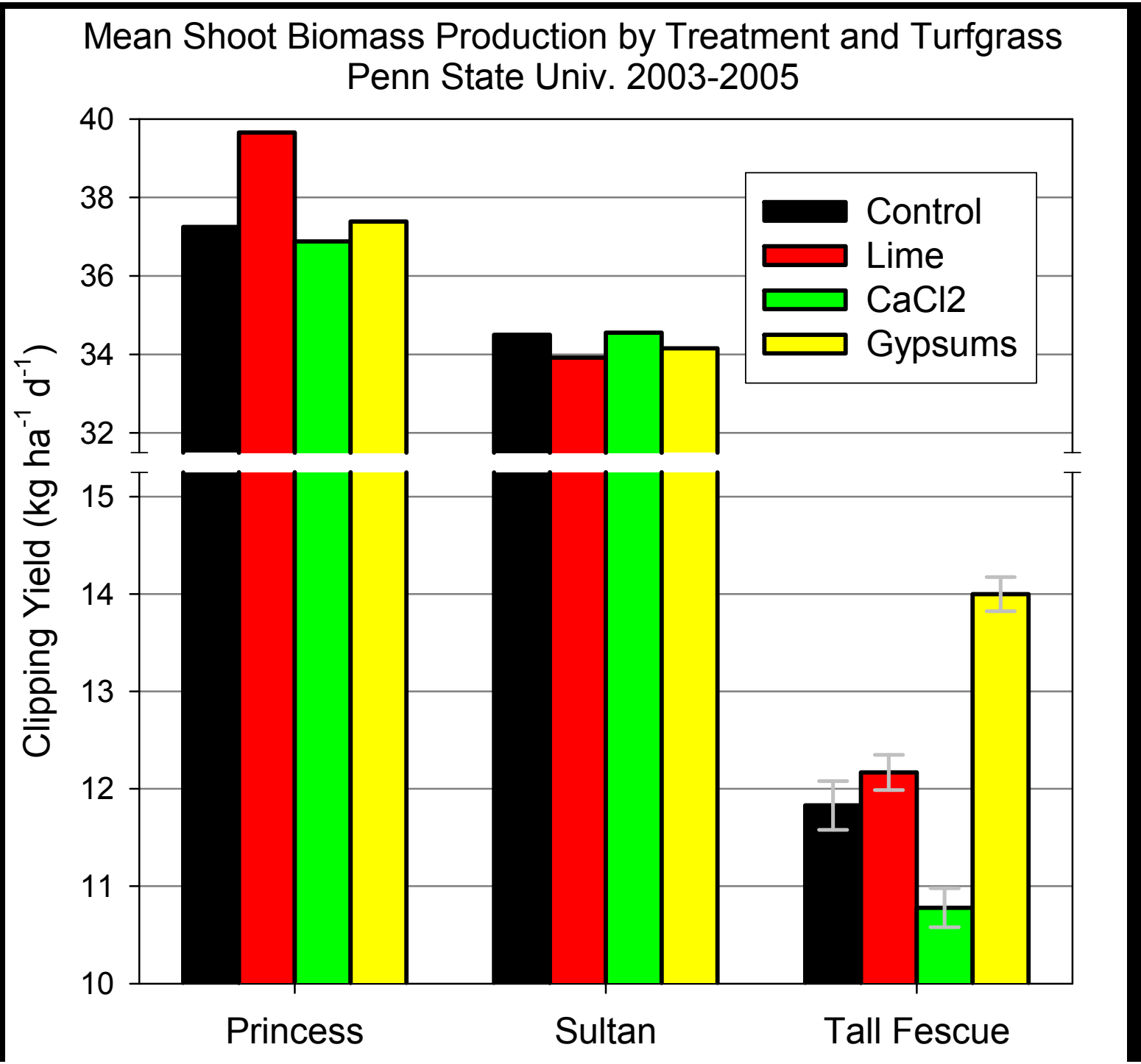
# Solute transport through ~55 cm of red clay, by time after treatment

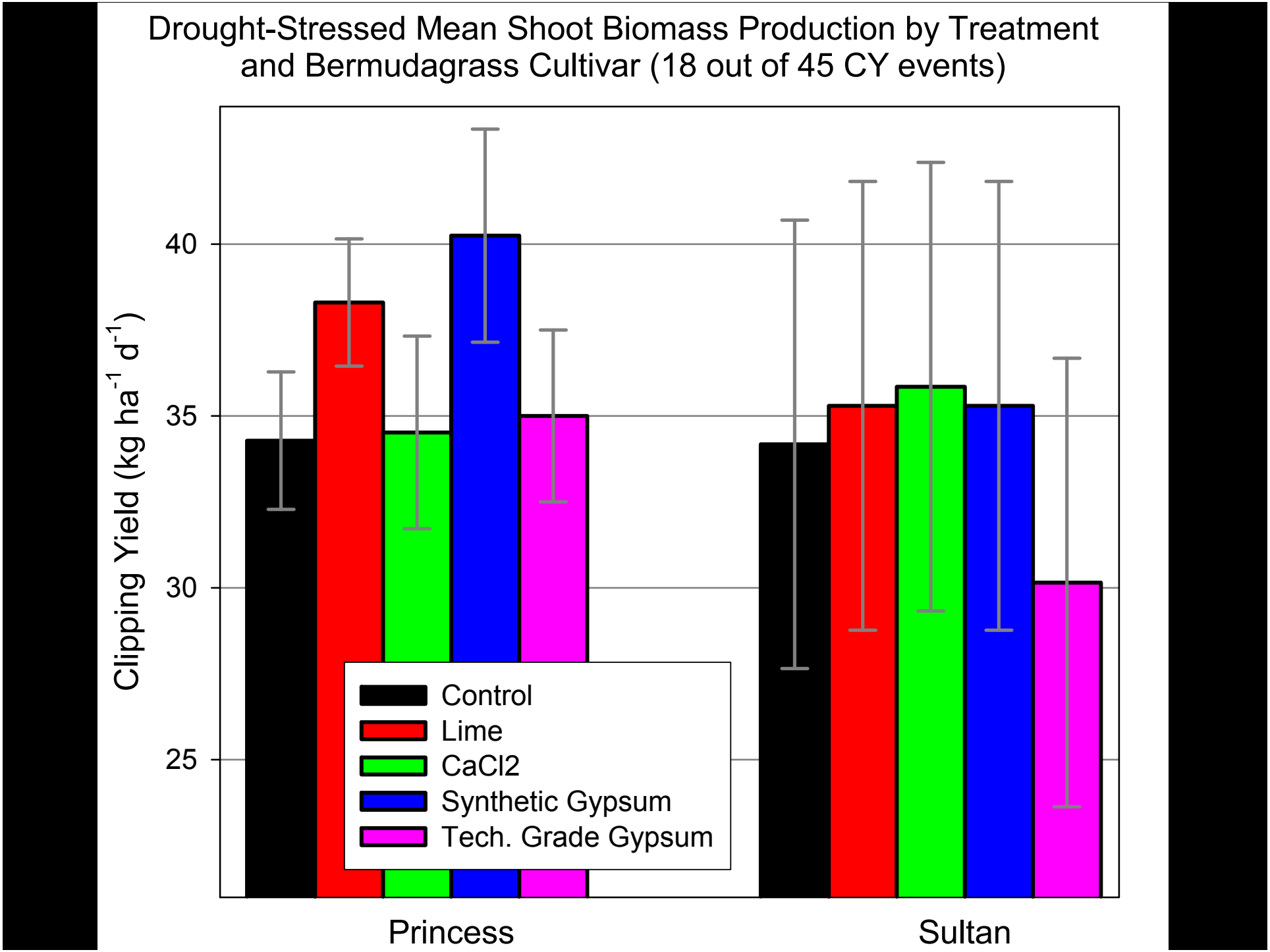


# Calcium (Ca) concentration in leachate, by time after TRT

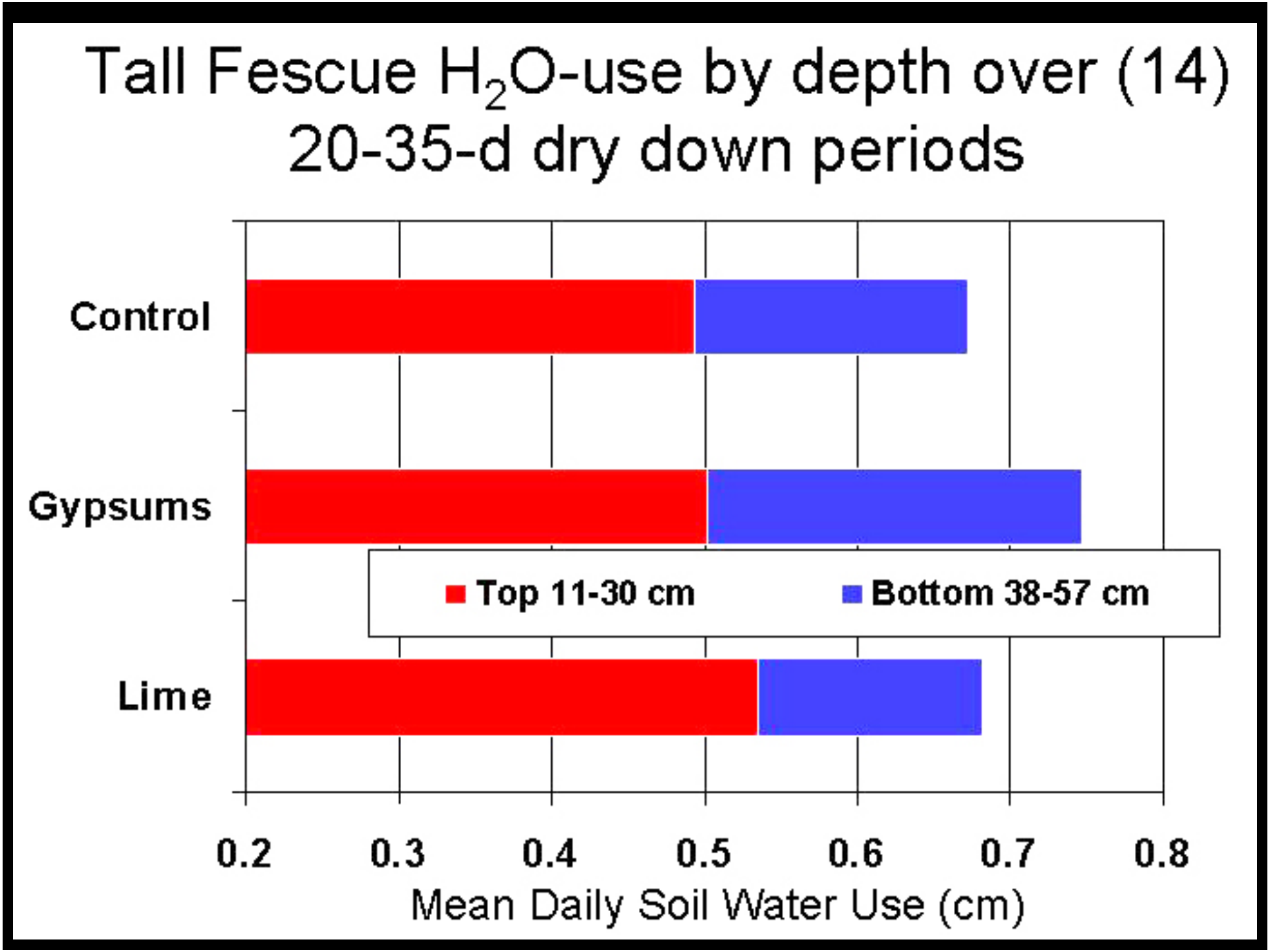


Leaf/shoot biomass production (generally analogous with quality/vigor)

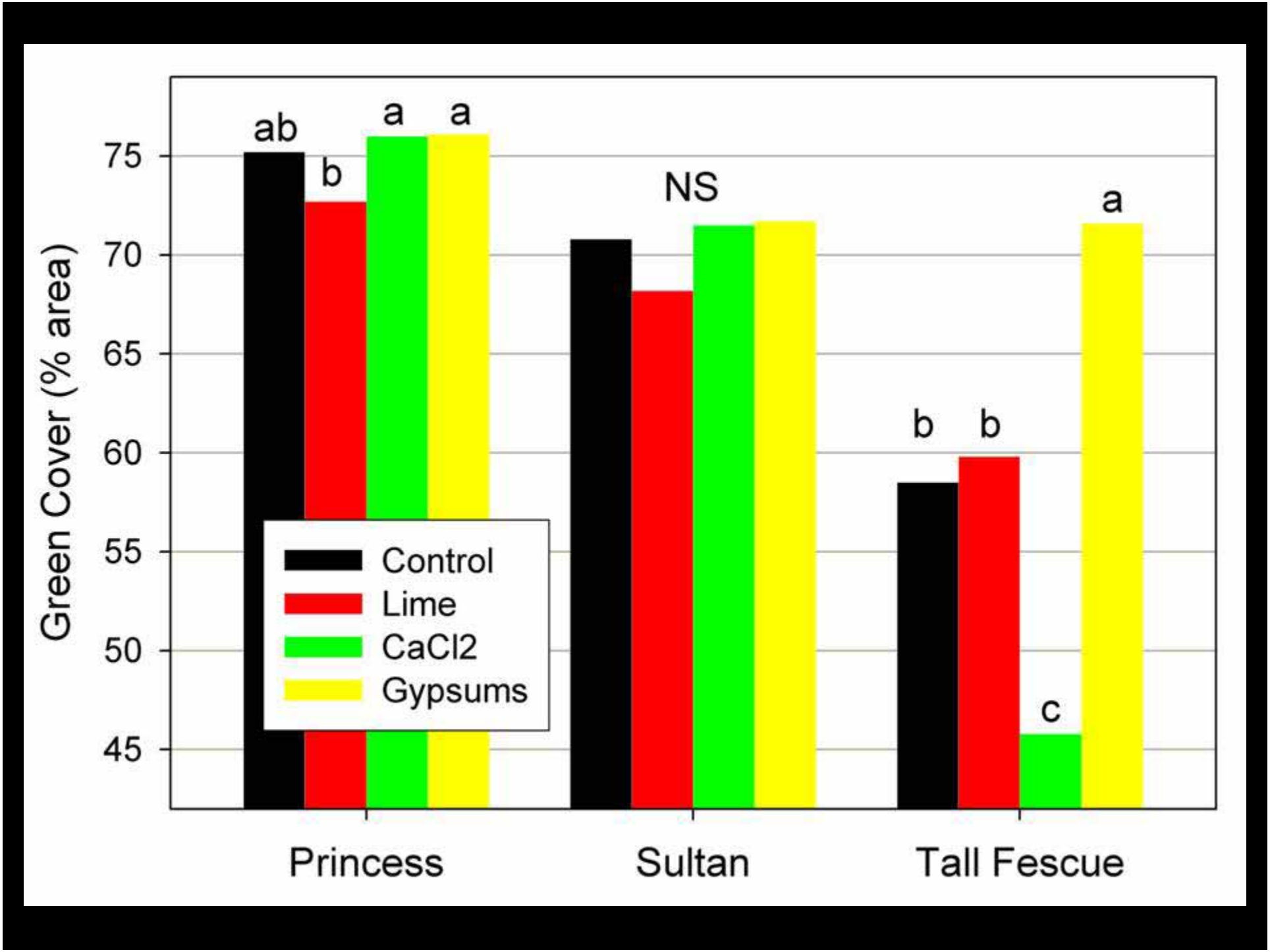

Mean Shoot Biomass Production by Treatment and Turfgrass
Penn State Univ. 2003-2005
Clipping Yield (kg ha-1 d-1)
40
38
36
34
32
15
14
13
12
11
10
Control
Lime
CaCl2
Gypsums
Princess
Sultan
Tall Fescue


Drought-Stressed Mean Shoot Biomass Production by Treatment and Bermudagrass Cultivar (18 out of 45 CY events)
Clipping Yield (kg ha-1 d-1)
40
35
30
25
Control
Lime
CaCl2
Synthetic Gypsum
Tech. Grade Gypsum
Princess
Sultan

# Turfgrass water use by soil depth

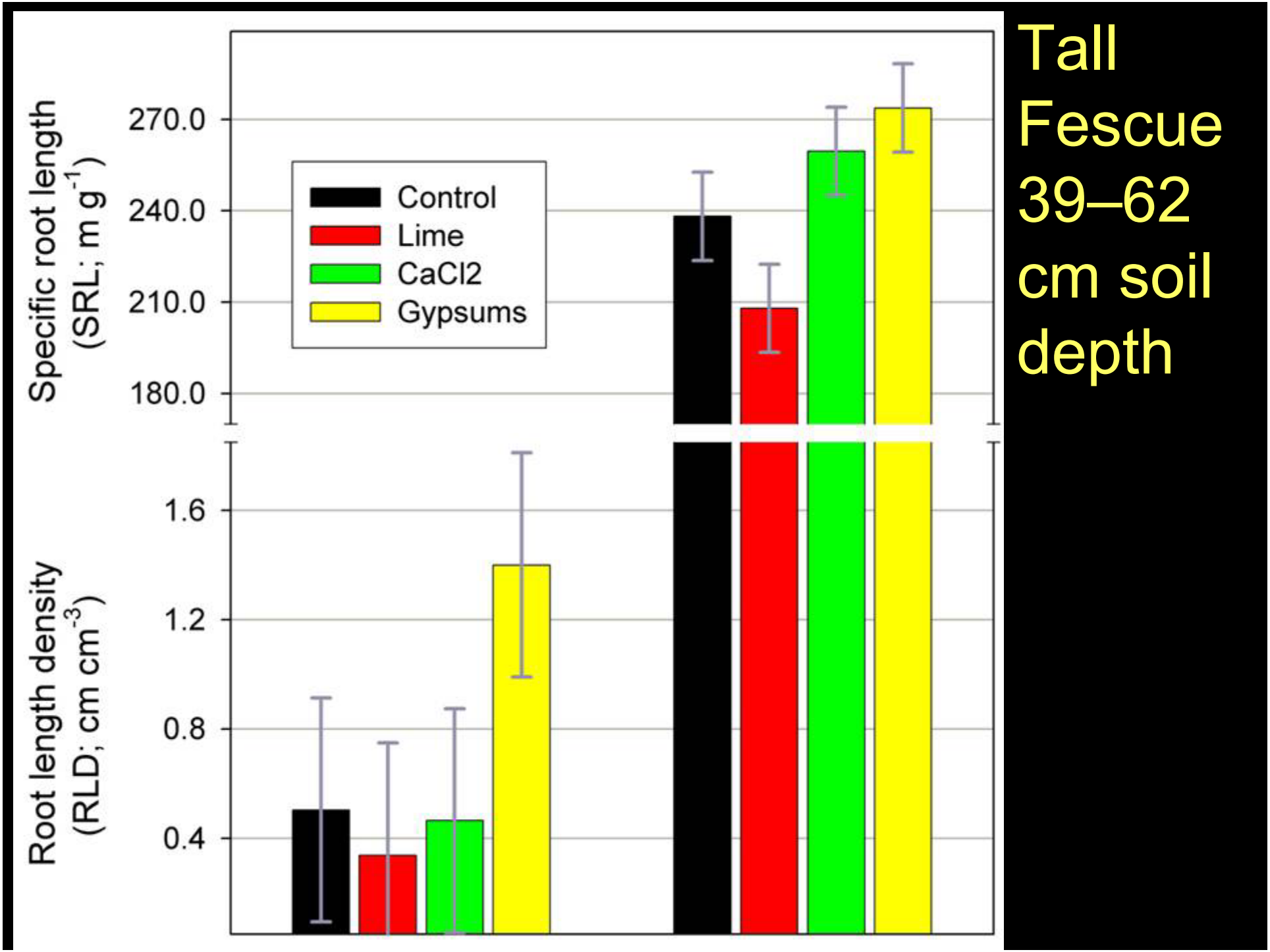

Tall Fescue $H_2O$-use by depth over (14) 20-35-d dry down periods
Control
Gypsums
Lime
Top 11-30 cm
Bottom 38-57 cm
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Mean Daily Soil Water Use (cm)

# Lateral growth and density of turfgrass


Green Cover (% area)
75
70
65
60
55
50
45
ab
b
a
a
NS
b
b
c
a
Control
Lime
CaCl2
Gypsums
Princess
Sultan
Tall Fescue

# Turfgrass root growth

Bermudagrass root growth




Tall Fescue 39–62 cm soil depth

# Greenhouse Study Summary

- Gypsum trts effectively penetrated 60 cm of clay soil 1 year after a ~7 ton/A application
- Differences between mined & synthetic gyp were minor, do not appear significant
- Benefits to TF were stark: enhanced growth, total & deep water uptake, deep roots, and leaf nutrients; compared to both Lime and Con trts (with no resulting BC deficiencies)
- Benefits to Bermudagrass include: enhanced growth & color response under drought conditions (deeper roots?)

# Acknowledgements


- The Southern Company, Birmingham, AL
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  Grand Pooh-Bah of all things soil chemical