

# Frustrated By Fertilizers? Get to Know 'Em!



**Laurie Trenholm**  
**UF-IFAS Turf Specialist**

# There are lots of fertilizers to choose from



# Nutrients Needed From Soil or Fertilizer

## Macronutrients:

### Primary:

**Nitrogen**

**Phosphorus**

**Potassium**

### Secondary:

**Calcium**

**Magnesium**

**Sulfur**

## Micronutrients:

**Iron**

**Manganese**

**Boron**

**Copper**

**Molybdenum**

**Zinc**

**Nickel**

# What Do the Nutrients Do?

- **Nitrogen:**
  - growth, green color, amino acids, proteins
- **Deficiencies:**
  - seen in older leaves (transported to newer growth)
  - slow growth, yellowing

# What Do the Nutrients Do?

- **Phosphorus:**
  - Makes up ATP, RNA, DNA
  - Electron transport in photosynthesis
- **Deficiencies:**
  - seen in older leaves (transported to newer growth)
  - slow growth, often dark green, may have reddish cast



# What Do the Nutrients Do?

- **Potassium:**
  - Turgor pressure, regulating stomatal cells
  - Accumulation and transport of carbohydrates
  - Alleviates stress symptoms
- **Deficiencies:**
  - seen in older leaves (transported to newer growth)
  - Older leaf edges may have scorched look
  - Increased disease incidence

# What Do the Nutrients Do?

- **Iron:**
  - Enzyme reactions, chlorophyll formation and function
- **Deficiencies:**
  - Seen in younger leaves
  - Interveinal chlorosis
  - Availability decreases in high pH soils

# What Do the Nutrients Do?

- **Manganese:**
  - Photosynthetic reactions, electron transport
- **Deficiencies:**
  - Seen in younger leaves
  - Interveinal chlorosis
  - Availability decreases in high pH soils



# Quick Release Nitrogen

- Soluble in water
- Provide fairly rapid response in turf
- Volatilize readily if not irrigated in
- Useful for repair of injured turf- athletic fields
- Provide for quicker turf establishment if growing plugs or sprigs in
- Response seen for 30-45 days unless applied at excessive rate

# Ammonium Sulfate



- 21% N  $(\text{NH}_4)_2\text{SO}_4$
- Highly soluble and leachable
- Subject to volatilization
- Very acidifying – useful in high pH soils
- High salt index - 3.25 – must be watered in
- Deep green and longer response than many other soluble N sources

# Urea



- 46% N
- Soluble Synthetic Organic
- Nonionic, highly leachable
- Subject to volatilization
- Low acidity - 1.8/kg N
- Low salt index - 1.62

# Urea

- **Organic (but quick-release) N source**
- **Converted to ammonium-N form by enzyme urease in the soil after short time in the soil**
- **This happens within about 24 hours**
- **After this conversion, much less likely to leach if rainfall does occur**

# Ammonium Nitrate



- 33 – 34 % N
- Very soluble
- Subject to volatilization and leaching
- Low acidity
  - 1.8kg acid/kg
- High salt index -2.99
- Can be explosive
- Short term response

# Slow or Controlled Release Nitrogen

- **Controlled Release**
  - Granulated fertilizer that releases nutrients gradually and is not soluble
  - Release affected by soil temps
  - Typically coated
  - Release rate timed to meet changing crop nutrient requirements
- **Slow Release**
  - Nutrient availability delayed due to various mechanisms
  - Microbial, soil conditions
  - Can be organic or synthetic



# Slow or Controlled Release Nitrogen

- Use various mechanisms to release N
  - Coating through which N diffuses
  - Chemical reaction used to create chemical bonds that ties the N up
- Release rates vary widely between products and due to temperature and microbial activity
- More expensive than QRN
- Less likely to leach than QRN if applied to bare soil, few differences in healthy turf that provides a ground cover

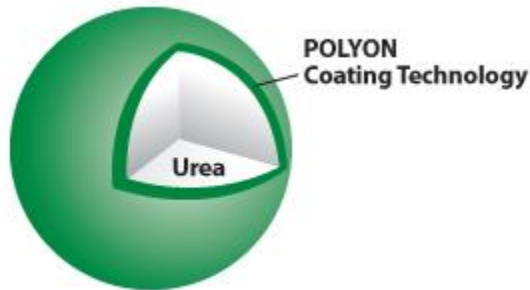
- **Slow release products**
  - Natural organics
- **Controlled release products**
  - Sulfur coated urea
- **Both controlled and slow**
  - Polymer coated
  - Polymer sulfur coated
  - Methylene urea and urea formaldehyde

# Sulfur Coated Urea



- 32-38% N
- Release depends upon
  - thickness of sulfur coating
  - microbial activity
  - soil environment
    - temperature
    - pH
- Cool season response-erratic
- Coating fragile- some spreaders may crack
- Response usually 60-90 days

# Polymer Coated



- Variable N
- N release varies, influenced by
  - coating thickness
  - soil temperature
  - not soil moisture
  - not influenced by soil moisture, pH, microbial activity
- Week 1: Moisture comes in through polymer coating, dissolves encapsulated N inside
- After week 1: Soil temperature causes N to diffuse through membrane





# Osmotic Diffusion

1. Water is moving into the bag by osmosis
2. Tea inside the bag is dissolving which creates a concentration gradient
3. Tea moves out of the bag by diffusion

Elapsed time 20 min



# 41 • 41-0-0

POLYON, POLYMER-COATED UREA (PCU), IS FERTILIZER COATING TECHNOLOGY WHICH CONTROLS THE RELEASE OF NUTRIENTS TO MEET THE PROLONGED FEEDING REQUIREMENTS OF TURFGRASS AND ORNAMENTALS.

### GUARANTEED ANALYSIS:

TOTAL NITROGEN (N) ..... 41.00%  
41.00% Urea Nitrogen\*

Derived from Polyurea Coated Urea.

\*41.00% Slowly Available Urea Nitrogen from Polyurea Coated Urea.



KEEP OUT OF REACH OF CHILDREN

### WARNING

CAUSES SKIN IRRITATION. CAUSES EYE IRRITATION. MAY CAUSE RESPIRATORY IRRITATION.

PRECAUTIONARY STATEMENTS: Avoid breathing dust. Wash thoroughly after handling. Use only outdoors or in a well-ventilated area. Call a poison center / doctor if you feel unwell. See specific instructions, first aid section on this label.

PERSONAL PROTECTIVE EQUIPMENT: Wear protective gloves / protective clothing / eye protection / face protection. Take off contaminated clothing and wash before reuse.

FIRST AID: IF ON SKIN: Wash with plenty of water. Wash with soap and water. If irritation persists, get medical advice / attention. IF IN EYES: Flush carefully with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists, get medical advice / attention.

STORAGE AND DISPOSAL: STORAGE: Store in a well-ventilated place. Keep container tightly closed. Store locked up. DISPOSAL: Dispose of contents / container in accordance with local / regional / national regulations.

### BENEFITS: BEST POLYON 41 • 41-0-0

- All the Nitrogen is 100% controlled-release, no immediate release.
- Turf response of 16-24 weeks can be expected. All the Nitrogen is released during that time period, no immediate portion remaining.
- Polyon is easy to apply and durable. It is not breakage during blending, bagging and spreading. No quick premature release of Nitrogen to burn foliage from cracked or damaged particles.
- Release mechanism by osmosis for a constant gradual diffusion of Nitrogen through the urea thick polymer coating. Release is unaffected by varying amounts of soil moisture, microbes or pH levels.

POLYON 41 TEMPERATURE RELEASE RATES	
60 F =	20-24 weeks
70 F =	16-20 weeks
80 F =	10-16 weeks

### APPLICATION RATES:

	Lbs. of Actual Nitrogen desired per 1,000 sq. ft.	Lbs. of BEST POLYON 41 • 41-0-0 to apply per 1,000 sq. ft.	Lbs. of BEST POLYON 41 • 41-0-0 to apply per Acre
Turfgrass:	2'	4.8'	213'
*Recommended Rate	3	7.3	318
	4	9.8	427

NOTE: BEST® POLYON® 41 • 41-0-0 is 100% controlled release, no immediate release. No immediate response is expected. Allow approximately 2 weeks for visible turf response. Adequate phosphate and potash should be provided for optimum plant growth.

GROUND COVER: Broadcast at 3 lbs. per 1,000 sq. ft. (1/2 lb. per 100 sq. ft.)

SHRUBS & EVERGREENS: Sprinkle 1/2 cup evenly around drip line or broadcast work to top 1 inch of soil.

TREES: Apply 1/2 lb. per 1 inch of trunk diameter. Distribute evenly side branches to the drip line.

TREE & SHRUB NURSERIES: In early spring, as soon as soil is possible, broadcast at 300 lbs. per acre between rows. Adjust P & K according to soils.

For a tree and shrub seed or propagation bed, apply 5 lbs. per 1,000 sq. ft. along with adequate phosphate and potash.

CONTAINER & GREENHOUSE SOIL MIXES: Seedlings—1/2 lb. per 1 b. & 1 lb. per phosphate and 1/2 lb. sulfate of potash or other low salt index equivalent per cubic yard of mix.

NOTE: Liquid measuring cups are very close in estimating the weight of dry granular fertilizers. Example: an 8 oz. (1 cup) measuring cup holds approximately 8 oz. (12 lb.) of dry granular fertilizer.

### PRODUCT COVERAGE:

ONE 50 LB. BAG COVERS 10,200 SQ. FT.

Based on the Recommended Turfgrass Rate

### SPREADER SETTINGS:

Label Settings Will

Apply Approximately the

Recommended Rate.

BEST® Pro .....	5X8
Spyker / BEST® Model 34, 44, 64 .....	4.8
Earthway .....	18
Le Sco .....	16
Scott R-3A (Core 6) .....	P1/4
Leiy 1250 (Simpl) .....	654
Vicon (Simpl) .....	41

Rates are for spreading one times over in one direction

SON 250

NOTE: Spreader settings are guidelines only. Spreaders should be checked for accuracy.

### APPLICATION PRECAUTIONS:

- Keep away from pools, ponds, etc. Do not contaminate potable water.
- Do not apply with a drop type spreader. The grinding action of these spreaders can damage the coating of polymer-coated urea and can cause turf burn potential.

### PACKAGE SIZE:

50 LB (22.68 Kg.) BAGS

Information regarding the contents and levels of metals in the product is available on the Internet at <http://www.regulate-by-tribe.com>

DISCLAIMER OF WARRANTY: Seller warrants that the composition of the product conforms to the description given on the label. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES AND REPRESENTATIONS EXPRESSED, IMPLIED OR STATUTORY, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR USE. Timing, rate and method of application, weather and crop conditions, moisture and specifically mentioned on the label is an accompanying written recommendation are beyond the control of the seller. Buyer assumes all risk of use, storage and handling of the material not in strict accordance with directions given hereon. Buyer will be liable in the event of damages arising from the use of the product to accept a replacement of the product at a refund of the purchase price of the product, at Buyer's option, or full coverage of Seller's liability. No other remedies shall be available to the buyer. Guarantees or warranties do not concern this product, and no such warranties, guarantees or warranties shall be valid or binding upon seller.

BEST® is a registered trademark of J.R. Simplot Company. Polyon® is a registered trademark owned by KODIC Agonomic Services, LLC.

PCAP 1491 SUR 10-20-2014



**Guaranteed Analysis**

Total Nitrogen (N).....37.00%  
37.00% Urea Nitrogen\*  
Soluble Potash (K<sub>2</sub>O).....8.00%

**Derived From:** Polymer Coated Urea, Urea and Muriate of Potash.

\*31.6% Slowly Available Urea Nitrogen from Polymer Coated Urea

**KEEP OUT OF REACH OF CHILDREN  
CAUTION**

**Guaranteed By:**

AGRIUM ADVANCED TECHNOLOGIES (U.S.) Inc.  
2915 ROCKY MOUNTAIN AVE  
LOVELAND, CO 80538

**Net Weight 50 lbs. (22.68 kg)**



**F1828**

Tests have not been carried out under all possible use conditions and Seller cannot and does not warrant that the goods are compatible with all other chemicals or under all use conditions.

**FIRST AID**

**if in Eyes:** If in Eyes: Hold eye open and rinse slowly and gently with water for 15 to 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice. **if on Skin:** Take off contaminated clothing. Rinse skin immediately with plenty of water for 15 to 20 minutes. Call a poison control center or doctor for treatment advice. **if Swallowed:** Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. Do not give anything by mouth to an unconscious person. **if Inhaled:** Move person to fresh air. If person is not breathing call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.

**STORAGE and DISPOSAL:** **STORAGE:** Store in original containers only. Keep containers tightly closed when not in use. Store in a cool dry well-ventilated area, preferably in a locked storage area away from children, food and food products, and seed. Store at ambient temperatures. Do not contaminate water, food, or feed by storage or disposal. **DISPOSAL:** Do not reuse container. Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke. Do not contaminate water, food, or feed by storage or disposal.

**HANDLING:** Avoid breathing fertilizer dusts. Avoid prolonged or repeated skin contact. Avoid eye contact. Wash hands thoroughly after handling this product.

Product Code: 8121011

**37-0-8**  
**with Duration CR®**

**DIRECTIONS FOR USE:** Apply as needed based on soil tests or according to recommendations in your approved nutrient management plan.

Lbs. N / 1000 sq. ft.	Lbs. Product / 1000 sq. ft.	Lbs. Product / Acre	
2.4	6.4	279	Low
2.9	7.7	335	Medium
3.4	9.1	396	High

	AccuPro 2000	Bigfoot	Lesco Rotary	Spyker
Low	Q	Q ½	28	7.2
Medium	S	P ½	18 ½"	7.8
High	U	Q ¾	20"	8.4

\* Use lower setting and spread in 2 directions to achieve high rate with this spreader.

**CONDITIONS OF SALE AND LIMITATION OF WARRANTY AND LIABILITY**

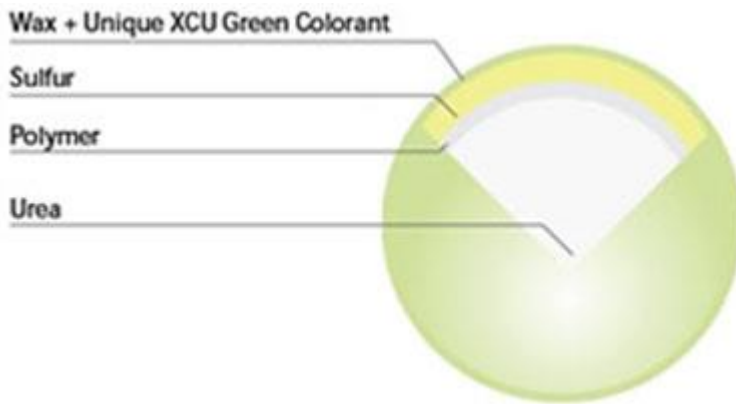
BEFORE BUYING OR USING THIS PRODUCT read the Directions for Use and the following Conditions of Sale and Limitation of Warranty and Liability, which no employee or agent of Agrium Advanced Technologies (U.S.), Inc. or the seller is authorized to vary. Agrium Advanced Technologies (U.S.), Inc. warrants this product conforms to the chemical description on the label and is reasonably fit for the purposes stated in the Directions for Use, when the product is used in accordance with such Directions for Use under normal conditions of use. AGRIUM ADVANCED TECHNOLOGIES (U.S.), INC. MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THE BUYER'S OR USER'S EXCLUSIVE REMEDY FOR ANY INJURY, LOSS, OR DAMAGE RESULTING FROM THE HANDLING OR USE OF THIS PRODUCT SHALL BE LIMITED TO ONE OF THE FOLLOWING, AT THE ELECTION OF AGRIUM ADVANCED TECHNOLOGIES (U.S.), INC. OR THE SELLER: DIRECT DAMAGES NOT EXCEEDING THE PURCHASE PRICE OF THE PRODUCT OR REPLACEMENT OF THE PRODUCT. AGRIUM ADVANCED TECHNOLOGIES (U.S.), INC. AND THE SELLER SHALL NOT BE LIABLE TO THE BUYER OR USER OF THIS PRODUCT FOR ANY CONSEQUENTIAL, SPECIAL, OR INDIRECT DAMAGES, OR DAMAGES IN THE NATURE OF A PENALTY.

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Information regarding the contents and levels of metals in this product is available on the internet at <http://www.aapfco.org/metals.htm>

# Polymer-Sulfur Coated Urea

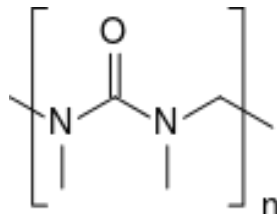


- **N release influenced by**
  - coating thickness (vary by product)
  - diffusion rate
  - Less influenced by soil temperature and moisture
- **Good for both warm and cool season application**

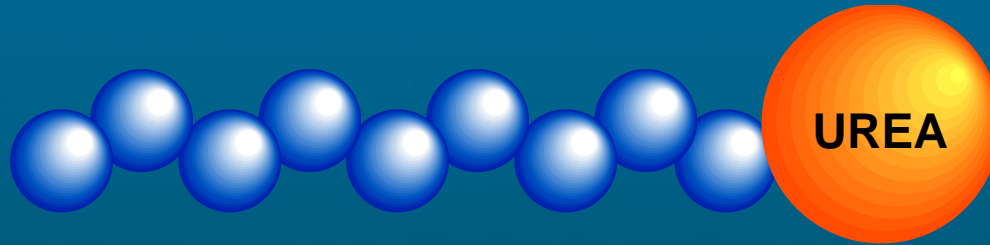
# Urea Formaldehyde



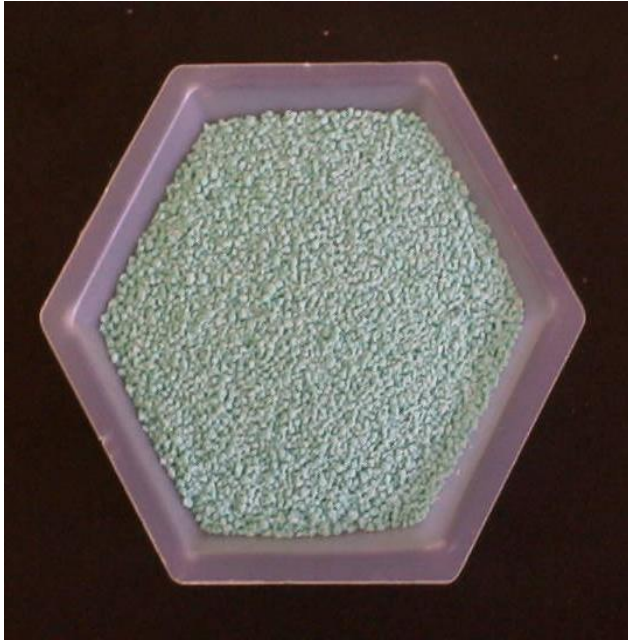
- Insoluble organic
- 38% N ; 65-71% WIN
- Biological N release
  - release by microbial activity
  - soil temperature
- Less effective in cool seasons
- Reaction of urea and formaldehyde gives chains of alternating C and N
  - Longer chains, slower release
- Nitroform, Blue Chip, Nutralene
- Can also be in solution



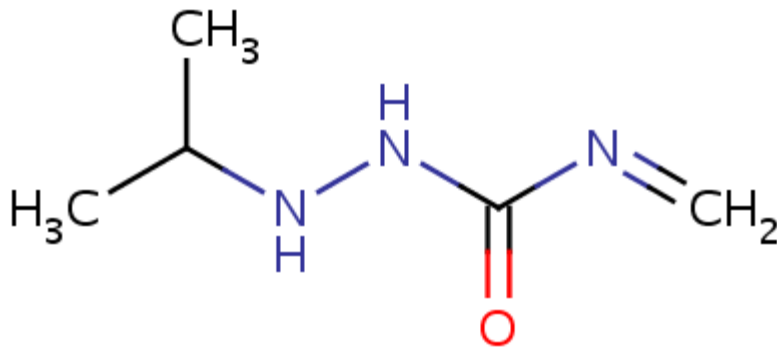
# UF Synthesis



# Methylene Urea

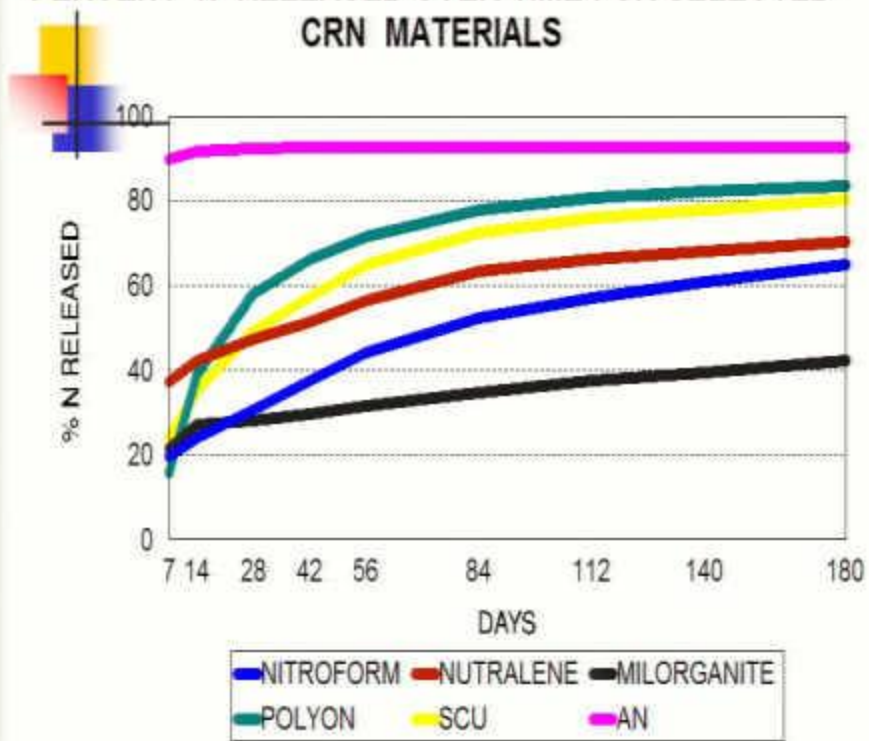


- 40% N - 36% WIN
- Microbial N release
- More rapidly available than UF
- Not as adversely influenced by cool temperatures
- Reaction of urea and formaldehyde gives chains of alternating C and N





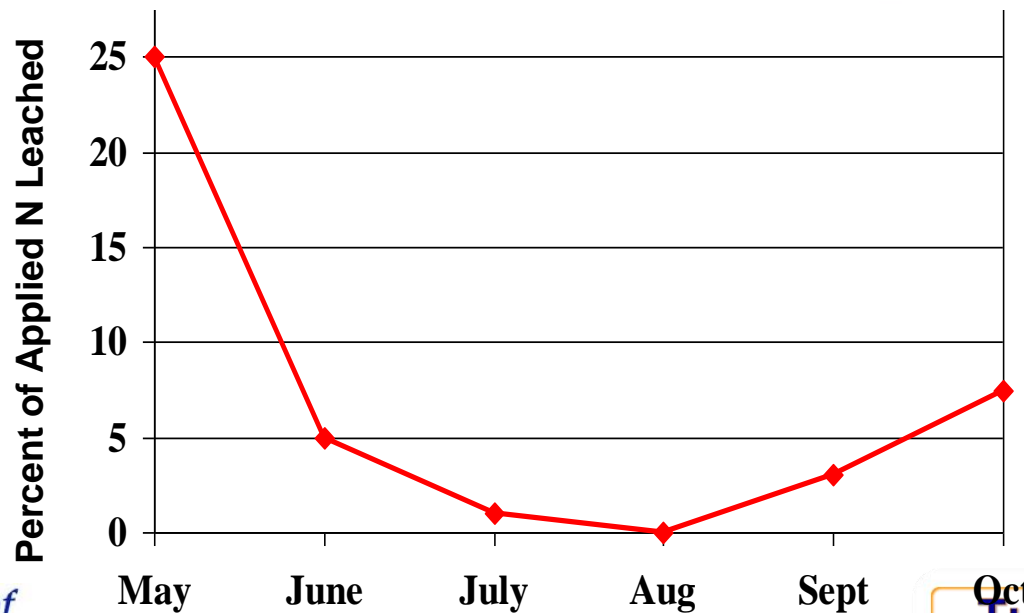
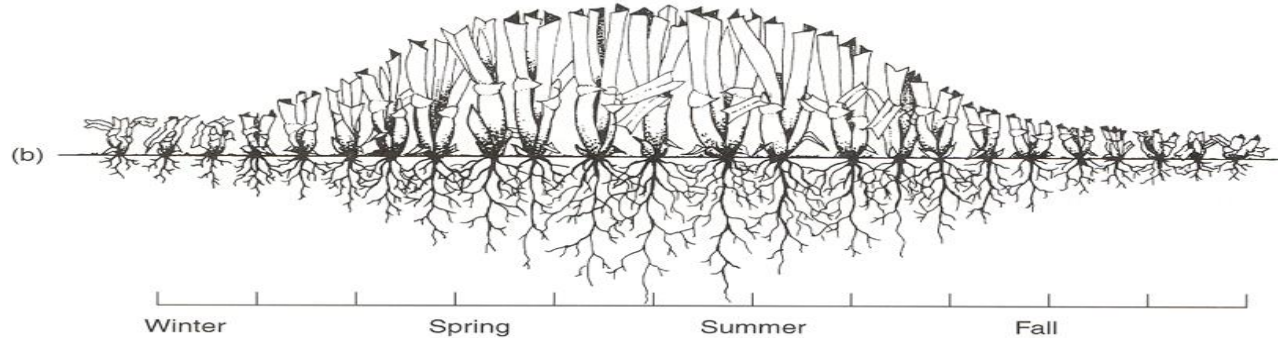
### PERCENT N RELEASED OVER TIME FOR SELECTED CRN MATERIALS





# Environmental Fate of Fertilization Timing

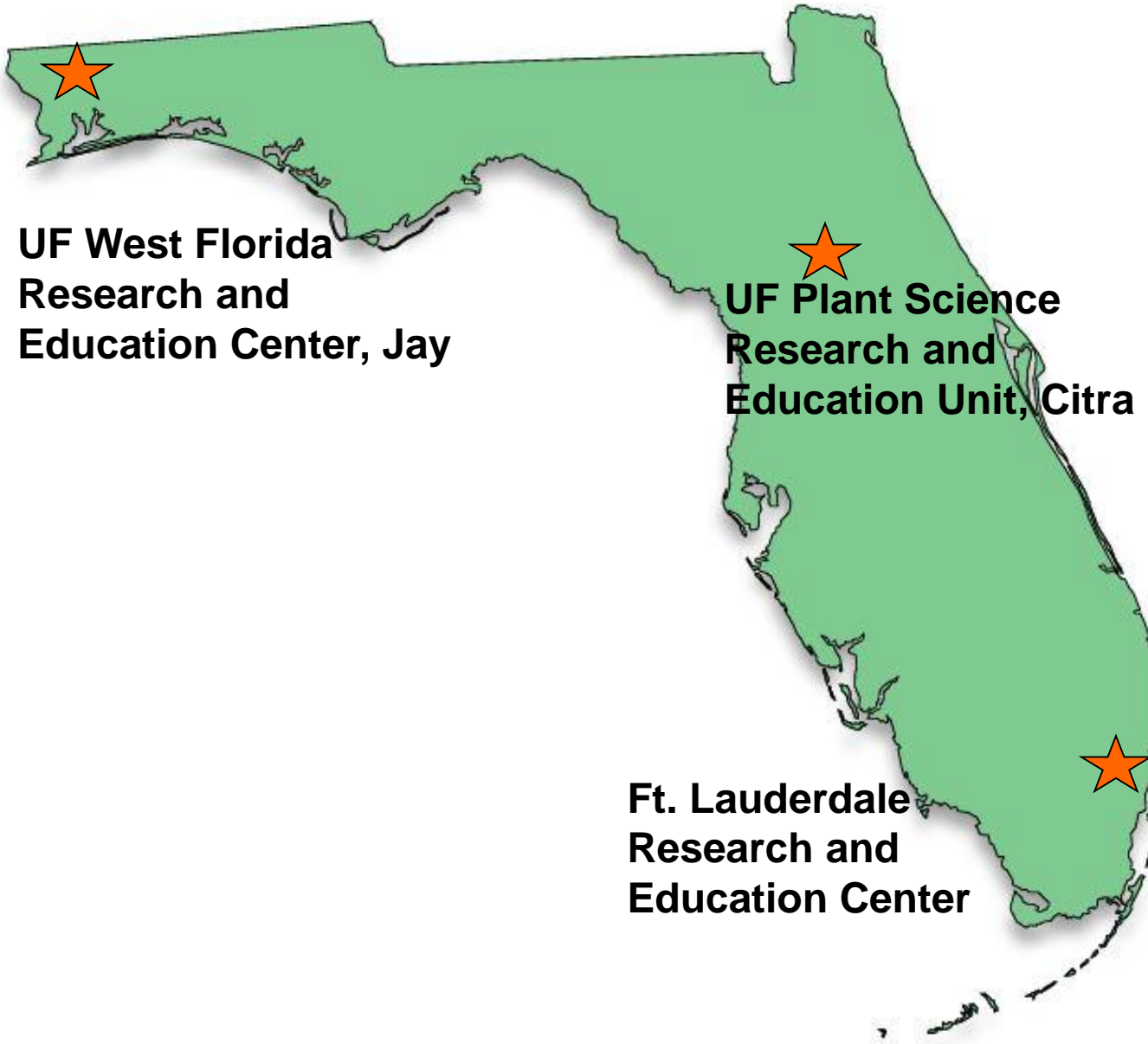
Seasonal shoot and root growth of warm-season turfgrasses. (Turgeon, 2002)



Trenholm et al., 2012

# DEP Research – Nutrient Leaching

- Part of a FDEP \$3.5 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

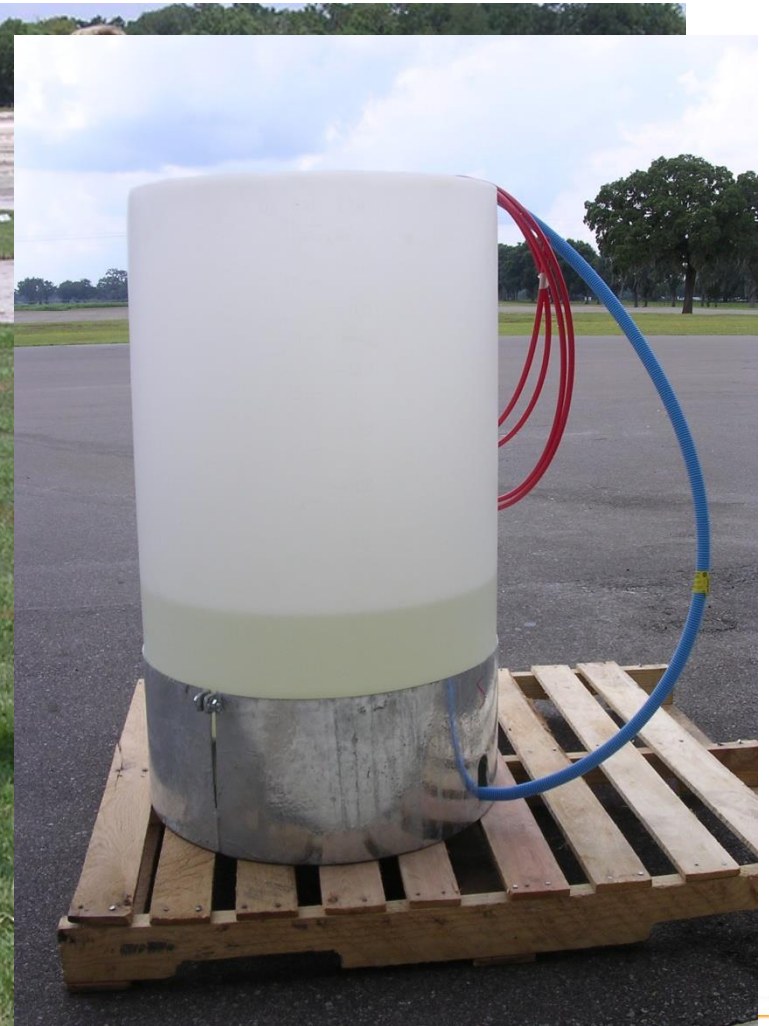
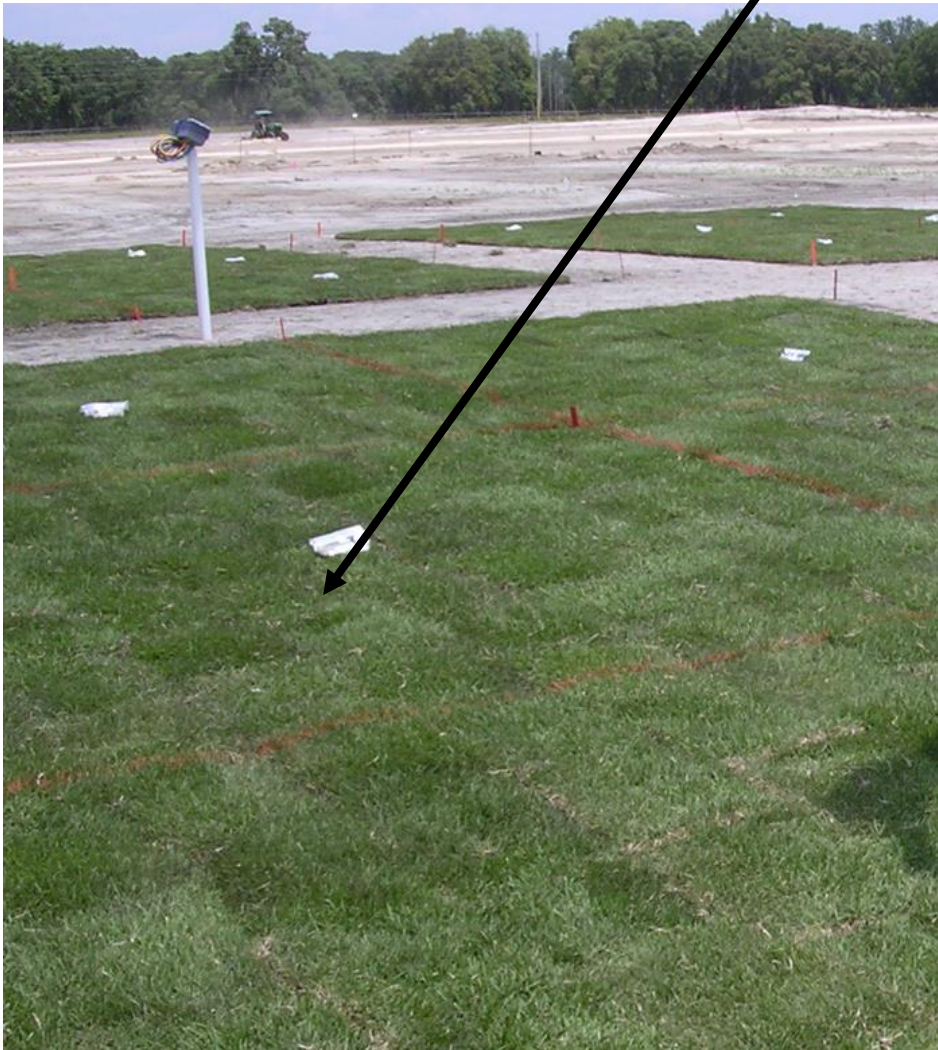


**UF West Florida  
Research and  
Education Center, Jay**

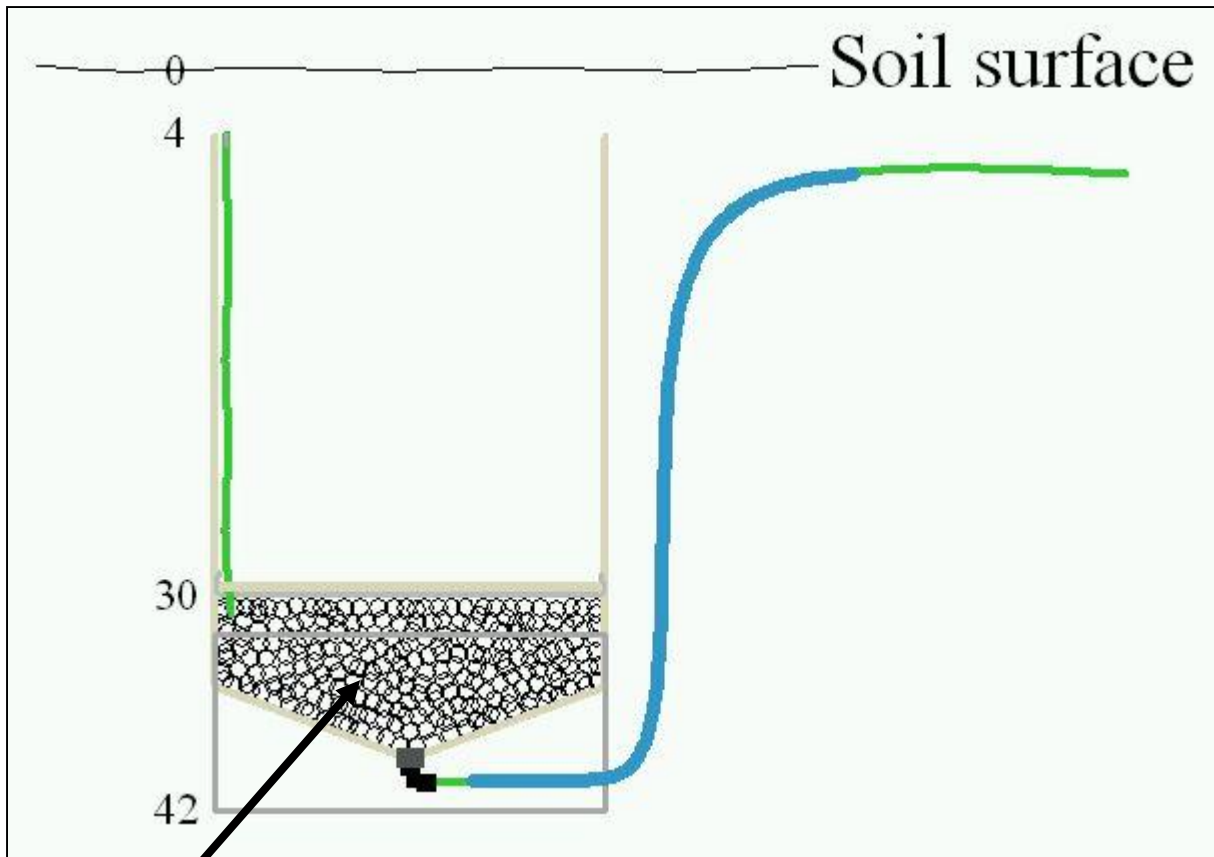
**UF Plant Science  
Research and  
Education Unit, Citra**

**Ft. Lauderdale  
Research and  
Education Center**

Lysimeters buried in center of each plot

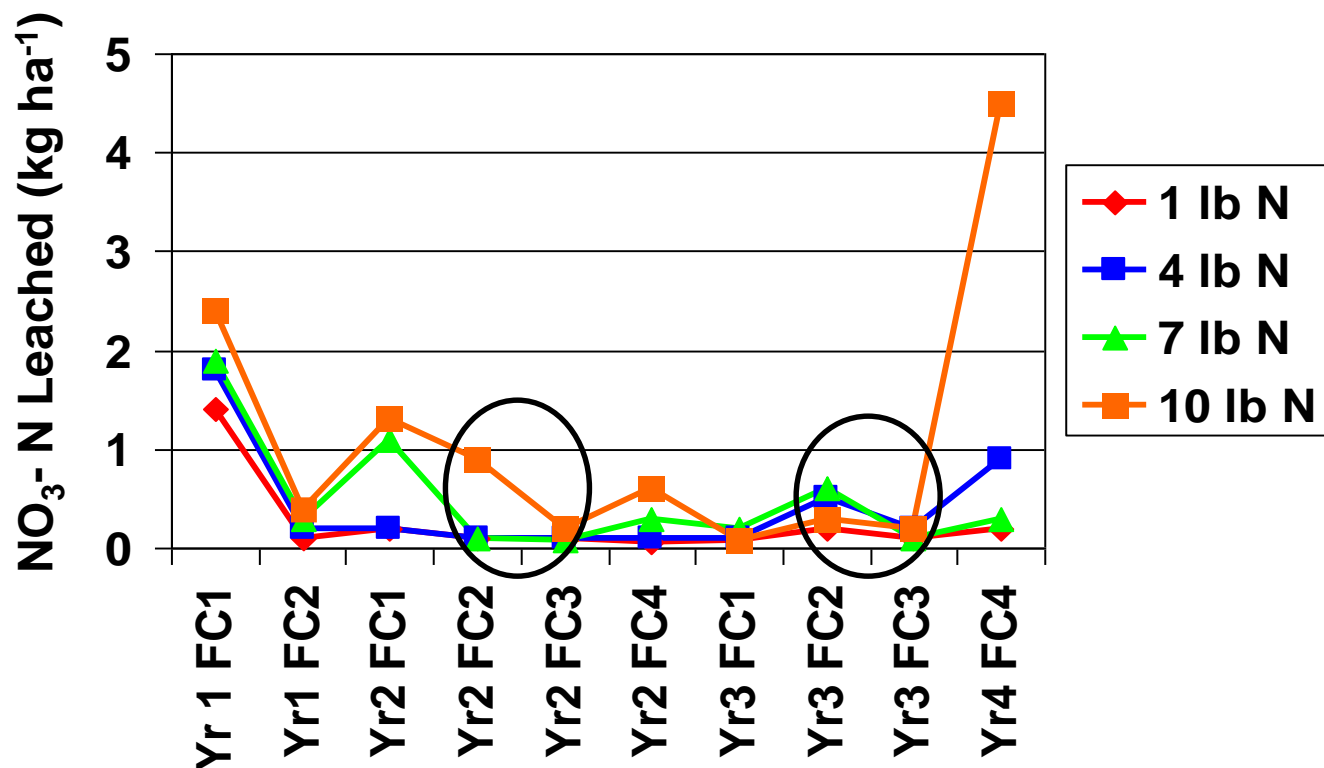






As nitrate percolates downward through the column, it collects in reservoir filled with gravel. At bottom of lysimeter is a portal for tubing that runs to collection device aboveground. To collect leachate, a vacuum pump is attached to the tubing and water evacuated from base. A sub-sample is collected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

# Nitrogen Rate Study - Nitrate-N Leaching from Floratam



Nitrogen applied as 100% soluble urea



# Conclusions

- Floratam very effective in taking up applied N during growing season
- Even at excessive rates applied here, nitrate leaching loss was very minimal or below detection levels – turf quality and health, however, did not sustain at the high rates

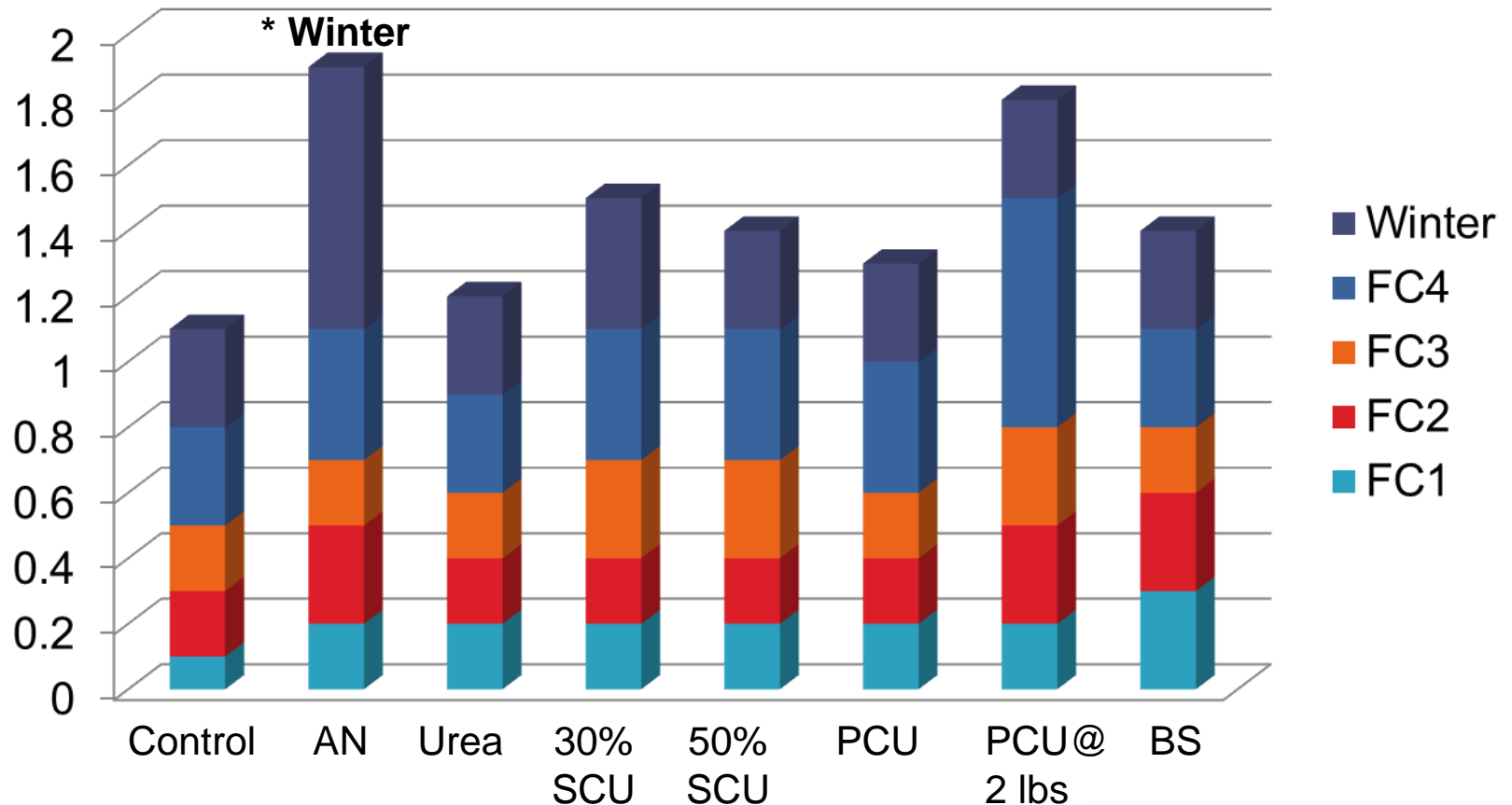
# Nitrate Leaching Due to Nitrogen Source

- 8 nitrogen sources applied @ 1 lb N 1,000 ft<sup>-2</sup> 4x yr (consistent with currently recommended rates)
- Established Floratam and Empire
- Study on going through this year

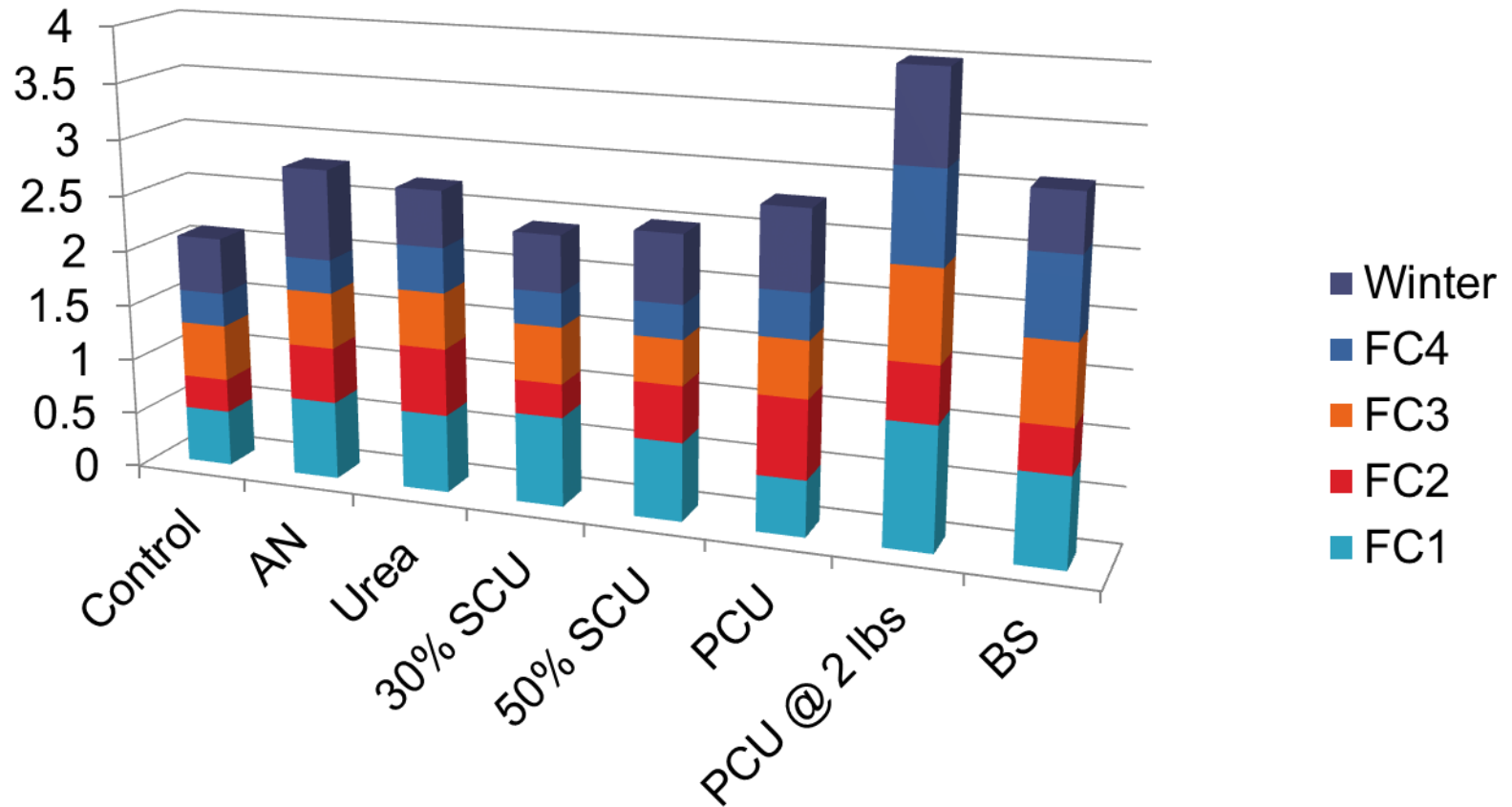


Figure 1 - Leaching columns experiment aspects

# No<sub>3</sub>-N Loading by Fertilizer Cycle in 2009



# No<sub>3</sub>-N Loading by Fertilizer Cycle in 2010

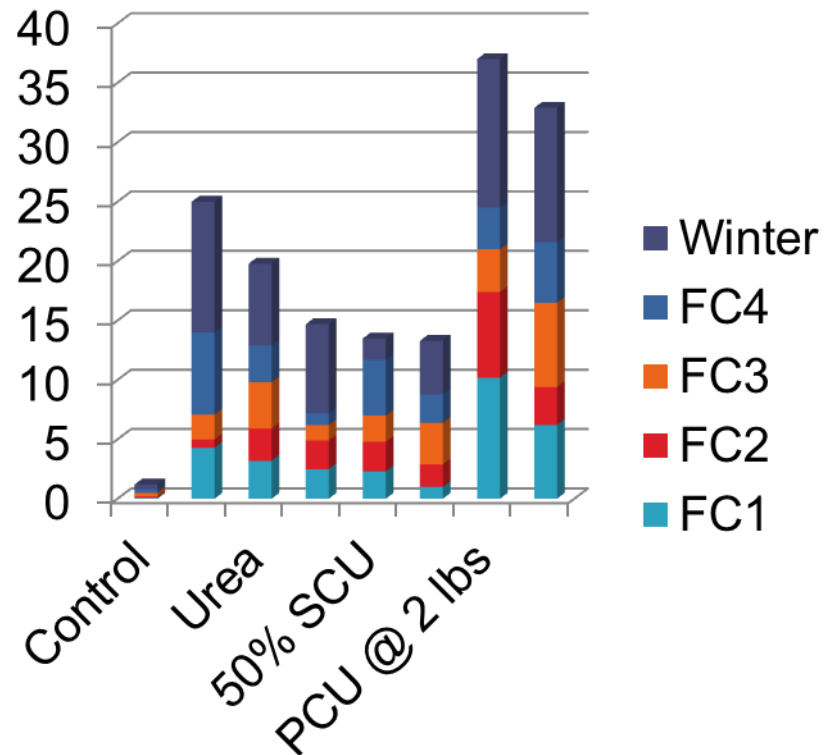
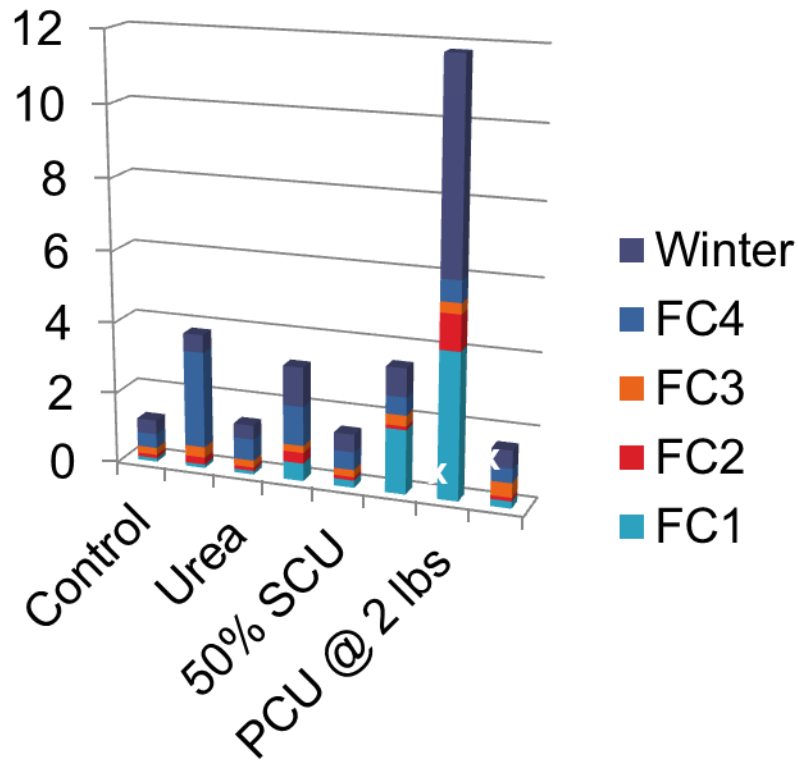


No Significant Differences

# No<sub>3</sub>-N Loading by Fertilizer Cycle in 2011

## St. Augustinegrass

## Zoysiagrass

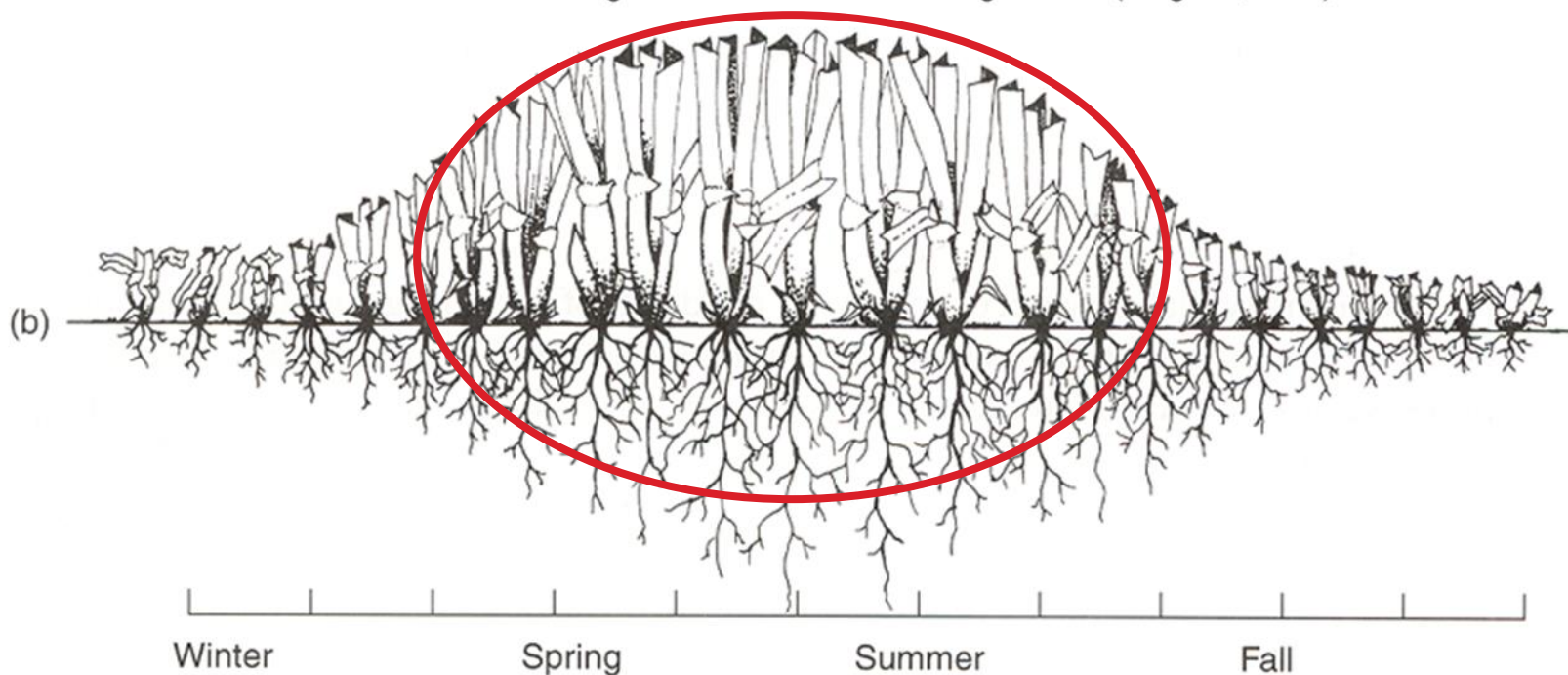


# Conclusions

- **Few differences between N sources in Floratam at the rates applied**
- **In areas with summer fertilizer ban, use controlled release products prior to summer fertilizer ban**
- **Do not use controlled release products if applying after fertilizer ban period in central and north FL**

# When Should We Apply Fertilizer?

Seasonal shoot and root growth of warm-season turfgrasses. (Turgeon, 2002)





# How Much Should We Apply Annually? (lbs. N 1,000 ft<sup>-2</sup> yr<sup>-1</sup>)

	North	Central	South
Bahiagrass	2-3	2-3	2-4
St. Augustinegrass	2-4	2-5	4-6
Zoysiagrass*	2-3	2-4	2.5-4.5

\*These are new recommendations based on Nitrate leaching and turf quality data over 8 years

# How Much to Apply Each Time

- Frequency of application: 1-4 times yearly
- Each application: maximum amount to apply is 1 lb N per 1,000 sq. ft. if fertilizer has slow-release N
- Only fertilize during the growing season
- North and Central Florida: April – September
- South Florida: Year round

# Fertilizer Calculations

- Divide your yard up (front, back, sides)
- Determine square footage of each area

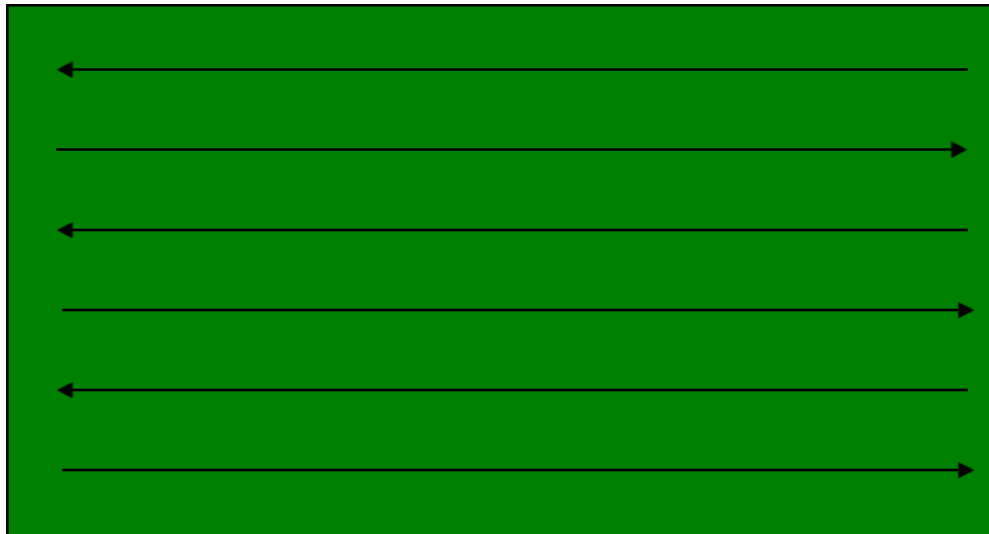


# Fertilizer Calculations

- Look at fertilizer analysis on bag (ex. 15-0-15)
- Take the amount of N (15% in this case) and divide it into 100.
- This gives you 6.6 – this is the pounds of fertilizer that you need for 1,000 sq. ft. to apply 1 lb. N
- This works for ANY fertilizer analysis

# Fertilizer Calculations

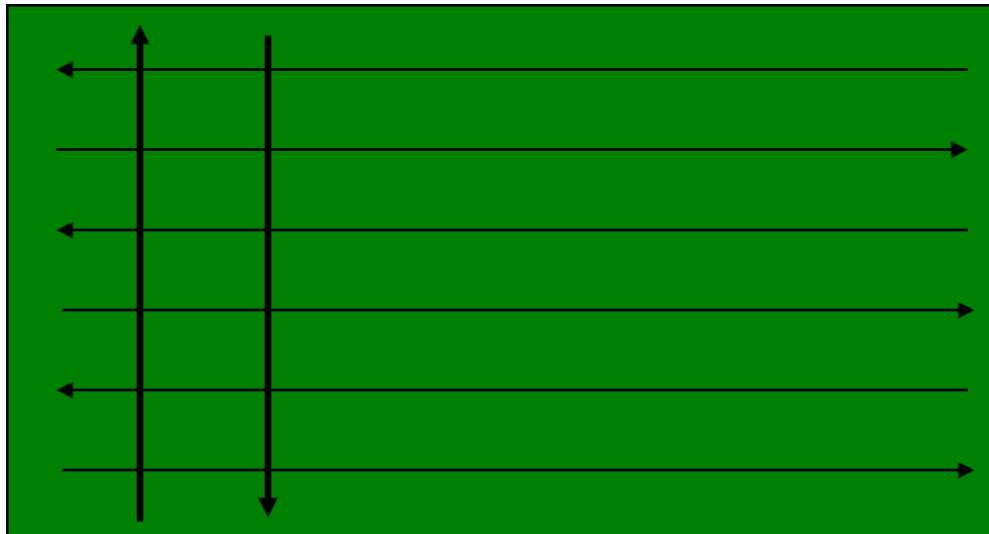
- To apply the correct amount:
  - Take half of the total amount of fertilizer:
    - 15% = 6.6 lbs fertilizer per 1,000 square feet
    - Half of this = 3.3 lbs fertilizer in spreader





# Fertilizer Calculations

- To apply the correct amount:  
Take the remaining 3.3 lbs, put in spreader and go back and forth at 90° angles



# Points To Remember

- Know what is in your soil so that you know what nutrients grass may need from fertilizer
- Only fertilize during the growing season for your area
- Apply fertilizer at the correct rates
- There are many different fertilizer options, know what you are using
  - What are the N sources?
  - Do I need phosphorus?
  - Do I need micronutrients?

# Questions?



[letr@ufl.edu](mailto:letr@ufl.edu)