Nitrogen Sources: The Form that Fits

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Nitrogen Availability in Soils is Complicated

Largely driven by a wide range of microbial species which act on the different N forms

N In →  → N Out

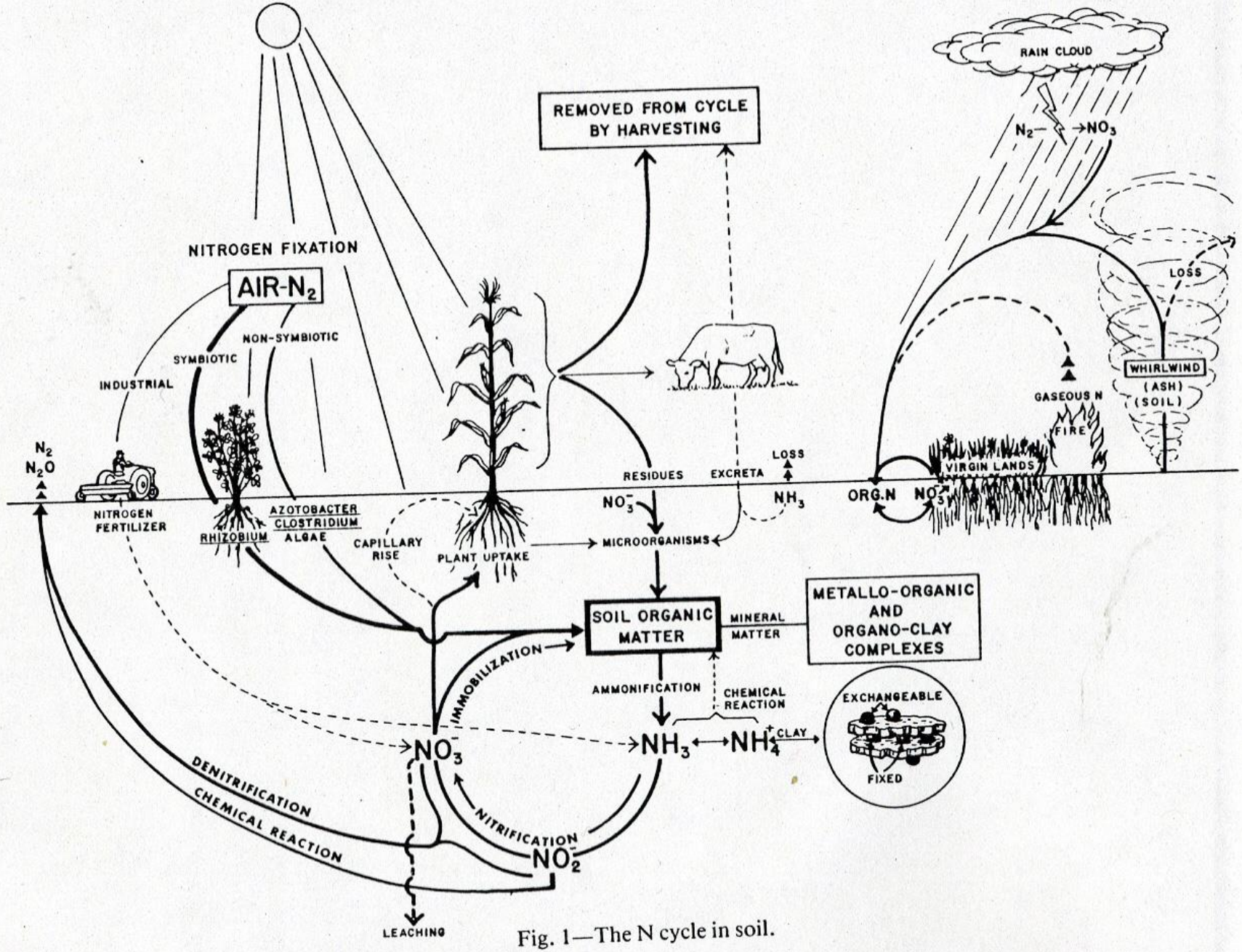


Fig. 1—The N cycle in soil.

The basics of N availability

- Plants take up nitrate and ammonium.
- A little urea (possibly) directly through the leaf.
- Regardless – it has to be converted in the plant into plant available forms.
- N availability in the soil is largely controlled by microbial activity, which is affected by factors such as water content and temperature.

Fertilizer Technologies – sorting out the terms

- *Soluble*
  - Immediately available for plant uptake and growth
  - Produce a rapid response, more frequent application may be needed
  - Can have environmental issues if applied incorrectly
  - Often cheapest per pound of N
  - Burn if used incorrectly
- *Slow release*
  - Available over some longer period of time for plant use
  - Slower, long-term plant response, fewer applications
  - Can help with environmental protection, especially in sandy soils
  - May cost a bit more per pound of N
  - Often considered ‘safer’ to use – less risk of burn
  - There are different types of slow release fertilizers

Soluble Fertilizers

- Immediate nutrient release
- Rapid turfgrass response
- Possibility of turf burn
- Tend to be inexpensive
- Examples: urea, $(NH_4)_2SO_4$

Slow-Release Fertilizers

- Physically slow-release
  - Slow release via a physical coating around a soluble prill
  - Technologies have been around since the 1950s, others newer (80s and 90s)
    - SCU
    - PCU, resin-coat, multi-coat
- Chemically slow-release
  - Slow release by their manufacturing method (homogeneous) – 1950s
  - Ureaformaldehyde/Methylene urea
  - IBDU
- 'Stabilized®' (Trademarked Agrotain name) N sources
  - Keep N in certain forms via the presence of denitrification inhibitors and/or urease inhibitors
  - Not classed as a true 'slow release' fertilizer

Chemically Slow-Release

- Slow release due to a chemical reaction
- Nitrogen must be made plant available by bonds being broken
- Methylene ureas (urea formaldehyde)
- Isobutlyidene diurea (IBDU)
- Slower, more consistent N release
- Higher cost than soluble

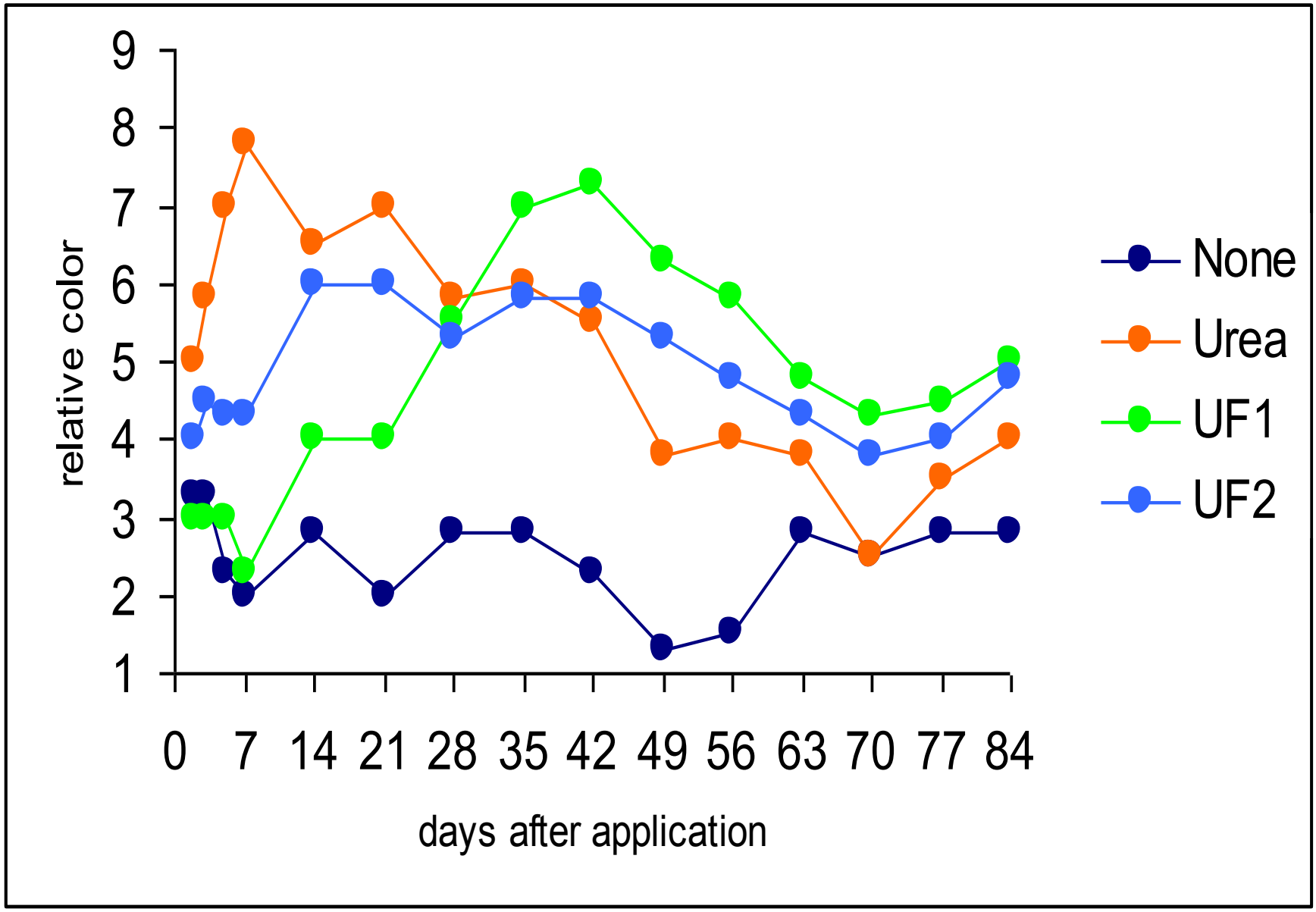
Ureaformaldehyde (UF)

- Ureaformaldehyde (UF) - one of the oldest controlled-release N technologies, commercialized in 1955.
- Urea and formaldehyde are reacted together to produce polymer-chain molecules of varying lengths. Longer the chains – slower the release.
  - *Ureaform*. Very slow solubility. Ureaform is largely of longer-chained molecules of UF polymers.
  - *Methylene ureas* are a class of sparingly soluble products that were developed in the 1960s and 1970s. Contain intermediate-chain-length polymers.
  - *UF solutions* are clear water solutions. Can include triazones.

Nutrient release from slow-release UF fertilizers:

Must have both the activity of water and microbes. Chains must be broken for conversion to plant-available N forms. Since microbial activity is needed, anything that affects that (soil moisture, pH, aeration, temperature) affects the rate of N release.

Relative Color of Bermudagrass as Affected by N Source



Physically Slow Release

- Coated with wax, sulfur or plastic to make slow-release
- Typically urea, but also may be K_2SO_4
- Consistent, slow N release
- Length of release varies with coating thickness and other coating characteristics

Sulfur-Coated Urea (SCU)

- Sulfur-coated urea (SCU) fertilizers - developed in the 1960s and 1970s.
- SCU is urea coated with a layer of sulfur, and often a wax sealant.
- N release from SCU is by water penetration through micropores. If there is a wax sealant microbial activity will be needed as well.
- Release rate varies with coating thickness and integrity.

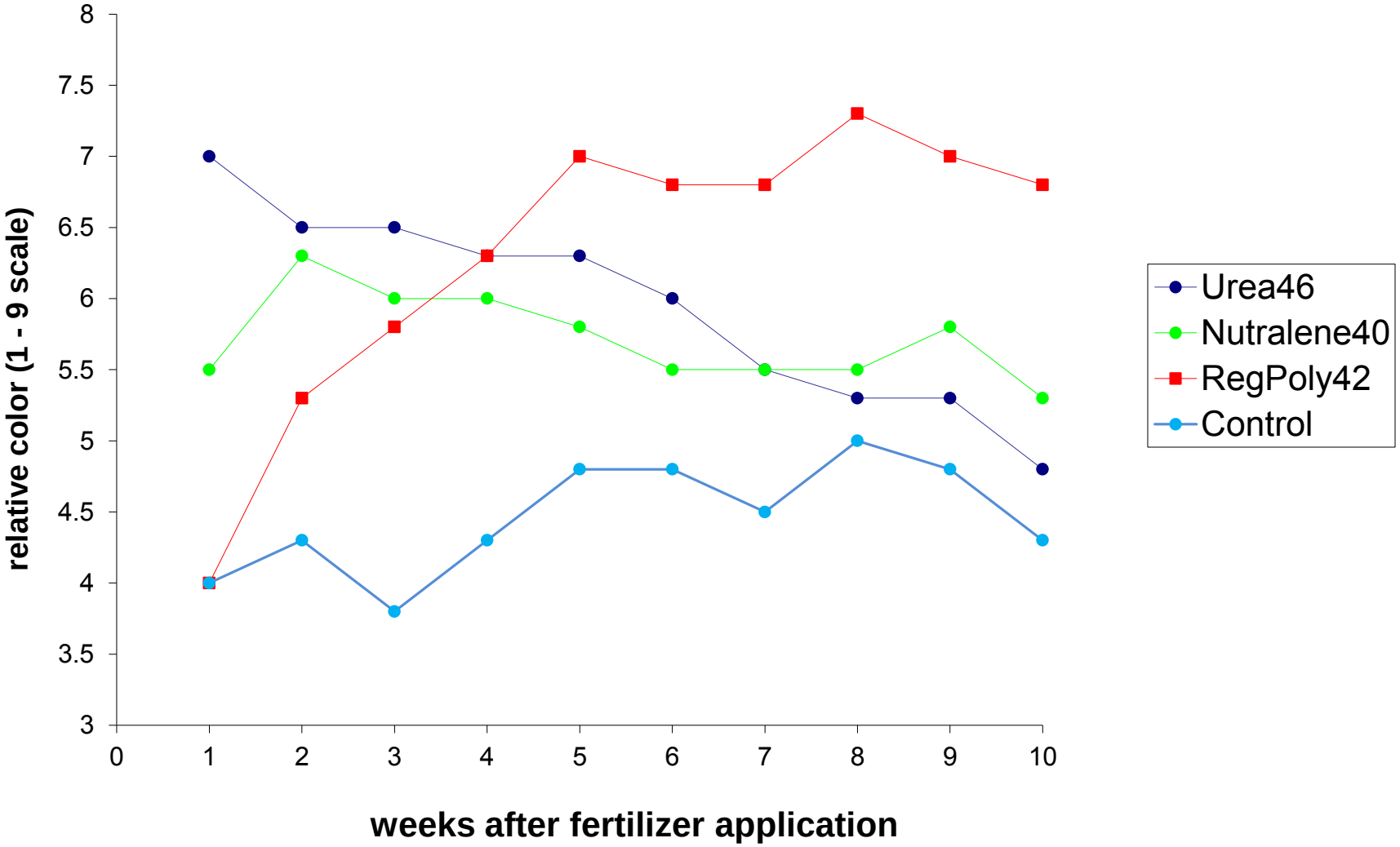
Polymer-coated fertilizers

- ***Polymer-coated fertilizers*** - Nutrients released via diffusion through a semipermeable polymer membrane. Release rate can be controlled by varying the composition and thickness of the coating. Release is largely controlled by temperature.

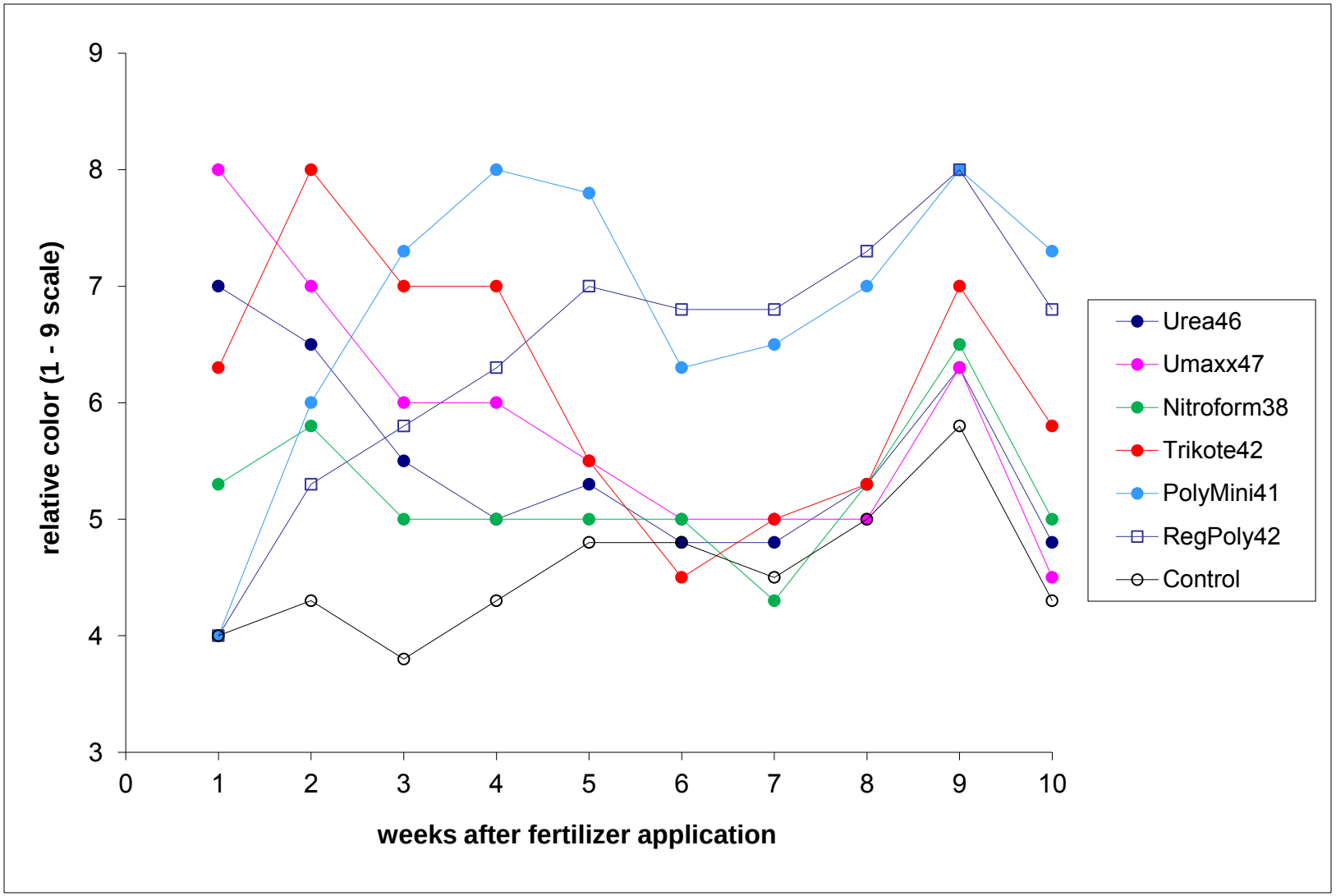
- ***Reactive Layer Coating*** - Two reactive monomers are simultaneously applied to the fertilizer substrate, which creates an ultra-thin membrane coating, which controls nutrient release by osmotic diffusion. Coating thickness determines the diffusion rate and the duration of release for RLC products.

- ***Polymer-coated sulfur-coated fertilizers –*** These are hybrid products that use a coating of sulfur and a secondary polymer coat. They are lower cost than poly-coated products. The nutrient-release mechanism is a combination of diffusion and capillary action. Greater uniformity in nutrient release compared to typical SCU fertilizers, tend to be less temperature sensitive.

Relative Color of Hybrid Bermudagrass



Penn G-2 color as affected by slow-release N source, Farmlinks GC, 2007



‘True Organics’ Slow Release

- Slow release because they need microbial activity to release the plant available N.
- Same process by which N is release from thatch, clippings etc.
- N release is affected by anything that affects soil microbial activity.

Total Nitrogen (N).....4%

0.4% Ammoniacal Nitrogen
0.4% Water Soluble Nitrogen
3.2% Water Insoluble Nitrogen

Available Phosphate (P_2O_5) 6%

Soluble Potash (K_2O) 4%

Calcium (Ca) 2%

Primary plant food sources derived from aerobically composted turkey litter, hydrolyzed feathermeal and sulfate of potash.

OMRI™
Listed
Organic Materials Review Institute

Listed by the Organic Materials Review Institu
(OMRI) for use in organic production

Total Nitrogen (N).....18%
2.6% Ammoniacal Nitrogen
11.7% Urea Nitrogen
1.5% Slowly Available
Water Soluble Nitrogen
2.2% Water Insoluble Nitrogen

Available Phosphate (P_2O_5) 1%

Soluble Potash (K_2O) 8%

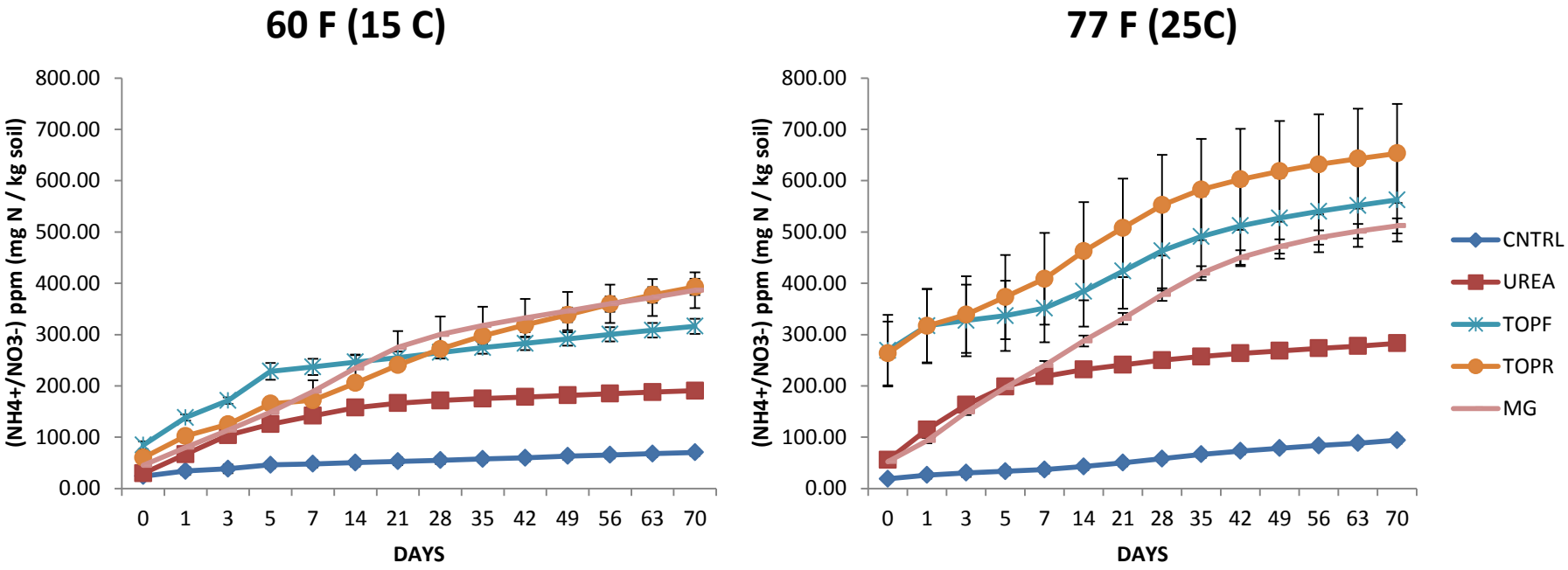
Calcium (Ca) 1%

Sulfur (S) (Combined) 7%

Iron (Fe) 1%

Primary plant food sources derived from aerobically composted turkey litter, hydrolyzed feathermeal, ammonium sulfate, ferrous sulfate, methylene urea, polymer coated sulfur coated urea and muriate of potash.

Temperature Effects on Nutrient Release



'Stabilized' Nitrogen Fertilizers

- Urea with the addition or either a nitrification inhibitor (dicyandiamide), urease inhibitor (N-(n-butyl) thiophosporic triamide), or both.
- Inhibits the enzymes urease and ammonium mono-oxygenase.
- Trade names U-Flexx ®/U-Maxx®
- Another product is NutriSphere-N, which is a maleic-itaconic copolymer

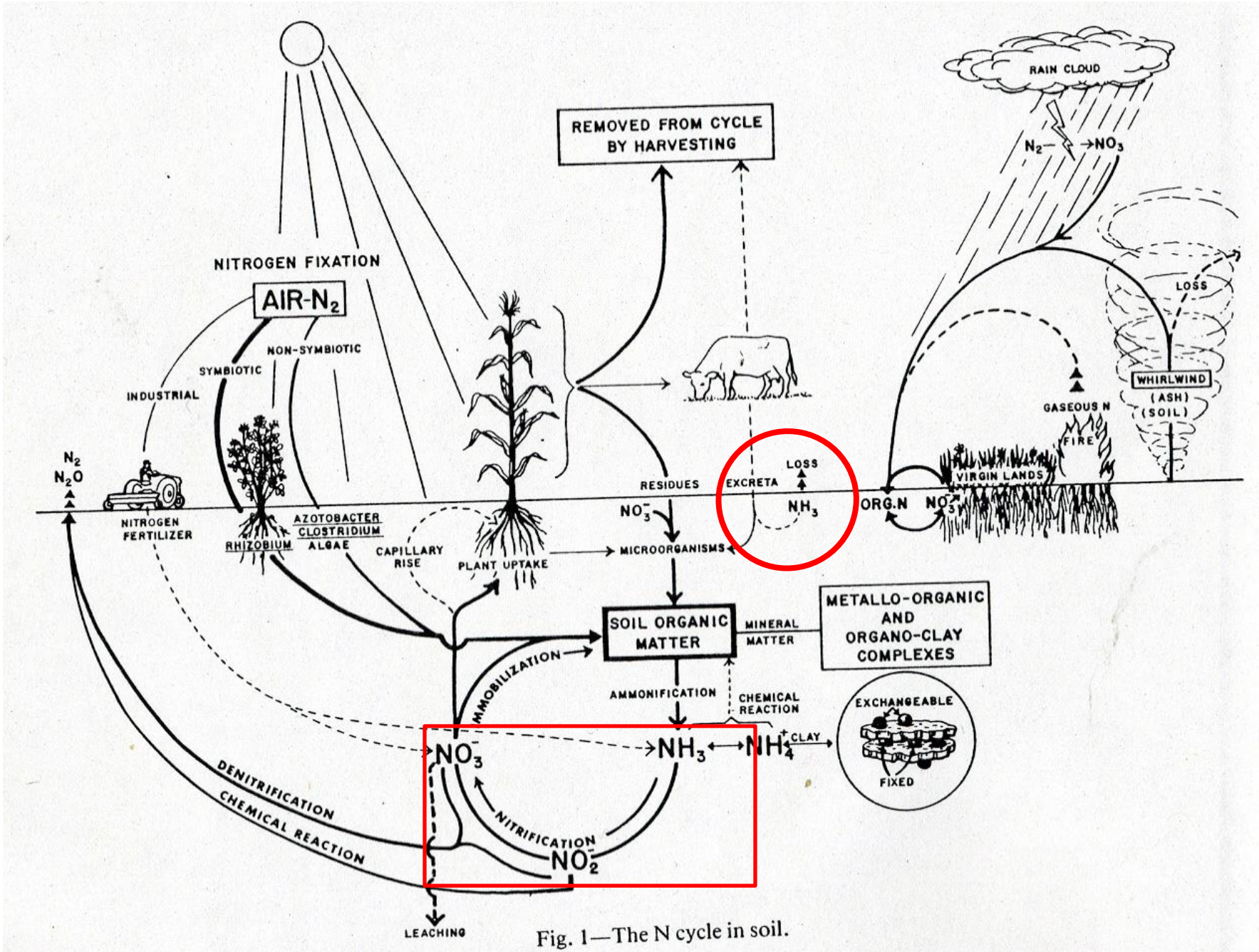
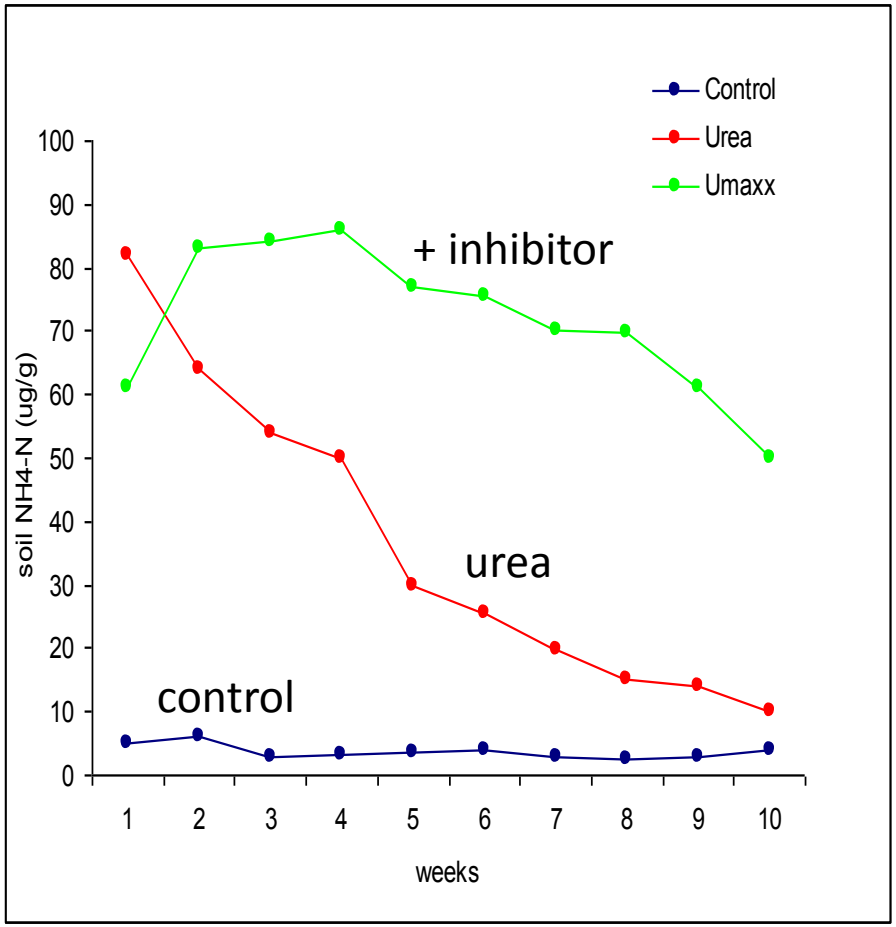
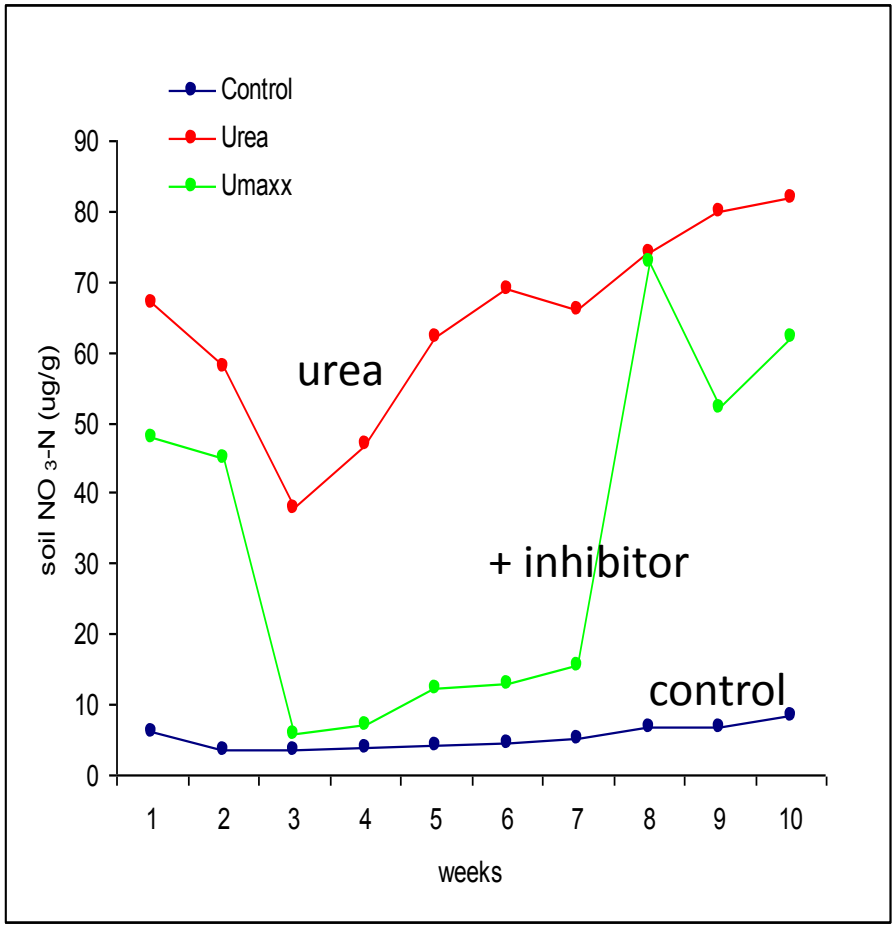


Fig. 1—The N cycle in soil.

Nitrification – Conversion of ammonium into nitrate, done by nitrifying bacteria. Incubation study. Effect of addition of dicyandiamide.



Extractable soil ammonium

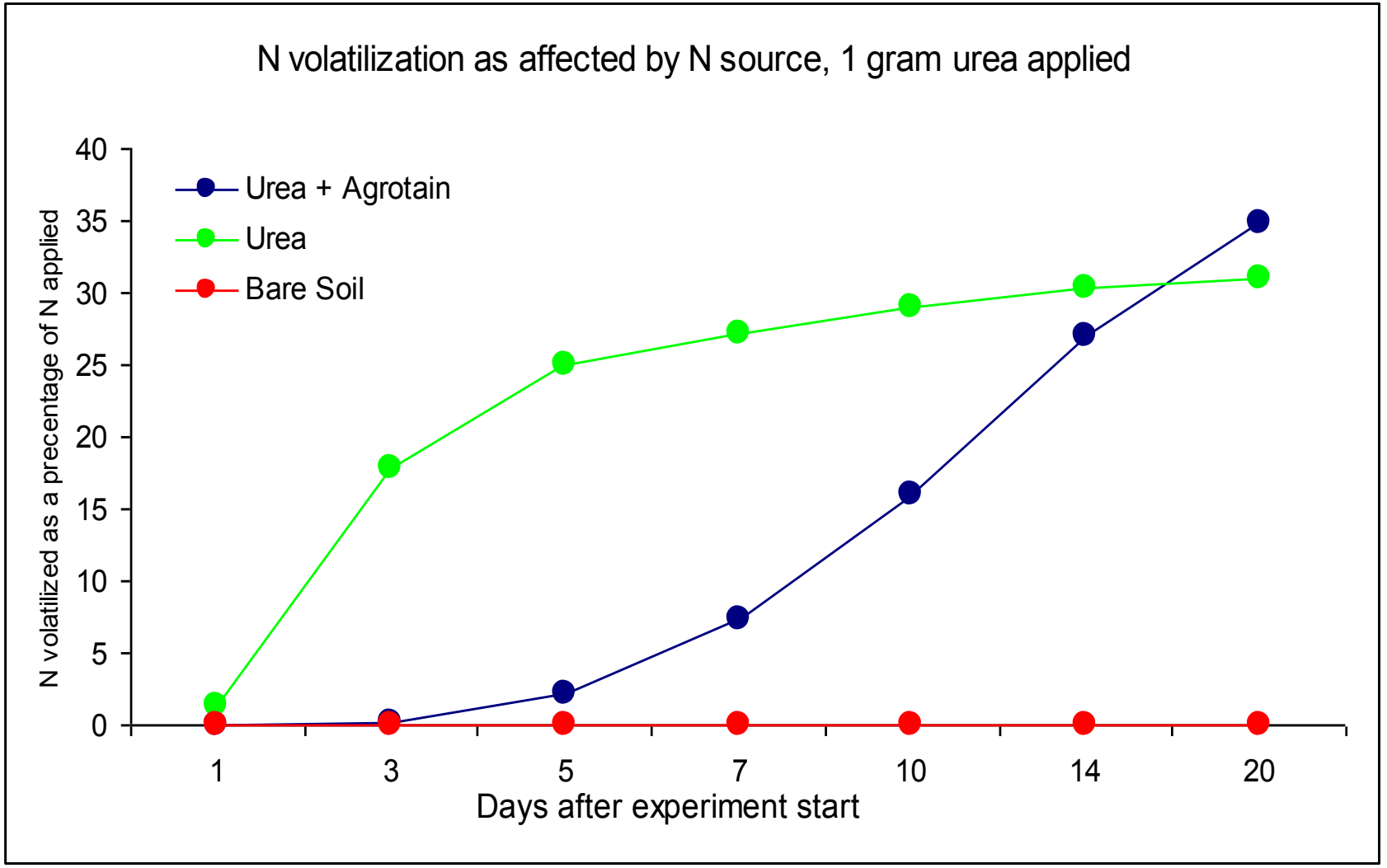


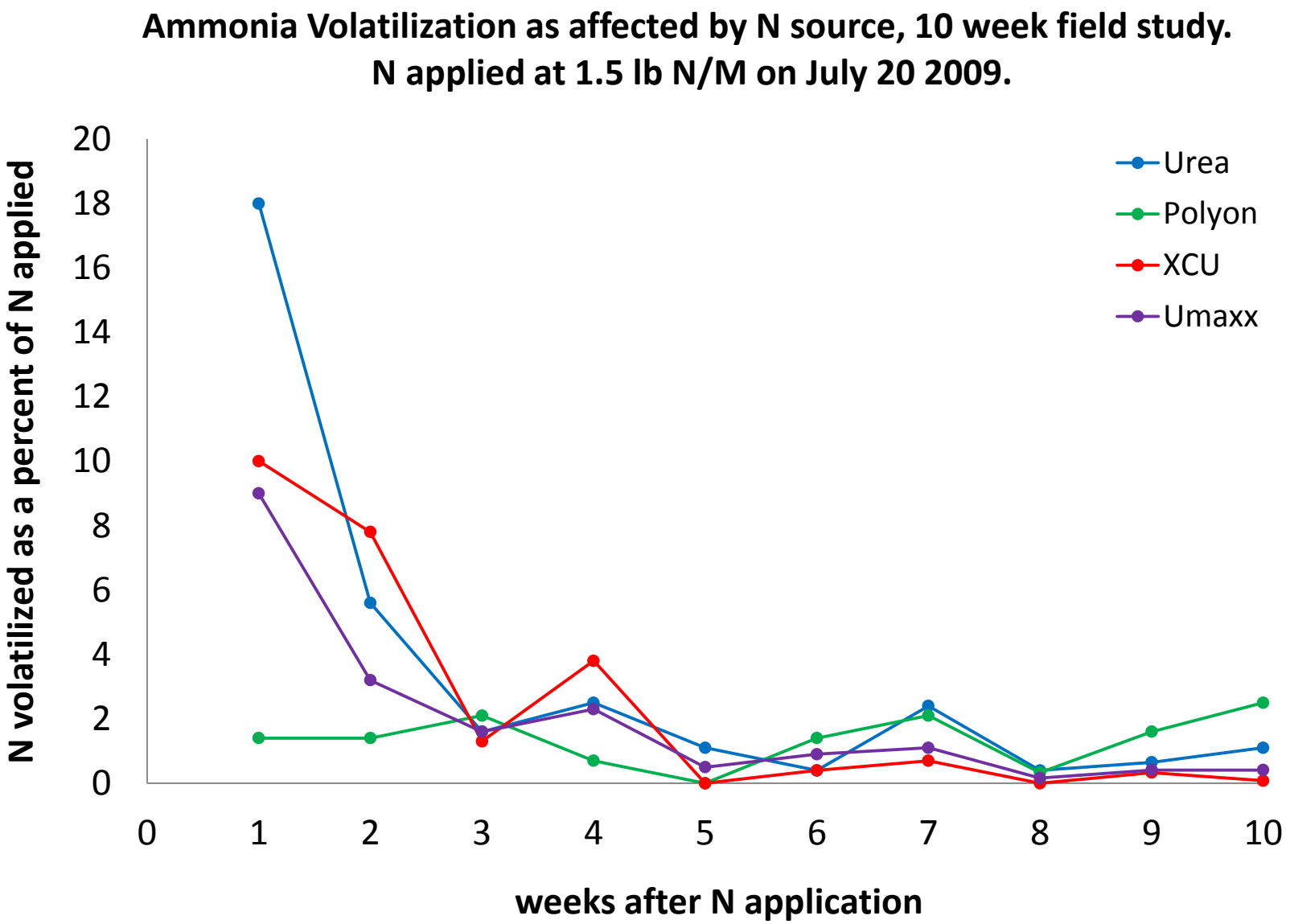
Extractable soil nitrate

Fertilizer


Harrells MAX
foliar nutritionals
Long Iron
15-0-0 with UMAXX®
GUARANTEED ANALYSIS
Total Nitrogen (N) 15.00%
15.00% Urea Nitrogen
Sulfur (S) 3.00%
3.00% Combined Sulfur
Iron (Fe) 6.00%
Derived from: low biuret urea and ferrous sulfate.
*7.50% urea nitrogen stabilized with dicyandiamide and N-(n-butyl) thiophosphone triamide.
UMAXX® is a registered trademark of Agrotain Int'l LLC.
• Rapid plant response
• Corrects iron deficiency
CAUTION: Keep out of Reach of Children
RECOMMENDED RATES
Spray Volumes For Turfgrass: Spray volumes can range from 0.5-4 gallons per 1,000 sq. ft. for adequate coverage. For LONG IRON tank mixtures containing amine formulations of herbicides, spray volumes greater than 2 gallons per 1,000 sq. ft. are recommended.
Bahiagrass, Bentgrass, Centipedegrass, Tall Fescue, St. Augustinegrass, and Zoysiagrass: Apply 2-8 oz. per 1,000 sq. ft. with sufficient water for good coverage. Three to five applications per growing season usually produce the best results. For bentgrass, do not exceed 5 fl. oz. per 1,000 sq. ft. per application. When temperatures can exceed 90° F, do not apply more than 3 fl. oz. per 1,000 sq. ft. to centipedegrass if applied with other fertilizers, pesticides, or specialty products.
Bermudagrass: Apply 4-10 fl. oz. per 1,000 sq. ft. with sufficient water for good coverage. Three to five applications per growing season usually produce the best results.
Bluegrass, perennial ryegrass and other northern grasses: Apply 2-8 fl. oz. per 1,000 sq. ft. with sufficient water for good coverage. Three to five applications per growing season usually produce the best results.
❑ 30 gal drum (113.52 liters) Net Wt. 327.9 lbs (149.1 Kg)
❑ 55 gal. drum (208.12 liters) Net Wt. 601.2 lbs (273.3 Kg)
❑ 250 gal. Tote (946 liters) Net Wt. 2732.5lbs (1242.2 Kg)
Weight per gallon: 10.93 lbs.

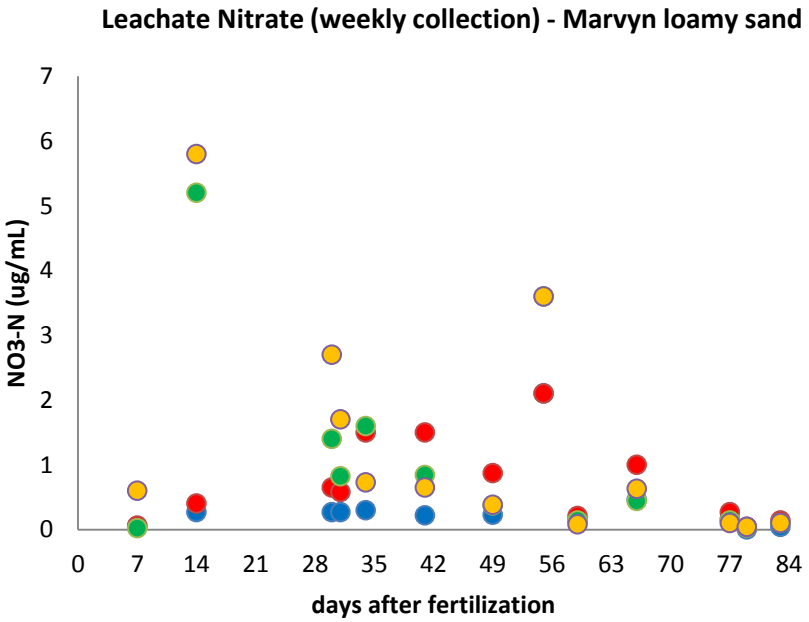
Ammonia volatilization as affected by N source and inhibitor

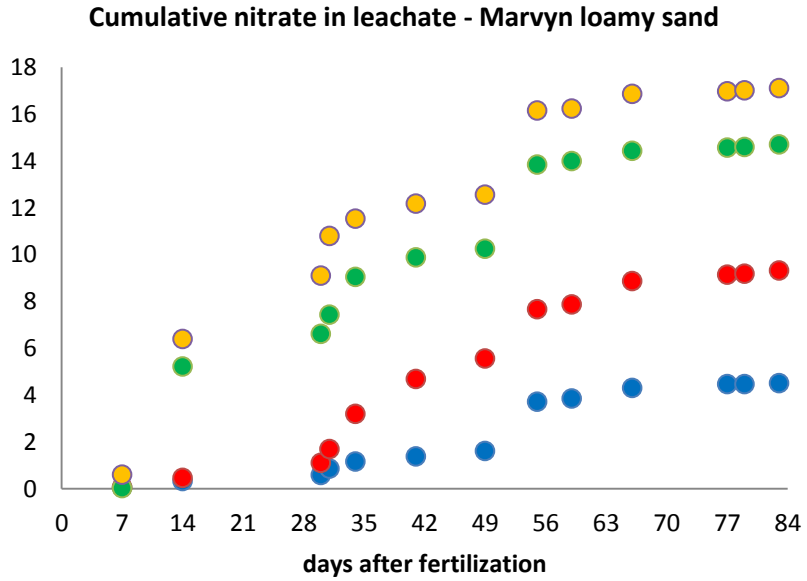



Ammonia Volatilization as affected by N source, 10 week field study.
N applied at 1.5 lb N/M on July 20 2009.
N volatilized as a percent of N applied
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
8
9
10
weeks after N application
Urea
Polyon
XCU
Umaxx

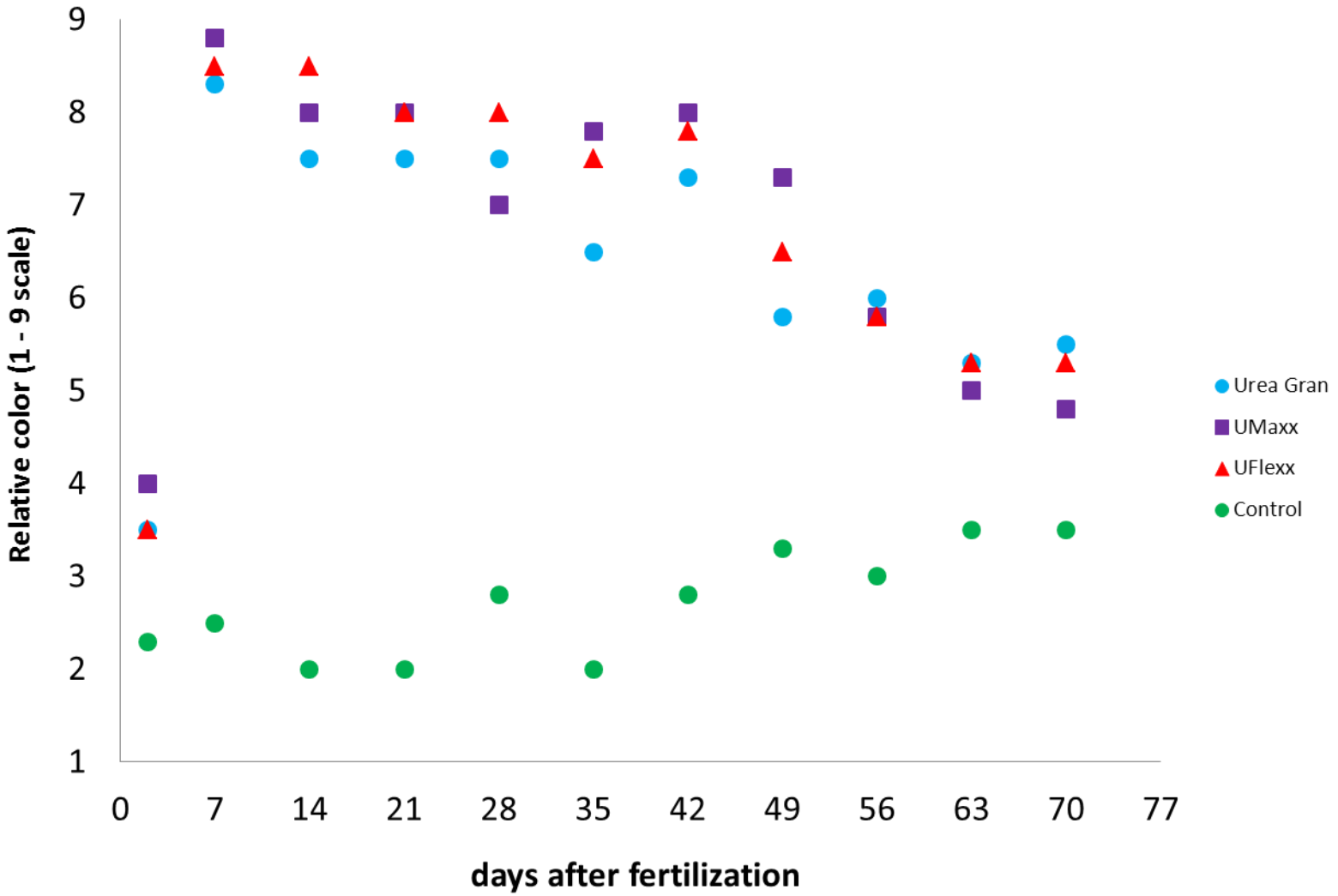
Possible environmental consequences of soluble fertilizers.

Nitrate-N in leachate – Marvyn loamy sand - 2009

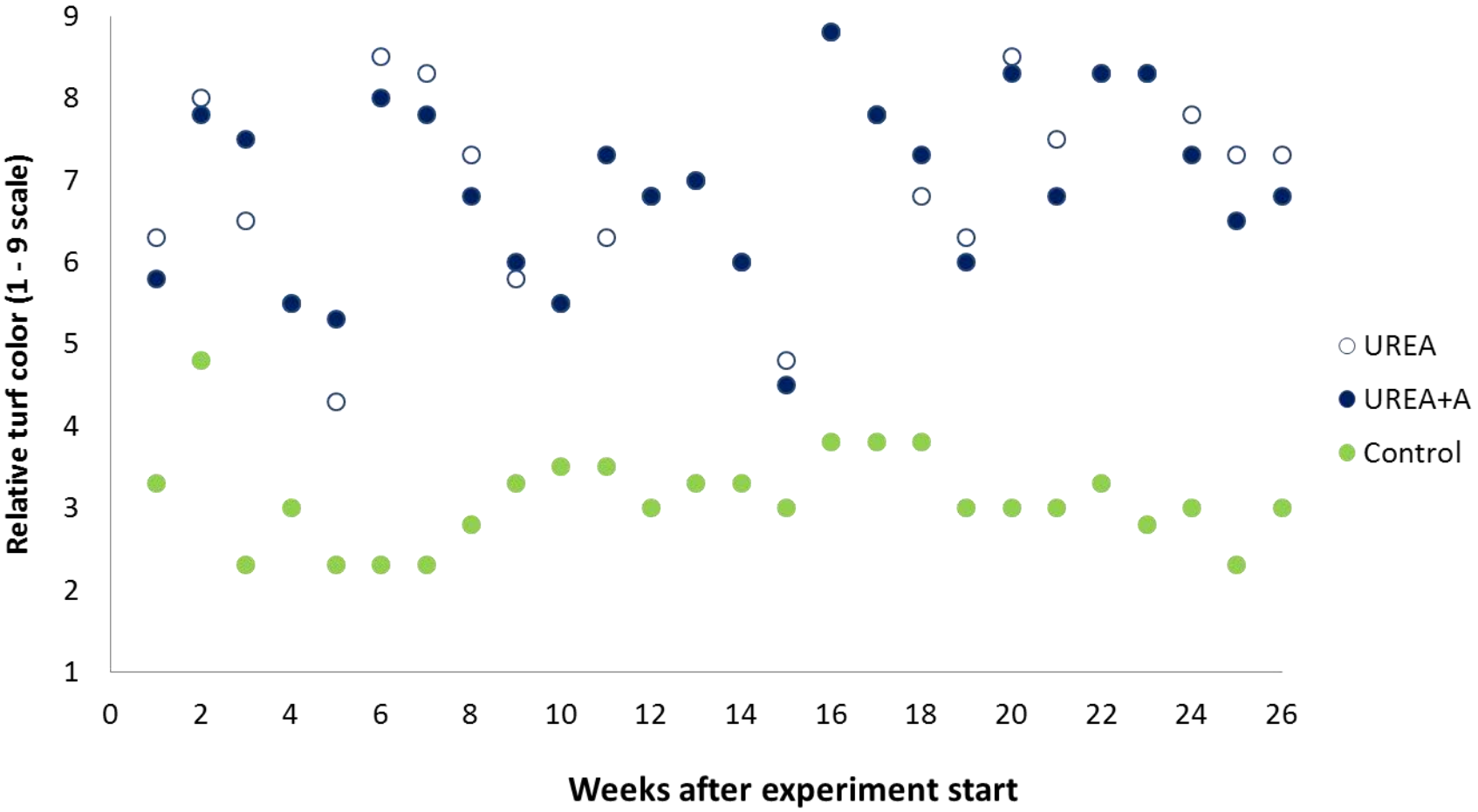




Relative color of Tifway hybrid bermudagrass as affected by N source, 2013
N applied at 1 lb N/M



Urea versus Urea + additive



Never a significant difference between the two treatments.

‘Added’ Fertilizers

- Possibly Sea kelp extracts
- Some have Humate-based materials
- Bring some added nutrient benefits
- Some possible hormonal effects (growth regulator)
- Rate and dosage issues?
- READ THE LABEL

5-0-1

Bio Green™

Product Specifications

Nitrogen derived from Feed Grade Urea,
Potassium derived from sulfate of potash
Iron derived from ferrous sulfate.
Contains non plant food ingredients:

- 10% Humic Acid from Leonardite
- 7% Fulvic Acid
- 2% North Atlantic Kelp (ascophyllum nodosum)

Weight per gallon..... 9.5 lbs.
pH..... 3.9
Nitrogen per gallon..... .48 lbs nitrogen

Product Description:

Because of Bio Green's unique bio based formulation, it is effective in all types of soil and on all types of plant life. Professional turf, lawns, flowers, shrubbery, trees, row and forage crops, pastures and natural habitats, etc. all thrive with Bio Green. Bio Green is ideal for spray applications to turf, foliar feed, trunk spray and root injection of trees and ornamentals. Bio Green is non-clogging and non-abrasive to equipment.

Bio Green uses nutrients that focus on the expansion of topsoil organisms. By providing foods based on pH, nutrient content and a large number of physiological factors, that these organisms will use efficiently, the numbers of these organisms will return to properly balanced populations quickly. Additionally, the plant nutrients in Bio Green are held in suspension in the liquid concentrate and are readily available to the seeds or plants. They become readily
available to the seeds or plants when catalyzed with water and applied.

Application Recommendations

Tank Mixing: Dilute product in a tank sprayer at a rate of 20 gallons of water to 1gallon of Bio Green concentrate. Apply 5 gallons of concentrate per acre on turf and trees. *Product can be mixed stronger (up to 10 to 1).*

Golf Course: Apply weekly at a rate of 1 gallon of Bio Green concentrate per acre to all turf areas.

Sports Field: Apply at a rate of 6 gallons of Bio Green concentrate per acre every 6 weeks. (If weekly or bi-weekly applications are used, divide application rate accordingly)

For Distressed Turf and Turf with Insect Problems :
Apply weekly at a rate of 2 gallons of Bio Green concentrate per acre until heath of turf is restored. Spot treat pest, weed or fungus accordingly

Trees: Dilute at normal rate. Apply a soaking spray to tree from top to bottom on foliage and trunk. Apply 3-5 times per season. *For distressed trees, apply every 3 weeks.*

Shrubs and Flower Beds: Dilute at normal rate. Apply a soaking spray to plants on the foliage and stems. Apply every 4-6 weeks.

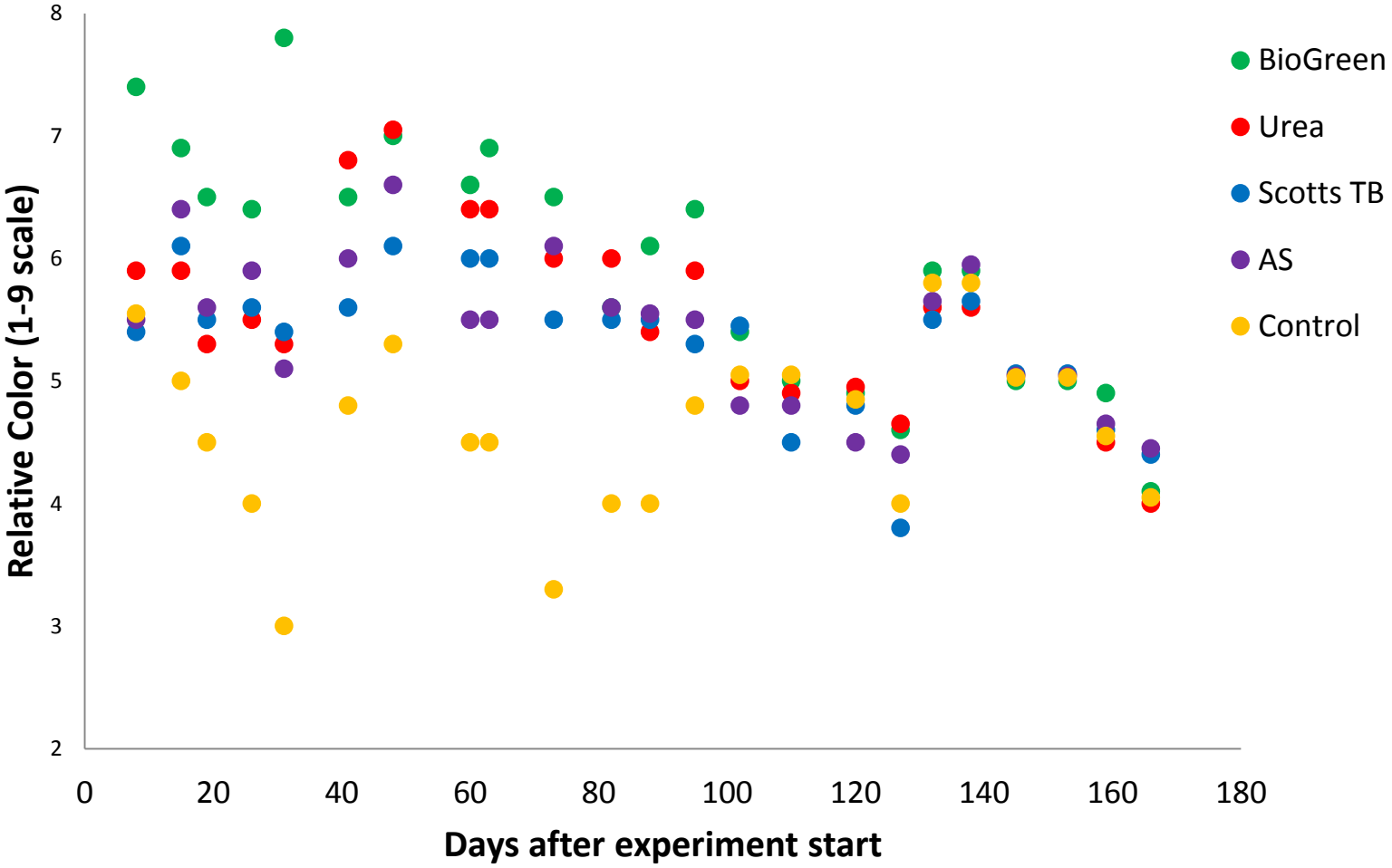
Sod Production:

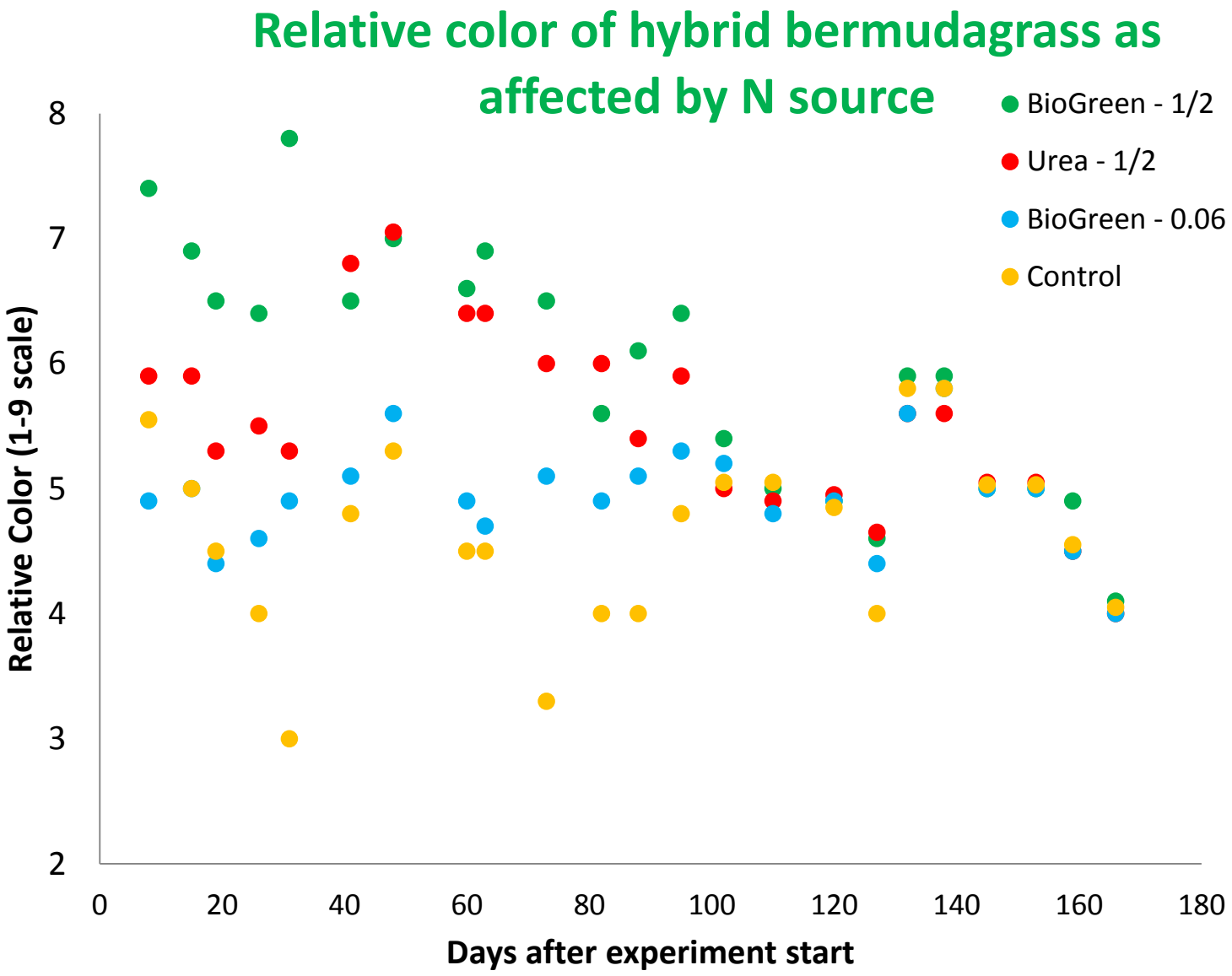
1) Two Applications
Apply at a rate of 3 gallons per acre at seeding and at 2 weeks prior to cutting.
2) Three Applications
Apply at a rate of 2 gallons per acre at seeding, at mid season and at 2 weeks prior to cutting.

Storage and Handling:

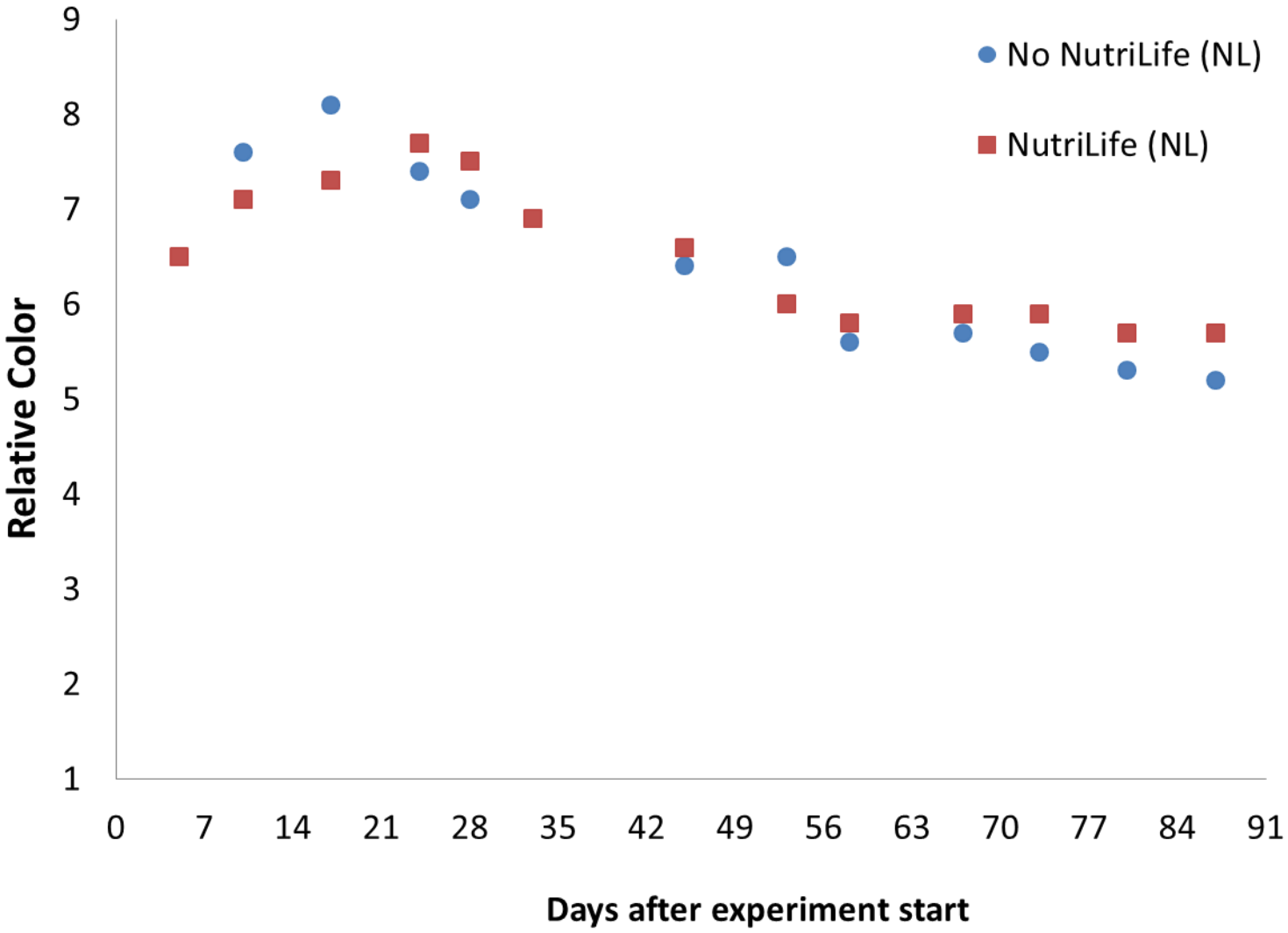
All Bio Green products can be stored in normal warehouse

Relative color of hybrid bermudagrass all N sources applied at 1/2 lb N/M per month




Relative color of hybrid bermudagrass as affected by N source
BioGreen - 1/2
Urea - 1/2
BioGreen - 0.06
Control
Relative Color (1-9 scale)
8
7
6
5
4
3
2
0
20
40
60
80
100
120
140
160
180
Days after experiment start

Fertilizer BioEnhancement Product - Hybrid Bermudagrass Color



Clipping yield, shoot density and dry weight of roots of hybrid bermudagrass as affected by BioEnhanced Fertilizer. Shoot density was collected from two 2.5 inch diameter soil cores. Experiment initiated on July 30 2011. 24-0-5 N Source

	Data collected								
NLAF	Clipping yield (grams per plot)				Shoot density (shoots per core)			Root wt (g)	
gal/ton	Aug 10	Aug 24	Sept 7	Sept 21	Aug 10	Aug 24	Sept 19	July 18	Sept 7
0	2.8 c	3.2 c	1.3 c	1.1 c	155 b	171 b	171 a	14.8 a	3.9 a
1.0	5.1 b	7.0 b	3.6 b	3.4 b	162 b	189 a	175 a	13.1 a	3.1 b
1.5	8.3 a	11.3 a	4.8 a	4.9 a	184 a	192 a	177 a	13.2 a	2.7 b

For each date, means followed by the same letter are not significantly different from each other via means separation at an alpha of 0.10.

Final Thoughts

- What to rapidly green and grow turf? – Soluble
- Want to produce a background green with minimal clipping production? – Slow Release
- More N is usually not the answer (not > 1 lb N/M/app).
- Determine your cost per pound of N.
- If they say you only need a pound or gallon per acre – ask to see the data.