The Primary Fertilizer Sources and Use Characteristics in Turfgrass Fertility Programs

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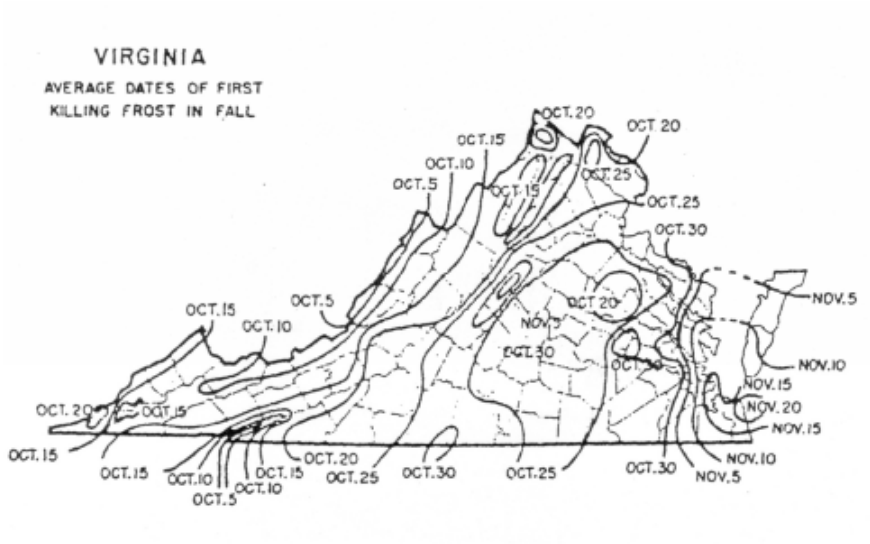
Section VI. Turfgrass Nutrient Recommendations for Home Lawns, Office Parks, Public Lands and Other Similar Residential/Commercial Grounds

Recommended Season of Application For Nitrogen Fertilizers - Applies to all Turf

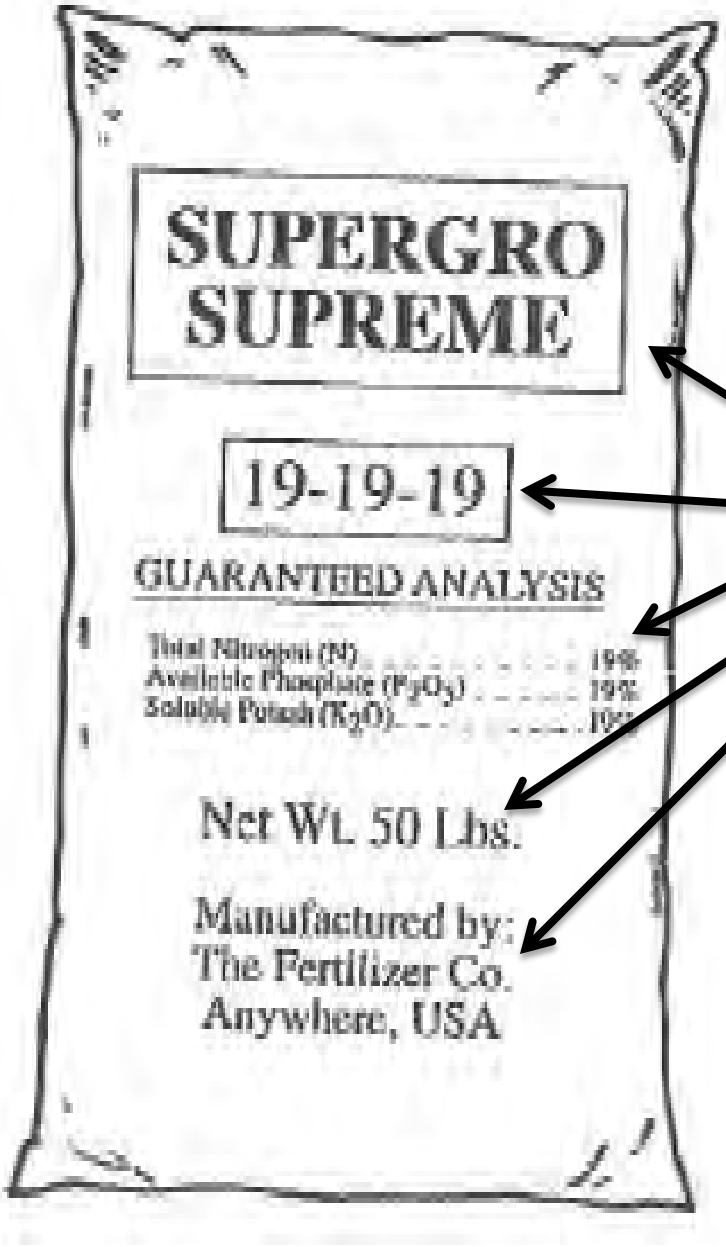
A nitrogen fertilization schedule weighted toward fall application is recommended and preferred for agronomic quality and persistence of cool season turfgrass; however, the acceptable window of applications is much wider than this for nutrient management. The nutrient management recommended application season for nitrogen fertilizers to cool season turfgrasses begins six weeks prior to the last spring average killing frost date and ends six weeks past the first fall average killing frost date (see Figures 6-1 & 6-2). Applications of nitrogen during the intervening late fall and winter period should be avoided due to higher potential leaching or runoff risk, but where necessary, apply no more than 0.5 pounds per 1,000 ft^2 of water soluble nitrogen. Higher application rates may be used during this late fall and winter period by using materials containing slowly available sources of nitrogen, if the water soluble nitrogen contained in the fertilizer does not exceed the recommended maximum of 0.5 pounds per 1,000 ft^2 rate. Do not apply nitrogen or phosphorus fertilizers when the ground is frozen.

The acceptable nitrogen fertilizer application season for non-overseeded warm season turfgrass begins no earlier than the last spring average killing frost date and ends no later than one month prior to the first fall average killing frost date (see Figures 6-1 & 6-2).

Figure 6-1



This image is from the Turfgrass Nutrient Recommendations section of the Virginia Dept. of Conservation and Recreation's 2005 Nutrient Management Standards and Criteria. It serves as the basis for nutrient management programming and training in turfgrass systems.



The Big Five

Five required components must appear on a fertilizer label:

1. The Brand
2. The Grade
3. Guaranteed Analysis
4. Net Weight
5. Name and Address of the Registrant or Licensee

Water Soluble Nitrogen Sources

- Also referred to as “Readily Available N” sources
- Rapid growth and color responses expected
- Leaching potential (especially on sandy soils) and foliar burn potential significantly higher

Standard WSN Sources

Fertilizer	Analysis	Salt Index (>2.5 = high; 2.5 to 1=mod; <1 = low)	Water Solubility g/L (lb/gal)
Ammonium nitrate	34-0-0	3.2	1810 (15)
Urea	45-0-0	1.7	780 (6.5)
Ammonium Sulfate	21-0-0	3.3	710 (5.9)
Potassium nitrate	13-0-44	5.3	130 (1.1)

Water Soluble Nitrogen Sources

- Application levels of up to 1 lb of WSN/1000 sq feet/growing month are suitable in MOST situations. However, application levels SHOULD vary depending on:
  - The specific situation…. the grass and its use, the soil, the climate, impending weather conditions, surrounding environment.
  - While it is more labor intensive, N-use efficiency is improved by applying smaller levels of WSN on a more frequent basis… often referred to as ‘Spoon Feeding’
  - ‘Foliar Feeding’: nutrients delivered as a spray solution at a spray volume of at least 40 gallons per acre; N applied typically at 0.05 to 0.25 lb N/1000 sq ft.

Seasonal N totals when using predominately water soluble N sources*

Month	TF/PR/KBG	Berm/ St. Aug	Zoysia/ Centipede
Sept	1	0	
Oct	1	0	
Nov	0.5	0	
Apr	0.5 to 1	0.5	
May		1	1
June	0	1	
July	0	1	1
Aug	0	0.5	
Range for annual lbs N per 1000 sq ft	2-3.5	2-4	1-2

*100% WSN sources such as urea or ammonium sulfate and any other source that is ≤ 50% slow release N.

American Association of Plant Food Control Officials Definitions

- Term “Enhanced Efficiency” be adopted to describe fertilizer products with characteristics that minimize the potential of nutrient losses to the environment, as compared to a “reference soluble” product (AAPFCO, Pub. 62, 2009).
  - “reference soluble” products are materials that are 100% water soluble fertilizers such as ammonium nitrate, urea… (AAPFCO, 1995).
- Enhanced Efficiency is an ‘umbrella term’ that covers categories of both ‘slow release’ and ‘stabilized’ N sources.

American Association of Plant Food Control Officials Definitions–AAPFCO, 2009

- The term “stabilized” be adopted to describe products that have been amended with an additive that reduces the rate of transformation of fertilizer compounds, resulting in extended time of availability in the soil. Examples of stabilizing amendments are nitrification inhibitors, nitrogen stabilizers, or urease inhibitors.
- Stabilized N is not classified as WIN or SAN at this time. It is the opinion of VT scientists that stabilized N be handled as water soluble N in terms of nutrient application levels and planning.

American Association of Plant Food Control Officials Definitions –AAPFCO, 2009

- The term “slow release” be adopted to describe fertilizer products that release (convert to a plant available form) their plant nutrients at a slower rate relative to a “reference soluble” product. Examples of slow release products are **coated or occluded materials** that regulate soluble nutrient release, **water insoluble**, or **slowly available water soluble.**

Defining Slowly Available N (SAN)

- "Slowly available nitrogen" means nitrogen sources that have delayed plant availability involving compounds which dissolve slowly, materials that must be microbially decomposed, or soluble compounds coated with substances highly impermeable to water such as polymer coated products, methylene urea, isobutylidene diurea (IBDU), urea formaldehyde based (UF), sulfur coated urea, and natural organics.

Nutrient Management Training and Certification Regulations 4 VAC 5-15.

Defining SAN Sources

- There will be a designation on the label's guaranteed analysis indicating a specific percentage of SAN, Water Insoluble Nitrogen (WIN), Controlled Release Nitrogen (CRN) or Slow Release Nitrogen (SRN)
- For standardization the goal is to follow guidelines defined by AAPFCO– Assoc. of American Plant Food Control Officials)
- Slowly Available N is due to either:
  - Inherent synthesis/composition of the product (e.g. ureaformaldehyde, natural organics, or isobutyraldehyde diurea)
  - Coating (sulfur, polymer, or a combination of the two)

Controlled Release Fertilizers

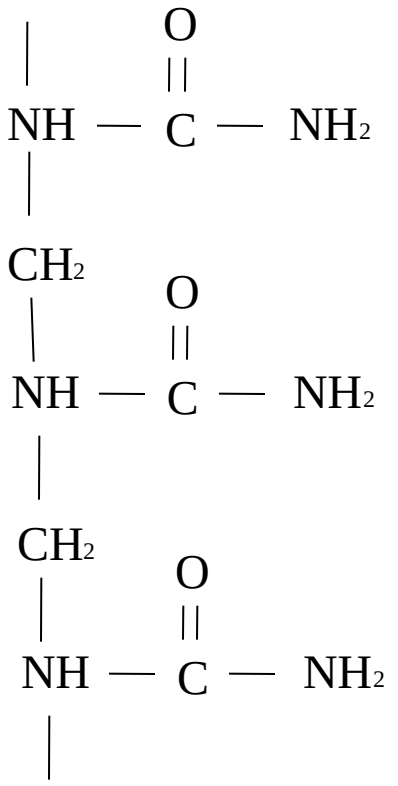
- Reduced Solubility
  - Urea formaldehyde or “urea forms”
  - Methylene urea
  - Isobutylidene diurea (IBDU)
  - Occluded urea
- Coatings
  - Sulfur
  - Polymers
  - Resins

Low Water Solubility N Fertilizers

- Urea-formaldehydes or urea-forms
  - White, ordorless solids containing about 38% N that are made by reacting urea with formaldehyde in the presence of a catalyst.
- Methylene urea
  - React methylene molecules with urea
- Isobutylidene Diurea (IBDU)
  - Approximately 30% N
  - React isobutyaldehyde with urea

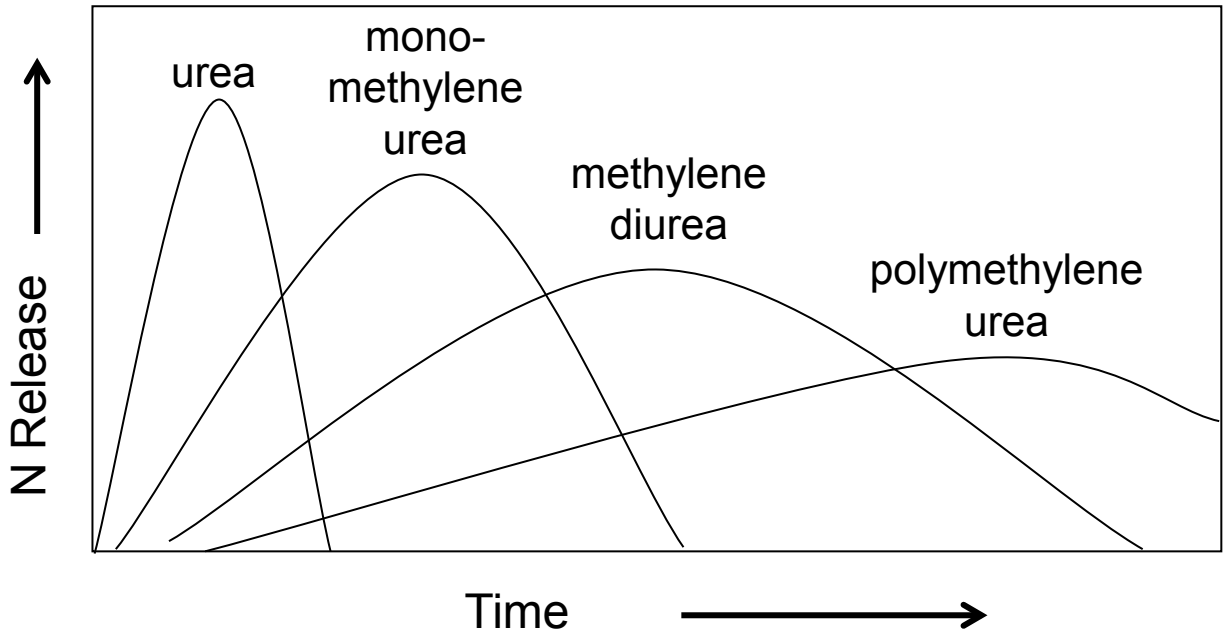
Low-Solubility Compounds (UF, MU)

- Urea-formaldehyde reaction products
  - Discovered in 1930s
  - First fertilizer use in 1940s
  - Mixture of urea and UF polymers of various chain lengths
  - Solid and liquid products
    - Solubility dependent on chain length
- Products: Nutralene, Nitroform, Nitamin, CoRoN



Low-Solubility Compounds (UF, MU)

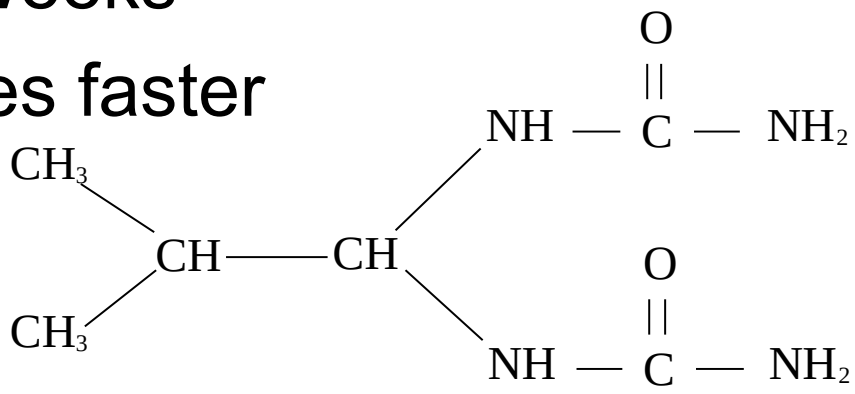
- N release by microbial mineralization (soil temperature, moisture, pH, etc)
- Longer chains = slower release
- Typical release 8-12 weeks



More complex molecules require more time to decompose

Low-Solubility Compounds (IBDU)

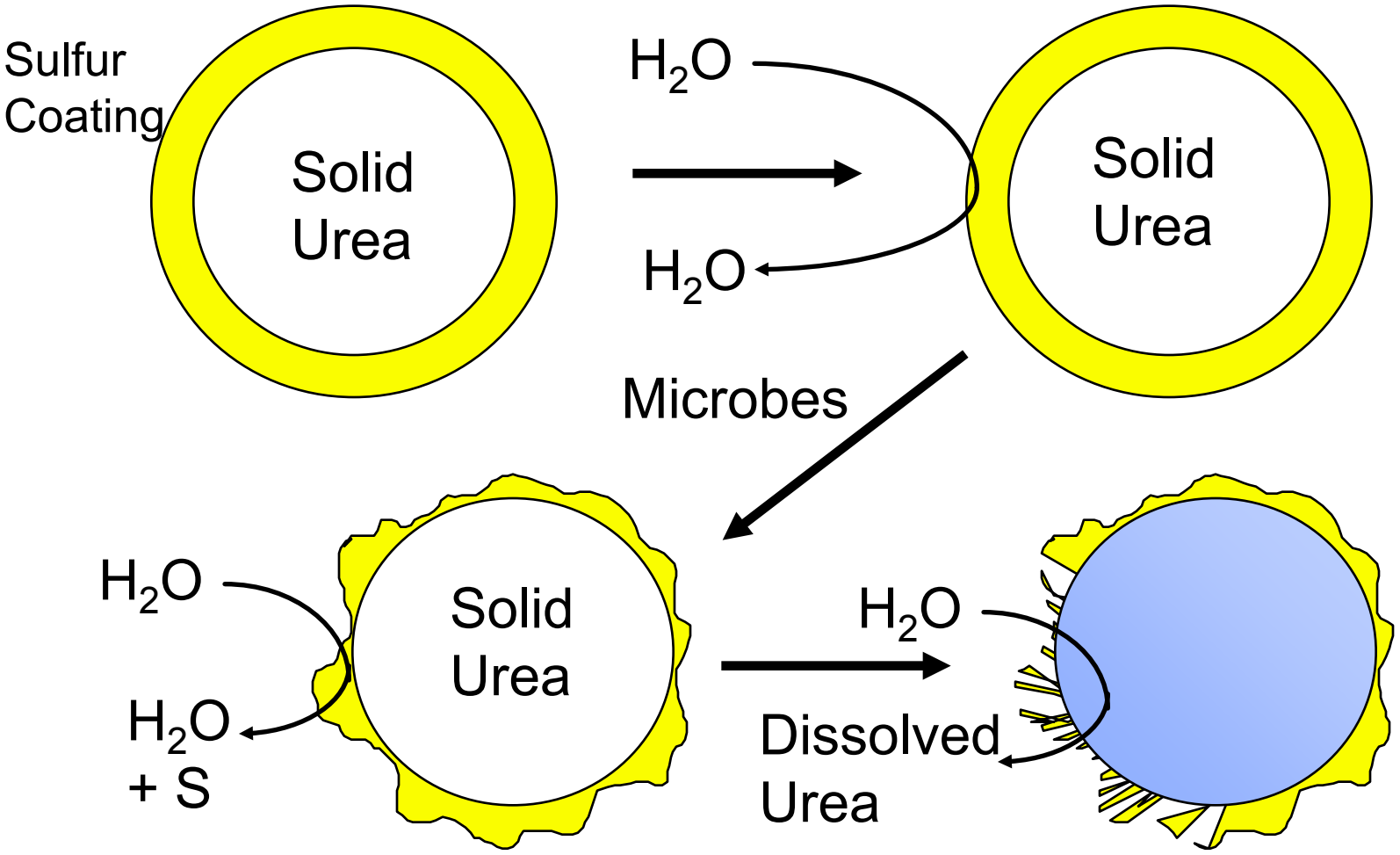
- Isobutylidene diurea – IBDU (Solid)
- Uniform chemical composition – no free urea
- Release by slow dissolution and hydrolysis
  - IBDU reacts with water to release urea
  - Typical release 8-12 weeks
  - Finer material dissolves faster



Coated Water-Soluble Fertilizers – Sulfur-Coated Urea

- N availability dependent on destruction of sulfur coating and diffusion
  - Physical breakage
  - Dispersion
  - Biological oxidation
- Release rate determined by
  - Thickness of coating
  - Environmental conditions
- Release slow and rates vary greatly

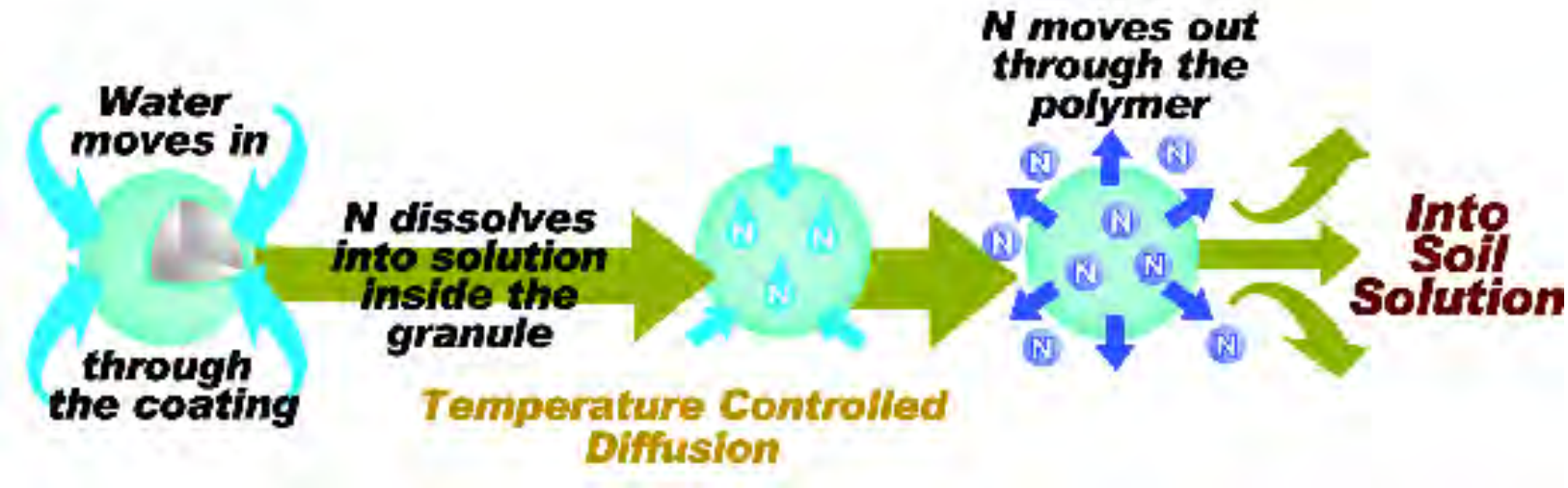
Breakdown of Sulfur Coating



Coated Water-Soluble Fertilizers – Polymer-Coated Fertilizers

- Polymer coatings applied to soluble fertilizer
- Release by diffusion through coating
- Release rate determined by
  - Polymer chemistry, thickness, coating process
  - Temperature
- Release can be highly controlled
- Can be designed to match plant uptake.
- Osmocote in 1967
- Products: Trikote, Polyon, Duration, ESN

How Does Polymer-Coated N Work?



N Fertilizers of Low Solubility

- Availability of N in these materials is
  1. related to their water solubility
  2. Related to the rate of microbiological decomposition of organic molecules
  3. Rate of chemical hydrolysis (getting the N molecules into solution) which is dependent on solubility, particle size and soil temperature.

Seasonal N totals when using predominately slow release N sources*

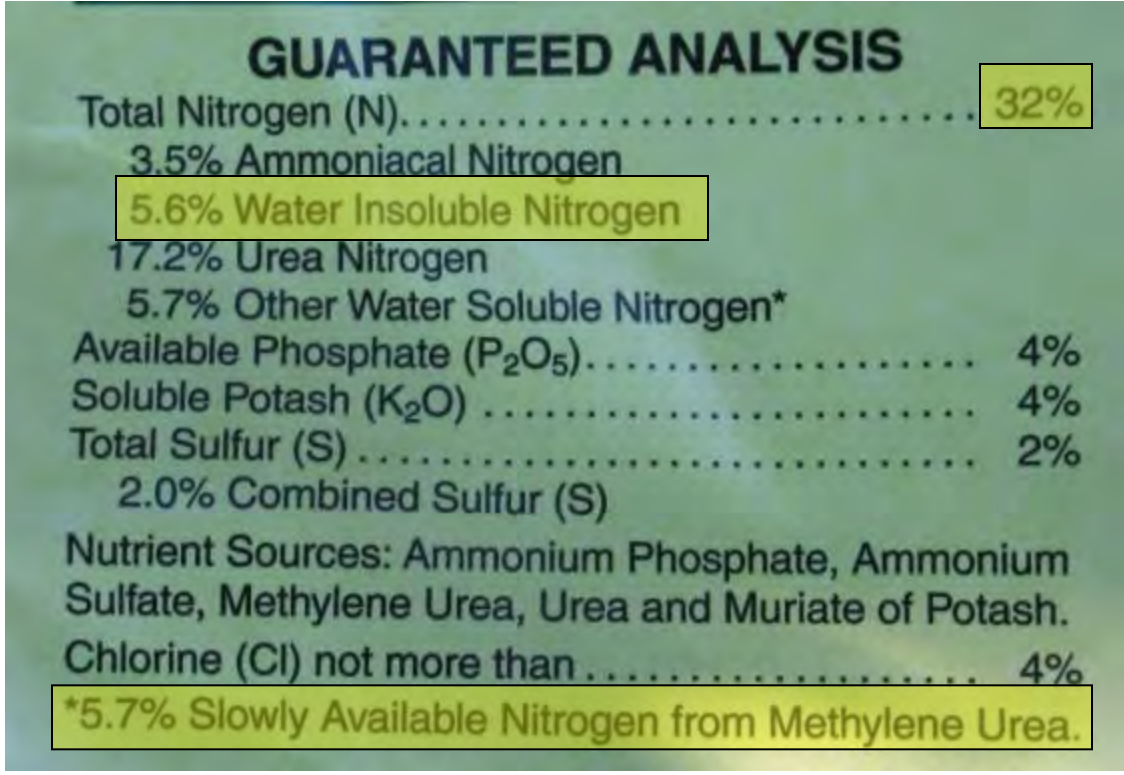
Date	TF/PR/KBG	Berm/ St. Aug	Zoysia/ Centipede
Sept 1	1.5	0	
Oct 15	1.5	0	
Nov	0	0	
Apr		1 to 1.5	
May	0 to 1		1
June		1 to 1.5	
July	0		1
Aug	0	1	
Range for annual lbs N per 1000 sq ft	3-4	3-4	1-2

*Sources that are ≥ 50% slow release within a product (as indicated by terms such as Water Insoluble N or Slowly Available N in the guaranteed analysis)

DCRs Recommended Application Levels of Slow Release N Sources

- The intent is still to never apply more than 1 lb of N/1000 sq ft/turf growing month, so adjust application frequency for slow release sources accordingly to meet this recommendation. Based on current Standards and Criteria:
  - ≥ 50% Slow Release? levels up to 1.5 lb N/1000 sq ft in a single application are acceptable during optimal growing conditions… this N would be expected to release over 6 wks.
  - <50% Slow Release N? no more than 1 lb N/1000 sq ft should be applied in a single application during optimal growing periods, releasing over a 4 week period

Does this 32-4-4 fertilizer contain slow release N, and if so, what % of the N is slow release?



5.6% WIN + 5.7% slowly available N = 11.3%;

11.3% 32% = 35.3% slow release N

While it contains both WIN and slowly available N, it would be restricted to a single maximum application level of 1 lb N/1000 sq ft.

Guaranteed Analysis:

Total Nitrogen (N) 18%

7.5% Urea Nitrogen
1.5% Ammoniacal Nitrogen
9.0% Slowly Available Water Soluble Nitrogen*

Available Phosphate (P_2O_5) 3%

Soluble Potash (K_2O) 6%

Copper (Cu) 0.05%

0.05% Chelated Copper (Cu)

Iron (Fe) 0.1%

0.1% Chelated Iron (Fe)

Manganese (Mn) 0.05%

0.05% Chelated Manganese (Mn)

Zinc (Zn) 0.05%

0.05% Chelated Zinc (Zn)

Derived From: Urea, Methylene Urea, Potassium Carbonate, Monoammonium Phosphate, Phosphoric Acid, Copper EDTA Chelate, Iron EDTA Chelate, Manganese EDTA Chelate, Zinc EDTA Chelate.

Chelating Agent: EDTA

*9% slowly available Nitrogen from Methylene Urea

Weight per gallon . . . . . 10.33 lbs.

Potential acidity equivalent to 573 lbs. Calcium Carbonate per ton.

How much of this product (lbs N/1000 sq ft) can be safely applied in a single application?

9% SAN/18% Total N = 50% SAN

Looking beyond N fertilization, almost every other nutrient should be applied on the basis of a current (and properly conducted) soil test.

Strive for at least a 4” depth sample if at all possible.

Report Number:
R07135-0071
Account Number:
77643

A&L Eastern Laboratories, Inc.

7621 Whitepine Road Richmond, Virginia 23237 (804) 743-9401
Fax No. (804) 271-6446 Email: office@al-labs-eastern.com

Send To: VIRGINIA GREEN LAWN CARE
POB 8623
RICHMOND, VA 23226

Grower: VIRGINIA GREEN LAWN CARE

Submitted By: VIRGINIA GREEN LAWN CARE

Farm I D:

Field I D:

SOIL ANALYSIS REPORT

Page: 1 **Date Received:** 5/15/2007 **Date of Analysis:** 5/16/2007 **Date of Report:** 5/17/2007

Analytical Method(s):
Mehlich III

Sample Number	Lab Number	Organic Matter			Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Acidity	C.E.C.
		%	ENR lbs/A	Rate	Available ppm	Rate	Reserve ppm	Rate	K ppm	Rate	MG ppm	Rate	CA ppm	Rate	NA ppm	Rate	Soil pH	Buffer Index	H meq/100g	meq/100g
2548	4138	4.5	128	M	10	VL			101	M	125	M	550	L			4.8	6.5	4.0	8.5
3961	4139	3.5	107	M	19	L			101	M	135	M	490	VL			4.5	6.4	5.3	9.1

Sample Number	Percent Base Saturation					Nitrate		Sulfur		Zinc		Manganese		Iron		Copper		Boron		Soluble Salts		Chloride		Aluminum	
	K %	Mg %	Ca %	Na %	H %	NO3-N ppm	Rate	SO4-S ppm	Rate	ZN ppm	Rate	MN ppm	Rate	FE ppm	Rate	CU ppm	Rate	B ppm	Rate	ms/cm	Rate	CL ppm	Rate	AL ppm	Rate
2548	3.0	12.2	38.2		46.6																				
3961	2.8	12.3	26.8		58.0																				

Values on this report represent the plant available nutrients in the soil.
Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High).
ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

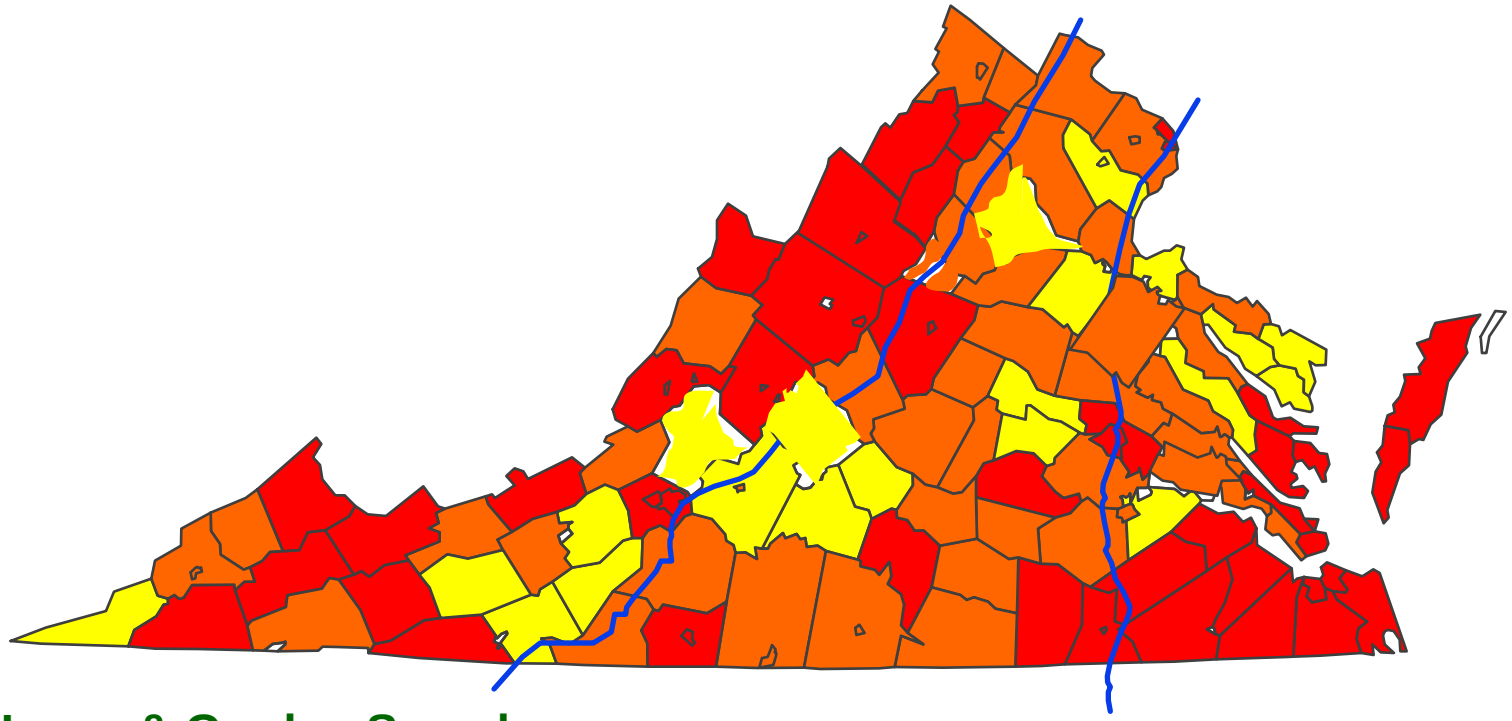
Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams).
Conversions: ppm x 2 = lbs/A. Soluble Salts ms/cm x 640 = ppm.

by: Paul Chu, Ph.D.

Phosphorus– a known source of water quality issues that has direct links to urban landscapes

It only takes 25-75 ppb phosphorus contaminating a water source to trigger something this bad.

Agronomic Soil Test P Data Base in Virginia for years 2004-2006. (% soils rated “Very High”)



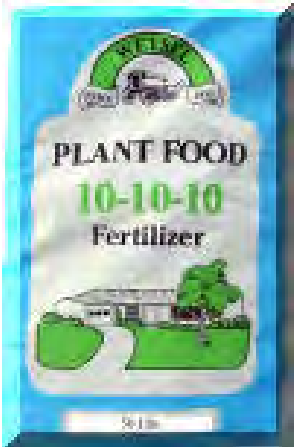
32,172 Lawn & Garden Samples

- ≥10%-Yellow
- ≥20%-Orange
- ≥33%-Red

Heckendorn and Maguire, 2007

Worrisome?

- Yes… however, do these data correspond to all lawns statewide?
- Still, if P is not needed, then why apply it?



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19-0-19

LESCO® PROFESSIONAL TURF FERTILIZER

For use in Rotary Spreaders Only

Contains LESCO® Poly Plus® Sulfur Coated Urea to provide uniform growth with extended nitrogen feeding

50 lb COVERS 9,500 sq ft

DIRECTIONS FOR USE: This LESCO product is a professional quality turf fertilizer for use on all lawn areas. The best results with this product are obtained when it is applied to actively growing grass, and watered into the turf soon after application. Avoid mowing immediately following application to prevent pick-up.

For best results, sweep or blow the fertilizer off walks and painted surfaces following application to avoid discoloration.

Recommended applications are at the rate of one pound of nitrogen and potash per 1,000 sq ft. Actual rates and timing of applications will vary with weather, soil and turf conditions.

For additional product assistance, call LESCO, Inc. in Strongsville, Ohio at 1-800-321-5325.

COVERAGE: 50 pounds of LESCO 19-0-19 Fertilizer covers approximately 9,500 sq ft at the application rate of one pound of nitrogen and potash (5.3 pounds of fertilizer) per 1,000 sq ft.

ROTARY SPREADER SETTINGS: Apply LESCO Fertilizers and Combination Products only with a rotary spreader. The following rotary spreader settings are approximate for the application rates of one pound of nitrogen and potash per 1,000 square feet. You may need to adjust the setting depending on walking speed, spreader condition and product.

ROTARY SPREADER		SETTINGS
LESCO	Calibration Gauge	#17
SCOTTS® R8A		K ½
Cyclone® or Spyker®		4½
LESCO Pendulum		32
Lely®		4½ ll

GUARANTEED ANALYSIS

TOTAL NITROGEN (N) 19.00%
19.00% Urea Nitrogen*
SOLUBLE POTASH (K_2O) 19.00%
SULFUR (S) Total 11.00%
4.20% Free Sulfur (S)
6.80% Combined Sulfur (S)
IRON (Fe) Total 2.00%
0.02% Water Soluble Iron
MANGANESE (Mn) Total 3.00%
0.43% Water Soluble Manganese (Mn)

DERIVED FROM: Polymer Coated Sulfur Coated Urea, Urea, Sulfate of Potash, Iron Sucrate, Manganese Sucrate.

CHLORINE (Cl) Max 2.00%

*12.80% Slowly Available Urea Nitrogen from Polymer Coated Sulfur Coated Urea

F1406

WARRANTY

LESCO, Inc. warrants that this product conforms to the analysis on its label. When used in accordance with label directions, under normal conditions, this product is reasonably fit for its intended purposes. Since time, method of application, weather, plant and soil conditions, mixture with other chemicals, and other factors affecting the use of this product are beyond our control, no warranty is given concerning the use of this product contrary to label directions or under conditions which are abnormal or not reasonably foreseeable. The user assumes all risks of any such use.

Information concerning the raw materials composing the product can be obtained by writing to LESCO, Inc., Attn: [illegible] Dept., 15885 Sprague Rd., Strongsville, OH 44136-[illegible] referring to the [illegible] number found on the bag.

Information regarding the contents and levels of [illegible] in this product is available on the Internet at [illegible]

LESCO and Poly Plus are registered trademarks and the [illegible] design is a trademark of LESCO Technologies, LLC. Poly Plus is composed of Polymer Coated Sulfur Coated Urea. SCOTTS is a registered trademark of The SCOTT Company. Cyclone and Spyker are registered trademarks of Spyker Spreaders, LLC. Lely is a registered trademark of C. Van Der Lely N.V.

[illegible]

NET WEIGHT 50 lb (22.7 kg)

Made in U.S.A. Distributed by LESCO, Inc. • 1301 East 9th Street • Cleveland, OH 44114-1849

#084097

Name	CAS #
Urea	57-13-6
Potassium Sulfate	7778-80-5
Iron Sucrate	8047-67-4
Manganese Complex	7439-96-5

(01)00758073804178

“What’s the difference between a poison and a cure?”

Where P is needed (as indicated by a soil test), it would be environmentally IRRESPONSIBLE to NOT apply P. Note the difference in turf establishment success from pre-plant P fertilization when needed as indicated by soil testing (left) vs. failure in establishment due to P deficiency (right) (photo courtesy of Dr. Tom Turner, University of Maryland).

So for phosphorus fertilization, decisions on applications are quite simple…

- 2 times that make sense regarding P applications:
  - ABSOLUTELY, On the basis of soil test results… if needed, then it SHOULD be applied because a healthy turf protects water quality
  - POSSIBLY, At establishment… typically 1 lb of phosphate per 1000 sq ft… benefits initial rooting at or just below soil surface… 'brings P to the root'

Primary Phosphorus Sources

Analysis	Salt Index (>2.5 = high; 2.5 to 1=mod; <1 = low)	Acid. Effect (units of lime to neutralize 100 units of fertilizer by weight)	Water Solubility (g/l, lb/gal)
11-48-0 Monoammonium phosphate	2.7	58	230 (1.9)
20-50-0 Diammonium phosphate	1.7	75	430 (3.6)
0-20-0 Superphosphate	0.4	0	20
0-45-0 Treble superphosphate	0.2	0	40

Potassium fertilization…

- Soil testing is still the most valid decision making tool, but since potassium does not have water quality concerns, there is quite a bit more flexibility in its application.
- POSSIBLY, 1 lb of potash per 1000 sq ft in spring and/or fall… potassium functions as the ‘coolant/anti-freeze’ of the plant world
- But as with anything, there can be too much of a good thing if it is overapplied.

Primary Potassium Sources

Analysis	Salt Index (>2.5 = high; 2.5 to 1=mod; <1 = low)	Acid. Effect (units of lime to neutralize 100 units of fertilizer by weight)	Water Solubility (g/l, lb/gal)
0-0-60 KCl	1.9	0	350 (2.9)
0-0-50 K_2SO_4	0.9	0	120 (1)
KNO_3 13-0-44	5.3	(-23)	130 (1.1)

Other Macronutrients Used as Turf Fertilizers

- Magnesium: typically applied as a component of dolomitic limestone, but can also apply as magnesium sulfate and potassium magnesium sulfate (SulPoMag)
- Sulfur: can be applied as elemental S, but also applied as ammonium sulfate, potassium sulfate, calcium sulfate, magnesium sulfate, potassium magnesium sulfate (SulPoMag)


6 '98

Micronutrient of Most Importance in Turf Fertility: Iron

- What is gained from Fe applications:
  - almost immediate color response from foliar application
  - no rapid increase in shoot growth rates that are often seen with N applications
  - 10-14 days in duration response is typical
  - Normal application rate 3 to 6 lbs Fe/Acre
  - potential to “mask” phytotoxicity concerns from pesticide or plant growth regulator applications
- Chelated forms are most popular for ease in handling, application, and response

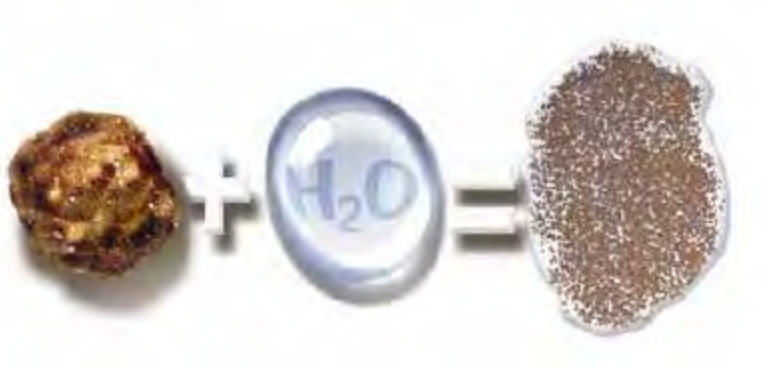

BULLDOGS
40
30
20
10
10
20
30
40

Micronutrients

- Micronutrient packages (B, Cu, Mn, Mo, Zn) are readily available
- Usually only necessary on sand-based systems
- rarely deficient, but might be a problem in sand based soils and/or soils with inappropriate pH's
- Chelated forms again are most popular.

How is the turf and fertilizer industry evolving to address nutrient management issues?

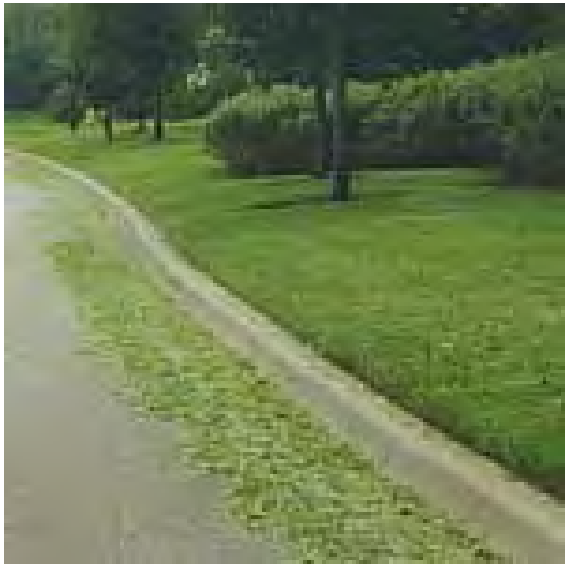
- Formulation technology (e.g. Dispersible Granule products, resulting in granular delivery with ‘liquid-carrier type performance’.)



Other ways the turf industry is addressing nutrient management.

- More micronutrients being used.
- Microbial ‘activators’, biostimulants, supplemental plant growth products.
- Use of organics (fertilizers and compost sources) in appropriate locations.

Education: Convincing homeowners and municipalities that lawn debris on hardscapes IS a water quality concern



- *The major sources of phosphorus in runoff in storm sewers are from lawn clippings and tree leaves left in the streets and gutters. Other sources of phosphorus may come from soil particles either blown into the lakes by wind erosion or carried in runoff over bare soil.*

  FO-2903, Rosen and Horgan, Univ. of Minnesota Extension Service Publication.

Can not ‘brown’ be the new ‘green’ when it comes to expanding the realm of warm-season grasses where they are best adapted?

And where one must have green, how about one of the new organic lawn dyes?

Grass painting spreads as U.S. drought ravages lawns

Updated 7/27/2012 12:40 PM

INDIANAPOLIS (AP) – When this summer's harsh U.S. drought turned her prized lawn brown, Terri LoPrimo had it painted green, making her suddenly lush-appearing yard the envy of her neighborhood.

By Michael Conroy, AP

Ronnie Sharp, left, and Brandy Birdwell of Imperial Painting spray turf paint on a drought ravished lawn outside a auto repair shop in Indianapolis Friday.

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"It's a night-and-day difference," he said.

Missouri Turf Paint Inc. president Jon Graves said he's seen a slight increase this year in calls from people interested in either greening up residential lawns or wanting to get into the lawn-painting business.

Most Popular

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- Raw Video: Curiosity descends to Martian surface
- Raw Video: Clinton dances in Johannesburg
- Protest, near perfection give USA's Aly Raisman gold, bronze

Photos
- Editorial Cartoons
- Deadly shooting at Wis. Sikh temple
- Baby animals spring up at zoos

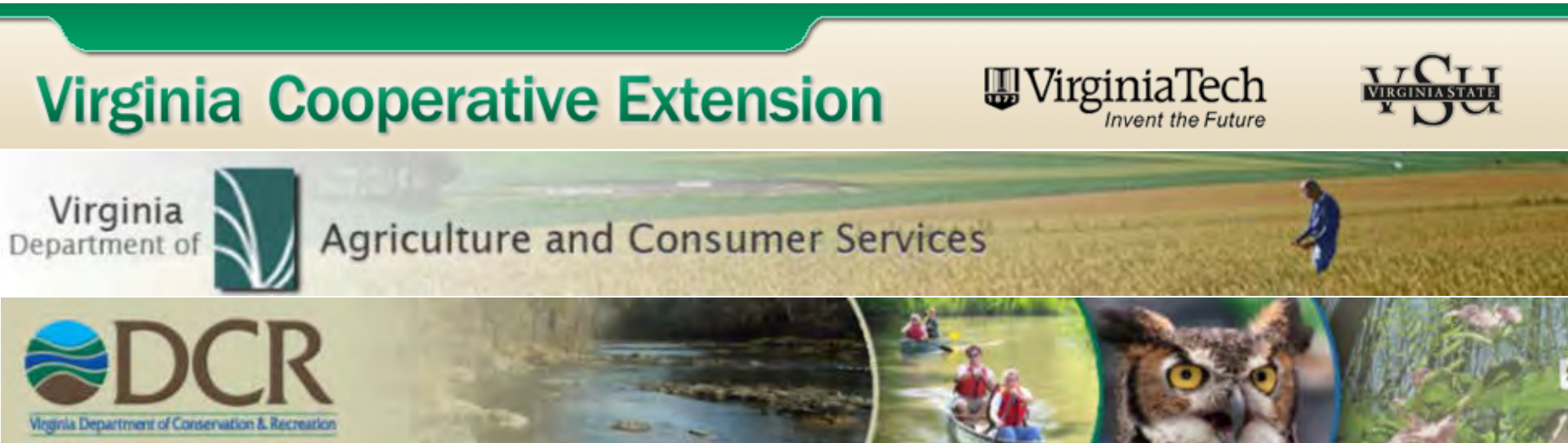
Acceptance (albeit SLOW) and utilization of Buffers

*The logical utilization of buffer zones to enhance water quality protection continues to grow. ‘Buffers’ do not even need to be as dramatic as these to be effective.

Increased design and utilization of more ‘Green Space’ in golf and park settings… i.e. low impact vegetation.

Fertilizer Applicator Certification Training (FACT)

Module 1. Understanding and Interpreting Fertilizer Labels



Please utilize Turf and Garden Tips, a weblog specifically developed for homeowners as a means of providing environmentally responsible lawn management information.

www.anr.ext.vt.edu/lawnandgarden/turfandgardentips/

Questions???

Turfgrass Short Course, Dec. 11-13, Fredericksburg Convention Center

Va Turfgrass Conference and Trade Show, Jan. 28-30, Fredericksburg Convention Center

HRAREC Turfgrass Research Field Day, June 25, 2013, Virginia Beach

VT Campus Turfgrass Research Field Days, August 27-28, 2013, Blacksburg