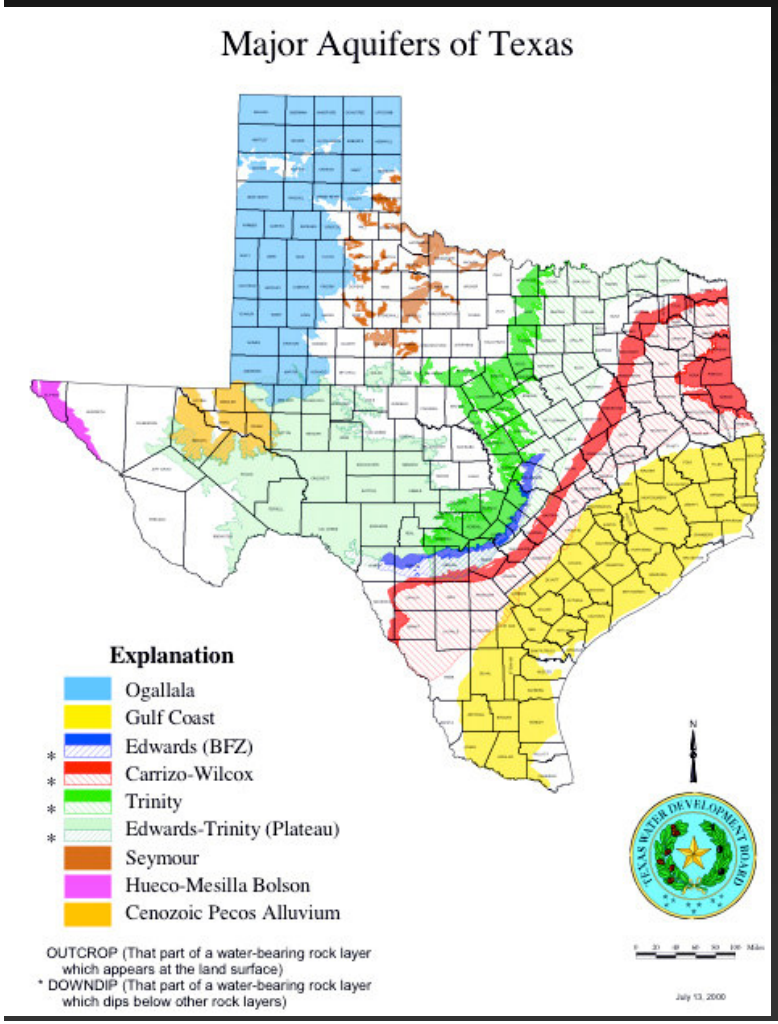
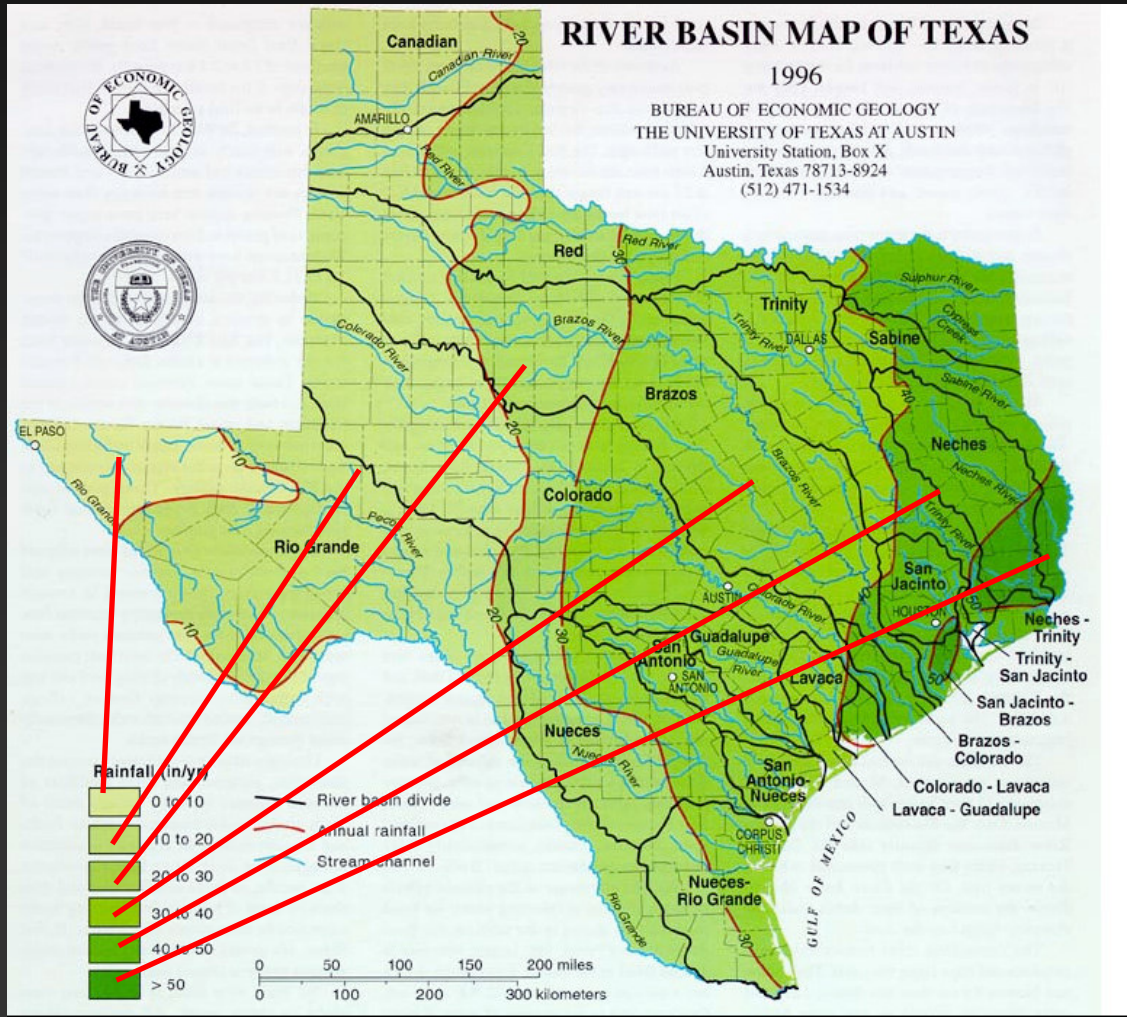
What is a Nutrient Management Plan?

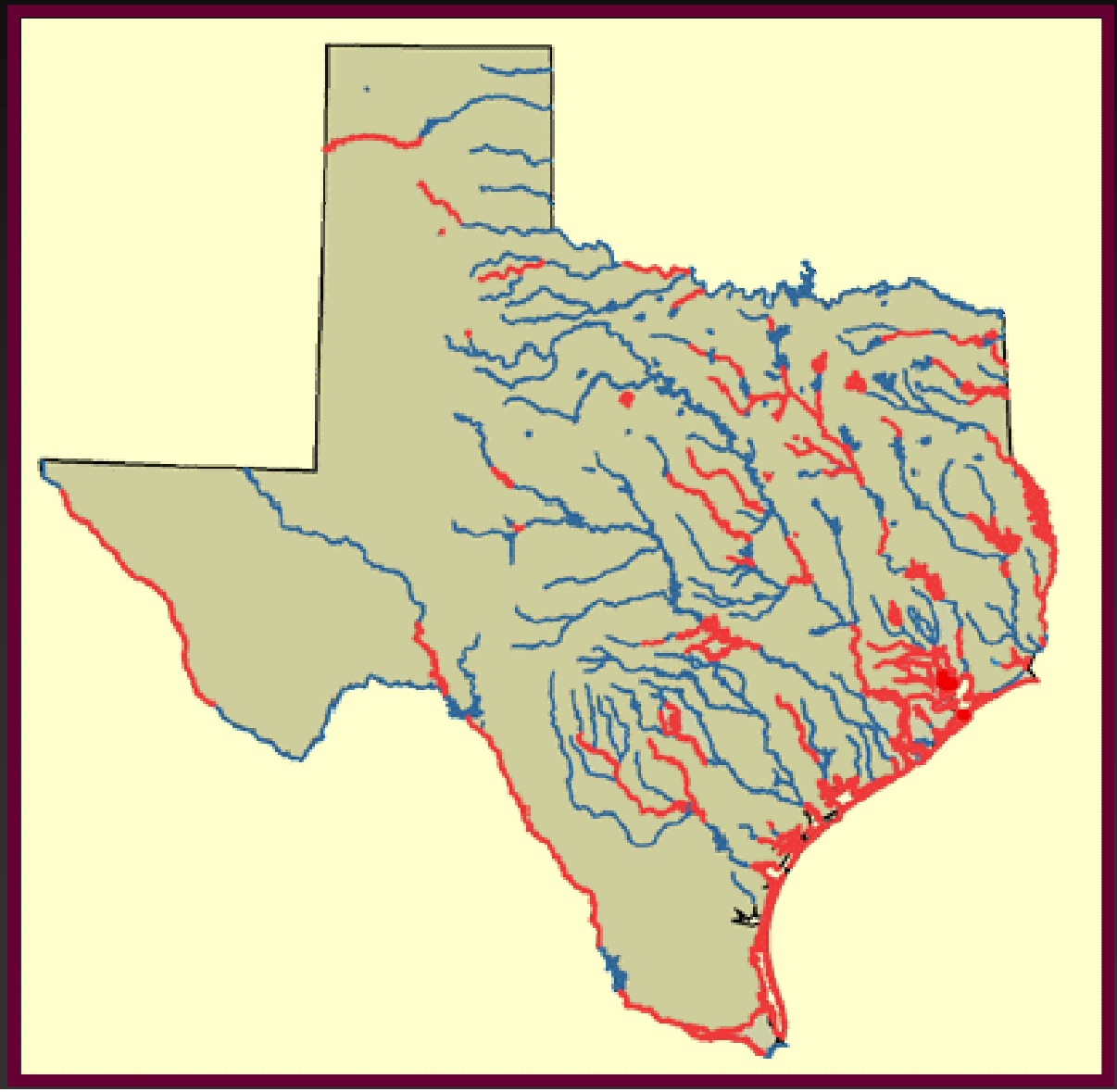
- ✓ Used to be your "Fertilizer Program"
- ✓ An environmentally sensitive approach to fertilizer application. Potential "Non-Point" sources (N&P)
- ✓ Goals and considerations:
  - targets all agriculture, agronomic
  - environmentally sensitive,
  - business oriented? An Opportunity?
- ✓ Influenced by perception or reality?
- ✓ What "drives" ordinances/regulation is "sensitive locations"

Conservation & Protection: Water Sources & Water Quality





Impaired surface water quality segments (in red) in Texas.



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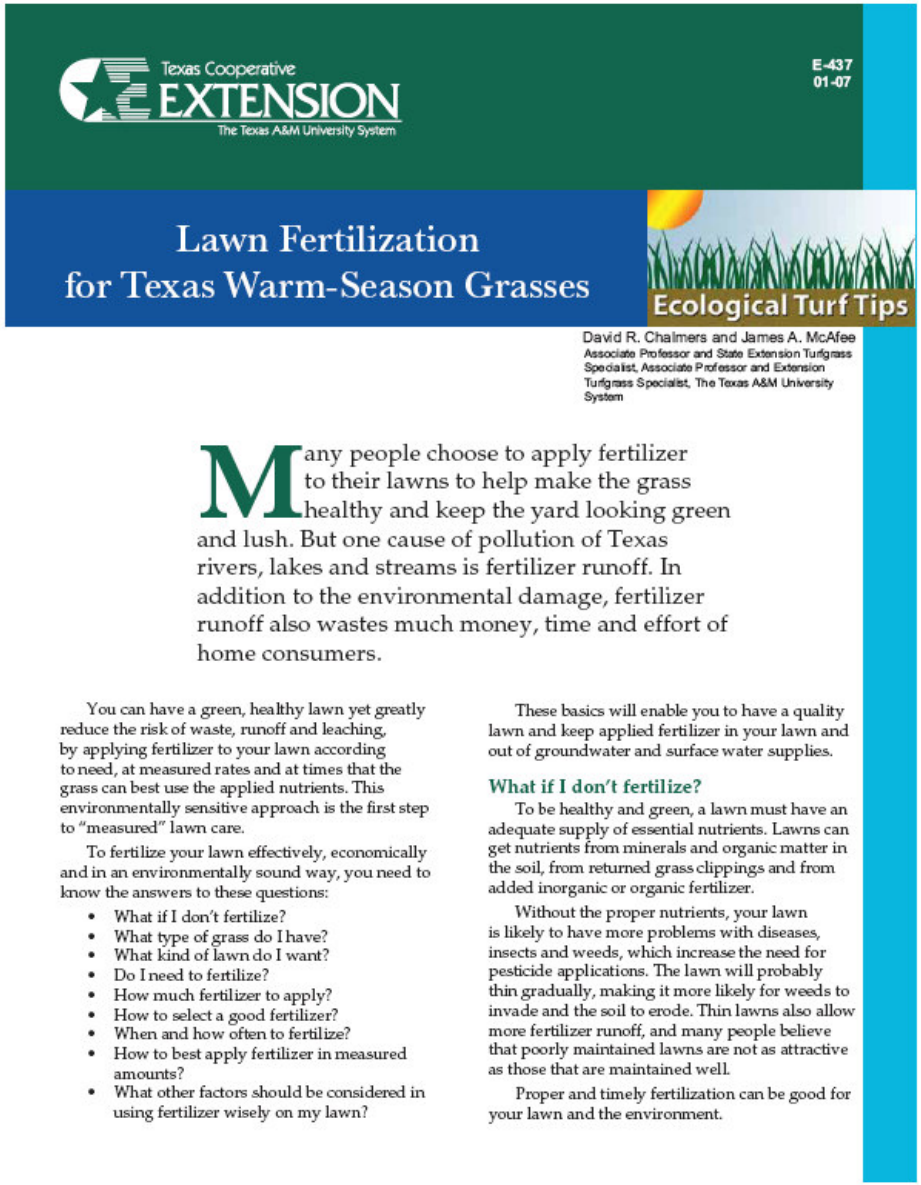
http://aggie-turf.tamu.edu/ THEN answers4you/fertilization.htm OR
Publication E-437 http://tcebookstore.org/



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Lawn Fertilization for Texas Warm-Season Grasses

Ecological Turf Tips

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Many people choose to apply fertilizer to their lawns to help make the grass healthy and keep the yard looking green and lush. But one cause of pollution of Texas rivers, lakes and streams is fertilizer runoff. In addition to the environmental damage, fertilizer runoff also wastes much money, time and effort of home consumers.

You can have a green, healthy lawn yet greatly reduce the risk of waste, runoff and leaching, by applying fertilizer to your lawn according to need, at measured rates and at times that the grass can best use the applied nutrients. This environmentally sensitive approach is the first step to "measured" lawn care.

To fertilize your lawn effectively, economically and in an environmentally sound way, you need to know the answers to these questions:

- What if I don't fertilize?
- What type of grass do I have?
- What kind of lawn do I want?
- Do I need to fertilize?
- How much fertilizer to apply?
- How to select a good fertilizer?
- When and how often to fertilize?
- How to best apply fertilizer in measured amounts?
- What other factors should be considered in using fertilizer wisely on my lawn?

These basics will enable you to have a quality lawn and keep applied fertilizer in your lawn and out of groundwater and surface water supplies.

What if I don't fertilize?

To be healthy and green, a lawn must have an adequate supply of essential nutrients. Lawns can get nutrients from minerals and organic matter in the soil, from returned grass clippings and from added inorganic or organic fertilizer.

Without the proper nutrients, your lawn is likely to have more problems with diseases, insects and weeds, which increase the need for pesticide applications. The lawn will probably thin gradually, making it more likely for weeds to invade and the soil to erode. Thin lawns also allow more fertilizer runoff, and many people believe that poorly maintained lawns are not as attractive as those that are maintained well.

Proper and timely fertilization can be good for your lawn and the environment.

- What if I don't fertilize??
- What type of grass do I have?
- What kind of lawn do I want?
- Do I need to fertilize?
- How much fertilizer to apply?
- How to select a good fertilizer?
- When and how often to fertilize?
- What if I do not have a soil test?
- How to best apply fertilizer in measured amounts?
- Other factors to consider in using fertilizer wisely

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Let's talk about the nutrient most often applied - Nitrogen

- ✓ Nitrogen (N) is the nutrient required in the largest quantity by lawn grasses and it is applied most often.
  - Other nutrients can "come along" with the nitrogen in a "complete" fertilizer or they can be applied separately.
- ✓ Typical recommendation with homeowner type fertilizers suggest applying up to 1 LB of actual nitrogen per 1000 square feet per application.
  - More may lead to excessive growth or too much for the plant to use (potential leaching)
- ✓ Individual applications added together make up the annual nitrogen rate applied to lawns grasses
- ✓ Grass type, lawn quality, and maintenance level are also important considerations in determining how much and how often you apply nitrogen fertilizer

Nutrient Management Issues: The Non-Point Source Focus

- ✓ Potential Non-Point Sources - Areas of Impact
  - Cropping systems
  - Turf: Home Owner, Lawn Care, Golf, Sports Turf
- ✓ Application Windows
  - Agronomic: Best Management Practices or BMP's
- ✓ Nutrient Carry Over/Excess Nitrate or P Availability
  - Application Rates & Timing
  - Nutrient Availability (N sources)
  - short-term vs. long term influence
- ✓ Storm Water Issues with Nitrate and Phosphorus

Environmental Concerns: N and P Application

- Ground water & Surface waters
  - Nitrate leaching & runoff AND Phosphorus runoff
- Nitrate leaching (10 mg/L = drinking water standard but 3 mg/L in wells = human impact)
  - Nitrate reduction to nitrite in gastrointestinal tract moves into blood stream and reacts with hemoglobin. Result is oxygen transport impairment in humans
  - methemoglobinemia (blue baby syndrome) but susceptibility varies. Infants less than 3 months
- Non-point source impacts = surface runoff (storm water) & groundwater

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Definitions - Groundwater

- water that occurs in saturated strata (aquifer) of non-consolidated geologic material in fractured and porous rock (Patrick et al. -1987)
- recharged by precipitation (4% of hydrologic cycle)
- In U.S. main source of drinking water for more than 1/2 the population (36% municipal, 95% of rural population)
- Supplies 30% of stream flow - groundwater contamination from polluted streams can occur with negative aquifer pressure.

Eutrophication

- ✓ Increased biological productivity in streams, lake, estuaries from nutrient enrichment.
- ✓ Phosphorus (P) and nitrogen (N)
- ✓ Background levels 0.3 mg/L N

  and 0.5mg/L P
- ✓ Prolific algae growth at "elevated" nitrate and phosphorus levels
- ✓ RESULT = Oxygen deficits, turbidity, decline in SAV and habitat

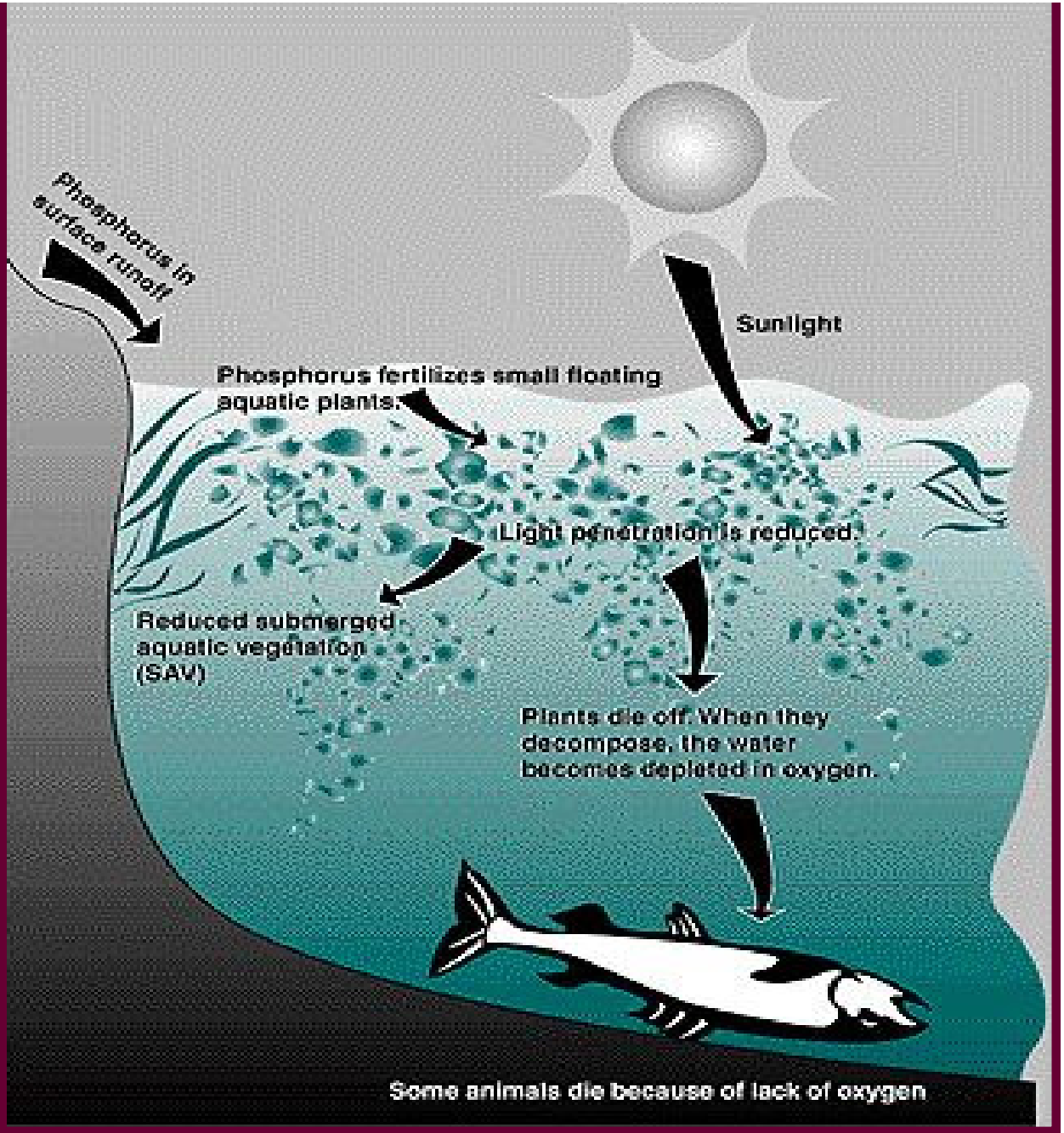
Phosphorus in surface runoff

Minimum Nutrient Concentrations

N = 1 mg/L total N

P = .025 mg/L total P

* 0.10 mg/L total P in streams
* US EPA



Sequence of changes in surface water quality with increasing nutrients

- ✓ Increased algal growth
- ✓ Reduced water clarity
- ✓ Water treatment problems
  - odor and bad taste
  - increased filtration costs
  - disinfectant byproducts w/ possible health effects
- ✓ Reduced water O_2
- ✓ Altered fisheries/fish kills
- ✓ Possible toxins from blue-green algae- human and animal health effects

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Soil pH Affects Phosphorus Availability

- ✓ Maximum P solubility at pH 6.0 to 7.5
- ✓ pH < 6, P precipitates with Fe and Al
- ✓ pH > 7.5, P precipitates with Ca
- ✓ P also adsorbs to clay minerals, decreasing availability

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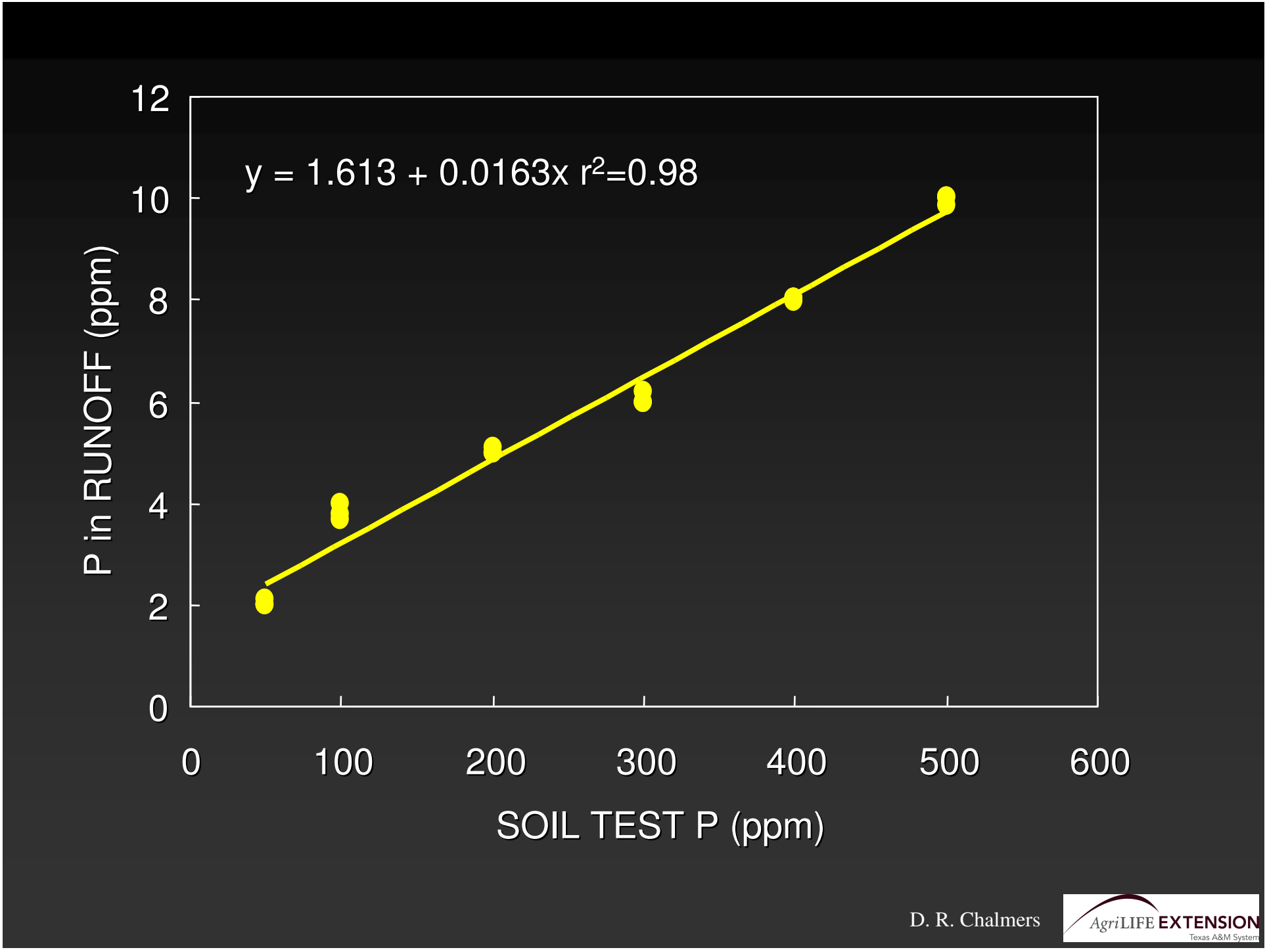
More About Phosphorus:

- ✓ Phosphorus levels > 0.02 PPM in surface waters can cause algal blooms
- ✓ Rain + bare soil some P dissolves as soluble P
- ✓ Bare soil croplands = greater runoff potential. P attached to soil is Sediment P
- ✓ P resides in soluble, sediment and organic forms
- ✓ Total P in water samples as both soluble and sediment P can become bio-available for algal growth.



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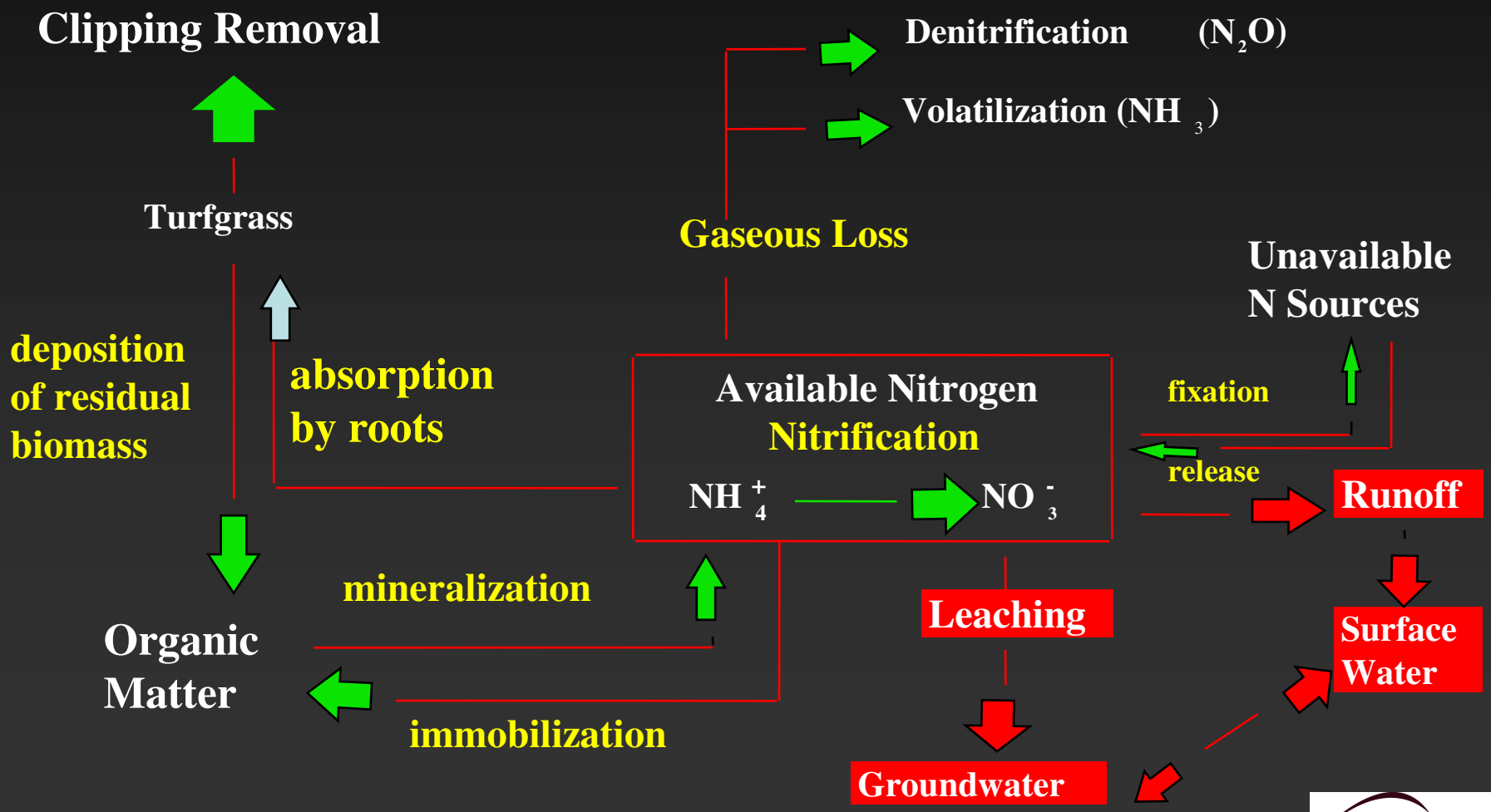
And a bit more!

- ✓ Research shows a "properly" fertilized turf has less runoff than non-fertilized turf = increase density decrease runoff!
- ✓ Background levels of P from dust, pollen & leached from vegetation.
- ✓ Study determined streets with 80% tree cover had 0.8 P ppm runoff while without trees had 0.1 ppm in runoff
- ✓ Natural fertilizer products & compost contain P
- ✓ P by other sources:
- ✓ Organic sources also include wild animal waste
  - 100 C. Geese produce > 5 oz P/Day!
  - A pet dog contributes 2.6 lbs/year which is 5 time greater than a typical turf fertilizer program/1000 sq ft.!

Reference:J. Stier, August 2005 Sports Turf Mag.

Fate Of Nitrogen In Turf/Soil Systems



Example of Nitrogen Source and Soil pH Effects On Cumulative NH_3 Loss - 14 Days After Application

N Source	Acid (pH 6.0)	Calcareous (pH 7.6)
	% of added N lost as NH_3	
NH_4NO_3	0.1	7.0
$(NH_4)_2SO_4$	0.9	22.5
SCU-30	0.7	9.0
Urea	18.5	51.5

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Factors That Influence Nitrogen Leaching

- Soil type
  - sand vs clay
  - organic matter content
- Irrigation rate/frequency
- Nitrogen source
  - inorganic N
  - natural organic vs synthetic organic N
  - coated nitrogen
- Nitrogen rates
- Season of N application

Nitrogen Uptake Influenced By:

- Temperature
- Moisture
- Available N pool
- Plant growth rate (season)
- Nitrogen source
- Nitrogen application rate
- Plant genetic differences

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Determination of Turf Requirements

- ✓ soil tests (everything but Nitrogen - do not apply Phosphorus if not needed)
- ✓ tissue tests (golf courses use)
- ✓ visual observations
- ✓ yearly programs (nitrogen)

Organizing A Nutrient Management Program

- ✓ Project an amount of N/1000 sq. ft/year
- ✓ Consider use,climate, soil type
- ✓ Schedule N: timing & rate (agronomic principles/N source/demands)
- ✓ Soil test (P, K, Ca, Mg)
- ✓ Determine need for complete analysis fertilizer or single nutrient sources

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Nutrient Management Programs

Considerations - PAGE 1 of 5

- ✓ Program to achieve a result or response
- ✓ Program is not a "Cookbook"
- ✓ Depends upon:
  - Species
  - Mixtures/varieties
  - Nitrogen source
  - Soil texture (CEC)
  - Past fertilizer applications
  - Irrigation practices

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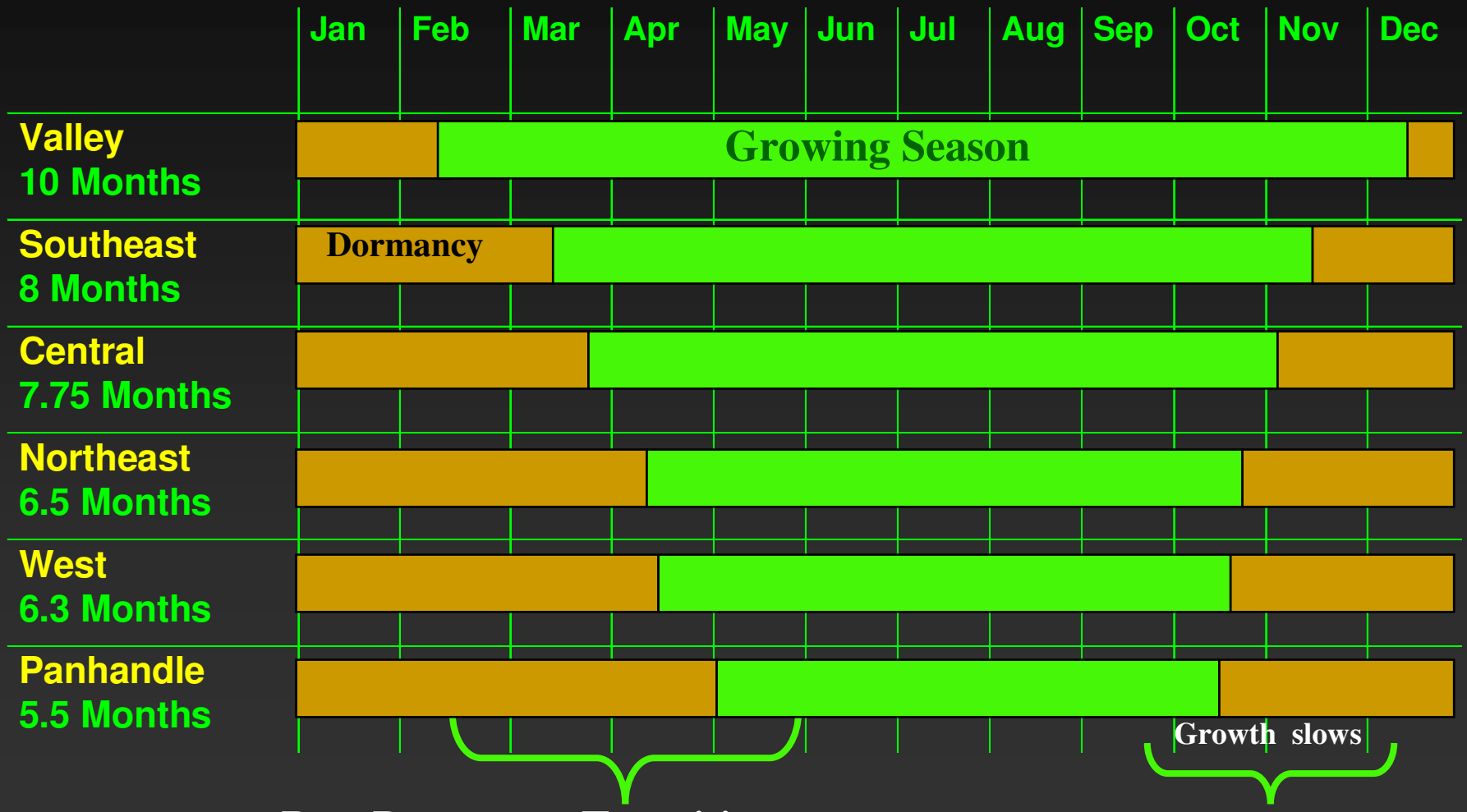
Nutrient Management Programs

Considerations - Page 2 of 5

- Traffic (season and amount)
- Cultural intensity
- Color requirements
- Shade
- Length of growing season
- Age of stand
- Season of year

The Length of the "Growing Season" For Warm Season Grasses at Six Texas Locations (In Months)

Last freeze date in Spring to first freeze date in the Fall



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Nutrient Management Programs

Considerations - Page 3 of 5

- Environmental stresses
- Number of applications
- Application timing
- Rate of each application
- Organic soil additives
- Microbial activity

Nutrient Management Programs

Considerations - Page 4 of 5

- Long term vs. short term response
- Nitrogen carryover
- Potential to leach or runoff.
- Soil test results
- Labor
- Cost
- Size of the area

Nutrient Management Programs

Considerations - Page 5 of 5

- Fertilizer - pesticide combinations
- Fertilizer analysis
- Minor elements
- Application equipment
- Fertilizer solubility
- Calibration

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Setting Up An Annual Nutrient Management Strategy

	Analysis	N	P	K	Ca	Mg	Other	Lime
Target								
Jan								
Feb								
Mar								
Apr								
May								
Jun								
Jul								
Aug								
Sep								
Oct								
Nov								
Dec								
Total								

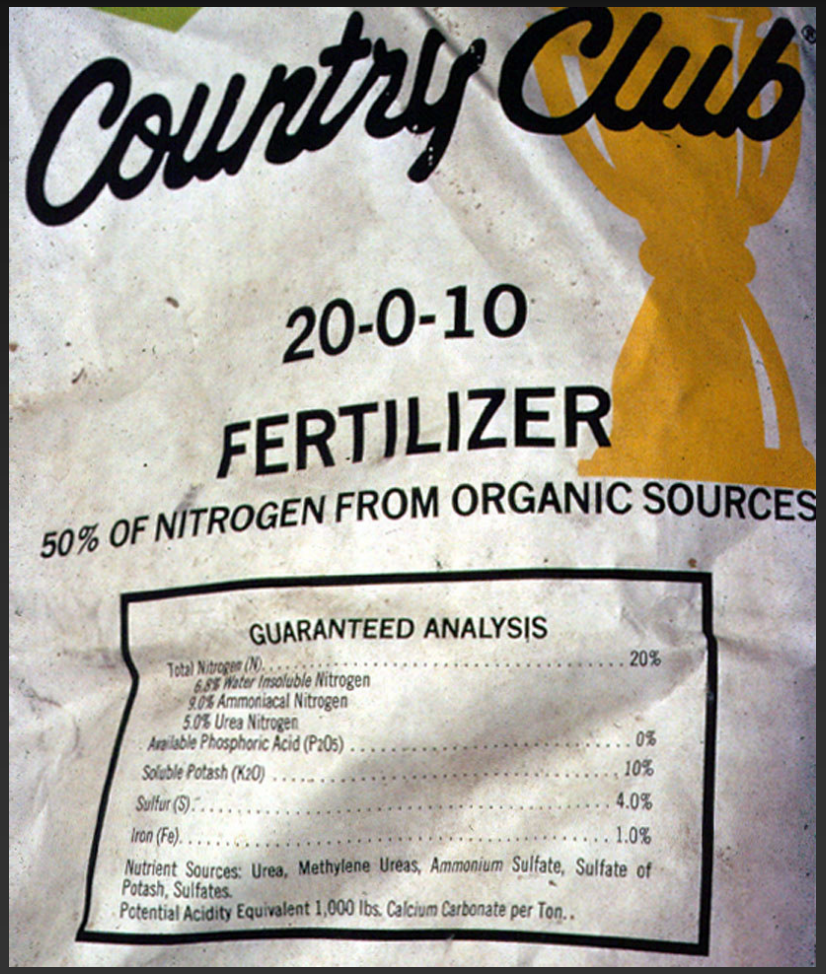
Setting Up An Annual Nutrient Management Strategy - Soil Test for P, K, Ca, Mg, pH

	Analysis	N	P	K	Ca	Mg	Other	Lime
Target		5	2	4	????	????	????	????
Jan								
Feb								
Mar								
Apr	15-0-30	1	0	2				
May	15-5-5	0.75	0,25	0.25				
Jun	25-5-15	1	0.2	0.6				
Jul								
Aug	16-4-12	1	0.25	0.75				
Sep	20-20-20	1	1	1				
Oct								
Nov								
Dec								
Total		4.75	1.7	4.6				

Fertilizer Programs

Avoiding Confusion and Inefficiency

- ✓ Similar N sources to all areas
- ✓ Minimize the total number of products
- ✓ Efficient applications (use "complete" fertilizers) BUT only if needed!



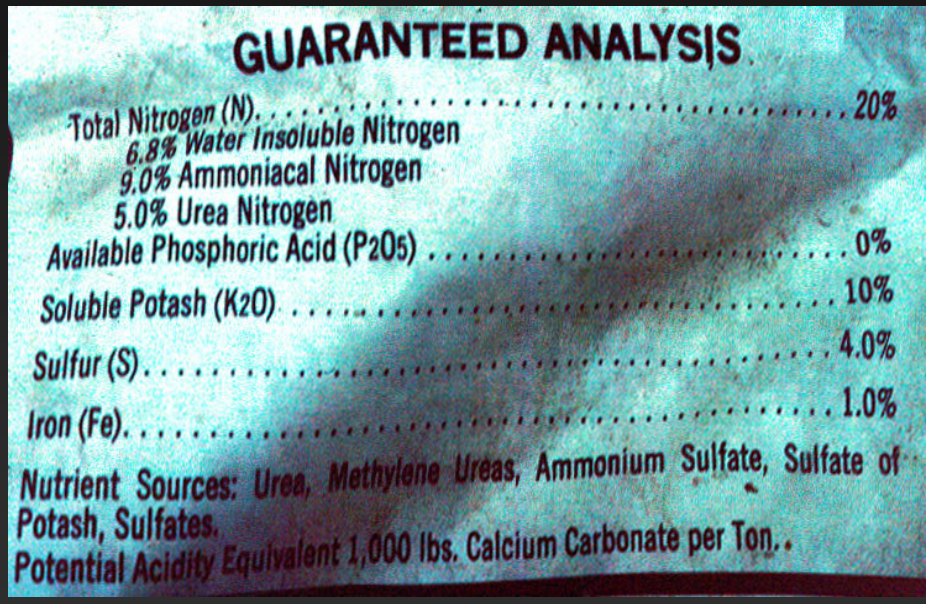
Fate of N Applied to Turfgrass

Literature review by Petrovic. 1990. JEQ 19: 1-14.

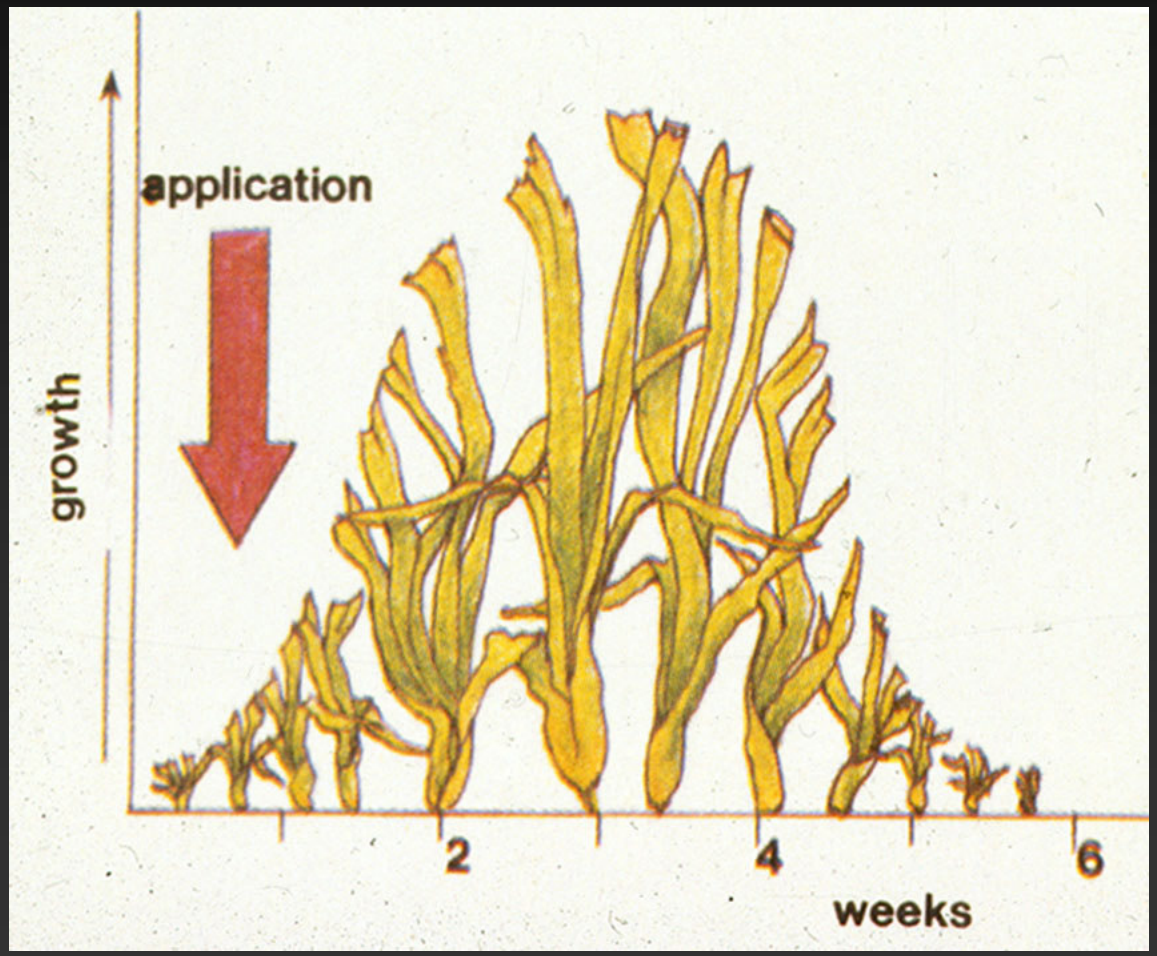
Nitrogen fate reported…	% of applied
Plant uptake	5 - 74%
NH_3 volatilization	0 - 36%
Denitrification	0 - 93%
Leaching	0 - 53%
Residual N (soil)	15 - 21%
Residual N (thatch)	21 - 26%
Runoff	< 7%

Nitrogen Source Response

- ✓ Quickly available
  - Inorganic: ammonium nitrate, am. sulfate, am.phosphates
  - Organic: urea
- ✓ Slowly available
  - Slowly soluble: IBDU
  - Slow release: SCU, polymer coated
  - Microbial release: UF, Natural Organics



Readily Available N Sources Growth Response



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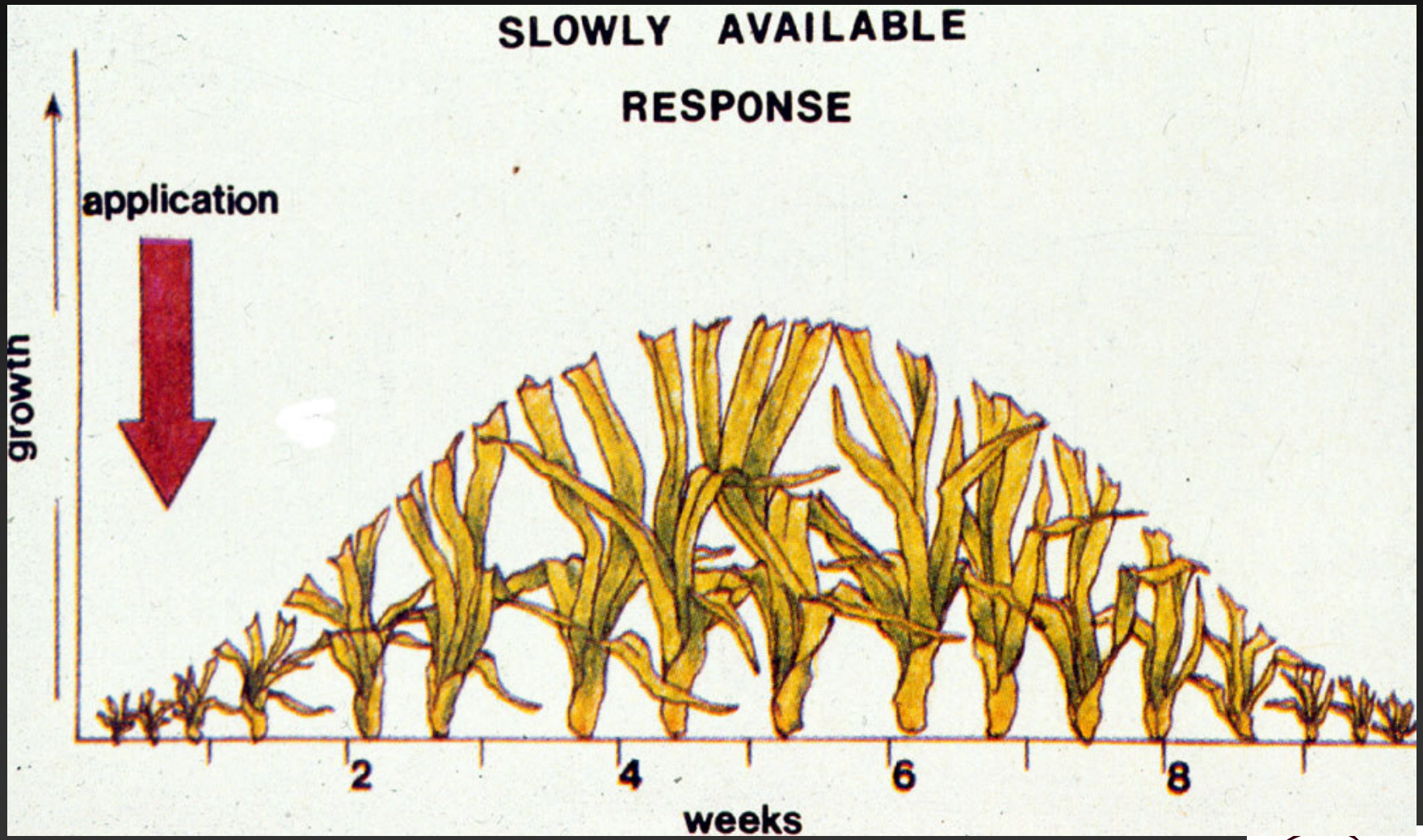
Slowly Available N Sources Growth Response



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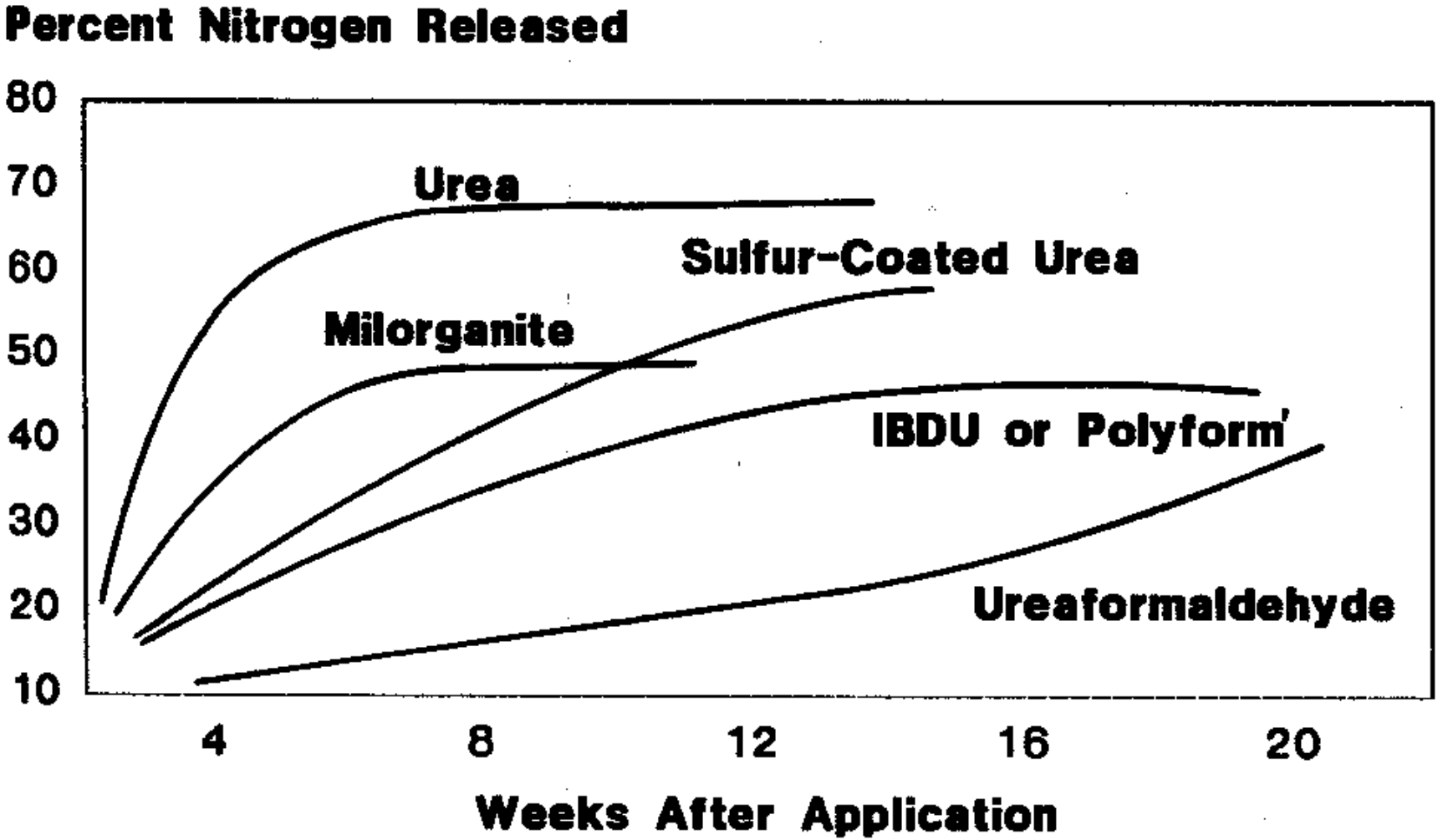
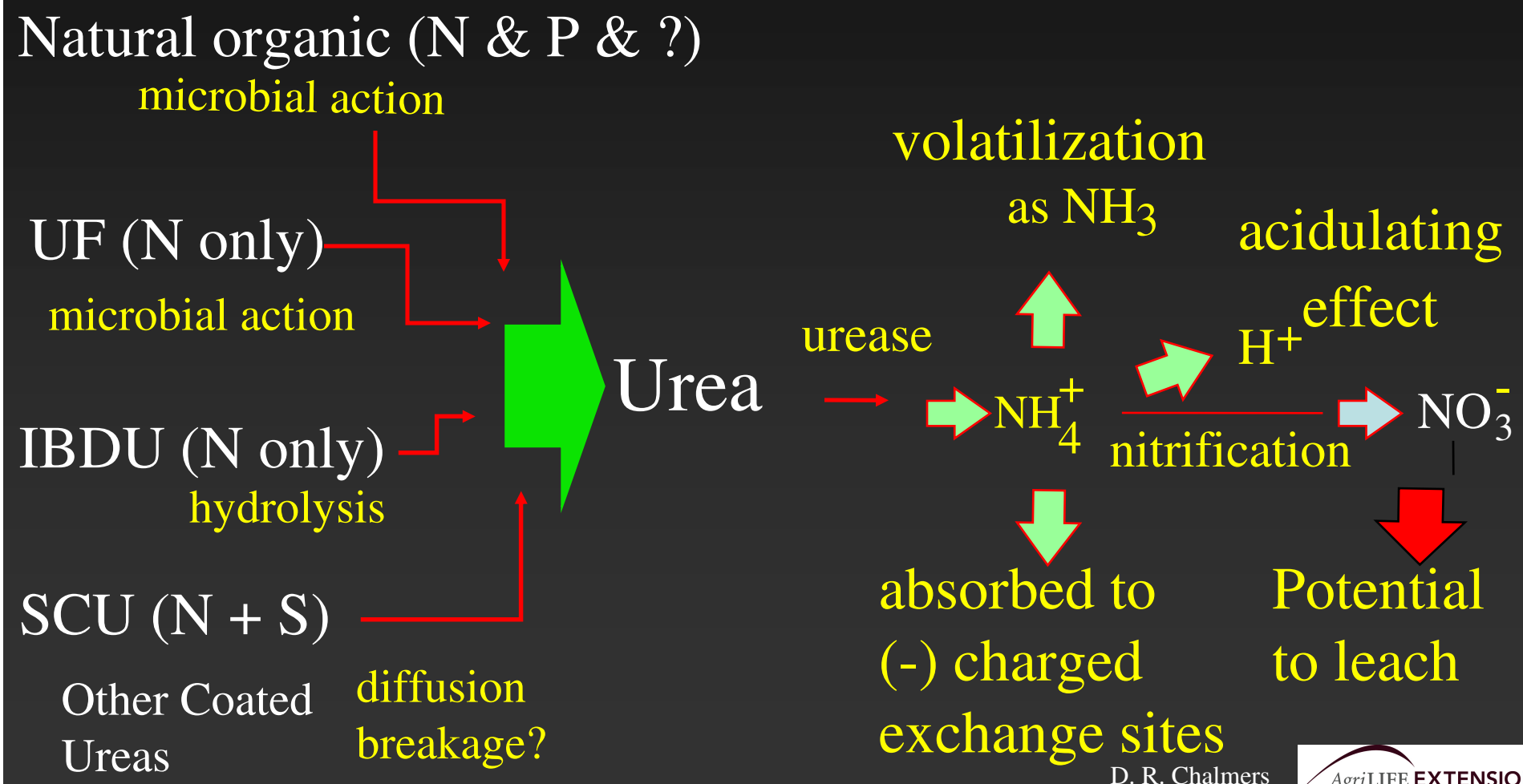
Nitrogen Release Rates

Soluble > Organic > Slow release



Nitrogen Source Conversion to Inorganic Nitrogen



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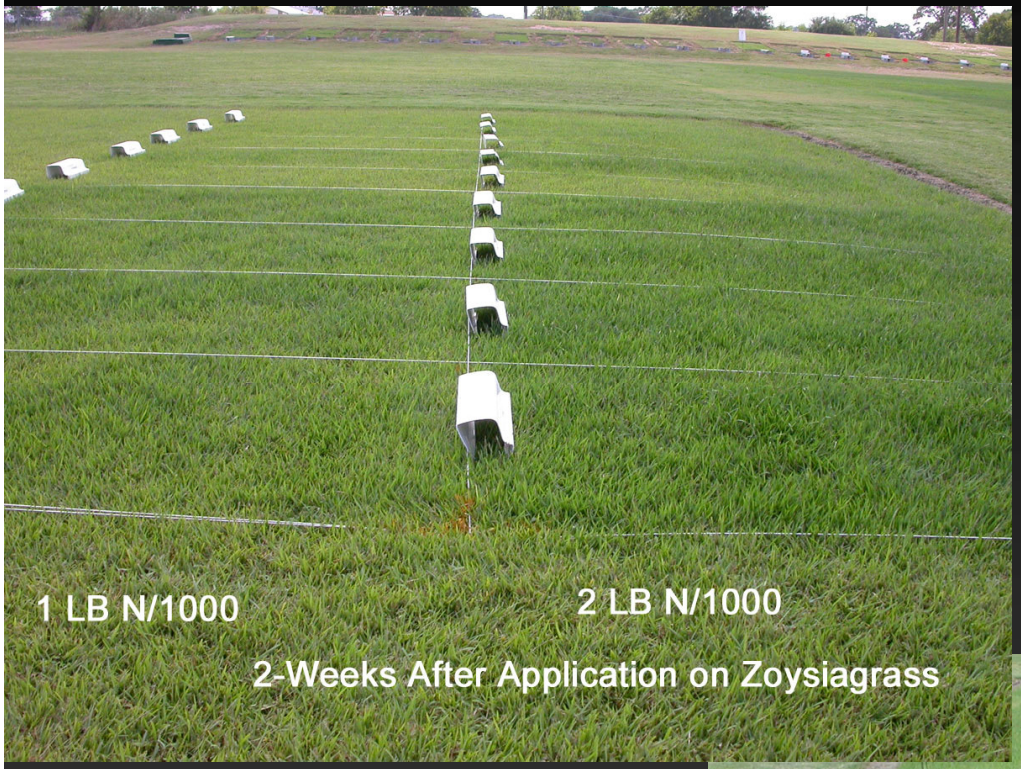
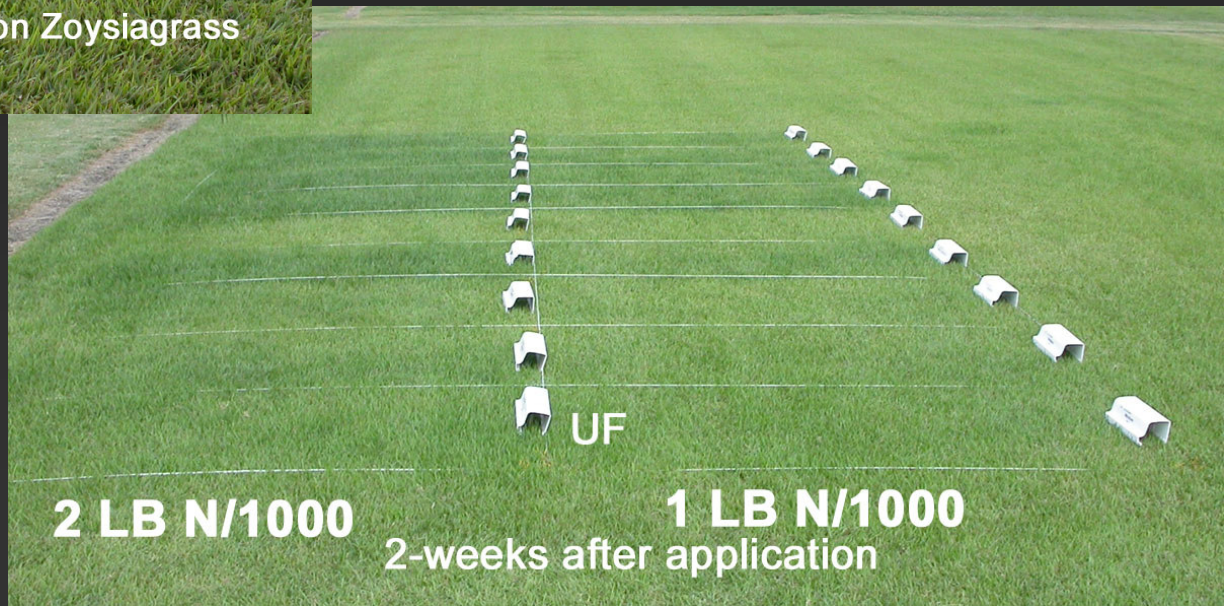
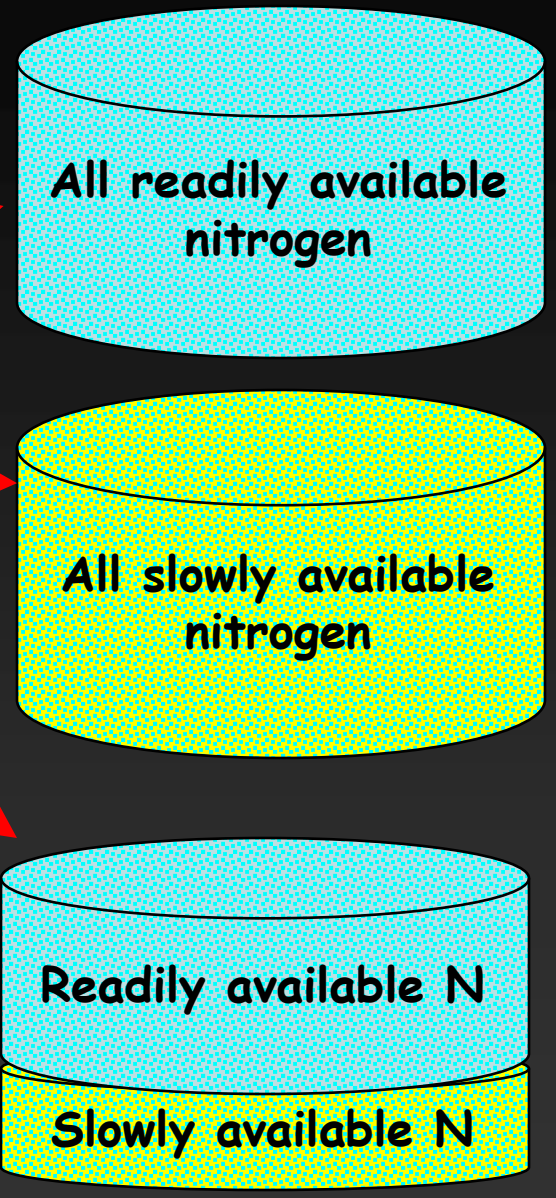
Comparing N-sources





Knowing how your fertilizer will respond so you can use it properly!

- ✓ Nitrogen fertilizers sold can be:
  - All readily available N
  - All slowly available N
  - Or mixtures of readily available and slowly available N sources
- ✓ Often homeowner-type fertilizers are a mixture of readily available N and slowly available N
- ✓ Knowing what proportion of the nitrogen that is readily available and what if any is slowly available allows you to use nitrogen wisely!



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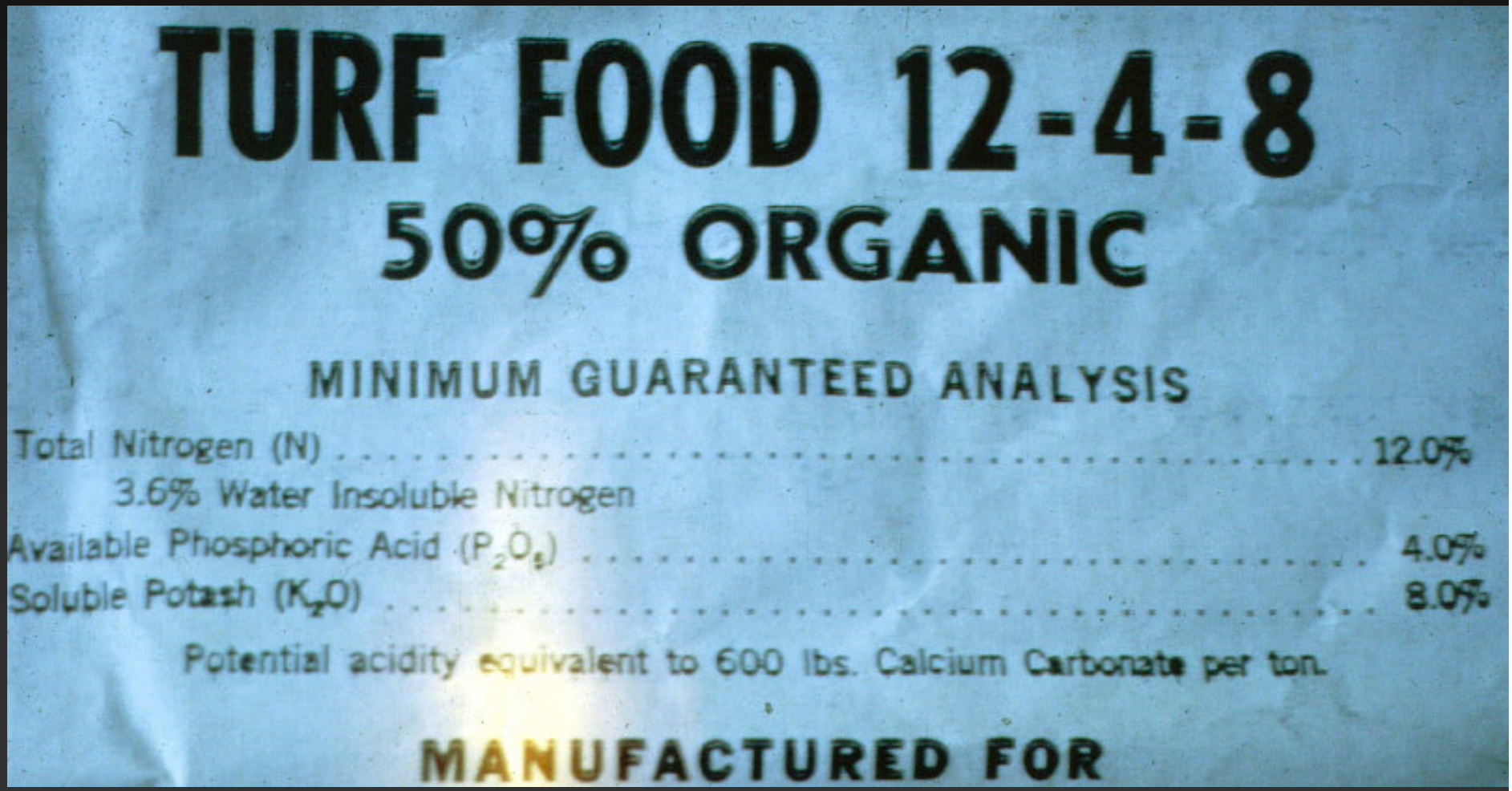
Ready Response &/or Residual Response?



Warm Season Grass N

- ✓ SPRING: if enough residual nitrogen delay spring application, until after several mowings
- ✓ If the lawn appears vigorous and healthy delay first application until May.
- ✓ SUMMER: supplemental N most commonly used on bermudagrass - spaced at least 45 to 60 days apart.
  - N not to exceed 1 lb of actual nitrogen per 1000 sq ft.
- ✓ Slow release nitrogen sources are particularly suited for summer and early autumn fertilizer applications to prevent surges of lush growth.
  - they can be used for any nitrogen application.

Warm Season Grass N

continued

- ✓ Areas in moderate to heavy shade likely perform well with only spring and autumn applications.
- ✓ St. Augustinegrass lawns may require periodic applications of iron sulfate or iron chelate to prevent iron chlorosis (yellowing) several times during the growing season
- ✓ The late summer to autumn N application increases density to resist winter weeds, improves fall color and enhances spring recovery. Modest rates (less than 1 lb per 1000 sq ft) provide benefit but reduce potential nitrogen carryover and potential leaching during winter months.

Selecting that fertilizer

- ✓ **Soil test results say:**
  - If you need phosphorus
  - If you need potassium
  - If you need calcium, magnesium and other nutrients.
- ✓ Select a fertilizer ratio to meet your soil needs but to do so you will need to soil test!
- ✓ Find an analysis fertilizer that supplies what is recommended by soil testing
- ✓ Do not apply phosphorus if not needed

✓Nitrogen sources influence cost but also turf response

✓Fertilizer manufacturing process will affect cost

✓Ease of spreading

✓Only buy what is needed

✓If you have not soil tested you may use a nitrogen only fertilizer until you can soil test

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Application Concerns

Nutrient Management & Environmental Sensitivity

- Adjust nitrogen rates and application scheduling
- Adjust nitrogen carriers (N release rates)
- Adjust irrigation rates & frequencies
- Know your soil types & use soil tests - P
- Don’t rely on only nitrogen to make your reputation
- Make adjustments based upon species, season and environmental conditions

Phosphorus Summary

- ✓ Most phosphorus in runoff is attached to soil particles (clay and silt- erosion).
- ✓ Only a small portion is water-soluble.
- ✓ Sediment-attached phosphorus in surface waters, however, can be released over long periods of time (years).
- ✓ Thus, once sediment-associated phosphorus enters a water body, eutrophication potentially may last for years.
- ✓ Best solution is to prevent initial erosion losses of phosphorus.

Your Nutrient Management Plan…

- ✓ Used to be your "Fertilizer Program"
- ✓ Is an environmentally sensitive approach to fertilizer application. (Nitrogen & Phosphorus)
- ✓ Is environmentally sensitive
- ✓ Is agronomic
- ✓ Is business oriented and an opportunity!
- ✓ Deals with perceptions but anchored in science!
- ✓ Attempts to avoid non-point source movement of nitrogen and phosphorus to groundwater and surface waters AND find an "acceptable" level of turf quality.
- ✓ Impacts turfgrass water requirement & use

Micronutrients

- ✓ **Iron (Fe) is #1 micronutrient deficiency in Texas**
- ✓ **Deficiencies of Fe, Zn most common in:**
  - **sandy soils**
  - **high pH soils**
  - **soils with excess P**
  - **clippings removed**

Nitrogen Mineralized From Soil Organic Matter During The Growing Season

Soil OM %	*Sandy Loam*	*Silt Loam*	*Clay Loam*
	N Released, lbs/acre		
1	50	20	15
2	100	45	20
3	-	68	45
4	-	90	75
5	-	110	90

Recommendations for fertilization in sensitive areas:

- Maintain dense, healthy turf
- Use buffer strips; soil & tissue testing
- Do not apply near ponds or streams;
- Use drop spreader near these areas
- Use slow-release fertilizers, or with soluble fertilizers decrease rate and apply more frequently;
- Use proper rate for species and use
- Avoid application of fertilizers to non-target areas such as sidewalks and roads
- Load spreaders on impermeable surfaces to ease cleanup of spilled material
- Rinse sprayers and spreaders on grassed areas to decrease runoff of rinsate or collect in dedicated containment wash area

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What do the numbers mean?

The analysis (10-10-10) is the percent by weight of Nitrogen (N), Phosphorous (P) and Potassium (K) in the bag.

Example:

A 100 pound bag of 10-10-10 will contain 10 pounds of Nitrogen, 10 pounds of P and 10 pounds of K.

Example

What is the difference between a 15-5-10 fertilizer and a 21-7-14?

In a 50 pound bag of __-__-__ , you get ___ pounds of

Pounds of

Fertilizer	N	P	K
15-5-10	7.5	2.5	5.0
21-7-14	10.5	3.5	7.0

Selecting a Fertilizer

- By the amount of Nitrogen you need to apply to your lawn.
- In turf we make recommendations based on the number of pounds of N applied per 1000 square feet of turf.
- Typically, we recommend no more than 1.0 pound of N / 1000ft2 at any one time.

So how much will I need?

Example: Your lawn area equals 6,000 ft2, and you have a bag of 28-3-6 fertilizer. Your rate of N application is 1.0 lb/1000 ft2.

$$\frac{1.0}{.28} \times \frac{6{,}000}{1000} = \text{21.4 pounds of 28-3-6}$$

How much will my lawn need over the year?

Pounds of N per 1000ft2 per year	
St. Augustine	3 - 5
Bermudagrass (common)	4 - 6
(hybrid)	5 - 8
Zoysiagrass	3 - 5
Tall Fescue	3 - 4
Buffalograss	1 - 3
Centipedegrass	1 - 3

How often should I fertilize?

- ✓ Start at spring green up then every 6-8 weeks through September.
- ✓ Hybrid bermudagrass may require applications every 4-6 weeks.
- ✓ A master gardener once told me she fertilized her lawn on all of the major holidays starting at Easter and ending on Labor day. A great way to remember when to fertilize!

Organic vs. Synthetic fertilizers

As long as it meets the nutritional needs of the turf and you apply the fertilizer at the same rate, it should not matter! (except when soil temperature is low (<55oF).)

Why should soil temperature matter?

Organic sources of N typically require microbial activity, moist conditions and warm temperatures to release the N. If the temps are low, then microbial activity will reduced so the N will not be released. With synthetic fertilizers, N release is not dependent on microbial activity.

Fertilizer Miss-Application

Proper Fertilizer Spreading Pattern