Turf Fertility, Timing & Amount

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An effective fertilization program-

- **Promotes uniform growth**
- **Cost-effective**
- **As agronomically sound as possible**

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Topics

- **Nutrients: N, P, K**
- **Application Timing**
- **Choosing Products**

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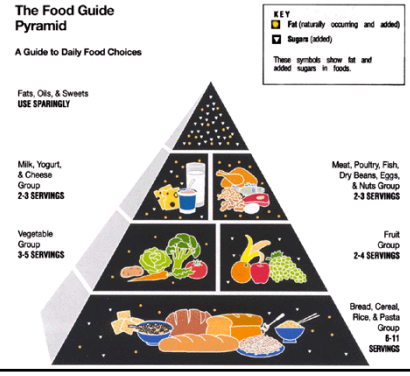

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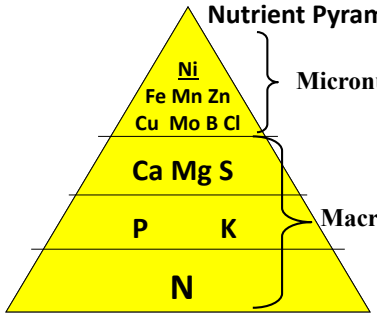
Nutrient Pyramid



Micronutrients

Macronutrients

+ Carbon, Hydrogen and Oxygen

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Agronomic Law of Minimum

- *"growth is proportional to the amount of the most limiting nutrient, whichever nutrient it may be"*
- Macronutrients are not "more important" than micronutrients simply used in great quantity.

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Classification of Nutrients

- **Macro nutrients**
  - **0.1 to 6.0% concentration by dry wt. of tissue**
  - **N 2-6%; P 0.25-1%; K 1-3%**
  - **Most common fertilizer needs**
  - **Structure of molecules**
    - **DNA, RNA, Chlorophyll**

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Classification of Nutrients

- **Micronutrients**
  - **–<1.0 to 500 ppm concentrations**
    - **–ppm: 1 inch in 16 miles**
  - **–Required in small quantities**
  - **–Catalytic or regulatory roles**
    - **Make reactions proceed/'go'**

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N Deficiency Symptoms

- **Reduced growth rate, old leaves lose color**
- **Chlorosis (yellowing of leaves)**
- **Density loss**

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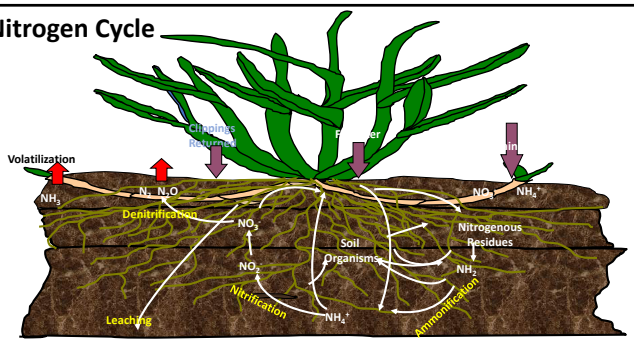
Nitrogen Cycle



The biological driver is microbial activity

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Nitrogen Cycling

- **Microbial activity influenced by:**
  - **Food source**
  - **Specific microbe**
  - **Soil pH**
  - **Soil aeration (oxygen or lack of)**
  - **Soil moisture (water)**
  - **Soil temperature**

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Key Processes (N loss)

- Volatilization – loss of N as ammonia

$$\text{Urea} + H_2O \xrightarrow{\text{Urease}} CO_2 + NH_3 \uparrow$$

- Factors:
  - Urea level
  - Urease enzyme present (thatch)
  - Temperature (slow < 50 F, increases to 77 F)

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Phosphorus (P)

- Function
  - –Energy transformations (ATP, ADP)
  - –Constituent of genetic material

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Plant Responses to P

- Root growth
- Shoot growth
  - P for energy transformations and structural components

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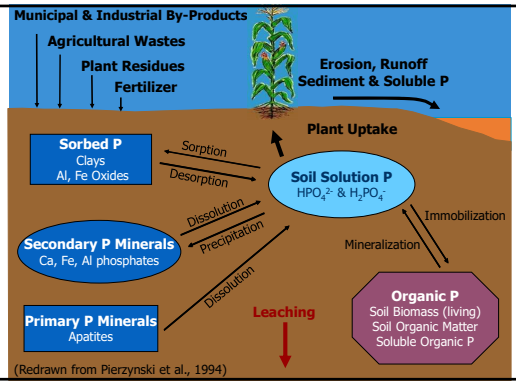

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P Deficiency Symptoms

- Reduced shoot growth
  - ATP/ADP involved in many metabolic reactions
- Dark green color
  - Reduced leaf area, more chloroplasts/unit area,
- Red/purplish color
  - Anthocyanin accumulation

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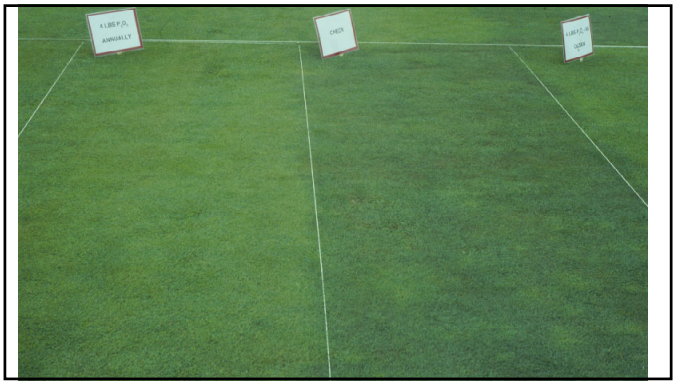

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Phosphorus Applications

- **Apply according to soil test recommendations as part of annual program**
- **Critical for rooting initiation**
- **Apply at (re)seeding**
- **Apply after aeration**
- **Immobile so residual is high but may not be where the plant can use it (at the surface for seeding)**

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Potassium (K)

- **Only nutrient that is not a constituent of any plant compound**
- **K is second behind only N in concentration in the plant**
- **What role does K serve in the plant?**

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Function

- **Photosynthesis**
- **Carbohydrate and protein formation**
- **Enzymatic reactions**
- **Water relationships**
- **Enhances stress tolerance**

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Plant Responses to K

- Root growth
  - deeper rooting & branching
- Stomatal control
  - K influences transpiration by regulating opening and closing of stoma
- Uptake of other nutrients
- Cell wall size and thickness
- Carbohydrate synthesis

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K Deficiency Symptoms

- Leaves soft, drooping –reduced hardiness
- Interveinal yellowing of older leaves
- Reduced rooting
- Wilting
- Leaf margins brown
- Leaf tips roll
- Decreased tillering

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Potassium Applications

- Sand rootzones – apply as part of annual program
  - Potassium leaches from sand rootzones
- Native profiles (medium, fine textured) – soil test
  - Recommendations based on annual amounts
- General recommendation:
  - Sand rootzone: N:K ratio of 1:1
  - Native rootzone: N:K ratio of 1:0.5

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Fertilizer Products

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Types of N Carriers

1. Fast/quick release - water soluble

- Salt based N carriers - all types dissolve readily when adequate water is present forming either NO_3^- or NH_4^+
- Provide immediate nitrogen availability

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Quickly Available N Fertilizers

Advantages
- less expensive
- quick response
- water-soluble
- not temperature dependent

Disadvantages
- peak and valley feeding
- higher burn potential
- higher labor costs

Examples: urea, ammonium sulfate, potassium nitrate

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Quick Release N Carriers (Salt Types)

Carrier	Analysis	N Release
Ammonium nitrate (NH_4NO_3)	33-0-0	Water soluble
Ammonium sulfate ($(NH_4)_2SO_4$)	20-0-0	Water soluble
Potassium nitrate (KNO_3)	13-0-44	Water soluble

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Characteristics of Salt Types

- High salt index/high potential for burn
- Rapid response
- Apply at low rates, spoon feeding programs
- Inexpensive

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Slowly Available N Fertilizers

Advantages
- longer residual effect
- low burn potential
- less peak and valley feeding
- lowered N losses
- reduced labor

Disadvantages
- higher cost
- slower response
- most are temperature and/or moisture dependent

Examples: ureaformaldehyde, IBDU, methylene urea, sulfur- and resin-coated fertilizers, natural organics

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Urea

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

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UMAXX (47-0-0) and UFLEXX (46-0-0)

- Contains both nitrification (dicyandiamide) and urease (NBPT) inhibitors
- SuperN – liquid mix of dicyandiamide and NBPT without urea

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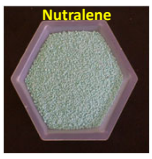
Slow Release N Carriers

1. Synthetic organic N carriers - methylene urea based, provide a mixture of sources to provide both short- and long-term response



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Methylene Ureas

- Short chain molecules are water soluble
- Longer chain molecules are water insoluble
- Longer chain molecules - N is released by microbial degradation

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Slow Release N Carriers

2. Natural organic N carriers
   - Derived from a variety of sources such as animal, plant, sewage, composts
   - N release is based on microbial degradation

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Slow Release N Carriers
3. IBDU

- 31-90% WIN
- N released by hydrolysis
- Relatively unaffected by
  - temperature
  - pH
- Particle size important
- Excellent cool season response

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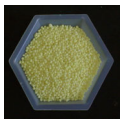
Slow Release N Carriers

4. Coated N carriers
   - Several coating technologies including sulfur, resins, plastics, waxes, polymers
   - N release occurs with diffusion of water into the granule and diffusion of urea out of the granule into soil solution
   - Some temperature response



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Water Soluble vs. Water Insoluble Nitrogen

	WSN (Fast)	WIN (Slow)
Cost	Low	High
Solubility	High	Low
Response	Quick	Slow
Residual	Short	Long
Run off/ Leaching	High	Low
Burn Potential	High	Low
Appl. Frequency	High	Low

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N SOURCE CHARACTERISTICS

N-SOURCE	SALT INDEX	RESIDUAL (WEEKS)
QUICK RELEASE		
Urea	1.62	4-6
Ammonium Nitrate	3.18	4-6
Ammonium Sulfate	3.25	4-6
SLOW RELEASE		
IBDU	0.20	6-8
Methylene Urea	0.86	6-8
Ureaformaldehyde	0.20	52+
Sulfur Coated Urea	0.70	Varies
Natural Organics	0.70	Varies

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Which is best? Use both!

- Fertilizer blending takes advantage of the benefits of quickly and slowly available N sources
- Blending can make slowly available N sources more affordable

Guaranteed Analysis

Super Turf Builder® 30-3-3	F643
Total nitrogen (N)	30%
3.9% ammoniacal nitrogen	
14.3% urea nitrogen	
10.8% other water soluble nitrogen*	
1.0% water insoluble nitrogen	
Available phosphate (P_2O_5)	3%
Soluble potash (K_2O)	3%
Sulfur (S)	4.5%
4.5% combined sulfur (S)	
Iron (Fe)	1.8%
1.8% water soluble iron (Fe)	
Manganese (Mn) (Total)	0.9%
0.14% water soluble manganese (Mn)	

Derived from: urea, methyleneurea, sulfate of potash, monoammonium phosphate, ferrous sulfate, manganese oxide, manganese sulfate, ammonium sulfate.
*Contains 7.7% slowly available methylenediurea and dimethylenetriurea nitrogen.

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- Fertilizer selection depends economy, preference, labor and goals
- If slow-release fertilizers selected:
  - Apply early enough to provide available nitrogen at the expected period of vertical growth slowing or stoppage

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Timings for Carriers

- Soluble N sources: applied about the time growth ceases
- Sulfur coated ureas: 10 – 14 days prior
- Natural organics: 3 – 4 weeks prior
- IBDU: 4 – 6 weeks prior
- Mixed soluble and slow release: 4 – 10 days prior depending on % slow release and carrier

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"Growth Potential" dictates application timing

- N carriers requiring soil microbial activity for N release must be applied 3 – 8 weeks prior to need in fall and spring in contrast in the summer where N availability may occur in 7 – 14 days.

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Late Fall Fertility is no longer recommended

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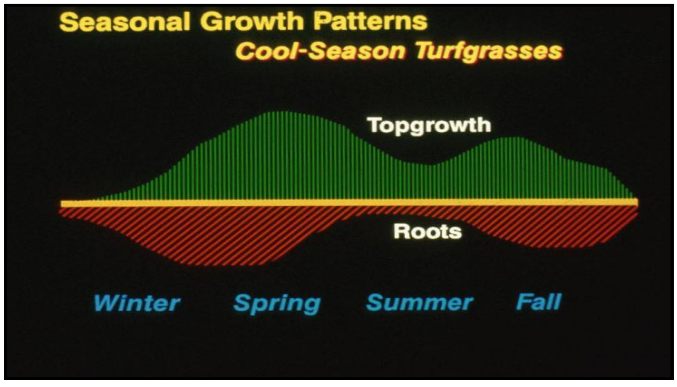

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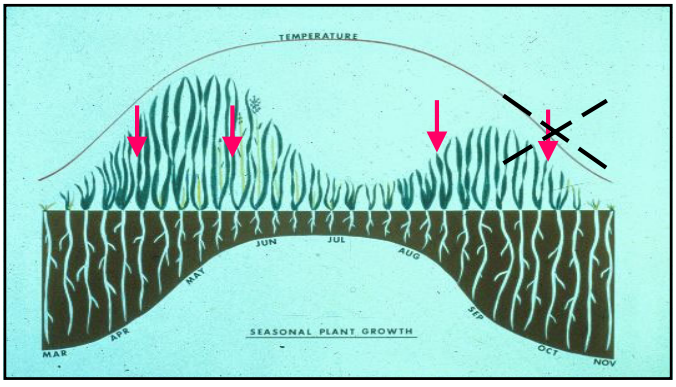

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Why the change?

- Environmental
- Agronomic

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Risks with Late Fall App's

- Snow mold

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Risks with Late Fall App's

- Runoff/Leaching

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Factors Affecting Leaching

- **Soil temp. – microbial nitrification**
  - **Frozen or impermeable?**
- **Soil moisture**
- **Drainage**
- **Turfgrass characteristics**
- **Soil texture (sand vs. clay)**

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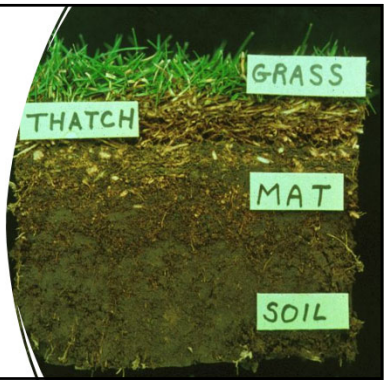
Possible Risks

Thatch

Limited evidence that late fall N may cause some increase in thatch accumulation



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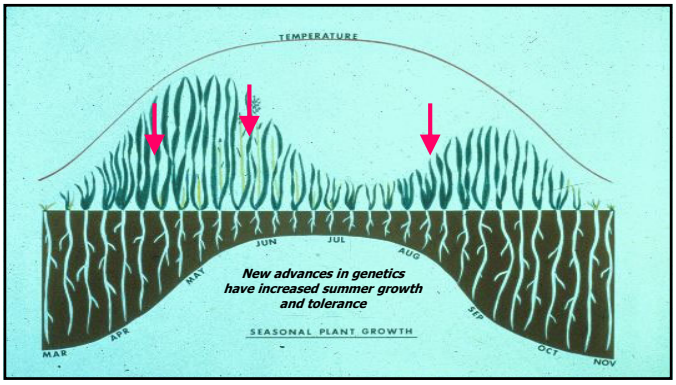

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Factors Affecting Fertilizer "Value"

- Initial Cost
- Turf safety
- How long does it last?
- How easy is it to apply (spreadability)?
  - SGN
  - Uniformity
- Incidental nutrients and other "stuff"

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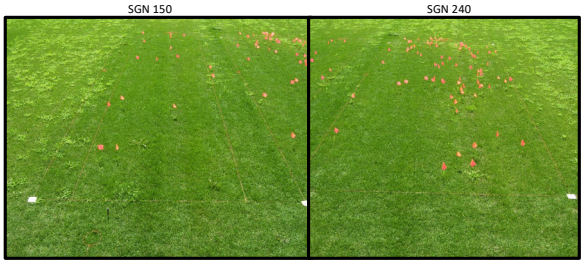
Fertilizer Particle Size (SGN)



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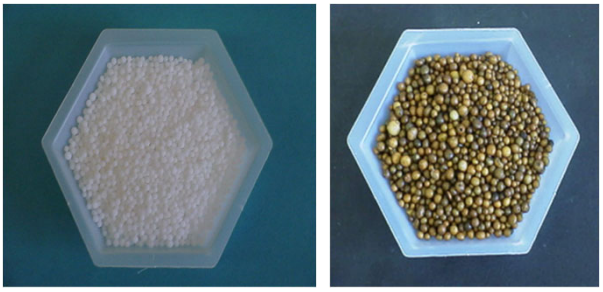

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Fertilization Tips

- Fertilize to promote acceptable color, adequate growth, and rapid traffic recovery
- Use a combination of slow- and quick N sources
- Use iron if you want color without growth
- Let the grass tell you when it needs fertilization

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Nitrogen Mineralization

- **Release of significant plant available nitrogen occurs when soils are warm, moist and aerated.**
- **Nitrogen is mineralized from organic matter; older turf stands (with more soil organic matter) require less fertilizer (up to a 1 lb/yr).**
- **If clippings are returned, fertility can be reduced up to a 1 lb/yr.**

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Nitrogen Fertilization Considerations

- **Don't fertilize turf that isn't actively growing.**
- **Eliminate late fall fertility.**
- **Older lawns need less fertilizer and fewer applications annually than newer stands. Eliminate applications during high mineralization periods such as mid-summer or spring.**
- **Over-fertilized turf wastes money, can lead to excessive thatch accumulation, increased diseases and nitrate leaching to groundwater.**
- **Different fertilizer sources have different release characteristics.**

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How Much?

- Depends on use and end goal
- Depending on stand age, cool season grasses in the central great plains need from 2-4 lbs/N/YR/M

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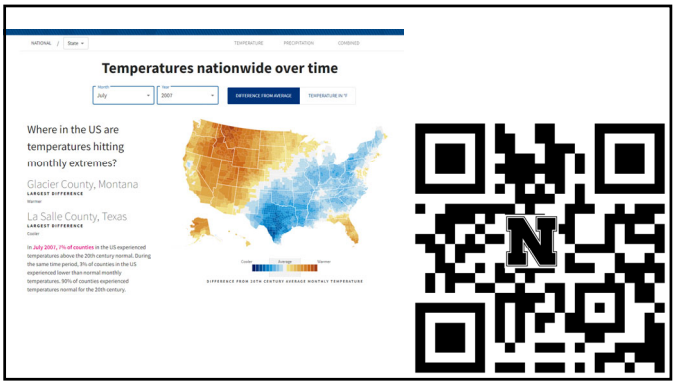

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