

Nutrient Sources, Analyses and Application Methods

Basic NRCCA Training Competency Area 4



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Soil fertility & nutrient management

Six Competency Areas:

- 1: Basic Concepts of Plant Nutrition
- 2: Basic Concepts of Soil Fertility
- 3: Soil Testing and Plant Tissue Analysis
- 4: Nutrient Sources, Analyses, Application Methods
- 5: Soil pH and Liming
- 6: Nutrient Management Planning

Common N Fertilizers

- Urea
- UAN (urea ammonium nitrate)
- Ammonium Sulfate
- Anhydrous Ammonia



Urea

- Fertilizer grade: 46-0-0
- Soluble, readily available N source
- Dry fertilizer product
- Contains the highest percentage of N for all dry fertilizers
- Significant N losses as NH_3 may occur when surface applied



UAN (Urea Ammonium Nitrate)

- Fertilizer grade: range 28-0-0 to 32-0-0
- Soluble, readily available N source
- Liquid fertilizer product
- Made by dissolving urea and ammonium nitrate in water
- Urea portion is subject to NH_3 volatilization



Ammonium Sulfate

- Fertilizer grade: 21-0-0-24S
- Contains 24% Sulfur
- Soluble, readily available source of N and S
- Dry fertilizer product
- NH_3 volatilization is not a concern unless applied to high pH soils (>7.5)



Anhydrous Ammonia

- Fertilizer grade: 82-0-0
- Fertilizer with the highest analysis of N
- Stored as a liquid under pressure
- Injected in the soil as a gas



Common P Fertilizer Products

- Diammonium phosphate (DAP)
- Monoammonium phosphate (MAP)
- Ammonium polyphosphate



Diammonium Phosphate

- Fertilizer Grade: 18-46-0
- Soluble, readily available source of P & N
- Dry fertilizer product
- Initial soil reaction can produce free NH_3 , which can cause seedling injury if too much is placed near the seed



Monoammonium Phosphate

- Fertilizer grade: 11-52-0
- Soluble, readily available source of P & N
- Dry fertilizer product
- Most common dry P fertilizer in NNY



Ammonium Polyphosphate

- Fertilizer grade: 10-34-0 or 11-37-0
- Soluble, readily available source of P & N
- Liquid fertilizer product
- Popular source for starter fertilizer



Common K Fertilizers

- Potassium chloride (KCl)
- Potassium magnesium sulfate ($K_2SO_4 \cdot 2MgSO_4$)



Potassium Chloride (KCl)

- Fertilizer grade: 60-63% K_2O
- Most abundantly used K fertilizer
- Often referred to as muriate of potash
- Water soluble source of K



Potassium Magnesium Sulfate

- Contains about 22% K_2O , 11% Mg, 22% S
- Good source of Mg and S
- Often referred to as Sul-Po-Mag or K-Mag
- Water soluble source of nutrients



Liquid N vs Dry N Fertilizer

- Generally no measurable difference in crop response as long as they supply the same amount of soluble nutrient
 - From a plant's perspective, a pound of N from urea is equal to a pound of N from UAN
- The agronomic differences among N fertilizers is their risk for N losses due to volatilization, denitrification and leaching

N Loss: Volatilization

- Urease enzymes in soil and plant residues convert urea to free ammonia gas and is lost into the atmosphere
- This is the major concern for effective management of urea based fertilizers
- Surface applied applications only
 - Mechanical incorporation (tillage) or rain controls loss

Factors Favoring Ammonia Loss

- No rain after application
- Crop residue on the soil surface
- High temperatures
- High soil pH
- Low clay and organic matter

Striking the Balance:

- Basic fertilizer application methods:
 - “band” fertilizer
 - “pop-up” fertilizer
 - Broadcast/topdress fertilizer
 - Sidedress fertilizer



What is “starter” or “banded” fertilizer?



(Univ. of Michigan)

soil surface

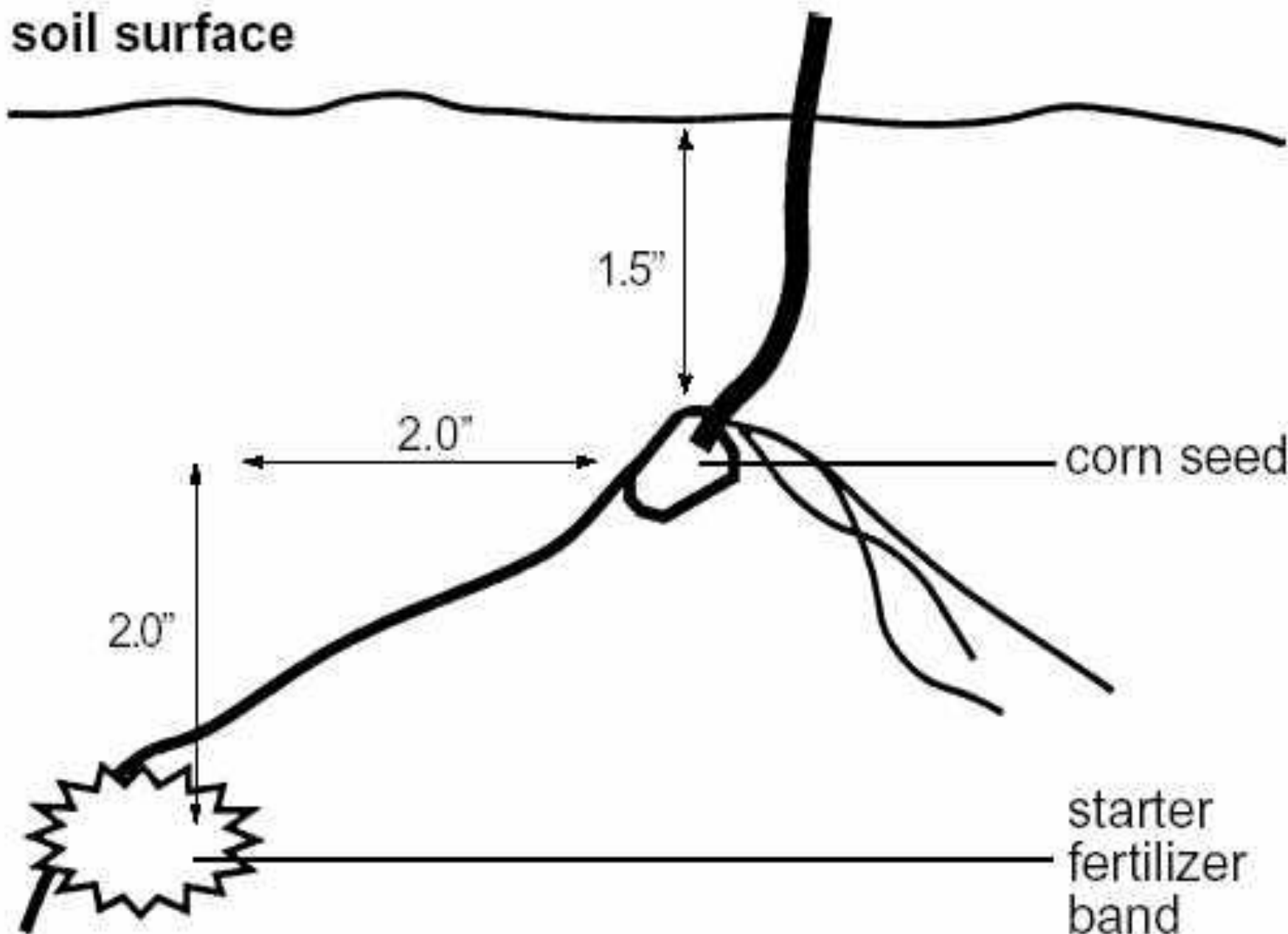
1.5"

2.0"

2.0"

corn seed

starter
fertilizer
band



Why Band?

- Historically, most soils were P deficient
- Soil minerals bind P
- Cold soils reduce P availability
- P source near developing plant roots
- Great idea, *if the nutrients are needed!*



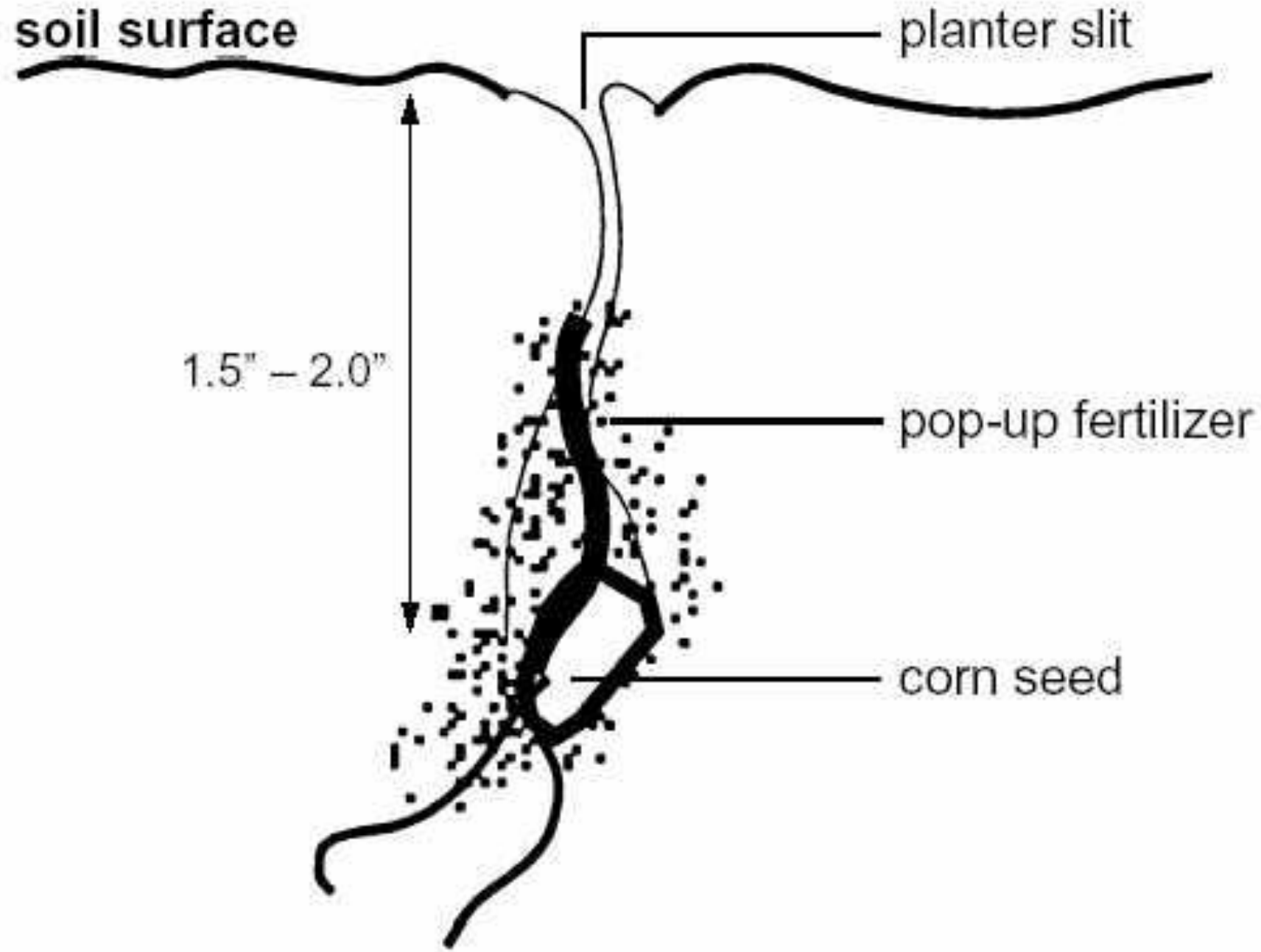
soil surface

planter slit

1.5" – 2.0"

pop-up fertilizer

corn seed

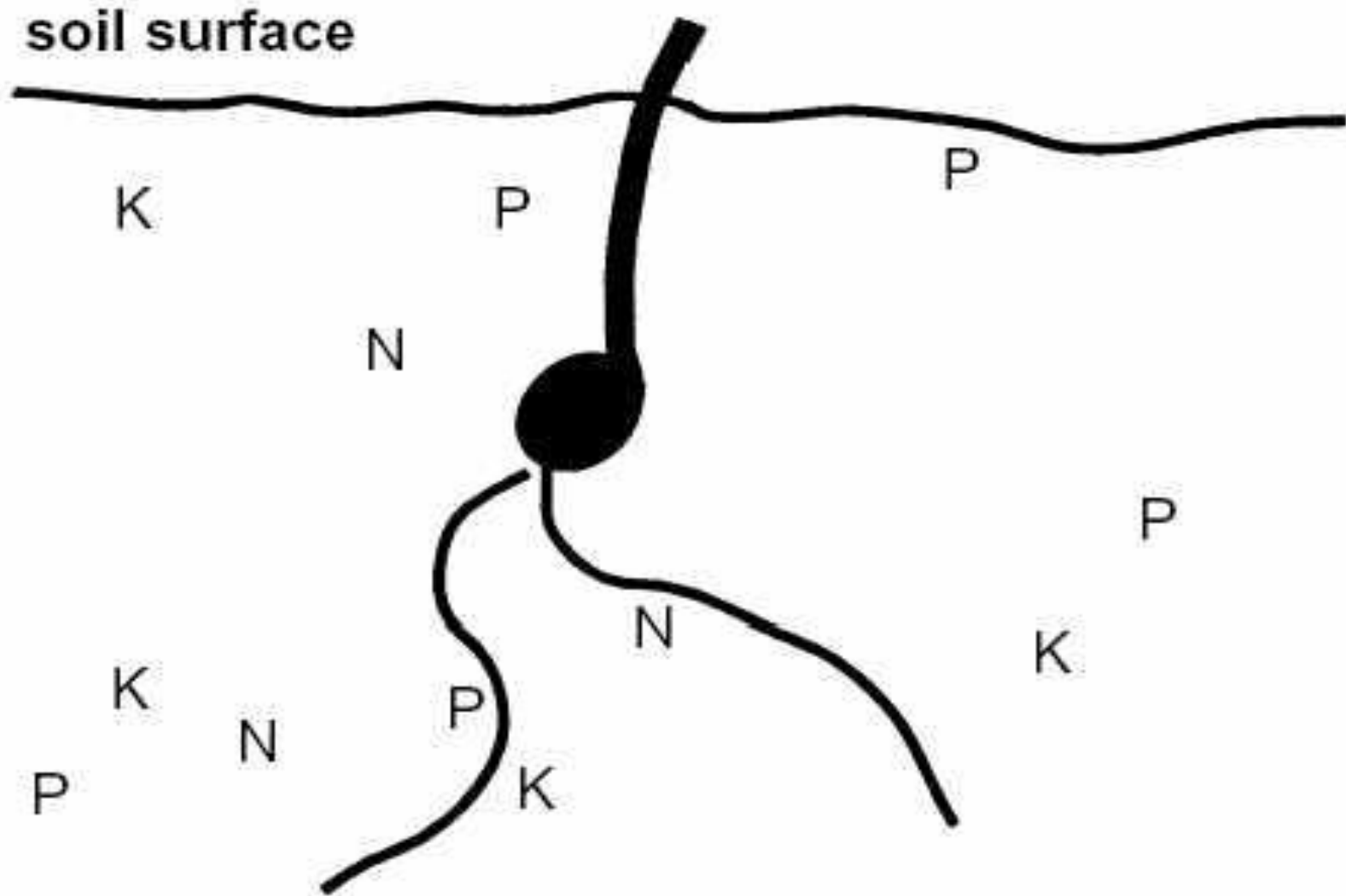


Pop-up Fertilizer Rules

- Pop-up fertilizer rate must be kept below 10 lbs of N + K₂O in band
- Cannot use any urea or DAP
- Both liquid and dry can be used



Broadcast/Incorporate:



Broadcast

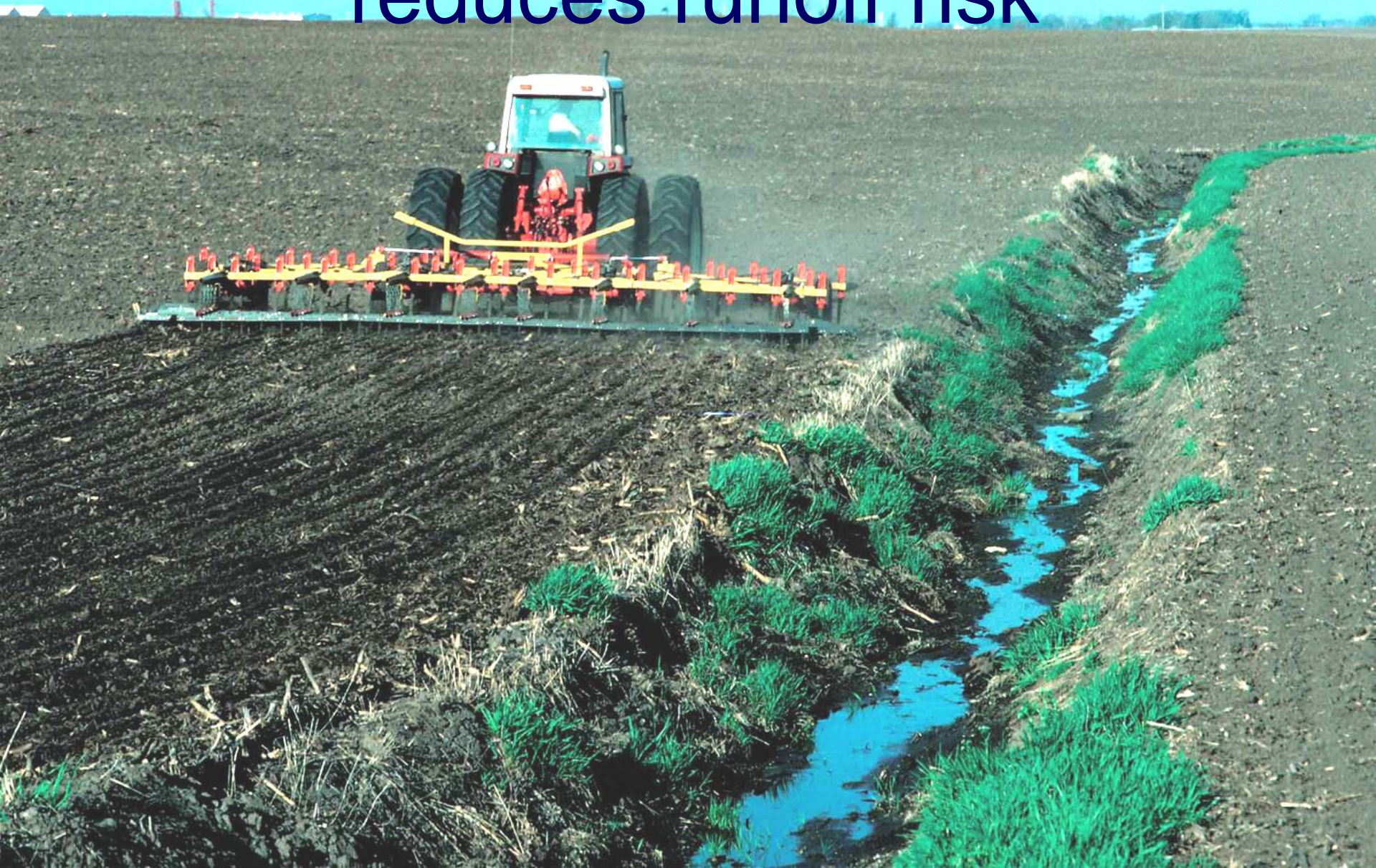
- Fast and easy
- Uniformity often an issue
 - pneumatic booms or water carried improves
- P efficiency compared to band only 3 or 4:1
- Great idea, *if the nutrients are needed!*





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Incorporating broadcast fertilizer reduces runoff risk





Sidedress $\text{NH}_3\text{-N}$

Reading Fertilizer Labels

Before using any fertilizers, it is important to understand how to read a fertilizer label.

All fertilizers are labeled as %N - %P₂O₅ - %K₂O.

For example, a fertilizer labeled as a 20-5-10 means that the product contains, by weight:

20% N

5% P₂O₅

10% K₂O



Guaranteed Analysis / Grade

- Association of American Plant Food Control Officials (AAPFCO) writes rules, definitions, labeling standards for fertilizer industry
 - States then have laws for guaranteed analysis, sales and distribution
 - e.g. Section 10 of Ag. and Markets Law in NYS

Guaranteed Analysis		26 - 4 - 12
Total Nitrogen	26%	1
3.2% Ammoniacal Nitrogen		
9.7% Water Insoluble Nitrogen*		
3.4% Urea Nitrogen		
9.7% Other Water Soluble Nitrogen*		
Available Phosphate (P ₂ O ₅)	4%	2
Soluble Potash (K ₂ O)	12%	3
Total Sulfur (S)	1.5%	4
1.5% Combined Sulfur (S)		
Nutrient Sources: Ammonium Phosphate, Ammonium Sulfate, Isobutylidene Diurea, Urea, Methylene Urea, Muriate of Potash.		
Chlorine (Cl) not more than	10.0%	
* 19.4% Slowly Available Nitrogen from Methylene Ureas and IBDU.	F699	5
Information regarding the contents and levels of metals in this product is available on the Internet at http://www.regulatory-info-lebsea.com		

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Fertilizer Ratio

- Relative proportion of N, P_2O_5 and K_2O in a fertilizer

Grade	Ratio
6-24-24	1:4:4
5-10-30	1:2:6
19-19-19	1:1:1



Fertilizer Equivalent Conversions

- $\text{P}_2\text{O}_5 * 0.44 = \text{P}$
- $\text{P} * 2.29 = \text{P}_2\text{O}_5$
- $\text{K}_2\text{O} * 0.83 = \text{K}$
- $\text{K} * 1.20 = \text{K}_2\text{O}$

Calculating Fertilizer Rates

The basic formula for calculating how much fertilizer to apply to a given area for a specific amount of nutrient is:

$$\text{Amount of fertilizer} = (\text{nutrient needed} \div \% \text{ nutrient in fertilizer})$$



"Rate" often refers to two things:

- 1) The desired lbs of actual nutrient per acre
 - e.g. a crop nutrient goal of 100 lbs N/acre, 25 lbs P_2O_5 /acre, and 50 lbs K_2O /acre
- 2) Pounds of fertilizer material per acre necessary to achieve the lbs of nutrient per acre goal
 - e.g. given a 20-10-0 fertilizer, how many lbs of fertilizer material do we need to apply 25 lbs N/acre?
 - How much P_2O_5 and K_2O tag along?

If 700 lb of 46-0-0, 500 lb of 11-52-0, and 800 lb of 0-0-60 are mixed, what is the grade of the resulting fertilizer blend?

If 700 lb of 46-0-0, 500 lb of 11-52-0, and 800 lb of 0-0-60 are mixed, what is the grade of the resulting fertilizer blend?

$$\begin{array}{rcl} 700 \times 0.46 & = & 322 \text{ lbs of N} \\ 500 \times 0.11 & = & 55 \text{ lbs of N} \end{array} \begin{array}{l} \searrow \\ \nearrow \end{array} \mathbf{377} \text{ lbs of N}$$

$$500 \times 0.52 = \mathbf{260} \text{ lbs of P}_2\text{O}_5$$

$$800 \times 0.60 = \mathbf{480} \text{ lbs of K}_2\text{O}$$

If 700 lb of 46-0-0, 500 lb of 11-52-0, and 800 lb of 0-0-60 are mixed, what is the grade of the resulting fertilizer blend?

$$\frac{377 \text{ lbs N, } 260 \text{ lbs P}_2\text{O}_5, 480 \text{ lbs K}_2\text{O}}{2000}$$

$$= 0.19 - 0.13 - 0.24$$

These are in fraction so
multiply by 100 to get percent!

Nutrients in liquid fertilizers

Calculation of nutrient content of liquid fertilizers requires information on weight per gallon of the liquid fertilizer

<u>Material</u>	<u>Weight (lbs/gal)</u>
10-34-0	11.7
9-18-9	11.7
28-0-0	10.7

Summary

- Starter fertilizer selection combines many issues.
- The ratio(s) should be based on the fertility status of the whole farm.
- The only way to really know the status is to have a full set of soil samples.
- Cannot ignore manure nutrient contributions.
- Cannot guess at soil fertility.
- Use fertilizer imports to SUPPLEMENT, not SUBSTITUTE for on-farm nutrients.