Drought Implications for Nutrient Management

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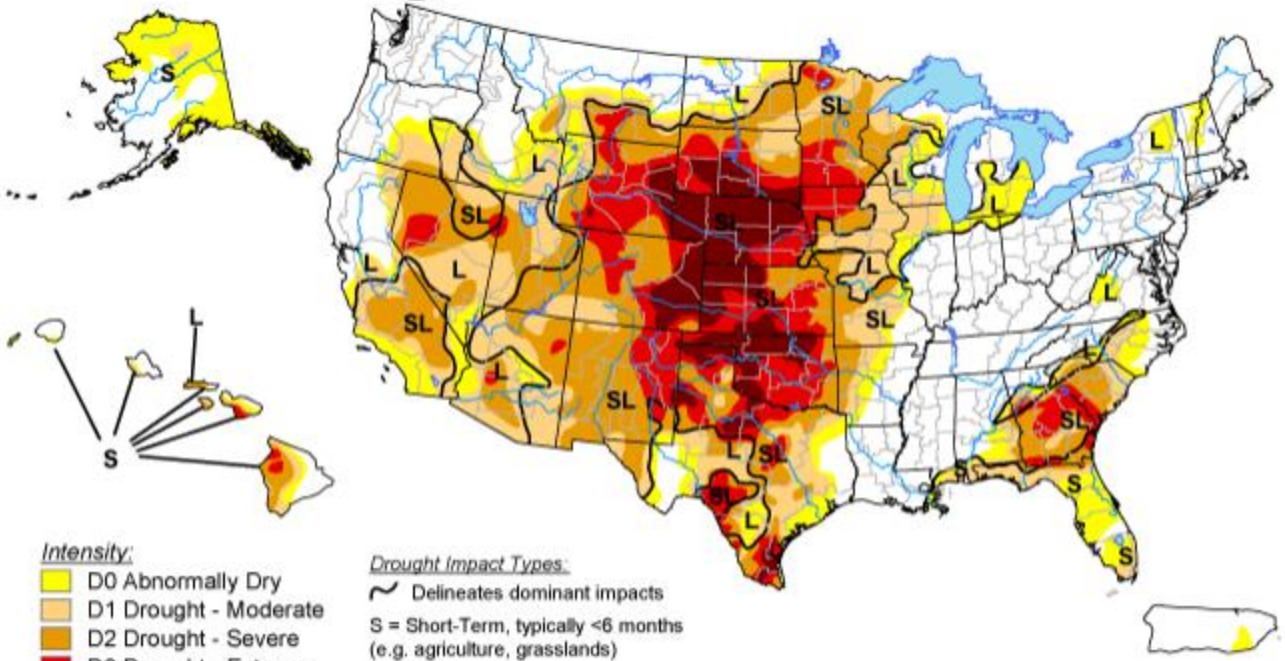
U.S. Drought Monitor

February 12, 2013
Valid 7 a.m. EST



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
- Delineates dominant impacts
- S = Short-Term, typically <6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically >6 months (e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/

Released Thursday, February 14, 2013
Author: Michael Brewer/L. Love-Brotak, NOAA/NESDIS/NCDC

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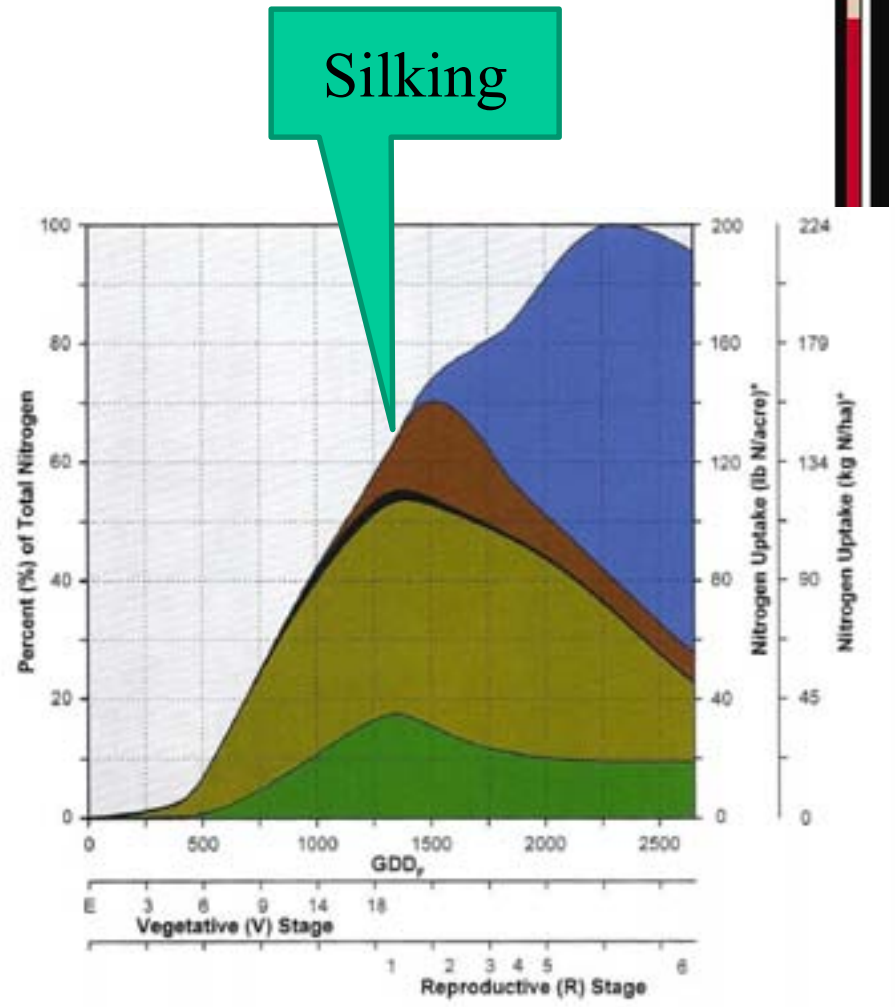
- What are the implications of the 2012 drought for nutrient management in 2013?
- Do fertilizer rates need to be adjusted?
- Is the soybean credit still valid?
- How was the release of manure nutrients affected?
- Is this a good time to invest in grid sampling?

2012 dryland field conditions

- Did corn growth stop? When?
- What % of N uptake compared to normal?
- Total biomass produced?
- More organic N mineralization??
- Were N losses reduced?



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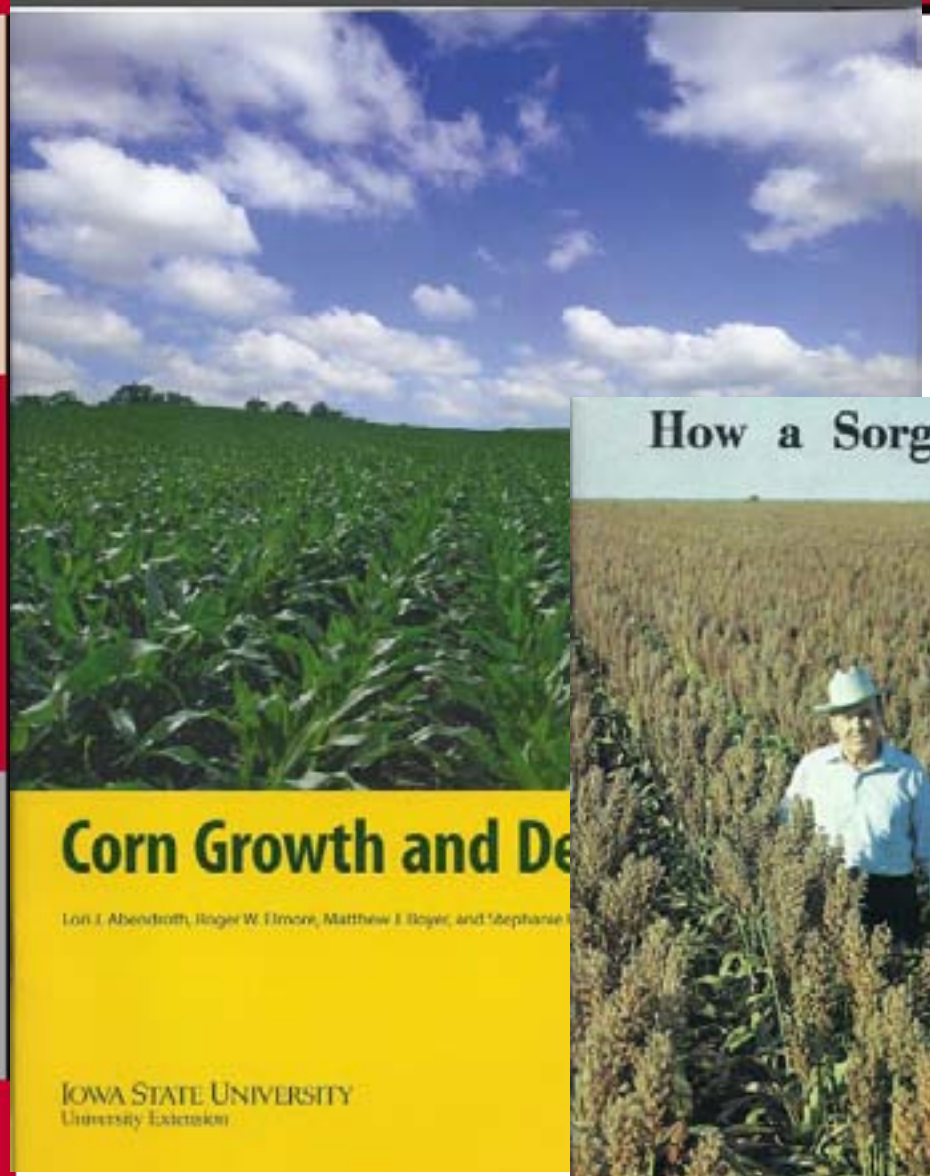

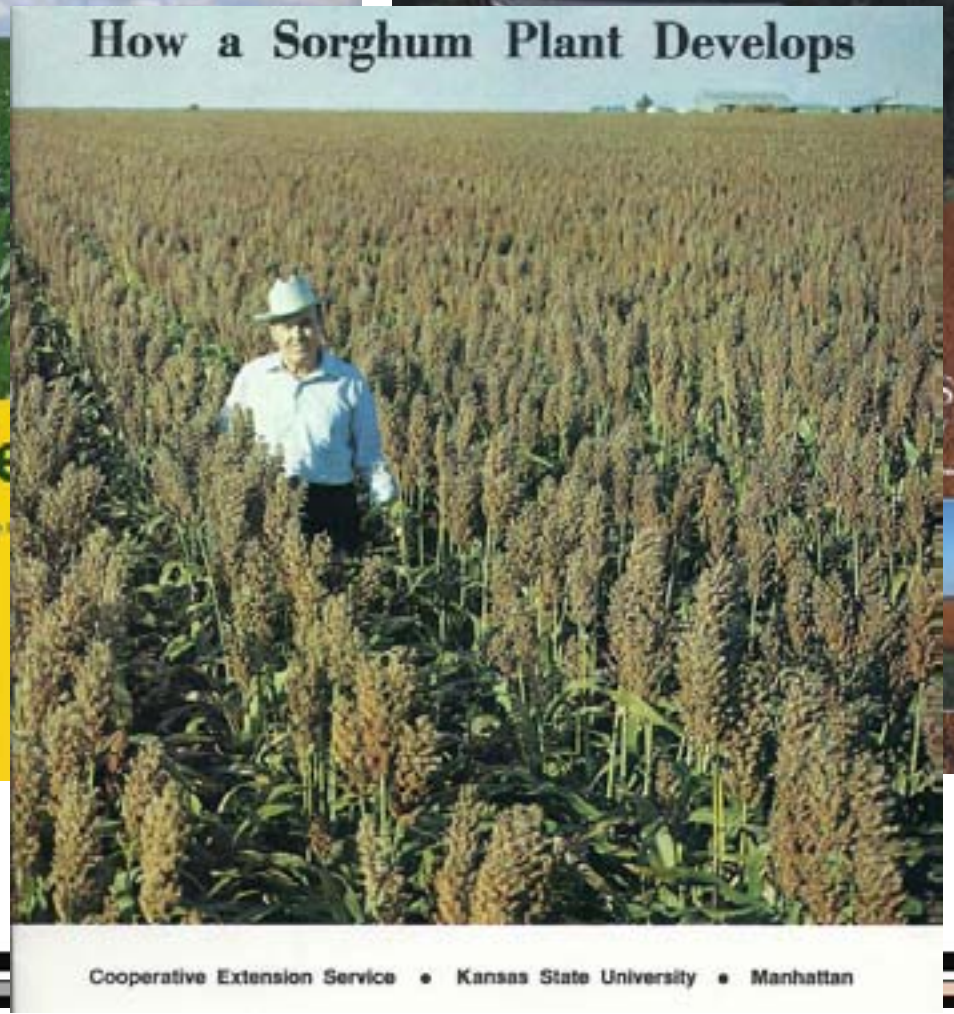

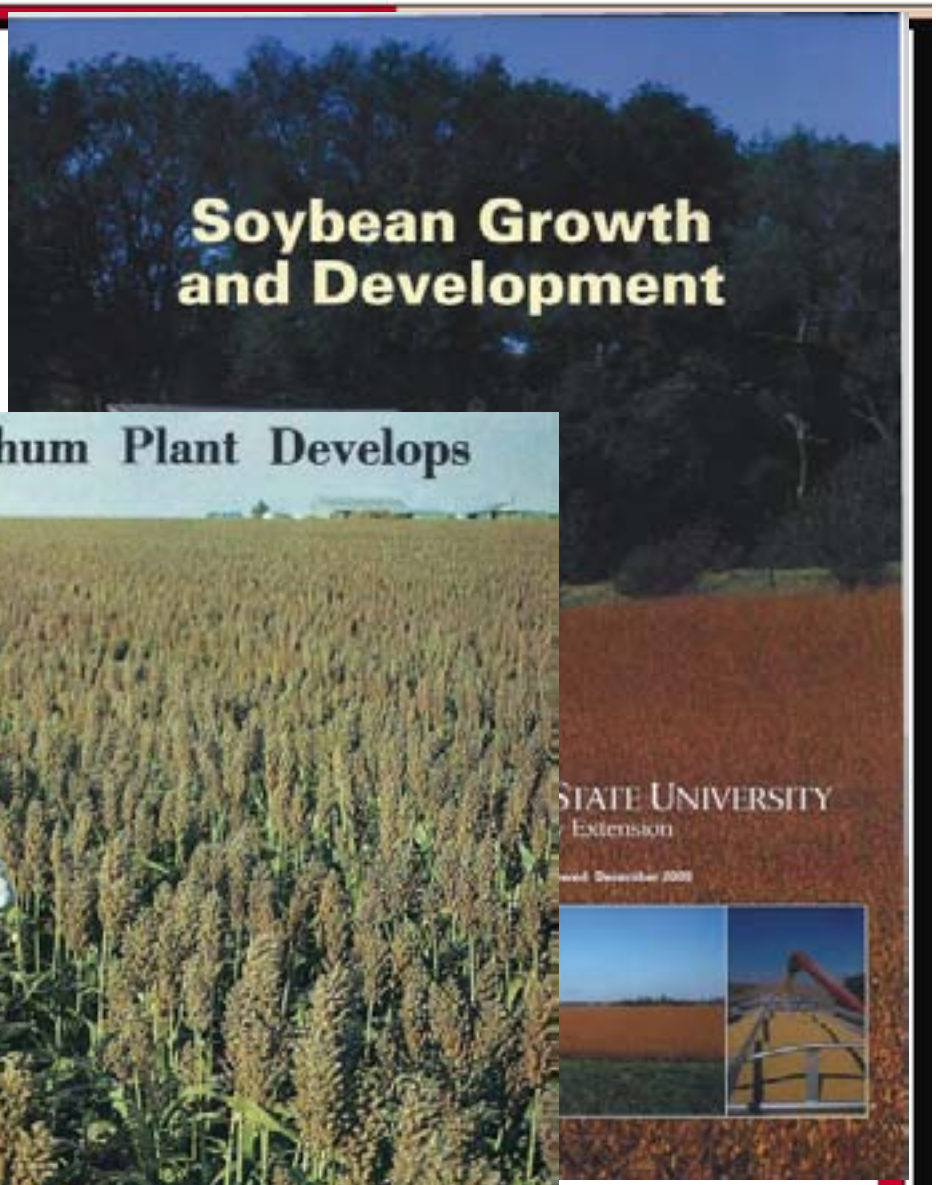

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N management

- Residual soil nitrate levels
  - often unusually high
    - rainfed and irrigated fields
    - following soybean as well as corn
  - Several contributing factors relating to 2012 weather conditions.

High residual soil nitrate levels

- Reduced yield ~ reduced N uptake
- Less leaching and denitrification losses
- Early crop maturity, less robust plants, a warm fall, & more soil N resulted in more decomposition of crop residue, especially soybean leaves, for more N release.
- High soil organic N mineralization because of high temperatures.

- High residual soil nitrate following soybean and corn.

What happens to residual nitrate-N?

- Immobilization by microbes
  - Microbial activity and immobilization reduced with very dry conditions, but
  - Extra N increases activity and rate of decomposition, if water is adequate, and N is released from crop residues
- Denitrification
- Leaching

Taking stock of residual nitrate-N

- Sampling to 24” or deeper, but especially the 0-8” depth for 2013
- Give credit to at least 50-60% of nitrate-N found but more if low soil water, especially if
  - used with in-season diagnosis
    - pre-sidedress nitrate test
    - reading the crop canopy reflectance
  - soil sample near planting for more accuracy

What is the soybean N credit? Will it be affected?

- Less immobilization of N with soybean compared with corn crop residue
- Soil organic N increases with soybean but decreases with corn production
- Less nodulation and probably less high N exudates from soybean in 2012 rainfed

Manure N and S

- Organic N and S release
  - Less in 2012 for very dry fields but
  - Maybe more for irrigated fields because of high temperature and high microbial activity

N suggestions for 2013

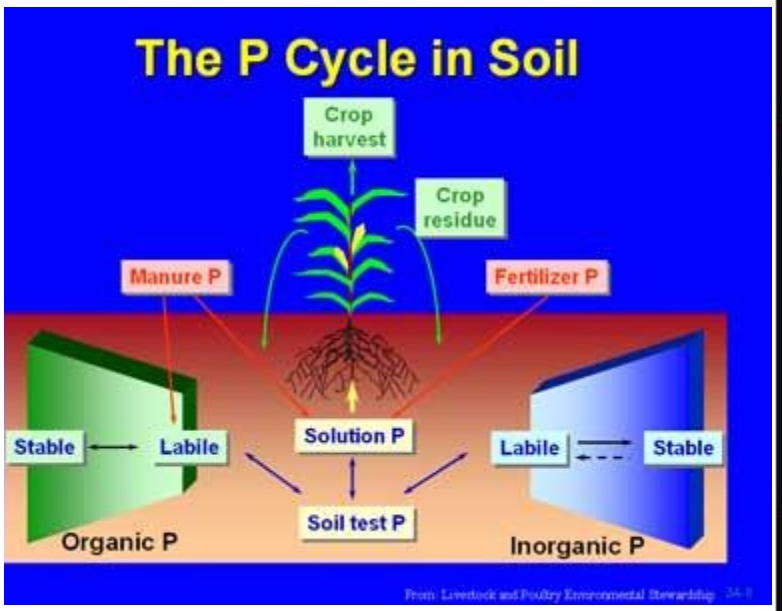
- Give the 45 lb credit, even where soybean yields were low.
- Deep sample for nitrate for 2013 N management
- Consider N from manure applied in 2012
- Apply less than normal N pre-plant and sidedress or fertigate according to crop need
  - Pre-sidedress soil nitrate test
  - Apply according to canopy greenness
- Consider yield potential

Phosphorus (P), Potassium (K), Zinc (Zn)

- Where are the applied 2012 nutrients for rainfed fields? How will low 2012 uptake affect 2013 availability?
- Immobile nutrients

P-rainfed fields

- Unused 2012 P was sorbed
  - Still present
  - in equilibrium with solution and non-labile P
- Increased soil test P is expected
  - Soil test important for 2013 management but mis-leading for future years
- Generally less fertilizer P needed in 2013



Potassium for rainfed fields

- Less K uptake in 2012
  - 4-8 lb K_2O to raise STK by 1 ppm
    - Affected by soil CEC
- However, little leaching of K from crop residue; STK can be increased by 30-40 ppm by leaching of K from crop residues
  - Less leaching from residues and lower STK?

Drought effect on soil test K

- Some evidence that ratio of exchangeable to less-exchangeable K in soil decreases with drought; therefore, reduce STK
  - Lab results may under-represent STK in 2012

Relatively unavailable K ←→	Slowly available K ←→	Readily available K
90–98 percent of total	1–10 percent of total	0.2-1 percent of total
Non exchangable K	Exchangable K (90 percent of 2 percent)	
	Soil Solution K (10 percent of 2 percent)	

Potassium for rainfed fields

- High or low STK expected this spring?
- Depends on
  - K uptake
  - K leached from crop residues
  - Drought effects on representiveness of soil K test
- STK important for 2013 management but mis-leading for future years
- Probably reduced fertilizer K needed in 2013

Zinc

- Similar guidelines as for P and K

Drought and soil pH

- Soil pH likely to be reduced
  - maybe by 0.1 to 0.3 unit
  - But soil pH can be restored to normal with ~2” of rain
  - no clear effect on buffer pH, the value used to determine lime requirement
  - less movement of liming effect into dry soil
    - Soil shrinking and cracks??

Grid sampling

- Delay to a more typical year

U. Missouri suggestion for 2013

Table 1. Estimated impact on next year's fertilizer need (drought nutrient credits) for selected harvest strategies for drought stressed corn or soybean. Assumes fertilizer applied this year was based on 150 B/A yield for corn and 50 B/A yield for soybean. Arrow down means recommended fertilizer rate for next year should decrease by the associated value.

	Corn			Soybean		
Harvest Management	N	Phosphate	Potash	N	Phosphate	Potash
	- - - - lbs/acre - - - -			- - - - lbs/acre - - - -		
No crop harvested	↓□145	↓□50	↓□40	0	↓□40	↓□65
Harvested as grain (40% of yield goal)	↓□70	↓□30	↓□25	0	↓□24	↓□40
Grazed	↓□40	↓□50	↓□40	0	↓□40	↓□65
Chopped and removed[1]	0	↓□15	↑ 60	0	↓□20	↓□25

[1] Assumes most growth stopped at R1 for corn and R3/4 for soybean.

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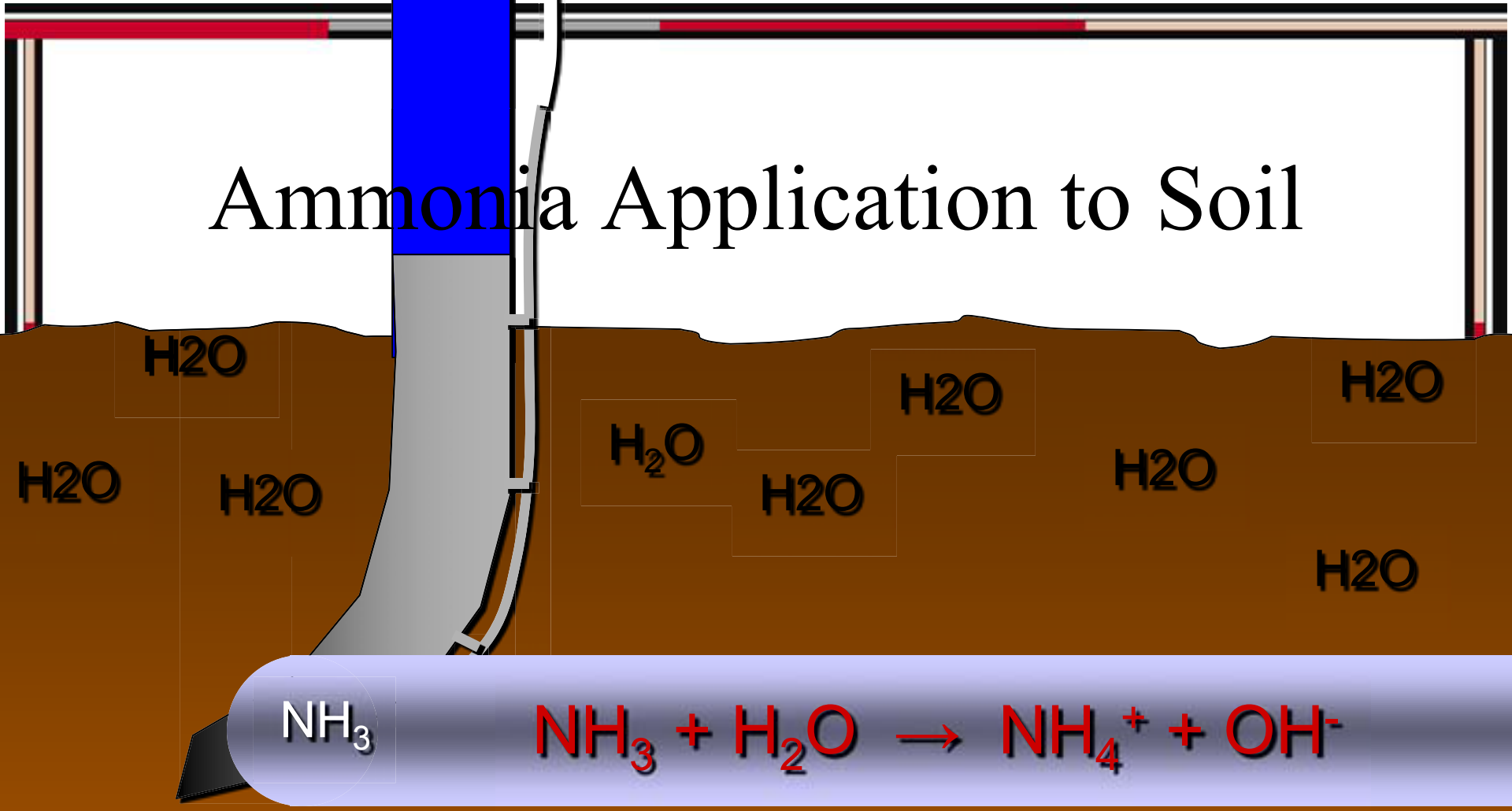
Anhydrous application with dry soil?

- Can you get it into the ground??
- Will the soil close well?
- Is soil water adequate?
  - Soil water needed for NH_3 to convert to NH_4^+ and react with soil

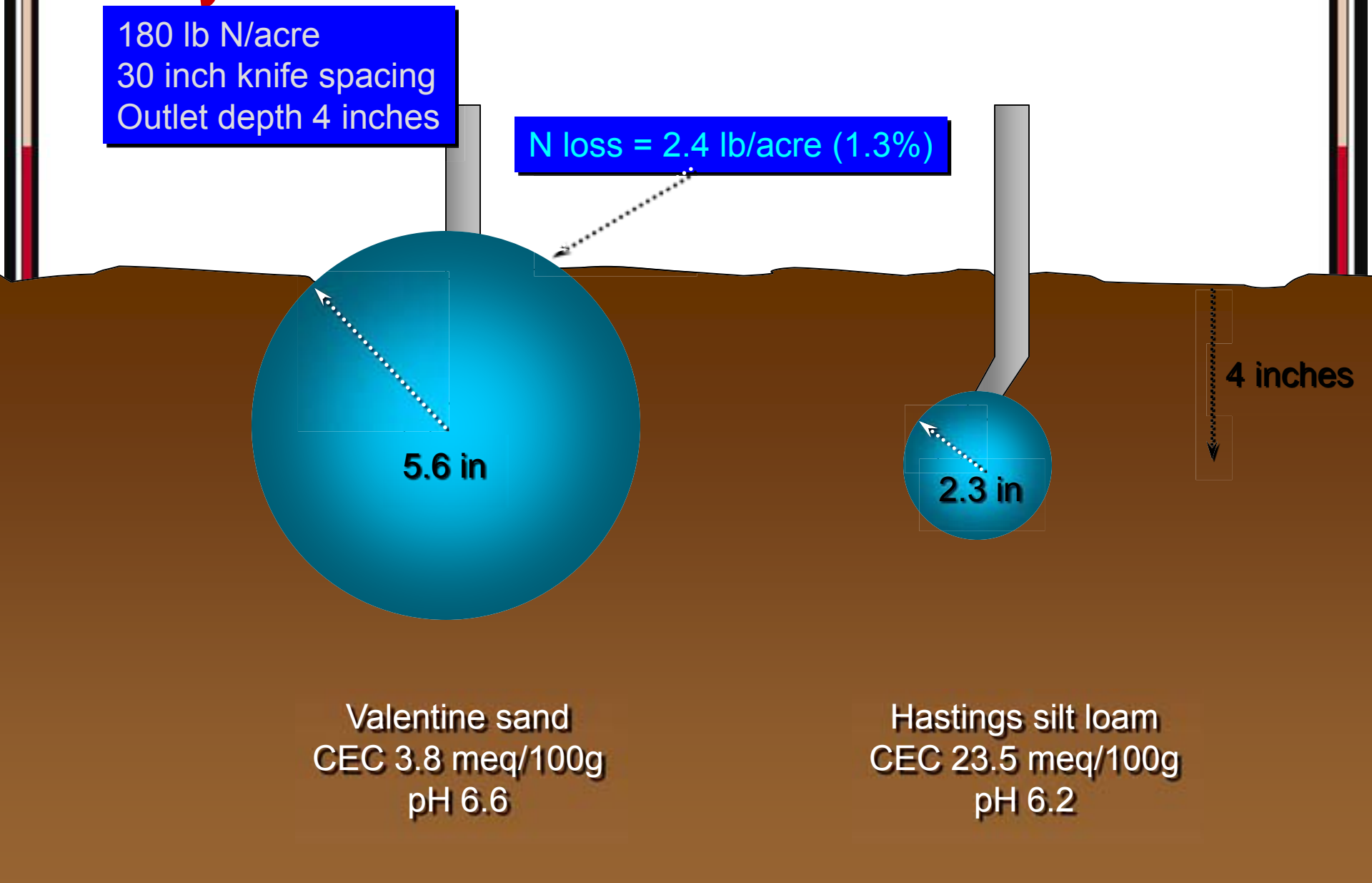
Ammonia Application to Soil



Ammonium (NH_4^+) binds rapidly to cation exchange sites on soil clay particles and soil organic matter.

Hydroxyl anions effectively increase soil pH.

Anhydrous Ammonia Retention Zone



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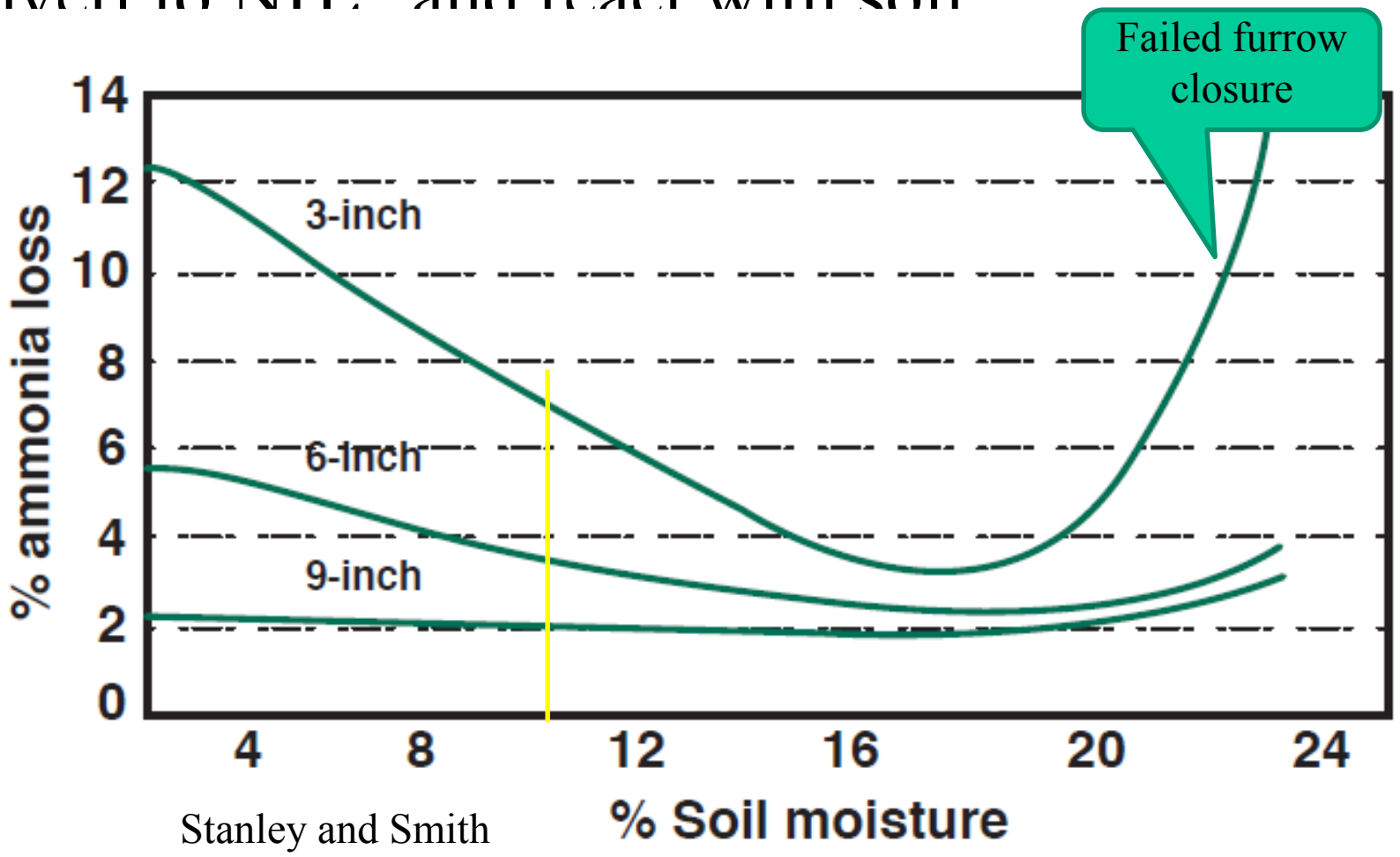

Stanley and Smith

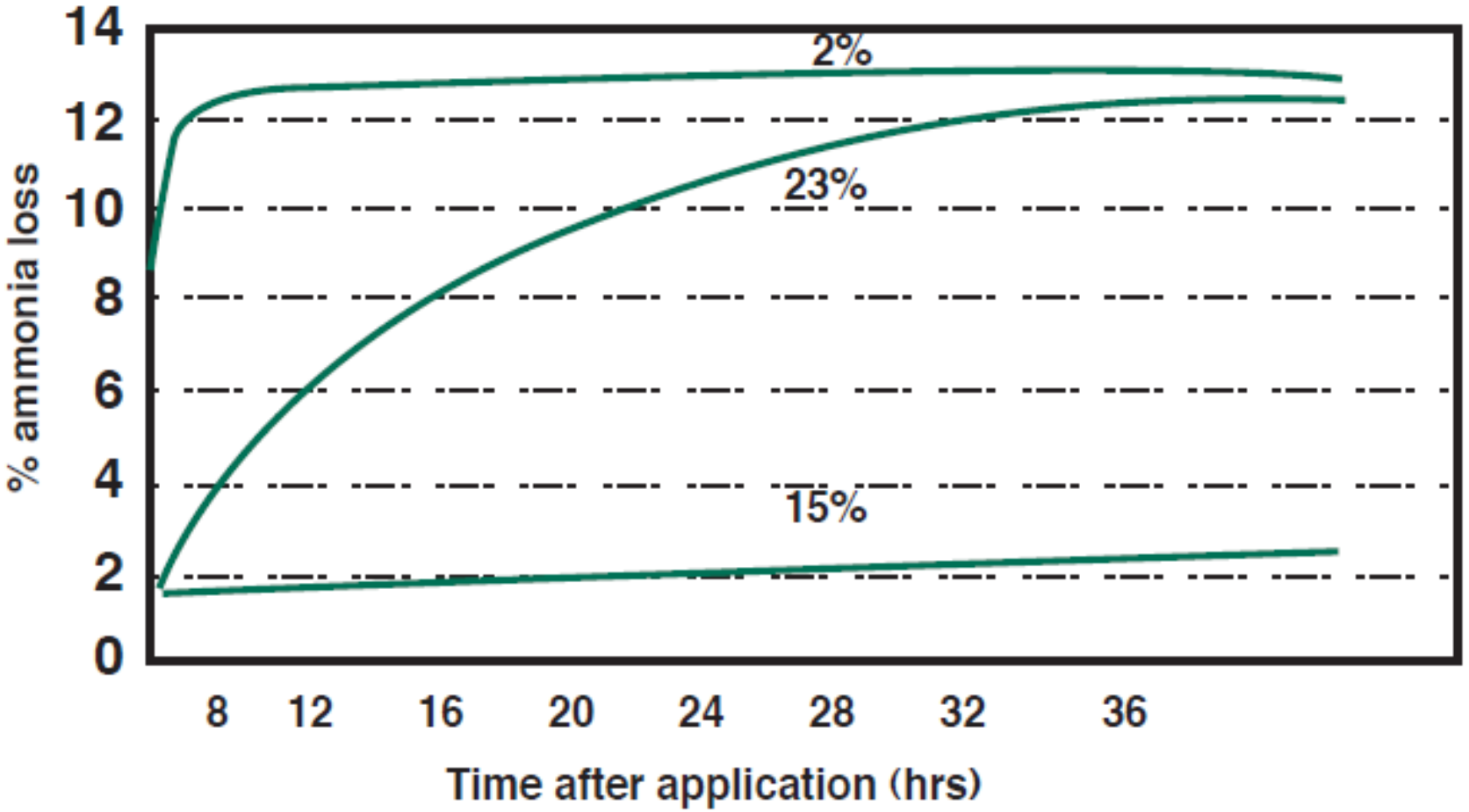

Figure 2. Rates of ammonia loss from soil at different soil moistures (Stanley and Smith. Soil Sci. Soc. Am. J., 20:557).

Greater risk with moist compared with dry soil? Slot sealing!!

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Anhydrous application with dry soil

- Most important is good furrow closure
- Soil water is probably adequate

Thank you!

Questions?

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