



Cornell University
Cooperative Extension

Managing the Soil to Manage the Pasture

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Take Home Points

- Optimal Soil pH Maximizes Nutrient Availability
- Set Realistic Yield Goals
- Replace Nutrient Removal by
 - Using Manure
 - Applying Fertilizer When Necessary
- What Does and Does Not Improve Pasture Fertility

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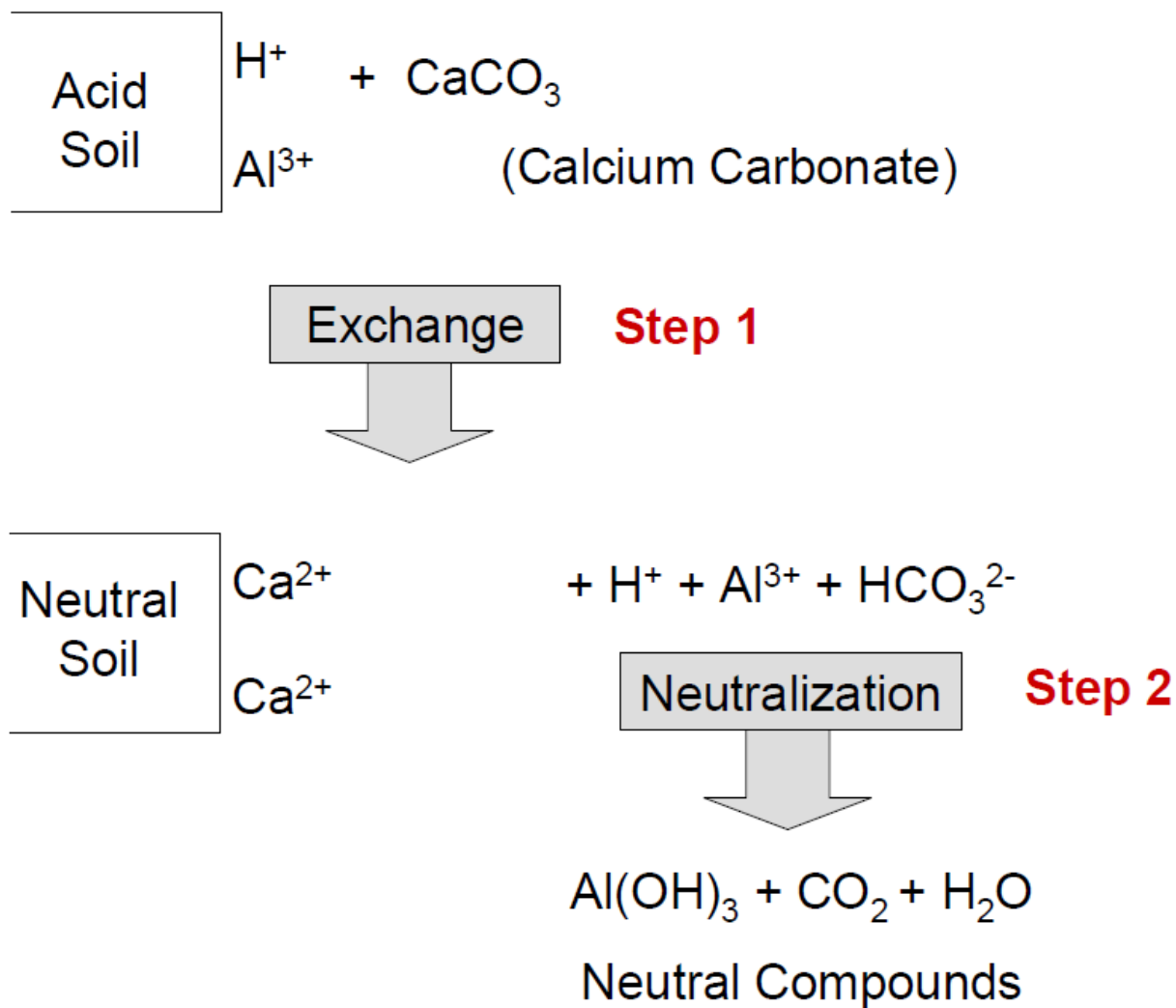
Pasture Sampling Soil

- Take 2-3 samples per acre up to 10 acres for each sample.
- Sample different soil types/drainage areas separately.
- Regularly sample pastures every 3-4 years at the same time of the year.

Correcting Soil pH

- Most grasses and legumes grow best when soil pH is 6.0-6.5.
- Some grasses (*i.e. tall fescue*) and legumes (*i.e. clovers*) are more tolerant of lower pH levels (5.5 to 6.5).
- Liming recommendations on soil test report.

How Lime Works



Liming Materials

Common Name	Chemical Formula	CCE
Calcitic Limestone	CaCO ₃	100
	MgCO ₃	119
Burned Lime, Quick Lime	CaO	179
Hydrated Lime, Slack Lime	Ca(OH) ₂	136
Dolomitic Limestone	CaMg(CO ₃) ₂	109
	CaSiO ₃	86
Wood Ash	Variable	50-80

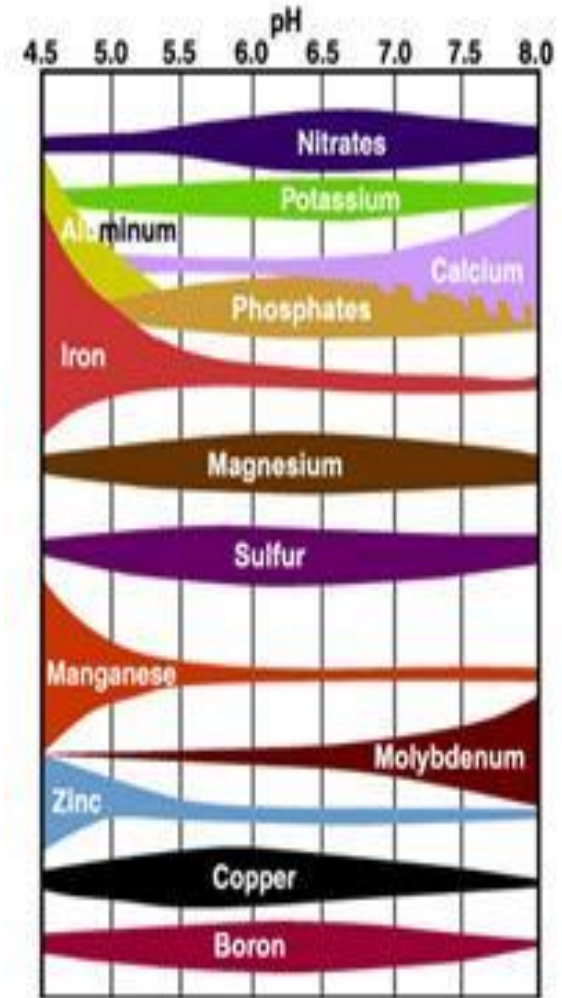
- Increases mesh size only increases speed of the reaction (only use 20 to 100 mm mesh lime)

Cornell ENV

- The ENV is the fraction of the material's CCE that will react with soil acidity in the first year of application.
- The ENV is calculated by multiplying a liming material's CCE and its fineness.
- As an example: a liming material with CCE of 90% and a fineness of 0.86 has an ENV of $90 * 0.86 = 77.4$.

Correcting Soil pH

- No yield or quality responses to changing base saturation ratios.
- Increasing pH (up to 7.0) increases nutrient availability to pasture plants.



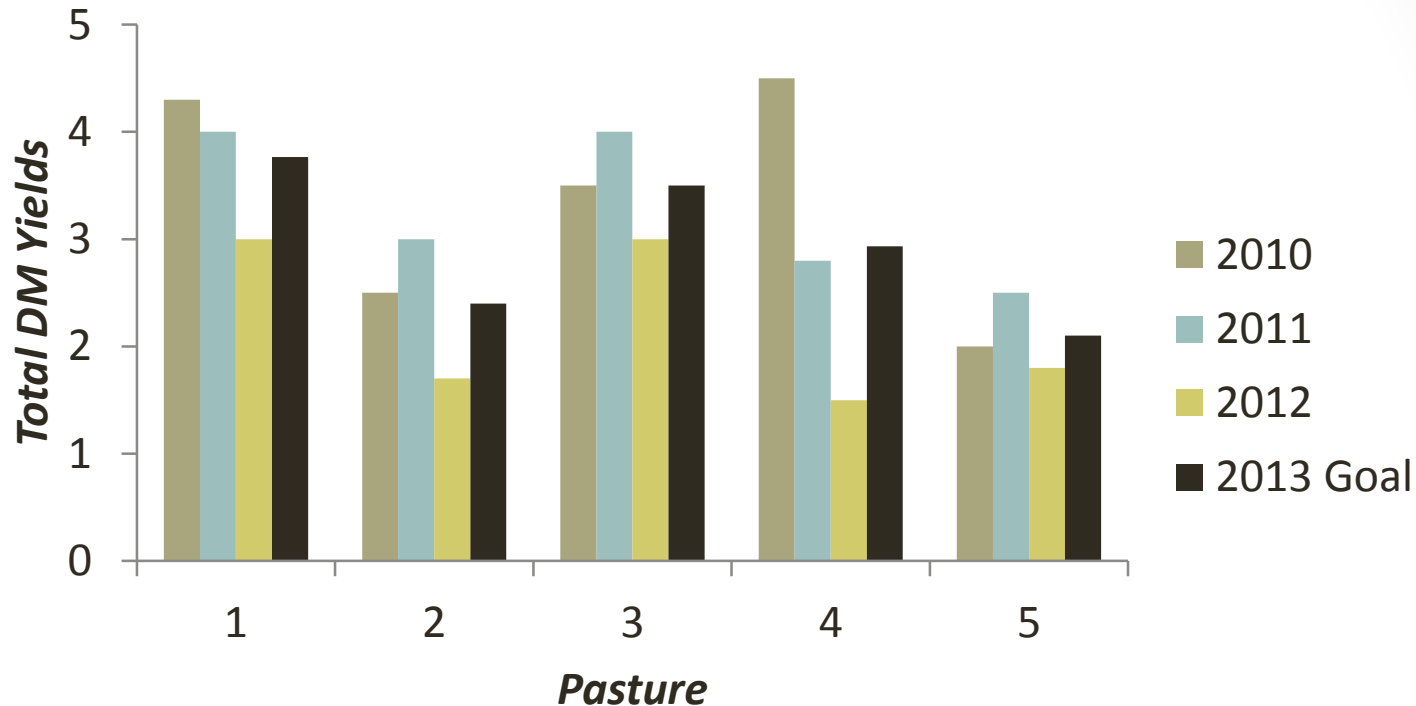
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Set Realistic Yield Goals

Crop	Tons DM/acre	Tons AF/acre
Pastures	3-5	12-25
Haylage, seeding year	2-3	4-6
Haylage, 1 st through 3 rd production years	4-6	8-12
Corn Silage	6-10	18-30
Small Grain Silage	2-4	5-10

Set Realistic Yield Goals



Set *separate yield goals* for *each pasture* based on multiple years of yield data.

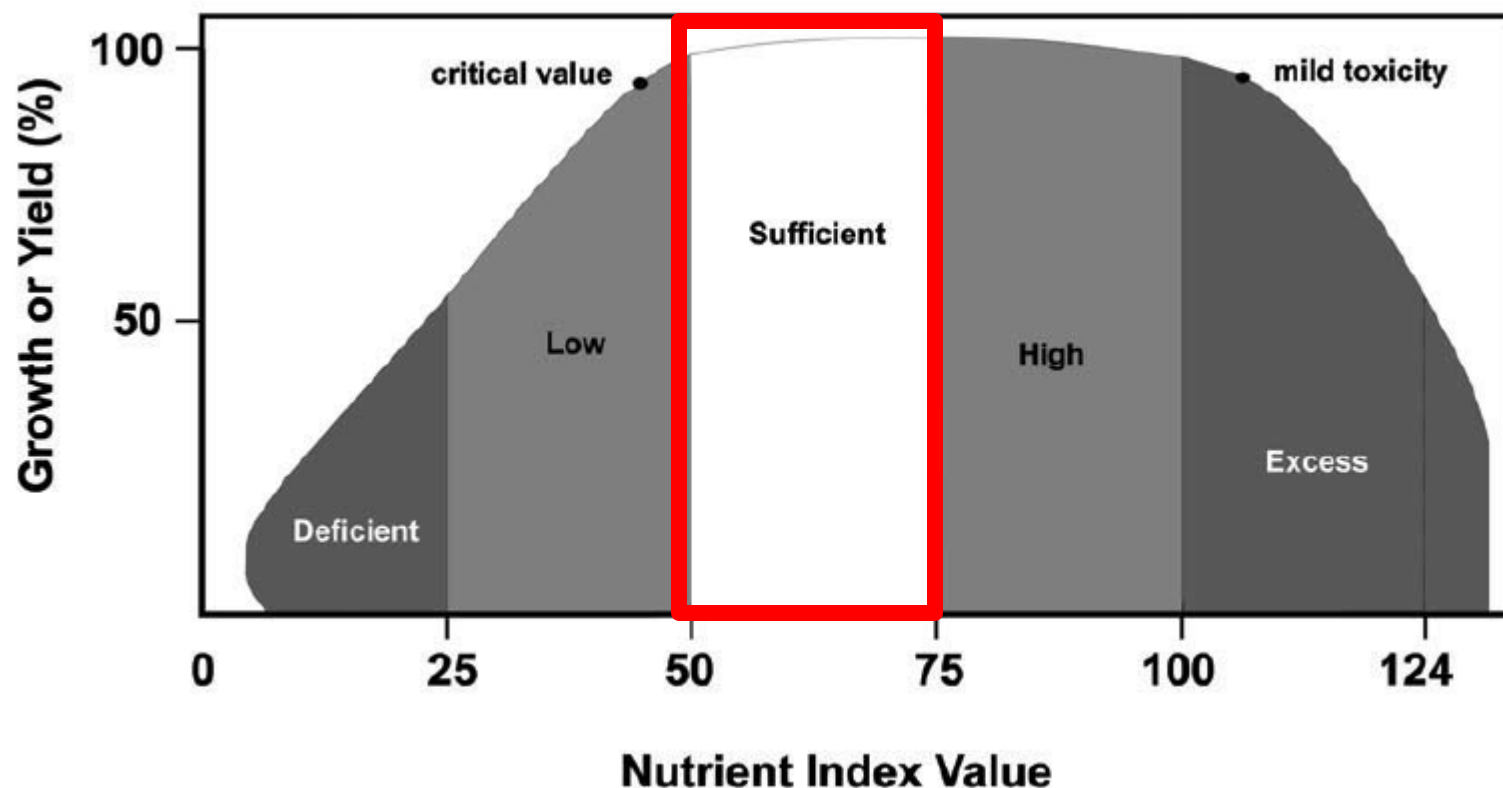
What's My Farm's Yield Potential?

- Go to <http://forages.org/tools/fsst.php?t=2>
- Enter county, zip code, animal use, drainage, and soil type.
- Yield potential given for a number of mixtures for local conditions

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Crop Removal of Nutrients



Source: Reference Sufficiency Ranges for Plant Analysis in the Southern US

Crop Removal of Nutrients

- Sufficiency ranges in plant tissue samples
- Legumes

<i>Macronutrients</i>					
N	P	K	Ca	Mg	S
3.00–5.00%	0.25–0.70%	2.00–3.50%	0.80–3.00%	0.25–1.00%	0.25–0.50%

<i>Micronutrients</i>				
Fe	Mn	Zn	Cu	B
30–250 ppm	25–100 ppm	20–70 ppm	4–30 ppm	20–80 ppm

Source: Reference Sufficiency Ranges for Plant Analysis in the Southern US

Crop Removal of Nutrients

- Sufficiency ranges in plant tissue samples
- Grasses

<i>Macronutrients</i>					
N	P	K	Ca	Mg	S
2.50–3.50%	0.25–0.35%	2.50–3.50%	0.30–0.50%	0.15–0.30%	0.20–0.30%

<i>Micronutrients</i>				
Fe	Mn	Zn	Cu	B
50–250 ppm	50–200 ppm	20–50 ppm	3–10 ppm	5–20 ppm

Source: Reference Sufficiency Ranges for
Plant Analysis in the Southern US

Crop Removal of Nutrients

- Legumes

Nutrient	Lb/ton DM
N	80
P	6
K	49
Ca	30
Mg	6
S	6
B	0.08
Zn	0.05
Mn	0.12
Cu	0.01
Fe	0.33
Mo	0.002

- Grasses

Nutrient	Lb/ton DM
N	40
P	14
K	60
Ca	30
Mg	6
S	5
B	0.08
Zn	0.05
Mn	0.12
Cu	0.01
Fe	0.33
Mo	0.002

Source:
Alfalfa
Fertilization

<http://learningstore.uwex.edu/assets/pdfs/A2448.pdf>

Crop Removal of Nutrients

- Legumes

Nutrient	Lb/ 5 ton
N	400
P	30
K	245
Ca	150
Mg	30
S	30
B	0.40
Zn	0.25
Mn	0.60
Cu	0.05
Fe	1.65
Mo	0.01

- Grasses

Nutrient	Lb/ 5 ton
N	200
P	70
K	300
Ca	150
Mg	30
S	25
B	0.40
Zn	0.25
Mn	0.60
Cu	0.05
Fe	1.65
Mo	0.01

But cows recycle nutrients?



FHR-10236-00069-798 - (c) - FLPA/Wayne Hutchinson

Grazing cows removing 5 ton DM/acre remove 10 lb P and 50 lb K per acre of pasture

Grazing cows remove 2 lb P and 10 lb K per ton of feed grazed.



Pasture Fertility Management

- Soil test and correct pH
- The fertility of pasture systems should be ***built up*** to maintain ***3-5 tons*** of dry matter per acre.
- ***Once soil fertility levels are built up***, then use lower applications of manure, fertilizers, and lime to **maintain**.

Fertilizer Value of Manure

- Testing is the only way to accurately determine manure nutrient value

How do I manage all my pastures?

- Enter yield goals, pasture, manure, and fertilizer into **Cropware Classic**: available for free at:

<http://farminfotech.com/CropwareDownloads/InstallCropwareClassic.1.0.18.exe>

- Use Web Soil Survey for soil types and RUSLE loss (T value)

<http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>

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Why apply nitrogen?

- Most pastures are less than 75% legumes.

	Yield Potential (tons DM/acre)			
<i>Stand Composition</i>	1-2	2-4	4-6	6-8
<i>100% grass</i>	50	75	100-150	150-200
<i>75% grass, 25% legume</i>	25	50	75-100	100-150
<i>50% grass, 50% legume</i>	0	25	50	75
<i>25% grass, 75% legume</i>	0	0	25	50

Reference:

http://extension.usu.edu/files/publications/publication/AG-FG-_03.pdf

Why apply phosphorus & potassium?

- Grasses outcompete legumes for P & K when soil levels are low.



- Regular applications of P & K are necessary for long term legume persistence.

Should I worry about calcium and magnesium replacement?

- If you maintain soil pH through regular liming---NO
- Five tons of DM removed, removes 150 lb/ac of Ca and 30 lbs/acre of Mg
 - However 80% will of this will be in manure/urine if intensively grazed. (30 lb Ca & 6 lbs Mg/acre removed)

Common Name	Chemical Formula	Ca lb/ton	Mg lb/ton
Calcitic Limestone	CaCO ₃	800	0
Dolomitic Limestone	CaMg(CO ₃) ₂	435	260
Cow Manure	Variable	~7	~2

But what about grass tetany?

- Too much N (>25% CP) & K (>3% DM) in forage during rapid spring growth with cloudy days
 - Low forage Mg (<0.2% DM)
- Corrected by
 - Feeding MgO or MgSO₃ in diet
 - (free choice mineral with 10% Mg)
 - Liming with a dolomitic lime
 - Not applying K if soil tests high-excessively high

Doesn't high K cause milk fever?

- Analyze all forages for mineral content
 - Feed corn silage and straw (low %K) to close up dry cows
- **Feed anionic salts (lower DCAD)**
 1. MgSO₃ until ration Mg 0.4% DM
 2. CaSO₃ or NH₄SO₃ until ration S 0.4-0.5% DM
 3. CaCl or NH₄Cl until
 - DCAD = -5 to -15 milliequivalents per 100 g DM
- Raise Ca to 1.5-1.8 % of DM
- After 1 week check urine pH
 - >7.0 add more anionic salts
 - 6.5 to 5.5, ok
 - <5.5, remove some anionic salts
- Don't use NaCl, KCl (doesn't change DCAD)
- Keep NPN <70% if using NH₄⁺ salts

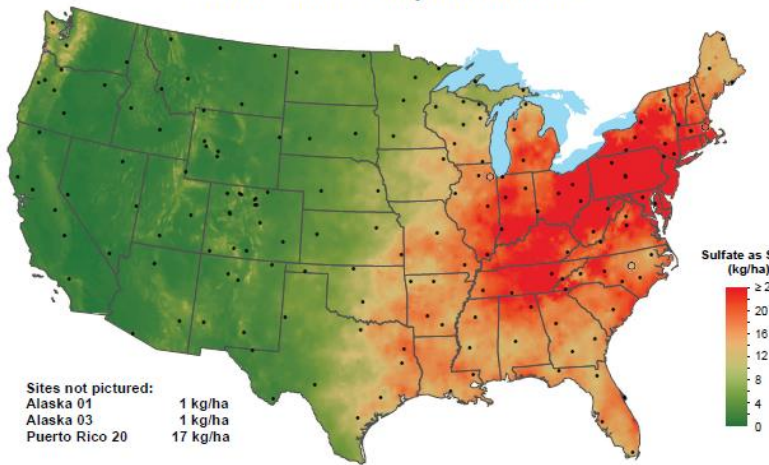
Should I fertilize my soils with selenium?

- No
- Very small amounts needed in dairy rations, use a mineral mix if needed

Why apply sulfur?

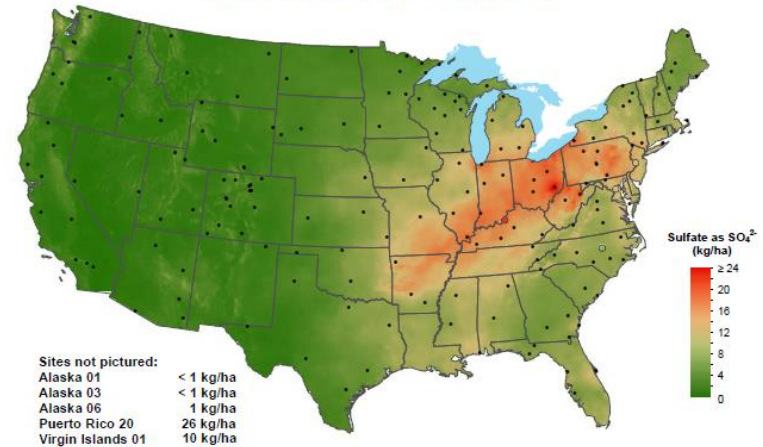
- It's no longer free.

Sulfate ion wet deposition, 1994



National Atmospheric Deposition Program/National Trends Network
<http://nadp.isws.illinois.edu>

Sulfate ion wet deposition, 2011



National Atmospheric Deposition Program/National Trends Network
<http://nadp.isws.illinois.edu>

Should I apply boron?

- Only in small amounts
 - if soil tests is low apply 2 lb/acre every 3 years
- Sandy soils should get 1 lb/acre per year



Boron deficiency in clover

Source:
www.aragriculture.org

What about zinc?

- Very little needed,
 - 0.25 lb/acre removed with 5 tons of pasture DM.
- A response not likely

Nutrient	Lb/ 5 ton
N	200
P	70
K	300
Ca	150
Mg	30
S	25
B	0.40
Zn	0.25
Mn	0.60
Cu	0.05
Fe	1.65
Mo	0.01

Should I apply gypsum?

- Good source of S
 - 372 lb S/ton of gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)
- Probably won't improve soil structure
- Will not change pH, **not a cure-all**
- Used primarily to remediate sodic soils out west

Will the Cl in potash poison my soils?

- NO
- Cl is
 - Universal present in soils (about 200 lb/acre)
 - Rapidly leaches from the soil
 - Doesn't not decrease biological activity
- KCl does have a higher salt index than other fertilizers and should not be placed in furrow with corn and soybean seeds

How fast will OM increase in pastures?

- Depends on where you start.
 - Low OM sands and heavily-weathered soils have potential for quicker responses
 - Heavy manured fields and glacial loams probably won't respond very much
- Measured over **decades**, not a couple of years
- A soil with 1% OM has 20,000 lb or 10 tons of OM.
 - Most OM added to soil (90%) decays quickly to CO₂
 - Adding crop residues and manure can help **aggregate stability in the short term**

But doesn't mob grazing increase soil OM?

- Mob grazing is great way to...
 - Waste valuable feed
 - less than 30% grazed
 - 75% grazed in true rotational system
 - Kill desirable pasture species (too short for regrowth)
 - Increase weed pressure

What about soil health?

- Optimal fertility
- **Reduce compaction**
 - Graze and operate machinery w/o damaging soil
- Smaller organic matter additions can increase aggregate stability in the **short term**
- **Constant living ground cover**
 - Well-managed pastures

How about applying....

- Sugar?
- Humic substances?
- Enzymes?
- Mycorrhizal fungi?
- Milk?



Does fertilizer change forage quality?

- Forage quality mostly determined by plant maturity and species selected
- Nitrogen fertilizer increases crude protein
- Split applications of K to reduce tissue K
- No response from micro nutrients

How about liquid fertilizers?

- Can work very well
- Still need to put on enough to meet plant requirements

Do nitrogen stabilizers work?

- Some work very well....
 - Agrotain (NBPT)
 - N-Serve (nitrapyrin)
 - Guardian (DCD)
 - Nitroform
 - ESN, Osmocote, and Isobutylidene diurea
- Others not so much
 - Nitri-Sphere
- Nothing “stabilizes” manure nitrogen

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Questions?

