Fertilizing Forages for Fun and Profit!

Glen Harris – UGA (Tifton)
Basics of Soil Fertility for Forages

- Nitrogen
- pH and Liming
- Potassium
- Soil Testing
Lime -
* Dolomitic vs. Calcitic
* High Rates ?
### Some common soil liming materials.

<table>
<thead>
<tr>
<th>Material</th>
<th>Relative Neutralizing value</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>pure CaCO₃</td>
<td>100</td>
<td>not generally available</td>
</tr>
<tr>
<td>Calcitic agricultural lime, (calcium carbonate, CaCO₃ + impurities)</td>
<td>90 - 100</td>
<td>easily available</td>
</tr>
<tr>
<td>Dolomitic agricultural lime, CaCO₃ + MgCO₃</td>
<td>95 - 108</td>
<td>easily available; provides Mg</td>
</tr>
<tr>
<td>Ground oyster shells</td>
<td>85 - 95</td>
<td></td>
</tr>
<tr>
<td>Selma chalk/marl, CaCO₃ + clay</td>
<td>50 - 85</td>
<td>contains clay; keep dry</td>
</tr>
<tr>
<td>Burned lime, CaO</td>
<td>150 - 175</td>
<td>very caustic; don't use</td>
</tr>
<tr>
<td>Hydrated lime or builders' lime, Ca(OH)₂</td>
<td>120 - 135</td>
<td>caustic; use with caution; no Mg</td>
</tr>
<tr>
<td>Basic slag</td>
<td>50 - 70</td>
<td>contains some P &amp; micronutrients; byproduct</td>
</tr>
<tr>
<td>Wood stove or fireplace ashes</td>
<td>40 - 70</td>
<td>provides some plant nutrients</td>
</tr>
<tr>
<td>Boiler wood ash</td>
<td>30 - 60</td>
<td>provides some plant nutrients</td>
</tr>
<tr>
<td>By-products</td>
<td>Variable</td>
<td>use as specified by manufacturer</td>
</tr>
<tr>
<td>Gypsum and/or ground drywall, CaSO₄</td>
<td>0</td>
<td>NOT A LIMING MATERIAL</td>
</tr>
</tbody>
</table>

Source: Soil Acidity and Liming, Internet Inservice Training, Lippert et al.
Why Lime?

Nutrient Availability
Nutrient Unavailability
Provide Ca and Mg
Nitrogen Fixation
Biological Activity

Source: Foth and Ellis
Soil Fertility
Calcitic and Dolomitic Lime
(x 1000 tons)
Magnesium Ratings for Forages
( Coastal Plain Soils - lb/a, Mehlich 1)

*Low = 0 – 30

*Medium = 31- 60

High = 61 +

From The Soil Test Handbook for Georgia” :
“If soil test magnesium is low, use dolomitic limestone”!
Figure 1. Relationship between pH and manganese availability. Maintain soil test manganese levels above the line to help avoid manganese deficiency.
Source: Soil Test Handbook for Georgia
N with no K can kill a stand in 2 years!
K is for Persistence!

Deficiency
Weeds
Winterkill
Loss of Stand
CEC – Ability of soil to hold cations = how many “neg charges” from clay and OM

Base saturation (%) – what percent of CEC is Ca, Mg and K (and Na?)
“Enhanced Efficiency (EE)” Fertilizers
New Term Coined by The Fertilizer Institute (TFI)

“…products that minimize the potential of nutrient loss to the environment.”

**Slow/Controlled Release**
- Absorbed
- Coated
- Occluded
- Reacted

**Stabilized/Additive**
- Urease Inhibitors
- Nitrification Inhibitors
- Stabilizers
- Humates

**CoRoN**

**Nutrisphere – N (?)**

Association of American Plant Food Control Officials (AAPFCO)
# Comparing Nitrogen Fertilizers

<table>
<thead>
<tr>
<th>Nitrogen Source</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anhydrous Ammonia (82%N)</td>
<td>Gas Safety/Dealer Insurance Methamphetamines</td>
</tr>
<tr>
<td>UAN Solutions (28-32%N)</td>
<td>Liquid Urea+Ammonium+Nitrate</td>
</tr>
<tr>
<td>Urea (46%N)</td>
<td>Solid Concentrated Volatilization</td>
</tr>
<tr>
<td>Ammonium Nitrate (34%N)</td>
<td>Solid Regulations/Availability</td>
</tr>
<tr>
<td>Ammonium Sulfate (21%N)</td>
<td>Least Concentrated Acidifying</td>
</tr>
</tbody>
</table>
Nitrogen Fertilizers Sold in Georgia - 2010

X 1000 tons

- AnyH: 2
- AS: 20
- AN: 25
- Urea: 63
- N Soln: 234
Volatilization = Urea $\rightarrow$ Ammonium (NH₃) gas

Nitrification = Ammonium (NH₄⁺) $\rightarrow$ Nitrate (NO₃⁻)
Forms of Nitrogen

- Ammonia – $\text{NH}_3$ (gas)
- Ammonium – $\text{NH}_4^+$
- Nitrate – $\text{NO}_3^-$
- Urea – $\text{CO(NH}_2)_2$
Composition of UAN (32 – 28 % N)

- Urea: 50%
- Ammonium (NH4): 25%
- Nitrate (NO3): 25%
Composition of “19-E” (19 – 18 %N)

- Nitrate (NO₃): 59%
- Ammonium (NH₄): 41%
Composition of 24-0-0-3(S)
(Urea+Ammonium Nitrate+Sodium Nitrate)
• Agrium Company
• ESN = Environmentally Smart Nitrogen
• Polymer Coated Urea
• “Controlled Release” (not “slow release” ?)
• “Releases as the Soil Warms”
• Slow Release vs. Split Applications
How Much Fertilizer Do I Need for 300 Bushel Corn?

Soil Test Handbook of Georgia (aesl.ces.uga.edu)

Base (Irrigated) Yield Goal = 150 bu/a

For every 10 bushel increase → add 12-6-10

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<thead>
<tr>
<th></th>
<th>150</th>
<th>200</th>
<th>250</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>180-110-130</td>
<td>240-140-180</td>
<td>300-170-230</td>
<td>360-200-280</td>
</tr>
<tr>
<td>Med</td>
<td>180-90-90</td>
<td>240-120-140</td>
<td>300-150-190</td>
<td>360-180-240</td>
</tr>
<tr>
<td>High</td>
<td>180-70-70</td>
<td>240-100-120</td>
<td>300-130-170</td>
<td>360-160-220</td>
</tr>
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</table>

4Rs = Rate, Timing, Source and Placement
High Yield Corn – 2013

(Pioneer 2023     35,000 pop.     planted 3/20)

Bu/a

270
254
222
157
64

Sonly 150 200 250 300
## Nutrient Removal

<table>
<thead>
<tr>
<th>Crop</th>
<th>Yield</th>
<th>N-P2O5-K2O</th>
</tr>
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<tbody>
<tr>
<td>Bermuda hay</td>
<td>8 tons</td>
<td>400-80-300</td>
</tr>
<tr>
<td>Corn grain</td>
<td>120 bu</td>
<td>115-47-32</td>
</tr>
<tr>
<td>Corn silage</td>
<td>16 tons</td>
<td>160-67-160</td>
</tr>
<tr>
<td>Peanuts</td>
<td>2 tons + vines</td>
<td>240-39-185</td>
</tr>
<tr>
<td>Wheat grain</td>
<td>60 bu</td>
<td>70-33-20</td>
</tr>
<tr>
<td>grain+straw</td>
<td>60 bu</td>
<td>100-40-122</td>
</tr>
<tr>
<td>Fescue pasture</td>
<td>300 lb. beef</td>
<td>9-7-1</td>
</tr>
<tr>
<td>Bahia pasture</td>
<td>200 lb. beef</td>
<td>6-5-1</td>
</tr>
</tbody>
</table>
50-10-40 lb. N-P$_2$O$_5$-K$_2$O per ton

Exports

Hay Removes A Lot of Nutrients
Inputs
* fertilizer
* manure
* legumes (N)
* feed

Nutrient Cycle

Exports
* calves
* beef

Pastures Recycle Nutrients
Nitrogen  12.5 lb  
Phosphorus  3.4 lb  
Potassium  0.75 lb  
Sulfur  0.75 lb  
Calcium  6.5 lb  
Magnesium  0.75 lb
The Value of Litter

- **Pre 2005 Prices**
  - 60# N \( \times \) .28 \( \times \) .6 = 10.08
  - 60 # P2O5 \( \times \) .22 \( \times \) .8 = 10.56
  - 40 # K2O \( \times \) .12 \( \times \) .8 = 3.84
  - » Total = $24.48

- **2008 Prices**
  - 60#N \( \times \) .85 \( \times \) .6 = 30.60
  - 60&P2O5 \( \times \) .85 \( \times \) .8 = 40.80
  - 40#K2O \( \times \) .80 \( \times \) .8 = 25.60
  - » Total = $97.00

- **2013 Prices**
  - 60#N \( \times \) .72 \( \times \) .6 = 25.92
  - 60&P2O5 \( \times \) .55 \( \times \) .8 = 26.40
  - 40#K2O \( \times \) .52 \( \times \) .8 = 16.64
  - » Total = $68.96

Other Nutrients?  
Organic Matter?  
Liming?  
Nematode Suppression?
Basics of Soil Fertility for Forages

- Soil Testing
- pH and Liming
- Potassium
- Nitrogen
Questions ?