2009 Georgia Grazing School:

Soil fertility and nutrient cycling in grazing systems

Soil Fertility and Nutrient Cycling in Grazing Systems

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What we'll cover

Soil tests and fertility
• Lime - more bang for your buck
• Nitrogen, phosphorus and potassium cycles
• Fertilizer tips and poultry litter

Soil Testing and Fertility

If you don't test, you don't know what you need
Take 6 to 12 samples per area, zig zag pattern, 0-4 inches, same time each year

Keep your records, look for patterns over time

Liming – More Bang for Your Buck

Our soils natural pH 4.5 to 5.5
pH is master variable

Nutrient | Amt. Used Annually | Unit Price | Dec. in Efficiency | Value of Decrease | Diff. of pH
--- | --- | --- | --- | --- | ---
N | 200 | $0.55 | 35% | $39 | 0.55
P₂O₅ | 50 | $0.62 | 50% | $26 | 0.62
K₂O | 150 | $0.63 | 10% | $16 | 0.63
Total | | | | $64 |

The difference of a soil pH of 5.6 vs. 6.2:

Poultry Litter & Liming

• Calcium provides some liming value
  - about 1/10th strength of limestone
• NW Georgia after 4 years
  • PL at 4 t/ac pH= 5.76
  • NO₃NH₄ (no lime) pH= 5.18
• NE Georgia after 5 years
  • PL at 4 t/ac pH= 6.6
  • NO₃NH₄ + lime pH= 6.0

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Nutrient Cycling in Grazing Systems Simplified!

- Volatilization
- Hay/animal removal
- Manure and Urine
- Organic matter mineralization & immobilization
- Plant residue
- Leaching and runoff
- N fixed from legumes
- Commercial fertilizer, poultry litter, biosolids

Nutrient Budgets

Need to replace what’s lost

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Budget (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>250</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>300</td>
</tr>
<tr>
<td>Potassium</td>
<td>350</td>
</tr>
</tbody>
</table>

Four-legged Spreaders Very Efficient

- White et al., 2001 J. Environ. Qual. 30:2180–2187

You Can Get Better Distribution with More Frequent Rotation

<table>
<thead>
<tr>
<th>Rotation Frequency</th>
<th>Years to Get 1 Pile/sq. yard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
<td>27</td>
</tr>
<tr>
<td>14 day</td>
<td>8</td>
</tr>
<tr>
<td>4 day</td>
<td>4 – 5</td>
</tr>
<tr>
<td>2 day</td>
<td>2</td>
</tr>
</tbody>
</table>

University of Missouri Study

Nitrogen Cycle

- Volatilization - up to 60% of applied N
  - Type of fertilizer
    - urea, NH4NO3, poultry litter
  - Soil pH
    - higher soil pH, higher losses
  - Environmental conditions
    - high temperatures, moist soils
  - Amount of plant material
    - surface interception and enzymes
- Denitrification - in areas with high soil organic matter and fluctuating water tables

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**Nitrogen Cycle**

*Leaching/runoff - *

- Timing of application
  - Try not to apply before big rainstorms
- Soil type
  - Heavy and/or compacted soil increase runoff losses
- Pasture condition
  - Overgrazed, bare spots, low soil organic matter increase leaching/runoff losses

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**Poultry Litter**

- "3-2-2" 
  - Varies with type of bird, ration, # of growouts, feed efficiency, storage & handling
  - Most N is organic form (about 50 lbs/ton)
  - Has to be mineralized before plant available
  - Only 50 to 60% of total N available

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**Cattle Gains**

Franzluebbers AJ, and Stuedemann JA.
USDA ARS J. Phil Campbell, Sr. Natural Resource Center

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**Split Applications to Maximize Efficiency of Nitrogen Fertilizers**

- Long-term, this can increase yields by 5-10% and increase NUE by 25-30%
- Helps prevent
  - Leaching/runoff
  - Volatilization (in the case of urea-based products)
- Especially important under extremes
  - Late freeze
  - Drought
- Helps to prevent NITRATE TOXICITY!

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**Phosphorus Cycle**

Plants need 3 to 4 times more nitrogen than phosphorus

Issue with poultry litter
3-2-2 fertilizer equivalent

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Phosphorus Cycle
- Soil testing important, particularly if used poultry litter
- Apply it when you need it
- It high soil test P soils, just N fertilizer may be more cost efficient

The Value of Poultry Litter
2009 Prices
60#N \( \times 0.50 \times 0.6 = 18.00 \)
40#\( \text{P}_2\text{O}_5 \) \( \times 0.80 \times 0.8 = 25.60 \)
40#\( \text{K}_2\text{O} \) \( \times 0.70 \times 0.8 = 22.40 \)
\( \Rightarrow \) Total = $66.00

Phosphorus Fertilizer
- P can essentially be applied any time during the year on established forage crops
- Purchase P fertilizer in "off-peak" times of the year (i.e., summer and fall)
  - Demand for the product is low
  - Demand for spreading services is low
  - Less risk of P runoff

Potassium Cycle
- Can’t get no respect
- Potassium important for persistence
- Helps enhance root growth & development
- Increases resistance to cold stress, leafspot diseases (bermudagrass)

Potassium
- Poultry litter OK, but may not supply enough for bermudagrass
- Biosolids not a good source of K
- Leachable
- Split applications commercial fertilizer: 40 to 50% spring, 50 to 60% mid to late season
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Fertilizer Tips

- Soil test - apply what you need
- Split applications and apply when forage needs it
- Purchase and apply P during off-peak times (summer and fall)

Fertilizer Strategy

<table>
<thead>
<tr>
<th>Product Used</th>
<th>lbs of product/acre</th>
<th>Price, $/acre</th>
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</thead>
<tbody>
<tr>
<td>Homogenized Fertilizer 17-17-17</td>
<td>1471</td>
<td>$404.53</td>
</tr>
<tr>
<td>Mixed Fertilizer 488</td>
<td>$119.56</td>
<td></td>
</tr>
<tr>
<td>DAP (18-46-0) 141</td>
<td>$36.31</td>
<td></td>
</tr>
<tr>
<td>Potash (0-0-60) 375</td>
<td>$140.63</td>
<td></td>
</tr>
<tr>
<td>Poultry Litter 8000</td>
<td>$120.00</td>
<td></td>
</tr>
<tr>
<td>Potash 110</td>
<td>$41.25</td>
<td></td>
</tr>
</tbody>
</table>

Target Fertilizer Rate: 250-65-225
(Assumes Medium Soil Test Level P & K)

Fertilizer Tips

- Poultry litter, biosolids, etc - test and know fertilizer value
- Poultry litter - calibrate spreaders, know how much you are applying
- Don’t apply close to streams, ponds, wetlands
- Be considerate of neighbors

In pastures
use your 4-legged spreaders

AGRICULTURAL POLLUTION PREVENTION PROGRAM
www.agp2.org

Sustainable Agriculture Programs
www.SustainAgGa.org

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