Nutrient Composition of Selected Versus Available Forage in Cool-Season Grass Pastures

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Iowa Feed and Nutrition Seminar
April 8th, 2008

Introduction

- Nitrogen and Phosphorus
  - Essential nutrients for livestock
  - Available in forage
  - Supplementation may be required
  - Supplementation expensive
  - Potential negative impacts on surface and ground water

Phosphorus Supplementation

- Early Studies
  - P supplementation increased calving percent and calf weaning weight (Black et al., 1943, 1949)
  - Texas rangeland
    - Forage P = 0.10 to 0.12% P

Phosphorus Supplementation

- Recent Studies
  - No difference in animal performance when Holstein steers on pasture received a 6% P supplement compared to a trace mineral mix. (Brokman et al., 2008)
  - Wisconsin pasture
    - Forage P = 0.30 to 0.32%
  - Phosphorus is usually adequate when cattle graze P-fertilized grasses. (Greene, 2000)

Iowa Forage P

- Beef Nutrition Farm (Bormann, 2004)
  - Bray-1 P \(>^{170 \text{ ppm}}\)
    - Forage P = 0.32 to 0.73%

- Rhodes Research Farm (Haan, 2005)
  - Bray-1 P 21 ppm
  - Forage P = 0.18 to 0.22%

P Concentration of Smooth Bromegrass Pasture Forage Grown on a Soil With Adequate to High P and the P Requirements of Lactating Spring-Calving Cows (Haan et al., 2007)
CRUDE PROTEIN AND P CONCENTRATIONS OF FORAGE FROM PASTURES GRAZED BY DIFFERENT GRAZING SYSTEMS AND REQUIREMENTS OF BEEF COWS

Objectives

- To determine the crude protein and phosphorus concentrations and IVDMD of forage selected by beef cattle grazing cool-season grass pastures.
- To compare nutrient value of selected forage to animal requirements.

Materials & Methods

Grazing Management

- 4 - 30 acre pastures
  - Rotational Stocking
  - Continuous Stocking
- 15 fall-calving Angus cows per pasture
  - Initial BW 1369 ± 124 lbs.
- Mid-May through mid-October 2007

Forage Analysis

- Top half clipped samples sorted
  - Top-half live
  - Top-half died
- Hand clipped samples dried (65°C) for 48hr and ground to 1 mm.
- Rumen grab samples freeze dried and ground to 1 mm.
- Analysis
  - Phosphorus
  - Crude protein
  - In Vitro dry matter disappearance.

Materials & Methods

- Hand-clipped Forage
  - Clipped simultaneously with grazing of evacuated steers.
  - Twelve - 0.25 m² areas clipped from random locations near area of grazing
  - Clipped to ground level (AVAILABLE Forage)
  - Top half of forage sward (TOP HALF Forage)
  - Clipped to ground level and placed in the rumen for 2 hours following the animals selecting (SOAKED forage)
  - To determine salivary phosphorus and nitrogen contributions to selected forage

Materials & Methods

Sampling Periods

- Early July and mid-August 2007
  - Two consecutive days per block per month

Forage Selection

- One rumen fistulated steer per pasture
- Fistulated steer acclimated to pasture for one week prior to sampling
- NormallyMovemred and allowed to graze for two hours.
- Forage samples - Hand forage collected from chosen (SELECTED Forage)

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- Forage samples - Hand forage collected from chosen (SELECTED Forage)
Calculations

**ADJUSTED SELECTED Forage**

\[ \text{SELECTED forage} - (\text{SOAKED forage} - \text{AVAILABLE forage}) \]

Statistics

- Data were analyzed using the GLM procedure of SAS.

<table>
<thead>
<tr>
<th>Phosphorus</th>
<th>Crude Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Available Forage</strong></td>
<td><strong>Adjacent Forage</strong></td>
</tr>
<tr>
<td>%P in continuously stocked pastures tended to be greater (P=0.06) than in rotationally stocked pastures</td>
<td>%SCP was greater (P&lt;0.05) than in rotationally stocked pastures</td>
</tr>
<tr>
<td>No difference by month</td>
<td>%SCP tended (P=0.06) to be greater in rotationally stocked pastures than in rotationally stocked pastures</td>
</tr>
<tr>
<td>No difference by treatment</td>
<td>%SCP of forage did not differ by month</td>
</tr>
<tr>
<td>%P was greater (P&lt;0.05) in continuously stocked pastures than in rotationally stocked pastures</td>
<td>%SCP of selected forage was 44% greater than that of available forage (P=0.05)</td>
</tr>
<tr>
<td>%P did not differ by month</td>
<td>%SCP in continuously stocked pastures (P=0.08) than in rotationally stocked pastures</td>
</tr>
<tr>
<td>%P did not differ by treatment</td>
<td>Top Half Forage: %SCP was greater (P&lt;0.05) in top half live and top half dead forage in August than in July.</td>
</tr>
</tbody>
</table>

**Calculation**

\[ \text{ADJUSTED SELECTED Forage} = \text{ADJUSTED SELECTED Forage} = \]

**Data**

- Phosphorus concentration of hand sorted live and died forage fractions.
- Crude protein concentration of hand sorted live and died forage fractions.

**In Vitro Digestible Dry Matter**

<table>
<thead>
<tr>
<th>Forage Mass</th>
<th>Mineral Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Available forage mass</strong></td>
<td><strong>Mineral Analysis</strong></td>
</tr>
<tr>
<td>did not differ by grazing treatment or month</td>
<td>$743/ton, 200 IU/lb, 1,700 ppm, 28 ppm, 1,300 ppm, 1,100 ppm, 1.0%, 18.0%</td>
</tr>
<tr>
<td><strong>Forage intake (NRC, 1986)</strong></td>
<td></td>
</tr>
<tr>
<td>Max - 2250 kg/ha</td>
<td>Cost $385/ton, 3,750 ppm, 1.0%, 0.5%, 0.0%</td>
</tr>
<tr>
<td>60% Max - 450 kg/ha</td>
<td></td>
</tr>
</tbody>
</table>

**Available forage mass.**

- Mass of live and died forage fractions in the upper half of the forage sward.
Conclusions

- Cattle managed by either rotational or continuous stocking are able to select forage with a greater P, CP, and IVDDM concentrations than that of the available forage.
- Phosphorus supplementation of cattle on cool-season grass pastures with adequate soil P will not increase production but will increase production costs.
- By not supplementing excess nutrients cattle producers can decrease input costs while decreasing environmental impacts.

Phosphorus

- Requirements
  - Maintenance – 16 mg / kg BW
  - Gestation – 7 g / kg fetal weight
  - Lactation – 0.95 g / kg milk produced
- Distribution in the body
  - Bone formation, cell growth (DNA), energy metabolism (ATP), phospholipids, acid-base balance, growth and metabolism of rumen microorganisms
- Deficiencies
  - Reduced growth and feed efficiency
  - Impaired reproduction
  - Weak, brittle bones

Acknowledgements:
- This material is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Award No. 2006-51130-03700 and 2007-35102-15115
- Iowa Department of Natural Resources (US EPA 319 Program)
- Leopold Center for Sustainable Agriculture

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