Forage analysis

Using it to design a supplementation program

2016 Tri-State Beef Conference

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Over the next 35 - 40 minutes...

- Value of conducting a forage analysis
- Quantify some “generic” beef cow nutrient requirements
- Characteristics of supplemental feedstuffs
- Identifying the most economical supplement and designing a supplementation program that works for you
Nutritional management programs in the tri-state area

Protein/energy

Minerals/vitamins
Nutritional management

- Will your forages meet the nutrient requirements of your cattle?
  - If they won’t, you’re going to sacrifice performance
  - How do you know if you don’t test them?
Forage analysis

- Begin with a forage analysis
  - TN Soil, Plant, and Pest Center
    - Beef Basic: $17.00
    - Beef Plus: $30.00

- Very few things can yield as much of a return on investment

- Shifts supplementation decisions from reactive to proactive

- Can (should) be used as the first step toward developing a supplementation program that complements your forage(s)
Forage analysis

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>County</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Number</td>
<td>Sample Type</td>
</tr>
<tr>
<td>Test Type</td>
<td>Beef PLUS</td>
</tr>
<tr>
<td>Moisture</td>
<td>%</td>
</tr>
<tr>
<td>Dry Matter (DM)</td>
<td>%</td>
</tr>
<tr>
<td>Relative Forage Quality (RFQ)</td>
<td>&lt;90 - ≥140</td>
</tr>
<tr>
<td>Crude Protein (CP)</td>
<td>%</td>
</tr>
<tr>
<td>Acid Detergent Fiber (ADF)</td>
<td>%</td>
</tr>
<tr>
<td>Neutral Detergent Fiber (NDF)</td>
<td>%</td>
</tr>
<tr>
<td>Total Digestible Nutrients (TDN)</td>
<td>%</td>
</tr>
<tr>
<td>Net Energy Maintenance (NEm)</td>
<td>MCal/lb</td>
</tr>
<tr>
<td>Net Energy Gain (NEg)</td>
<td>MCal/lb</td>
</tr>
<tr>
<td>Lignin</td>
<td>%</td>
</tr>
<tr>
<td>Ash</td>
<td>%</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>%</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>%</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>%</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>%</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>ppm</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>ppm</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>ppm</td>
</tr>
<tr>
<td>Sulfur (S)</td>
<td>%</td>
</tr>
</tbody>
</table>

*All values reported on a 100% DM Basis*

https://ag.tennessee.edu/spp/Pages/forage.aspx
Focus on cow requirements: energy

Calculated for a 3-yr old cow with a mature body weight of 1300 lbs
Adapted from the NRC, 2000
Focus on cow requirements: protein

Assumes that enough energy is present to not limit conversion of crude to metabolizable protein
Calculated for a 5-yr old cow with a mature body weight of 1300 lbs
Adapted from the NRC, 2000
Energy and protein

- **Net energy for maintenance (NEm)**
  - They must consume enough NEm to meet their requirements for maintenance before they can grow, lactate, reproduce, etc.

- **Net energy for gain (NEg)**
  - After they meet their NEm requirement, they need to consume enough NEg to drive the desired level of growth

- **Crude protein (CP)**
  - After they meet their NEm and NEg requirements, they need to consume enough CP to support that level of growth or production
When requirements aren’t met...

- You sacrifice...
  - Growth performance
  - Reproduction (longevity)
  - Health and wellbeing
  - Carcass quality

- Both direct and indirect effects
  - Direct → the cattle whose requirements aren’t being met
  - Indirect → their offspring (fetal programming)
Nutrient restriction during gestation

- Generally results in nutrient deprivation of the developing calf → fetal programming

- Leads to restricted postnatal performance
  - Reduction in colostrum production and quality
    - Impaired immune function and calf health
  - Insufficient thermoregulation
  - Reductions in growth performance, efficiency and carcass traits
  - Reduction in reproductive performance of dams and calves

(Reviewed by Funston et al., 2010)
Supplementing females during gestation

- What about birth weight and dystocia (calving difficulty)?
  - What if I told you that you can’t make a calf’s birthweight heavier than it’s genetic potential?
  - Starving a developing calf will decrease birth weight slightly, but will not decrease the incidence of calving difficulty!
    - But all the negative consequences of fetal programming come along with it
    - And they’re harder to get bred back!

- Don’t be afraid to feed her to meet her requirements
  - Just don’t make her obese
Effects of late gestational supplementation to meet maintenance requirements on calf performance and subsequent maternal performance as first-calf heifers

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Supplemented</th>
<th>Non-supplemented</th>
<th>Statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Supplemented</td>
<td>Non-supplemented</td>
<td>Statistical significance</td>
</tr>
<tr>
<td>Calf performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth weight, lbs</td>
<td>79</td>
<td>77</td>
<td>Not different</td>
</tr>
<tr>
<td>Weaning weight, lbs</td>
<td>498</td>
<td>481</td>
<td>Different</td>
</tr>
<tr>
<td>Maternal performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnancy rate, %</td>
<td>93</td>
<td>80</td>
<td>Different</td>
</tr>
<tr>
<td>Calved in first 21 d, %</td>
<td>77</td>
<td>49</td>
<td>Different</td>
</tr>
<tr>
<td>Calf birth weight, lbs</td>
<td>73</td>
<td>73</td>
<td>Not different</td>
</tr>
<tr>
<td>Unassisted births, %</td>
<td>78</td>
<td>64</td>
<td>Not different</td>
</tr>
</tbody>
</table>

1Extrapolated from Martin et al., 2007
2Cows were supplemented with 0.4 lb of CP and 0.75 lb of TDN per d during the last trimester of gestation
Effects of late gestational supplementation above maintenance requirements on calf performance

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Supplemented</th>
<th>Non-supplemented</th>
<th>Statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calf performance</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Birth weight, lbs</td>
<td>84.4</td>
<td>83.2</td>
<td>Not different</td>
</tr>
<tr>
<td>Unadjusted weaning weight, lbs</td>
<td>640</td>
<td>640</td>
<td>Not different</td>
</tr>
<tr>
<td>Adjusted 205-d weaning weight, lbs</td>
<td>612</td>
<td>618</td>
<td>Not different</td>
</tr>
<tr>
<td>Weight per d of age, lbs</td>
<td>2.6</td>
<td>2.6</td>
<td>Not different</td>
</tr>
</tbody>
</table>

1Work conducted at Blount, Holston, Highland-Rim, Middle TN, and Plateau RECs and included 515 cows
2Supplemented with 5 lbs of distiller's dried grains w/ solubles per d, 3 d per week
Can they eat enough?

- Energy content is the primary indicator of voluntary forage intake
  - Net energy for maintenance ($NE_m$)

- If forage has a low $NE_m$ content, they may not be able to eat enough to meet their requirements
  - Voluntary intake decreases as energy content decreases

Adapted from the NRC, 2000 Calculated for a 1300 lb cow
Selecting the right supplement

- If your goal is to use supplements to fill a nutrient void...
  - Select supplemental feeds that complement your forage
    - Low protein forage → supplement that is high in protein
    - Low energy forage → supplement that is high in energy
Selecting the right supplement

- If that goal includes maximizing profitability...
  - Evaluate the value of your options
    - Cost per unit of nutrient rather than only retail cost
  - Select the most economical option

Cost per unit of nutrient = \(\frac{\text{Cost per lb of feed}}{\text{amount of nutrient per lb of feed}}\)
Supplement nutrient composition

NRC, 2000
Supplement nutrient composition

NRC, 2000
## Supplement cost per unit of nutrient

<table>
<thead>
<tr>
<th>Feedstuff</th>
<th>Retail cost ($/ton)</th>
<th>Retail cost ($/lb)</th>
<th>Cost of CP ($/lb)</th>
<th>Cost of NEm ($/mcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brewer’s grains</td>
<td>210.00</td>
<td>0.11</td>
<td>0.45</td>
<td>0.15</td>
</tr>
<tr>
<td>Corn gluten feed</td>
<td>170.00</td>
<td>0.09</td>
<td>0.42</td>
<td>0.11</td>
</tr>
<tr>
<td>Cottonseed meal</td>
<td>325.00</td>
<td>0.16</td>
<td>0.41</td>
<td>0.25</td>
</tr>
<tr>
<td>Cracked corn</td>
<td>185.00</td>
<td>0.09</td>
<td>1.20</td>
<td>0.11</td>
</tr>
<tr>
<td>Distiller’s grains</td>
<td>185.00</td>
<td>0.09</td>
<td>0.33</td>
<td>0.10</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>400.00</td>
<td>0.20</td>
<td>0.46</td>
<td>0.26</td>
</tr>
<tr>
<td>Soybean hulls</td>
<td>115.00</td>
<td>0.06</td>
<td>0.52</td>
<td>0.10</td>
</tr>
<tr>
<td>14 % CP commodity blend</td>
<td>235.00</td>
<td>0.12</td>
<td>0.84</td>
<td>0.17</td>
</tr>
<tr>
<td>Protein tub</td>
<td>600.00</td>
<td>0.30</td>
<td>1.00</td>
<td>0.41</td>
</tr>
<tr>
<td>Liquid feed supplement</td>
<td>210.00</td>
<td>0.11</td>
<td>0.66</td>
<td>0.19</td>
</tr>
</tbody>
</table>
## Real-world scenario

- Let’s compare the ability of three forages to meet the nutrient requirements of a 1300 lb cow

<table>
<thead>
<tr>
<th>Forage example</th>
<th>TDN (% of DM)</th>
<th>NEm (Mcal/lb of DM)</th>
<th>CP (% of DM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>50</td>
<td>0.45</td>
<td>8.2</td>
</tr>
<tr>
<td>B</td>
<td>60</td>
<td>0.61</td>
<td>9.8</td>
</tr>
<tr>
<td>C</td>
<td>70</td>
<td>0.76</td>
<td>11.4</td>
</tr>
</tbody>
</table>
Predicted voluntary forage intake

Adapted from the NRC, 2000
Forage A

4 lbs distiller’s
3 lbs cracked corn

OR

6 lbs gluten
2 lbs cracked corn

- TDN = 50% of DM
- NE\textsubscript{m} = 0.45 Mcal/lb of DM
- CP = 8.2% of DM

MP = metabolizable protein, or protein that is absorbed
Forage B

3 lbs distiller’s OR 3 lbs gluten OR 3 lbs cracked corn

- TDN = 60 % of DM
- NE\textsubscript{m} = 0.61 Mcal/lb of DM
- CP = 9.8 % of DM

MP = metabolizable protein, or protein that is absorbed
Forage C

She doesn’t need any supplemental energy or protein!

- TDN = 70 % of DM
- NE\textsubscript{m} = 0.76 Mcal/lb of DM
- CP = 11.4 % of DM

MP = metabolizable protein, or protein that is absorbed
Mineral supplementation

- Which mineral supplement is the right choice?
- Should I be feeding the same mineral supplement year-round?
- Forage analysis is the only way to answer these questions
Ensiled feeds

- Forage analysis can also be used to screen for ensiled feed safety issues
  - Clostridia
  - Listeria

- pH is currently the best indicator of silage safety
  - Corn silage → pH > 4.5 should be tested prior to feeding
  - Haylage → pH > 5 should be tested prior to feeding

- Screen via forage analysis PRIOR TO feeding
  - If pH is too high, test for clostridia and listeria
Take-home points

- Importance of a forage analysis cannot be overemphasized!

- Focus on meeting the nutrient requirements of your cattle in the most economical way possible

- Base supplementation decisions on nutrient needs and supplement value (cost per unit of nutrient) rather than retail cost
Closing thoughts

- Design a program that works for you
  - Just because it works for your neighbor, doesn’t mean it’ll work for you
  - Just because it’s what you’ve done in the past, doesn’t mean it’s the best option

- Don’t be afraid to supplement your cattle if they need it
  - View it as an investment, rather than an expense
  - Make economically responsible supplementation decisions

- When purchasing supplements...
  - You generally get what you pay for
  - Be skeptical of “fix-all” product claims
What’s on the horizon?

- Decision-making tools
  - Cost per unit of nutrient calculator for supplemental feedstuffs
  - Cost per unit of nutrient calculator for different forms of the same supplemental feedstuff

- Educational materials
  - How to conduct a forage analysis
  - Beef cattle nutrient requirements
  - Specific supplemental feedstuffs
Questions?