ROLE AND IMPORTANCE OF ALFALFA IN BEEF DIETS

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Alfalfa is often referred to as the “Queen” of forage. Is this because of its high fertility needs and more finicky soil fertility needs along with greater management for optimal growth and persistency? Or is it because of it being on top of nearly all other forages for yield and quality? Truth be told, it is likely a combination of all these factors. Alfalfa is a versatile forage as it can be harvested for hay or silage and also grazed with proper management. For these reasons, this forage can fit well in beef operations.

Alfalfa’s high nutrient content makes it attractive as a forage for high producing animals or young growing animals. Alfalfa is recognized as having a high crude protein content. This is partially due to its high leaf-to-stem ratio. Maintaining these leaves on the forage is critical when making hay with this forage if quality is to be maximized. As the plant matures, the leaf-to-stem ratio declines as the plant gets taller producing more stem which essentially dilutes the ratio of leaves on whole plant. As the plant matures, the concentration of lignin, needed for rigidity in the cell wall, increases to support the upright growth of the plant. Therefore, most publications refer to the quality of alfalfa at various growth stages. In Table 1, the quality of alfalfa is listed at various growth stages. Note that as the plant increases in maturity, the total digestible nutrient (TDN) concentration declines as does the crude protein. The acid detergent fiber (ADF) fraction which is essentially the least digestible components of the cell wall increases with plant maturity lowering the TDN value of the forage. The TDN value is essentially the energy value of the forage and with beef cattle energy is often the limiting nutrient for performance with protein often being second. Other nutrients such as minerals can be higher in alfalfa than other forages. More details on minerals will be covered below.

Table 1.--Relationship of the Stage of Alfalfa Maturity at Harvest to Total Digestible Nutrients (TDN), Crude Protein (CP) and Acid Detergent Fiber (ADF).*

<table>
<thead>
<tr>
<th>Maturity</th>
<th>TDN (%)</th>
<th>CP (%)</th>
<th>ADF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-bud</td>
<td>65</td>
<td>21.7</td>
<td>28</td>
</tr>
<tr>
<td>Bud</td>
<td>62</td>
<td>19.9</td>
<td>31</td>
</tr>
<tr>
<td>1/10 bloom</td>
<td>58</td>
<td>17.2</td>
<td>34</td>
</tr>
<tr>
<td>1/2 bloom</td>
<td>56</td>
<td>16.0</td>
<td>38</td>
</tr>
<tr>
<td>Full bloom</td>
<td>54</td>
<td>15.0</td>
<td>40</td>
</tr>
<tr>
<td>Mature</td>
<td>52</td>
<td>13.6</td>
<td>42</td>
</tr>
</tbody>
</table>


How does alfalfa relate to a more common forage, say tall fescue? Recent research with various genotypes of tall fescue at different phonological stages is shown
in Table 2. As maturity advances from vegetative to seed ripening, the nutrient concentrations change similarly to that of alfalfa and quality declines. The TDN and CP fractions decline as ADF increases. The challenge of cutting fescue in the boot stage or at heading due to inclement weather in early spring combined with the rapid maturing rate of fescue results in most of the tall fescue hay being very low in quality.

Table 2. Tall fescue nutrient content at various stages of maturity.

<table>
<thead>
<tr>
<th>Maturity</th>
<th>DMD (%)</th>
<th>TDN (%)</th>
<th>CP (%)</th>
<th>ADF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetative</td>
<td>57.3</td>
<td>59.8</td>
<td>17.8</td>
<td>40.4</td>
</tr>
<tr>
<td>Heading</td>
<td>58.2</td>
<td>58.0</td>
<td>15.7</td>
<td>39.7</td>
</tr>
<tr>
<td>Full Flowering</td>
<td>55.1</td>
<td>53.3</td>
<td>12.6</td>
<td>43.1</td>
</tr>
<tr>
<td>Seed Milky</td>
<td>51.0</td>
<td>51.1</td>
<td>10.4</td>
<td>43.1</td>
</tr>
<tr>
<td>Seed Ripening</td>
<td>46.8</td>
<td>48.2</td>
<td>9.8</td>
<td>48.3</td>
</tr>
</tbody>
</table>

DMD = dry matter digestibility, similar to TDN; TDN = Total Digestible Nutrients calculated; CP = Crude protein; ADF = acid detergent fiber

(Source: Adapted from Jafari and Rezaeifard, 2010)

How does alfalfa fit beef cattle production from a nutrient perspective? Above the forage nutrient content was touched on as maturity increases. Animal requirements also need to be categorized. This is often done by age of animal, phase of production, and level of performance or production. For beef cows, we typically discuss requirements for the dry cow in mid-gestation, late gestation and then the lactation phase. Table 3 lists the general feeding recommendations for a 1,400 pound beef cow with average milk production for various stages of production. Note that once the calf is weaned and during mid-gestation when fetal growth is minimal, the cow’s nutrient requirements are at the lowest point for the production year. As gestation progresses and fetal growth increases during the last trimester, nutrient requirements increase. The nutrient requirements of the beef cow are highest at peak lactation which occurs about eight weeks after calving.

Table 3. Nutrient requirements for beef cows at various stages of production.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Dry cow, mid-gestation</th>
<th>Last Trimester</th>
<th>Peak Lactation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDN, %</td>
<td>48-50</td>
<td>50-57</td>
<td>58-60</td>
</tr>
<tr>
<td>CP, %</td>
<td>7-8</td>
<td>8-9</td>
<td>9-11</td>
</tr>
<tr>
<td>Ca, %</td>
<td>0.17</td>
<td>0.26</td>
<td>0.28</td>
</tr>
<tr>
<td>P, %</td>
<td>0.13</td>
<td>0.13</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Normal intakes near 2% of body weight on a dry matter basis. No environmental stress.

Alfalfa can meet nutrient requirements of beef cows if harvested at the bud to 1/10 bloom stage. This of course assumes that the cows are in good body condition and there is no cold stress, mud, etc… which would increase maintenance energy requirements. Alfalfa exceeds the crude protein requirement of beef cows at all phases of production and energy would be the first limiting nutrient. Alfalfa cut at full bloom or later would not meet the energy needs for beef cows at peak lactation and body stores
would be mobilized to support lactation reducing cow body condition scores. However, most alfalfa harvested for beef cows is often harvested at less than 1/2 bloom stage and meets the protein and energy requirements at most stages of production. Minimal energy supplementation may be required for beef cows at peak lactation, but much less than required for the typical fescue hay.

For growing calves, the weight of the animal is often considered along with the desired daily rate of gain. Table 4 lists selected nutrients requirements for growing steers at different performance levels. Alfalfa is a great forage for the growing calf. As purchased feeds costs continue to rise, the cost competitiveness of alfalfa improves in grower programs. High quality alfalfa alone may support daily gains in the 2.0 lb/d range. Contrast this to the typical tall fescue hay in which daily gains may only be 1.0 pound.

Table 4. Nutrient requirements for growing steers that have an average weight of 600 pounds at various daily rates of gain.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>1.5 lb</th>
<th>2.0 lb</th>
<th>2.5 lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDN, %</td>
<td>63</td>
<td>68</td>
<td>74</td>
</tr>
<tr>
<td>CP, %</td>
<td>9.8</td>
<td>10.5</td>
<td>11.4</td>
</tr>
<tr>
<td>Ca, %</td>
<td>0.35</td>
<td>0.40</td>
<td>0.46</td>
</tr>
<tr>
<td>P, %</td>
<td>0.21</td>
<td>0.22</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Intake is 15 lbs DM. No environmental stress, ionophore or implants.

A second way to look at this is to use the information from Tables 1 and 2 in a ration balancing software. Using an average weight of 600 lbs for growing steers, rations were formulated to meet the energy and protein needs for 2.5 lb daily gains with 1/10 bloom alfalfa and tall fescue at the milky seed stages. A typical 50:50 blend of soyhulls and corn gluten feed were used as the supplement. Feed was valued as follows: alfalfa hay = $175/ton; fescue hay = $80/ton; soyhulls:corn gluten feed = $250/ton. Alfalfa consumed at 12 lbs per day plus 6 pounds of soyhull:corn gluten feed mixture provided enough energy to support 2.5 lbs/day of gain at an estimated cost of $0.73/lb. When feeding the tall fescue hay, it requires 67% more grain supplementation or 10 lbs of soyhulls and corn gluten mixture to obtain 2.5 lb of daily gain with 6 pounds of fescue hay. However, even with the additional purchased supplement being fed, the feed cost of gain is lower at $0.62/lb. To be cost competitive, alfalfa hay in this example would need to be valued at $125/ton. Even though the alfalfa seems to be less cost competitive in this example, for lower rates of gain such as 1.75 lb/d the estimated feed cost of gain were similar between the two forage diets as less supplement had to be fed with the alfalfa than the fescue. This makes it more attractive in growing or developing replacement heifers than for animals where one desires high rates of gain. Additionally, alfalfa will have greater rates of intake compared to fescue hay that has been cut late and has significant seed content. This is not just because of lower forage digestibility, but also because of the negative impact the endophyte has on forage intake. Reduced intakes lower nutrient intake and will limit performance.
Alfalfa also is a great source of minerals. The calcium content is greater than that of grasses. This is beneficial for beef cows during lactation. As milk production increases, the amount of calcium required to be consumed increases either through the forage or from supplementation. Additionally, alfalfa is generally higher in trace mineral concentrations such as copper and zinc. These are often severely deficient in fescue-based diets. Increasing the proportion of legumes in the stand can increase the trace mineral intake though it will not negate the need to provide a supplemental source such as free-choice mineral.

Alfalfa is an excellent forage to graze and produces greater beef production per unit of land than straight grass stands. Its deep roots allow for greater drought tolerance than shallow-rooted grasses like bluegrass. When grazing alfalfa, it needs to be as if one were cutting it to for stored forage. It can be grazed close to the ground, but it needs about 4-5 weeks of rest between grazing periods. This allows for the root reserves to be replenished and increases stand persistency. This is best achieved by implementing a rotational grazing system. Continuous grazing implemented by most cattle producers will result in overgrazing and weakening of the forage and thinning of the stand quickly. For more information on grazing alfalfa please read fact sheet ID-97 Grazing Alfalfa.

Grazing of alfalfa is met with concerns of bloat. There is a risk of bloat when grazing alfalfa, however, there are management practices than can reduce the risk of bloat. The use of feed additives such as ionophores or poloxalene is one method that can aid in reducing the risk of bloat. Mixing grasses in the pasture stand with alfalfa is another strategy and actually may enhance animal productivity as the digestibility of the cell wall fraction of Neutral Detergent Fiber (NDF) is greater for grasses than alfalfa. Several other management strategies for reducing the risk of bloat when grazing alfalfa can be found in the fact sheet ID-186 Managing Legume-Induced Bloat in Cattle.

In summary, alfalfa has several factors that allow it to fit well into beef production systems. The high productivity of alfalfa combined with great quality attributes makes it attractive to be included in the forage system in some proportion. This forage can meet the nutrient requirements of most phases of production for beef cows and support moderate rates of gain for growing beef calves. Alfalfa does require a higher level of management than other forages, but often greater management has trickle down impact improving the entire operation as management of all factors improves. For those interested in additional information related to forage quality and current hay markets, please review the information in the appendix. Best of luck with your forage systems for your beef operation. Remember to be successful, the forage needs to fit your soil resources and your management resources.
Appendix 1

**USDA Hay Quality Definitions used when reporting hay market prices in various states.**

<table>
<thead>
<tr>
<th></th>
<th>Relative Feed Value (RFV) index</th>
<th>Acid Detergent Fiber (ADF) %</th>
<th>Neutral Detergent Fiber (NDF) %</th>
<th>(Alfalfa*) Crude Protein (CP) %</th>
<th>(Mixed &amp; Grass) Crude Protein (CP) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supreme</td>
<td>&gt; 185</td>
<td>&lt; 27</td>
<td>&lt; 34</td>
<td>&gt; 22</td>
<td>**</td>
</tr>
<tr>
<td>Premium</td>
<td>170-185</td>
<td>27-29</td>
<td>34-36*</td>
<td>20-22</td>
<td>&gt; 13</td>
</tr>
<tr>
<td>Good</td>
<td>150-170</td>
<td>29-32</td>
<td>36-40</td>
<td>18-20</td>
<td>9-13</td>
</tr>
<tr>
<td>Fair</td>
<td>130-150</td>
<td>32-35</td>
<td>40-44</td>
<td>16-18</td>
<td>5-9</td>
</tr>
<tr>
<td>Utility</td>
<td>&lt; 130</td>
<td>&gt; 35</td>
<td>&gt; 44</td>
<td>&lt; 16</td>
<td>&lt; 5</td>
</tr>
</tbody>
</table>

* Alfalfa & alfalfa with up to 10% grass (USDA)

** The 'Supreme' category is not appropriate for grass hays

Visual hay quality descriptions used in the USDA Hay Market News.
(Note: these visual traits do not necessarily equate to the forage analysis ranges listed in the previous chart.)

**Supreme**
Very early maturity, pre-bloom, soft, fine stemmed, extra-leafy. Factors indicative of very high nutritive content. Hay is excellent color and free of damage.

**Premium**
(dairy quality) pre bloom or very early bloom legumes, grass vegetative, generally green with no rain damage

**Good**
(dairy and feedlot quality) early to mid-bloom legumes, grass vegetative or very early head, generally no rain

**Fair**
(feedlot or beef quality) mid- to late-bloom legumes, grass headed, coarse/stemmy, may show some rain damage

**Utility**
(formerly 'Low') - very late maturity, or very coarse/stemmy, or considerable discoloration or rain damage

Appendix 2

Fall Hay Market Report of Regional Prices

“Northern & Central Illinois” (October 2011 USDA Market Report)

Alfalfa:
Supreme:  LgSq $225-235/T
Premium:  SmSq $200-240/T; LgSq $225-245/T
Good:  SmSq $160-200/T; LgSq $175-205/T; LgRd $100-120/T
Fair:  SmSq $100-140/T; LgSq $140-185/T; LgRd $85-120/T
Utility:  SmSq $40-60/T; LgSq $90-135/T; LgRd $60-90/T

Mixed Legume/Grass:
Premium:  SmSq $200-240/T; LgSq $185-245/T
Good:  SmSq $160-200/T; LgSq $165-225/T; LgRd $80-120/T
Fair:  SmSq $100-120/T; LgSq $120-140/T; LgRd $75-85/T
Utility:  SmSq $40-60/T; LgSq $60-80/T; LgRd $45-75/T

Grass:
Premium:  SmSq $160-180/T; LgSq $160-180/T; LgRd $100/T
Good:  SmSq $120-160/T; LgSq $140-180/T; LgRd $80-100/T
Fair:  SmSq $80-120/T; LgSq $80-120/T; LgRd $110-115/T
Utility:  SmSq $40-60/T; LgSq $60-80/T; LgRd $45-50/T

Straw:
SmSq $2.50-4.00/bale; $130-150/T; LgSq $100-130/T; LgRd $70-95/T

“Minnesota (Pipestone) Market” SW MN (Mid- to late- October 2011 USDA Market Report)

Alfalfa:
Supreme:  SmSq $165-175/T; LgSq $165/T; LgRd $162.50-175/T
Premium:  LgRd $130-150/T
Good:  SmSq $4.10-4.40/bale; LgRd $105-125/T
Fair:  LgRd $105/T

Mixed Legume/Grass:
Premium:  (SmSq $162.50/T Oct); LgRd $145-165/T
Good:  (SmSq $90/T Oct); LgRd $105-135/T
Fair:  LgRd $82.50-110/T
Utility:  LgRd $67.50-75/T

Grass:
Premium:  SmSq $117.50-127.50/T; (LgRd $125/T Oct)
Good:  SmSq $95-105/T; LgRd $90-105/T
Fair:  SmSq $80-85/T; LgRd $75-87.50/T
Utility:  LgRd $30-72.50/T

Straw:
SmSq $3.60-4.90/bale; LgSq $24/bale; (LgRd $36/bale Oct)
“Missouri Market” (Mid- to late-October 2011 USDA Market Price Report)

Alfalfa:
- Supreme (RFV >185): SmSq $150-195/T
- Premium (RFV 170-180): SmSq $130-175/T
- Good/Fair (RFV 130-170): SmSq $80-125/T

Mixed Leg/Grass: Good $40-85/T

Grass:
- Supreme/Premium: SmSq $4.00-8.00/bale
- Premium/Good: LgSq $65-150/T
- Good: SmSq $3.00-6.00/bale; $40-120/T
- Good/Fair: LgRd $25-50/bale
- Fair: LgRd $35-75/bale

Prairie hay:
- Premium/Good: SmSq $80-120/T
- Good/Fair: LgRd $40-80/T

Bermudagrass: Good/Fair $80-120/T

Straw: SmSq $2.00-5.00/bale

“Nebraska Market” (Mid- to late- October 2011 USDA Report)

Alfalfa:
- Premium: LgSq $180-200/T
- Good : LgSq $145-180/T; LgRd $120-135/T
- Fair: LgSq $140-150/T; LgRd $100-120/T

Mixed Alfalfa/Grass: (Quality not stated LgSq $180/T Oct)

Grass:
- Good: LgSq $115-145/T; LgRd $90-95/T
- Fair: SmSq $125-135/T; LgRd $70-75/T

Straw: LgRd $60-70/T

Cornstalks: LgSq $80/T; LgRd $50-60/T, $75/T delivered

‘Cane’ (sorghum & sorghumxsudangrass): LgRd $70-80/T