Interactions of forage quality and quantity, their implications in grazing and hay management

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Outline

1. Factors affecting forage quality
2. Planning proper stocking rate for multipurpose crops
3. Quality vs. quantity considerations for haying multipurpose crops
4. Final considerations
Factors affecting Forage Quality

Five main factors:
- Plant species
- Plant part
- Climate
- Fertilization
- Diurnal fluctuations
- Stage of Maturity
Factors affecting forage quality: **Plant Species**

- **Legumes** > **Cool season grasses** > **Tropical grasses**

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Legend:
- Dairy cow, 57 lb milk/day
- 500 lb Steer, 2.5 lb daily gain
- Mature brood cow, average milking ability
- Dry, beef brood cow (2nd trimester)
Factors affecting forage quality: **Plant Parts**

- Leaves have higher quality than stems
- Young plant tissues have higher quality than old
- **Upper canopy has higher quality than lower canopy**
Factors affecting forage quality: **Plant Parts**

- The higher the Leaf:Stem ratio, the higher the quality.
- Correct rotational grazing will keep the pasture in a leafy state through the season.

Source: [http://learn.e-limu.org/topic/view/?t=27&c=5 Limu website](http://learn.e-limu.org/topic/view/?t=27&c=5)
Did you mean Leaf/Stem?
Paulina Velez Gomez, 2/29/2016
Factors affecting forage quality:

**Climate**

- **High temperature (Summer):**
  - may decrease digestibility and crude protein

- **Drought:**
  - nitrates or prussic acid poisoning

- **Wet (less likely):**
  - Less dry matter intake (sorghum-sudan, pearl millet)
  - Low crude protein (nutrient leaching)
Factors affecting forage quality:

**Diurnal Fluctuations**

- **Time of the day affects soluble carbohydrates levels:**
  - high SCLs during late afternoon,
  - low SCLs during morning

**Fertilization**

- **Nitrogen:**
  - may increase CP if other nutrients are not deficient
  - little effect in very young forages

- **Sulfur and Calcium:**
  - In deficient, application of S and Ca increase forage digestibility (improves rumen fermentation).
Factors affecting forage quality: Maturity Stages

Forage quality decreases as plant maturity progresses.
There is a trade-off between quality and quantity of forage produced. Mature forages will have higher yields and lower quality (High lignin content and low soluble carbohydrates). The opposite is true!
Take out this comma
Paulina Velez Gomez, 2/29/2016
Therefore, we must find the "happy medium point". The growing season period where good forage quality and good yield amount coexist.

Changes according to:
- Type of forage
- Type of livestock
- Growth stage of livestock
Potential cool-season cover crops

- Wheat
- Rye
- Ryegrass
- Triticale
- Barley
- Oats
Potential cool-season multipurpose crop (cover crop and forage)

- **Wheat**
  - good winterkill tolerance
  - versatile crop: grain – forage – cover crop
  - withstand wetter soils than barley or oats
  - less tolerant of poorly drained soils than rye or triticale
Potential cool-season multipurpose crop (cover crop and forage)

- **Rye**
  - High winter kill tolerance
  - Adapted to low fertility soils
  - Produces more forage in Fall than Spring.
Potential cool-season multipurpose crop (cover crop and forage)

- **Ryegrass**
  - Production decreases in NW Oklahoma (better growth in wet soils)
  - Produces more forage in spring (matures late)
  - Tolerates high grazing level
Potential cool-season multipurpose crop (cover crop and forage)

- **Triticale**
  - Wheat x Rye
  - Adapted for Fall forage production (early planning)
  - Longer grazing period than rye and wheat
  - Higher tolerance to drought, pests, low pH than wheat
Potential cool-season multipurpose crop (cover crop and forage)

- **Barley**
  - Less winter-hardy than rye and wheat
  - May need to be cultivated early in Fall
  - Provides good forage cover; however other options might be a better option
Cool-season multipurpose crop

- **Oats**
  - prone to winterkill which limits it to Southern OK
  - planted in
    - late summer - early fall
    - late winter - early spring
Potential cool-season multipurpose crop (cover crop and forage)

Table 1. Planting information for cool-season annual grasses¹.

<table>
<thead>
<tr>
<th>Species</th>
<th>Planting Date</th>
<th>Seeding Rate (lbs/ac)</th>
<th>Planting Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>Late Aug-Sept</td>
<td>90-120</td>
<td>1-2”</td>
</tr>
<tr>
<td>Oat</td>
<td>Late Aug-Sept</td>
<td>60-90</td>
<td>1-2”</td>
</tr>
<tr>
<td>Rye</td>
<td>Late Aug-Sept</td>
<td>90-120</td>
<td>1-2”</td>
</tr>
<tr>
<td>Ryegrass</td>
<td>Late Sept, Jan</td>
<td>20-30</td>
<td>1/4-1/2”²</td>
</tr>
<tr>
<td>Triticale</td>
<td>Late Aug-Sept</td>
<td>90-120</td>
<td>3/4-1”</td>
</tr>
</tbody>
</table>

¹ Assumes planting primarily for forage
² Annual ryegrass does not require seedbed preparation.

Source: OSU Extension Facts F-2517: Cool-season Forage Grasses
Potential cool-season multipurpose crop (cover crop and forage)

Two years average forage yield, Ardmore, OK

Forage Yield (lbs. acre⁻¹)

- Oat
- Rye
- Ryegrass
- Triticale
- Wheat

Source: OSU Extension Facts F-2517: Cool-season Forage Grasses
**Cover Crop + Grazing = Multipurpose Crop**

- **Benefits:**
  - Grazing ensure nutrient recycling
  - Remove excessive no till residue
  - Cover crop termination
  - Increase Profit (animal gain)

- **Issues:**
  - Make sure that 90-100% ground cover is left after grazing, otherwise
    - Soil moisture losses
    - Soil compaction

*Use light or moderate stocking rate as your grazing strategy!*
Light to moderate grazing not only assure good soil cover but also good net return.
Cool-season multipurpose crop

- **Grazing considerations for cool-season small grains.**
  - **Start grazing** when forage reaches **6-8 inches high** (4-6 weeks after planting)
  - Grazing should **stop** when plant height reaches **3-4 inches high**
  - Resume grazing when forages reach 6-8 inches high

- **Low regrowth will be observed late Fall if:**
  - cattle is introduced too early during early Fall (before forage reaches 6-8 inches)
  - cattle grazes plants too short (lower than 3-4 inches)
Cool-season multipurpose crop

Grazing considerations for cool-season small grains.

Table 6. Small grain forage yield and quality when harvested in the vegetative stage, June 2012.

<table>
<thead>
<tr>
<th>Vegetative Stage</th>
<th>DM %</th>
<th>Yield lb ac⁻¹</th>
<th>CP %</th>
<th>ADF %</th>
<th>NDF %</th>
<th>dNDF %</th>
<th>Starch %</th>
<th>TDN %</th>
<th>NEL Mcal lb⁻¹</th>
<th>NFC %</th>
<th>NSC %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everleaf Oats</td>
<td>12.4</td>
<td>3180</td>
<td>19.9*</td>
<td>29.0*</td>
<td>42.7</td>
<td>60.3</td>
<td>2.8</td>
<td>65.2</td>
<td>0.678</td>
<td>23.7*</td>
<td>12.7*</td>
</tr>
<tr>
<td>Tack Oats</td>
<td>14.4</td>
<td>4183</td>
<td>15.0</td>
<td>33.2</td>
<td>51.7</td>
<td>61.9</td>
<td>2.2</td>
<td>62.6</td>
<td>0.648</td>
<td>21.6*</td>
<td>12.0*</td>
</tr>
<tr>
<td>Triticale 141</td>
<td>15.5</td>
<td>3344</td>
<td>18.2</td>
<td>33.6</td>
<td>51.4</td>
<td>58.8</td>
<td>2.9</td>
<td>62.1</td>
<td>0.640</td>
<td>18.1</td>
<td>10.8</td>
</tr>
<tr>
<td>Magog Wheat</td>
<td>21.2</td>
<td>3185</td>
<td>18.9*</td>
<td>32.2</td>
<td>50.4</td>
<td>62.6</td>
<td>2.2</td>
<td>63.7</td>
<td>0.660</td>
<td>19.3</td>
<td>11.1</td>
</tr>
<tr>
<td>Soren Wheat</td>
<td>17.5</td>
<td>2582</td>
<td>19.1*</td>
<td>31.2*</td>
<td>49.6</td>
<td>61.5</td>
<td>3.0</td>
<td>64.6</td>
<td>0.670</td>
<td>20.4</td>
<td>11.4</td>
</tr>
<tr>
<td>Veg Stage Mean</td>
<td>16.2</td>
<td>3295</td>
<td>18.2</td>
<td>31.8</td>
<td>49.2</td>
<td>61.0</td>
<td>2.6</td>
<td>63.6</td>
<td>0.659</td>
<td>20.6</td>
<td>11.6</td>
</tr>
<tr>
<td>LSD</td>
<td>NS</td>
<td>759</td>
<td>1.23</td>
<td>2.67</td>
<td>2.84</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>2.36</td>
<td>1.13</td>
</tr>
</tbody>
</table>

Varieties with an asterisk indicate that it was not significantly different than the top performer in column (in bold).

NS - None of the varieties were significantly different from one another.

Calculating Stocking Rate

1. **Forage/acre = 600 lbs/acre (4 x 150)**
   - Plant height = 8 in – 4 in = 4 in.
   - Forage available = 150 lbs/ac/inch
Calculating Stocking Rate

2. **Paddock size = 10 acres, 4 fields or paddocks**
   - Total area = 40 acres/4 paddocks = 10 acres/paddock
   - Each paddock grazed for 1 weeks, rested for 3 weeks

3. **Total available forage = 3,600 lbs/paddock**
   - Slow rotation (4 paddocks) = 60%

<table>
<thead>
<tr>
<th>Grazing Method</th>
<th>Low Efficiency</th>
<th>High Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Stocking</td>
<td>30%</td>
<td>50%</td>
</tr>
<tr>
<td>Slow Rotation (2-4 paddocks)</td>
<td>50%</td>
<td>60%</td>
</tr>
<tr>
<td>Moderate Rotation (4-6 paddocks)</td>
<td><strong>60%</strong></td>
<td><strong>70%</strong></td>
</tr>
<tr>
<td>Strip Grazing, MOB, Daily, etc.</td>
<td>70%</td>
<td>80%</td>
</tr>
<tr>
<td>Hay Harvest</td>
<td>30%</td>
<td>75%</td>
</tr>
</tbody>
</table>
Calculating Stocking Rate

4. **1 animal-unit consumes 26 lbs forage/day**
   - 1 animal-unit (AU) = 1,000 lbs mature cow
   - 1 AU consumes in average 2.6% of its weight per day

5. **Total number of animals = 19.7 AU**
   - 3600 lbs/paddock / 26 lbs forage day / 7 days
Cool-season multipurpose crop

**Hay production**

YIELD

```
<table>
<thead>
<tr>
<th>Growth Stage</th>
<th>Summit</th>
<th>Stellar</th>
<th>Plata</th>
<th>Trical 96</th>
<th>Crown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boot</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Flowering</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Milk</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Soft Dough</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>
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CRUDE PROTEIN

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<table>
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<th>Growth Stage</th>
<th>Summit</th>
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<td>13</td>
<td>12</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Milk</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Soft Dough</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>8</td>
</tr>
</tbody>
</table>
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Cool-season multipurpose crop

Hay production

Cool-season multipurpose crop

- **Hay production - Cutting time**
  - CP, NDF, and ADF are higher at boot stage
  - Total yield and TDN are higher at soft dough stage
    - Yields were 2-4 times higher
    - High TDN are related to grain filling after flowering (high NSC, NDF/ADF dilution)
  - Harvest at boot stage for high CP
  - Harvest at soft dough for high Yield and **Energy (TDN)**
One last thing: Nitrate toxicity

- It can be include to the forage analysis.

### Interpretation for forage nitrate test:

<table>
<thead>
<tr>
<th>ppm NO$_3$ (dry matter basis)</th>
<th>interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3,000</td>
<td>Generally safe for all cattle</td>
</tr>
<tr>
<td>3,000-5,000</td>
<td>Generally safe for non-pregnant beef cattle. Low risk of reduced breeding performance and early term abortions. Total ration for dairy cattle should be less than 2500 ppm NO$_3$.</td>
</tr>
<tr>
<td>5,000-10,000</td>
<td>Some risk for all cattle. May cause mid to late term abortions and weak newborn calves. May decrease growth and milk production.</td>
</tr>
<tr>
<td>&gt;10,000</td>
<td>Potentially toxic for all cattle. Can cause abortions, acute toxicity symptoms, and death.</td>
</tr>
</tbody>
</table>
Questions?

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