GUIDELINES FOR PRODUCING QUALITY FORAGE

FGV-00247

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FORAGE
A highly digestible vegetative material in either a fresh, dried or preserved state which constitutes the major feed ingredient of many livestock rations.

PRIMARY PURPOSE
To economically produce the maximum amount of nutrients per acre.

BASIC GUIDELINES
Varieties¹: Choose a forage variety that is adapted to the specific climate and soil conditions on which it is to be grown. Also consider the plant’s nutritional qualities, palatability, winter hardiness, regrowth potential, yield characteristics, fertilizer and water requirements, and drought resistance.

Table 1 depicts some of the nutritional differences in various species.

Table 1. Chemical Analysis of Some Common Forage Plants From The Matanuska Valley

<table>
<thead>
<tr>
<th>Forage &amp; Growth Stage</th>
<th>Dry Matter %</th>
<th>Crude Protein %</th>
<th>Fat %</th>
<th>Crude Fiber %</th>
<th>Nitrogen Free Extract %</th>
<th>Ash %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue joint (Calamagrostis sp)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>just before flowering</td>
<td>33.7</td>
<td>17.5</td>
<td>1.9</td>
<td>27.6</td>
<td>36.4</td>
<td>12.0</td>
</tr>
<tr>
<td>in flower</td>
<td>42.3</td>
<td>4.6</td>
<td>1.0</td>
<td>42.9</td>
<td>40.4</td>
<td>3.9</td>
</tr>
<tr>
<td>Sedge, just</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>before flowering</td>
<td>37.8</td>
<td>10.3</td>
<td>2.1</td>
<td>25.7</td>
<td>45.3</td>
<td>10.6</td>
</tr>
<tr>
<td>Fireweed, just</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>before flowering</td>
<td>28.7</td>
<td>19.4</td>
<td>1.8</td>
<td>14.9</td>
<td>50.1</td>
<td>8.1</td>
</tr>
<tr>
<td>Horsetail (Equisetum)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluegrass, just</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>before flowering</td>
<td>39.0</td>
<td>9.2</td>
<td>1.6</td>
<td>16.5</td>
<td>39.4</td>
<td>27.5</td>
</tr>
<tr>
<td>Timothy, just</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>before flowering</td>
<td>31.1</td>
<td>8.2</td>
<td>2.8</td>
<td>29.8</td>
<td>42.1</td>
<td>6.5</td>
</tr>
<tr>
<td>Bromegrass, just</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>before flowering</td>
<td>29.0</td>
<td>9.2</td>
<td>2.7</td>
<td>27.4</td>
<td>42.7</td>
<td>6.5</td>
</tr>
<tr>
<td>Oats &amp; peas, oats in late milk stage</td>
<td>25.3</td>
<td>12.1</td>
<td>2.9</td>
<td>27.2</td>
<td>39.1</td>
<td>7.8</td>
</tr>
</tbody>
</table>

¹(Reference: Better Forage for Alaska’s Dairy Industry)

¹(Examples: Engmo Timothy, Manchar Smooth Brome, Arctared Fescue, Nugget Kentucky Bluegrass).
Seedbed and Seeding:
1. Prepare a firm, clean, moist seedbed as weed-free as possible.
2. Use only certified seed.
3. Drill the seed, using a grain drill, Brillion seeder or similar implement.
4. Seed at the proper depth and rate, into moist soil followed by a packing, to seal in ground moisture and promote good soil-seed contact.
5. Plant early in the season – preferably not later than mid-July. This should produce a dense, pure stand of desired forage capable of overwintering.

Companion Crop: The use of companion crops with perennial grasses is not recommended as they present considerable competition. If a companion crop is planted, it should be planted at one-half the recommended solid stand seeding rate or less, and harvested and/or removed by early August to permit maximum growth of the perennial forage prior to the onset of winter.

Annual Fertilizer: Test the soil to determine what nutrients are available. Use the soil analysis as a guide to select appropriate fertilizers for sufficient balancing of soil nutrients to meet the forage requirements for your expected yield. The influence of nitrogen on bromegrass yield and protein content is shown in Table 2. Select the proper form of fertilizer and apply it correctly to achieve full benefits (Panciera, 1992). One ton of grass hay contains approximately 40 lbs. of nitrogen, 10 lbs. of phosphorus, 50 lbs. of potassium and 3 lbs. of sulfur.

<table>
<thead>
<tr>
<th>Pounds of Nitrogen per Acre per Year</th>
<th>Crude Protein in Crop (%)</th>
<th>Dry Matter (lbs/acre)</th>
<th>Approximate Yields</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hay (tons/acre)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Silage (tons/acre)</td>
</tr>
<tr>
<td>None</td>
<td>11.2</td>
<td>100</td>
<td>0.5</td>
</tr>
<tr>
<td>16</td>
<td>11.4</td>
<td>132</td>
<td>1,158</td>
</tr>
<tr>
<td>32</td>
<td>12.4</td>
<td>182</td>
<td>1,467</td>
</tr>
<tr>
<td>64</td>
<td>14.6</td>
<td>324</td>
<td>2,213</td>
</tr>
<tr>
<td>128</td>
<td>18.3</td>
<td>636</td>
<td>3,480</td>
</tr>
</tbody>
</table>

(Reference: Better Forage for Alaska’s Dairy Industry)

Control Weeds: Weeds compete with the forage crop for space, moisture, sunlight, and nutrients. They often cause more than 50% of their damage before producing a seedhead. Most weeds will not yield the quantity of digestible nutrients that domestic forages will. Anticipate your weed problems early and be prepared to control them as necessary.
Harvest at Optimum Maturity: The quality of a forage will never improve beyond that at the time of harvest. Harvest at the optimum period for maximum production of total nutrients. Stage of maturity at harvest has a very significant effect on forage quality as seen in Table 3.

Table 3: Quality & Quantity of Bromegrass
Harvested At Different Stages Of Maturity

<table>
<thead>
<tr>
<th>Date</th>
<th>Stage of Growth When Harvested</th>
<th>% Crude Protein</th>
<th>Yield per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/28</td>
<td>3 - 6 inches of early growth</td>
<td>27.4</td>
<td>1,080 lbs</td>
</tr>
<tr>
<td>6/12</td>
<td>Internodes elongating, 10&quot; high</td>
<td>22.1</td>
<td>1,835 lbs</td>
</tr>
<tr>
<td>6/26</td>
<td>Still growing, 27&quot; high</td>
<td>13.7</td>
<td>3,600 lbs</td>
</tr>
<tr>
<td>7/10</td>
<td>Panicles emerged, full bloom</td>
<td>12.2</td>
<td>4,364 lbs</td>
</tr>
<tr>
<td>8/07</td>
<td>Seeds developing</td>
<td>10.2</td>
<td>5,079 lbs</td>
</tr>
<tr>
<td>8/28</td>
<td>Seed ripened, leaves yellow</td>
<td>5.4</td>
<td>6,030 lbs</td>
</tr>
<tr>
<td>9/25</td>
<td>Leaves dry and shattering</td>
<td>4.2</td>
<td>3,392 lbs</td>
</tr>
</tbody>
</table>

(Reference: Better Forage for Alaska’s Dairy Industry)

The most economical production of nutrients requires a certain trade-off between dry matter yields and nutrient content, as illustrated in Figure 1. Harvesting early in the growing season, at the early heading stage (see Line A, Figure 1), will provide both good quality (digestible nutrients) and quantity (yield) of forage. In addition, this will hasten regrowth and improve harvest opportunities of the second crop.

Figure 1: Bromegrass at Different Stages of Development

(Reference: Alberta Forage Course)
**Harvest and Store Properly:** Normal losses incurred in the production of field-cured hay are presented in Table 4. The extent of loss varies with weather conditions, equipment operating speeds and adjustment and storage facilities. These losses can be minimized by:

- Mowing only what can be harvested each day to avoid rain damage.
- Use a hay conditioner to speed drying.
- Do not windrow hay with a conditioner - this delays drying.
- Rake hay when moisture is approximately 40% to reduce leaf shatter.
- Avoid excess speed when raking which causes leaf loss.
- A hay tedder can be used to spread and fluff wet windrows following rains.
- Windrow inverters can be used to turn over a windrow exposing the damp underside and moving it onto dry stubble.
- Bale at 20% moisture or less to avoid spoilage.
- Store under cover to prevent weathering losses from rain and snow.

**Table 4: Losses During Field-Curing Of Hay**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Loss in Dry Matter</th>
<th>Loss Via</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting</td>
<td>1 – 6 %</td>
<td>Respiration</td>
</tr>
<tr>
<td>Conditioning</td>
<td>1 – 4 %</td>
<td>Respiration &amp; Mechanical</td>
</tr>
<tr>
<td>Raking</td>
<td>5 – 15%</td>
<td>Mechanical</td>
</tr>
<tr>
<td>Baling</td>
<td>1 – 15%</td>
<td>Mechanical</td>
</tr>
<tr>
<td>Rain (1 inch)</td>
<td>3.5%</td>
<td>Nutrient leaching, Respiration &amp; Mechanical (re-rake)</td>
</tr>
<tr>
<td>Storage</td>
<td>5 – 10%</td>
<td>Microbial growth &amp; Heat (Some heating until 15% moisture)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Fungi break down complex sugars)</td>
</tr>
<tr>
<td><strong>Total losses</strong></td>
<td><strong>13 – 50%</strong></td>
<td></td>
</tr>
</tbody>
</table>

(Reference: *Hay Preservation*)

**Preservatives**: Some preservatives and drying agents (organic acids, liquid urea, anhydrous ammonia, bacteria) can be used to preserve higher moisture forage (up to 25% and perhaps even 30%) by inhibiting the formation of molds. In some cases they may also increase digestibility and provide a source of non-protein nitrogen.

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2 Contact your nearest Cooperative Extension Agent for specifics relating to your area.
DRY FORAGE ALTERNATIVES

SILAGE
Silage is a fermented high-moisture (usually 40 - 70%) forage stored under oxygen-limiting conditions.

Advantages:
• Less weather related harvest delays - more nutrients harvested.
• Totally mechanical harvest.
• Weed seeds destroyed in preservation process.
• Tends to improve palatability and lessen feeding waste.
• Shortens harvest time.
• Good storage life.

Disadvantages:
• Faster harvest demands proper timing and management skills.
• Contains more weight and bulk because of additional moisture.
• Less marketable than hay.
• Better management required to prevent spoilage.
• Susceptible to freezing.
• Requires specialized storage and feeding equipment - silos, bunkers (limit oxygen).

Producing Quality Silage
1. Harvest at the proper stage of maturity.
2. Allow forage to wilt to 50 - 65% moisture before chopping.
   a. Moisture greater than 65% causes seepage losses, reduced palatability, freezing problems and impedes fermentation.
   b. Moisture less than 50% increases compaction problems and spoilage.
3. Fine chopping - chop hollow-stemmed plants (grass and small grains) at 1/4" - 3/8" in length to aid in proper packing and air exclusion.
4. Pack and fill the silo as rapidly as possible. Do not fill a bunker silo layer by layer, but fill at an incline from the back to expose the least possible surface area to the air.
5. Seal the silo when full to prevent air intake and spoilage.

HAYLAGE
Haylage or Balage is the process of preserving high moisture hay (usually 40-60% moisture) bales, either in bags or wrapped in stretch-tight plastic to seal in moisture and limit oxygen.

Advantages:
• Bales are somewhat mobile and can be placed in favorable locations around farm.
• Many weed seeds destroyed in preservation process.
• Reduces fuel consumption 33% below normal silage production costs.
• Good winter storage life.
• Bale can be self-fed.
Disadvantages:
• Primarily suited for large bale applications.
• Less marketable than hay, if freight is a factor.
• Better management techniques are necessary to insure quality control and prevent product spoilage.
• Contains more weight and bulk because of additional moisture. Livestock feeder will have to adjust rations to insure dry matter intake needs are met (1 lb. of 60% moisture haylage does not equal 1 lb. of 15% moisture hay).
• Equipment costs: need high moisture baler, medium-high horsepower tractor, bale wrapping equipment, plastic wrap and squeeze equipment to pick up and move wrapped bales.
• Birds, rodents and moose can damage sealed plastic wrap.
• Plastic disposal.

Quality Haylage Production
1. Harvest at the proper stage of maturity.
2. Allow forage to wilt to 40-60% moisture before baling and wrapping.
   a. Moisture greater than 60% causes seepage losses, reduced palatability, freezing problems and impedes fermentation.
   b. Moisture less than 40% may cause improper fermentation and spoilage under certain conditions (ie. warm weather). This is an area requiring further research to determine potential benefits/problems under Alaska conditions.
3. Bale and wrap as soon as possible after forage has reached a desired moisture content to minimize forage deterioration and changes in moisture content. Do not bale with excess surface moisture on forage (i.e., during rain or with a heavy dew).
4. Place wrapped bales in a well-drained site free of vegetation and trash. It is preferred that bales be placed in permanent storage areas after initial wrap to minimize damage to wrapping.
5. All wrapped bales should be periodically inspected for holes in plastic and patched immediately regardless of size. Duct-tape works well.
REFERENCES

Alberta Agriculture 1981. *Alberta Forage Course*, University of Alberta, Faculty of Extension, 1981.

Bolson, K. and H. ILG. *How to Make Good Silage*. Kansas State University. CES publication #C-618, 1980.


*Contact your local Cooperative Extension Service office for further publications on forages, fertilization, weed control or other related brochures.*

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