Improving Grass Hay Quality Through Fertilizer and Irrigation Management

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Introduction

Grass and grass-clover hay is produced on more than 200,000 acres in northeastern Nevada. Hay quality is dependent on factors that include: the type of plants in the field; the time of harvest; fertilization practices; and irrigation management.

This fact sheet focuses on how irrigation and fertilizer management determine which plants will grow in a hay field. The type of plants growing in the field will directly impact the quality of the harvested hay. Proper management can increase the number of desirable plant species and improve their quality.

Most meadow haylands in northeastern Nevada are irrigated under a system of continuous irrigation. Meadows are saturated during the growing season and dry during late summer, encouraging the growth of sedges and rushes, both low quality plants.

Applying water for a prescribed period every other week is often called intermittent irrigation. The soil type will dictate the amount of water and how long it will remain on the field. This type of irrigation promotes warmer soil temperatures and more soil oxygen. Both of these factors favor the more desirable grass species that improve hay quality.

Fertilizer applications are even more important in changing the plant species composition in a meadow. However, when determining which meadows will respond to fertilizer, the presence of sedges and rushes can be misleading. If fertilizer has not been used previously, and small amounts of desirable grass species are present, fertilizer applications can change the composition to predominantly grasses. This conversion may take from three to five years. Applying higher rates of fertilizer will speed up the process. If the use of fertilizer is discontinued, sedges and rushes will once again become the dominant plants in the field.

Nitrogen is the most important fertilizer element to apply. The quantity is more important than the type of nitrogen applied. As a rule of thumb, 80 to 100 pounds of actual nitrogen should be applied on each acre of meadow. Higher rates will speed up the conversion, but may not be economical. These high rates of nitrogen will also increase production of hay on most meadows if they are irrigated properly.
Nitrogen should be applied in the fall unless the fields are wet throughout the winter because of a high water table or flooding. If the fields are grazed in the spring, fertilizer should be applied after livestock are removed. Nitrogen concentrates in leaves. If livestock remove the leaves, nitrogen is lost.

Phosphate fertilizer applications are also often beneficial on Nevada hay meadows. The soils are usually shallow and have a high pH. Both factors limit the amount of phosphorous available to plants. When phosphorous is needed, producers should apply three parts nitrogen to one part phosphorous (i.e. 30-10-0). Other macro and micro nutrients required for plant growth are normally not deficient in northeastern Nevada.

Percent crude protein and total digestible nutrients (TDN) are often used as indicators of hay quality. As the percentages of crude protein and TDN increase, hay quality also rises. The crude protein percentages represent nitrogen compounds in forage and are lumped together when computing rations for livestock. TDN is a calculated figure representing the sum of all the digestible organic nutrients in the feed.

Forage test results obtained over the past 40 years in northeastern Nevada demonstrate the value of fertilizing hay to improve quality. These results are supported by research data in Colorado, Oregon, and Idaho. In all instances, crude protein levels were increased by the application of nitrogen. Some words of caution are in order. Nitrogen rates less than 80 pounds per acre may actually reduce protein levels. Small amounts of nitrogen will increase early plant growth, but the nitrogen is soon depleted. The plants continue to grow, the amount of nitrogen in the leaves is diluted, and reduced protein levels result.

More than 300 hay samples were obtained in northeastern Nevada from 1946 through 1987. Chemical analysis of these samples indicate that crude protein levels can be increased by an average of 2.6 percent with the addition of fertilizers. Hay cut early (before July 15) and fertilized, averaged 5.0 percent higher in crude protein than non-fertilized, late cut (after July 15) hay.

Table 1 summarizes the average chemical analysis obtained from samples. Samples were divided into fertilized and non-fertilized hay. The fertilized hays received varying amounts and types of nutrients. The figures shown in Table 1 represent a combination of hays cut early and late.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>% Crude Protein</th>
<th>% Phosphorus</th>
<th>% Calcium</th>
<th>%Crude Protein</th>
<th>% TDN*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilized</td>
<td>10.10</td>
<td>0.21</td>
<td>0.45</td>
<td>30.90</td>
<td>55.10</td>
</tr>
<tr>
<td>Non-fertilized</td>
<td>7.51</td>
<td>0.17</td>
<td>0.54</td>
<td>31.20</td>
<td>51.30</td>
</tr>
<tr>
<td>Difference</td>
<td>-2.59</td>
<td>-0.04</td>
<td>0.09</td>
<td>0.03</td>
<td>-3.80</td>
</tr>
<tr>
<td>% Change</td>
<td>-25.60</td>
<td>19.70</td>
<td>20.00</td>
<td>0.10</td>
<td>-6.90</td>
</tr>
</tbody>
</table>

*TDN = Crude Protein x 1.454 + 40385

The quality differences are readily apparent when compared to the nutrient requirements of a pregnant, 1000-pound cow. Table 2 shows the nutrient requirements of a 1000-pound cow during the middle and last thirds of pregnancy (October-March). It also details how each hay does or does not meet the requirements of that cow. Table 2 clearly shows that non-fertilized hay does not meet a cow’s requirements in any category except calcium. Table 2 also shows that fertilized hay is adequate in every category.
Table 2. Nutrient requirements of a 1000-pound cow during the last two-thirds of pregnancy compared to the nutritive value of fertilized and non-fertilized northeastern Nevada hays

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Nutrient Requirements Middle 3\textsuperscript{rd}</th>
<th>Nutrient Requirements Last 3\textsuperscript{rd}</th>
<th>Nutrient Value Fertilized</th>
<th>Nutrient Value Non-Fertilized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein %</td>
<td>7.00</td>
<td>7.90</td>
<td>10.10</td>
<td>(7.50)*</td>
</tr>
<tr>
<td>TDN %</td>
<td>48.80</td>
<td>53.60</td>
<td>55.10</td>
<td>(51.30)</td>
</tr>
<tr>
<td>Calcium %</td>
<td>.18</td>
<td>.26</td>
<td>.45</td>
<td>.54</td>
</tr>
<tr>
<td>Phosphorus %</td>
<td>.18</td>
<td>.20</td>
<td>.21</td>
<td>(.17)</td>
</tr>
</tbody>
</table>

*Figures in parenthesis do not meet the nutrient requirements of a 1000-pound pregnant cow.

Hay yields are usually expressed as tons of hay harvested per acre. However, a measurement such as pounds of crude protein harvested per acre may be more meaningful when determining production. Fertilized hay produces an average of 2.6 percent more crude protein per acre than non-fertilized hay. This means fertilized hay will produce 52 more pounds of crude protein per acre than non-fertilized hay. The fertilizer will also produce significantly more total forage from the same acreage.

Several factors determine the economic returns from a fertilization program. Typically, fields with favorable soils and abundant, manageable water will produce the greatest economic returns. However, lower quality field can also produce economic returns if fertilizer prices are not too high. Producers are advised to follow recommended irrigation practices and then try fertilization on a small scale. Production increases should then be compared with the cost of the fertilizer. Producers should remember that changing plant species with fertilizer and water management takes time. A two to three-year trial may be necessary.

Summary

Grass hay producers in northeastern Nevada can produce high quality hay with a proper management program. That program should include intermittent irrigation, application of fertilizers, and cutting at the proper stage. Each individual practice is helpful, but by applying all three techniques, the highest quality hay is produced at the lowest price.

Literature Cited