Influence of Clipping Frequency on Herbage Yield and Nutrient Content of Tall Wheatgrass

D. J. UNDERSANDER AND C. H. NAYLOR

Abstract

Grazing or cutting frequency has been shown to affect yield and quality of many grasses, but similar data are lacking for tall wheatgrass [Agropyron elongatum (Host) Beauv. 'Jose']. The objective of the research was to determine the effect of frequency of clipping on tall wheatgrass. The study was conducted at the Texas Agricultural Experiment Station at Bushland, Texas, in 1979, 1980, 1981, and 1984 on a Pullman clay loam soil. Plots were irrigated as needed from February to the end of the growing season and fertilized with 112 kg N/ha every 2 months for maximum yield and clipped every week, 2 weeks, or 4 weeks at a 5-cm stubble height. Herbage yield was highest from spring harvests and declined over summer as is typical of cool-season grasses. The plots that were clipped every 4 weeks produced greater herbage yields than plots that were clipped 1 or 2 weeks, suggesting that rotational grazing would increase productivity. The nutrient content of the herbage was highest during summer when herbage yield was lowest. Plants clipped less frequently had the highest concentrations of phosphorus and potassium and the lowest concentrations of calcium and magnesium. The greatest differences in nutrient content occurred among years, which emphasizes the importance of continual herbage analysis to optimize mineral supplementation of grazing cattle.

Key Words: Agropyron elongatum, nitrogen, phosphorus, potassium, calcium, magnesium

The dry winter and wet summer precipitation pattern of the Southern Plains favors warm-season grasses. Cattle are grazed on wheat (Triticum aestivum L.) pasture during the early November to mid-March period prior to the time when warm-season grasses are available for grazing. This void in available pasture has increased interest in cool-season grasses, particularly where supplemental irrigation is available. In recent years, tall wheatgrass [Agropyron elongatum (Host) Beauv.] has been grown on many hectares in the Southern Plains. This cool-season grass begins growth early in March most years and provides pasture near the time cattle are taken off wheat pasture. Little information is available on the management of this grass in the Southern Plains. Schuster and Garcia (1973) reported tall wheatgrass to be the easiest to establish of several cool-season species evaluated in the Texas Panhandle. They further reported that tall wheatgrass would be available for grazing in late September through November until wheat was available for grazing and that it could be grazed in the spring beginning in April when the cattle are removed from wheat pasture. They found that tall wheatgrass survived under dryland conditions when other cool-season grasses, that yielded more under full irrigation, did not survive.

Clipping has been shown to increase herbage yields of some species, (Drawe et al. 1972, Eck et al. 1975, Svejcar and Rittenhouse 1982) while clipping too frequently reduced yields and reduced plant survival of crested wheatgrass (Carter and Law 1948) and of rough fescue (McLean and Wikeem 1985). Pitman and Holt (1983), when evaluating 2-, 4-, and 8-week harvest frequencies of kleingrass (Panicum coloratum L.), green sprangletop
generally increased dry matter production of the grasses, and also
found that the 4-week harvest frequency produced optimum yields of
highly digestible, leafy herbage.

Similar information on the effects of clipping frequency is not
available for tall wheatgrass. Further, there is little information on
seasonal changes or effects of frequency of clipping or grazing on
nutrient content. Such information may be useful for suggesting
supplementation regimes for cattle grazing tall wheatgrass.

The objectives of this research were to evaluate the effect of
frequency of clipping on yield and nutrient content of tall wheat-
grass over the growing season.

Materials and Methods

Tall wheatgrass cv. 'Jose' was established in pure stands in level
bordered field plots during the fall of 1978 and 1983. The soil was a
Pullman clay loam (fine, mixed, thermic Torrertic Paleustoll). Plots were fertilized with 112 kg N/ha as ammonium nitrate, at the
end of February, April, June, and August of 1979-1984. Plots were
irrigated from the beginning of February until mid-October when-
erver visual symptoms of stress occurred. Approximately 5 m water
per week was applied to the plots during peak water use periods,
less during spring and fall.

Treatments consisted of 3 frequencies of clipping: every 1, 2, or 4
weeks. Treatments, in 1.2 X 3-m plots, were arranged in a random-
ized complete block design with 3 replications. Once randomized,
plot areas were not changed during 1979 to 1981. No observable
stand changes occurred that could be attributed to clipping fre-
quency. Data from 1984 were from a new seeding made in Sep-
tember 1983. Entire plots were clipped with a lawn mower at 5-cm
stubble height and accumulated at dates shown in Table 1 when
4-week clippings occurred. Individual harvest samples were oven
 dried at 60°C for 72 hours and weighed. Yields were totaled for
each replicate of each treatment for each 4-week period.

Nutrient analyses were determined only on samples collected
when all 3 frequencies of clipping were harvested on the same day.
Oven-dried samples were ground through a 1-mm screen in a Wiley
mill1 prior to analysis. Nitrogen determinations were made by the
micro-kjeldahl method using a Tecator digestor and distiller.
Other nutrients were determined on ground samples ashed in a
muffle furnace at 450°C for 6 hours. The ash was then dissolved in 5
ml of 4N hydrochloric acid and brought to 25 ml final volume.
Phosphorus content of the digest was determined by the vanado-
Chem., 1980) while potassium, calcium, and magnesium were
determined by atomic absorption on a Perkin Elmer 4000 spectro-
photometer. Calcium and magnesium determinations were made in
0.18 M lanthanum oxide/hydrochloric acid solution.

Yields, totaled for 4-week periods, and compositional data were
analyzed by analysis of variance using the Statistical Analysis
System. Harvests were considered to be nested within years. Where
a significant F value occurred, Student-Newman-Keuls' multiple
range test was used to separate means.

Results and Discussion

Annual herbage yields ranged between 8,690 and 15,980 kg/ha
during 1979 to 1981 (Table 2) while yields were in a considerably
lower range during 1984. The 1984 data were collected from a

Table 2. Forage production of Jose tall wheatgrass totaled over 6-week intervals for each clipping frequency during each year at Bushland,
TX.

<table>
<thead>
<tr>
<th>Year</th>
<th>1979</th>
<th>1980</th>
<th>1981</th>
<th>1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly</td>
<td>8690 b</td>
<td>15980 ns</td>
<td>10690 b</td>
<td>4060 b</td>
</tr>
<tr>
<td>2 weeks</td>
<td>9120 b</td>
<td>14290</td>
<td>10660 b</td>
<td>3790 b</td>
</tr>
<tr>
<td>4 weeks</td>
<td>11760 a</td>
<td>15050</td>
<td>12970 a</td>
<td>5430 a</td>
</tr>
<tr>
<td>Standard error</td>
<td>162</td>
<td>414</td>
<td>312</td>
<td>322</td>
</tr>
</tbody>
</table>

Table 1. Forage production of Jose tall wheatgrass totaled over 4-week harvest period are presented in Figure 2. The yield difference
among the treatments occurred in 1979 at the second harvest when
different planting than the first 3 years of the study; however, stand
density was sufficient for considerably greater yields and other
management practices were similar to those of previous years. The
daily low temperatures were lower into the spring in 1984
(Fig. 1) than in other years of the study. This cool weather
undoubtedly reduced forage growth for the first harvest and
resulted in the considerable reduction in total herbage production
for the year.

No significant difference in yield occurred among plots clipped
weekly or biweekly. The plots that were clipped monthly yielded 12
and 18% more than those clipped weekly or bi-weekly, respect-
ively. The data are basically in agreement with data of previous
researchers (Drake et al. 1972, Eck et al. 1975, Pittman and Holt
1983, Mutz and Drake 1983), which indicate some clipping during
the growing season can increase herbage yield, but clipping too
frequently can decrease herbage yields. Moore et al. (1981)
reported that there was no difference under irrigation in yield or
quality of Jose tall wheatgrass when clipped at either 5-cm or
12.7-cm or 21 day intervals. Frequent clipping, particularly at a
low stubble height, may reduce photosynthetic area to the extent
that photosyntheate is not available for regrowth after clipping.
This would suggest, that under intensive management, pastures
should be rested periodically to maximize herbage yields.

Herbage yields of the 3 clipping frequencies for each 4-week
harvest period are presented in Figure 2. The yield difference
among the treatments occurred in 1979 at the second harvest where

1Mention of a trademark is for informational purposes only and does not constitute endorsement of the product by the Texas Agricultural Experiment Station.
Fig. 2. Herbage yield of tall wheatgrass at 6 harvest periods for 3 clipping frequencies during 1979, 1980, 1981 and 1984.

Less frequently clipped plots yielded more. Harvest 1 occurred between the middle of May and the first week of June each year while harvest 2 occurred during the last week of June or the first week of July. Less frequent clipping may have allowed the higher rate of spring growth to continue for a longer period. In 1981 and 1984, the higher total annual yield of the plots clipped every 4 weeks resulted from nonsignificant trends in higher yield of this treatment throughout the growing season.

The nitrogen content of herbage was not affected by the 3 clipping frequencies (Table 3). The results are somewhat surprising because, generally as herbage matures, the nitrogen content declines (Van Soest 1983). Tall wheatgrass is considered to be a late maturing cool-season grass, which may mean that the normally observed trend would have occurred in older material than 4 weeks. The herbage remained in vegetative stages during all samplings. Therefore, maturity may not have been an important factor in determining nitrogen content. Further, nitrogen content of the tall wheatgrass remained at higher levels than reported for other grass species (Mutz and Drawe 1983, Koshi et al. 1982, Eck et al. 1981). This may have occurred because the plots were heavily fertilized and irrigated, which may have resulted in higher nitrogen content than under other conditions. However, the experience of this author has been that tall wheatgrass tends to maintain higher nitrogen content than other species grown in the region, even at low levels of fertilization.

Potassium and phosphorus contents were lower in herbage from the more frequently clipped plots while calcium and magnesium were higher. Potassium decreased from 2.22% in the plots clipped every 4 weeks to 2.03% in the weekly clipped plots. While differences among treatments were not always significant within years, trends were fairly consistent. All levels were above the minimum requirement of animals (National Research Council 1976) and thus the changes in levels of this nutrient may be of little consequence in grazing systems. Phosphorus declined from 0.19% to 0.17% in the respective treatments but differences were generally not significant within years. Calcium and magnesium contents were not affected by clipping frequency in some years but the overall effect was for calcium to increase from 0.37 to 0.43% and magnesium to increase from 0.16 to 0.18% as clipping frequency increased.

The most striking observation from the nutrient analysis of tall wheatgrass herbage was that the highest content of each nutrient occurred in harvest 3 or 4 during the mid-summer period (Table 4). Speculatively, this may arise from the lack of water stress during the summer period when growth is restricted by high temperatures.
Transpiration, and therefore water uptake from the soil, continued because water was not limiting due to the irrigation procedure. Thus, mineral uptake was continuing and, since growth was not limited by water uptake from the soil, continued due to the irrigation procedure. Harvesting nutrient supplementation has the highest yields. While mineral differences among treatments were frequently not significant, over the 4 years of the study, less frequently clipped plants had the highest concentration of phosphorus and potassium and the lowest concentration of calcium and magnesium. This would indicate that rotational grazing would tend to result in higher herbage production than continuous grazing and may require different mineral supplementation to optimize animal production. Herbage harvested during mid-summer contained the highest concentration of nutrients. The greatest, however, variation in nutrient content was among years.

Table 3. Nitrogen, potassium, phosphorus, calcium, and magnesium content of Jose tall wheatgrass averaged over 6-four week intervals for 3 clipping frequencies in 4 years at Bushland, TX.

<table>
<thead>
<tr>
<th>Year</th>
<th>Clipping Frequency</th>
<th>Nitrogen</th>
<th>Potassium</th>
<th>Phosphorus</th>
<th>Calcium</th>
<th>Magnesium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>Weekly</td>
<td>2.30</td>
<td>2.19</td>
<td>0.14</td>
<td>0.46</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>2 weeks</td>
<td>2.14</td>
<td>1.73</td>
<td>0.14</td>
<td>0.46</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>4 weeks</td>
<td>2.48</td>
<td>2.50</td>
<td>0.15</td>
<td>0.45</td>
<td>0.16</td>
</tr>
<tr>
<td>1980</td>
<td>Weekly</td>
<td>2.53</td>
<td>2.07</td>
<td>0.17</td>
<td>0.51</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>2 weeks</td>
<td>2.90</td>
<td>2.24</td>
<td>0.18</td>
<td>0.39</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td>4 weeks</td>
<td>2.71</td>
<td>2.25</td>
<td>0.17</td>
<td>0.49</td>
<td>0.18</td>
</tr>
<tr>
<td>1981</td>
<td>Weekly</td>
<td>3.43</td>
<td>1.62</td>
<td>0.14</td>
<td>0.43</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>2 weeks</td>
<td>3.60</td>
<td>1.72</td>
<td>0.19</td>
<td>0.37</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>4 weeks</td>
<td>3.10</td>
<td>1.94</td>
<td>0.19</td>
<td>0.29</td>
<td>0.14</td>
</tr>
<tr>
<td>1984</td>
<td>Weekly</td>
<td>3.51</td>
<td>2.25</td>
<td>0.22</td>
<td>0.30</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>2 weeks</td>
<td>3.44</td>
<td>2.20</td>
<td>0.22</td>
<td>0.31</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>4 weeks</td>
<td>3.44</td>
<td>2.28</td>
<td>0.20</td>
<td>0.31</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Table 4. Four year average nitrogen, potassium, phosphorus, calcium, and magnesium content of Jose tall wheatgrass for 6 harvest periods at Bushland, TX.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Harvest Period</th>
<th>Nitrogen</th>
<th>Potassium</th>
<th>Phosphorus</th>
<th>Calcium</th>
<th>Magnesium</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1879</td>
<td>2.3</td>
<td>2.11</td>
<td>0.14</td>
<td>0.50</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>2.7</td>
<td>2.19</td>
<td>0.17</td>
<td>0.53</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>1981</td>
<td>3.4</td>
<td>1.76</td>
<td>0.17</td>
<td>0.36</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>1984</td>
<td>3.5</td>
<td>2.50</td>
<td>0.21</td>
<td>0.31</td>
<td>0.16</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.06</td>
<td>0.042</td>
<td>0.01</td>
<td>0.013</td>
<td>0.004</td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Harvest Period</th>
<th>Nitrogen</th>
<th>Potassium</th>
<th>Phosphorus</th>
<th>Calcium</th>
<th>Magnesium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>2.3</td>
<td>2.11</td>
<td>0.14</td>
<td>0.50</td>
<td>0.17</td>
</tr>
<tr>
<td>1980</td>
<td>2.7</td>
<td>2.19</td>
<td>0.17</td>
<td>0.53</td>
<td>0.20</td>
</tr>
<tr>
<td>1981</td>
<td>3.4</td>
<td>1.76</td>
<td>0.17</td>
<td>0.36</td>
<td>0.17</td>
</tr>
<tr>
<td>1984</td>
<td>3.5</td>
<td>2.50</td>
<td>0.21</td>
<td>0.31</td>
<td>0.16</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.06</td>
<td>0.042</td>
<td>0.01</td>
<td>0.013</td>
<td>0.004</td>
</tr>
</tbody>
</table>

*Means within a column followed by the same letter are not significantly different, Student Newman-Keuls’ (P<0.01).


