Grazing Animal Preferences for Cultivated Forages in Canada

R.H. GESSHE AND P.D. WALTON

Abstract

Ten perennial forage species and one forage mixture were evaluated for yield and animal preference at three growth stages. The most preferred but lowest yielding grass was Russian wild rye. Intermediate wheatgrass yielded most but was less preferred. Bromegrass gave high yields and was a preferred species. For the legumes, birdsfoot trefoil had the highest preference rating and also gave some high yields. Alfalfa was a productive, preferred species. The advantages, in terms of both animal preference and production, of a mixed forage stand over pastures containing a single species were demonstrated. Plant moisture, crude protein, digestibility, and crude fibre all influenced preference at certain times of the growing season.

Animal nutrition plays an important role in grazing management. The animal makes a marked contribution to this management process by selecting plant species and plant parts from a mixed sward. Consequently, it determines its own nutritional level in terms of both quality and quantity. Animals ingest greater quantities of preferred species and this increased intake affects the animal's weight gain (Cowlishaw and Alder 1960, Tribe 1952). Also, the physical and chemical properties of a forage influence selective grazing behaviour of animals (Hardison et al. 1954, Meyer et al. 1957, Tribe 1952) so that the quality of the material consumed is also determined by animal selection.

Much research in animal grazing preference has been conducted on native rangeland. Information regarding animal preference for cultivated forage species in western Canada is limited. Thus, this study undertook to determine the preferences of steers offered an assortment of cultivated forages. The forage quality characteristics of the material for which the animals showed a preference was also studied.

Materials and Methods

The study was conducted at the University of Alberta Ranch at Kinsella, situated in the thin black soil zone in east-central Alberta. The soil was a glacial loam of the Viking moraine (Wyatt et al. 1944). Topographically, the area is rolling to hilly with sloughs occurring in the depressions. Mean annual precipitation is 40.6 cm with the maximum precipitation occurring between July 1st and July 15th (Wonders 1969). Ten forages and one forage mixture (2.24 kg/ha alfalfa, 4.48 kg/ha creeping red fescue, 6.72 kg/ha bromegrass) were sown on May 31 and June 2, 1972, in strips 3.5 m wide and 45.7 m long at the rates and row spacings listed in Table 1. After the second year, forage establishment was good. The study area was separated into three pastures each containing four replications of each species and the mixture. A 15.2-m length from each 3.5-m strip was fenced to form enclosures. In 1973, these three pastures were grazed when the plants were in the vegetative stage (May 31 to June 17), at heading or flowering (June 21 to July 10) and at or after seed set (July 11 to July 31). After each grazing period, one-half meter samples were clipped from each plot in both the grazed and exclosed area. Samples were divided into leaves and stems, dried at 65°C, and weighed.

Production was the total dry weight from each clipped species in the exclosed area. Utilization was the difference between the total forage clipped from the grazed area and that corresponding from the exclosure. The preference rating was calculated by the method used by Van Dyne and Heady (1965) and Rosier et al. (1975). Values greater than 1.0 indicated preference, values less than 1.0 indicated avoidance. In addition to evaluating dry matter production (and, consequently, percent moisture) for leaves and stem, the clipped samples were used to determine the proportion of leaves by weight as well as percent crude protein, acid detergent fibre, and acid-pepsin dry matter disappearance. Crude protein was determined with a Colman nitrogen analyzer (Stavant et al. 1963). The Van Soest method (1963) was used for acid detergent fibre evalua-
Animal Preference

The acid-pepsin determination was that used by Donefer et al. (1966), Koundall et al. (1970) and Sleper et al. (1973). The various chemical and physical forage characteristics studied were compared with the animal preference rating by using stepwise multiple regression. This method introduced variables into the regression equation according to the proportion of variation of the dependent variable accounted for. The regression analysis was considered complete when the introduction of a new independent variable resulted in a change of less than one per cent of the variance of the dependent variable. Simple correlation coefficients were calculated between all variables studied.

Results and Discussion

Animal Preference

During the first grazing period, plants were in vegetative stage and differences in preference were small, with the exception that white clover and sainfoin were rejected. Some preference was shown for broomgrass, intermediate wheatgrass, Russian wild ryegrass, alfalfa and the forage mixture. With the exception of Russian wild ryegrass, these species were also high yielding (Table 1). Overall, grasses were preferred (Preference rating = 1.06) over legumes (0.78). By the second grazing period this situation was reversed. The grasses had a mean preference rating of 0.6, while that for legumes was 1.04 (Table 1). Russian wild ryegrass was the most highly utilized species, closely followed by birdsfoot trefoil which gave a high yield. Alfalfa was another preferred species which was also highly productive. The animals avoided crested wheatgrass, intermediate wheatgrass and sainfoin during this grazing period. This rejection of intermediate wheatgrass is unfortunate in view of the high yield obtained (6,160 kg per ha). During the third grazing period (Table 1) three grasses (creeping red fescue, crested wheatgrass and intermediate wheatgrass) were rejected entirely. The animals avoided only one legume (sainfoin). The forage mixture yielded the highest (8,300 kg per ha) and it was well

Table 1. Seeding rates, production, utilization, and relative preference rating for ten forages and a forage mixture for three grazing periods.

<table>
<thead>
<tr>
<th>Species</th>
<th>Seeding rate (kg/ha)</th>
<th>Production (kg/ha)</th>
<th>Utilization (kg/ha)</th>
<th>Preference rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grazing Period 1</td>
<td>Grazing Period 2</td>
<td>Grazing Period 3</td>
<td></td>
</tr>
<tr>
<td>Bromegrass</td>
<td>6.7</td>
<td>2320</td>
<td>1320</td>
<td>1.2</td>
</tr>
<tr>
<td>Creeping red fescue</td>
<td>9.0</td>
<td>2900</td>
<td>1400</td>
<td>1.1</td>
</tr>
<tr>
<td>Crested wheatgrass</td>
<td>11.2</td>
<td>1550</td>
<td>560</td>
<td>0.8</td>
</tr>
<tr>
<td>Intermediate wheatgrass</td>
<td>9.0</td>
<td>2870</td>
<td>1560</td>
<td>1.2</td>
</tr>
<tr>
<td>Redtop</td>
<td>10.1</td>
<td>1260</td>
<td>530</td>
<td>0.9</td>
</tr>
<tr>
<td>Russian wild ryegrass</td>
<td>5.6</td>
<td>650</td>
<td>350</td>
<td>1.2</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>6.7</td>
<td>1700</td>
<td>980</td>
<td>1.3</td>
</tr>
<tr>
<td>Birdsfoot trefoil</td>
<td>12.3</td>
<td>830</td>
<td>350</td>
<td>0.9</td>
</tr>
<tr>
<td>Sainfoin</td>
<td>20.2</td>
<td>1640</td>
<td>380</td>
<td>0.5</td>
</tr>
<tr>
<td>White clover</td>
<td>7.8</td>
<td>1020</td>
<td>20</td>
<td>0.0</td>
</tr>
<tr>
<td>Forage mixture</td>
<td>13.4</td>
<td>2320</td>
<td>1320</td>
<td>1.2</td>
</tr>
<tr>
<td>Mean</td>
<td>—</td>
<td>1730</td>
<td>800</td>
<td></td>
</tr>
<tr>
<td>at 5% Level</td>
<td>—</td>
<td>835</td>
<td>939</td>
<td></td>
</tr>
<tr>
<td>1% Level</td>
<td>—</td>
<td>1125</td>
<td>—</td>
<td>2850</td>
</tr>
</tbody>
</table>

1 Seeding rate was 17.8 cm apart for all species except Russian wild ryegrass, which was 35.6 cm.

2 White clover stems not analyzed

Table 2. Protein, acid detergent fibre, digestibility (acid pepsin dry matter disappearance) moisture content and per cent leaf for ten forage species for three grazing periods.

<table>
<thead>
<tr>
<th>Species</th>
<th>Crude protein (%)</th>
<th>Acid detergent fibre (%)</th>
<th>Digestibility</th>
<th>Moisture content</th>
<th>Leaf dry weight as % of total plant dry weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Leaf</td>
<td>Stem</td>
<td>Leaf</td>
<td>Stem</td>
<td>Leaf</td>
</tr>
<tr>
<td>Bromegrass</td>
<td>16.9</td>
<td>18.9</td>
<td>15.0</td>
<td>10.9</td>
<td>8.5</td>
</tr>
<tr>
<td>Creeping red fescue</td>
<td>17.6</td>
<td>11.7</td>
<td>8.6</td>
<td>14.6</td>
<td>8.5</td>
</tr>
<tr>
<td>Crested wheatgrass</td>
<td>24.2</td>
<td>19.1</td>
<td>17.8</td>
<td>13.5</td>
<td>10.7</td>
</tr>
<tr>
<td>Intermediate wheatgrass</td>
<td>18.6</td>
<td>15.3</td>
<td>15.9</td>
<td>11.2</td>
<td>8.3</td>
</tr>
<tr>
<td>Redtop</td>
<td>21.6</td>
<td>16.3</td>
<td>16.1</td>
<td>11.1</td>
<td>9.9</td>
</tr>
<tr>
<td>Russian wild ryegrass</td>
<td>23.0</td>
<td>25.4</td>
<td>28.2</td>
<td>13.9</td>
<td>10.5</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>26.5</td>
<td>25.4</td>
<td>28.2</td>
<td>13.9</td>
<td>10.5</td>
</tr>
<tr>
<td>Birdfoot trefoil</td>
<td>28.0</td>
<td>19.6</td>
<td>19.8</td>
<td>14.5</td>
<td>10.9</td>
</tr>
<tr>
<td>Sainfoin</td>
<td>26.0</td>
<td>26.5</td>
<td>22.8</td>
<td>11.4</td>
<td>13.7</td>
</tr>
</tbody>
</table>

1 Row spacing was 17.8 cm apart for all species except Russian wild ryegrass, which was 35.6 cm.

2 White clover stems not analyzed

JOURNAL OF RANGE MANAGEMENT 34(1), January 1981 43
liked by the animals. Considering all grazing periods, steers preferred Russian
deryegrass but it had low yields because of wide row spacing and slow
establishment. Once established, it has been reported to out-yield
bromegrass and crested wheatgrass in the brown soil zone (Law-
rence and Heinrichs 1966). Russian wild rye was probably
otherwise preferred because it had the highest proportion of leaves and
highest moisture content of all the grass species (Table 2). Bromegrass yielded slightly less than intermediate wheatgrass but
was most utilized of all grasses throughout the trial. Animal
preference for red top increased as the season progressed. This
species matures late, retaining many leaves and having relatively
high moisture toward the end of the season. For intermediate and
crested wheatgrasses, the decline in preference from the first of the
third grazing period was associated with a decline in the proportion
of leaves and leaf moisture and an increase in crude fiber (Table 2).
Intermediate wheatgrass was the highest producing species. It grew
rapidly, matured late and was relatively low in protein. Lawrence
et al. (1971) recommended intermediate wheatgrass over
bromegrass or reed canarygrass (Phalaris arundinacea L.) for
irrigated conditions because of its high dry matter yield.

With the exception of the first grazing period, birdsfoot trefoil
was the most preferred legume, giving high yields and out-
producing alfalfa during the second grazing period. The animals
did not readily graze this species when first turned into a pasture,
but subsequent utilization was high. Alfalfa was a productive,
well-utilized species with a high proportion of leaves. Sainfoin
was avoided throughout the trial. It was relatively high yielding during
the first grazing period but was the lowest yielding legume in the
second and third periods. Hanna et al. (1972) reported sainfoin
yields to be 85% of alfalfa. The animals selected only the leaves of
this forage, leaving stems untouched. White clover yielded little in
the first grazing period but yields increased later in the season.
Cooper et al. (1971) in Montana also reported poor forage yields
for white clover.

Animals preferred the forage mixture during all grazing periods,
suggesting that grazing animals were attracted to a heterogeneous
plant community (Jones 1952). The high production from the
mixture may be attributed to the effect which the nitrogen fixing
legume had on grass yields. The variation in individual animal
preference gave the forage mixtures on advantage when compared
to pure stands because each animal had a choice of forage, allowing
individuals to adjust their own diets. The forages tested in this trial
are all commonly seeded into Alberta pastures. Any of them would
be readily utilized by cattle if no alternatives were offered. Minor
variations in utilization, such as were obtained during the first
grazing period, were of little practical significance because they
probably would not affect animal intake. Also, variations in indi-
vidual animal grazing behaviour nullified (P>0.05) the importance
of small over all differences in animal preference.

Forage Quality Characters Associated with Animal Preference

For each grazing period (vegetative, flowering, and seed set) a
multiple regression equation was developed to evaluate the effect of
various forage quality factors on the preference rating (Y). The
prediction equation developed for the first grazing period was not
significant. The high quality (Table 2) of all species at this time
discounted selective grazing patterns based on forage quality. A
significant (P<0.01) multiple regression equation was developed
for the second grazing period. Simple correlation coefficients
indicated that the percent leaves, stems, crude fibre, and stem acid-
pepsin dry matter disappearance had a positive influence on the
preference rating during this period, while both leaf and stem
protein decreased animal preference. The prediction formula was

\[ Y = -2.42 + 0.16x_1 - 0.15x_6 + 0.01x_2 \]

where \( x_2 \) was percent leaves by weight, \( x_6 \) percent crude fibre in the
stem, \( x_5 \) acid-pepsin dry matter disappearance in the stem, \( x_4 \)
percent leaf crude protein, and \( x_7 \) percent stem crude protein. The
mature forage data from the third grazing period showed (P<0.01)
that moisture (\( x_1 \)) was the major positive influence on the preference
rating. The prediction equation (\( R^2 = 0.77 \)) was:

\[ Y = -2.42 + 0.16x_1 - 0.15x_6 - 0.12x_7 + 0.01x_2 \]

Coleman and Barth (1973), Fontenot and Blaser (1965), Hardi-
son et al. (1954), Weir and Torell (1959), and Kama Rao et al.
(1973) all showed that grazing animals tend to select diets high in
protein, digestible, and low in crude fibre when offered a variety of forage. Other workers (Crampton 1957, Dubbs 1966,
Meyer et al. 1957, Milford and Minson 1966, Tribe 1952, Van
Soest 1964) reported poor correlations between preference or intake and the nutritional value of forages. Crampton (1957) indi-
cated that as long as the animal's basic nutritional needs were
satisfied, little selection was likely to occur. In other studies, a close
relationship existed between preference or intake and nutritive
forage value (Blaxter et al. 1961, Blaser et al. 1960, Cook 1959,
Pice 1952). This study indicated that the various quality compo-
ents do influence animal preference. The multiple regression
relationships between crude protein, digestibility, and crude fibre
are associated with these characters with animal preference. Moisture
content of forage is seldom mentioned as a factor in forage preference.
Here, moisture content significantly (P<0.01) affected preference in
the third grazing period. Hilton and Bailey (1972), also working
on the University of Alberta Ranch, reported the importance of
moisture content to animal preference for native forage species.

\[ Y = -2.42 + 0.16x_1 - 0.15x_6 + 0.01x_2 \]

Literature Cited

Blaser, R.E., R.C. Hames, H.T. Bryant, W.A. Hardison, J.P. Fontenot,
Proc. 8th Int. Grassland Cong., Reading 601-606.
Cowlishaw, S.J., and F.E. Alder. 1960. The grazing preferences of cattle
and sheep. J. Agric. Sci. 54:257-265.
Crampton, E.W. 1957. Inter-relations between digestible nutrient and
energy content voluntary intake and the overall feeding value of forages.
J. Animal Sci. 16:546-552.
Donefer, E., E.W. Crampton, and L.E. Lloyd. 1966. The prediction of
digestible energy intake potential (NVI) for forages using a simple in
Dubbs, A.L. 1966. Yield, crude protein and palatability of dryland grasses
Hardison, W.A., J.T. Reid, C.M. Martin, and P.C. Woolfolk. 1954. Degree
Cong. Pennsylvania 1348-1353.
of dry matter disappearance technique to estimate forage quality. Crop.
Lawrence, T., and D.H. Heinrichs. 1966. Russian wild ryegrass for
Western Canada. Canada Dep. of Agr public. 991.
Lawrence, T., F.G. Warder, and R. Ashford. 1971. Effect of stage and
height of cutting on crude protein content and crude protein yield of
Plice, M.J. 1952. Sugar versus the intuitive choice of foods by livestock.
J. Range Manage. 5:69-75.
Rosiere, R.E., R.F. Beck, and J.D. Wallace. 1975. Cattle diets on semi-
desert grassland—Botanical composition. J. Range Manage. 28:89-93.
improved dry matter digestibility in smooth bromegrass. Crop Sci. 13:
556-558.


