Influence of Watering Frequency on Forage Consumption and Steer Performance in Southeastern Kenya

N.K.R. Musimba, Rex D. Pieper, Joe D. Wallace, and Michael L. Galyean

Abstract

Forty-five zebu steers (avg wt 311 kg) were allotted to 3 watering frequency treatments with 15 steers/treatment. The treatments involved watering once every day (1/1), watering once every 2 days (1/2) and watering once every 3 days (1/3) to investigate the effect of watering frequency on forage consumption and steer performance. Three steers/treatment were used to quantify fecal output and estimated forage consumption. All steers were grazed together in a 100-ha paddock for 10 hours daily and confined in a corral overnight. Steers were allowed ad libitum access to water only in the evenings according to the watering schedule. The study was conducted over 6 months, during which time total fecal collections were made in March, April, June, and July. All steers were weighed approximately every 2 weeks. Forage consumption was reduced \( P<0.01 \) for steers watering (1/2) and (1/3), compared with the (1/1) watered group. Forage intake was highest \( P<0.01 \) in April when herbage was green and growing. Steer performance followed a seasonal pattern reflecting changes in forage quality. Watering frequency did not influence steer performance. Reducing watering frequency from daily to once every 2 or 3 days may enhance utilization of available range and save on cost of providing water for cattle under certain pastoral conditions.

Key Words: intake, cattle weight changes, diet consumption

Materials and Methods

The study was conducted at the National Range Research Station Kiboko, Kenya, 104 km southeast of Nairobi. The area is classified as transition between Acacia/Themeda savanna and Commiphora/Acacia woodland (Pratt et al. 1966). Long-term mean annual rainfall averages 600 mm/year with a bimodal pattern of a minor peak during October through December, and a major peak from March through June. Mean annual temperature averages 23°C.

A study paddock of 100 ha was established in a grazing block and 10 x 100-m transects were systematically laid out in the study paddock. Total herbage production was measured by clipping 0.49-m² circular frames systematically placed at 10-m intervals along each transect. The study was conducted from February to July 1984 and included 4 sampling periods: 16-21 March, 20-29 April, 2-9 June, and 14-24 July. Vegetation was characterized by Commiphora spp., Acacia spp. and Balanites aegyptica in the upper story with woody shrubs such as Greura spp., Hermania spp. and Lantana virguloides in the middle layer. Grasses comprising the understory included Digitaria macroblephara, Chloris roxburghiana, Bothriochloa inscupta, Enteropogon macrochaythus, Cymbopogon spp. and Ergrostis spp.

Forty-five intact zebu steers about 3 years old and averaging 311 kg were selected and allotted to 3 watering frequency treatments: watered once every day (1/1), watered once in 2 days (1/2), and watered once in 3 days (1/3). Within each treatment 3 steers were trained to wear fecal bags for total fecal collection. Feces were collected for 5 consecutive days during each sampling period. Fecal bags were emptied twice daily and the daily fecal output weighed wet, subsampled, oven-dried, and reweighed. Two esophageal fistulated zebu steers were allocated to each watering treatment for sampling grazed forage. Esophageal masticates were collected from steers during 30-min periods each day for 3 alternate days during each sampling period. Esophageal fistulated steers and intact steers grazed together in the study paddock for 10 hours daily from 0700 h to 1700 h and then were confined in the night corral. All steers were allowed to water only in the evenings in accordance with their respective watering frequency treatment.

The 45 intact study steers were weighed approximately every 2 weeks throughout the study period. Steers were weighed in the mornings after an overnight fast.

Chemical Analyses

Dry samples of feces and esophageal masticates were analyzed for dry matter and organic matter content (AOAC 1984). Masticate samples were subjected to in vitro dry matter and organic matter digestion by the 2-stage procedure of Tilley and Terry (1963) using inoculum from steers maintained on native grass hay diets. Forage consumption (dry and organic matter) was estimated by dividing fecal output by forage indigestibility (Van Dyne 1968).

Data for intake of nutrients and steer performance were subjected to statistical analyses as a split-plot design, with watering treatment as fixed and sampling period as random variables using steers as the sampling units.

Results and Discussion

Herbage Standing Crop

The yield of perennial grasses differed \( P<0.01 \) among sampling
periods, being highest at the beginning of the study and after the rains in April (Table 1). Annual grasses declined (P<0.01) after the first sampling in March and occurred only in trace amounts in June and July. Forbs and small shrub biomass components did not differ (P>0.01) among periods. Total herbage decreased from 648 to 494 kg/ha by the end of the study, which could be mainly attributed to below-average precipitation in March and April. 

Herbage availability, however, was never low enough to influence forage intake by steers (Handl and Rittenhouse 1972). The decline in herbage weight was probably related to consumption by the cattle, other herbivores, and physical losses.

Table 1. Standing crop of herbage (kg/ha) during the four sampling periods.

<table>
<thead>
<tr>
<th>Sampling period</th>
<th>March</th>
<th>April</th>
<th>June</th>
<th>July</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perennial grasses</td>
<td>406.5&lt;a&gt;</td>
<td>466.2&lt;a&gt;</td>
<td>271.1&lt;a&gt;</td>
<td>280.2&lt;a&gt;</td>
<td>67</td>
</tr>
<tr>
<td>Annual grasses</td>
<td>86.5&lt;a&gt;</td>
<td>13.1&lt;b&gt;</td>
<td>13.1&lt;b&gt;</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Forbs</td>
<td>154.7</td>
<td>156.3</td>
<td>224.9</td>
<td>213.2</td>
<td>69</td>
</tr>
<tr>
<td>Total herbage</td>
<td>647.7</td>
<td>635.6</td>
<td>496.1</td>
<td>493.9</td>
<td>83</td>
</tr>
</tbody>
</table>

*<a>Pooled standard error of the mean, n = 10. *<a>Row means with different superscripts differ (P<0.01). *<a>Trace.

Table 2. Daily intake of dry matter (DM), digestible organic matter (DOM), neutral detergent fiber (NDF) and crude protein (CP) during the four sampling periods averaged over watering treatments.

<table>
<thead>
<tr>
<th>Item</th>
<th>Sampling period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>March 16-25</td>
</tr>
<tr>
<td>DM intake/day</td>
<td>1.65</td>
</tr>
<tr>
<td>DOM intake/day</td>
<td>0.85&lt;a&gt;</td>
</tr>
<tr>
<td>NDF intake/day</td>
<td>1.09</td>
</tr>
<tr>
<td>CP intake (g/day)</td>
<td>581</td>
</tr>
</tbody>
</table>

*<a>SE = Standard error of means (n = 9). *<a>Row means with different superscripts differ (P<0.01).

Table 3. Intake of dry matter (DM), digestible organic matter (DOM), crude protein (CP) and neutral detergent fiber (NDF) as influenced by watering regimen averaged over periods.

<table>
<thead>
<tr>
<th>Watering regimen</th>
<th>% of body weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM intake/day</td>
<td>1.84</td>
</tr>
<tr>
<td>DOM intake/day</td>
<td>1.06</td>
</tr>
<tr>
<td>NDF intake/day</td>
<td>1.21</td>
</tr>
<tr>
<td>CP intake (g/day)</td>
<td>534d</td>
</tr>
</tbody>
</table>

*<a>SE = pooled standard error of mean, n = 9. *<a>Row means with different superscripts differ (P<0.01).

Table 4. Average initial and final steer weights and standard errors for the different frequency of watering treatments.

<table>
<thead>
<tr>
<th>Frequency of watering treatments</th>
<th>Initial wt. ± S.E.</th>
<th>Final wt. ± S.E.</th>
<th>Weight gain (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once a day</td>
<td>308 ± 4.8</td>
<td>337 ± 5.5</td>
<td>29</td>
</tr>
<tr>
<td>Once in 2 days</td>
<td>307 ± 4.7</td>
<td>355 ± 5.4</td>
<td>30</td>
</tr>
<tr>
<td>Once in 3 days</td>
<td>307 ± 4.7</td>
<td>337 ± 5.5</td>
<td>30</td>
</tr>
</tbody>
</table>

declined drastically as forage advanced in maturity to early dormancy in July.

Effect of Watering Frequency

Compared with daily watered steers, intermittent watering reduced (P<0.01) intake of DM, DOM, and NDF for steers watered at 1/2 and 1/3 watering frequencies (Table 3). The decrease in feed intake found in this study confirms findings of earlier studies in which ruminants were subjected to water restriction (Johnson et al. 1966, Thornton and Yates 1968 and Moore et al. 1983). Crude protein intake decreased (P<0.01) for animals watered 1/3 relative to those watered at the 1/1 and 1/2 watering schedules. Reduction in intake with reduced watering is associated with decreased rate of digesta passage, hence extended retention time of digesta especially in the rumino-reticulum (Phillips 1960, Musimba et al. 1987).

Steer Performance

Watering frequency did not affect (P>0.01) average steer growth rate over the whole study period (Table 4, Fig. 1). Steer weights were not significantly different (P>0.01) across watering frequencies although mean steer weights were somewhat variable across watering frequencies during early stages of the trial (Fig. 1). Steers gained about 30 kg on all watering frequencies (Table 3). Digestibility was increased when animals were subjected to water restriction (Johnson et al. 1966, Thornton and Yates 1968 and Moore et al. 1983). Crude protein intake decreased (P<0.01) for animals watered 1/3 relative to those watered at the 1/1 and 1/2 watering schedules. Reduction in intake with reduced watering is associated with decreased rate of digesta passage, hence extended retention time of digesta especially in the rumino-reticulum (Phillips 1960, Musimba et al. 1987).

Steers lost weight in March and July when forage was mature, and gained weight faster in April when forage was growing than in June when forage was in early maturity stage (Fig. 1). The growth pattern shown by steers in the current study, which can be considered a response to changing forage quality, has been reported in studies conducted in temperate and tropical pastures. Romero and Siebert (1980) observed that cattle on native pastures of northern Australia had rapid weight gains for short periods, and frequently lost weight for long periods in response to changes in forage quality.
Fig. 1. Average steer weights for the 3 watering regimes during the study period.

**Management Implications**

Cordova et al. (1978) showed that average forage intake by cattle is about 1.8% of body weight, which does not deviate from findings of the current short-term study where dry matter intake ranged from 1.6 to 1.7% of steer body weight. Such data can be useful for budgeting of forage requirements in areas similar to those where the present study was conducted. Researchers with the International Livestock Centre for Africa (ILCA) have recently initiated a 3-day watering strategy for pastoralists in Ethiopia to reduce the labor cost associated with raising water from underground wells (ILCA 1983). While intermittent watering of animals can be regarded as cost effective, concomitant benefits may be accrued, such as increased efficiency of forage utilization and extended grazing period to cover dry periods due to reduced intake by animals. In addition, better utilization of available range and potentially reduced soil erosion around watering points can be achieved with intermittent watering when animals travel to graze distant pastures from watering points without returning to the watering points on a daily basis. Based on data from the current study, it appears that watering once every 2 or 3 days may be possible for certain classes of cattle.

**Literature Cited**


