EFFECTS OF SUPPLEMENTAL ALFALFA HAY ON FEED INTAKE AND DIGESTION BY HOLSTEIN STEERS CONSUMING HIGH-QUALITY BERMUDAGRASS OR ORCHARDGRASS HAY


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ABSTRACT

Effects of level and frequency of supplementation with alfalfa (A) on feed intake and digestion by steers fed bermudagrass (B) or orchardgrass (O) were determined in two Latin square experiments. In Exp. 1, six Holstein steers (224 kg) were fed B (2.25% N; 71.4% NDF) or O (2.52% N; 64.3% NDF) with 0, 15 or 30% (DM) A (2.70% N; 44.0% NDF). Total DMI was 2.43, 2.72 and 2.85% BW for B and 2.98, 3.00 and 2.87% BW for O with 0, 15 and 30% A, respectively. Total DMI was affected by forage (P < .05), A level (linear; P < .06) and a forage × A level (linear) interaction (P < .05). Digestible OM intake increased .42 (15%) and .67 kg (24%) with feeding of 15 and 30% A, respectively, for B, but for O, only dietary inclusion of 30% A elevated digestible OM intake (.14 kg and 4% increases). In Exp. 2, five Holstein steers (165 kg) were fed B (1.81% N; 78.6% NDF) alone or with A (2.76% N; 52.8% NDF). Morning meals consisted of ad libitum B (OA), .3% BW of A daily (.3A), .6% BW of A every 2nd d (.6A), .9% BW of A every 3rd d (.9A) or 1.2% BW of A every 4th d (1.2A). All steers received B in the afternoon ad libitum, and B was given in the morning when A was not fed. Total DMI was 2.31, 2.12, 2.12, 2.26 and 2.29% BW for OA, .3A, .6A, .9A and 1.2A, respectively (SE .049). Grass characteristics affected response in feed intake to legume supplementation. Frequency of dietary legume addition may alter feed intake.

(Key Words: Cattle, Intake, Digestion, Forage.)


Introduction

Cool- and warm-season grasses and legumes often contribute to year-round forage-based ruminant production systems. Tropical grasses produce much edible DM but, generally, they are of low digestibility (Reid et al., 1988). Legumes and grass-legume mixes usually promote higher ruminant performance than grasses alone (Moseley, 1974; Thomson et al., 1983), presumably because of rapid ruminal breakdown, digestion and outflow of forage (Moseley and Jones, 1979) and high intestinal entry of protein with legumes (Beever et al., 1986a,b). However, maintaining leguminous forage throughout grass pastures may be costly or impractical, and daily manual supplementation necessitates considerable labor input. Hence, ruminants consuming low-quality grasses sometimes are given intermittent access to a leguminous forage (Paladines, 1984). Knowledge concerning supplementation modes that yield the most efficient basal forage utilization is inadequate.

Warm- and cool-season grasses differ considerably in chemical and physical characteristics that can affect feed intake and digestion (Akin, 1986; Reid et al., 1988). Legume supplementation and grass source may interact in alterations of ruminal conditions. This study was conducted to determine effects on feed intake and digestion by Holstein steers of
supplementing a warm- (bermudagrass) or a cool-season grass (orchardgrass) diet with different levels of legume (alfalfa) and effects of frequency of supplementation of our warm-season grass with legume. Feed intake and digestion were measured because of the high relationship between digestible nutrient intake and animal performance.

Materials and Methods

Experiment 1. Six tethered Holstein steers (184 ± 9.6 and 259 ± 8.0 kg initial and final BW, respectively) were used in a 6 × 6 Latin square experiment with a 2 × 3 factorial arrangement of treatments. Diets consisted of long-stemmed bermudagrass (B) (Cynodon dactylon; vegetative growth stage, vegetative stems without inflorescence) hay or orchardgrass (O) (Dactylis glomerata; vegetative regrowth, no elongated stems) hay plus 0, 15 or 30% (DM) of alfalfa (A) (Medicago sativa; early bloom) hay (Table 1). Hays were weighed individually and hand-mixed prior to being provided ad libitum (105 to 110% of consumption on previous days) at 0800 and 1600. Orts were removed, weighed and sub-sampled before the 0800 meal. All steers received 49 g (DM) of a 1:1 mix of dicalcium phosphate and trace mineralized salt. Ten days before trial initiation, steers were dewormed and injected with 500,000 IU vitamin A and 75,000 IU vitamin D3. Steers had ad libitum access to B until the experiment began. Steer BW was determined on d 14 at 1300 of each period.

On d 9 at the afternoon feeding, 75 g (air-dry) of B labeled with Yb (Goetsch and Galyean, 1983) was fed with a small portion of unlabeled B. After consumption, remaining B of the meal was offered. Rectal grab samples were obtained on d 11 through 14 at 12-h intervals advancing 3 h daily. Samples were frozen, dried at 55°C and ground through a 2-mm screen. Composite samples were constructed within steer and period (air-dry) and ground through a 1-mm screen. Feed composites, obtained by sampling on d 9 through 14, and ort composites were ground through a 1-mm screen. Composite samples of feed, feces and orts were analyzed for DM, ash, Kjeldahl N (AOAC, 1975), NDF (Goering and Van Soest, 1970) and AIA (Van Keulen and Young, 1977). Hay was analyzed for ADF and ADL (Goering and Van Soest, 1970). Neutral detergent fiber and ADF analyses were conducted on air-dry sample; cellulose was determined as the loss in weight upon sulfuric acid treatment and ADF subtracted from NDF yield hemicellulose. Individual fecal samples were ashed; mineral residue was solubilized with acid (Ellis et al., 1982) and analyzed for Yb by atomic absorption spectrophotometry.

Feed intake the last 5 d of each period was first analyzed as a split plot in time (SAS, 1985) to check for effects of day and the treatment × day interaction. Because this interaction was not significant (P > .10), intake over the last 5 d was averaged. Acid insoluble ash was used as an internal marker to calculate digestion. Regression of the natural logarithm of Yb concentration in fecal samples vs time post-dosing yielded particulate passage rate.

Data were analyzed by ANOVA with steer, period and treatment in the statistical model.

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6Contained 96 to 98% NaCl and more than .5% Fe, 2% Mn, .2% Zn, .04% Cu, .002% I and .0007% Co.
Contrasts with orthogonal polynomials were made for forage type and linear and quadratic effects of A level and interactions between these effects. Simple correlation coefficients were determined (SAS, 1985).

Experiment 2. Five Holstein steers (154 ± 7.8 and 176 ± 8.0 kg initial and final BW, respectively) were used in a 5 x 5 Latin square experiment with periods lasting 16 d. Steers were weighed at 1300 at experiment initiation and on d 16 of each period.

Steers were given ad libitum access to mature B (Table 1) in the afternoon (1600) (105 to 110% of previous B consumption on comparable experimental days). Morning meals (0800) consisted of ad libitum B daily (OA), .5% BW of mid-bloom A (Table 1) daily (.3A), .6% BW of A every 2nd d (.6A), .9% BW of A every 3rd d (.9A) or 1.2% BW of A every 4th d (1.2A). On days A was not fed, fresh B was fed in the morning. A mineral supplement (30 g DM) of 50% dicalcium phosphate and 50% trace mineralized salt7 was given at the 1600 meal.

Hay samples were collected throughout the experiment, and composites were formed within period. Fecal grab samples were collected every 8 h at 1400, 2200 and 0600 daily on d 13 through 16 for OA, .3A, .6A, .9A and 1.2A; d-13 samples were not taken for .9A. Feces were dried at 55°C, ground through a 1-mm screen and subsampled for composting (air-dry). Hay samples were ground through a 1-mm screen. Hay and fecal composite samples were analyzed for DM, ash, N, NDF and AIA. Mean DM intake on d 11 through 16 for .9A and d 9 through 16 for other groups, and AIA intake and concentration in feces were used to determine digestibilities of OM, NDF and N. Hay samples also were analyzed for ADF and ADL.

Data were analyzed considering steer, period and diet in the statistical model. Intake, excretion and digestion of OM, NDF and N were analyzed with contrasts for OA vs other treatments and for the linear effect of frequency of A supplementation (.3A, .6A, .9A and 1.2A). For DMI averaged over days, differences among treatment means were determined by Least Significant Difference (LSD) with a protected F-test (Snedecor and Cochran, 1967). Effects of day of the feeding cycle (1-d cycle for OA and .3A, 2-d cycle for .6A, 3-d cycle for .9A, 4-d cycle for 1.2A) within treatment on DMI were determined by protected LSD.

Results

Experiment 1. High concentrations of N and NDF in grass hays (Table 1) reflect adequate fertilization with N and harvest at relatively early maturity stages. The NDF concentration was lower for A than for B and O, although the concentration of ADL was highest for A.

Basal hay and total DMI was higher for O than for B (P < .05; Table 2) and was affected by A linearly (P < .06). The rate of decline in basal hay intake as A in the diet increased was lower for B than for O (interaction; P < .05). Total DMI increased 12 and 17% with 15 and 30% A in B diets, respectively, but DMI was not altered by including 15% A with O and declined slightly (4%) when A was increased to 30% (interaction; P < .05).

Increasing dietary A was accompanied by an increased NDF intake (kg/d) with B but a decreased NDF intake with O (Table 2; interaction, P < .05). Dietary NDF content was 72, 67 and 63% for B and 64, 61 and 58% for O with 0, 15 and 30% A, respectively. Total tract NDF digestion was higher (P < .05) for O than for B but similar among diets within each grass. Digestion of NDF (kg/d) with O decreased as dietary A increased but was relatively steady as the A content of B diets increased (interaction; P < .10).

Nitrogen intake increased linearly with A level and was affected by forage (P < .05); forage modulated the linear effect of A (interaction, P < .05; Table 2). Total tract N digestion as a percentage of intake and in kg/d was higher (P < .05) for O than for B (Table 2) and the rate of increase with increasing A was greater for B than for O (interaction; P < .05). Particulate passage rate was greater for O than for B (P < .05; Table 2) but was not affected by A.

7Contains more than 95% NaCl, 25% Mn, 2% Fe, 0.3% S, 0.33% Cu, 0.025% Co, 0.07% I and .005% Zn.
TABLE 2. DMI AND DIGESTION OF OM, NDF AND N AND PARTICULATE PASSAGE RATE FOR HOLSTEIN STEERS FED DIETS OF BERMUDAGRASS OR ORCHARDGRASS HAY AND 0, 15 OR 30% ALFALFA HAY (A) (EXP. 1)

<table>
<thead>
<tr>
<th>Item</th>
<th>Bermudagrass</th>
<th>Orchardgrass</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>0% A</td>
<td>15% A</td>
</tr>
<tr>
<td>DMI, % BW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alfalfa</td>
<td>0</td>
<td>.41</td>
</tr>
<tr>
<td>Basal hay</td>
<td>2.43</td>
<td>2.31</td>
</tr>
<tr>
<td>Total</td>
<td>2.43</td>
<td>2.72</td>
</tr>
<tr>
<td>OM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake, kg/d</td>
<td>4.96</td>
<td>5.61</td>
</tr>
<tr>
<td>Digestion %</td>
<td>55.8</td>
<td>56.5</td>
</tr>
<tr>
<td>NDF Intake, kg/d</td>
<td>3.84</td>
<td>4.08</td>
</tr>
<tr>
<td>Digestion %</td>
<td>59.7</td>
<td>58.1</td>
</tr>
<tr>
<td>Nitrogen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake, kg/d</td>
<td>.123</td>
<td>.143</td>
</tr>
<tr>
<td>Digestion %</td>
<td>59.7</td>
<td>60.3</td>
</tr>
<tr>
<td>Particulate passage rate, %</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>3.90</td>
<td>4.25</td>
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*Effect: F = forage type (P < .05); L and 1 = linear effects of alfalfa level (P < .05 and .10, respectively); F*L and F*L1 = interactions between forage type and the linear effect of alfalfa level (P < .05 and .10, respectively).

TABLE 3. EFFECTS OF FREQUENCY OF SUPPLEMENTATION WITH ALFALFA HAY ON DMI (% BW) BY HOLSTEIN STEERS GIVEN AD LIBITUM ACCESS TO BERMUDAGRASS HAY (EXP. 2)

<table>
<thead>
<tr>
<th>Feeding cycle day&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Treatment&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>0A</td>
</tr>
<tr>
<td>Bermudagrass</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2.31</td>
</tr>
<tr>
<td>2</td>
<td></td>
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<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.31&lt;sup&gt;†&lt;/sup&gt;</td>
</tr>
<tr>
<td>Alfalfa</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
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<tr>
<td>2</td>
<td></td>
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<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.31&lt;sup&gt;‡&lt;/sup&gt;</td>
</tr>
<tr>
<td>SE</td>
<td>2.12&lt;sup&gt;‡&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>0A = no alfalfa, bermudagrass fed daily; 3A, 6A, 9A and 12A = 3, 6, 9 or 12% BW (DMI) of alfalfa offered daily or 1 of every 2, 3 or 4 d in a feeding cycle, respectively.

<sup>b</sup>Day of alfalfa supplementation; 2 = 1 d after alfalfa; 3 = 2 d after alfalfa; 4 = 3 d after alfalfa.

<sup>c</sup>Standard error of the treatment mean.

<sup>d</sup>Standard error of the day mean.

<sup>e</sup>Means in a column within treatment group without a common superscript letter differ (P < .05).

<sup>f</sup>Means in a row without a common superscript letter differ (P < .05).
Experiment 2. The N content of A was similar and relatively low for both trials. However, A in Exp. 2 was higher in NDF and lower in ADL than in Exp. 1. Specific cutting date and maturity for A hays are unknown. Alfalfa made up 12 to 14% of total DMI, with only occasional small refusals of alfalfa occurring. Bermudagrass hay intake for .6A, .9A and 1.2A was lowest (P < .05) on the day of A supplementation (d 1; Table 3). Compared to OA, mean B intake declined .49% BW when A was given daily (.3A) and every other day (.6A), .35% BW for .9A and .30% BW for 1.2A. For .6A and 1.2A, total DMI was similar for different days of the feeding cycle. However, for .9A, total DMI was greater (6.8%; P < .05) on d 1 (day of A supplementation) of the feeding cycle than on d 2 and 3 (1 and 2 d, respectively, after A supplementation). Mean total and B DMI were lower (P < .05) for .3A and .6A than for OA and 1.2A, whereas intake for .9A tended to be higher than for .3A (P < .08) and .6A (P < .07).

Discussion

Experiment 1. Greater digestion of O than of B diets probably resulted from differences between grasses in physical and chemical characteristics (e.g., higher NDF for O than for A; Akin, 1989). Tissues of low inherent digestibility make up a substantial portion of warm-season grasses, and warm-season grass tissues are more tightly arranged and compact than are tissues of cool-season grasses (Akin, 1986).

Less readily fermentable carbohydrate in B than in O and a greater necessity of microbial adherence for fiber digestion with B imply that A should have greater potential for favorable effects with B than with O through enhanced substrate supply for glycocalyx formation and for high growth and activity of fiber-degrading microbes (Demeyer, 1981; Hiltner and Dehority, 1983). Ndlovu and Buchanan-Smith (1987a,b) suggested that A also may improve
digestion of low-quality forages by increasing availability of minor fatty acids, amino acid and degradable cell walls to elevate microbial growth and digestion. Holloway et al. (1985) observed that DM digestion by beef cows was 9.3 percentage units greater for cows grazing tall fescue-legume pastures than for cows grazing pastures with fescue alone, even though consumption of mixed pasture DM was 1.3 kg higher. Reasons for the lack of significant changes in OM and NDF digestion with A additions in the present trial, besides the relatively high level of N in grasses, are unclear, although Jones et al. (1987) and Bowman and Asplund (1988) also did not appreciably affect OM digestion by adding leguminous forage to warm-season grass diets.

Faster particulate passage for O than for B agrees with results of Poppi et al. (1980) and Prigge et al. (1984). The cause of longer ruminal retention of B than of O digesta is unknown. Brake et al. (1989) noted a greater mean particle size of feces from dairy steers fed B compared with O, but they found no relationship of grass type to particulate passage rate. Further, the specific gravity of duodenal digesta DM of beef cows fed 1.2% BW of B or O was similar and did not relate to particulate passage rate. Perhaps the rate of change of physical characteristics of particles to properties acceptable for and conducive to ruminal exit is slower for ingested tropical grass than for temperate grasses.

The lack of effect of A supplementation on particulate passage rate contrasts with results of Ndlovu and Buchanan-Smith (1987a) with a basal corn cob diet. These workers found that A addition to the diet (30%) increased the outflow rate of digesta without affecting ruminal digesta fill. Increased feed intake may have been responsible for their effect. Abomasal protein infusion increased feed intake similarly by increasing ruminal fill without altering digesta passage rate. Particulate passage rate and fecal NDF flow in the current experiment suggest that ruminal NDF volume was not markedly affected by A level. Perhaps rate of ruminal digesta outflow and(or) ruminal digesta fill are changed by A supplementation only if feed intake is influenced markedly (Ndlovu and Buchanan-Smith, 1987a,b). Likewise, Moseley and Jones (1979) observed that feed intake and particulate passage rate were greater in sheep fed a 2:1 mix of ryegrass:clover than in sheep fed diets of pure ryegrass or clover.

Factors governing feed intake in this experiment are unknown. The chemical composition of forages, most notably the level of NDF, often is related to feed intake (Waldo, 1986). Waldo (1986) summarized that greater intake of legumes than of grasses of equal digestibility is because undigested legume occupies less gut volume. If so, one would expect that DM and NDF intake would increase as A was substituted for grass in our study. Intake of NDF increased when 15% A was substituted for B, but not when the dietary A level was increased to 30%. Instead, neutral detergent fiber ingestion decreased as A replaced dietary O. Dietary concentration of NDF did not correlate with total DMI (P > .10), and DMI for O diets remained constant regardless of A level. Hence, ruminal or gut fill did not appear to regulate feed intake.

The level of readily fermented OM and N in O was higher than in B; O was lower in NDF than B. Storage polysaccharide of temperate grass is degraded more rapidly in the rumen than that of tropical grass (Jones and Wilson, 1987). Generally, legumes are low in cell walls and high in ruminal fluid-soluble nitrogenous compounds compared to grasses, leading to rapid and extensive nutrient release shortly after consumption (Beever and Siddons, 1986). As a relative indicator of quantities of ruminally available N and readily fermentable substrate, N:cell contents (100 minus NDF) was 0.80, 0.71 and 0.48 for B, O and A, respectively. Further, cell contents may be less available to ruminal microbes in B than in cool-season grasses (Mertens and Loften, 1980). The rate of in situ degradation for two legumes and two cool-season grasses was about twice as great for N-containing compounds as for cell wall constituents (Kennedy et al., 1986). The rate of digestion of warm-season grass cell walls is slow and digestion lag time is long (Mertens and Loften, 1980; Akin, 1986; Jones and Wilson, 1987). Differences between tropical and temperate grasses in quantities and times of availability to ruminal microbes of nitrogenous compounds and fermentable OM suggest that postruminal microbial protein flow and amino acid absorption would be lower and more likely to limit feed intake and performance with tropical grasses than with temperate grasses of the same relative maturity (Flores et al., 1979; Jones and Wilson, 1987). Further, ruminal N loss (as % of N intake and with a similar grass concentration of total N) probably is greater.
for tropical grass (Stobbs et al., 1977; Beever and Siddons, 1986).

Effects of supplemental A on amounts of amino acids absorbed postruminally with B diets also may have affected feed intake. Adding A to the grasses increased ingestion of readily fermentable OM such as pectin and non-cell wall nitrogenous compounds to improve coincidence of times of availability to microbes of energy and nitrogenous compounds (MacRae and Ulyatt, 1974; Flores et al., 1979; Beever et al., 1986a,b; Jones and Wilson, 1987), with magnitudes of change being greater for B than for O. The change in diet composition with A addition presumably caused a greater shift with B than with O from relatively slowly degradable carbohydrate with long digestion lag to carbohydrate of rapid degradability with short digestion lag. Thus, A should have had more effect in stimulating microbial cell production with B than with O to improve the ratio of protein:energy in absorbed products of digestion and thereby to elevate DMI (Ulyatt et al., 1975; Egan, 1977; Flores et al., 1979; Moseley and Jones, 1979; Barry, 1981; Weston and Poppit, 1987). In support of this, ruminal ammonia absorption (g/d) was greater with a clover than ryegrass diet; non-ammonia N entering the intestines, primarily of microbial origin, also was greater for the legume (Beever et al., 1986a,b). Similar results were observed by Moseley and Jones (1979) with diets of ryegrass and clover and a 2:1 mix. In addition, undigested feed N at the duodenum as 32, 42 and 49% of total N for the grass, clover and mixed diets.

Neither gut fill nor factors governing B diet intake appeared responsible for control of intake of O diets. Perhaps excess ruminal absorption of ammonia N was involved. Beever and Siddons (1986) listed a high supply of ammonia for the liver as a nutritional circumstance with high-N forage diets unfavorable for maximal animal performance, forage intake and efficiency of forage utilization. Symonds et al. (1981) suggested that when high-N forages are consumed, ammonia is not completely removed from blood by the ruminant liver, leading to high systemic blood ammonia levels and subclinical ammonia toxicity. The rate of ammonia presentation to the liver rather than the total amount entering is of greatest importance (Symonds et al., 1981). Because a number of toxic effects are caused by high systemic blood ammonia, systems to recognize and prevent high systemic blood ammonia may exist (Visek, 1984).

In support, Egan (1966) fed mature wethers a 1.47% N diet, primarily of chaffed oaten hay, and lowered DM intake in one animal by 132 g and in another by 289 g by infusing 70 g of casein duodenally. Likewise, Barry (1981) depressed consumption by lambs of ryegrass-clover forage slightly (9%), yet improved performance substantially, by duodenally infusing casein. In the current study, perhaps relatively constant total DMI among O diets was because of physiological mechanisms to avert elevated peripheral blood ammonia.

Experiment 2. Daily supplementation with A has increased total dietary DMI with low-quality basal diets of timothy hay (Heavens, 1978), soybean stover (Soofi et al., 1982), fescue hay (Hunt et al., 1985), native grass (Judkins et al., 1985) and corncobs (Brandt et al., 1986; Ndlovu and Buchanan-Smith, 1987a,b). Supplemental leguminous forage often elevates ruminal digestion if the basal dietary forage is N-deficient (Moseley, 1974; Ndlovu and Buchanan-Smith, 1985), although increased feed intake with legume addition can increase ruminal digesta outflow rate to depress extent of digestion (Ndlovu and Buchanan-Smith, 1987a). Increases in DMI when legumes are added to grasses have been, therefore, attributed to an increased postruminl protein supply resulting from greater ruminal outflow of microbial and undegraded feed protein (Ndlovu and Buchanan-Smith, 1987a,b), even when basal forage is not extremely low in N (Moseley and Jones, 1979; Beever et al., 1986a,b). The concentration of N in B in this trial should have been adequate to support all microbial growth possible with the limited energy supply (Ndlovu and Buchanan-Smith, 1987b). Without a marked effect on DMI of A addition, constancy of DM and OM digestion is not surprising.

The lack of increase in total DMI when A was supplemented and, in fact, the decrease with supplementation daily and every other day, coupled with constant total tract digestion, imply that intake was not regulated directly by ruminal or gut fill or by mechanisms similar to those with B diets in Exp. 1. Consumption of A for .3A and .6A was during a short time span; B was not available for consumption until considerably later. Hence, inadequate readily fermentable substrate may have been available to support microbial growth ample
for complete capture of all the N liberated from A, resulting in a high rate of ruminal ammonia absorption. An ensuing incomplete capture of ammonia by the liver may have led to the decline in total DMI when A was given every day (.3A) or every other day (.6A), as was postulated for O diets in Exp. 1.

With .9A and 1.2A, the completeness of microbial capture of forage N should have been greater than with .3A and .6A because the period of consumption of A was longer and B was available all day on more days for .9A and 1.2A. Differences in results between .6A and .9A may relate to the length of time that peripheral blood ammonia was elevated.

In Exp. 1, supplementation with A increased intake of DM and digestible OM with B but not with O. With the tropical grass, an improved nutritional status with supplemental A may have facilitated increased total intake, but with O being higher in N, excess ruminally absorbed N could have precluded increased intake. Nutrient supplies must match needs for efficient tissue accretion (Stobbs et al., 1977; Egan, 1980), so changes in digestible OM intake might not necessarily parallel BW gain. But the tendency for supplementation with A to increase digestible OM intake more with B than with O in Exp. 1 suggests a larger potential for A to enhance performance with the tropical than with the temperate grass. Elevated DMI, and not digestion, seems primarily responsible (Reid et al., 1988). With very low-quality grass, however, digestion might increase if nutrients limiting microbial growth and(or) digestion are supplied. Results of Exp. 2 suggest that value with tropical grasses of dietary legume addition will not be maximum if the supplement is given alone and if a prolonged time elapses before grass is consumed.

**Implications**

Effects of supplementation of grasses with legumes on feed intake and digestion vary with forage characteristics. Generally, opportunities to increase nutrient supply to ruminants appear greater for tropical than for temperate grasses; levels of legume necessary for improvement appear to be lower for tropical grasses. Legumes should be added to tropical grasses in ways to improve digestive and metabolic conditions existing with the basal grass.

**Literature Cited**


