Forages and Pastures: Improving Silage Conservation, Utilization and Performance of Grazing Ruminant

48 Effect of microbial inoculants on the quality and stability of bermudagrass haylage. K. G. Arriola*[1], O. C. M. Queiroz[1], J. J. Romero[1], J. Kivipelto[1], E. N. Muniz[1,2], J. C. Hamie[1], M. A. Zarate[1], L. G. Paranhos[1], and A. T. Adesogan[1], *[1]Department of Animal Sciences, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, [2]Embrapa Tabuleiros Costeiros, Aracaju, SE Brazil.*

The objective was to compare the efficacy of 4 bacterial inoculants at improving the fermentation, and aerobic stability of bermudagrass haylage. Bermudagrass (4-wk regrowth) was harvested, chopped (approximately 2 cm) and treated with 1) deionized water (CON); 2) Buchneri 500 (B500) containing 1×10^5 of *Pediococcus pentosaceus* and 4×10^5 *Lactobacillus buchneri* 40788, 3) Biotal Plus II (BPII) containing $1.2 \times 10^5$of *P. pentosaceus* and *Propionibacteria freudenreichii*; 4) Silage Inoculant II (SI) containing 1×10^5 of *L. plantarum* and *P. pentosaceus* and 5) SiloK (SK), containing 1×10^5 of *L. plantarum*, *Enterococcus faecium*, and *P. pentosaceus*, respectively. Four replicate round bales (441 ± 26 kg) per treatment were wrapped with 7 layers of plastic and stored for 112 d. Four additional bales per treatment were prepared and analyzed for pH after 3, 7 and 30 d of ensiling. The experiment had a completely randomized design and data were analyzed with Proc Mixed of SAS. The pH of Control and inoculated d 3 silages was similar ($P > 0.05$) but B500 had lower pH than SK by d 3, and B500 and BPII had lower pH ($P < 0.001$; 5.79 ± 0.07 vs. 6.16 ± 0.07; 5.02 ± 0.23 vs. 5.69 ± 0.23, respectively) than other treatments by d 7 and 30. Treatments B500, BPII, and SI had lower pH than the Control ($P = 0.003$; 4.76 ± 0.16 vs. 5.2 ± 0.16) after 112 d but SK had similar pH to other treatments. No difference ($P > 0.05$) was found among treatments in NDF digestibility, DM losses, DM, lactic and acetic acid concentrations, and yeast and coliform counts. Other VFA were not detected. Treatments B500, BPII, SI, and SK improved ($P < 0.001$) aerobic stability by 195%, 161%, 162%, and 75%, respectively compared with the Control (273 ± 36 vs. 110 ± 36 h). Treatment B500 and SI had lower mold counts than other treatments ($P = 0.02$; 2.19 ± 1.01 vs. 3.68 ± 1.01 cfu/g), while SK had lower clostridia counts than the Control ($P = 0.02$; 1.15 ± 0.43 vs. 2.42 ± 0.43 cfu/g). All treatments improved the fermentation and aerobic stability of bermudagrass haylage to varying extents.

Key words: bermudagrass, haylage, inoculants

49 The impact of aerobic deterioration of corn silage on feed intake by goats. K. Gerlach*, F. Roß, W. Büscher, and K.-H. Südekum, *University of Bonn, Bonn, Germany.*

This study evaluated the impact of aerobic deterioration of corn silage on feed intake. Corn was harvested at 2 stages of maturity in October 2009 and chopped. Eight whole-crop corn silages were produced differing in dry matter (DM) content (34% and 40%), chopping length (10 mm and 21 mm) and packing density in the silo (high, 275 kg DM/m^3; low, 256 kg TM/m^3). Each factor combination, i.e., treatment, was ensiled in 6 110-L plastic tons for at least 3 mo. At the day of silo opening (d 0) and then at 2-d intervals (d 2, 4, 6, and 8) the following measurements were conducted: temperature, sensory evaluation, chemical composition and microbiological testing. For use in preference trials, samples of silages were taken and stored anaerobically in evacuated and vacuum-sealed polyethylene bags. Eight preference trials with goats (n = 6) were conducted, each one lasting 21 days. Each possible pair of the five silages (days 0, 2, 4, 6, and 8) and one standard alfalfa hay (n = 15 pairs), were offered for 3 hours in the morning. Data were analyzed by analysis of variance and multidimensional scaling (MDS), which was used to develop a spatial arrangement representing the differences expressed as selective forage intake by the animals. For most treatments, the animals showed a strong preference for silages from days 0, 2 and 4 and avoided silages exposed to air for 6 and 8 days ($P < 0.05$). Analysis of variance was conducted after averaging silage intake across all pairs by each animal. During 3 h, average intake for silages from day 0 ranged from 580 to 723 g DM per goat, while the average intake of day 8 silage was between 136 and 464 g DM. Using the Waller-Duncan k-ratio t-test, the minimum significant difference (ranging from 82 g to 128 g DM, $P < 0.05$) was calculated for each treatment. Average DM intake (DMI) by goats (y) was linearly related to silage temperature at the different days of aerobic storage (x, expressed as the difference to ambient temperature): $y = 662.61 - 11.669$ x; $R^2 = 0.6808$; $P < 0.0001$. This study demonstrated the negative impact of aerobically deteriorated silage on preference and DMI by goats.

Key words: aerobic deterioration, corn silage, preference trial

50 Caloric content of brown midrib sorghum silage harvested at two maturities, fed with concentrate at two levels of intake using in vivo, in vitro and prediction equation methods as related to rumen fermentation and fractional passage. J. Lim, M. A. Froetschel*, and L. O. Ely, *The University of Georgia, Athens.*

Four rumen fistulated Holstein yearling steers, were fed brown midrib (BMR) forage sorghum (*Sorghum bicolor* (L.) Moench) harvested at 2 maturities (earlier maturity (EM), flowering stage or later maturity (LM), milk to soft dough stage), in total mixed rations (TMR), 60% BMR sorghum silage (% DM) and were fed at 2 levels of intake (~1.5x maintenance or free access for 5 h/d), to compare methods of estimating digestible energy (DE) as related to rumen fermentation and fractional passage of particulate. A 4 × 4 Latin square design with a 2 × 2 factorial arrangement of treatments was used. The concentrate consisted mainly of corn and soybean meal with chromic oxide as a digestibility marker. Periods were 14 d, 7 d to adapt and 7d for data collection. Daily DMI was measured, feed and fecal samples were collected at incremental 12 h intervals from d 8 to 13. On d 14, rumen contents of steers were evacuated 5, 11, 17 and 23 h after feeding, weighed, sampled for nutrient analysis and returned. Ruminal fluid was collected for ammonia and volatile fatty acid analysis (VFA). The EM silage had less grain development and more NDF (60.7 VS 56.7 ± 0.74), ADF (33.3 VS 31.8 ± 0.41) but lower ADL (4.11 VS 5.12 ± 0.25) and ash (7.16 VS 6.18 ± 0.45) than the LM silage. Apparent DE, and DM digestibility (DMD) were not influenced by BMR maturity or intake. Fractional disappearance rate (FDR) of ruminal DM, NDF, NDS, OM and ash were not influenced by BMR maturity but increased in steers fed at higher intake ($P \leq 0.01$). Apparent DE, DMD and FDR of ruminal DM, NDF, NDS, OM and ash were not influenced by BMR maturity ($P \geq 0.05$). The DE predicted using NRC method correlated with in vitro DE ($y = 0.684x+.838$; $r^2 = 0.82$, $P \leq 0.01$) but not apparent DE. Rumen NH3 was higher at lower intakes and VFA were higher at greater intakes ($P \leq 0.01$). In vitro DE appears to be as accurate as the NRC prediction method to assess caloric content of a 60% BMR (DM%) TMR. DE content of total mixed rations with 60%

BMR sorghum (% DM) as a basal forage was minimally influenced forage maturity.

Key words: forage quality, digestible energy, in vitro

51 Intake and digestibility in steers fed sugarcane ensiled with different levels of calcium oxide. F. H. M. Chizzotti*[1], O. G. Pereira[2], S. C. Valadares Filho[2], M. L. Chizzotti[1], and R. T. S. Rodrigues[3], *[1]Universidade Federal de Lavras, Lavras, MG, Brazil, [2]Universidade Federal de Viçosa, Viçosa, MG, Brazil, [3]Universidade Federal do Vale do São Francisco, Petrolina, PE, Brazil.*

A trial was conducted to evaluate the effects of calcium oxide levels (CO) as additive for sugarcane silage on intake and nutrient digestibility. Thirty-five crossbred steers (Holstein x Nellore), averaging 350 ± 18.3 kg BW, distributed in 7 randomized blocks were used. Diets consisted of 50% roughage and 50% concentrate, formulated to be isonitrogenous (12% CP, DM basis). The 5 treatments consisted of sugarcane ensiled with 4 CO levels (0, 0.5, 1.0, and 1.5%, as fed basis) and a standard diet with corn silage. The experiment lasted 99 d. DMI was measured daily and individually. Indigestible ADF was used as an internal marker to estimate apparent nutrient digestibility and fecal output. A mixed model with random effect of blocks was used. There was a quadratic positive effect ($P < 0.05$) of levels of CO on OM, NDF, non-fiber carbohydrates (NFC) and TDN intakes. The highest TDN intake (6.17 kg) was observed at 0.5% of CO in sugarcane silage. The TDN intake of corn silage diet was similar to TDN intake of diet with 0.5% of CO. There were positive linear effects ($P < 0.05$) of CO levels on apparent total digestibility of DM, OM, CP, NDF and % of TDN of the diets. There was no difference ($P > 0.05$) of DM, OM, and NDF digestibilities of sugarcane silage with CO and corn silage. The addition of calcium oxide (up to 1.5%) in silage improves sugarcane silage quality, increasing apparent digestibility of DM, OM, CP and NDF. However, the TDN intake decreased for CO levels above 0.5% which may decrease animal performance. Sponsored by CNPq/INCT-CA and Fapemig, Brazil.

Key words: additive, feedlot, roughage supplementation

52 Effects of co-grazing dairy heifers with goats on animal performance, pasture composition, and dry matter yield. T. S. Dennis*, M. K. Neary, L. J. Unruh-Snyder, J. E. Tower, and T. D. Nennich, *Purdue University, West Lafayette, IN.*

Various pasture management systems, such as co-grazing, may offer alternative methods for rearing dairy heifers. The objective of this study was to determine the effects of co-grazing dairy heifers with goats on animal performance, pasture composition, and forage DM yield. Twenty-four Holstein heifers (BW = 168.0 ± 1.7 kg) and 6 Boer x Kiko goats (BW = 33.7 ± 0.9 kg) were allocated to 6 paddocks and used to evaluate 2 grazing strategies (heifers grazed alone (HO) or heifers co-grazed with goats (HG)). Additionally, 6 goats were randomly assigned to 2 paddocks and grazed alone to compare parasitism between grazing strategies. Heifers were weighed biweekly and measured monthly for body condition score, hip and withers heights, and heart girth. Blood samples were collected monthly from heifers to measure plasma urea nitrogen (PUN) and glucose. Fecal egg counts (FEC), FAMACHA scores, and PUN were measured monthly in goats. Forage heights before and after grazing were measured to calculate pasture DMI. Pasture samples were collected monthly by manually harvesting forage and photographs were taken to visually estimate composition. Data were analyzed by paddock as repeated records using PROC MIXED of SAS. Total and pasture DMI were greater for HO than HG heifers ($P < 0.01$); however, ADG and feed efficiency were similar between grazing strategies. Final hip and withers heights were greater for HO heifers ($P < 0.01$). Heifer PUN concentrations tended to be greater for HG heifers at 8 wks ($P < 0.10$), and blood glucose concentrations tended to be less for HG heifers over the entire study ($P < 0.10$). Overall FEC, FAMACHA scores, and PUN concentrations were also similar between grazing strategies for goats. Grass and total DM yield tended ($P < 0.10$) to be greater in HO pastures compared with HG pastures after 2 rotations. Using visual estimation, HO pastures had 3.5 times greater weed presence than HG pastures ($P < 0.05$) at the conclusion of the study. In summary, co-grazing did not affect weight gains or feed efficiency of heifers, indicating that dairy heifers can be successfully co-grazed with other livestock species.

Key words: dairy heifer, goat, grazing

53 Forage mineral concentrations and mineral status of beef cattle grazing cool season pastures in northwestern Florida, emphasizing magnesium. J. N. Carter[2], L. R. McDowell*[1], R. O. Myer[2], M. K. Maddox[2], and M. Brennan[2], *[1]University of Florida, Gainesville, [2]University of Florida, Marianna.*

This study evaluated mineral status (particularly Mg) of grazing beef cows (42 Angus, Brangus and Romosinuano crosses in early lactation) on annual ryegrass (*Lolium multiflorum* 'Rio') or oat pastures (*Avena sativa* 'Horizon 474'). The fertilizer used on the oat and ryegrass pastures was 355 kg of 3–7-28 at time of planting per ha. Forage, blood and urine were collected every 2 weeks, while liver biopsies were taken on d 68. From urine was determined creatinine-corrected urine (CCU), Mg and K and fractional clearance ratio (FCR) for Mg. Mineral data for blood, urine and forage samples were analyzed as a completely randomized design with repeated measures over time. Forage mineral concentrations of P, K, Na, Fe, Mn and Mo were normally greater than critical levels for beef cattle, while Mg (<0.20%), Ca (<0.30%), Cu (<10ppm), Co (<0.10ppm), Zn (<30ppm) and Se (<0.10ppm) were at deficient levels. In general ryegrass had greater concentrations of Ca, Mg, P, K, Cu, Mn and Zn than oats. As examples Ca, P and Cu were higher ($P < 0.05$) for 3 collection dates in ryegrass than oats. All plasma mineral levels were greater than critical levels, but plasma Mg was borderline to slightly deficient, (<2.0 mL%). Cows grazing oats had the lowest plasma Mg. There were no difference in liver Cu, Fe, Mn and Se between forage treatment types ($P > 0.05$). The FCR for oats was less than the critical recommended level of 10%, which indicates Mg deficiency, until d 41. However, ryegrass treatment had greater FCR values for all collection days except d 1. Except for d 55, CCU Mg for oats treatment was less than 1.0 mmol/L throughout the trial, the level at which cattle generally respond to Mg supplementation. The ryegrass treatment had higher values than for all oat treatment values; except at d 1. In conclusion higher mineral concentrations are found in ryegrass versus oats. Special attention should be given to Mg supplementation because forages are deficient and contain excess K.

Key words: oats, ryegrass, mineral status

54 In vitro rumen fluid digestion activity of grazing cows as related to productivity and days postpartum. E. G. Tesfaye, M. A. Froetschel*, L. O. Ely, N. S. Hill, and M. J. Mathis, *The University of Georgia, Athens.*

In vitro rumen fluid digestion activity and indigestible fecal NDF were measured in 10 multiparous Angus cows averaging 8 ± 3 years of age, with ≥5 calves from a pure-bred herd (104 cows). Five cows with the lowest and 5 cows with the highest life-time weaning weight ratio (WWR) records (lowest = 6% below herd average; highest = 9.4% above herd average) were selected using breed association data. The cows, were managed with the herd, grazing permanent pasture of primarily Tall Fescue or Bermuda grass depending on seasonality. Rumen fluid was collected by stomach tube from each cow at 3 dates (March 14th, June 25th, and September 23rd, 2008) averaging 64, 167 and 257 d postpartum and used for in vitro incubations. Data was analyzed according to cow productivity and date of sampling in a 2 × 3 factorial designed experiment. Two stage incubations were conducted for 24 and 48 h, in quadruplicate, using a modified Tilley and Terry procedure. A composite sample of mixed pasture grass, collected the previous year (68.7% NDF and 12.1% CP) was used as substrate. In vitro DM and NDF digestion (IVDMD and IVNDFD) were determined as differences in DM and NDF of particulate. Volatile fatty acid (VFA) and soluble protein (SP) production (μ moles/24 or 48 h) were determined from differences in VFA and SP during the time of the incubations (24 and 48 h). Rumen fluid from cows, selected for productivity as based on WWR did not impact IVDMD, IVNDFD and IVSP production ($P \geq 0.05$). The acetate to propionate ratio (A/P) was 6.9% lower in rumen fluid from more productive cows. In vitro propionate and butyrate production (μ moles/24 h) were 9.8 and 16.7% greater and A/P was 9.8 % lower with rumen fluid from more productive cows ($P \leq 0.05$). IVDMD was 9.6% greater with rumen fluid sampled 167 and 257 d post- partum ($P \leq 0.01$). Potentially digestible NDF tended to be lower (29% vs. 33%) in feces from higher productivity cows ($P \leq 0.13$). In vitro rumen fluid digestion activity and fecal parameters were influenced by cow productivity and sampling time postpartum.

Key words: in vitro, cow performance, digestion

55 Forage characteristics and animal performance of beef heifers grazing ′Mulato II′ brachiariagrass in North-Central Florida. J. M. B. Vendramini*[1], G. C. Lamb[2], L. E. Sollenberger[3], J. L. Foster[4], and M. Maddox[2], *[1]UF/IFAS Range Cattle Research and Education Center, Ona, [2]UF/IFAS North Florida Research and Education Center, Marianna, [3]Agronomy Department, Gainesville, FL, [4]Texas Agrilife Research and Education Center, Beeville.*

Mulato II (*Brachiaria* sp.) is a warm-season grass adapted to tropical regions and it has superior nutritive value when compared with other warm-season grasses. The objective of this study was to compare forage production, nutritive value, and animal performance of beef heifers grazing Mulato II, pearl millet (*Pennisetum glaucum* 'Tifleaf 3'), or sorghum-sudangrass (*Sorghum bicolor* 'Hay Day') pastures. The study was conducted in Marianna, Florida (30.7° N) from June to August 2008 and June to September 2009 in a completely randomized design with 3 replicates. Pastures (0.6 ha) were sampled to determine herbage mass (HM), crude protein, and in vitro organic matter digestion (IVODM) every 14 d. Pastures were continuously stocked using a variable stocking rate with 2 testers per pasture [heifers; 426 ± 40 kg initial body weight (BW)]. Additional animals were added to maintain similar stubble height, 30 cm. The data was analyzed using PROC MIXED, by year, with treatment as fixed effect and replicates as random effect. The data was analyzed by year due to the different experimental periods within year. Single degree of freedom contrasts were used to detect difference among treatments. In 2008, there was no difference ($P > 0.10$) in HM (1600 ± 300 kg/ha), IVDOM (62 ± 1 %), CP (18 ± 0.5 %), herbage allowance (HA, 0.9 ± 0.1 kg DM/kg BW), and ADG (0.5 ± 0.05 kg/d) among treatments. Gain per ha was greater ($P = 0.08$, SE = 20) for sorghum-sudangrass (240 kg) than pearl millet (168 kg) and Mulato II (130 kg). In 2009, despite the use of ′put and take′ animals, Mulato II had greater HM ($P < 0.01$, SE = 0.3; 3000 vs. 1500 kg/ha), HA ($P = 0.02$, SE = 0.1; 2.0 vs. 0.8 kg DM/kg BW), IVDOM ($P = 0.06$, SE = 0.1; 65 vs. 59%), and ADG ($P = 0.02$, SE = 0.08; 0.7 vs. 0.4 kg/d) than pearl millet and sorghum-sudangrass. There was no difference in CP concentration ($P > 0.10$; 20 ± 0.4 %) and gain per ha ($P > 0.10$; 302 ± 28 kg) among treatments. Mulato II may be a feasible option as a warm-season annual grass in North Florida for beef cattle.

Key words: Mulato II, pearl millet, sorghum

56 Bermudagrass–legume forage systems for summer stockers. B. M. Nichols[1], C. A. Moffet[1], J. T. Biermacher[1], T. J. Butler[1], R. R. Reuter[1], J. K. Rogers[1], J. A. Guretzky[2], and J. R. Blanton Jr.*[1], *[1]The Samuel Roberts Noble Foundation, Ardmore, OK, [2]University of Nebraska, Lincoln.*

Stocker cattle grazing warm season perennial grasses is an important agricultural enterprise in the Southern Great Plains. Increases in the price of nitrogen fertilizer (N) lead to questions of whether or not alternate grazing systems including the use of legumes differ from the conventional practice of N fertilization. The objective of this study was to determine the effects of interseeding legumes in bermudagrass on performance of stocker cattle compared with N fertilization. Research was initiated in the fall of 2007 at The Noble Foundation Pasture Demonstration Farm on Midland bermudagrass stands established in 1965 near Ardmore, OK and continued for a 3-yr period. Treatments were applied to pastures (1.29 ± 0.11-ha) in a CRD with 3 replications that included 1) N- fertilized bermudagrass (112 kg/ha; control); 2) 18 kg pure live seed (PLS)/ha "Bulldog 505" alfalfa interseeded into bermudagrass (BG+A); and 3) 14.4 kg PLS/ha "AU early cover" hairy vetch, 9 kg PLS/ha "Dixie" crimson clover, and 6 kg PLS/ha "Apache" arrowleaf clover interseeded into bermudagrass (BG+L). The paddocks were stocked with 4 steers in 2008 (3.21 ± 0.30 steers/ha; initial BW = 221 ± 15.9 kg) and 3 steers in 2009 and 2010 (2.35 ± 0.22 steers/ha) with initial BW of 254 ± 5.1 and 321 ± 11.6 kg, respectively. Paddocks were initially stocked to provide 1.15 kg forage per kg animal BW. Grazing days per hectare, ADG, and BW gain per hectare were analyzed by ANOVA with year and paddock considered random. Means were compared using the PDIFF function of SAS. Grazing days did not differ ($P = 0.14$) between control, BG+L, and BG+A (244, 184, and 221 ± 20.4 d/ha, respectively). Average daily gain was not significantly different ($P = 0.92$) between control, BG+L, and BG+A (0.77, 0.78, and 0.74 ± 0.06 kg/d, respectively); and BW gain per hectare was also not different among forage systems ($P = 0.15$; 199, 151, and 148 ± 19.7 kg/ha, respectively). Overall, interseeding bermudagrass pastures with legumes has the potential to decrease the need for producers to employ costly N inputs while maintaining similar animal performance.

Key words: stocker cattle, grazing systems, legumes

57 Stocker production systems utilizing warm-season perennial grass pasture: Cattle performance and nitrogen use efficiency. B. W. Wallis*, P. A. Lancaster, E. D. Sharman, D. B. Arnall, J. G. Warren, T. E. Ochsner, S. R. Lancaster, and G. W. Horn, *Oklahoma Agricultural Experiment Station, Stillwater.*

In grazing systems only 5–10% of ingested nitrogen (N) is retained in BW gain of growing beef cattle. The objective of this study was to evaluate the effects of levels of N fertilizer and source of N for growing beef cattle on N use efficiency of stocker cattle grazing systems using warm-season perennial grass pastures. Mixed-breed heifers (n = 235; 274 ± 33 kg) grazed Plains Old World bluestem pastures (3 pastures/system) in a completely randomized design (Proc GLM of SAS) comparing 4 summer grazing systems: (1) non-fertilized, low stocked (336 kg of BW/ha) pastures (CONT); (2) N fertilized (90 kg N/ha), high stocked (672 kg of BW/ha) pastures (NFERT); (3) N and phosphorus (P) fertilized (39 kg P/ha), high stocked pastures (NPFERT); and (4) non-fertilized, high stocked pastures plus supplementation of dried distillers grains with solubles (DDGS; 0.75% BW•hd^{-1}•d^{-1}). Heifers grazed for 135 d from May 18 to Sept. 28, 2010. Heifers grazing non-DDGS supplemented pastures were fed a protein supplement (0.45 kg•hd^{-1}•d^{-1}) beginning on d 66 to meet the DIP requirement of heifers grazing late-summer forage. Gain per hectare (kg/ha) was greatest for treatment 4 and least for treatment 1 (Table 1). N recovery (%) was greatest for treatment 1 due to low N inputs. However, replacing N fertilizer with DDGS supplementation improved N recovery 2.00 and 1.95-fold compared with treatments 2 and 3, respectively. These data indicate that DDGS can be effectively used to replace N fertilizer in stocker cattle grazing systems to increase stocking rates, increase BW gain/ha, and increase N use efficiency of the production system.

Table 1. Cattle performance and nitrogen use efficiency of stocker grazing systems

Item	CONT	NFERT	NPFERT	DDGS	SEM
Gain, kg/heifer	128[a]	114[b]	117[b]	136[a]	3.54
Gain, kg/ha	162[a]	284[b]	291[b]	344[c]	7.17
N inputs, kg/ha	8.0[a]	99.6[b]	99.8[b]	38.2[c]	0.26
N retention[1], kg/ha	3.4[a]	6.2[b]	6.3[b]	7.1[c]	0.12
N recovery, %	42.6[a]	6.2[b]	6.3[b]	18.6[c]	0.75

[1]Calculated as N in BW gain of heifers using NRC (1996) equations. [a,b,c]Within a row, means without a common superscript letter differ ($P < 0.01$).

Key words: dried distillers grains, N use efficiency, stocker cattle

58 Effect of protein supplementation on intake and digestion of three bermudagrass hays of divergent quality by beef cattle. C. P. Payne*, T. M. Warnock III, J. E. Sawyer, and T. A. Wickersham, *Texas A&M University, College Station.*

Quality of bermudagrass (*Cynodon dactylon*) varies in response to management and environmental factors. Supplementation decisions are complicated by this variability. Therefore, our objective was to determine the effect of 4 protein supplementation levels (0, 82, 119 and 155 mg N/kg BW) on the utilization of 3 bermudagrass hays (5.6, 6.3, and 8.1% CP). Thirteen ruminally fistulated Angus × Hereford steers (BW = 330 ± 19 kg) were used in a 13 × 4 incomplete Latin square with 13 treatments and 4 periods. Treatments were arranged as a 3 × 4 factorial plus a control bermudagrass hay (10.8% CP). Hay was provided ad libitum and protein supplements were offered as range cubes once daily. Periods were 15-d long with intake determinations made on d 10 through d 13 to correspond with fecal grab samples collected from d 11 through d 14. Acid detergent insoluble ash was used as an internal marker of fecal output. Eleven contrasts were used to separate treatment means. Hay OM intake in unsupplemented steers increased quadratic ($P = 0.05$) from 75 to 77, 96 and 94 g/kg BW$^{0.75}$ as hay CP content increased from 5.6 to 6.3, 8.1 and 10.8% CP hays, respectively. There was a linear increase ($P < 0.01$) in total digestible OM intake in response to hay nutritive value from 35 to 45, 51, and 60 g/kg BW$^{0.75}$ for 5.6, 6.3, 8.1, and 10.8% CP hays, respectively. A significant ($P = 0.04$) supplemental × hay CP content interaction was observed for forage OM intake and total OM intake. Forage OM intake of the 6.3% CP hay tended to increase linearly with supplemental protein ($P = 0.08$). Total OM intake increased linearly ($P < 0.01$) when CP was supplemented to the 6.3% CP hay from 77 to 88, 92, and 98 g/kg BW$^{0.75}$ for 0, 82, 119, and 155 mg N/kg BW, respectively. No supplement × hay CP interaction was apparent ($P > 0.10$) for total digestible OM intake; however, supplemental protein tended to increase total digestible OM intake (linear, $P = 0.07$) We conclude that forage quality was the primary driver in determining total digestible OM intake, and the effect of protein supplementation was dependent on forage digestibility and protein content.

Key words: bermudagrass, supplementation, cattle

59 Effect of level and frequency of protein supplementation on utilization of South Texas grass hay. G. R. Monson[1], J. E. Sawyer[1], R. O. Dittmar III[1], M. L. Drewery[1], C. P. Payne[1], K. C. McCuistion[2], and T. A. Wickersham*[1], *[1]Texas A&M University, College Station, [2]Texas A&M University-Kingsville, Kingsville.*

Reducing frequency of supplementation may effectively reduce costs of delivery; however, little research has evaluated the level of supplemental protein required with infrequent supplementation. Our objective was to quantify forage utilization when graded levels of protein were delivered infrequently. Five ruminally cannulated Angus × Hereford steers (BW = 410 ± 43 kg) were used in a 5 × 4 incomplete Latin square. Steers were provided ad libitum access to grass hay (2.3 % CP, 81.8% NDF). Supplemental protein, provided as a range cube (40.7% CP), was fed at 0645h to provide a specified level of N (0, 160, 320, or 480 mg of N/kg BW) daily (/d) or every third day (/3d), resulting in the following treatment combinations: 0/d, 160/d, 160/3d, 320/3d, and 480/3d. Experimental periods were 18 d long. Forage intake was determined from d 10 through 15 to correspond with fecal grab samples collected from d 11 to d 16. Acid detergent insoluble ash was used as an internal marker to estimate fecal output. On d 16 to d 18 of each period ruminal fermentation profiles were evaluated. Hay OM intake was 4.41, 6.18, 5.46, 6.10, and 6.27 kg/d for 0/d, 160/d, 160/3d, 320/3d, and 480/3d. Intake increased linearly ($P < 0.01$) with increasing protein per 3 d, but the 160/d rate did not differ from 160/3d, 320/3d, and 480/3d ($P > 0.05$) provision. Total OM intake responded in a similar fashion, but was lower for 160/3d than 160/d ($P < 0.05$; 7.08 and 5.83 kg/d, respectively). Total digestible OM intake increased quadratically ($P = 0.06$) with increasing protein provision per 3 d (2.02, 2.82, 3.59, and 3.34 kg/d for 0/d, 160/3d, 320/3d, and 480/3d, respectively). When protein was provided at 160/d, total digestible OM intake was 3.30 kg/d, which did not differ from any treatment receiving supplement. There were no significant effects ($P > 0.05$) on digestibility. Reduced levels of protein supplemented infrequently may be an effective means of capturing additional cost savings.

Key words: frequency, protein, cattle