

FORAGES AND PASTURES II: FORAGES FOR LIVESTOCK SYSTEMS

0317 Interseeding bermudagrass pastures with alfalfa or clovers for growing calves. P. Beck^{*1},

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Bermudagrass [*Cynodon dactylon* (L.) Pers.] pastures ($n = 8$; 0.8 ha) were interseeded with 13 kg red clover/ha (*Trifolium pretense*, cv. Morningstar, Cal/West Seeds, Woodland, CA) and 3.3 kg ladino white clover/ha (*Trifolium repens*, cv. Regal Graze, Cal/West Seeds) or with 28 kg alfalfa/ha (*Medicago sativa*, cv. PGI 459, Producers Choice, Woodland, CA in yr 1 and cv. Rebel, Producers Choice, Woodland, Cain yr 2). Twelve additional bermudagrass pastures received 0, 56, or 112 kg N/ha as ammonium nitrate. Beef steers ($n = 283$, BW = 243 ± 30.5 kg) were used for BW gain analysis and grazed treatment pastures through the summer over 4 yr in this put and take experiment. In the fifth year of the experiment, clovers and alfalfa were killed before grazing and steers ($n = 80$, BW = 223 ± 13.3 kg) grazed pastures to determine the carry-over N benefit to the bermudagrass following these legumes. Data were analyzed as a completely randomized design with the mixed procedure of SAS. Single df contrasts were used to determine the linear N fertilization rate effect and the effects of alfalfa and clover. Over the 4-yr experiment, ADG, BW, gain per hectare and grazing days per hectare increased ($P < 0.01$) linearly with increasing N rate. Yet ADG and BW of alfalfa and clover additions did not differ ($P \geq 0.14$) from the 112 kg N rate or each other. During the 4-yr experiment, grazing-d/ha was greater ($P < 0.01$) for alfalfa than clover, which was greater than all N fertilization rates ($P \leq 0.05$). Gain/ha of alfalfa and clover did not differ ($P \geq 0.31$) but were greater ($P < 0.01$) than all fertilization rates. In the final year of the experiment, ADG, grazing-d/ha, and gain/ha were not affected ($P \geq 0.19$) by N fertilization rate or carry-over N from previous legume stands, indicating that benefit of carryover N from legumes to subsequent grass crops is minimal. Both clovers and alfalfa produced equivalent BW to the 112 kg N/ha fertilization rate and produced more grazing-d/ha and BW gain/ha than N fertilization, indicating improvements in diet quality with greater levels of fertilization or legume additions. Increases in grazing-d/ha and gain/ha with alfalfa or clovers were primarily through extension of the grazing season due to an earlier start of grazing.

Key Words: alfalfa, bermudagrass, clover, growing steers

0318 Grazing novel endophyte-infected fescue following grazing endophyte-infected fescue to alleviate fescue toxicosis in beef calves.

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The objective was to investigate the efficacy of grazing novel endophyte-infected fescue following grazing endophyte-infected fescue as a means to alleviate fescue toxicosis; exhibited as poor ADG, BCS, hair coat score (HCS; 1–5), increased respiration rate, and decreased serum prolactin (PRL). Fall-born, Simmental \times Angus calves (yr 1: $n = 36$ steers, average BW = 182 ± 28 kg; yr 2: $n = 36$ heifers, average BW = 240 ± 16 kg) were stratified by BW and randomly allotted into 6 groups within each yr. In yr 1, grazing (139 d) initiated May 2, 2012; in yr 2, grazing (121 d) initiated May 5, 2013. Groups were randomly assigned to 3 treatments: 1) endophyte-infected fescue (KY-31; whole grazing season), 2) novel endophyte-infected fescue (MaxQ; whole grazing season), and 3) KY-31 (early half of season, period 1) followed by MaxQ (late half of season, period 2; KY-31/MaxQ). Groups were rotated every 5 d through 3.24 ha pastures that were subdivided into six 0.54 ha paddocks. Put-and-take cattle were used to ensure forage availability was not different ($P = 0.73$) between treatments. Period 1 ADG, BCS, HCS and respiration rate were analyzed using a contrast of MaxQ vs. KY-31 and KY-31/MaxQ as both treatments grazed KY-31 pastures during this time. Period 1 respiration rate was not different ($P = 0.26$); yet, ADG was greater ($P < 0.01$) for cattle grazed on MaxQ than KY-31. Period 2 respiration rate was greater ($P = 0.01$) for KY-31 than MaxQ, with KY-31/MaxQ being intermediate. Period 2 ADG and final BCS were greater ($P \leq 0.04$) for MaxQ and KY-31/MaxQ than KY-31. There was a year \times treatment interaction ($P = 0.02$) for final HCS. In yr 1, MaxQ and KY-31/MaxQ had improved ($P \leq 0.01$) final HCS than KY-31. In yr 2, MaxQ had improved ($P \leq 0.04$) final HCS, with no difference ($P = 0.10$) between KY-31 and KY-31/MaxQ. There was a treatment \times time interaction ($P < 0.01$) for PRL. Mid- and end of period 1 PRL for MaxQ were greater ($P \leq 0.01$) than KY-31 and KY-31/MaxQ; however, mid- and end of period 2 PRL for MaxQ and KY-31/MaxQ were greater ($P \leq 0.01$) than KY-31. Overall ADG was greater ($P < 0.01$) for MaxQ and KY-31/MaxQ than KY-31. Grazing MaxQ following grazing KY-31 alleviated fescue toxicosis symptoms; thus, cattle experienced compensatory gain resulting in similar overall performance to cattle that grazed MaxQ continuously.

Key Words: beef cattle, endophyte, fescue grazing

0319 Metagenomic analysis of the rumen microbiome in wheat-induced frothy bloat among steers.

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Frothy bloat is a serious metabolic disorder that causes reduced performance or mortality in stocker cattle grazing hard red winter wheat forage in the Southern Great Plains. We hypothesized a dysbiosis to develop in the rumen microbiome of stocker cattle when grazed on high quality winter wheat pasture that predisposes them to frothy bloat risk. In this study, rumen contents were harvested from six cannulated steers (mean BW 450 lb; three with bloat score '2' and three with bloat score '0'), extracted for genomic DNA and subjected for shotgun sequencing on 454/Roche platform. Approximately 1.5 million reads were sequenced, assembled and assigned for phylogenetic and functional annotations. Differences in microbial communities between bloated and non-bloated steers were analyzed using Mixed procedure of SAS. Bacteria predominated up to 84% of the sequences while archaea contributed to nearly 5% of the sequences. The abundance of archaea tended to be higher in bloated animals ($P < 0.12$) dominated by *Methanobrevibacter*. Predominant bacterial phyla were *Firmicutes* (65%), *Actinobacteria* (13%), *Bacteroidetes* (10%) and *Proteobacteria* (6%). *Firmicutes* were largely represented by *Eubacteriaceae*, *Ruminococcaceae*, *Lachnospiraceae* and *Eubacteriaceae*. However, only a few genera from Firmicutes such as *Butyrivibrio* and *Lactobacillus* showed differences ($P < 0.05$) between both groups. *Bacteroidetes* showed distinct differences between both groups with lineages from *Prevotellaceae* to be higher ($P < 0.05$) in bloated animals while non-bloated animals had higher ($P < 0.05$) abundance of *Porphyromonadaceae*, and *Bacteroidaceae* members. *Actinobacteria* was dominated by *Coriobacteriaceae* lineages, which tended to be higher ($P < 0.12$) in non-bloated steers. Functional annotations of assembled reads to KEGG database revealed the abundance of several metabolic pathways, with carbohydrate and protein metabolism well represented. Among the carbohydrate metabolism, utilization of monosaccharides was higher ($P < 0.05$) in bloated animals while disaccharide degradation tended to be higher ($P < 0.12$) in non-bloated animals. Assignment of contigs to CaZy database revealed the distribution of Glycosyl Hydrolases across all samples showing the presence of a core microbiome associated with fiber digestion. Principle component analysis based on phylogenetic and functional assignments both revealed the tendency to cluster microbial communities by the incidence of bloat, however validation will require greater sample numbers. It can be concluded that the rumen microbial community structure and metabolic potential are substantially altered under moderate frothy bloat conditions.

Key Words: rumen microbiome, frothy bloat, metagenomics, wheat forage

0320 Stocking density effects in short duration grazing systems on botanical composition and soil characteristics of grasslands. J. J. Bisinger*, Iowa State University, Ames.

To evaluate stocking density effects in short duration grazing systems on grassland forage and soil properties, three replicated pastures containing cool season grass and legume species without (BL1) and with (BL2) warm season grasses were divided into 5 paddocks. In each pasture, one paddock was not grazed (NG) and 4 were strip (moved once daily with a back fence) or mob (moved 4 times daily with a back fence) grazed beginning in May 2011 (BL1) and 2012 (BL2) by 10 cows at a live forage DM allowance of 2% BW/d. Within each pasture, one mob (MR) and strip (SR) paddock were rotationally stocked to remove 50% of the live forage with 35 d rest periods beginning 60 d after mob or strip grazing in yr 1 of each block and in the two (BL1) and one (BL2) subsequent grazing seasons. Water infiltration, soil penetration resistance, soil bulk density, and soil carbon were measured in May and October and botanical composition was determined in May, July, and October of each year. Compared to NG paddocks, water infiltration was lower ($P < 0.05$) in rotationally stocked paddocks in October 2011 and 2012 in BL1 and greater ($P < 0.05$) in all grazed paddocks in October 2012 in BL2. Penetration resistance at 5 cm was greater ($P < 0.05$) in rotationally stocked than NG paddocks from May 2012 to October 2013 in BL1 and in October 2013 in BL2. Bulk density to 7.5 cm was less ($P < 0.05$) in NG than grazed paddocks in BL1 in October 2012 and rotationally stocked paddocks in October 2013 in BL2. Soil carbon content to 7.5 cm was greater ($P < 0.05$) in BL1 SR and BL2 MR paddocks than NG paddocks in May and October 2013, respectively. The proportions of cool season grasses in BL1 were lower ($P < 0.05$) in grazed than NG paddocks in July 2011 and in rotationally stocked paddocks after July 2012. Conversely, in grazed paddocks there were greater proportions of annual grasses ($P < 0.05$) in July 2011 and legumes ($P < 0.10$) in May and October 2012 than NG paddocks. In BL2, proportions of warm season grasses were less ($P < 0.05$) in rotationally stocked than NG paddocks in July 2013. Strategic spring mob or strip grazing will reduce competition from cool season grasses to allow establishment of legumes in perennial grasslands.

Key Words: beef cattle, mob stocking, botanical composition

0321 Seasonal changes in DM, CP, NDF, and NDF digestibility of pasture forage in grazing production systems.

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Nine grazing dairy farms were utilized in a study to measure monthly changes in forage quality of pastures over a 2-yr period. Farms were from a wide geographical area across Minnesota representing a range in soil type and annual rainfall amounts as well as herd size, pasture size and pasture management. Pasture forage was sampled every 2 wk during the growing season and analyzed for DM, CP, NDF, and NDF digestibility concentrations. Data were analyzed using PROC MIXED of SAS. Independent variables for analyses were the fixed effects of farm ($n = 9$), season (spring, summer or fall), year (1 or 2) and their interactions. Across the 9 farms, spring pasture DM (23.96%) was higher ($P < 0.05$) than summer (23.52%) and fall (19.76%) pasture DM. Average DM for each year was 22.71% and 22.12% for 2004 and 2005, respectively and they were not different. There were ($P < 0.05$) differences in CP concentrations between farms and across seasons on all farms and averaged 21.52% in year 1 and 21.85% in year 2. Seasonal average CP concentrations were 21.01%, 20.11% and 23.93% for spring, summer, and fall, respectively. NDF concentration in the pasture forage was different ($P < 0.05$) across the 9 farms, as well as different ($P < 0.05$) for spring, summer, and fall grazing. However, there were no differences within farm and season or across year for NDF; averaging 46.91% in year 1 and 47.53% in year 2. Seasonal NDF concentrations were 46.63%, 49.25%, and 45.97% for spring, summer, and fall, respectively. There was a difference ($P < 0.05$) across farms for NDF digestibility-30 h and within farm and year. Average NDF digestibility-30 h values for year 1 were 46.33% and for year 2 were 46.55%, and 46.64%, 44.71% and 47.98% for spring, summer, and fall, respectively. In summary, fall pasture growth was higher in CP and NDF digestibility when compared to spring and summer growth across all farms. However, NDF concentrations were highest in summer but CP and NDF digestibility were lowest in summer. There are significant seasonal effects on forage quality.

Key Words: dairy, grazing, forage quality

0322 Relationship between pasture nutritive measurements and plasma urea nitrogen in lambs grazing silvopasture or open pasture.

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Relationship of herbage energy content relative to crude protein (CP) is an important aspect in nitrogen use efficiency of grazing livestock. Plasma urea nitrogen (PUN) is an indicator of animal nitrogen status, increasing with excessive dietary

nitrogen, resulting in greater urinary N excretion. Analytical procedures utilized to estimate herbage energy content can be laborious and expensive. Our objective was to evaluate the relationship between herbage CP and herbage energy content indicators of differing assessment cost (total non-structural carbohydrate [TNC]; total digestible nutrients [TDN]), with animal PUN. We utilized winter born lambs ($n = 187$; initial weight 28.7 ± 2.1 kg; final weight 41.4 ± 2.9 kg), grazing either open or silvopasture over 4 consecutive grazing seasons. Grazing began in mid-April each year on cool-season mixed pastures and concluded mid-September. Forage nutritive value was determined from clipped samples taken the day before grazing events. Herbage TNC was determined directly, while TDN was estimated from ME (NRC, 1996) via ADF (MAFF/ADAS, 1987). Lambs grazed fresh paddocks (minimum 35 d regrowth after initial grazing) for 2 h and held an additional 1 h in drylot before blood draw. We correlated (Pearson) the relationship of pasture nutritive measurements and PUN. After tallying across treatments and years the number of correlation coefficients within the following categories: $r > 0.5$, > 0.6 , > 0.7 or > 0.8 , we evaluated the relationships. All nutritive components except TDN performed similarly using the $r > 0.5$ criteria. Within this grouping, the ratio of TDN:CP (a negative relationship, -) had the greatest total number of r values > 0.5 (16 of 22, or 73%), while TDN alone (-) had just 3 of 22 (14%). Using > 0.6 criteria, sampling date (+) and TNC:CP (-) were best, with 11 of 22 (50%) being greater. They were followed closely by TDN:CP (-) and TNC (-), 10 of 22 (45%), and 9 of 22 (41%), respectively. Within the grouping $r > 0.7$, sampling date and TNC:CP remained highest at 9 of 22 (41%), while TDN:CP and TNC were 5 of 22 (23%) and 8 of 22 (36%), respectively. For $r > 0.8$, sampling date and TNC:CP still had approximately 25% of the correlation coefficients falling within this category. The use of TNC:CP appears to be a quick, economical, and useful tool to evaluate pasture energy status relative to crude protein.

Key Words: silvopasture, plasma urea nitrogen, nutritive value, total non-structural carbohydrate

0323 Effect of organic grain supplementation on production, body weight, body condition score, and fatty acid profiles of organic dairy cows.

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Organic cows ($n = 153$) were used to evaluate the effect of grain supplementation levels during 2 grazing seasons (May to September 2012 and May to September 2013) on production, body weight, body condition score (BCS), and fatty acid profiles of organic dairy cows. Cows were assigned to 1 of 3 replicate supplementation groups: 1) no grain supplementa-

tion (100% pasture, GRS, $n = 51$), 2) low grain (2.72 kg/head/day, LOW, $n = 51$), and 3) high grain (5.44 kg/head/day, HI, $n = 51$), and calved at the University of Minnesota West Central Research and Outreach Center, Morris, Minnesota. Supplementation (organic corn and minerals) was fed with a partial mixed ration (PMR) of corn silage and alfalfa haylage, and at least 30% of diet dry matter intake for LOW and HI cows consisted of organic pasture. Milk production, from daily milk weights, was averaged weekly for cows, and body weight and BCS were recorded bi-weekly. Milk for fatty acid analysis was collected monthly and analyzed at R-Tech Analytical Laboratory (Arden Hills, MN). The PROC MIXED of SAS was used for statistical analysis, and independent variables were fixed effects of year (2012 or 2013), season of calving (fall or spring) nested within year, parity (1, 2, 3+) nested within year, supplementation group, breed group; week nested with supplementation group, with replicate nested within year and cow nested within supplementation group and breed group as a random effect with repeated measures. The GRS (14.4 kg/d) cows had lower ($P < 0.05$) energy-corrected milk than LOW (16.2 kg/d) and HI (17.0 kg/d) cows; however, the LOW and HI cows were not different from each other. The GRS, LOW, and HI cows were not different for body weight across the grazing season (491, 498, 498 kg, respectively); however, GRS (3.05) cows had lower ($P < 0.05$) BCS than LOW (3.14) and HI (3.15) cows. Milk urea nitrogen was higher ($P < 0.05$) for GRS (19.5 mg/dl) than LOW (12.0 mg/dl) and HI (9.9 mg/dl) cows. Furthermore, omega-3 fatty acid was higher ($P < 0.05$) for the GRS (0.05%) cows compared to the LOW (0.04%) and HI (0.03%) cows. Organic dairy cows that consume 100% pasture had lower production, but milk from cows that consume 100% pasture compared to pasture and PMR had fatty acid composition of potential benefit to human health.

Key Words: organic, fatty acid profile, pasture

0324 Chemical composition and in vitro gas production of forage cereals associated with common vetch (*Vicia sativa*). M. Gonzalez Ronquillo*, E. Y. Aguilar Lopez, A. Morales, M. G. Gutierrez, and O. Castelan Ortega, *Universidad Autonoma del Estado de México, Toluca, Mexico.*

Cereal grain forages and legume silages are an important part of dairy cattle rations in many parts of the world. The increasing importance of these crops as feedstuffs has highlighted the need to understand the factors that influence their nutritive value. The use of in vitro gas production (GP) techniques to estimate digestibility of feeds was based on empirical relationships between digestibility and in vitro gas production. The objectives were to evaluate forage yield, chemical composition and in vitro gas production of some varieties of spring triticale (T-UAEMex and Siglo XXI), barley (Doña Josefa) and its association with common vetch (CV). The experimental unit consisted in seven rows, each 50 linear meters by 30 cm wide (with two lines of planting and spaced at 80 cm). The planting density was 80,000 plants/ha, harvested at 145 d (milky-dough stage) and ensiled in three repetitions, at 60 d the samples were opened from micro-silos (2 kg FM), and chemical composition was determined, GP profiles were determined using a semi-automated pressure transducer technique. Approximately 800 mg of each substrate was weighed into 125 mL serum bottles and incubated in a water bath at 39°C with 10 mL strained rumen fluid and 90 mL of medium. The volume of gas produced was recorded at 3, 6, 9, 12, 24, 36, 48, 72, and 96 h of incubation. Each sample was incubated in triplicate in three series in different weeks. Data were analyzed by a completely randomized design. There were differences ($P < 0.001$) in DM (dry matter) production, being greater T-Siglo XXI and associated with CV (6.50 and 5.4 ton DM/ha respectively), the greater CP content ($P < 0.001$) was for CV (217 g/kg) and their associations (185 g/kg). No significant differences ($P > 0.05$) were observed among varieties and their associations in NDF contents. Barley had a greater content ($P < 0.05$) of NE_l 1.5, and NE_g 0.9 (Mcal/kg DM). GP was greater for the association Barley-CV ($P < 0.05$) (124 ± 6 mL gas/g DM) compared to the rest (117 ± 3 mL gas/g DM). Considering its nutritional quality and energy content forage cereals associations with CV are an option with higher forage yield and improved nutritional content for feeding livestock.

Key Words: common vetch, silage, in vitro gas production.