92 Effects of microclimate and pasture characteristics on temporal/spatial distribution of beef cows in Midwestern pastures. D. A. Bear*, J. R. Russell, and D. G. Morrical, *Iowa State University*, *Ames, IA*.

Pastures located on southern Iowa cow/calf farms, from 8 to 125 ha in size, were used to evaluate the effects of microclimate, shade, botanical composition, and other pasture characteristics influencing the temporal/spatial distribution of cattle within and outside streamside zones of pastures. Cows were Angus and Angus-cross on 4 of the farms, and Mexican Corriente on the remaining farm. During spring, summer, and fall of 2007–2009, 2 to 3 cows on each farm were fitted with Global Positioning Systems (GPS) collars and used to record location within a pasture at 10 min intervals for periods of 5 to 14 d. One hundred 39 data sets were obtained throughout the 2007–2009 grazing seasons. Data loggers recorded microclimate variables at 10 min intervals. Water sources and fence lines were referenced on a geospatial map and used to establish zones within the pastures; in the stream or pond (water source), closer or further than 30.5 m (Uplands) from the water source. Farm and seasonal effects on cow distribution in pastures were analyzed using the GLM procedure of SAS using years as replicates. LOGISTIC procedure of SAS tested microclimate variables effects on the probability of cattle being in or within 30.5 m of the water. Mean proportions of observations when cattle were in the water source differed ($P < 0.0001$) between seasons. Mean proportion of cattle observations within the streamside zone (defined as being in the water source or within 30.5 m of the water source) differed ($P < 0.0001$) between farms. The proportion of time cattle were within the streamside zone increased with decreasing pasture size ($r^2 = 0.40, 0.55, 0.59$) and increasing the proportion of streamside zone within a pasture ($r^2 = 0.40, 0.64, 0.39$) for the spring, summer, and fall seasons, respectively. Proc LOGISTIC determined the probability of cattle located in the streamside zone increased with increasing ambient temperatures. Implementation of grazing management practices for the protection of pasture streams will likely be most effective on small and/or narrow pastures in which cattle have less opportunity to locate in upland locations.

Key Words: GPS, distribution, water quality

93 Preference for diverse pastures by sheep in response to intraruminal administrations of tannins, saponins, and alkaloids. J. J. Villalba*[1], F. D. Provenza[1], A. K. Clemensen[1], R. Larsen[2], and J. Juhnke[1], [1]*Utah State University*, *Logan,* [2]*University of California*, *Templeton*.

Plant secondary compounds (PSC) are increasingly recognized as important in animal health, welfare and nutrition. We explored how sheep modify their foraging behavior in pastures with different PSC when challenged with a single PSC. Six pairs of lambs received intraruminal administration of a PSC (Treatment) in 3 successive periods (1- Condensed tannins, 2-Saponins, or 3-Ergotamine) of 5 d each. Six other pairs of lambs received just the vehicle (Control). The design was a split-plot with pairs of lambs nested within group (Treatment, Control). Day and period were the repeated measures. Pairs of lambs were allowed to graze a choice of 1) *Lotus corniculatus* (birdsfoot trefoil - BFT), 2) *Medicago sativa* (alfalfa - AA), 3) *Festuca arundinacea* (endophyte-infected tall fescue - TF) with high concentration of tannins, saponins, and alkaloids, respectively, and 4) *Dactylis glomerata* (orchardgrass - OG). Lambs were observed at 1 min. intervals and their behavior recorded (scans). Control lambs manifested a strong preference for AA (75–85% of all scans; $P < 0.0001$) throughout all testing periods. In contrast, lambs treated with tannins had more scans than Controls on BFT ($P = 0.002$) and TF ($P = 0.004$). Lambs that received saponins had more scans than Controls on TF ($P = 0.01$), and animals treated with ergotamine had more scans than Controls on BFT ($P = 0.03$). Lambs showed the lowest proportion of scans on AA after treatment with saponin ($P \leq 0.09$) and on TF after infusions of ergotamine ($P \leq 0.009$). Lambs infused with PSC thus utilized forage species more evenly than did Controls, and they avoided plants (AA, TF) containing PSC (saponin, ergotamine) that matched those delivered into their rumens. Treatment lambs also diluted the effects of the PSC by increasing preference for OG, and selectively increased preference for certain PSC-containing forages such as TF and BFT. Animals offered a diversity of plants with multiple PSC may minimize the negative impacts of PSC in their bodies through changes in their foraging behavior.

Key Words: forage diversity, foraging, plant secondary compounds

94 Grazing behavior of cattle and sheep grazing alone or together on grass swards differing in plant species diversity. H. M. Cuchillo* and J. Isselstein, *Georg-August University of Goettingen, Institute of Grassland Science*, *Goettingen. Germany.*

Grassland composition and animal species may modify the grazing efficiency and ingestive behavior of pasture. However, precise knowledge on potential interactions between sward diversity and mixed grazing is not available. Thus, a trial was conducted to evaluate the main (grazing, walking, and ruminating) and secondary (bites per minute, steps per minute, and bites per step) animal behavior patterns of cattle and sheep grazing alone or together on grass swards differing in botanical composition. The study was conducted in Lower Saxony/Germany from May to September 2009. Three blocks (A, B and C) individually arranged into 6 treatments were employed; i.e., low diversity/cattle, low diversity/sheep; low-diversity/cattle-sheep; high diversity/cattle, high diversity/sheep and high diversity/cattle-sheep. Botanical composition of either mixed grass-legume-forb (14 species per $9m^2$) or grass dominated swards (7 species) was manipulated by the use of herbicides. The stocking density was 3000 kg of animal weight per plot. Animals were moved to the next block when the compressed sward height decreased from 12 to 6.5 cm. The main behavior patterns of 3 core animals within each paddock were recorded 7 times by conducting scan sampling every 10 min from 0600 to 2200 h. Secondary patterns were obtained from 15 measurements per core animal and observation day. Results were analyzed with a Completely Random Variance Analysis in a 2 × 2 factorial arrangement using the Proc Mixed of SAS. Results show that cattle on high diversity swards spent more time grazing, have the lowest time for ruminating and the lowest mean of bites per minute ($P < 0.05$). Co-grazing increased the rumination time of cattle regardless of sward composition ($P < 0.05$). Interestingly, there were no significant differences on main and secondary behavior patterns of sheep, neither due to the type of grazing nor the sward composition ($P > 0.05$). Complementary studies of vegetation consumption preferences joined with ruminal physiology assessments should be done to evaluate the benefits and limitations pasturing on rich or poor diversity swards.

Key Words: grassland, mix-grazing, botanical composition

95 Evaluation of dairy heifer performance and pasture composition when co-grazing heifers and goats. T. S. Dennis*, L. J. Unruh-Snyder, M. K. Neary, J. E. Tower, and T. D. Nennich, *Purdue University*, *West Lafayette, IN*.

Alternative feeding strategies that reduce costs and maintain animal performance improve the sustainability of livestock operations. The objective of this study was to evaluate the effects of co-grazing heifers and goats supplemented with co-product feeds on heifer performance, pasture composition, and DM yield. Forty-eight Holstein heifers (BW = 147.4 kg, BCS = 2.9) were randomly assigned to one of 12 paddocks and allocated to a 2 × 2 factorial design with 2 co-product supplements (dried distillers grains (DDGS) or soybean hulls (SBH)) and 2 grazing strategies (heifers with goats (HG) or heifers without goats (HO)). Heifers were intensively grazed on tall fescue/white clover pastures and supplemented at 0.9% of BW. Body weights were measured biweekly. Wither heights (WH), hip heights (HH), and BCS (1 to 5 scale) were measured and blood samples were collected for plasma urea nitrogen (PUN) analysis monthly. Pasture intakes were estimated 2 times/wk. Pasture composition, DM yield, and nutrient analysis were determined monthly. Heifer data were analyzed by paddock as repeated records using PROC MIXED of SAS. Heifers fed DDGS tended to gain more weight ($P = 0.1$) and had greater changes in HH and WH ($P = 0.02$ and $P = 0.03$, respectively). The percent of weeds in the pasture tended to decrease ($P = 0.06$) for HG. Pasture DM yields for HO and HG did not differ between treatments ($P > 0.1$). Heifer growth and feed efficiency improved when heifers were supplemented with DDGS. Co-grazing heifers with goats did not affect heifer performance ($P > 0.1$).

Table 1. Effects of supplementation type (SUPP) and grazing strategy (GS) over all time periods on intake, growth, feed efficiency, and plasma urea nitrogen in dairy heifers

	DDGS	DDGS	SBH	SBH		P-value		
Item/pd	HO	HG	HO	HG	SEM	SUPP	GS	SUPP x GS
DMI, kg/d	6.1	5.9	5.9	5.8	0.17	0.31	0.43	0.80
ADG, kg/d	0.52	0.55	0.48	0.51	0.02	0.10	0.19	0.82
G:F	0.67	0.61	0.34	0.36	0.09	0.01	0.80	0.63
PUN, mg/dL	11.7	12.8	10.4	11.5	0.31	<0.01	<0.01	0.96
WH change, cm	2.62	2.08	1.82	1.87	0.19	0.03	0.24	0.16
HH change, cm	2.14	1.92	1.61	1.80	0.11	0.02	0.89	0.11

Key Words: dairy heifer, co-grazing, goats

96 Effects of aluminum from water-treatment-residual applications to pastures on mineral status of cattle and forage mineral concentrations. R. K. Madison, L. R. McDowell** G. A. O′Connor, N. S. Wilkinson, P. A. Davis, A. T. Adesogan, T. L. Felix, and M. Brennan, *University of Florida*, *Gainesville*.

Extensive efforts have been focused on finding ways to reduce soluble P in manure-impacted soils. Aluminum binds to P and application of Al could be one potential solution to the problem. Two experiments (145 and 148d) using Holstein steers were conducted to determine the pasture application of water treatment residuals (Al-WTR) on mineral status (primarily P) and performance of grazing cattle. Experiments (1995 and 1996) began June 1st with cattle initially weighing 306 and 169 kg, respectively, on d 0. The experiments were a completely randomized design with treatments replicated 3 times. Four treatments were with and without Al-WTR and with and without P-free mineral supplement. Total pasture application of Al-WTR over 2 years was 75.8 t dry weight/ha. Steers were allotted (3/pasture) to one of 12 0.81 ha bahiagrass (*Paspalum notatum*) pastures. Body weights, blood samples and liver biopsies were taken at d 0, d 84 and 148. Plasma was analyzed for Al, Ca, Cu, Mg, P and Zn; liver for Al, Cu and P and bone for Al, Ca, P and Mg. A second objective was to evaluate the effects of the applied Al-WTR on mineral concentrations of the bahiagrass pastures. Forage samples were taken on d 0 and every 28 d thereafter for 5 mo. The Al-WTR had little or no effect ($P > 0.5$) on weight gains and mineral tissue concentrations. Forage mineral concentrations were generally unaffected by treatment but were affected ($P < 0.05$) by collection dates. Forage P contractions ranged from 0.12 to 0.22%. Most forage samples were deficient in Na (<0.06%), Cu (<10ppm), Se (<0.1ppm) and Co (0 < 0.1ppm) and at various collections deficient in Ca (<0.35%), P (<0.18%), Fe (<50ppm) and Zn (<30ppm). In conclusion, Al-WTR applications had little effect on animal status of P or any other mineral analyzed. Likewise, Al-WTR had little effect on forage mineral concentrations. Applications of Al-WTR are effective in reducing P contamination without affecting forage or cattle mineral status.

Key Words: cattle, forages, water treatment residuals

97 Effect of maturity and nitrogen fertilization on bahiagrass production and nutritive value. N. M. Kenney*, J. E. Sawyer, R. O. Dittmar III, and T. A. Wickersham, *Texas A&M University*, *College Station*.

Bahiagrass (*Paspalum notatum*), a forage resource in the southern United States, often has lower forage quality than cool-season grasses and legumes, but may require fewer nutrient inputs than other available forage options. Our objectives were to determine the effects of N fertilization and maturity on nutritive value, in situ OM digestibility, and yield of bahiagrass. Treatments were arranged as a 4 × 4 factorial with 4 levels of N fertilization (0, 45, 90, and 135 kg N per ha) and 4 maturities (3, 5, 7, and 9 wk after N fertilization). An established stand of bahiagrass was divided into 3 blocks with all treatments contained in each block. In situ determinations were made with 3 steers fed Bermudagrass hay and samples were incubated for 0, 2, 6, 12, 24, 48, and 72 h. Increasing provision of N tended ($P = 0.06$) to quadratically increase in DM yield (3354, 4386, 4876, and 5182 kg DM per ha for 0, 45, 90, and 135 kg N, respectively). Similarly, advancing maturity increased DM yield quadratically ($P < 0.01$; 3206, 4580, 4894, and 5119 kg DM per ha for 3, 5, 7, and 9 wk, respectively). A maturity by N interaction ($P = 0.02$) was observed for CP concentration. Increasing N resulted in more rapid declines in CP with advancing maturity. At 3 wk CP was 8.0% for 0 N and 11.6% for 135 N. In contrast, at 9 wk the CP was 5.0% for 0 N and 6.6% for 135 N. In situ OM digestibilities were determined on samples from wk 5, 7, and 9. A maturity by N interaction ($P = 0.03$) was observed for the rapidly degraded (A) fraction of OM. At 5 wk maturity the A fraction decreased with increasing N fertilization, whereas at 9 wk maturity the A fraction increased with increasing N fertilization. The B fraction was linearly reduced ($P < 0.01$) and the C fraction was linearly increased ($P < 0.01$) with advancing maturity. At a fixed passage rate of 3% per h, the calculated extend of OM degradation was 58.6, 54.9, and 53.4% for maturities 5, 7, and 9, respectively (linear, $P < 0.01$). Overall, additional fertility increased bahiagrass CP content, despite more rapid declines with advancing maturity, and maturity was the primary driver of bahiagrass degradability.

Key Words: bahiagrass, in situ, maturity

98 Effect of mineral supplementation on the performance by stocker cattle grazing winter-wheat pasture. S. A. Gunter*[1] and G. F. Combs[2], [1]*USDA-ARS, Southern Plains Range Research Station*,

Woodward, OK, [2]*USDA-ARS, Grand Forks Human Nutrition Research Center*, *Grand Forks, ND*.

To evaluate the efficacy of mineral supplementing stocker cattle grazing wheat pasture, 2 experiments were conducted. In Exp 1, 72 steer and heifer calves (BW = 228 ± 11.4 kg) were randomly assigned to 12, 4.9-ha pastures on November 12 at 1.2 animals/ha (4 pastures), and February 5 at 2.5 animals/ha (8 pastures) for 84-d. In Exp 2, 38 steers (BW = 248 ± 4.8 kg) were randomly assigned to 12, 2.5-ha wheat pastures on February 24 for 84 d at 1.3 steers/ha. In Exp 2, pastures were planted with conventional tillage or a no-till drill. In Exp 1 and 2, half the pastures received a free-choice mineral mixture (Wheat Pasture Pro; Land O Lakes Purina Feed, LLC; St. Paul, MN; Ca, 16% and P, 4%) provided in ground-type mineral feeders (Exp 1: completely random design; Exp 2: 2 × 2 factorial); feeders were weighed weekly to determine intake. All pastures were drilled the first of September 2008 (67 kg of seed/ha) and were fertilized with 50 kg of urea-N/ha. Standing herbage DM was determined in pastures when cattle were weighed every 28-d by clipping wheat to the ground along 122 cm of drill row at 10 transects. Data were analyzed by AOV with treatment as the fixed effect and pasture as the random effect. In Exp 1, cattle offered the minerals had a 45% faster ADG ($P < 0.01$; 0.75 kg) than cattle not offered minerals (0.52 kg); hence, the supplemented cattle weighed 8% more ($P < 0.01$; 308 kg) after grazing than non-supplemented cattle (289 kg). In Exp 2, supplementation did not interact ($P \geq 0.44$) with tillage. Also, steers offered the mineral had a 30% faster ADG ($P = 0.03$; 1.12 kg) than steers not offered minerals (0.86 kg) and the supplemented cattle weighed 6% more ($P = 0.03$; 341 kg) after grazing than non-supplemented cattle (320 kg). In both experiments, daily standing herbage DM averaged 1,536 kg/animal and never differed ($P \geq 0.13$) between treatments. Mineral intakes averaged 73 (Exp 1) and 168 (Exp 2) g/d, resulting in cost of supplement to kilogram of added BW gain conversions of $0.26 and $0.57 assuming a mineral cost of $0.88/kg. Overall, there was an improvement in ADG and the supplement to added BW gain conversion seemed profitable.

Key Words: cattle, grazing, wheat pasture

99 Effect of corn hybrid on the amount of residue available for grazing relative to grain yield. J. A. Musgrave*, L. A. Stalker, T. J. Klopfenstein, M. C. Stockton, and K. H. Jenkins, *University of Nebraska*, *Lincoln*.

Utilization of corn crop residue by cattle to extend grazing can have positive economic impacts. Cattle primarily consume the leaf and husk portions of the corn residue. Amount of residue available to grazing cattle may be influenced by corn hybrid. Ten corn hybrids were evaluated to determine differences in corn grain yield and crop residue dry matter. Ten hybrids that best represented a wide range of production traits were selected from a total of 40 hybrids grown in a test plot located near Paxton, Nebraska. The following hybrids were evaluated: Pioneer P0541XR, P1173HR, P1395XR, Dekalb 59–35, 61–04, NK N68B–GT, N74C–3000GT, Croplan Genetic 5757 VT3, Golden Harvest 8211 3000GT, and Midwest Genetics 76482R. Each sample consisted of the complete above ground portion of the corn plant and was collected randomly. Each sample was sorted into the following parts: stems, leaves (including leaf sheath), husks, cobs, and corn grain. Plant parts were dried in a forced air oven at 60°C to determine dry matter yield. Data were analyzed as a completely randomized design. There was no difference in corn grain yield among hybrids (13,240 kg/ha ± 788, DMB; $P = 0.23$). Differences were present between hybrids in amount of stems ($P < 0.001$), leaves ($P = 0.05$), husks ($P = 0.01$), and cobs ($P < 0.001$). Considering these differences, it is not surprising that total residue production (sum of stems, leaves, husks and cobs) was different ($P = 0.02$) among hybrids. However, differences also existed in the ratio of corn grain to total residue production ($P < 0.001$) and corn grain to leaf and husk ($P < 0.001$), indicating potential differences in plant efficiency. Corn hybrids differ in the amount of residue produced independent of the amount of grain. Since corn hybrids differ in the amount of residue they produce, possible differences in amount of residue available for cattle to graze, also differs. Using these differences, economic estimates of the ranking identify potential value differences.

Key Words: corn stalks, corn residue, grazing

100 Replacing synthetic N with clovers or alfalfa in bermudagrass pastures for growing calves. P. Beck*[1], D. Hubbell[1], T. Hess[1], K. Haas[2], and J. Jennings[1], [1]*University of Arkansas*, *Fayetteville,* [2]*Haas Hay & Cattle Co.*, *Gurley, AL*.

The objective of this research was to determine the impact of alfalfa or clover additions to common bermudagrass (*Cynodon dactylon* [L.] Pers.) pastures on performance of growing calves and pasture carrying capacity compared with commercial N fertilizer. In October 2008, 0.81 ha bermudagrass pastures were interseeded with 1) a mixture of 13 kg/ha red clover (*Trifolium pretense*, cv. Morningstar, Cal/West Seeds, Woodland, CA) and 3.3 kg/ha ladino white clover (*Trifolium repens*, cv. Regal Graze, Cal/West Seeds, n = 4) or 2) 28 kg/ha alfalfa (*Medicago sativa*, cv. PGI 459, Producers Choice, Woodland, CA, n = 4). The following summer 12 bermudagrass pastures received 0, 56, or 112 kg N/ha as ammonium nitrate. Beef steers (BW = 278 ± 13.6 kg) grazed pastures from 29 May to 9 September in a put and take experiment. Data were analyzed as a completely randomized design with 4 pastures/treatment using the mixed procedure of SAS. A single df contrast was used to determine the linear N fertilization rate effect, and predicted differences separated the effects of alfalfa and clover. Stand counts of alfalfa pastures decreased from 34 ± 10.6% in May to 15 ± 12.7% in October, but remained relatively unchanged in clover pastures 43 ± 12.8% in May and 38 ± 5.2% in October. Daily gains and BW tended ($P = 0.08$) to increase linearly with increasing N rate. Gains and BW of steers from alfalfa pastures did not differ ($P \geq 0.91$) from 56 kg N rate. Gains and BW of clover steers was greater ($P \leq 0.02$) than alfalfa and 56 kg N rate, but did not differ ($P = 0.11$) from 112 kg N rate. Grazing-d/ha and gain/ha increased linearly ($P = 0.01$) with increasing N rate. Grazing-d/ha of alfalfa and clover did not differ ($P \geq 0.31$) from 56 or 112 kg N/ha rates. Pastures containing clover produced more ($P = 0.02$) gain/ha than 56 kg N rate and tended ($P = 0.10$) to produce more BW gain/ha than 112 kg N rate. Gain/ha for alfalfa did not differ ($P = 0.95$) from 56 kg N rate. Clovers produce equivalent BW gains and animal grazing days to 112 kg/ha N, but stands of alfalfa were not dense enough throughout the grazing season to maintain animal performance above that of 56 kg/ha N.

Key Words: alfalfa, clover, bermudagrass

101 Effects of winter swath grazing barley and millet on background and feedlot performance and rumen metabolism of beef calves. R. Kumar*[1], H. A. Lardner[1,2], and J. J. McKinnon[1], [1]*University of Saskatchewan*, *Saskatoon, Canada*, [2]*Western Beef Development Centre*, *Humboldt, Saskatchewan, Canada*.

A 2-year winter grazing and feedlot finishing trial (Exp1) and subsequent metabolic study (Exp2) were conducted to evaluate the effects of swath grazing forage barley *(Hordeum vulgare* cv. Ranger) and foxtail millet *(Setaria italica* cv. Golden German) compared with grass-legume hay fed in drylot on beef calf performance and rumen degradation kinetics.

In Exp1, 120 spring born Angus calves (60 steers, 60 heifers) were fall weaned, stratified by weight, allocated into 20-head groups then assigned randomly to 1 of 3 replicated (n = 2) backgrounding (BG) systems.. Data were analyzed using Proc Mixed with year as a block. Systems were (i) field swath graze barley (BR); (ii) field swath graze millet (ML); and (iii) bunk fed ground hay drylot (DL). Field calves were limit grazed in 8 ha paddocks for 3 d grazing period using electric fencing for 96 d each year, with all groups receiving additional pelleted supplement at 0.62% BW. Calves were weighed at start, every 21 d and end of background period. Following BG period, calves were placed in feedlot, separated by sex and BG treatment and fed a similar finishing ration and harvested once a targeted endpoint of 12 mm backfat was reached. Forage samples collected every 21 d were analyzed for DM, CP and digestible energy (DE). Forage dry matter analyses was greatest ($P = 0.03$) for barley swath (DE = 2.6 Mcal/kg) and lowest ($P = 0.03$) for grass-legume hay (DE = 2.2 Mcal/kg). Calf background ADG was greatest ($P = 0.002$) for BR compared with ML or DL, while feedlot ADG was not different ($P = 0.32$) for all calves. In situ degradability (Exp2) of barley DM and CP was greater ($P = 0.0001$) compared with millet or hay, while millet had greater ($P = 0.0001$) NDF degradability. These findings indicate that swath grazing barley or foxtail millet with beef calves resulted in similar or improved performance compared with a traditional dry-lot pen system.

Key Words: barley, millet, swath grazing