

was initiated. One-half of the samples were incubated in 5 % CO<sub>2</sub>/95 % air, and the remaining half were incubated in 100 % N<sub>2</sub> gas. Motility, live-dead, capacitation and acrosomal status were evaluated at 0, 4, 24, 48 and 72 h of incubation. Osmolarity was 295, 353 and 280 mOsm for RSD-1, caprogen and SOF, respectively. There was no difference between N<sub>2</sub> gas and 5 % CO<sub>2</sub>/95 % air on motility scores when incubated in caprogen or SOF. Motility scores in RSD-1 were not different at 4, 24 or 72 h of incubation. Motility was greater ( $P \leq .05$ ) at 48 h when RSD-1 cultured sperm were incubated in CO<sub>2</sub> and air ( $1.1 \pm .2$ ) than in N<sub>2</sub> gas ( $.6 \pm .2$ ). RSD-1 maintained motility for 24 h (motility score  $2.5 \pm .4$ ) which was better ( $P \leq .01$ ) than both caprogen (motility score  $1 \pm .1$ ) and SOF (motility score  $.7 \pm .1$ ). There was no motility at 48 and 72 h of culture when sperm were incubated in caprogen or SOF, and only minimal motility when incubated in RSD-1 ( $.9 \pm .2$  and  $.2 \pm .1$ , respectively). Live/dead staining followed the same trend except that over 10 % were classified as live in all treatments at 72 h of incubation. Neither incubation time, type of media, nor gas used for incubation caused sperm to be classified as capacitated or acrosome reacted. In conclusion, RSD-1 was the best extender tested for body temperature storage of ram sperm, although significant motility was maintained for only 48 h.

**Key Words:** Semen Extenders, Sperm Motility, Body Temperature

**224 Effects of zeranol upon luteal maintenance and fetal development in peripubertal gilts.** W.E. Trout<sup>1</sup>, C.T. Herr<sup>2</sup>, B.T. Richert<sup>2</sup>, W.L. Singleton<sup>2</sup>, and M.A. Diekman\*<sup>2</sup>, <sup>1</sup> *Trout Technologies*, <sup>2</sup> *Purdue University*.

The objectives of this study were to determine whether zeranol could maintain hCG-induced corpora lutea (CL) in peripubertal gilts and to examine the gross effects of zeranol on the number of fetuses and their development. Crossbred gilts ( $171 \pm 0.3$  d of age,  $109.1 \pm 1.4$  kg) were blocked by weight and ancestry to control ( $n=40$ ) or treatment ( $n=40$ ) groups. To induce ovulation and CL formation, treated gilts received 500 IU of hCG and a Ralgro<sup>®</sup> ear implant (zeranol, 36 mg; d 0). On d 42, treated gilts received two 10 mg injections of Lutalyse (PG) spaced 6 h apart. Treated gilts not displaying estrus within 7 d of PG treatment on d 42 received an additional 20 mg of PG on d 49. All gilts were checked once daily for estrus with a mature boar starting on d 3. On d 45-58, gilts detected in estrus were inseminated twice 24 hours apart with pooled semen via AI. Blood samples were obtained on d 0, 7, 18 and 42 and analyzed for serum progesterone (P4). Bred gilts were slaughtered on d 58-62 of gestation. Zeranol appeared to maintain hCG-induced CL function based on 45% of treated gilts vs 0% of control gilts having elevated P4 on d 7, 18 and 42 ( $P < .0001$ ). Of gilts detected in estrus and bred on d 45-58, 16/21 treated gilts and 16/18 control gilts were pregnant at slaughter on d 58-62 of gestation. Number of fetuses (7.5 vs 12), fetal weight, (83 vs 121 g), fetal length (117 vs 132 mm) and fetal survival (45% vs 78%) were reduced ( $P < .001$ ) by zeranol. These data indicate that treatment of peripubertal gilts with a 36 mg zeranol implant did maintain pseudopregnancy, but did not significantly improve estrous synchronization while causing dramatic deleterious effects upon the fetuses.

**Key Words:** Ralgro, Pseudopregnancy, Swine

**225 Feeding melengestrol acetate (MGA) to resynchronize repeat estrus in beef heifers previously synchronized using a MGA/Prostaglandin F<sub>2α</sub> protocol.** C. R. Dahlen\* and G. C. Lamb, *University of Minnesota*.

One hundred twenty-one commercial beef heifers were used to determine whether feeding melengestrol acetate (MGA) for 7 d, after an initial estrous synchronization with an MGA/Prostaglandin F<sub>2α</sub> (PGF) protocol,

would resynchronize repeat estrus in heifers that either had an embryo transferred or were previously observed in estrus, and initiate cycling in heifers that were not previously observed in estrus. Initial estrous synchronization was achieved by feeding 0.5 mg MGA daily for 13 d, followed 19 d later with one 25-mg injection of PGF. Seventy-four heifers received embryos 7 d after observed estrus. Heifers were randomly assigned to one of two treatments: 1) heifers were fed 0.5 mg MGA daily for 7 d, beginning 15 d after PGF (Resynch;  $n = 61$ ); or 2) heifers did not receive MGA from d 15 to d 21 after PGF (Control;  $n = 60$ ). If observed in estrus (observed visually 4x daily, from d 10 to d 31 after PGF), heifers were inseminated following the am/pm rule. On d 35 and d 71 after PGF, transrectal ultrasonography was used to determine the presence of a viable fetus. Of the 34 Resynch heifers receiving an embryo, 23 were pregnant, whereas 22 of the 41 Control heifers receiving an embryo were pregnant. The percentage of heifers detected in estrus from d 23 to d 31 was greater ( $P < .01$ ) for Resynch heifers (28/30 [74%]) than Control heifers (16/38 [42%]). Estrus was induced (i.e., a heifer in estrus that had not previously been observed in estrus) in 11 of 15 Resynch heifers and 7 of 12 Control heifers (73% vs. 58%, respectively). Conception rates were similar for Resynch (15/28 [54%]) and Control (10/16 [63%]) heifers. Overall pregnancy rates after 2 estrous synchronizations were 62% (38/61) for Resynch heifers and 53% (32/60) for Control heifers. We conclude that feeding MGA to resynchronize repeat estrus in commercial beef heifers may increase the percentage of animals observed in estrus, without altering pregnancy rates.

**Key Words:** Estrous Synchronization, Beef Heifers

**226 Response of the small intestine to pregnancy in Romanov and Columbia ewes.** A.N. Scheaffer, J.S. Luther\*, D.R. Arnold, M.L. Bauer, D.A. Redmer, J.S. Caton, and L.P. Reynolds, *North Dakota State University*.

Pregnancy results in a large increase (50% by the end of gestation) in energy demands. To evaluate small intestinal responses to the metabolic demand of pregnancy, litter-bearing (R,  $n = 4$ ) and standard (C,  $n = 3$ ) ewes, which were mated to rams of their respective breeds, were slaughtered on day 130 of gestation. Weights of the gravid uterus, fetuses, total small intestine, and jejunum were determined. In addition, a sample of jejunum was perfusion-fixed, embedded in paraffin, and sectioned. Jejunal tissue sections were used to quantify vascularity (vascular density = percentage of tissue occupied by capillaries, arterioles, and venules) using morphometric techniques. Compared with C ewes, R ewes had a smaller ( $P < 0.01$ ) live weight (LW;  $98.1$  vs  $44.8 \pm 7.9$  kg) and maternal body weight (MBW [LW - (blood+gut fill+gravid uterus)];  $68.2$  vs  $24.5 \pm 7.8$  kg). Compared with C ewes, R ewes also had smaller ( $P < 0.01$ ) individual fetal ( $4.7$  vs  $2.2 \pm 0.3$  kg) but similar ( $P = 0.41$ ) total fetal ( $6.6$  vs  $4.5 \pm 0.32$  kg) weights. However, when scaled to maternal body weight, R ewes had greater ( $P < 0.01$ ) gravid uterine weights than C ewes ( $282$  vs  $163 \pm 30$  g/kg MBW). R ewes also had greater ( $P < 0.01$ ) total small intestinal and jejunal weights ( $37.1$  vs  $17.3 \pm 2/5$  g/kg MBW and  $24.2$  vs  $9.9 \pm 2/1$  g/kg MBW, respectively). In addition, jejunal vascularity was greater ( $P < 0.05$ ) in R compared with C ewes ( $20.2$  vs  $12.1 \pm 2.7\%$ ). These data demonstrate that, compared with Columbia ewes, Romanov ewes support a 40% greater gravid uterine mass per unit of maternal body weight. The intestinal response to this greater metabolic demand of pregnancy in Romanov ewes is reflected by a 2-fold larger, 70% more vascular small intestine. Supported by NIH grant HL64141 to DAR and LPR.

**Key Words:** Pregnancy, Small Intestine, Vascularity

## Ruminant Nutrition And Forages

**227 Changes in nutritive value of tall fescue hay as affected by natural rainfall and initial moisture concentration at baling.** J. E. Turner, W. K. Coblenz, D. A. Scarbrough, R. T. Rhein\*, K. P. Coffey, D. W. Kellogg, C. F. Rosenkrans, Jr., and J. V. Skinner, Jr., *University of Arkansas*.

Relatively little is know about the combined effects of rain damage and spontaneous heating on the storage characteristics and nutritive value

of tall fescue (*Festuca arundinacea*, Schreb.) hay. Our objectives were to assess the effects of these variables for tall fescue hay in five different management situations. Kentucky 31 tall fescue infected with the fungal endophyte (*Neotyphodium coenophialum*) was packaged in conventional rectangular bales at 99 (low), 164 (ideal), and 225 (high) g kg<sup>-1</sup> of moisture (L, I, and H respectively) prior to rainfall and at 246 g kg<sup>-1</sup> of moisture after a 2.26 cm rainfall event (H-R) and at

93 g kg<sup>-1</sup> of moisture after a total accumulation of 7.07 cm of rain (L-R). Heating degree-days > 30 (HDD) accumulated were greater ( $P < 0.05$ ) for the H (163) than the H-R (129) hay; the other baling treatments accumulated minimal HDD. Concentrations of fiber components immediately after baling were increased substantially ( $P < 0.05$ ) by rain damage but concentrations of N and N-associated-fiber components were only marginally affected by rain damage. Concentrations of most fiber and fiber-associated N increased ( $P < 0.05$ ) during a 40-d storage period but were fairly limited during the storage period, due to the low concentrations of moisture at baling and the limited HDD accumulated. In situ DM disappearance after 48 h (ISDMD) was lower ( $P < 0.05$ ) at baling for the L-R hay than hays packaged without rainfall, while ISDMD was similar ( $P > 0.05$ ) for the H, H-R, and L-R hays after the storage period. Hay that was exposed to rainfall generally had greater concentrations of fiber components and ADIN at the end of the storage period than hay that was not exposed to rainfall. Rainfall after mowing decreased the nutritive value and ISDMD of these hays. Generally, hays packaged at less than 200 g kg<sup>-1</sup> were not affected adversely by storage, while those packaged above this concentration of moisture produced poorer quality hays.

**Key Words:** Rain Damaged Hay, Tall Fescue

**228 Effect of legume persistence in endophyte-infected tall fescue pastures on forage production and steer performance.** L.W. Lomas\*, J.L. Moyer, and G.L. Kilgore, *Kansas State University, Parsons.*

Grazing and subsequent finishing performance of steers that grazed high-endophyte tall fescue pastures previously interseeded with lespedeza, ladino clover, or red clover in 1995, 1996, and 1997 were evaluated. Initial weights of steers grazed in 1998, 1999, and 2000 were 260.3, 256.8, and 250.4 kg, respectively. Nine 2.02-ha established #Kentucky 31 tall fescue pastures with more than 65% endophyte infection were used in a randomized complete block design with three replications per legume treatment. Five mixed-breed steers were randomly allotted to each pasture on April 1, 1998, March 30, 1999, and April 4, 2000 and grazed continuously for 223, 218, and 218 d, respectively, and then transported to a feedlot facility and fed a finishing diet for 154, 140, and 111 d, respectively. All steers were fed .9 kg of ground grain sorghum per head daily during the grazing phase. Legume cover, available forage DM, grazing steer performance, subsequent feedlot performance, and carcass parameters were measured. Available forage DM was higher ( $P < 0.01$ ) in pastures with ladino clover than in those with lespedeza in all 3 yr, and higher ( $P < 0.05$ ) than those with red clover in 1999 and 2000. Legume coverage was highest ( $P < 0.01$ ) for pastures with ladino clover and similar ( $P > 0.05$ ) for pastures with red clover and lespedeza in all 3 yr. However, ladino clover coverage declined from 10.5% in 1998 to 1.3% in 2000. Gains by steers grazing lespedeza, ladino clover, and red clover treatments were .42, .56, and .47 kg/d in 1998; .44, .45, and .46 kg/d in 1999; and .46, .48, and .51 kg/d in 2000. In 1998, steers grazing ladino clover pastures gained 33.5% more ( $P < 0.01$ ) and 20.2% more ( $P < 0.05$ ), respectively, than those grazing lespedeza and red clover pastures. Gains by steers grazing red clover and lespedeza pastures were not different ( $P > 0.05$ ). Grazing gains between legume treatments were not different ( $P > 0.05$ ) during 1999 and 2000. Legume treatment during the grazing phase had no effect ( $P > 0.05$ ) on finishing performance or carcass parameters except steers that grazed pastures interseeded with red clover in 1998 gained more ( $P < 0.05$ ) than those that grazed pastures interseeded with ladino clover. Overall gains from the beginning of the grazing phase through the end of the finishing phase were similar between legume treatments.

**Key Words:** Tall Fescue, Legumes, Grazing

**229 Performance of lambs grazing three different forages during the summer months in Missouri.** D.O. Kiesling\*, A.N.V. Stewart, A. Woldegebriel, S. Meredith, G. Dudenhofer, and R. Savage, *Lincoln University, Jefferson City, MO/USA.*

The objective of this experiment was to evaluate growth rate and carcass characteristics of lambs grazing different warm-season forages. Forty-eight lambs (40 ± 2 kg) were divided into three groups and randomly assigned to the following grazing paddocks: 1) forage soybean (*Glycine max*; n=12); 2) foxtail millet (*Setaria italica*; n=18); and 3) sorghum sudan bmr (*Sorghum bicolor*; n=18). Lambs received a 14% CP grain

ration (227 g hd<sup>-1</sup>d<sup>-1</sup>) along with alfalfa hay (227 g hd<sup>-1</sup>d<sup>-1</sup>) during the grazing trial. The number of lambs in each paddock was determined by the size of the pasture. The grazing trial was initiated in mid July and completed at the end of August (42 d). Lambs were weighed every 2 wks during the grazing trial. At the end of the grazing trial, ultrasound was performed to measure loin eye area and backfat thickness. Four wethers from each paddock were placed in drylot and fed a 14% CP ration at 908 g hd<sup>-1</sup>d<sup>-1</sup> and fed hay ad libitum for 2 wks before evaluation of carcass characteristics. Total gain of lambs during the grazing trial was higher ( $P < 0.05$ ) for paddock 1 (5.87 ± 0.89 kg) than for paddock 2 (1.84 ± 0.76 kg) or paddock 3 (2.5 ± 0.68 kg). Backfat thickness of lambs in paddocks 1 and 3 (0.09 ± 0.006 in) was higher ( $P < 0.05$ ) than in paddock 2 (0.07 ± 0.006 in). There was no difference in loin eye area among lambs grazing the different forages. Also carcass characteristics of wethers placed in drylot were not different. In conclusion, all three forages proved satisfactory for summer grazing, however, lambs grazed on forage soybean gained better than lambs on the other two forages.

**Key Words:** Lambs, Forages, Carcass characteristics

**230 Improving utilization of soybean hulls by cattle with digestive enzymes and dietary buffers.** C. A. Loest\*, E. C. Titgemeyer, J. S. Drouillard, B. J. Johnson, A. M. Trater, and B. D. Lambert, *Kansas State University, Manhattan.*

Four ruminally cannulated Holstein steers (340 kg) were used in a 4 × 4 Latin square to evaluate the benefits of supplementing digestive enzymes and dietary buffers to a soybean hull-based diet (95.5% soyhulls, 3% molasses, 1% minerals, 0.5% urea) fed once daily at 7.0 kg/d (as fed basis). Treatments were mixed with the diet and included: 1) control (C), 2) 3 g/d digestive enzymes (E), 3) 62 g/d NaHCO<sub>3</sub> and 31 g/d MgO (B), and 4) E plus B (EB). Enzymes were from *Trichoderma reesei* and included activities of β-glucanase, galactomannase, xylanase, and mannanase. Periods were 14 d with 8 d for adaptation, 5 d for fecal collections, and 1 d for rumen fluid collections. Digestibilities of OM (75.9, 76.2, 76.5, and 78.6% for C, E, B, and EB) and NDF (77.2, 77.6, 77.7, and 79.9% for C, E, B, and EB) increased ( $P \leq 0.05$ ) with enzyme or buffer supplementation. Digestibilities of ADF (74.7, 74.9, 75.4, and 77.8% for C, E, B, and EB) also increased ( $P \leq 0.05$ ) with buffer addition and tended to increase ( $P = 0.06$ ) with enzyme addition. Enzyme and buffer addition did not alter passage of liquid (4.8, 5.1, 4.9, and 4.7%/h for C, E, B, and EB) or solids (3.4, 3.7, 4.0, and 3.5%/h for C, E, B, and EB) and therefore cannot account for any of the responses in digestion. Ruminant pH (5.88, 5.97, 5.90, and 5.99 for C, E, B, and EB) and of NH<sub>3</sub> (9.9, 10.0, 10.0, and 8.5 mM for C, E, B, and EB) and total VFA (134, 127, 148, and 131 mM for C, E, B, and EB) were not altered by enzyme or buffer supplementation. However, enzyme addition resulted in lower ( $P \leq 0.05$ ) molar proportions of propionate and tended to increase ( $P = 0.10$ ) proportions of butyrate. Enzyme addition also resulted in greater molar proportions of branched-chain VFA (isobutyrate,  $P \leq 0.05$ ; isovalerate,  $P = 0.08$ ). Results demonstrated that both digestive enzyme and buffer supplementation improved the digestibility of soybean hull-based diet, and responses were greatest when both additives were supplemented together.

**Key Words:** Soybean Hulls, Enzyme, Buffer, Cattle

**231 Effect of processing sprouted grains on performance and carcass characteristics of beef steers.** J.J. Reed\*, E.R. Loe, M.L. Bauer, and G.P. Lardy, *North Dakota State University.*

The feeding value of sprouted barley and sprouted durum in finishing rations was evaluated using 141 crossbred steers (417.4 ± 5.4 kg initial BW) fed for 83 d or 108 d. Steers were blocked by weight and allotted randomly to five treatments in 25 pens. Treatments were dry-rolled corn (CON), whole sprouted barley (WB), rolled sprouted barley (RB), whole sprouted durum (WD), and coarse-rolled sprouted durum (RD). Diets contained 77% grain, 8.5% wet beet pulp, 5% CSB, 4.0% alfalfa, and 5.5% supplement containing 30 mg/kg monensin and 11 mg/kg tylosin. The durum diets contained 37% corn and 40% durum as the grain source. Diets were formulated to contain a minimum 13.5% CP, 0.7% Ca, 0.28% P, and 0.94% K. Data were analyzed as a 2 × 2 plus 1 factorial arrangement of treatments. Particle size was 3438 and 2897 μm for WB and RB and 2628 and 2287 μm for WD and RD. There was a grain × processing interaction ( $P = .01$ ) for DMI; steers fed RB ate more than WB while steers fed RD ate less than WD. Corn-fed steers ate less ( $P =$

0.02) than barley-fed steers. Steers fed rolled grains were heavier, had increased ADG, and were more efficient ( $P < 0.001$ ). Steers fed durum were heavier, gained faster, ate less, were more efficient, and were fatter ( $P > 0.05$ ) compared to barley-fed steers. Corn-fed steers were similar to durum-fed but were heavier, gained faster, ate less, were more efficient, and had increased marbling ( $P < 0.05$ ) compared to barley-fed steers. Feeding corn improves performance and carcass quality of steers compared to barley. Rolling sprouted grains increases performance of steers fed finishing rations.

Item	CON	WB	RB	WD	RD	SEM
ADG, kg	1.78	1.29	1.52	1.54	1.68	0.09
DMI, kg/d	11.23	11.75	11.95	11.61	10.90	0.35
G:F	0.159	0.101	0.127	0.133	0.155	0.002
HCW, kg	369.8	340.5	359.4	355.8	370.2	6.1
Fat, cm	0.86	0.71	0.76	0.84	0.84	0.02
Marbling	419	371	385	388	394	11

**Key Words:** Grain, Processing, Steers

**232 Characterizing the ensiling properties of wet beet pulp. I. Addition of dry feedstuffs.** A.M. Encinas\*, T.C. Gilbery, G.P. Lardy, M.L. Bauer, and J.S. Caton, *North Dakota State University*.

Ensiling properties of wet sugar beet pulp (WBP; 25% DM) mixed with dry feedstuffs (>85% DM) was evaluated in a 47 d study. Treatments were arranged in a 4#6#2 factorial (3 replicates) to determine the effects of: 1) DM, 2) feedstuff, and 3) addition of beet tailings on ensiling characteristics of WBP. Levels of DM tested were 25, 30, 35, 40, 45, and 50%. Feedstuffs added to WBP included: dry pelleted beet pulp (DPB), dry pelleted corn gluten feed (DCGF), dry rolled corn (DRC), or wheat midds (WM). The third component was addition of sugar beet tailings (WBT) to make up 25% DM of the ensiled product. Replicates were individually sealed into 2 heavy-duty plastic liners within a 19-L bucket and fermented for 47 d. Following fermentation, pH was measured and samples were analyzed for CP, soluble CP, IVDMD, VFA, and lactic acid. Dry feedstuffs, with exception of DRC, increased ( $P < 0.001$ ) pH of ensiled WBP. Inclusion of DCGF, DRC, and WM enhanced ( $P < 0.001$ ) protein fractions (crude and soluble), whereas DBP decreased CP and soluble CP ( $P < 0.001$ ). Pelleted DBP, DCGF, and DRC, but not WM, improved ( $P < 0.05$ ) IVDMD. Lactic acid ( $P = 0.11$ ), total VFA ( $P < 0.001$ ), and total organic acids ( $P < 0.001$ ) decreased with DBP addition. Lactic acid production increased ( $P < 0.05$ ) in ensiled WBP products containing DCGF (up to 30% DM), DRC (up to 35% DM) and WM. Total VFAs decreased ( $P < 0.05$ ) with inclusion of DCGF and WM, and increased ( $P < 0.001$ ) with DRC (up to 40% DM). Moreover, total organic acids were suppressed ( $P < 0.05$ ) in DCGF and enhanced ( $P < 0.001$ ) in DRC and WM. Addition of WBT did not influence ( $P < 0.05$ ) CP, soluble CP, or IVDMD of ensiled WBP products with dry feedstuffs. Lactic acid was not affected ( $P < 0.05$ ) with addition of WBT. However, added WBT increased ( $P < 0.05$ ) total VFA in DCGF and WM, but not DBP or DRC. Nutrient quality of ensiled WBP was influenced by inclusion of dry feedstuff. Additionally, WBT (included at 25% DM) improved fermentation characteristics of some WBP-dry feedstuff combinations.

**Key Words:** Silage, Wet Beet Pulp, Feedstuffs

**233 Inclusion of sprouted grain in steer grower diets and effect on performance.** J.J. Reed\*, E.R. Loe, M.L. Bauer, G.P. Lardy, and J.S. Caton, *North Dakota State University*.

The feeding value of sprouted barley and sprouted durum in grower rations was evaluated using 142 crossbred steers ( $328.1 \pm 1.7$  kg initial BW) fed for 62 d. Steers were blocked by weight and allotted randomly to dietary treatments (5 pens/treatment). Treatments were dry-rolled corn (CON), coarse-rolled sprouted barley (CRB), fine-rolled sprouted barley (FRB), whole sprouted durum (WD), and coarse-rolled sprouted durum (CRD). Diets contained 40% grain, 35% corn silage, 20% alfalfa, and 5% supplement containing 28 mg/kg monensin. All diets were formulated to contain a minimum 12% CP, 0.60% Ca, 0.27% P, and 0.93% K. Initial weight and final weight were an average of two consecutive day weights. Grain samples were taken weekly and composited for analysis of particle size. Data was analyzed as a 2 x 2 plus 1 factorial arrangement of treatments with GLM procedure of SAS. There were no grain

x processing interactions ( $P > 0.28$ ). Particle size was  $2722 \pm 1.45$  and  $1998 \pm 1.74 \mu\text{m}$  for coarse-rolled and fine-rolled barley. Particle size was  $2628 \pm 1.24$  and  $2126 \pm 1.52 \mu\text{m}$  for whole durum and rolled durum. Fine rolling barley increased final weight, ADG, and feed efficiency ( $P < 0.07$ ). Rolling durum increased final weight, ADG, and feed efficiency ( $P < 0.01$ ). There were no differences in corn versus barley or corn versus durum ( $P > 0.25$ ). Treatment did not have an effect on DMI ( $P > 0.13$ ). Fine rolling sprouted barley and rolling sprouted durum increased performance of steers fed silage-based grower rations.

Item	CON	CRB	FRB	WD	CRD	SEM
Final wt, kg	413.2	416.7	422.9	415.4	423.5	5.4
ADG, kg	1.34	1.40	1.51	1.40	1.51	0.09
DMI, kg/d	9.50	9.43	9.50	9.74	9.47	0.26
G:F	0.141	0.149	0.159	0.144	0.160	0.004

**Key Words:** Grain, Processing, Steers

**234 Characterizing the ensiling properties of wet beet pulp. II. Addition of liquid feedstuffs.** A.M. Encinas\*, T.C. Gilbery, G.P. Lardy, M.L. Bauer, and J.S. Caton, *North Dakota State University*.

Objectives of this project were to determine ensiling properties for wet sugar beet pulp (WBP) ensiled with combinations of liquid feedstuffs. Effects evaluated included: 1) type of liquid feedstuff and 2) level of liquid byproduct feedstuff on a WBP based ensiled product arranged in a 3 x 4 factorial experimental design. Ensiled products were mixed to achieve four DM levels: 25, 30, 35, or 40%. Liquid feedstuffs used were beet molasses (MOL), concentrated separator byproduct (CSB), and corn steep liquor (CSL). Silage products were prepared in triplicate and sealed into 2 heavy-duty plastic liners within a 19 L bucket and fermented for 47 d. Following fermentation, pH was measured and samples were analyzed for DM, CP, soluble CP, IVDMD, VFA, and lactate. Inclusion of MOL and CSB increased ( $P < 0.002$ ) pH of ensiled WBP, whereas pH was not affected ( $P = 0.63$ ) with CSL. Maximum CP of ensiled WBP (8.55%) was observed at 35, 40, and 40% DM in MOL (mean = 10.68), CSB (mean = 19.37) and CSL (mean = 22.56), respectively. Soluble CP were highest at 40% DM in all treatments. Increasing DM to 40% improved ( $P < 0.001$ ) IVDMD in all treatments. Molasses, CSB, and CSL, when added to WBP, increased ( $P < 0.001$ ) lactic acid production. Total VFA (% DM) in ensiled WBP products numerically peaked in MOL (8.10), CSB (10.42), and CSL (6.42) at 30% DM. Ratio of acetate to total VFA increased ( $P < 0.001$ ) in MOL (up to 40% DM), CSB (up to 35% DM), and decreased with inclusion of CSL ( $P = 0.001$ ). Inclusion of MOL, CSB, or CSL increased total organic acid content, and were highest at 40, 35, and 30% DM, respectively. Results of the current study indicate that ensiling WBP (25% DM) with MOL, CSB, or CSL up to 40% DM improved protein and digestibility fractions. Moreover, lactic acid concentration increased, however total VFA and organic acid was more variable as DM increased in ensiled WBP products. In conclusion, the most desirable fermentation environment may be achieved above 35% DM when ensiling WBP with MOL, CSB, or CSL.

**Key Words:** Silage, Wet Beet Pulp, Concentrated Separator Byproduct

**235 Effect of field pea level on intake, digestion, and ruminal fermentation in beef steers fed growing diets.** J.J. Reed\*, G.P. Lardy, T.C. Gilbery, M.L. Bauer, and J.S. Caton, *North Dakota State University*.

Four ruminally and duodenally cannulated steers ( $367 \pm 48$  kg initial BW) were used in 4 x 4 Latin square to evaluate the effect of field pea inclusion level on intake, site and rate of digestion, ruminal fermentation, and ruminal fill in steers fed growing diets. The control diet consisted of 50% corn, 25% corn silage, 20% alfalfa hay, and 5% supplement (DM basis). Field pea replaced corn at 0, 33, 67, and 100%, forming the treatments. Diets were formulated to contain at least 12% CP, 0.62% Ca, 0.3% P, and 0.8% K. Steers were adapted to diets for 9 d. On d 10 to 14, intakes were measured. Field pea was incubated in situ, beginning on d 10, for 0, 2, 4, 8, 12, 16, 24, 36, 48, 72, and 96 h. Ruminal fluid was collected and pH recorded at -2, 0, 2, 4, 6, 8, 10, and 12 h post-feeding on d 13. Duodenal samples were taken for three consecutive days beginning on d 10 in a manner that allowed for a collection to take place every other hour for a 24 h period. Dry matter intake (13.8, 11.4,

13.6, 11.1 ± 1.4 kg) decreased ( $P < 0.09$ ) in a linear and cubic manner with increasing field pea. In situ DM disappearance of field pea (2.2, 3.9, 1.6, 2.8 ± 0.5 %/h) changed ( $P < 0.02$ ) cubically with increasing levels of field pea. Increasing field pea tended to linearly increase ( $P < 0.08$ ) total tract DM (68.6, 75.9, 76.1, 75.5 ± 2.0%), OM (88.1, 90.9, 90.9, 90.6 ± 0.8%), and NDF (84.1, 89.0, 89.0, 88.7 ± 1.0%) digestion. There were no effects observed ( $P > 0.3$ ) in total tract CP (79.7 ± 1.9%) or apparent ruminal DM (74.8 ± 1.1%) digestion. Increasing field pea linearly decreased ( $P < 0.03$ ) ruminal fill (7.4, 6.0, 5.1, 5.3 ± 0.9 kg), ruminal pH (6.7, 6.7, 6.4, 6.6 ± 0.03), and fecal output (4.0, 3.0, 3.0, 3.0 ± 0.5 kg). It appears field pea is a suitable substitute for corn in growing diets.

**Key Words:** Cattle, Field Pea, Digestibility

**236 Characterizing the ensiling properties of wet beet pulp. III. Addition of urea.** A.M. Encinias\*, T.C. Gilbery, G.P. Lardy, M.L. Bauer, and J.S. Caton, *North Dakota State University*.

An experiment was designed to evaluate the addition of urea as a method to enhance utilization of ensiled WBP. Two ensiled WBP products were evaluated: 1)WBP (without urea), or 2)WBP (with urea). Urea was added (6.4 g /kg DM) to WBP in +urea treatment and thoroughly mixed. Silage products were prepared in triplicate and sealed in 2 heavy-duty plastic liners within a 19-L bucket and fermented for 47 d. Following fermentation, pH was measured and samples were analyzed for DM, CP, soluble CP, IVDMD, VFA, and lactate. In the current experiment there was no effect ( $P = 0.45$ ) of added urea on pH (4.13 vs 4.11 0.06). Feed DM was increased ( $P = 0.03$ ; 31.8 vs 27.9 0.8%) with urea addition. Ensiled products which included urea had higher CP ( $P < 0.0001$ ; 12.12 vs 9.50 0.06%) and soluble CP ( $P < 0.0001$ ; 6.19 vs 3.63 0.06%) than without urea. Added urea however, did not influence IVDMD ( $P = 0.15$ ; 83.6 vs 82.6 0.4%) in the current experiment. Lactate (% DM) increased with the addition of urea ( $P = 0.02$ ; 5.21 vs 4.20 0.20). Moreover, VFA's increased ( $P = 0.03$ ) 22% in ensiled WBP products with urea. Acetate (% of total VFA) increased 3% with added urea ( $P = 0.006$ ). Furthermore, enhanced lactic acid and VFA resulted in increased ( $P = 0.002$ ) total organic acid (10.71 vs 8.71 0.32%) of ensiled WBP products with urea vs without urea, respectively. The results of the current experiment indicate WBP may be ensiled with urea to increase DM content, promote a more desirable fermentation environment, and increase nutrient quality after a 47 d fermentation period.

**Key Words:** Silage, Wet Beet Pulp, Urea

**237 Influence of advancing season on intake, site of digestion, and microbial efficiency in beef steers grazing native range in western North Dakota.** H. J. Pitcher\*<sup>1</sup>, J. S. Caton<sup>1</sup>, D. A. Cline<sup>1</sup>, M. L. Bauer<sup>1</sup>, L. L. Manske<sup>2</sup>, and G. P. Lardy<sup>1</sup>, <sup>1</sup>*North Dakota State University, Fargo*, <sup>2</sup>*North Dakota State University, Dickinson*.

Effects of advancing season on intake, site and extent of digestion, and microbial efficiency in steers grazing native mixed-grass prairie in western North Dakota were evaluated in five sampling periods. Four crossbred steers (349.9±17.4 kg initial wt), fitted with ruminal and duodenal cannula, grazed a 4.5 month season-long pasture. Sampling periods (10 d) were early June, late July to early August, late August, mid-September, and mid-November. Chromic oxide (8 g twice daily) was dosed on d 1 to 10. Masticate samples were taken on d 1 prior to marker dosing. Duodenal and fecal samples were taken at 0, 4, 8, and 12 h on d 6 to 10. Dietary N content (% OM) decreased linearly across season ( $P < 0.01$ ; 1.95, 1.41, 1.56, 1.24, 1.15±0.11). In addition, OM intake (g/kg BW) decreased linearly across season ( $P = 0.001$ ); highest in late June (31.7) and lowest in mid-November (13.4). Total tract and true ruminal OM digestion decreased linearly across season ( $P < 0.001$ ). Organic matter digestion in the small intestine did not change as a percent of intake; however, OM digestion as a percent of entering decreased ( $P = 0.002$ ) with advancing season. Ruminal N digestion decreased linearly with advancing season ( $P < 0.04$ ); however, small intestinal N digestion increased across season ( $P < 0.08$ ). A greater portion of N was apparently digested in the small intestine than ruminally. Apparent ruminal N digestion was negative at all periods with the exception of late June indicating substantial N recycling. Microbial efficiency (g microbial protein/kg OM truly fermented) increased linearly ( $P = 0.03$ ) as season advanced (12.8 in late June to 21.7 in mid-November). Results

indicate that dietary N declines with advancing season. In addition, OM digestion declines with advancing season and N-recycling was more important later in the season when forage N declines. Microbial efficiency appears to increase with advancing season.

**Key Words:** Native Range, Intake, Microbial Efficiency

**238 Effects of degradable intake protein on forage utilization and performance of periparturient beef cows fed native prairie hay.** W. W. Dvorak\*, M. L. Bauer, J. S. Caton, and G. P. Lardy, *North Dakota State University, Fargo*.

Thirty-two Angus crossbred cows (670±60 kg initial wt) were used to evaluate effects of degradable intake protein (DIP) supplementation on forage use and performance of beef cows fed native prairie hay. Treatments were control (C; corn-based supplement), urea (U), steep liquor (L), and sunflower meal (S) based supplements. Supplements were fed at 0.28, 0.28, 0.296, and 0.296% of BW during gestation, and 0.589, 0.598, 0.625, and 0.633% of BW during lactation for C, U, L, and S, respectively. All supplements provided similar energy, (NE<sub>m</sub>; 2.09 Mcal/kg). Corn-based control supplements provided 44.0 g/kg DIP during gestation and 44.9 g/kg DIP during lactation. Protein supplements were formulated to provide 131.6 g/kg DIP during gestation and 116.2 g/kg DIP during lactation. Intake of forage was measured daily during six 7-d collection periods, which represented mo 7, 8, and 9 of gestation and mo 1, 2, and 3 of lactation. Prairie hay (7.2% CP) was offered daily for ad libitum consumption. Cow weights were determined from a 3-d average weight and condition-scores were taken on d 7 for each period. Milk production was determined using the weigh-suckle-weigh method. Forage intake was similar among treatments and greater during lactation compared with gestation (2.50 vs. 1.79% of BW, respectively). Forage digestion and calf performance were unaffected ( $P > 0.10$ ) by supplementation. There was a time x treatment interaction ( $P = 0.02$ ) for cow BW. After cows were fed DIP for two months U and S were heavier ( $P < 0.10$ ) than C. Cows fed L were heavier ( $P < 0.11$ ) than C after three months. Milk production was greater for DIP supplemented cows compared to C cows ( $P = 0.02$ ; 9.5 vs. 7.1 kg/d, respectively). These data suggest that DIP supplementation may improve body weight and milk production in beef cows consuming native prairie hay.

**Key Words:** Protein Supplementation, Beef Cows, Degradable Intake Protein

**239 Performance of heifers fed a corn silage based diet and supplemented with soybean meal versus distillers dried grains plus solubles.** J. B. Corners\* and J. E. Williams, *University of Missouri-Columbia*.

A study was conducted using 63 Angus crossbred heifers (234.5 ± 18.97 kg) to compare Distillers Dried Grains with Solubles (DDGS) versus Soybean Meal (SBM) as a supplemental protein source. Animals were assigned to three treatments, which were SBM and two levels of DDGS, fed as a top-dressed supplement. Treatments were formulated to provide .30 kg SBM (12.5% CP, 1.08 Mcal NEg/kg; SBM), .30 kg DDGS (11.7% CP, 1.08 Mcal NEg/kg; LDDGS) and .76 kg DDGS (12.5% CP, 1.10 Mcal NEg/kg; HDDGS). The basal diet consisted of corn silage (22.2% DM, 8.61% CP, .79 Mcal NEg/kg), soyhulls and corn. Data were analyzed as a split plot design, while overall data were analyzed as a randomized block design (pen was the experimental unit). The ADG for the HDDGS group was numerically greater ( $P < .13$ ) than SBM, while ADG was similar ( $P > .64$ ) for the SBM and LDDGS groups. During the 112-day study, DMI ( $P > .74$ ) and F:G ratio ( $P > .24$ ) did not differ. Numerically higher ADG and numerically improved F:G ratio created a lower cost of gain ( $P < .11$ ) for the HDDGS treatment compared to the SBM group. An in situ study was conducted with two mature Angus cows consuming the test basal diet and a mixture of .45 kg SBM and .45 kg DDGS. The DDGS and SBM (4.0g in triplicate) were placed in Dacron bags and incubated up to 48 hours. The DM ( $P < .03$ ) and N ( $P < .02$ ) disappearance for SBM were increased compared to DDGS. These results revealed that the greater amount of protein escaping ruminal degradation is potentially available for utilization in the small intestine, and improved ADG in the High DDGS treatment. Based on findings, DDGS is an economically viable replacement for SBM in a corn silage based diet for growing heifers.

Item	SBM	LDDGS	HDDGS	SE	P<
ADG, kg/d	1.23 <sup>a</sup>	1.20 <sup>a</sup>	1.34 <sup>b</sup>	0.034	.13
DMI, kg/d	7.70	7.72	7.99	0.277	.74
F:G Ratio, kg/kg	6.26	6.43	5.96	0.083	.24
Cost/100 kg Gain	61.82 <sup>a</sup>	58.96 <sup>a</sup>	55.80 <sup>b</sup>	1.297	.11

<sup>a,b</sup>Values in rows not sharing a common superscript are different ( $P < .13$ ).

**Key Words:** Cattle, Distillers Grains

**240 Effect of restricted forage intake on ruminal disappearance of a blood meal, feather meal and fish meal supplement.** E. J. Scholljegerdes\*, B. W. Hess, and P. A. Ludden, *University of Wyoming, Laramie, Wyoming.*

Six Angus-cross cattle (average initial BW = 589 kg) fitted with ruminal cannulae were used to determine in situ disappearance of a ruminally undegraded protein supplement. Cattle were fed chopped (2.54 cm) bromegrass hay (8.9% CP) at one of three percentages of maintenance intake (30%, 55%, 80%) and a ruminally undegraded protein supplement (6.8% blood meal, 24.5% feather meal, and 68.7% fish meal) formulated to balance metabolizable protein across all levels of hay consumption. Adaptation to experimental diets was 7 d. On d 8, 50- $\mu$ m in situ bags containing 5 g of protein supplement were inserted into the rumen and then removed at 3, 6, 9, 12, 15, 18, 24, 36, and 48 h after insertion. Non-linear regression models were used to determine protein fractions A and B and protein degradation rate. Effective ruminal degradation was estimated using a combination of this experiment's non-linear regression data and previously determined fluid passage rates for the respective forage intake levels. Ruminally undegraded protein was not different ( $P = 0.16$  to  $0.49$ ) across treatments at 3, 6, 9, and 18 h. Increasing forage intake from 30 to 80% of maintenance resulted in a linear increase ( $P \leq 0.05$ ) in ruminally undegraded protein at 12, 15, 24, and 36 h. Dietary treatment had no effect ( $P = 0.30$ ) on protein fractions A and B; however, protein degradation rate declined linearly ( $P = 0.03$ ) as forage intake was increased from 30 to 80% of maintenance. Therefore, effective ruminal degradation decreased (linear,  $P = 0.01$ ) from 50.8 to 40.9% as forage intake increased from 30 to 80% of maintenance. Corresponding estimates of ruminally undegraded protein were 49.2, 56.5, and 59.1% for the 30, 55 and 80% of maintenance intake treatments, respectively. Restricting dietary intake can reduce the quantity of N that escapes ruminal degradation. Tabular estimates of ruminally undegraded protein are not appropriate for formulating diets to balance metabolizable protein in beef cattle consuming limited quantities of forage.

**Key Words:** Cattle, Undegraded Protein, Intake

**241 Effects of high linoleic safflower seed supplement to gestating ewes on survivability of lambs.** H. B. Encinias\*, T. C. Faller, M. L. Bauer, and G. P. Lardy, *North Dakota State University, Fargo, ND, USA.*

Lamb survival during periods of cold weather can be a problem in northern climates. Prepartum safflower seed supplementation for ewes was investigated during two consecutive years (avg high and low temp: 2.6,-9.8°C) and effects on lamb survival and performance were analyzed. One hundred twenty-two and 112 gestating ewes (78.7  $\pm$  0.6 kg initial wt) were allotted randomly to one of two dietary treatments (4 pens/treatment). Ewes were fed alfalfa-based, isocaloric and isonitrogenous diets containing either 2.8 (LF) or 5.7% (HF) dietary fat beginning approximately 45 d prepartum. Rolled safflower seeds (32% fat; 80% linoleic acid) were used as the fat source. Solvent extruded safflower meal was used as protein source in LF and energy was balanced with corn. Initial and final ewe body condition and weights, birth weights, lamb mortality, and weaning weights were measured. Mortality was separated by cause: born dead, starvation, or pneumonia. Pregnancy rate, mortality, and weaning rate data were analyzed with square root transformation. Means and 95% confidence intervals were squared for reporting. Initial (3.66  $\pm$  0.03;  $P = 0.45$ ) and final (3.91  $\pm$  0.02;  $P = 0.46$ ) body condition were similar for LF and HF supplemented ewes. There was no difference in initial (78.7  $\pm$  0.6;  $P = 0.25$ ) or final (95.0  $\pm$  0.9;  $P = 0.22$ ) BW. Number of lambs born per ewe was similar across treatments (1.70  $\pm$  0.12;  $P = 0.13$ ). Lambs weighed 5.6  $\pm$  0.1 kg at birth ( $P = 0.24$ ). More lambs ( $P = 0.03$ ) from HF supplemented dams survived (88.3 vs 78.0  $\pm$  6.5%) and less tended ( $P = 0.07$ ) to die from pneumonia (0.0 vs 0.7  $\pm$  0.5%). Ewes receiving LF had more ( $P =$

0.03) lambs die due to starvation (13.7 vs 4.2  $\pm$  5.8%). Lambs born dead were similar ( $P = 0.40$ ) across treatments (2.2  $\pm$  3.7%). Weaning weights were similar (18.5  $\pm$  0.7 kg;  $P = 0.18$ ). High fat ewes weaned more lambs per ewe (1.5 vs 1.2  $\pm$  0.001;  $P = 0.03$ ) and tended ( $P = 0.12$ ) to wean more lamb weight per ewe (24.9 vs 21.5  $\pm$  1.5 kg). High linoleic safflower seeds fed during gestation may be beneficial in improving lamb survivability.

**Key Words:** Safflower, Supplementation, Lamb Survival

**242 Urinary allantoin as an estimate of microbial protein synthesis.** M. Lamothe\*, T. Klopfenstein, D. Adams, J. Musgrave, and G. Erickson, *University of Nebraska-Lincoln.*

Sixteen primiparous March-calving cows were randomly assigned to upland native range or subirrigated meadow in the Nebraska Sandhills to determine microbial protein synthesis (BCP) by using urinary allantoin excretion as a marker. Urine and diet samples were collected from May to September. Spot urine samples were taken from each cow for five days each month. Urinary creatinine excretion was used as a marker of total urine excretion. Diet samples were taken with esophageally-fistulated cows and analyzed for in vitro dry matter digestibility (IVDMD, %). The NRC (1996) model was used to predict BCP production and intake. Actual body weights and IVDMD values were used as inputs. Cow weights increased from 410 kg in May to 500 kg in December. The table below shows the decrease in IVDMD as forage matured. The BCP production estimated by allantoin decreased with advancing season ( $P < 0.001$ ). The values were significantly higher for cows grazing meadow than range ( $P < 0.05$ ). The NRC model estimated decreasing BCP production from May to September for both meadow and range. The BCP predicted by allantoin excretion was well related to the BCP predicted by the NRC model ( $R^2 = .60$ ). Allantoin has potential to be a useful tool to estimate BCP production in grazing cattle.

Item	May		June		July		Aug		Sept	
	M <sup>a</sup>	R <sup>a</sup>	M	R	M	R	M	R	M	R
IVDMD	70.2	67.7	67.3	63.6	59.0	61.8	57.2	55.8	50.3	52.5
Allantoin <sup>a</sup>	41.5	34.9	47.1	38.8	49.4	46.0	19.4	21.7	23.9	20.5
BCP <sup>b</sup>	1163	945	1397	1122	1495	1350	605	559	645	546
BCP <sup>c</sup>	964	922	994	895	713	820	644	597	434	491

<sup>a</sup>M=meadow, R=range, Allantoin, g/d <sup>b</sup>BCP production estimated from allantoin, g/d <sup>c</sup>BCP production estimated from NRC, 1996, g/d

**Key Words:** Beef Cows, Microbial Protein, Allantoin

**243 Effect of pasture fertilization with urea or ammonium sulfate on feed selection and feed intake in sheep.** M. Abdullah\*, S.C. Loerch, D.D. Clevenger, G.D. Lowe, and B.R. Stinner, *OARDC, The Ohio State University, Wooster.*

Due to its sulfur content, fertilization of pastures with ammonium sulfate (NH<sub>4</sub>SO<sub>4</sub>) may affect forage intake. Two experiments were conducted to evaluate the effect of fertilizing orchard grass (OG) pasture with urea or NH<sub>4</sub>SO<sub>4</sub> on feed selection and dry matter intake (DMI) by lambs. In Exp. 1, OG pasture was fertilized with 89.7 kg N/ha using either urea or NH<sub>4</sub>SO<sub>4</sub>. Twenty individually penned lambs were fed supplements (0.45 kg/d) with either high (0.743%) or low (0.215%) sulfur content 14 d preceding the test period. During the test period, lambs were given free choice access to urea and NH<sub>4</sub>SO<sub>4</sub> fertilized OG for 5 d. In Experiment 2, OG pasture was fertilized with 134 kg N/ha using NH<sub>4</sub>SO<sub>4</sub> or urea. Twenty four lambs (2/pen) were fed either a low or high sulfur diet as in Experiment 1, but the supplementation continued through out the test period of 5 d. During the test period, the lambs were fed OG fertilized either with urea or NH<sub>4</sub>SO<sub>4</sub>. In Exp. 1, there were no differences ( $P > 0.05$ ) due to low or high sulfur background on selective consumption of OG fertilized with urea or NH<sub>4</sub>SO<sub>4</sub>. Total DMI however, was lower (0.74 vs. 1.10 kg/d;  $P < 0.05$ ) in high as compared to low sulfur background lambs. Dry matter intake by lambs fed the NH<sub>4</sub>SO<sub>4</sub> fertilized forage increased ( $P < 0.01$ ) from d1 (31.6% of total forage intake) to d5 (70.5% of total forage intake) irrespective of the sulfur background. Mean sulfur contents of the pastures differed ( $P < 0.01$ ) due to fertilizer source (0.346% S for urea vs. 0.488% S for NH<sub>4</sub>SO<sub>4</sub>). In Exp. 2, there was no difference ( $P > 0.05$ ) in DMI by the lambs due to sulfur background (1.44 vs. 1.40 kg/d for high vs. low sulfur background, respectively) or between lambs fed either urea or NH<sub>4</sub>SO<sub>4</sub> fertilized forage (1.39 vs. 1.45 kg/d, respectively). NH<sub>4</sub>SO<sub>4</sub>

can be used as pasture fertilizer without affecting forage palatability and feed intake by sheep.

**Key Words:** Pasture Fertilization, Urea, Ammonium Sulfate

**244 Using orchardgrass and endophyte-free fescue versus infected fescue overseeded on bermudagrass for cow herds: year 2.** D. A. Scarbrough<sup>1</sup>, W. K. Coblenz<sup>\*1</sup>, K. P. Coffey<sup>1</sup>, T. F. Smith<sup>2</sup>, J. B. Humphry<sup>1</sup>, D. S. Hubbell, III<sup>2</sup>, J. K. Martin<sup>2</sup>, J. E. Turner<sup>1</sup>, K. F. Harrison<sup>2</sup>, and D. H. Hellwig<sup>1</sup>, <sup>1</sup>University of Arkansas, Fayetteville, <sup>2</sup>Livestock and Forestry Branch Station, Batesville.

On January 11, 2000, a trial was initiated to compare the production potential of spring-calving cow-calf pairs grazing 4-ha pastures of either endophyte-free fescue (FF), or orchardgrass (OG) overseeded into bermudagrass sods versus cow-calf pairs grazing previously established mixed pastures of infected fescue (IF) and common bermudagrass. Two rotation schemes (twice weekly = HIGH; twice monthly = LOW) have been established for FF and OG pastures; IF pastures are being managed on a LOW rotation schedule only. This project was supported by grant number 2001-35209-10079 from the USDA/NRICGP Agricultural Systems Program. For the second year of this study (2001), grazing treatments did not affect cow BW at calving (P=0.08) or breeding (P=0.83), but affected BW at weaning (P=0.04). Body condition scores of cows at calving, breeding, and weaning were not affected (P≥0.11) by grazing treatments. In contrast, grazing treatments affected actual (P=0.01) and 205-d adjusted (P<0.01) weaning weights of calves. Adjusted 205-d weights of calves weaned from FF-HIGH pastures were numerically the lightest (221 kg), but did not differ (P≥0.28) from weights of calves grazing FF-LOW or IF-LOW pastures. Calves weaned from OG-HIGH pastures had the heaviest (P<0.05) 205-d adjusted weaning weights, which were in excess of 270 kg. Calves weaned from OG-LOW pastures had adjusted weaning weights that were intermediate (247 kg) between OG-HIGH and all fescue pastures. Forage availability and percentages of desired cool-season grasses (IF, FF, or OG) in the sward were not affected (P≥0.67) by grazing treatments. Overseeded perennial cool-season grasses may provide opportunities to improve cow-calf performance for beef producers in Arkansas.

**Key Words:** Fescue Toxicosis, Weaning, Rotational Grazing

**245 Storage structure and density affects the VFA profile of corn silage and hay crop silage.** P. A. Porter<sup>\*1</sup>, R. J. Marfilus<sup>2</sup>, M. A. Klemme<sup>2</sup>, D. F. Schueller<sup>2</sup>, and S. L. Gunderson<sup>3</sup>, <sup>1</sup>Land O'Lakes, Webster City, Iowa/USA, <sup>2</sup>CP Feeds, LLC, Valders, Wisconsin/USA, <sup>3</sup>University of Wisconsin Extension, Manitowoc, Wisconsin.

55 corn silage (CS) and 52 hay crop silage (HCS) samples were taken from commercial dairies in eastern Wisconsin in 2000. 7 CS and 10 HCS samples were from Ag Bags; the remaining samples were from bunker silos. As fed and DM densities (AFD, DMD) and VFA concentrations were measured. For CS, bunker silos had relatively higher AFD, DMD, higher % lactic acid (L), % total VFA (tVFA) and lower pH compared to bags; for HCS, bunker silos had slightly higher AFD, DMD, % butyric acid (B) and lower L and tVFA when compared to bags (Table 1). The fermentation profile for bunker CS was slightly more favorable than that in bags, probably related to lower %DM and higher density. HCS in bags had a more favorable profile than did bunker HCS. Compared to HCS, CS had lower %DM, pH and B and higher L and tVFA. A minority of samples met the criteria of well-fermented forage: >70% L as a % of tVFA (L%tVFA), <2% acetic (A) and <.1% B (Table 1). Correlation coefficients were developed for the forages stored in bunker silos. For both forages, AFD and L, A and P, P and B, P and NH<sub>3</sub>-N were positively correlated. Selected HCS correlations: %DM & L (P=.02, R<sup>2</sup>=-.36), %DM & tVFA (.0001, -.84), %DM & A (.0001, -.74), %DM & P (.0004, -.52), %DM & B (.01, -.42), %DM & NH<sub>3</sub>-N (.001, -.48); AFD & tVFA (.0001, .71); pH & L, L%tVFA or B (.0001, -.61, -.71, .79, respectively); B & NH<sub>3</sub>-N (.0001, .84). Selected CS correlations: %DM & pH (.05, .29), %DM & tVFA (.0002, -.51), %DM & L (.006, -.39); pH & AFD (.001, -.49), pH & DMD (.01, -.36), pH & L (.0001, -.83), pH & tVFA (.01, -.37); A & P (.0001, .61), A & L%tVFA (.0001, -.86).

	% samples with:										
	DM	AFD <sup>1</sup>	DMD <sup>1</sup>	pH	L	B	tVFA	L	X <sup>2</sup>	Y <sup>2</sup>	Z <sup>2</sup>
CS:											
Bunker	36.0	41.2	14.6	4.0	5.2	.13	8.3	63	35	25	62
Bag	41.0	25.1	9.8	4.2	4.4	.10	6.9	64	-	-	-
HCS:											
Bunker	41.5	37.7	15.0	5.0	4.3	.73	7.8	57	24	40	21
Bag	38.5	35.3	13.3	4.9	6.4	.10	9.2	71	-	-	-

<sup>1</sup>lbs/ft<sup>3</sup>

<sup>2</sup>X => 70% L tVFA, Y =< 2% A, Z =< .1% B.

**Key Words:** Fermented Forage, Volatile Fatty Acid, Bunker Silo

**246 Pasture and weaning management systems to reduce the incidence of tall fescue toxicosis in cow-calf pairs.** D. A. Scarbrough<sup>1</sup>, K. P. Coffey<sup>\*1</sup>, W. K. Coblenz<sup>1</sup>, J. K. Martin<sup>2</sup>, J. B. Humphry<sup>1</sup>, and D. H. Hellwig<sup>1</sup>, <sup>1</sup>University of Arkansas, Fayetteville, <sup>2</sup>Livestock and Forestry Branch Station, Batesville.

Many methods have been evaluated to reduce the toxic effects of grazing infected fescue (IF) pastures, but diluting those with non-infected forage species appears to be the most effective. A trial was initiated in April 2000 to evaluate effects of pasture rotation frequency (twice weekly = HIGH vs. twice monthly = LOW) and weaning date (early April vs. late May) on performance of fall-calving cow-calf pairs grazing IF pastures overseeded with crabgrass, lespedeza, red clover, and white clover. This project was supported by grant number 2001-35209-10079 from the USDA/NRICGP Agricultural Systems Program. Cow BCS was not affected (P≥0.46) by treatments at calving (6.8), but was 0.3 units higher (P<0.01) at breeding for cows grazing pastures at the LOW rotation. Pasture rotation and weaning date did not affect calving date (P≥0.38), ADG (P≥0.47), or 205-d weaning weights (P≥0.56) of calves (mean values = October 1, 0.95 kg, and 228 kg, respectively). Late-weaned calves weighed 49.8 kg more (P<0.01) than early-weaned calves, but weights were not affected (P=0.94) by pasture rotation. At their respective weaning dates, calves were transported to a local auction facility, handled by routine procedures, held overnight, and then transported back to the research station. Pasture rotation did not affect (P≥0.16) calf shrink percentages at any time between transportation to and from the auction facility. Total shrink losses were 1.25 percentage units higher (P=0.05) for late-weaned calves than for early-weaned calves. To date, forage species composition has not been affected by pasture rotation (P≥0.69) or weaning date (P≥0.09). Results from the first calving cycle show little improvement in animal performance due to pasture rotation and weaning management, but trends may change as data from subsequent calving cycles are collected.

**Key Words:** Tall fescue, Cattle, Forage management

**247 Effect of carbohydrate types and supplemental degradable intake protein sources on low-quality forage utilization by beef steers.** J. I. Arroquy<sup>\*</sup>, R.C. Cochran, T.A. Wickersham, and D.A. Llewellyn, Kansas State University.

A trial was conducted to assess the impact of type of supplemental carbohydrate (CHO) and source of degradable intake protein (DIP) on low-quality forage utilization. Twelve ruminally fistulated beef steers (BW = 500 kg) given ad libitum access to tallgrass-prairie hay (5.3%CP, 74.8%NDF) were used in a 12-treatment, 2-period crossover experiment. Steers were subjected to two 20-d periods (11 d of adaptation) which included periods for intake and total fecal collection, ruminal evacuation, and monitoring ruminal fermentation. Treatments were arranged as a 2 x 6 factorial and consisted of two different CHO types (fed at 0.16% of initial BW) each offered with an equal amount of DIP (0.087% of initial BW) but with six different proportions of nonprotein nitrogen (NPN) and true protein as sources of DIP. The CHO types were starch and dextrose. The different proportions of the two sources of N contributing to the DIP were 100:0, 80:20, 60:40, 40:60, 20:80 and 0:100 % of supplemental N as sodium caseinate vs urea, respectively. Treatments were ruminally dosed once daily. No CHO x DIP source interactions were significant. Forage OM and total DOM intake increased linearly (P < 0.05) in response to increased supplemental true protein. However, CHO type did not affect intake (OM, P = 0.25; DOM, P = 0.23). Digestibility of OM and NDF was greater (P = 0.05 and P = 0.06, respectively) when dextrose was provided compared with starch. Solid passage rate

increased in a quadratic manner ( $P = 0.06$ ) in response to increasing supplemental true protein, but was slower ( $P = 0.02$ ) for dextrose than starch. In conclusion, while the CHO types evaluated did not interact with source of supplemental DIP with regard to effects on intake and digestion, both factors exerted independent effects on these characteristics. Forage digestibility was affected by the provision of sugar vs starch, whereas the relative proportion of true protein vs NPN in the supplemental nutrients affected forage intake.

**Key Words:** Carbohydrate, Protein, Beef Cattle

**248 Self-fed wheat middlings in backgrounding diets for beef heifers.** T.C. Gilbery<sup>\*1</sup>, G.P. Lardy<sup>1</sup>, B. Kreft<sup>2</sup>, J. Dhuyvetter<sup>3</sup>, and M.L. Bauer<sup>1</sup>, <sup>1</sup>North Dakota State University, Fargo, <sup>2</sup>Streeter, <sup>3</sup>Minot.

Wheat middlings are a relatively high in CP compared with other cereal grains in North Dakota backgrounding operations. Wheat middlings contain higher concentrations of digestible fiber than corn or barley, making them favorable for self-feeding. One hundred two crossbred heifers (333.7 ± 39.1 kg initial BW) were used in backgrounding study to evaluate self-fed vs. mixed diets containing wheat middlings for a 73 d period. Variables of interest were dry matter intake, average daily gain, and feed efficiency. The dietary treatments were: 1) totally mixed ration (TMR) and 2) self-fed wheat middlings-based diet. The TMR contained (DM basis) 48.25% grass hay, 48.25% wheat middlings, and 3.5% supplement. The self-fed diet consisted of ad libitum grass hay and self-fed wheat middlings. Hay in the self-fed treatment was fed as round bales in bale feeders. The wheat middlings were offered in a portable creep feeder mixed with a supplement (93.24% wheat middlings and 6.76% supplement; DM basis). Both diets were formulated to provide adequate calcium levels for a Ca:P ratio of 1.5:1. Initial and final weights were recorded, a daily record of feed offered was maintained, orts were collected and weighed as needed. Performance data were analyzed using the GLM procedure of SAS (6.11). There was no significant difference between treatments for total feed intake (11.13 ± 0.15 kg;  $P = .36$ ), average daily gain (.76 ± 0.03 kg;  $P = .79$ ), or feed efficiency (.685 ± 0.031 g/gain per kg/feed;  $P = .94$ ). Hay consumption was higher for the TMR treatment (5.42 vs. 4.44 kg;  $P = 0.01$ ), and wheat middling intake was higher on the self-fed diet (6.59 vs. 5.81 kg;  $P = 0.0001$ ). Feeding wheat middlings may be a practical way to background beef cattle at moderate rates of gain.

**Key Words:** Heifers, Backgrounding, Wheat Middlings

**249 Year round grazing systems for fall- and spring-calving beef cows: winter grazing management.** N. A. Janovick\* and J. R. Russell, Iowa State University.

Winter feeding systems utilizing fall- or spring-calving beef cows were compared over 165 d in 3 yr. In a fall-calving winter grazing system, six cows with fall-born calves strip-grazed duplicate 6.1-ha stockpiled tall fescue-red clover (TFRC) pastures. In a spring-calving winter grazing system, six cows in mid-gestation strip-grazed duplicate 6.1-ha corn crop residue (CCR) pastures followed by strip-grazing in duplicate 6.1-ha smooth bromegrass-red clover (SBRC) pastures. In a drylot system, six spring-calving cows were allotted to duplicate drylots. Spring- and fall-calving cows were fed hay as needed to maintain mean body condition scores (BCS) of 5 and 3, respectively. During summer in the TFRC and SBRC pastures used for winter grazing, first-cutting forage was harvested as large round bales, forage regrowth was grazed for 65 d, and forage was fertilized with 44.9 kg N/ha before stockpiling. For the drylot system, first-cutting forage was harvested as large round bales from 5.1 to 6.1 ha in duplicate smooth bromegrass-orchardgrass-birdsfoot trefoil pastures. All cows and calves were weighed at initiation of grazing in October, in January and March and at termination of grazing in April. Cow BCS were determined visually biweekly. Cows in the drylot system lost less ( $P < .05$ ) BCS after calving compared to spring-calving cows in the winter grazing system. However, cows in the drylot system had a greater ( $P < .05$ ) total loss of BCS over winter compared to cows in the winter grazing system. There were no differences ( $P > .05$ ) in initial BCS or in the seasonal change in BCS between fall-calving cows in the winter grazing system and spring-calving cows in either the winter grazing or drylot systems. Spring-calving cows in the drylot system required 1700 kg DM more hay/cow ( $P < .05$ ) than the mean of spring- and fall-calving cows in the winter grazing system. Hay balance (kg hay produced/cow - kg hay fed/cow) of cows in the drylot system was 1244

kg/cow greater ( $P < .05$ ) than the mean of spring- and fall-calving cows in the winter grazing systems.

**Key Words:** Beef Cattle, Winter, Grazing

**250 Effect Of Creep Feeding Pressed Block or Salt-Limited Pellets To Beef Calves.** T.C. Gilbery<sup>\*1</sup>, M.H. Knight<sup>1</sup>, G.P. Lardy<sup>1</sup>, B. Kreft<sup>2</sup>, J.S. Caton<sup>1</sup>, and R. Hall<sup>3</sup>, <sup>1</sup>North Dakota State University, Fargo, <sup>2</sup>Central Grasslands Research Center, Streeter, <sup>3</sup>Cooperative Research Farms.

A study was conducted to evaluate form of creep feed diets fed to nursing beef calves. Treatments were: control (CON; no creep), pressed blocks, (BLK; 26% CP; weight = 15 kg) and salt-limited pellets (SLP; 26% CP). Cows with calves ( $n = 118$ ; initial BW = 604 ± 11 kg and 602.8 kg, respectively) were allotted to 12 native pastures. The SLP and BLK diets were formulated using soybean meal, distiller's grain, and wheat middlings as the major ingredient. Calves were initially offered SLP containing 16% salt from d 0 to 29 and calves refused to consume the creep feed; therefore, salt inclusion was reduced to 0% from d 30 to 53 to encourage intake, which then averaged 1.46 kg/d (DMB). During the final 30 days, salt was added back to the SLP supplement; from d 54 to 69 the SLP treatment contained 8% salt and intake averaged 1.67 kg/d (DMB), and from d 70 to 85 inclusion was increased to 16% salt and average intake decreased to 1.20 kg/d (DMB). Feed intake remained relatively constant for the pressed block diet throughout the trial (Avg. intake = 0.55 kg/d). Calves fed creep gained more weight (102.4 vs 93.3 ± 2.6 kg;  $P = 0.02$ ) than calves not receiving creep. No difference ( $P = 0.36$ ) in calf weight gain between BLK and SLP was noted. Cow body condition score and weight changes were not different ( $P = 0.13$  and 0.70, respectively) among treatments. Dry matter intake was not different for BLK when compared to the SLP creep across the entire trial ( $P = 0.34$ ). Pressed blocks may be used to deliver moderate CP creep feeds to nursing beef calves. Salt should be introduced gradually in creep feeds to avoid feed aversions.

**Key Words:** Creep, Blocks, Salt

**251 Year round grazing systems for fall- and spring-calving beef cows: summer grazing management.** N. A. Janovick\* and J. R. Russell, Iowa State University, Ames.

Two summer forage management systems for Angus-cross cows were evaluated over 3 yr. In April 1999, six spring-calving cows with calves in a minimal land (ML) system were rotationally stocked on 2.0 to 3.0 ha of duplicate 8.1-ha smooth bromegrass-orchardgrass-birdsfoot trefoil (SB-OG-BFT) pastures for 58 d. Forage from the remaining 5.1 to 6.1 ha was harvested as first-cutting hay and these paddocks were incorporated into the rotational stocking system after 28-d regrowth. In a year round (YR) system, six spring-calving cows with calves and 12 stocker cattle lead-grazed paddocks of duplicate 8.1-ha SB-OG-BFT pastures by rotational stocking before six pregnant fall-calving cows for 55 d. Forage from duplicate 6.1 ha smooth bromegrass-red clover (SB-RC) and tall fescue-red clover (TF-RC) pastures was harvested as first-cutting hay from 3.0 to 6.1 ha. These pastures were strip-grazed by spring-calving cows with calves and fall-calving cows for 45 d, while stocker cattle remained in the SB-OG-BFT pastures. Thereafter, stocker cattle were removed and spring- and fall-calving cows were rotationally stocked in the SB-OG-BFT pastures for 80 d. Average daily gains of spring calves did not differ ( $P > .2$ ) between systems and were greater ( $P < .01$ ) than fall calves in the YR system (1.1 vs .9 kg/d). Total growing animal production (calves + stocker cattle) in the ML and YR systems were 143 and 130 kg/ha perennial pasture ( $P > .07$ ). Spring-calving cows in the YR system lost more body condition ( $P < .04$ ) and BW ( $P < .01$ ) over the summer grazing season compared to spring-calving cows in the ML system. Compared at similar physiological states, fall-calving cows lost less BW compared to either group of spring-calving cows ( $P < .01$ ) approximately 30 d pre-calving to 21 d post-calving. Over 3 yr, more hay was produced in the ML compared to the YR system expressed either as kg DM/harvested ha or kg DM/cow ( $P < .05$ ). Grazing treatment did not affect botanical composition (% of live DM) in SB-OG-BFT pastures in April and October of either year ( $P > .05$ ).

**Key Words:** Beef Cattle, Rotational Stocking, Grazing Systems

**252 Grazing potential of barley or oat forage for yearling beef heifers in the Northern Great Plains.** W. W. Poland\*, P. M. Carr, and L. J. Tisor, *North Dakota State University, Dickinson.*

Barley (*Hordeum vulgare*) forage has been shown to be higher in quality compared to oat (*Avena sativa*) forage in many agronomic experiments. Conversely, oat often produces more biomass. An experiment was designed to compare the grazing potential of barley and oat forage for yearling beef heifers. Forages were evaluated on the basis of animal performance and forage production and quality. In 2000, six 1-ha paddocks were blocked into two groups (3 paddocks per group) based upon previous cropping history and randomly allotted within group to be seeded to either barley or oat. Twenty-four bred yearling beef heifers ( $418.2 \pm 2.69$  kg;  $6.8 \pm .23$  body condition score) were then stratified by weight and randomly assigned to paddock within weight stratum (4 heifers/paddock). Heifers were turned out to graze paddocks in early June (approximately 47 d post-seeding) and grazed for 28 d. There were no differences in final BW ( $P=.15$ ) or condition score ( $P=.53$ ), ADG ( $P=.87$ ) or total gain ( $P=.87$ ). Heifers gained  $.87 \pm .07$  kg/d and produced  $95.9 \pm 7.6$  kg/ha of BW gain over the grazing period. There were no differences in cereal ( $P=.48$ ), weed ( $P=.46$ ) or overall ( $P=.29$ ) forage available for grazing between forage types. The percentage of cereal ( $P=.58$ ) contribution to overall forage mass also did not differ between forage types. On average, there was  $4338 \pm 154$  kg/ha of forage available for grazing of which  $78.2 \pm 2.5$  % was cereal. Crude protein ( $P=.20$ ), ADF ( $P=.85$ ), NDF ( $P=.30$ ), and TDN ( $P=.40$ ) concentrations did not differ with forage type. Average concentrations were  $139 \pm 6.4$ ,  $363 \pm 5.1$ ,  $579 \pm 8.6$  and  $556 \pm 3.8$  g/kg for CP, ADF, NDF and TDN, respectively. In difference to previous work, cattle performance when grazing barley or oat forage did not differ. Furthermore, forage production and quality were not affected by forage type. These data suggest that cattle can be grazed successfully on pastures annually seeded to small grain forage without regard to forage type during the summer in the Northern Great Plains.

**Key Words:** Barley, Oat, Annual Forage

**253 Influence of forage type on digestion, nutrient flow and microbial efficiency in beef steers.** T. D. Maddock\*, J. E. Leonard, M. L. Bauer, G. P. Lardy, V. I. Burke, T. C. Gilbery, and J. S. Caton, *North Dakota State University.*

Four ruminally and duodenally cannulated beef steers (BW = 419 33 kg) were used in a 4 x 4 Latin square to evaluate the effects of forage type on site of digestion, nutrient flow, and microbial efficiency. Diets, offered ad libitum, were alfalfa (ALF; 17.5% CP), brome (BRO; 8.9% CP), cornstover (CST; 3.3% CP), and native grass hay (NGH; 7.5% CP). Experimental periods were 21 d with 12 d adaptation to diet before collections began. Eight g chromic oxide was dosed twice daily. Duodenal samples were taken over a 3-day period. Fecal output was measured directly with fecal bags. Intake of OM and N differed ( $P < 0.004$ ) between treatments with CST lower than ALF, BRO, and NGH (2597 vs 7374, 6577, 5892  $\pm$  374 g/d OM; 15.3 vs 230.1, 104.9, 77.2  $\pm$  23.1 g/d N, respectively). Duodenal OM microbial and non-microbial flow was lower ( $P < 0.10$ ) for CST than ALF, BRO, and NGH (324.5 vs 694.2, 611.3, 709.5  $\pm$  80.8 g/d microbial; 1583 vs 3218, 2933, 2821  $\pm$  337 g/d non-microbial, respectively). Total and non-microbial N flow to the duodenum was higher ( $P < 0.10$ ) for ALF (181.3  $\pm$  18.3; 117.1  $\pm$  14.6 g/d) than other treatments and CST (55.2  $\pm$  14.2; 30.9  $\pm$  11.3 g/d) was lower ( $P < 0.10$ ) than BRO (117.2  $\pm$  14.2; 68.7  $\pm$  11.3 g/d) and NGH (102.1  $\pm$  14.2; 48.0  $\pm$  11.3 g/d). Microbial duodenal N flow was lower ( $P < 0.10$ ) for CST than ALF, BRO, and NGH (24.2 vs 64.2, 48.5, 54.1  $\pm$  6.4 g/d, respectively). Microbial efficiency was unaffected ( $P = 0.19$ ) by treatment. Total tract OM digestion did not differ ( $P = 0.50$ ) among treatments. Digestion was measured ruminal and post-ruminal and CST had lower N digestion compared to other treatments ( $P < 0.10$ ). Both apparent and true ruminal OM digestion was lower ( $P < 0.08$ ) for CST than ALF, BRO, and NGH (22.8 vs 49.0, 47.3, 40.2  $\pm$  7.4% apparent; 36.1 vs 58.2, 56.4, 52.4  $\pm$  5.7% true, respectively). Low quality forages such as CST may benefit from protein supplementation as a means to stimulate intake, digestion, and microbial efficiency.

**Key Words:** Forage, Steer, Digestion

**254 Methods to estimate DIP content and nutritive value of grazed Old World Bluestem and Tall Grass prairie across the calendar the calendar year.** R. Basurto\*, H. Purvis II, T. Bodine, and G. W. Horn, *Oklahoma State University.*

In trial one, in situ methods and a lab method (STREP) were compared to in vivo values obtained from digestion trial where six crossed multi-cannulated Angus steers were fed ad libitum Alfalfa, Bermuda or Prairie hay in a replicated 3x3 Latin square design. The in situ methods involved two single point estimations of nitrogen disappearance at 16 and 20 h (16IS and 20IS) and two methods using neutral detergent insoluble nitrogen pool (NDIN) times (kp / (kp+kd)), where kd was slope of in situ digestion equation of NDIN and kp was passage particle rate estimated by using ADIA as marker. NDIN was calculated as intercept of digestion equation (NDIN-1) or lab value determined directly in lab (NDIN-2). In vivo DIP values were 84.3, 67.5.0 and 49.7 % of total CP for Alfalfa, Bermuda, Prairie hay respectively. A method \* forage interaction was detected ( $P < .01$ ). DIP values of 16IS, 20IS and NDIN-2 for prairie hay differed with ( $P < .01$ ) respect to in vivo values. The DIP values for NDIN-1, NDIN-2 and STREP did not differ of those in vivo. Considering this and that STREP method is simple to attain in laboratory, it was utilized to determine changes in adequacy of supply of degradable protein (DIP) of Old World bluestem (OWB), and Tallgrass (TG) throughout the calendar year. Forage samples were monthly collected by rumen-fistulated steers over 5 yr. The adequacy of DIP was calculated as: (CP\* DIP; supply)/(IVOMD\*11.0%; required), where CP=crude protein, IVOMD=in vitro organic matter digestibility, DIP= S. griseus protease method (STREP) and, 11%=microbial efficiency growth. Degradable intake protein expressed as a percentage of CP ranged from 53.0 to 76 % and 55 to 70% for OWB and TG throughout calendar year. Content of CP of forages was highest in the early spring and decreased into fall and winter. The adequacy of DIP supply in both forages was deficient respect with to available energy from Sep to Mar period. Overall, both NDIN and STREP appear to estimate in vivo DIP values adequately. Addition timing of decline DIP relation to energy in OWB and TGP is supported by the observed responses to summer and winter protein supplementation on these forages.

**Key Words:** Forage, Degradable Intake Protein, Methods

**255 Influence of potato-processing waste in beef finishing diets on intake, ruminal fermentation, site of digestion and microbial efficiency.** A. E. Radunz\*, M. L. Bauer, G. P. Lardy, and E. R. Loe, <sup>1</sup>*North Dakota State University, Fargo.*

Four ruminally and duodenally cannulated Holstein steers (487 26.6 kg initial BW) were used in a 4 x 4 Latin square to evaluate inclusion level of potato-processing waste (PW) in finishing diets on intake, ruminal fermentation, site of digestion, and microbial efficiency. The control diet contained 82(CSB), and 3the diet at 0, 13, 27, and 4013tylosin/kg. Steers were offered diets ad libitum and adapted to diets for 9 d. Intakes were measured on d 10 to 14. Starting on d 9, Cr (8 g) was dosed ruminally every 12 h. Duodenal (200g) and fecal (200g) samples were taken every 4 h on d 11 and 12 and composited within period and steer. On d 13, Co-EDTA (200 mL) was dosed intraruminally 2 h prior to feeding and ruminal fluid was collected and pH recorded at 0, 2, 4, 6, 8, 10, and 12 h post-feeding. Linear, quadratic, and cubic contrasts were used to compare levels of PW. Dry matter intake ( $\bar{i}$  0.01) with increasing PW. Liquid dilution rate tended to increase from 6.8 to 9.7 increased (linear,  $P \bar{i}$  0.05) and NH<sub>3</sub>-N increased (quadratic and cubic,  $P \bar{i}$  0.04) with increasing PW. No effect on OM disappearance ( $P \bar{i}$  0.15) was observed among treatments. Inclusion of PW decreased true ruminal and apparent total tract N disappearance (linear,  $P \bar{i}$  0.01). Bacterial CP synthesis was not different among diets ( $P \bar{i}$  0.6). Starch intake and ruminal starch disappearance decreased with increasing PW (linear and quadratic,  $P \bar{i}$  0.05). Apparent total tract starch digestibility was not different with increasing PW ( $P \bar{i}$  0.4). Inclusion of PW did not effect OM and starch digestibility; however, PW appears to have a lower protein digestibility than corn.

**Key Words:** Potato-Processing Waste, Cattle, Digestion

**256 Effects of harvest date and late-summer nitrogen fertilization rate on mineral concentrations of stockpiled bermudagrass forage.** D.L. Lalman\*<sup>1</sup>, A.A. Gelvin<sup>1</sup>, C.M. Taliaferro<sup>1</sup>, and J. Ball<sup>2</sup>, <sup>1</sup>Oklahoma Agriculture Experiment Station, Stillwater, <sup>2</sup>Noble Foundation, Ardmore, Oklahoma.

A randomized complete block design with 4 replications was used to test the effects of harvest date and N fertilization rate on mineral concentration of stockpiled Greenfield bermudagrass at the Eastern Research Station near Haskell, Oklahoma. Four N fertilization rates were applied on August 25, 1998 (0, 33.7, 67.3, and 134.6 kg N/ha) and forage was sampled at five 28-d intervals beginning November 5 and ending March 4. During late April, prior to the experiment, 112 kg N/ha was applied and P & K was applied as indicated by soil test. Hay was harvested from the plots during early June and again during early August. Mineral concentration was determined using an inductively coupled plasma radial spectrometer, with the exception of S, which was determined using the combustion method (Leco Model SC-432). The effects of harvest date and N fertilization rate on direction (increase or decrease) of change in forage mineral concentrations were determined using linear regression. Mean macro mineral concentration (% of DM) was 0.41, 0.19, 0.09, 0.40, and 0.03 for Ca, P, Mg, K and Na, respectively. Mean micro mineral concentration (ppm, DM basis) was 194, 24.9, 4.12, 107, 0.58 and 0.27 for Fe, Zn, Cu, Mn, Mo and S, respectively. Concentration of Na and S increased ( $P < .01$ ) with increasing N fertilization, while concentrations of Ca, Fe, Zn, Mn, and Mo declined ( $P < .02$ ). Concentrations of P and Cu were not affected ( $P > .2$ ) by N fertilization rate. There was an N fertilization rate \* harvest date interaction ( $P < .01$ ) for Mg and K. This interaction was the result of a greater increase in forage Mg and K concentration with higher rates of N fertilization during autumn compared to late winter. Forage copper concentration did not change significantly over time ( $P = .18$ ), while Zn concentration increased slightly ( $P < .01$ ) as the winter progressed. Later harvest dates were associated with decreased ( $P < .05$ ) concentrations of all other minerals. Several key macro and micro minerals are marginal to deficient in stockpiled bermudagrass forage, compared to recommended dietary mineral concentrations for beef cattle. Moreover, concentrations of most minerals decrease throughout the winter.

**Key Words:** Stockpiled Bermudagrass, Minerals, Nitrogen Fertilization

**257 Nitrogen timing and rate effects on yield and quality of drought-stressed stockpiled fescue.** J. A. Jennings\*, W. K. Coblenz, and L. J. Sandage, *University of Arkansas Cooperative Extension Service.*

Stockpiled fescue is commonly used to reduce winter hay feeding in Arkansas. Little information exists on the optimum rate or date of nitrogen application or on quality of stockpiled fescue after a severe summer drought. The objective was to evaluate three nitrogen rates applied on each of three dates for yield and quality of stockpiled fescue following a summer drought. In 1998, plots were established in fescue fields at two locations in north Arkansas. Nitrogen fertilizer was applied at 0, 45, 67, and 90 kg/ha on August 20, September 4, and September 21. Plots were harvested on December 15. Forage samples were collected monthly between October and February from the 0 nitrogen and 67 kg/ha nitrogen treatments for the September 4 application date. Forage samples were analyzed for crude protein, ADF, TDN, and nitrate. Nitrogen rate or application date did not significantly affect dry matter yield ( $P > 0.10$ ). Crude protein ( $P < 0.06$ ) and TDN ( $P < 0.07$ ) were higher for the 67 kg/ha nitrogen rate than for the 0 nitrogen rate. Forage quality declined between the October and February sampling dates. Percent crude protein was highest in October at 21.6% and was lowest in January at 16.1% ( $P < 0.001$ ). Percent TDN declined significantly from 69.6% in October to 63.1% in January ( $P < 0.001$ ). Results indicate that drought-stressed fescue is responsive to fall-applied nitrogen for forage quality, but not for yield.

**Key Words:** Fescue, Stockpiled Fescue, Forage Quality

**258 Effects of nitrogen fertilization rate and harvest date on bermudagrass quality and in situ DM and fiber degradation.** N. W. Galdamez\*<sup>1</sup>, K. P. Coffey<sup>1</sup>, W. K. Coblenz<sup>1</sup>, J. E. Turner<sup>1</sup>, D. A. Scarbrough<sup>1</sup>, J. B. Humphry<sup>1</sup>, J. L. Gunzaulis<sup>2</sup>, and M. B. Daniels<sup>2</sup>, <sup>1</sup>University of Arkansas, Fayetteville, AR, <sup>2</sup>Cooperative Extension Service.

Nutrient composition and digestibility of bermudagrass [*Cynodon dactylon* (L) Pers.] may vary depending on different management practices such as fertilization and harvest date. Bermudagrass was fertilized at four rates (0, 56, 112, and 168 kg N/ha) approximately 31 d prior to first and third harvests on May 30 and August 18, 2000 to determine in situ DM and NDF degradation. Five crossbred ruminally cannulated steers (421.5 ± 21.0 kg BW) were used to evaluate these forages in situ in a randomized complete block design with a 2 × 4 (harvest × N fertilization rate) factorial arrangement. Forage N concentration increased with increasing N rate in May ( $y = 0.0027x + 2.69$ ;  $P = 0.018$ ;  $R^2 = 0.97$ ) and August ( $y = 0.0038x + 1.82$ ;  $P = 0.016$ ;  $R^2 = 0.97$ ), but fiber concentrations did not differ ( $P > 0.05$ ) across fertilization rates. Nitrogen concentrations were higher and NDF concentrations were lower ( $P < 0.01$ ) on May 30 compared with August 18. The N fertilization by harvest date interaction was evident for the immediately soluble fraction of DM ( $P = 0.01$ ) and NDF ( $P = 0.06$ ). The DM degradation rate tended to increase ( $y = 0.00003x + 0.032$ ;  $P = 0.07$ ;  $R^2 = 0.08$ ) and effective DM degradability increased with N fertilization rate ( $y = 0.018x + 49.97$ ;  $P < 0.01$ ;  $R^2 = 0.20$ ). Likewise, rate of NDF degradation increased ( $y = 0.00004x + 0.028$ ;  $P = 0.02$ ;  $R^2 = 0.13$ ) and effective NDF degradability tended to increase ( $y = 0.010x + 37.69$ ;  $P = 0.09$ ;  $R^2 = 0.08$ ) with increasing N fertilization rate. The undegradable DM fraction was higher and the potential extent of digestion and effective degradability were lower ( $P < 0.01$ ) on August 18 compared with May 30. Therefore, N fertilization improves quality of bermudagrass marginally by increasing N concentration in the plant as well as improving the degradation rate and effective ruminal degradability of DM and NDF.

**Key Words:** Bermudagrass, In Situ, Degradation Kinetics

**259 Relative Forage Quality: an alternative to Relative Feed Value.** J. E. Moore\*<sup>1</sup> and D. J. Undersander<sup>2</sup>, <sup>1</sup>University of Florida, Gainesville, FL, <sup>2</sup>University of Wisconsin, Madison, WI.

Forage quality indices estimate voluntary intake of available energy when forage is fed alone. Relative Feed Value (RFV), used widely in the U.S., is voluntary forage DM intake (VFI, % BW) times digestible dry matter (DDM, % DM) divided by a factor (1.29) so that RFV of full bloom alfalfa = 100. Accuracy of predicted RFV values is dependent on the equations used to predict VFI and DDM from NDF and ADF analyses, respectively. The intake equation used in RFV assumes that NDF intake is a constant 1.2% BW. For grasses, however, NDF intake is not constant and NDF is not correlated closely with DMI. Also, differences between observed and predicted DDM values are often large. Therefore, new approaches for predicting VFI and available energy of forages must be considered, but it is not possible to separate RFV from the equations used to predict it. We propose Relative Forage Quality (RFQ) as an alternative to RFV in order to facilitate improvements in the accuracy of predicting forage quality. The available energy component of RFQ is TDN, rather than DDM, thus  $RFQ = (VFI, \% BW) * (TDN, \% DM) / 1.22$ . The divisor, 1.22, was developed and evaluated using two independent animal data sets. In both sets, observed RFV and RFQ were correlated ( $r = .99$ ), and the means and ranges of RFV and RFQ were similar. Predicted RFQ and RFV values for individual samples may vary greatly, however, because RFQ will use more accurate prediction equations for VFI and TDN. Potential uses of RFQ include current uses of RFV. Advantages of RFQ are: multiplying RFQ by .0122 gives an estimate of TDN intake (% BW); TDN may be converted to NE; VFI can be calculated by dividing TDN intake by TDN; and both VFI and TDN can be used as inputs for nutritional models. New equations must be used to predict VFI and TDN, and these equations should be specific for particular classes of forages. A new VFI prediction equation for grasses is:  $VFI (\% BW) = -2.318 + .442*CP - .0100*CP^2 - .0638*TDN + .000922*TDN^2 + .180*ADF - .00196*ADF^2 - .00529*CP*ADF$  (Moore and Kunkle. 1999. *J. Anim. Sci.* 77[Suppl. 1]:204). For TDN, a summative equation is recommended (e.g., NRC. 2001. *Nutrient Requirements of Dairy Cattle*).

**Key Words:** Forage, Quality, Prediction

**260 Effect of grazing corn stalks in the spring on subsequent crop yields.** C. B. Wilson\*, G. E. Erickson, T. J. Klopfenstein, and W. Luedtke, *University of Nebraska, Lincoln, NE.*

Stalk grazing is often discontinued when soils thaw because of concern about soil compaction and subsequent crop yields. However, many producers want to maintain cattle on stalk fields to reduce costs. This study was initiated to evaluate the impact of spring corn residue grazing on subsequent crop yields in a corn-soybean rotation. Tillage treatments consisting of ridge-till, fall-till, spring-till, and no-till were also evaluated. Two consecutive two year studies were conducted within two 18 ha fields near Ithaca, NE. Grazed and ungrazed treatments were superimposed on some tillage treatments and replicated within field. Crop yields were evaluated for soybeans the subsequent fall and corn two years post grazing. In the first study (Exp1) stocking rate was 0.32 ha/hd/60 d. In the second study (Exp2) stocking rate was 0.13 ha/hd/60 d. Grazing was conducted from early February to late April; 48 d in 1998, and 56 d in 1999; 75 d in 2000 and 68 d in 2001. Soybean yields from Exp1 showed a trend for treatment effects ( $P = 0.14$ ) and no year x treatment interactions. Soybean yield on grazed treatments were actually higher than ungrazed treatments (3081.2 versus 3048.2 kg/ha;  $P = 0.02$ ). Corn yields following soybeans in Exp1 showed no effects of treatment or year x treatment interactions. Soybean yields from Exp2 were influenced by treatment ( $P = 0.02$ ) but not year x treatment interactions. Soybean yield on grazed treatments were higher than ungrazed treatments (4401.5 versus 4280.3 kg/ha;  $P = 0.01$ ). Corn yields following soybeans showed no effect of treatment or year x treatment interactions. Spring and fall tillage had no significant effect on yield in either experiment. In summary, spring corn residue grazing appears to have no detrimental impacts on subsequent soybean yields or corn yield the following season. Soybean yields were surprisingly higher in grazed no-till and ridge-till treatments than other treatments suggesting that producers can maintain livestock on crop acres in the spring if soybeans are planted the subsequent growing season.

**Key Words:** Grazing, Crop Residue, Crop Yield

**261 Comparison of Dry and Liquid Protein Supplements Fed to Stocker Cattle consuming Low-Quality Native Grass: performance and digestibility.** J. S. Weyers\*<sup>1</sup>, H. T. Purvis II<sup>1</sup>, C. R. Krehbiel<sup>1</sup>, D. L. Lalman<sup>1</sup>, D. A. Cox<sup>1</sup>, J. E. Moore<sup>2</sup>, and J. Harris<sup>3</sup>, <sup>1</sup>Oklahoma State University, Stillwater OK, <sup>2</sup>University of Florida, Gainesville FL, <sup>3</sup>Westway Ag, Tomball TX.

Two studies were conducted to determine the effect of differing amounts of degradable intake protein (DIP) from liquid or dry supplements on performance and digestibility by stocker cattle consuming low-quality forage. During trial 1, ruminally dosed supplements were a urea-based liquid feed formulated to provide .33 kg/d of DIP (LIQ1), a urea/feathermeal-based liquid feed formulated to provide .20 kg/d of DIP (LIQ2), or a cottonseed meal/soybean meal blend to provide .20 kg/d of DIP (DRY). Supplemented cattle had greater ( $P < .05$ ) total OM intake, total digestible OM intake, hay OM intake and fecal OM output than cattle not supplemented. Furthermore, cattle supplemented with LIQ2 had greater ( $P < .05$ ) total OM intake (4.16 kg), total digestible OM intake (2.34 kg), hay OM intake (3.53 kg) and fecal OM output (1.82 kg) than cattle supplemented with LIQ1 (3.42, 1.94, 2.79, 1.48 kg, respectively). Treatments did not affect total OM digestibility. During trial 2, supplement type and amounts were the same as trial 1. Cattle were fed 5 d/wk in individual stalls for one and no longer than four hours. Across the supplemental feeding period, average intake was only 39 and 79% of feed offered for LIQ1 and LIQ2, respectively, while no intake reductions were apparent with DRY. There were no differences ( $P > .10$ ) in initial and final body weights between treatments. Total gain and ADG were greater ( $P < .05$ ) for supplemented steers than for steers not supplemented, and steers receiving DRY had greater ( $P < .05$ ) total gains (12.77 kg) and ADG (.23 kg) than steers receiving liquid supplements (1.54 and .03, 3.02 and .05 kg for LIQ1 and LIQ2, respectively). There was no difference ( $P > .05$ ) between LIQ1 and LIQ2 for total gain or ADG. Limited intake of LIQ1 and LIQ2 during trial 2, could explain the decrease in performance compared with DRY. Relative to trial 1, these data suggest that sufficient intake of DIP from liquid supplements can increase low quality forage OM intakes. Also, different amounts and/or types of protein may influence digestion and performance.

**Key Words:** Degradable Intake Protein, Liquid Supplements, Low-Quality Forage

**262 Effect of the frequency of cracked corn supplementation on alfalfa hay utilization by growing cattle.** A.F. La Manna<sup>1</sup>, H.P. Purvis II\*<sup>1</sup>, T.N. Bodine<sup>1</sup>, G.W. Horn<sup>1</sup>, and F.N. Owens<sup>2</sup>, <sup>1</sup>Oklahoma State University, <sup>2</sup>Dupont Specialty Grains.

Two trials were conducted to study the effect of frequency of cracked corn supplementation on utilization of alfalfa hay. In Trial 1, eight ruminally cannulated crossbred steers (484kg) in a replicated 4 x 4 Latin square were given ad libitum access to chopped alfalfa hay with no supplement (CONT) or with a cracked corn supplement fed at one of three frequencies: 0.5 % of body weight (BW) every day (24); 1.0% of BW every other day (48) or 1.5% of BW every third day (72). Effects of supplemental corn grain and linear and quadratic effects of feeding frequency were tested. Total organic matter intake (OMI) was greater when corn was fed every day than when corn was fed less frequently (12.64, 13.97, 12.57 and 12.17 kg OMI/day for CONT, 24, 48 and 72 respectively) and decreased linearly ( $P < .05$ ) as time interval increased. Feeding cracked corn increased ( $P < .01$ ) organic matter digestibility (OMD) (68.89, 71.69, 73.90 and 75.31% for CONT, 24, 48 and 72 respectively). Ruminal concentration of butyrate (7.63, 8.97, 9.17 and 10.64 mmol/L for CONT, 24, 48 and 72 respectively) were greater for supplemented cattle ( $P < .01$ ) and increased linearly as time interval increased ( $P < .05$ ) but the acetate to propionate ratio of ruminal fluid decreased (4.54, 4.37, 4.24 and 4.11 for CONT, 24, 48 and 72 respectively;  $P < .05$ ). In Trial 2, 60 Holstein heifers (199kg) were stratified by weight and assigned to the same four treatments in a randomized complete block design with the exception that hay was not chopped. After 90 d on trial, feeding supplemental corn increased ADG (.48, .77, .75, .62 kg/day for CONT, 24, 48 and 72 respectively;  $P < .05$ ) and ADG decreased linearly ( $P < .05$ ) as time interval between supplement feedings increased. Fed supplemental energy will have greater ADG than unsupplemented controls. Additionally less frequency of supplement increased OMD but reduced OMI, which impacted ADG.

**Key Words:** Corn Feeding Frequency, Alfalfa Hay, Cattle

**263 Effects of weaning date and protein supplementation on cow/calf productivity.** L. A. Ciminski\*<sup>1</sup>, D. C. Adams<sup>2</sup>, T. J. Klopfenstein<sup>1</sup>, and R. T. Clark<sup>3</sup>, <sup>1</sup>University of Nebraska-Lincoln, Animal Science, <sup>2</sup>University of Nebraska-Lincoln, West Central Research and Extension Center, Animal Science, <sup>3</sup>University of Nebraska-Lincoln, West Central Research and Extension Center, Agricultural Economics.

Producers in order to manage cow/calf productivity, cow body condition score, and extend grazing through the winter can use weaning date and supplementation as tools. The objective of this study was to determine the long-term effects of weaning date and protein supplementation on cow body condition score, cow weight, calf performance, and pregnancy rate. A 4-year experiment was conducted to determine the effects of weaning date and supplementation on cow/calf productivity in the Nebraska Sandhills using 134 MARC II spring calving cows. Treatments were a 2x2 factorial design, weaning in mid-August (E) or early November (L), protein supplementation (Y) or no protein supplementation (N). Data were analyzed using the mixed procedures in SAS. Pregnancy rates for the four treatments were 96, 94, 95, and 94% for EN, EY, LN, and LY, respectively, and were not significantly different ( $P > 0.05$ ). Cow body condition scores and cow weights varied throughout the year as forage quality and cow requirements varied. At time of calving cow body condition scores were 4.8, 5.2, 4.0, and 4.7 (scale 1-9) for EN, EY, LN, and LY, respectively, and significantly different ( $P < 0.05$ ) among all treatments. Birth weight and birth date of calves were not significantly different ( $P > 0.05$ ) among the treatments. There was a significant main effect ( $P < 0.05$ ) for both weaning date and supplementation at the August weaning for the calf weights. Cows that were weaned in August or received supplement during winter grazing had calves with weights that were significantly greater ( $P < 0.05$ ) than those that were weaned in November or received no supplement. LY treatment had higher ( $P < 0.05$ ) calf weights than the LN treatment at the November weaning date. Weaning date and supplementation of cows had a significant affect on cow body condition score and weaning weights of the calves, yet no significant effect in pregnancy rate occurred.

**Key Words:** Cows, Weaning, Protein Supplementation

**264 Effect of field pea supplementation on intake, digestion, and ruminal fermentation in beef steers fed forage based diets.** J.J. Reed\*, G.P. Lardy, T.C. Gilbery, M.L. Bauer, and J.S. Caton, *North Dakota State University*.

Four ruminally and duodenally cannulated steers ( $397 \pm 55$  kg initial BW) were used in a  $4 \times 4$  Latin square to evaluate the effect of field pea supplementation on intake, site and rate of digestion, ruminal fermentation, and ruminal fill in steers fed moderate quality (8.0% CP) grass hay. Diets, offered ad libitum twice daily, consisted of grass hay and four field pea supplements (22.4% CP; 0, 0.9, 1.8, and 2.7 kg daily). Steers were allowed free access to water and trace mineralized salt blocks and were adapted to diets for 9 d. On d 10 to 14, intakes were measured. Field pea and grass hay were incubated in situ, beginning on d 10, for 0, 2, 4, 8, 12, 16, 24, 36, 48, 72, and 96 h. Ruminal fluid was collected and pH recorded at -2, 0, 2, 4, 6, 8, 10, and 12 h post-feeding on d 13. Duodenal samples were taken for three consecutive days beginning on d 10 in a manner that allowed for a collection to take place every other hour for a 24 h period. Total DMI (7.7, 9.2, 9.3,  $9.3 \pm 0.8$  kg) and OMI (6.7, 8.1, 8.2,  $8.3 \pm 0.7$  kg) increased ( $P < 0.03$ ) and grass hay DMI (7.7, 8.3, 7.5,  $6.6 \pm 0.8$  kg) and OMI (6.7, 7.2, 6.5,  $5.7 \pm 0.7$  kg) decreased ( $P < 0.04$ ) linearly with increasing level of supplementation. In situ DM disappearance of field pea (8.8, 6.5, 5.5,  $5.8 \pm 0.9$  %/h), and ruminal pH (6.84, 6.94, 6.76,  $6.79 \pm 0.02$ ) decreased ( $P < 0.05$ ) linearly with increasing field pea supplementation. Ruminal VFA increased linearly ( $P < 0.006$ ) and total tract CP and apparent ruminal DM digestion tended to increase linearly ( $P < 0.09$ ) with increasing field pea supplementation. Total tract NDF digestion tended to change ( $P = 0.08$ ) cubically with field pea supplementation. No effects were observed ( $P > 0.11$ ) for ruminal fill, fecal output, total tract DM digestibility, total tract OM digestibility, or in situ DM disappearance of grass hay. Due to effects on forage intake and ruminal pH, field peas appear to act like cereal grain supplements in high forage diets.

**Key Words:** Field Pea, Digestibility, Supplement

**265 Drought Stressed Soybean Supplementation for Gestating Beef Cows.** J.D. Steele\*, D.L. Lalman, R.P. Wettemann, and C.K. Krehbiel, *Oklahoma Agriculture Experiment Station, Stillwater*.

This study was designed to determine the effects of feeding whole or ground drought stressed soybeans (38% CP, 16% fat, U.S. No. 4) during late gestation on production of beef cows grazing dormant stockpiled native grass. Multiparous Angus and Angus x Hereford cows ( $n=91$ ) were ranked by initial body weight and sequentially assigned to supplement treatments. Treatments were: 1) 0.91 kg whole soybeans (WSB), 2) 0.91 kg ground soybeans (GSB), 3) 1.25 kg of soybean meal and soybean hulls formulated to be iso-nitrogenous and iso-caloric to WSB and GSB (PCON), and 4) no supplement (NCON). Initial BW and body condition score (BCS) was  $557 \pm 30$  kg and  $5.25 \pm 0.14$  (1-9 scale), respectively. Supplemented cows were individually fed twice their daily feeding rate on an every other day basis. The treatment period was initiated on November 11, 2000 and continued through February 2, 2001 for a total of 88 d. All BW and BCS were recorded after a 16-hour removal from feed and water. Blood samples were collected on May 2 and May 9. Cows that had  $> 1$  ng/ml plasma progesterone were considered to be cycling at the onset of breeding (May 10). Cow served as the experimental unit. Weight change during the treatment period was -26.5 kg, -7.9 kg, +10.6 kg, and -69.4 kg for WSB, GSB, PCON, NCON, respectively and differed between each treatment group ( $P < .01$ ). Compared to nonsupplemented cows, supplemented cows had less treatment period BCS loss ( $\#0.42$  vs  $\#1.6$ ;  $P < .01$ ), greater calf birth wt (39.0 vs 35.2 kg;  $P < .05$ ), and greater calf weaning wt (222.6 vs 203.3 kg  $P < .05$ ). Treatment period BCS loss, calf birth wt and weaning wt did not differ among supplemented groups ( $P > .1$ ). Percent cows cycling was 21.5, 64.8, 62.5, and 24.7 for WSB, GSB, PCON and NCON, respectively ( $P < .05$ ). Pregnancy rate was 96, 95, 84, and 82, for WSB, GSB, PCON and NCON, respectively ( $P = 0.21$ ). Drought stressed soybeans are an effective supplemental protein and energy source for gestating beef cows.

**Key Words:** Soybeans, Beef Cows, Winter Supplementation

**266 Influence of energy supplementation on intake, digestion, ruminal fermentation and microbial efficiency in nursing beef calves.** M.H. Knight\*, J.S. Caton, V. Burke, M.L. Bauer, and G.P. Lardy, *North Dakota State University, Fargo, North Dakota, USA*.

Five Angus crossbred cow-calf pairs ( $653 \pm 35$  kg;  $157 \pm 25$  kg initial BW for cows and calves, respectively) were used to evaluate the influence of supplementation to calves on intake, milk consumption, and digestion. Cow-calf pairs were stratified by calf age and assigned randomly to one of two treatments: control (no supplement) and supplemented. Supplemented calves received 0.9 kg daily of a 49% soy hulls, 44% wheat middlings, 6% molasses, and 1% limestone supplement (DM basis). All calves were given ad libitum access to chopped brome hay (9% CP). Supplementation was initiated on May 1 ( $88 \pm 10.3$  d calf age). Three sampling periods were conducted throughout the study (June 14 to 25, July 5 to 16, and August 9 to 20). Supplement and forage were offered at 0800. Calf total hay and DM intake were not altered by supplementation ( $2.1$  vs  $2.5 \pm 0.4$  kg/d;  $P = 0.56$  and  $1.7$  vs  $1.1 \pm 0.4$  kg/d;  $P = 0.42$ , respectively). Milk consumption was increased by supplementation ( $3.9$  vs  $5.8 \pm 0.04$  kg;  $P = 0.04$ ). Total tract organic matter digestion increased by supplementation ( $64.6$  vs  $72.1$  %;  $P = 0.02$ ) as did true ruminal OM digestion ( $P = 0.10$ ). Ruminal OM digestion also increased ( $P = 0.06$ ) with advancing collection periods, whereas post-ruminal ( $P = 0.001$ ) OM digestion decreased over time. Supplementation increased microbial efficiency ( $14.4$  vs  $18.3 \pm 0.5$  g;  $P = 0.01$ ). Supplemented calves had higher total VFA ( $78.9$  vs  $96.3 \pm 4.4$  mM;  $P = 0.05$ ) and ammonia ( $2.29$  vs  $5.53 \pm .59$  mM;  $P = 0.02$ ) production. Overall ruminal pH was not affected by treatment and averaged  $6.5 \pm .11$ . Data indicate supplementation of nursing calves increases OM digestion, ruminal VFA concentrations, and microbial efficiency.

**Key Words:** Nursing Calves, Supplementation, Digestion

**267 Influence of cow parity and genetic potential for milk production on forage intake of Brangus females during late gestation.** C.R. Johnson\*<sup>1</sup>, D.L. Lalman<sup>1</sup>, M.A. Brown<sup>2</sup>, and L. Appeddu<sup>2</sup>, <sup>1</sup>Oklahoma Agricultural Experiment Station, <sup>2</sup>USDA-ARS Grazinglands Research Laboratory.

Brangus females ( $n=24$ ) were used in a  $2^2$  factorial arrangement to evaluate the effects of cow parity (multiparous vs first-calf heifers; COW vs HFR) and genetic potential for milk production (MPP; HIGH vs LOW) on forage DMI. Mean sire milk EPD for COW were +9.5 and #9.7 and were +10.8 and #11.0, for HFR, HIGH and LOW groups, respectively. Average initial were 59015.1 kg for COW and 49820.9 kg HFR and average body condition was 4.7.0.1 (scale 1 to 9). Body condition score and BW were recorded prior to and at the conclusion of the collection period. Animals were housed in a barn equipped with Calan gates to allow for individual forage intake determination. Training and diet adaptation occurred simultaneously for 20 d followed by a 9 d collection period. Cows averaged 57 d and HFR averaged 42 d prepartum upon initiation of the collection period. Bermudagrass hay (4.4% CP and 74.4% NDF; DM basis) was offered at 130% of the previous 2-d average intake. Cottonseed meal was supplemented at 0.2 and 0.3% of initial body weight for cows and heifers, respectively, to ensure adequate degradable protein supply. Hay, orts, and waste were collected daily during the intake determination period. Fecal grab samples were collected at 1000 for 5 d and composited for each animal. Cows consumed 21% more forage DM than HFR ( $10.4$  vs  $8.2.4$  kg/d;  $P < .01$ ) on an absolute basis. When expressed as a percent of BW, forage DMI did not differ between COW and HFR ( $1.7.08$ % BW;  $P = .5$ ). Genetic potential for milk did not influence ( $P > .6$ ) forage intake, on an absolute or percent of BW basis. Acid detergent insoluble ash was used to estimate DM digestibility. Neither parity group nor milk production potential influenced apparent DM digestibility ( $P > .5$ ) nor fiber digestibility ( $P > .2$ ). During late gestation, Brangus cows and first-calf heifers consume similar amounts of forage DM, when forage DMI is expressed relative to body weight. Additionally, milk production potential did not influence forage DMI during late gestation.

**Key Words:** Forage Intake, Late Gestation, Parity

**268 Influence of cow parity and genetic potential for milk production on forage intake of Brangus females during early lactation.** C.R. Johnson\*<sup>1</sup>, D.L. Lalman<sup>1</sup>, M.A. Brown<sup>2</sup>, and L. Appeddu<sup>2</sup>, <sup>1</sup>Oklahoma Agricultural Experiment Station, <sup>2</sup>USDA-ARS Grazinglands Research Laboratory.

Brangus females (n=24) were used in a randomized complete block design to evaluate the effects of cow parity (multiparous vs first-calf heifers; COW vs HFR) and genetic potential for milk production (MPP; HIGH vs LOW) on forage DMI. Females were selected for MPP based on their sire's EPD for milk. Initial weights were 553 and 44610 kg for COW and HFR. Females were assigned to two periods by postpartum interval, each period averaging 60 d postpartum. Effects in the model included parity group and MPP, and period was considered a random effect. All females were placed in a drylot for a 7-d adaptation to the diet, followed by a 7-d adaptation in the barn and a 9-d collection period. Body condition score and BW were determined at the beginning and end of the collection period. Average BW for the feeding period was determined and used to express forage DMI. Cow-calf pairs were penned individually and bermudagrass hay (5.3% CP and 76.4% NDF; DM basis) was offered ad libitum (130% of previous 2-d average intake). Cottonseed meal was fed at the rate of .4 and .5% of BW for COW and HFR, to ensure adequate protein supply. Hay, orts, and waste were weighed every 2 d. Fecal grab samples were collected at 1000 for 5 d. Milk production was determined on d 7 using a portable milking machine, following a 12-h separation from calves. Acid detergent insoluble ash was used to estimate DM digestibility (DMD). A trend (P=.09) was observed for HIGH to produce 18% more milk than LOW (9.6 vs 7.9.7 kg;). Cows produced 39% more milk than HFR (P<.001). On an absolute basis, COW consumed 16% more forage DM than HFR (P<.001) and HIGH consumed 8% more forage DM (P<.01) than LOW. When forage DMI was expressed as a percent of body weight, parity did not influence forage DMI (2.5.05% BW; P=.2). Yet, HIGH females consumed more forage than LOW (2.6 vs 2.4.05% BW; P=.02). Cows had higher apparent DMD than HFR (51.8 vs 491%; P=.05). When forage DMI is expressed relative to body weight, multiparous cows and first-calf heifers have similar intakes. Females selected for high MPP consumed more forage DM during early lactation than females selected for low MPP.

**Key Words:** Forage Intake, Beef Cows, Lactation

**269 Influence of cow parity and genetic potential for milk production on forage intake of Brangus females during late lactation.** C.R. Johnson\*<sup>1</sup>, D.L. Lalman<sup>1</sup>, M.A. Brown<sup>2</sup>, and L. Appeddu<sup>2</sup>, <sup>1</sup>Oklahoma Agricultural Experiment Station, <sup>2</sup>USDA-ARS Grazinglands Research Laboratory.

Brangus females (n=24) were used in a randomized block design to evaluate the effects of cow parity (multiparous vs first-calf heifers; COW vs HFR) and genetic potential for milk production (MPP; HIGH vs LOW) on forage DMI. Females were selected for MPP based on their sire's EPD for milk. Initial weights were 550 and 46112 kg for COW and HFR. Females were allotted to two periods by postpartum interval, each period averaging 166 d postpartum. Effects in the model included parity group and MPP, and period was considered a random effect. All females were placed in a drylot for a 7-d adaptation to the diet, followed by a 7-d adaptation in the barn and a 9-d intake collection period. Cow-calf pairs were individually penned and bermudagrass hay (5.7% CP and 76.6% NDF; DM basis) was offered ad libitum (130% of previous 2-d average intake). Cottonseed meal was offered .4 (COW) and .45% (HFR) of BW to ensure adequate protein supply. Females were offered hay during 4-h feeding bouts at 0730 and 1800. During feeding, calves were separated and offered ad libitum creep feed and hay. Between feedings, all cows and calves had access to water and trace-mineralized salt. Hay, orts, and waste were collected for each feeding. Fecal samples were collected for 5 d. Milk production was determined on d 7 using a portable milking machine, following a 12-h separation from calves. Acid detergent insoluble ash was used to estimate DM digestibility (DMD). Selection for MPP did not influence milk production (6.7.8kg/d; P>.2) during late lactation. A parity group by MPP interaction was observed for forage DM intake per day (P=.05). Heifers with low MPP consumed 18% less forage DM compared to the mean of LOW and HIGH COW and HIGH HFR. When forage intake was expressed as a percent of body weight, neither parity nor MPP influenced intake (2.2.07% BW; P>.3). A parity group by MPP interaction was observed for DMD (P<.05). The LOW HFR group had 10% lower apparent DMD compared with the average of all others. During late lactation, neither parity group nor selection

of females for divergent MPP influenced forage DMI, expressed as a percentage of BW.

**Key Words:** Forage Intake, Lactation, Beef Cows

**270 Corn silage use in beef cattle growing and finishing diets: hybrid selection and economics.** S.R. Rust\*, J.R. Black, and D.D. Buskirk, *Michigan State University.*

Corn silage is a common feed resource for livestock operations in North America. The changing size and structure of beef cattle production units has influenced the usage of this feed resource. Although, use of corn silage has declined due to changes in bunk management and feed inventory control, it remains a significant component of many cattle growing and finishing diets. The pertinent question of cattle producers continues to be what level of corn silage is most profitable. This question is further complicated by the number of corn hybrids available and the diversity of the nutritional traits they possess. Emerging corn silage varieties, including brown midrib and high oil have the potential to impact both hybrid selection and optimum feeding levels. The economics of corn silage hybrid selection is driven by consideration of; 1) relative economic value per kg dry matter, including substitution and performance differences, 2) relative dry matter yield per area, including production and harvesting cost differentials; and 3) harvest scheduling and flexibility. Challenger-defender models may be used to determine both optimal feeding levels and hybrid selection.

**Key Words:** Corn Silage, Hybrid, Economics

**271 Estimating silage energy content and milk yield to rank corn hybrids.** R. D. Shaver\*, J. G. Lauer, E. C. Schwab, and J. G. Coors, *University of Wisconsin, Madison.*

We developed a model for estimating the energy value of corn silage and milk yield by dairy cows. The milk yield estimate was evaluated for its potential for ranking corn hybrids. The revised milk Mg-1 and milk ha-1 indices (MILK2000) were evaluated relative to MILK1995 in corn silage hybrid performance trials. A previously published summative energy equation, with crude protein, fat, non-fiber carbohydrate (NFC), and neutral detergent fiber (NDF) fractions and corresponding digestibility coefficients, was adapted for corn silage as follows: the crude protein and fat fractions were not altered, the NFC fraction with constant digestibility was replaced with starch and non-starch NFC fractions, the starch digestibility coefficient was varied in relationship to whole-plant dry matter (DM) content and kernel processing, and the NDF digestibility coefficient based on lignin content was replaced by a 48-hour or maintenance intake in vitro measurement of NDF digestion. For the MILK2000 model, we used this net energy for lactation estimate along with DM intake estimated from NDF content and in vitro measurement of NDF digestion to estimate milk Mg-1of corn silage DM. Corn hybrids with high and low milk Mg-1 were identified and selected on the basis of above average forage yield and either low or high NDF. These high and low NDF hybrids were then included in 61 trials conducted between 1995 and 2000. The frequency with which low NDF hybrids had equivalent or greater milk Mg-1 than high NDF hybrids was 90 to 93%. Maturity at harvest and NDF digestibility both strongly influence the relative hybrid rankings with MILK2000 versus MILK1995. MILK2000 has been found to rank corn hybrids consistently in hybrid performance trials. With advancing maturity, kernel vitreousness (ratio of vitreous to floury endosperm) increases and ruminal starch degradation decreases linearly. Kernel vitreousness is higher and ruminal starch degradation is lower for flint than dent hybrids. Differences in kernel vitreousness may explain differences in starch digestibility for corn hybrids harvested as silage. We hypothesize that future evaluation of corn hybrids for starch and endosperm characteristics and starch degradation may improve the utilization of corn silage by dairy cattle.

**Key Words:** Corn Silage, Dairy Cattle, Digestion

**272 Lactation performance by dairy cows fed wet brewers grains (WBG) or whole linted cottonseed (WCS) to replace forage.** J. L. Firkins\*, D. I. Harvatine, J. T. Sylvester, and M. L. Eastridge, *Ohio State University, Columbus.*

Sixty Holstein cows were used to evaluate lactation performance when WBG, WCS, or Easiflo WCS (E; 2.5% corn starch to mat linters) were substituted for forage. WBG were added to decrease forage NDF

(FNDF) from 21.1% for the control down to 19.1, 17.0, and 15.0%. The WCS and E diets both had 15% FNDF. Soybean hulls and corn were balanced to decrease nonfiber carbohydrates (NFC) with decreasing FNDF, with feed analyses averaging 41.3, 38.8, 35.1, 33.8, 33.1, and 36.0%, respectively. Cows were fed the control TMR during wk 8 and 9 of lactation. Then, biweekly BST injection commenced, and they were blocked to either remain on the control or be switched to one of the five other TMR diets from wk 10 to 25 of lactation. Cows were milked twice daily, and four consecutive milkings per week were sampled for fat and crude protein analyses. Feed samples were collected weekly and composited per month prior to standard nutrient analyses (DM, OM, CP, NDF, fatty acids, lignin, and CP contamination of NDF and ADF). Data were analyzed using repeated measures (Proc Mixed; cow was a random effect) for a randomized complete block design, and single df contrasts were performed. No treatment x time interactions ( $P > 0.10$ ) were detected. No differences ( $P > 0.10$ ) in any production measurement was determined except for a lower ( $P < 0.01$ ) concentration of milk fat for E vs WCS. The weighted mean of nutrient analyses plus the average performance data and body condition score for the treatment period were entered into the NRC (2001) software for each cow. The NRC accounted for an average of 99% of the  $NE_L$  intake as energy output; intake of discounted  $NE_L$  averaged 3.8% of maintenance. No treatment differences were detected ( $P > 0.10$ ). However, when analyzed for individual cows, the energy model resulted in nonrandom errors for prediction of BW change. Results are interpreted to support the NRC model for energy usage by groups of cattle and its guidelines for FNDF and NFC. The E cottonseed was interpreted to be nearly as effective as WCS.

**Key Words:** Wet Brewers Grains, Whole Linted Cottonseed, Dairy Cows

**273 Effect of alfalfa silage, corn silage and levels of crude protein on ruminal pH and ammonia concentration over a 24 hour period in lactating dairy cows.** K.L. Karg\*, L. Perdereau, and M.A. Wattiaux, *University of Wisconsin-Madison*.

Twelve multiparous ruminally cannulated Holstein cows were used to evaluate the effect of forage source (alfalfa silage (AS) or corn silage (CS)) and CP level (16.5% (LP) or 17.9% (HP)) on ruminal pH and ammonia concentration. Cows were blocked by calving date and assigned to dietary treatments arranged in a 2 x 2 factorial. Diets were 55% forage (DM basis; 14% CS and 41% AS or 14% AS and 41% CS). Diets provided RDP balance of -6 g/d (LP diets) or +132 g/d (HP diets) according to NRC 2001. Cows were fed a TMR ad libitum once a day at 8:00 am. At 60±3 DIM ruminal fluid was collected for pH and ammonia concentration measurements every two h for a 24 h period. Data were analyzed with the PROC MIXED procedure of SAS and differences between forage sources and protein levels were tested with orthogonal contrasts. There were no statistical differences in ruminal pH among dietary treatments, however changes over time were significant. The 24 h pH fluctuation was greater on CS diets compared to AS diets. From approximately 4 to 14 h after feeding, pH levels tended to be lower for CS than AS diets. From 16 h until 4 h after feeding, the converse was true and the differences widened to become significant two h after feeding (CS=6.98 vs. AS=6.54;  $P < .05$ ). Peak pH levels for AS (6.71) and CS (6.99) occurred at feeding and tended to be different ( $P = .07$ ); nadir occurred at 12 h after feeding AS (6.14) and CS (5.95) and were not statistically different. There were no statistical differences in ruminal ammonia concentration among dietary treatments, however changes over time were significant. From 4 to 8 h after feeding, ruminal ammonia concentrations were higher ( $P < .05$ ) on HP diets than LP diets. Ammonia concentration peaked higher (22.96 mg/dl) and later (6 h) after feeding and tended to remain higher for the HP diets compared to LP diets which peaked 2 hours after feeding at 17.25 mg/dl. Ruminal environment was more stable on the LP AS based diet, while the HP CS based diet exhibited larger fluctuations in pH and ruminal ammonia concentration.

**Key Words:** Forage, Diurnal Variation, Rumen

**274 Evaluation of graded levels of fish oil and extruded soybeans in diets of lactating dairy cows.** L. A. Whitlock\*, D. J. Schingoethe, A. R. Hippen, K. F. Kalscheur, and A. A. Abu-Ghazaleh, *South Dakota State University, Brookings*.

Inclusion of fish oil into the diets of lactating dairy cows has been shown to be one of the most effective ways of increasing the concentration of transvaccenic acid (TVA) and cis-9,trans-11 conjugated linoleic acid

(CLA) in the milk of dairy cows. The objective of this study was to determine the minimum level of dietary fish oil necessary to increase milk TVA and CLA concentrations. Eight multiparous Holstein (189 DIM) and four multiparous Brown Swiss (126 DIM) cows were assigned randomly to four treatments in a replicated 4 x 4 Latin square with 4 wk periods. The four treatments consisted of: 1) control; 2) control diet with 0.33% (DM basis) added fat from menhaden fish oil, and 1.67% added fat from extruded soybeans; 3) control diet with 0.67% added fat from fish oil and 1.33% added fat from extruded soybeans; and 4) control diet with 1% added fat from fish oil and 1% added fat from extruded soybeans. Milk production (21.9, 23.4, 22.9, and 23.9 for cows fed diets 1 to 4, respectively) was greater ( $P < 0.01$ ) for cows that received supplemental fats compared with control, but was not different ( $P > 0.10$ ) among cows fed supplemental fat. Milk fat (4.42, 3.81, 3.80, and 4.03%) and protein (3.71, 3.58, 3.54, and 3.55%) concentrations were greater ( $P < 0.01$ ) for cows fed the control diet. Milk fat ( $P = 0.07$ ) and protein ( $P = 0.49$ ) concentrations did not differ among cows receiving supplemental fat. Milk from cows fed the three diets containing supplemental fat contained greater ( $P < 0.01$ ) concentrations of TVA (1.12, 2.47, 2.13, and 2.63 g/100g FA) and CLA (0.55, 1.17, 1.02, and 1.19 g/100g FA) than did milk from cows fed the control diet. Concentrations of TVA ( $P = 0.42$ ) and CLA ( $P = 0.79$ ) were similar for cows fed the diets 2 and 4. These data showed that optimal TVA and CLA concentrations were achieved at the lowest level of fish oil inclusion.

**Key Words:** Conjugated Linoleic Acid, Trans Fatty Acid, Fish Oil

**275 Chronic glucagon administration and lipoprotein composition in periparturient dairy cows.** B. N. Ametaj\*, G. Bobe, J. W. Young, and D. C. Beitz, *Iowa State University, Ames, IA*.

The objective of this research was to study the effects of subcutaneous injections of glucagon on composition of plasma lipoproteins in postpartum dairy cows. One group of cows ( $n=8$ ) served as control, the second group ( $n=8$ ) was injected with 60 ml of saline, whereas two other groups ( $n=8$ ) were injected subcutaneously with 2.5 and 5 mg of glucagon (3xd), respectively, for 2 wk starting at 8 d after parturition. Blood was obtained from jugular vein at 4 d before parturition as well as on days 3, 8, 12, 14, 22, 27, 36, and 43 after parturition. Plasma VLDL, LDL, HDL and very high-density lipoprotein (VHDL) fractions were separated by ultracentrifugal flotation and the amounts of triacylglycerols (TG), total cholesterol (TC), and phospholipids (PL) associated with each fraction were determined. Concentrations of TG in VLDL and LDL fractions were at 45 and 65 mg/dl before parturition, declined at 12 and 30 mg/dl immediately after parturition and remained at these levels during 6 wk postpartum. Total cholesterol was low in LDL, HDL, and VHDL (15, 45, and 5 mg/dl, respectively) before calving and reached zenith at 6 wk after calving (40, 77, and 10 mg/dl, respectively). Concentrations of PL in HDL and VHDL fractions increased from precalving values of 50 and 4 mg/dl to 75 and 8.5 mg/dl, respectively, at 6 wk after parturition. Treatment with 7.5 and 15 mg of glucagon/d for 2 wk had no effect on concentrations of TG, TC, and PL in lipoprotein fractions of periparturient dairy cows.

**Key Words:** Glucagon, Lipoproteins, Dairy Cows

**276 Effect of protein level in prepartum diets on metabolism and performance of dairy cows.** A.F. Park\*, J.E. Shirley, E.C. Titgemeyer, R.C. Cochran, T.A. Wickersham, J.M. DeFrain, E.E. Ferdinand, A.K. Hammond, and D.G. Schmidt, *Kansas State University*.

Fifteen ruminally fistulated, crossbred steers (BW=190 ± 13 kg) were utilized in a randomized block design to validate the use of selected markers for estimating digestibility of typical dairy cattle diets. Steers were blocked by initial body weight and assigned to one of four dairy diets: late lactation (1.73 Mcal/kg  $NE_L$ , 18.7% CP), far-off (1.46 Mcal/kg  $NE_L$ , 11.5% CP), close-up (1.56 Mcal/kg  $NE_L$ , 15.6% CP), and an early lactation (1.70 Mcal/kg  $NE_L$ , 18.4% CP) diet. Dry matter intake was set at 2% of BW. Trial length was 21 d consisting of a 14-d adaptation period followed by a 7-d total fecal collection. Digestibility markers evaluated were indigestible acid detergent fiber (IADF), acid detergent insoluble ash (ADIA), and titanium dioxide ( $TiO_2$ ). Samples of feed, orts, and feces were analyzed for IADF (144 hr incubation in ruminal fluid followed by ADF determination conducted using standard procedures or with ANKOM adaptations), ADIA (ADF determined in

berzelius beakers or ANKOM apparatus followed by ashing for 8 hrs. at 450° C), and TiO<sub>2</sub> (determined calorimetrically; 5 g fed daily via canula). For both approaches, IADF was measured without acid/pepsin, with acid/pepsin before incubation, or with acid/pepsin after incubation. The ANKOM techniques for IADF without acid/pepsin and with acid/pepsin before incubation yielded fecal recoveries that were less ( $P < 0.01$ ) than 100% for all diets. The standard technique for IADF without acid/pepsin yielded fecal recoveries that were not different from 100% for the far-off, close-up, and early lactation diets. Fecal recoveries of ADIA were variable among diets. Fecal recoveries of TiO<sub>2</sub> were greater ( $P < 0.01$ ) than 100% for late lactation, far-off, and early lactation diets. In conclusion, IADF assessed via standard procedures without inclusion of an acid/pepsin incubation step appeared to yield relatively quantitative marker recovery for a range of typical dairy cattle diets.

**Key Words:** Digestibility, Internal Marker, Dairy

**277 Amplification of 18S rDNA sequences from protozoal-enriched rumen samples to study ruminal protozoal ecology.** S. K. R. Karnati\*, J. T. Sylvester, Z. Yu, B. A. Dehority, and J. L. Firkins, *The Ohio State University*.

Our current understanding of the role of rumen ciliate protozoa has suffered because of the difficulty associated with their cultivation and the expense and difficulties of manipulating protozoal populations in vivo. A PCR-cloning-sequencing approach was used to evaluate a protozoal-specific primer used with a eukaryotic-specific reverse primer to amplify the 18S rDNA from genomic DNA extracted from samples of protozoa from rumen fluid collected from two cows fed either a 50:50 forage:grain diet or all alfalfa hay. After incubation for 1 h at 39°C, sedimented protozoa were extracted and washed. An aliquot was fixed in 50% formalin and used for the counting and generic distribution of protozoa compared with the original ruminal sample. DNA was extracted using the CTAB method and a 1360-bp fragment of the 18S rRNA gene was amplified using PCR. One SSU rDNA clone library was constructed for each sample, and clones were randomly chosen and sequenced. All the DNA sequences (23 total) were 93-99% identical to sequences from rumen ciliates already deposited in databases, indicating that the primer is highly specific. Comparison of counts from the enriched samples vs original ruminal samples showed that there was a selective enrichment for *Dasytricha* and *Isotricha* at the expense of *Entodinium* from the alfalfa-fed cow. The use of a combination of filters to concentrate protozoa rather than through sedimentation has reduced sampling bias in preliminary experiments. For the cow fed only alfalfa hay, the protozoa-specific forward primer biased completely against *Entodinium* spp. due to a single base mismatch in the primer used. Use of a degenerate primer (original combined with a modified primer corrected for the base mismatch) is being evaluated to reduce this apparent PCR bias.

**Key Words:** Rumen Protozoal Ecology, 18S rDNA Analysis

**278 Effect of feeding time and sprinkling on performance and body temperature of steers.** M.S. Davis\* and T.L. Mader, *University of Nebraska*.

This study was conducted to examine possible strategies to reduce heat stress of feedlot cattle fed and finished in July and August. One hundred, ninety-two *Bos taurus* steers ( $BW = 424 \pm 26$  kg) were used to evaluate feeding time (0800 [AM] vs 1400 [PM]) and sprinkling (no sprinkling [DRY] vs sprinkling mounds in pens [WET]) in a 2 x 2 factorial arrangement of treatments (TRT). Steers were randomly assigned to 24 pens (8 hd/pen). Feed amount was adjusted daily so that all bunks were clean at 0800, while sprinkling was done via overhead water sprinklers on days when predicted temperature-humidity index was  $\geq 77$ . Feed and water intakes were recorded daily, while BW was determined on days 0, 21, 56 and 83 (termination of trial). From d 0 to 20 (June 8 to 28) all pens were managed similarly with no sprinkling and feed delivered at 0800. Tympanic temperatures (TT) of steers (6 hd/TRT) and climatic conditions of pens were obtained on d 29 to 34 and 56 to 63. Body weight and DMI were not affected by TRT ( $P \geq .10$ ). Average daily gain and feed efficiency from d 57 to 83 were improved 13% ( $P = .08$ ) and 15% ( $P = .06$ ), respectively by sprinkling (1.48 vs 1.68  $\pm$  .08 kg/d and .148 vs .170  $\pm$  .160). Water intake was increased 13% from d 22 to 56 in AM/DRY vs PM/WET steers (feeding time x sprinkling interaction,  $P \leq .05$ ) with AM/WET and PM/DRY being intermediate. Water intake of AM/DRY steers averaged 13% and 11% higher ( $P \leq .05$ ) than all other steers on d 57 to 83 and 22 to 83, respectively. On

d 30 to 33, of AM/DRY steers had higher TT ( $P \leq .06$ ). On d 62 to 63 TT of PM steers were higher ( $P \leq .05$ ) than AM steers from 1600 to 1900. Wetting mounds reduced soil temperatures ( $P \leq .05$ ) at all times, and temperatures at .15 and .76 m above the mound ( $P \leq .05$ ) between 1000 and 1730. Adjusting feeding time and sprinkling cattle can alter body temperature. Performance data suggest allowing cattle access to sprinklers during hot days improves performance. Effects of AM vs PM feeding were not observed, although interactions were apparent.

**Key Words:** Feeding Time, Sprinkling, Tympanic Temperature

**279 Type of corn bran and corn processing method in beef finishing diets.** C. N. Macken\*<sup>1</sup>, T. J. Klopfenstein<sup>1</sup>, G. E. Erickson<sup>1</sup>, and R. A. Stock<sup>2</sup>, <sup>1</sup>*University of Nebraska-Lincoln*, <sup>2</sup>*Cargill Inc., Blair, NE*.

A finishing trial was conducted to determine the effects of corn bran type in either dry-rolled or steam-flaked corn based diets. Three hundred and forty crossbred yearling steers (354 kg) were stratified by weight and randomly assigned to 1 of 40 pens (10 steers/pen in replication 1 and 8 steers/pen in replications 2, 3 and 4). Treatments were assigned based on a 2 # 4 + 2 factorial design with factors of grain source and bran type. Grain sources were dry-rolled (DRC) or steam-flaked (SFC) corn. Bran types were dry (90% DM), wet (40% DM), dry and rehydrated to either 40% or 60% moisture. Bran was fed at 30% of the dietary DM, replacing either DRC or SFC. Two control diets were fed with no added bran. All diets contained corn steep liquor with distillers solubles at 10% of the diet DM. Sorghum silage was included in all diets, including step-up diets, at 3.5% DM. Alfalfa hay was included at 3.5% DM in the final finishing diet. Step-up diets contained 41.5%, 31.5%, 21.5% and 11.5% DM alfalfa hay replacing the corn in each treatment diet. Bran type had no effect on performance or carcass characteristics. Dry matter intake was higher (11.4 vs. 10.7 kg/d;  $P < 0.01$ ) for steers fed bran compared to no bran and for steers fed DRC compared to SFC (11.6 vs. 11.0 kg/d;  $P < 0.01$ ). Interactions occurred ( $P < 0.01$ ) between grain source and bran inclusion for ADG and feed efficiency. Daily gain for SFC diet without bran was higher ( $P < 0.01$ ) than SFC diets with bran while DRC diets with or without bran were similar. Daily gain was 15.2% higher (1.95 vs. 1.69 kg/d;  $P < 0.01$ ) for steers fed SFC without bran compared to DRC without bran. Feed efficiency was 16.9% higher (0.183 vs. 0.157;  $P < 0.01$ ) for steers fed SFC without bran compared to DRC without bran. In DRC and SFC diets, feeding bran decreased feed efficiency by 5.2% and 13.8%, respectively. Bran type had no effect on finishing steer performance in either dry-rolled or steam-flaked corn based finishing diets.

**Key Words:** Beef Cattle, Corn Bran, Corn Processing

**280 Effects of growth promotants on feedlot heifers fed in winter vs. summer.** W.M. Kreikemeier\* and T.L. Mader, *University of Nebraska-Lincoln*.

Two 104 day finishing trials were conducted utilizing Angus x crossbred heifers (270 head/trial). Trials were conducted from December, 1999 through March, 2000 (winter) and from June, 2001 through September, 2001 (summer). Treatments (TRT) were identical for each trial and included 1) no implant or MGA (CONT); 2) estrogenic implant (E) 3) trenbolone acetate implant (TBA) 4) E+TBA 5) MGA fed (MGA); 6) E+TBA+MGA. Each TRT consisted of five pens/trt and nine head/pen in each trial. A common dressing percent (63%) was used to calculate final weight (FWT). Initial weights (mean=384 kg; SE=.57) were the same for each trial. There were no ( $P \geq .20$ ) TRT x season interactions for FWT, ADG or GF. Heifers receiving a growth promotant were 11.6 kg (SE=4.08) heavier and gained .108 kg/d (SE=.04) more ( $P \leq .05$ ) than CONT heifers. Average daily gains were 1.25, 1.33, 1.31, 1.38, 1.34 and 1.42 (SE=.036) for TRT 1 through 6, respectively. Heifers receiving E+TBA (TRT 4 and 6) gained .09 kg/day (SE=.032) more ( $P \leq .05$ ) than heifers not receiving E+TBA. Gain:feed ratios were .121, .129, .128, .131, .132 and .136 for TRT 1 through 6, respectively. Heifers receiving E+TBA with and without MGA and MGA alone (TRT 4, 5 and 6) had converted .007 (SE=.003) better than CONT, E and TBA heifers. There was a tendency to have TRT x season interaction ( $P=.13$ ) for DMI (Table). Heifers fed MGA and implanted with E+TBA tended to have enhanced DMI in the summer and suppressed DMI in the winter. Implanting tended to produce relatively similar performance in summer vs. winter. However, the effects of feeding MGA when combined with

E+TBA differed among seasons. Feeding MGA alone tended to decrease DMI regardless of season.

Table 1. Effects of treatment x season interaction on DMI (SE=.18)

	1	2	3	4	5	6
Summer	9.11 <sup>a</sup>	9.23 <sup>a</sup>	9.15 <sup>a</sup>	9.39 <sup>ab</sup>	9.14 <sup>a</sup>	9.65 <sup>b</sup>
Winter	11.57 <sup>ab</sup>	11.63 <sup>ab</sup>	11.54 <sup>ab</sup>	11.69 <sup>b</sup>	11.16 <sup>a</sup>	11.24 <sup>ab</sup>

<sup>ab</sup> means are different  $P \leq .05$

**Key Words:** Growth Promotants, Feedlot Heifers, Season

**281 Effects of supplemental energy source on utilization of corn silage by beef steers.** C. M. Howlett\*, E. S. Vanzant, B. G. Fieser, and K. B. Combs, <sup>1</sup>University of Kentucky.

Six crossbred steers (387 kg) were used in a 6 x 6 Latin square design to evaluate supplemental energy source effects on utilization of corn silage diets. Treatments consisted of six corn silage (CS; CP=9.1%, TDN=67%) diets. Treatments were 1) soybean meal (SBM) at 10% DMI; 2) corn and soybean meal (CSBM) at 56% DMI; 3) whole linted cottonseed (COT) at 15% DMI; 4) whole raw soybeans (SB) at 15% DMI (SB1); 5) SB at 25% DMI (SB2); or 6) pelleted soybean hulls (SH) at 30% DMI. CS comprised 88% of DMI in diet 1 and 42% of DMI in diets 3 through 6. COT, SB1, SB2, and SH replaced a portion of the corn and soybean meal. Diets were formulated to be isonitrogenous (13.7% CP) except for SB2 (17% CP) and were fed twice daily at 1.8 x NEm. DMD was lowest ( $P < .10$ ) for SBM (67.5%), intermediate for oilseed supplementation (COT, 73.3%; SB1, 75.6%; SB2, 73.9%), and greatest for CSBM (79.6%) and SH (78.3%). Ruminal ammonia concentrations were greater ( $P < .10$ ) for SB2 (11.3 mM) than for COT (6.2 mM), SBM (6.9 mM), CSBM (7.1 mM), SB1(7.0 mM), and SH (6.8 mM). Ruminal pH was lower ( $P < .10$ ) for CSBM (6.23) and SH (6.27) than for COT (6.46), SBM (6.51), SB1 (6.49), and SB2 (6.45). Molar proportions of ruminal acetate were lowest ( $P < .10$ ) for SB2 (61.4%), intermediate for SB1 (63.0%), COT (64.0%), and CSBM (64.0%), and greatest for SBM (67.6%), and SH (67.1%). Propionate proportions for SBM (16.8%), CSBM (17.3%), and SH (16.5%) were lower ( $P < .10$ ) than for SB1 (20.0%), COT (20.6%), and SB2 (21.6%). Acetate:propionate ratios were lowest ( $P < .10$ ) for SB2 (2.88), SB1 (3.17), and COT (3.19), intermediate for SBM (4.17) and CSBM (3.76), and greatest for SH (4.36). Molar proportions of butyrate were lowest ( $P < .10$ ) for SB2 (10.9%), SB1 (11.4%) and SBM (11.5%), intermediate for SH (12.9%), and greatest for CSBM (14.4%). Ruminal proportions of isobutyrate, isovalerate, and valerate were generally increased when oilseeds were supplemented. Inclusion of oil-rich supplements decreased ruminal VFA concentrations, reduced acetate:propionate ratio and decreased DMD. Supplementation with whole soybeans at 25% of DMI increased ruminal ammonia concentration.

**Key Words:** Oil, Rumens, Fermentation

**282 Influence of fish oil addition to finishing diets on carcass characteristics, immune function, and growth performance of cattle.** T. J. Wistuba\*, E. B. Kegley, and J. K. Apple, University of Arkansas, Fayetteville, Ar/USA.

Inclusion of fish oil, a source of omega-3 fatty acids, in ruminant diets may fortify the fatty acid composition of meats and modulate the immune system. Therefore, a 70-d study using 16 crossbred steers (441 ± 31.7 kg initial BW; 4 calves/pen; 2 pens/ dietary treatment) consuming a high concentrate ration was conducted. Dietary treatments consisted of: 1) control (75% corn, 11% soybean meal, and 10% cottonseed hull based diet); and 2) the control diet with 3% fish oil replacing a portion of the corn. Steers were weighed on consecutive days at d 0 and 70 to start and finish the trial and interim weights were taken on d 28 and 56. On d 63, all calves were bled by jugular venipuncture for flow cytometric analysis to determine the populations of leukocytes. Calves were stratified by treatment and harvested on d 71 and 72. Fish oil supplementation decreased daily feed intake (13.97 vs. 11.49 kg,  $P < 0.01$ ); conversely it had no effect on ADG or G:F ( $P > 0.05$ ). Fish oil did not alter color of longissimus muscle (LM), LM area, yield grade, dressing percentage, marbling, quality grade, or fat thickness. Though, fish oil supplementation decreased hot carcass weight (329 vs. 303 kg,  $P < 0.05$ ), and tended to decrease percentage internal fat (2.28 vs. 1.94,  $P = 0.12$ ). Fish oil supplementation increased the number of receptors expressed on lymphocytes ( $P < 0.01$ ), and tended to increase the ratio

of the number of receptors on T lymphocytes compared to the number of receptors on B lymphocytes ( $P = 0.06$ ). In summary, supplementation with fish oil decreased growth performance and subsequent hot carcass weights and had varying results on immune parameters. Nevertheless, no negative results were elucidated for the effects of fish oil supplementation on carcass quality. Further work is being conducted to determine the effect of supplementing fish oil on the fatty acid composition of the carcass.

**Key Words:** Fish Oil, Finishing Cattle, Carcass Characteristics

**283 Ruminal fermentation characteristics and duodenal amino acid flows in beef cattle fed varying levels of bloodmeal.** J.W. Lehmkuhler\*<sup>1</sup>, E.E.D. Felton<sup>2</sup>, C.J. Fu<sup>2</sup>, and M.S. Kerley<sup>2</sup>, <sup>1</sup>University of Wisconsin, <sup>2</sup>University of Missouri.

Five crossbred beef steers with rumen fistulas and duodenal #Y#-type cannulas were fed a high grain, feedlot-type diet with increasing levels of bloodmeal(BM). Levels tested included 0%, 3%, 6%, 9%, and 12% of the diet DM. Rumens fermentation characteristics and amino acid flows to the small intestine were examined. Dry matter intake was not affected by the level of BM included and averaged 2.4% of live body weight (BW). Organic matter digestibility in the rumen and total tract did not differ across dietary treatments. Nitrogen intake and flow to the duodenum increased linearly ( $P < .05$ ) with level of BM. The quantity (g/d) of total and nonmicrobial N increased linearly ( $P < .05$ ). When expressed as the percentage of duodenal N flow, microbial and nonmicrobial N contribution were not different ( $P > .10$ ). True ruminal N digestibility increased linearly ( $P < .01$ ) with level of BM addition resulting in a linear ( $P < .10$ ) decrease in the proportion of intake N corrected for microbial N arriving at the small intestine or escape N. Microbial efficiency responded quadratically ( $P = .08$ ) to level of BM. Total VFA production increased linearly ( $P = .05$ ) to BM. Total branched-chain VFA#s increased linearly ( $P < .05$ ) as BM level was increased. Duodenal amino acid flow increased linearly ( $P < .05$ ) with BM addition while most plasma amino acids did not respond to BM inclusion. These data illustrated that the rumen degradability of the BM protein was dependent upon dietary inclusion level.

**Key Words:** By-pass protein, Feedlot, Amino acid

**284 Effect of an inoculant extender on the pH decline of liquid applied silage inoculant and terminal silage pH.** J. S. White\*<sup>1</sup>, K. Katzung<sup>2</sup>, and N. Prescher<sup>3</sup>, <sup>1</sup>Silage Solutions, Sioux Center, IA, <sup>2</sup>Northland Farm Systems, Owatonna, MN, <sup>3</sup>AgScience, Sioux Falls, SD.

Silage managers question the shelf life of hydrated, liquid applied silage inoculant. The objectives of this study were to determine the influence of an inoculant extender on the pH decline of liquid applied inoculant, and determine if subsequent silage pH was affected by treatment with extended inoculant.

The pH of liquid applied silage inoculant replicates (n=4), without or with the addition of an extender was monitored from 0 to 103 hours after mixing. Multiple regression analysis was used to determine the effect of time after mixing (Hour) and the use of extender on the pH of the inoculant.

The R square was .859. Time after mixing and whether or not an extender was used explained most of the observed variation in inoculant pH.

Whole plant, soft dough barley and wheat were treated with: 1) Control, (no inoculant), 2) Fresh inoculant (6 hours old) 3) Old inoculant, (55 hours old) 4) Extended inoculant, Old inoculant, with extender added at mixing. Each treatment had four replicates. The 19 liter plastic silos were opened 42 days after ensiling, and the silage pH determined.

One way ANOVA indicated that significant differences,  $P < .001$ , existed among the treatments for both crops. Treatment means were compared using the LSD test. For barley the  $P = .05$  LSD was .0346. The treatment means were: Control 4.11<sup>a</sup>, Fresh inoculant 3.99<sup>b</sup>, Old inoculant 4.13<sup>a</sup>, Extended inoculant 3.96<sup>b</sup>. For wheat the  $P = .05$  was .065. The treatment means were: Control 4.18<sup>a</sup>, Fresh inoculant 3.92<sup>b</sup>, Old inoculant 4.15<sup>a</sup>, Extended inoculant 3.95<sup>b</sup>.

In this study the use of an extender significantly affected the pH decline of liquid applied silage inoculant. Silages treated with extended inoculant had pH values similar to silages treated with fresh inoculant.

Variable	Coefficient	SEM	P<
pH intercept	5.34	.137	.001
Hour	-.011	.002	.001
Extender	1.76	.081	.001

**Key Words:** Silage, Inoculant Extender, pH

**285 Effect of cutting height and genetics on intake and digestibility of corn silage.** L. R. Kennington<sup>\*1</sup>, C. W. Hunt<sup>1</sup>, J. I. Szasz<sup>1</sup>, A. V. Grove<sup>1</sup>, and W. Kezar<sup>2</sup>, <sup>1</sup>University of Idaho, Moscow, <sup>2</sup>Pioneer Hi-Bred International, Johnston, Iowa.

Four minimally cannulated beef heifers were used in a 4 x 4 Latin square experiment. Main effects and interactions of hybrid (Pioneer **3335** and **3223**) and cutting height (**LO**, 20 cm and **HI**, 61 cm) were evaluated. Corn silage treatments were stored in manually packed 1.0- x 1.25- x 1.5-m boxes lined with plastic bags. Dietary treatments consisted of 40% alfalfa and 60% corn silage (DM basis). Chromic oxide was fed (10 g/hd/d) beginning 7 d before fecal sample collection for use as an external digestibility marker. The hybrids were of similar maturity at time of harvest (60% milkline), however 3335 treatments were analyzed to have greater starch and less NDF than 3223 treatments (average 37.8 versus 33.7% and 34.8 versus 38.6%, respectively). The LO treatments averaged 3.1 percentage units higher in NDF and 3.45 percentage units lower in starch content than the HI treatments. Intake of DM was greater for 3335-HI than 3335-LO; however, DMI was greater for 3223-LO than 3223-HI (hybrid x cutting height, P < 0.05). Starch intake was greater (P < 0.05) for heifers fed HI than LO and 3335 than 3223 dietary treatments. Conversely, NDF intake was greater (P < 0.05) for heifers fed 3223 than 3335 and LO than HI dietary treatments. Digestibility of DM, starch, and NDF was greater (P < 0.05) for heifers fed 3223 diets than 3335 diets. Digestibility differences were not observed (P > 0.10) for cutting height treatments. Rate of *in situ* DM, NDF, and starch degradability was not affected (P > 0.10) by hybrid or cutting height; however, DM degradability was greater (P < 0.05) for HI than LO corn silage substrates at 8, 16, and 24 h of incubation. Degradability of NDF was greater (P < 0.05) for 3223 than 3335 substrates at 24, 36, and 48 h and tended (P = 0.07) to be greater at 96 h of incubation. Corn silage from 3223 was more digestible despite having a greater NDF content, suggesting fiber may not be an accurate measure of corn silage quality. While cutting height impacted chemical composition, we observed genetics to have a greater impact on corn silage quality.

**Key Words:** Forage Quality, Fiber, Starch

**286 Degradability of crude protein and nonstructural carbohydrate in selected feeds and grain mixes.** D.P. Casper<sup>\*1,2</sup>, M.J. Brouk<sup>3</sup>, and D.J. Schingoethe<sup>3</sup>, <sup>1</sup>Agri-King, Inc., Fulton, IL, <sup>2</sup>USDA-ARS, Beltsville, MD, <sup>3</sup>South Dakota State University, Brookings.

Estimates of degradability of crude protein (CP) and nonstructural carbohydrate (NSC) of feeds are required to synchronize CP and NSC for optimum ruminal fermentation. It is unknown if these estimates are different due to associative effects of individual ingredients when combined into grain mixes. Samples of corn (C), barley (B), soybean meal (S), extruded S (E), grain mixes (C-S, C-E, B-S, B-E), corn silage, and alfalfa hay were obtained from previous CP and NSC studies. Two rumen cannulated dairy cows were used with two replicates each of duplicate nylon bags inserted in reverse sequence for time points of 0, 1, 2, 3, 4, 6, 8, 10, 12, 18, 24, 36, and 48 hr. Data were fitted to the nonlinear equation of  $D=R+(P-R)*(1-e^{-ct})$ . Regression coefficients for NSC source (C vs B), CP source (S vs E), grain mixes, and forages were subjected to analysis of variance with cow and rep as sources of variation. Degradation rates were greater for B than for C in DM (.051 and .097%/hr for C and B, respectively, P<.01), CP (.033 and .104%/hr, P<.06), and NSC (.071 and .105%/hr, P<.07). Degradation rates were lower for E than for S in DM (.073 and .050%/hr for S and E, respectively, P<.01) and CP (.061 and .034%/hr, P<.01). Degradation rates of DM (.044, .043, .067, .080%/hr for C-S, C-E, B-S, and B-E, respectively) were greater for B grain mixes than C grain mixes. Degradation rates of CP (.042, .037, .057, .048%/hr) were greater (P<.05) for the B-S grain mix than other mixes. Degradation rates of NSC (.049, .048, .080, and .107%/hr) were greater (P<.05) for the B grain mixes than the C grain mixes. Degradation rates of DM (.024 and .048%/hr for corn silage and alfalfa hay, respectively) and CP (.003 and .044%/hr) were greater (P<.01) for

alfalfa hay, but NSC degradability (.158 and .051%/hr) was greater for corn silage. The degradation rates of CP and NSC in the grain mixes represented the combined percentages of the degradability estimates of CP and NSC from individual ingredients.

**Key Words:** Nonstructural Carbohydrates, Crude Protein, Degradation Rates

**287 The effects of volatile fatty acid on acid-resistance of cattle fecal *E. coli* and *E.coli* O157:H7.** C. J. Fu<sup>\*1</sup>, J. H. Porter<sup>1</sup>, E. E. D. Felton<sup>1</sup>, J. W. Lehmkuhler<sup>2</sup>, and M. S. Kerley<sup>1</sup>, <sup>1</sup>University of Missouri-Columbia, <sup>2</sup>University of Wisconsin-Madsion.

Hungate tube pure culture incubations were used to determine the effect of volatile fatty acid concentration (VFA: acetate, propionate, and butyrate) on extreme acid-resistance of cattle fecal *E. coli* and *E. coli* O157:H7. The fecal *E. coli* samples were from a continuous culture study designed for determining the effects of pH on extreme acid-resistance of fecal *E. coli* which was presented at the ASAS-ADSA-AMSA-PSA joint meeting of 2001 (abstract #: 322). The *E. coli* O157:H7 (505B strain) was kindly donated by another lab at the University of Missouri-Columbia. The acetate, propionate, and butyrate concentrations tested were 0-25, 0-20, and 0-20 mM, respectively. The media used for the pure culture incubations was tryptic soy broth without dextrose (pH: 7.3 ± 0.2) and the pure VFA was used to adjust their concentration in the media. Tubes were inoculated with fecal *E. coli* and *E. coli* O157:H7 and then sampled after 24 h of incubation. The acid shock media consisted of 10 grams tryptone and 5 grams yeast extract per liter and the pH was adjusted to 2.0 with 6N HCl. Viable *E. coli* were enumerated by the multi-tube fermentation method (AOAC, 1998) using lauryl sulfate trypticase broth. The viability after extreme acid shock (1 h for fecal *E. coli* and 4 h for *E.coli* O157:H7) of fecal *E. coli* and *E. coli* O157:H7 showed quadric responses (P < 0.05) as acetate and butyrate level increased with maximum acid-resistance at 20 and 12 mM, respectively. As the propionate concentration increased, the extreme acid-resistance showed trend of quadric responses (P < 0.15) with maximum acid-resistance at 12 and 4 mM for fecal *E. coli* and *E. coli* O157:H7, respectively. This study indicated that the extreme acid-resistance of *E. coli* could be induced by all three VFAs even though the environmental pH was near neutral; and further more, the acid-resistance might depend on the concentration of the VFAs. This study supported and enhanced the previous hypotheses that culture VFA levels affect acid-resistance of *E. coli*.

**Key Words:** E. coli/E. coli O157:H7, VFA, Acid-resistance

**288 Inhibition of methanogenesis in ruminal cultures by p-aminobenzoate (pABA) analogs.** B. A. DeMontigny\*, R. Dumitru, S. Schroeder, H. Palencia, S. W. Ragsdale, J. M. Takacs, and J. L. Miner, University of Nebraska-Lincoln.

Ruminal methane production is responsible for a loss of 5 to 15% of feed gross energy during digestion. Additionally, methane is a greenhouse gas and livestock account for 17% of total methane emissions. Inhibition of ruminal methanogenesis could both increase feed efficiency and mitigate global warming. Methanogenic archaea utilize a unique pathway to synthesize methane. The enzyme, 4-(β-D-ribofuranosyl) aminobenzene 5'-phosphate synthetase represents a promising target for inhibition. A natural substrate of this enzyme is pABA. We hypothesized that analogs of pABA could inhibit methanogenesis in ruminal cultures. Methanogenesis assays were conducted in 30-h, 4-ml anaerobic incubations of bovine ruminal inocula in buffer containing trypticase, cellobiose, and trace nutrients, with 5.4 ml of headspace pressurized to 190 kPa. Headspace methane was quantified by gas chromatography using a 6-m, silica gel column, thermal conductivity detection, and adjustment for headspace pressure. Sixteen pABA analogs were synthesized and tested at 10<sup>-5</sup> to 10<sup>-2</sup> M. Each experiment determined the effect of up to four analogs. A known inhibitor of methanogenesis, 2-bromoethanesulfonate (1mM) was used as a positive control and buffer addition was the negative control. Three analogs inhibited (P < 0.01) methane synthesis. Five mM 4-ethylamino-benzoate and 9 mM 4-isopropylamino-benzoate each completely inhibited methane production. Five mM 4-(2-hydroxy-ethylamino)-benzoate inhibited methane production to 2.5% of the control. Bromoethane-sulfonate completely inhibited (P < 0.01)

methane production in all experiments. We conclude that pABA analogs can inhibit methanogenesis in ruminal fermentations.

**Key Words:** Archaea, Methane, P-Aminobenzoate

**289 Response of breed and gender of beef cattle to copper sulfate supplementation.** M. J. Rincker\*, J. B. Barber, P. H. Coe, D. R. Hawkins, G. M. Hill, J. E. Link, and J. E. Rowntree, *Michigan State University, East Lansing, MI.*

Initial data (1993-97) evaluating copper (Cu) status of the Michigan State University beef herd indicated that, even though cupric oxide was provided in trace mineral salt, plasma Cu concentration of cows (age > 730 d) diminished each year (130 to 78  $\mu\text{g}/\text{dL}$ ) regardless of breed. Following 6 mo of supplementation with 48 g copper sulfate ( $\text{CuSO}_4$ )/kg to the trace mineral salt ( $\text{TMS}/\text{CuSO}_4$ ), an increase in plasma Cu concentration (106  $\mu\text{g}/\text{dL}$ ) was observed in 1998. Thus, the objective of this study was to further evaluate the effects of continued  $\text{CuSO}_4$  supplementation on plasma Cu concentration in this herd. Cattle were allowed ad libitum access to  $\text{TMS}/\text{CuSO}_4$  and were bled in 1999 and 2000. Plasma samples from 510 females: Angus (A) = 165, Hereford (H) = 219, and crossbred (XB) = 126, and 74 males: A = 27, H = 47, were obtained for determination of Cu concentration by atomic absorption spectroscopy. No differences in plasma Cu were observed between 1999 and 2000 (102 vs 98  $\mu\text{g}/\text{dL}$ ). When combining the 1999 and 2000 data, a breed effect was noted (A = 98, H = 103, and XB = 95  $\mu\text{g}/\text{dL}$ ,  $P < 0.05$ ). The response to  $\text{CuSO}_4$  also varied among age and sex: bull calves (age < 365 d) = 112, mature bulls (age > 365 d) = 107, cows = 98, heifers (365 < age < 730 d) = 99, and heifer calves (age < 365 d) = 103  $\mu\text{g}/\text{dL}$  ( $P < 0.01$ ). Data from a core group of cows ( $n = 45$ ) who were bled annually from 1996 to 2000 were analyzed. Plasma Cu concentration varied throughout the five year period (96, 77, 108, 93, and 91  $\mu\text{g}/\text{dL}$ , respectively,  $P < 0.01$ ). Copper concentration of H cattle was lower in 1997 when compared with A cattle (68 vs 90  $\mu\text{g}/\text{dL}$ ,  $P < 0.01$ ), but following supplementation Plasma Cu in H cows increased from 1998 to 2000, while plasma Cu of A cows peaked in 1998 and then declined in 1999 and 2000. These results indicate that cattle do indeed require an available form of supplemental Cu to maintain adequate Cu stores. However, there may be differences in Cu utilization and retention between breeds.

**Key Words:** Copper Sulfate, Cattle

**290 Effect of age on glutathione peroxidase activity in Angus females.** J.E. Rowntree\*, D.R. Hawkins, G.M. Hill, and J.E. Link, *Michigan State University.*

Michigan is considered to be a Selenium (Se) deficient state, however little is known of the Se status in cattle transplanted from Se adequate areas to areas of deficiency. Our lab previously reported that age influences copper status in beef cattle. Hence, the objective of this study was to determine the influence of age and location of origin on Se status measured by glutathione peroxidase activity (GPX1) in Angus females. Two central Michigan cowherds ( $n = 49$ ,  $n = 38$ ) were studied. The cooperater herd (CH) was composed of 24 mature cows, 11 two year old cows, and 14 yearling heifers. Cattle were assembled from Se adequate regions outside of Michigan. The Angus cowherd at Michigan State University (MSU) was composed of 22 mature cows, 8 two year old cows, and 8 yearlings. These females originated from Michigan and were reared since birth in the herd. Blood was collected and red blood cell GPX1 activity was determined by the method of Paglia and Valentine. The cows in the CH had higher GPX1 activity ( $P < 0.01$ ) than MSU, therefore only within herd age comparisons were made. Yearling heifers in the CH herd had higher GPX1 activity ( $P < 0.01$ ) than mature cows (27.22 vs 18.74 GPX1 EU/g Hb, respectively). Yearling heifers did not differ from two-year-old cows (27.22 vs. 21.54 GPX1 EU/g Hb, respectively). In the MSU cowherd, yearlings had higher ( $P < 0.01$ ) enzyme activity as compared to two year olds and mature cows (23.20 vs. 15.45 and 15.83 GPX1 EU/g Hb, respectively). These results indicate that Angus cows raised in Se adequate areas and placed into Se deficient areas maintained higher GPX1 activity than Angus cows that originated in a Se deficient area. In this small study, Angus yearling females appeared to have higher GPX1 activity as compared with two year old and mature cows.

**Key Words:** Glutathione Peroxidase, Selenium, Angus cattle

**291 Influence of supplemental sunflower oil and dexamethasone therapy on performance and adipose tissue development of early weaned beef steers.** M. P. McCurdy\*, D. D. Buskirk, A. C. Grant, and J. D. Cowley, *Michigan State University.*

Twenty-four early weaned steers (average of 156 d of age;  $\text{BW} = 237.3 \pm 26.1$  kg) were randomly assigned to a 2 x 2 factorial arrangement of dietary and drug therapy treatments for a period of 112-d. Diet consisted of basal diet only (control) or basal diet with the addition of 8% high-linoleate sunflower oil. Drug therapy consisted of three intramuscular injections of 0.1 mg dexamethasone/kg BW at 12-h intervals every 28-d or equal doses of physiological saline (control). Steers were fed individually and the amount fed was adjusted weekly so that treatment groups had isocaloric intake. Following the 112-d treatment period, all steers were fed a common basal diet until harvest. Lipid deposition was measured by ultrasound every 28-d throughout the trial and complete carcass data was collected after harvest. Dexamethasone decreased ADG by 0.17 kg ( $P < 0.01$ ), and decreased feed efficiency by 10% ( $P < 0.05$ ) during the 112-d treatment period. Over the entire trial, dexamethasone increased feed efficiency ( $P < 0.05$ ), however feed efficiency was decreased with the combination of dexamethasone and sunflower oil ( $P < 0.05$ ). Dexamethasone reduced ( $P < 0.05$ ) change in subcutaneous rib fat by 14%, and rump fat by 50%. Supplemental sunflower oil increased change in intramuscular fat by 41% ( $P < 0.01$ ). It was also observed that DMI during the 28-d intervals was correlated ( $P < 0.01$ ) with changes in intramuscular ( $r = 0.48$ ), subcutaneous rib ( $r = 0.68$ ), and rump fat ( $r = 0.60$ ). Carcass marbling score, rib fat, and yield grade of treatment groups were not significantly different than control. However, dexamethasone and sunflower oil both increased kidney, pelvic, and heart fat ( $P < 0.05$  and  $P < 0.07$ , respectively). Sunflower oil may be useful in increasing intramuscular fat. Additionally, dexamethasone treatment may result in subsequent improvement in feed efficiency and decreased subcutaneous fat over the feeding period.

**Key Words:** Dexamethasone, Sunflower Oil, Intramuscular Fat

**306 Effect of decreasing OM digestibility or direct addition of carbon source to pen surface on nitrogen balance in open-dirt feedlots.** J.R. Adams, G.E. Erickson, T.J. Klopfenstein, C.N. Macken, and C.B. Wilson, *University of Nebraska, Lincoln.*

Steers ( $n = 96$ ,  $325 \pm 1.7$  kg) were fed 180d through November to May to determine impacts of adding carbon (C) to pen surface through management (SWD) or diet (BRN) on manure nitrogen N removed or N lost via volatilization. Treatments were 75% dry-rolled corn (CON) and either 30% corn bran replacing dry-rolled corn (BRN) or CON diet with weekly sawdust applications (6.4 kg/steer) (SWD). Because CON and SWD diets were identical, performance was similar for these two treatments. Less energy dense BRN diet resulted in lower ADG than CON ( $P < 0.05$ ) and SWD ( $P < 0.09$ ). BRN had reduced feed efficiency when compared to other treatments ( $P < 0.01$ ) and no differences were seen in DMI ( $P > 0.3$ ). BRN excreted more N than CON due to higher N intakes. Addition of C increased manure N concentration above CON. Total N lost was calculated as N excretion minus manure N and runoff N. No significant differences were detected in kg of N lost due to variation, however, losses were decreased by 28% when comparing CON to BRN and SWD. BRN significantly reduced %N loss above CON. Losses from BRN and SWD were nearly identical, suggesting adding C directly to the pen surface or decreasing OM digestibility is beneficial in lowering N losses from open-dirt feedlots.

Item	CON	BRN	SWD	SE
N intake <sup>c</sup>	36.2 <sup>a</sup>	37.8 <sup>b</sup>	36.7 <sup>ab</sup>	0.5
N excretion <sup>c</sup>	32.2 <sup>a</sup>	33.9 <sup>b</sup>	32.6 <sup>ab</sup>	0.5
Manure N removed <sup>c</sup>	15.2 <sup>a</sup>	21.8 <sup>b</sup>	20.3 <sup>b</sup>	1.9
Runoff N <sup>c</sup>	0.4 <sup>a</sup>	0.3 <sup>b</sup>	0.3 <sup>b</sup>	0.05
N lost <sup>c</sup>	16.6	11.8	12.1	2.2
% N loss <sup>d</sup>	51.6 <sup>a</sup>	35.0 <sup>b</sup>	37.1 <sup>ab</sup>	6.2

<sup>a,b</sup> Within row, means with different superscripts differ ( $P < 0.10$ ).

<sup>c</sup> Kg/steer.

<sup>d</sup> N lost divided by N excretion.