Abstracts

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BREEDING AND GENETICS

001 Genetic Parameters for Fecal Egg Count and Body Weight in Katahdin Lambs.

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The objective of this study was to estimate genetic parameters for fecal egg count at weaning (WFEC) and postweaning (PWFEC), and weights at birth (BW), weaning (WW) and postweaning (PWW) in Katahdin lambs by investigating direct additive, maternal additive, maternal permanent environmental and maternal temporary environmental (litter) effects. WFEC (n = 2,537), PWFEC (n = 3,478), BW (n = 12,869), WW (n = 10,961) and PWW (n = 7,812) records of 12,869 Katahdin lambs were available for this study. These records, from 13 different flocks, were collected between 1998 and 2015. Animal models were investigated using the ASReml statistical package. The significance of inclusion of random effects was tested using the Likelihood ratio tests. Fixed effects were dam age, type of birth and rearing, and management group (defined by sex, site and birth year). Lamb age in days at the time of measurement was fitted as a covariate. Litter was a significant (P < 0.01) random effect for BW and WW but not for the other traits. Maternal effects were significant (P < 0.01) for all body weights, but were very small and not significant for fecal egg counts. Depending on the model used, heritability estimates ranged from 0.18 to 0.50 for BW, 0.15 to 0.40 for WW, and 0.16 to 0.40 for PWW. Heritability estimates were 0.24 for WFEC and 0.26 for PWFEC. Preliminary analyses, with less restrictive management groupings, gave higher estimates of heritability for fecal egg count. Bi-variate analyses revealed very low genetic (-0.06 to 0.16) and phenotypic (-0.09 to 0.08) correlations between weights and fecal egg counts. Genetic and phenotypic correlations were, respectively, 0.80 and 0.31 for WWEC and PWWEC; 0.66 and 0.47 for BW and WW; 0.44 and 0.38 for BW and PWW; and 0.89 and 0.82 for WW and PWW. This study revealed an influence of maternal effects on body weights of Katahdin lambs; the inclusion of both permanent and temporary maternal environmental effects may lead to better estimates of breeding values and selection decisions. The low correlations between body weights and fecal egg counts indicate that selection for parasite resistance may not affect genetic potentials for growth.

002 Prolactin, a Candidate Gene for Productivity Traits in Angus-Based Cattle.

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Previously we have demonstrated that individual single nucleotide polymorphisms (SNP) in the enhancer region and the coding sequence of the bovine prolactin (PRL) gene can serve as biomarkers of cattle productivity. Objective of this study was to determine PRL haplotype effects on traits of fall-calving Angus-based crossbred cows (n = 170). Genomic DNA was isolated from buffy coat samples and DNA genotyped (GeneSeek, Lincoln, NE) at three PRL SNP sites (C1286T, A1134T, and G8398A). Each cow's haplotype was assigned based on the following: if the cow was homozygous primary allele she was assigned that allele at that SNP, if she was heterozygous or homozygous minor allele then she was assigned minor allele for haplotype purposes. Three years (2012, 2013, and 2014) of production data were used to determine associations between haplotypes and cattle productivity. Traits of interest were: pre-breeding BCS and weight, Julian calving date, calf birth weight, cow weight and BCS at weaning, calf weaning weight, adjusted 205 day weight (adj205) and cow efficiency (calculated by dividing adj205 weight by cow weight at weaning). Hair coat scores were determined each year over three months (May, June, and July). Cows were categorized into age groups ($\leq$ 3 yr, 4 − 10 yr, and $\geq$ 11 yr) for analyses. Relationships were determined using mixed model ANOVA with main effects of genotype, year, and age group. Six haplotypes were identified: CAG (n = 107), TAA (n = 173), CTG (n = 50), TTA (n = 32), TAG (n = 50), and TTG (n = 37); n represents total number of records for that haplotype during 3-year trial. Cows that were CAG, TAA, or CTG increased (P < 0.05) calving percentage when compared with other haplotypes (92.3 vs. 82.7 %; respectively). Haplotype CAG cows had earlier hair coat shedding, the lowest pre-breeding body weight (509 ± 11 kg) and latest (P < 0.05) calving date (271 ± 2.9 d); however, their calves had the heaviest (P < 0.05) adj205 weights (214 ± 4.7 kg) resulting in CAG cows having the greatest (P < 0.05) cow efficiency (45 ± 0.9). Our results suggest that PRL haplotypes may be a useful tool for selecting replacement cattle that will yield increased sustainability of cow-calf enterprises.

003 Evaluation of Udder and Teat Scores in Beef Cattle and the Relationship to Calf Performance.

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The objectives of this study were to evaluate udder and teat scores in Angus (n = 163 cows with 354 records), Charolais (n = 54 cows with 100 records) and Hereford (n = 23 cows and 57 records) fall calving cows and determine the relationship with calf performance. Data were collected from 2011 to 2015 with dam age ranging from 2 to 13 yr. Udder and teat scores were taken at calving using Beef Improvement Federation guidelines. Udder scores ranged from 1 (very pendulous) to 9 (very tight). Teat scores ranged from 1 (very large, balloon-shaped teats) to 9 (very small teats). Calf performance data included BW and WW. Udder data were analyzed using the MIXED procedure of SAS with udder or teat scores as response variables with year, breed, and dam age as fixed effects with dam as a random effect. Calf performance data were analyzed within breed with WW as the response variable with fixed effects of sex and udder score with dam age and age at weaning as covariates and sire as the random variable. Birth weight was negatively correlated with udder (-0.20) and teat (-0.20) scores ($P < 0.001$). Breed significantly affected udder scores with Angus dams having the higher scores (6.76 ± 0.14) when compared to Charolais (6.14 ± 0.20) and Hereford (5.99 ± 0.25) which were similar ($P < 0.05$). Teat scores followed the same pattern as Angus dams had significantly higher scores than Charolais and Hereford which were not different ($P < 0.05$). Dams 11 yr or older had the lowest udder scores while 4 yr olds and 5 to 10 yr olds were intermediate with 2 and 3 yr olds having the highest ($P < 0.005$). Results were similar for teat scores with 11+ yr old cows having the lowest teat scores while 5 to 10 yr olds were higher but lower than 2, 3, and 4 yr olds which were similar ($P < 0.05$). There were no differences in WW due to udder scores for the three breeds. For teat scores, WW was significantly different in Angus with calves weaning the lightest from dams with a score of 1 and heaviest from dams with a score of 2, 3, and 5 ($P < 0.05$). These results are similar to other findings on udder conformation in beef cattle.

004 Recommended Duration for Evaluating Feed Intake and Validating the Residual Feed Intake Model in Brangus Heifers.

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Dry matter intake (DMI) was measured on 186 Brangus replacement heifers obtained from two purebred southeastern Brangus breeders. Heifers were delivered to the Auburn University Beef Cattle Evaluation Center (AUBCE) during 2014 and 2015. Seven contemporary groups were assigned based on date of trial and farm. Feed intake trials (70 day) were conducted using Calan gates. Heifers were weighed every 14 days. Carcass ultrasound measurements were taken by a certified ultrasound technician when average age was 365 days. Residual feed intake (RFI) was defined as actual feed intake minus expected feed intake based on maintenance and production requirements. The basic regression model for determining RFI was $Y_i = \beta_0 + \beta_1 ADG + \beta_2 MMWT + e_i$, where Y_i = expected DMI, β_0 = regression intercept; β_1 = partial regression coefficient of DMI on ADG, β_2 = partial regression coefficient of DMI on metabolic mid-test weight (MMWT) and e_i = RFI. ADG was determined by two methods. Individual animal ADG_1 was computed by regressing individual weight on day of test. ADG_2 was defined as (Final BW – Initial BW)/ days on test. Additionally, ultrasound 12th rib fat depth (ubf) was added to the basic RFI model. A maximum of four RFI values were determined for each individual heifer depending on ADG value and whether ubf was included in the model (RFI_{ADG1}, RFI_{ADG2}, RFI_{ADG1U}, RFI_{ADG2U}). To estimate linear relationships between models, regression analyses were performed for RFI_{ADG1} on RFI_{ADG1U}, RFI_{ADG2} on RFI_{ADG2U}, RFI_{ADG1} on RFI_{ADG2}, and RFI_{ADG1U} on RFI_{ADG2U}. Pearson and spearmen correlations were used to examine correlations among the four models. To assess whether a shorter feeding period could be implemented to accurately determine feed intake and ADG, subsets of the 70 d trials were created based on 14, 28, 42, and 56 d of data. Data subsets were regressed on the entire dataset to determine whether a shorter feeding trial could be implemented. Regression coefficient of RFI_{ADG1} on RFI_{ADG2} was 1.00 ± 0.01 ($P < 0.0001$), which did not differ from 1 (95% confidence limits; $0.98 < \beta < 1.01$), suggesting models were equivalent. Addition of ubf in the models accounted for an additional 2% of variation for DMI, but reranking of individuals for RFI was minimal. Accurately measuring ADG is the limiting variable in reducing test duration (r = 0.89 between day 70 and 56) for Brangus heifers. Results suggest testing length could be reduced to either 56 (r = 0.93) or 42 (r = 0.88) days.

005 Evaluation of Metal Loss through Simulated Rainfall-Induced Leaching of Salt-Based, Free-Choice Mineral Supplements: An Extension Service.

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Previous research identified preferential intake of Cu, Zn, and Mn-fortified supplements containing Zn and Mn hydroxychloride and basic Cu chloride vs. sulfate and organic forms of these metals among young beef calves. However, in the days following significant rainfall events, the preferential differences lessened. In addition, visual observation of the colored pooled water collecting under the raised mineral feeders suggested rainfall-induced leaching of trace minerals. Therefore, we designed a series of experiments to investigate rainfall-induced metal losses under laboratory conditions. From these efforts, a simplified laboratory procedure was established allowing benchtop evaluation of rainfall-induced leaching susceptibility from free-choice, salt-based mineral supplements. This procedure is now available as an extension service of the UF-IFAS, Range Cattle Research and Education Center. Briefly, the procedure is designed to simulate a 10.2 cm rainfall occurring over 3 separate events (3.4 cm on Monday, Wednesday, and Friday). The procedure requires a minimum of 4 kg of mineral supplement being tested, which is divided into 4, 1 kg subsamples. A single pre-leaching sample (250 g) is collected from each of the subsamples and the remaining 750 g of sample is placed into Buchner funnels (177 cm^2) on 20 to 25 μ pore filter paper. Deionized water (pH adjusted to 5.6) is poured over the mineral and the leachate collected into volumetric flasks. Along with the original pre-leaching sample, the remaining leached mineral is dried, weighed and analyzed for Cu, Zn, and Mn concentration using inductively coupled plasma spectroscopy techniques. Metal loss is estimated by calculating the difference between the total metal in the initial pre-leached sample less the metal remaining in the leached sample. Results are presented as percent metal loss ± SD of the 4 replications. The service is offered for $350 per sample with a turnaround time of approximately 14 d. In addition to leaching loss of trace metals, the analysis also provides important comparison between labeled nutrient specifications and actual chemical analysis. Results provide both manufacturers and producers with an understanding of the potential for essential nutrient losses due to rainfall interactions with free-choice, salt-based mineral and assist in evaluating the economic advantages of increased frequency of supplementation, use of weathering agents, and investment in rainfall-protected mineral feeders.

006 Use of Radio-frequency Identification Technology to Assess the Frequency of Cattle Visits to Mineral Feeders.

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A study was conducted from mid-June through July, 2016 to evaluate the effects of breed on behavioral characteristics of free-choice mineral supplements consumption. Radio-frequency identification (RFID) technology was constructed into custom-designed mineral feeders to accurately assess the frequency of individual animal visits. Twelve yearling heifers consisting of 3 breeds (Braford, Brahman, and White Angus (n = 4/breed) were fitted with RFID ear tags and placed in a "Jiggs" bermudagrass (*Cynodon dactylon*) pasture with free-choice access to a single RFID-equipped mineral feeder. Over 47 d, a total of 1400 readings were recorded. Visits were reported in 8 h periods; morning = 05:00 to 12:59, afternoon = 13:00 to 20:59, and night = 21:00 to 04:59. During the evaluation period, visits were consistently distributed throughout the day. The afternoon period had a numerically greater number of visits (562 visits) when compared to the other two periods. The afternoon period was followed by the morning period (554 visits) in number of visits. The night period was the least frequented period with 284 visits. There were no differences ($P = 0.85$) on the number of visits when comparing morning and afternoon periods; however, both periods had a greater ($P ≤ .001$) number of visits when compared to the night period. Brahman heifers had a greater number of visits to the feeder in the mornings when compared to the White Angus heifers ($P ≤ .001$), however; when compared to the Braford heifers the difference was only numerical ($P = 0.30$). For the afternoon period, Brahman heifers had the greatest ($P ≤ 0.01$) number of visits when compared to Braford and White Angus heifers, which did not differ for Braford and White Angus ($P = 0.55$). The White Angus heifers, during the night period had a greater ($P ≤ 0.01$) number of visits when compared to the Brahman heifers, and tended ($P = 0.10$) to have a greater number of visits when compared to the Braford heifers. There were no differences ($P = 0.22$) among Brahman and Braford heifers for the number of visits during the night period. Mineral supplement intake was recorded and calculated by disappearance; intake ranged from 38.1 g/head to 129.9 g/head daily (average = 78.5 g/head daily). These results suggest a seasonality of visits to a mineral feeder during a 24 h period and also a variability of visits according breed; suggesting a greater number of visits by the Brahman heifers.

007 The Effects of an Injectable Mineral Supplement on Weight Gain and Conception Rate.

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Minerals play an important role in achieving proper development and pregnancy in heifers. Environmental elements and low feed intake can prevent absorption and utilization of minerals from the diet. Circumventing the digestion process by injecting minerals directly may improve heifer weight gain and conception rates. Multimin 90 (MM; Multimin USA, Inc., Fort Collins, CO) is an injectable source of Cu, Mn, Se, and Zn. This product is being administered prior to weaning, shipping, breeding, and/or calving to improve animal performance, prevent mortality/morbidity, increase conception rates, and/or boost immunity. As part of an annual heifer development program, yearling heifers of various breeds were comingled and fed in confinement for 90 days beginning in October of 2015 (n = 83) or 2016 (n = 89). In both years, heifer diet consisted of *ad libitum* corn silage with supplemental feeding to meet NRC requirements for a moderate frame heifer gaining 0.8 kg BW per day. Additionally, in 2016, all heifers had *ad libitum* access to a commercial granular mineral supplement. At the end of the 90 d feeding period, heifers were assigned to treatment groups (MM or control). Heifers in the MM group received MM according to labeled instruction [5 mL subcutaneous injection of trace mineral solution containing Zn (60 mg/mL), Mn (10 mg/mL), Cu (15 mg/mL), and Se (5 mg/mL)]. Control heifers were not treated. Thirty days later all heifers were synchronized using the 7 d CO-Synch + CIDR and artificially inseminated. Heifer breed, heifer BW, and bull semen were equalized across treatment groups. Thirty days after insemination, pregnancy was determined using transrectal ultrasonography. Treatment with MM did not affect ($P >$ 0.1) ADG in 2015 or 2016. In 2015 the main effect of MM treatment on pregnancy rate was inconclusive ($P = 0.1$). When ADG was added to the model, MM heifers with high ADG out performed ($P < 0.01$) Control heifers with low ADG, but were not different ($P > 0.1$) from MM heifers with low ADG or Control heifers with high ADG. In 2016, there was no difference ($P > 0.1$) between pregnancy rate for MM and control heifers. These data may indicate that cattle with low rates of gain, possibly due to environmental factors or inadequate feed consumption, benefit the most from injectable mineral supplementation. Injectable mineral supplementation may not benefit cattle that are consuming adequate mineral from their diet.

008 Comparison of Heifer Conception Rates to Artificial Insemination after Synchronization with CO-Synch + Cidr with and without 14 d Cidr Pretreatment.

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It is well documented that presynchronization with progestins improves pregnancy rate to FTAI in *Bos taurus* breeds of cattle. The efficacy of presynchronization with progestins in Brahman-influenced breeds of cattle deserves further study. The objective of this study was to compare pregnancy rates resulting from fixed-time AI (FTAI) after synchronization with 1 of 2 controlled internal drug release (CIDR)-based protocols in peripubertal Brahman-influenced heifers. Crossbred heifers (n = 89) with varying degrees of Brahman-influence were equalized by breed, BW, and age across treatment groups (Pre-synch and Control). For 120 d, heifers were fed a diet consisting of *ad libitum* corn silage with supplemental feeding to meet NRC requirements for a moderate frame heifer gaining 0.8 kg BW per d. All heifers were fitted with an Estrotect (Rockway, Inc.; Spring Valley, WS), estrus detection patch on d -37. Also on d -37, Pre-synch heifers (n = 45) received a CIDR insert (Zoetis, Florham Park, NJ; 1.38 g of progesterone) for 14 d. On d -9, Pre-synch and Control (n = 44) heifers received GnRH (100 µg, intramuscularly; Cystorelin, Merial, Athens, GA) and a CIDR insert. On d -2, the CIDR insert was removed, $PGF_{2\alpha}$ (25 mg, intramuscularly; Lutalyse, Pfizer Animal Health) was administered, and a new Estrotect patch was applied. All heifers were artificially inseminated and a second dose of GnRH was administered on d 0, 54 h after $PGF_{2\alpha}$ injection. On d 30, pregnancy rates were determined by transrectal ultrasonography. Only 8 (9 %) of the heifers did not show signs of heat from d -37 to d -9. Heifers that displayed estrus within 54 h prior to breeding (34 %) were more likely to be pregnant ($P < 0.05$). Pregnancy rates for the main effect of synchronization protocol were not different ($P > 0.1$) at 27% and 16% for Pre-synch and Control groups respectively. Angus-influence heifers were more likely ($P < 0.01$) to become pregnant than non-Angus. Additionally, Pre-synch Angus-influenced heifers were the most likely ($P < 0.05$; 47 %) to become pregnant, and Control non-Angus heifers were least likely (9 %) to become pregnant. These results indicate that presychronization with progesterone for FTAI may be more effective on certain breeds.

009 Evaluating Variation in Haylage Collected in Arkansas - an Internship Project in Animal Science Extension Programming.

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To better harvest cool-season forages in unpredictable weather, harvesting forages as haylage or baleage is becoming increasingly popular in Arkansas. A summer internship project was created to increase our understanding of the variation in nutrient composition and basic preservation characteristics of Arkansas haylage while providing hands-on learning in Animal Science Extension programming. A survey instrument was first created to record the use of additives, harvest date, quantity of haylage produced, forage type harvested and notes were made on what method of wrapping was used. Seven farms were visited in northern Arkansas. There was an average of 4 samples/ farm with a minimum of 1 and a maximum of 13 samples within farm. A Colorado Hay probe (model 2004, UDY Corp., Fort Collins, CO) or Star Quality probe (multi-sampler, Star Quality Samplers, Irricana, AB, Canada) was used to collect the haylage samples. Samples were placed in plastic bags and pressed to remove air before sealing and were immediately placed on ice. Dry matter was measured after drying for 48 h at 50°C. Olfactory evaluations were determined by majority response using 3 appraisers and were scored as Desirable, Acceptable, or Undesirable. The pH was measured using a Oakton pH 150 meter (Oakton Instruments, Vernon Hills, IL). Nutritive values (CP, ADF, and NDF) were determined by Near Infrared Spectroscopy (FOSS, Eden Prairie, MN). The mean $\pm$ sd for moisture, CP, ADF, and NDF was 53.9 ± 10.8, 14.5 ± 3.6, 36.6 ± 4.4, and 58.2 ± 7.6, respectively. Principle component analysis revealed the main variant in the first principle component was moisture. The main variants in the second principle component were CP and fiber (ADF and NDF). The first 2 principle components explained 98% of the variation. The pH averaged 5.2 ± 0.5 and was negatively correlated with moisture ($r = -0.7$, $P < 0.001$). Olfactory counts were 11 desirable, 12 acceptable, and 12 undesirable. Logistic regression indicated that increasing CP ($P = 0.02$) and moisture ($P = 0.06$) increased the likelihood for an undesirable scent. This project provided insight into the strengths and weaknesses of haylage. In addition, this exercise provided a hands-on learning opportunity in forage evaluation methods and producer education for an agricultural student completing a summer internship in Extension.

010 Beef 101: A Hands-on Workshop Highlighting Carcass Fabrication and Processing.

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A workshop entitled Beef 101: From the Rail to the Plate was held on March 15, 2016 at the Mississippi State University Meat Science Laboratory at Ballew Hall in Starkville, MS. The objective of this one-day workshop was for beef cattle producers and extension agents to learn about the process of taking a live finished animal to a wholesale cut of beef. The workshop was designed to be very hands-on and as such was limited in size. Topics covered included: live animal evaluation, beef slaughter, carcass grading, carcass anatomy, fabrication of primal cuts, fabrication of wholesale cuts, and food safety. The participants were also treated to an "off the grill" lunch, which included a sampling of a wide variety of wholesale beef cuts. Speakers included Extension beef specialists, meat scientists, and the meat laboratory manager and other meat laboratory staff. All workshop sessions required active participation by attendees, which included having attendees break down whole sides of beef during the fabrication sessions. A pre-test and post-test was administered to participants to determine gains in knowledge. Participants were provided with an evaluation after the course to evaluate their understanding of workshop topics before and after the program, as well as certain practices that they may choose to adopt on their farm or beef buying habits. Participants were also asked demographic questions, where they learned about the workshop, and suggestions to improve this and future programs. There were 15 participants in the workshop, of which 14 completed the pre- and post-test and 14 submitted anonymous evaluations of the program. The pre- and post-test consisted of the same 10 questions covering various meat science topics. The average score on the pre-test was 37.7%, while the average score on the post-test was 75.4%. This indicated that participants exhibited a 51.6% increase in knowledge gained as a result of the course. Participants self-reporting of knowledge gained also showed an increase in knowledge, with all categories showing a positive average knowledge increase before and after the program. Participants were also asked about practices that may be changed as a result of the program, and 71% of participants indicated that they planned to adopt modifications to their beef buying habits. Overall the program and speakers were very well received and all participants indicated that speakers were very knowledgeable, and they'd be likely to very likely to recommend Mississippi State University Extension as a contact on beef cattle.

011 The Effect of Various Levels of Dietary Starch on Glycogen Replenishment in the Light Working Horse.

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Multi-day competitive events throughout the performance horse industry brings forth the necessity to understand recovery from exercise, especially from bouts of intense, anaerobic exercise. A recent trend of high fat, high fiber diets is promoted as a safe way to increase the energy density of a diet. This complicates the issue of fatigue and recovery as anecdotal evidence has shown that horses on a high fat, high fiber diet may fatigue during multi-day competitions faster than horses on traditional diets. Nine Quarter Horses (2 to 7 yr; 409 to 494 kg BW) were used in a 3 x 3 Latin square study lasting 105 d to determine the effect of various levels of dietary starch on glycogen replenishment in the light working horse. Horses were fed 1% BW/d in Coastal Bermudagrass hay with remaining calories met by a high starch (1,206.67 g/d)(HS), medium starch (844.61 g/d)(MS), or low starch (263.13 g/d)(LS) concentrate. After a 7 d washout period, horses were transitioned to 1 of the 3 diets over 7 d for a 14 d treatment period where they were then worked to fatigue in a standardized exercise test (SET). Horses were lightly exercised for 30 min 3 d/wk. The SET consisted of a 30 min trot in a panel exerciser, followed by 27 min of an incremental high-intensity work on a treadmill. Skeletal muscle was biopsied from the *biceps femoris* at rest, immediately after the SET, and 24 and 48 h post exercise. Samples were submerged in liquid nitrogen and stored at -80ºC until glycogen analysis using a commercial kit. Venous blood samples were taken at rest, immediately post exercise, 10 min after recovery, and 24 h post exercise. Data was analyzed using Proc Mixed (SAS) program with fixed effects of period, treatment, and time x treatment with horse included as a random block effect. High starch had higher resting muscle glycogen concentration ($P = 0.009$) than MS (10.25 vs. 8.28 µg/mg wet wt) (Figure 1). Low starch had higher glycogen concentration 24 h post ($P = 0.04$) than HS (9.52 vs. 7.68 µg/mg wet wt). High starch utilized more glycogen than MS or LS. A slight reduction in glycogen post exercise for MS and LS indicated that fat or protein may have been used as substrate for exercise. Results indicated that feeding the HS diet did not yield an advantage in recovery time over a MS or LS diet.

Table 012. Forage Produced and Consumed during Sand Mountain Elite Replacement Heifer Development Program in 2016

Forage Type	No. Grazing Days	No. Heifers Grazed	Total Forage Mass, kg DM1	Forage Disappearance, kg DM1	Forage Disappearance Rate, kg DM/heifer/d2
Fescue	84	323	15,143	6,571	5.9 ± 0.9[a]
Rye	71	462	14,014	7,926	6.5 ± 0.6[a]
Ryegrass	143	735	34,694	19,331	8.6 ± 0.5[b]

[1] Actual forage values available and consumed. Heifers grazed 3.2 ha of Fescue, 3.2 ha of Rye and 9.7 ha of Ryegrass.

[2] Least Squares Means. Values with different superscripts within this column are significantly different from one another P<0.05.

012 Sand Mountain Elite Heifer Development Program I: Forage Growth and Utilization.

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The Sand Mountain Elite Heifer Development program was established to demonstrate to northeast Alabama commercial cattle producers recommended methods for replacement heifer development. In Autumn 2015, 3.2 ha of a novel endophyte tall fescue (*Festuca arundinacae,* Schreb) was clipped, 67.3 kg/ha N applied and allowed to stockpile. In October 2015, 3.2 ha of rye (*Secale* cereale L.) and 15.8 ha of ryegrass (*Lolium perenne* L.) were drilled into sod and 56 kg/ha N applied. In March, an additional 33.6 kg/ha N was applied to rye and ryegrass paddocks. Each forage type was divided into 0.81 ha paddocks (n = 17). Heifers (n = 48) were delivered in early January. Paddocks were rotationally stocked (n = 154 days) ensuring each heifer group grazed each forage type the same number of days. Heifers were allowed continuous access to water and mineral supplementation. Forage height was taken when heifers were turned into each paddock using a grazing stick and converted to kg DM by multiplying kg of forage per cm by cm of forage height for each forage type. Heifers were moved to a new paddock when 50% of the forage disappeared (range 1 to 10 days) as determined by height of the forage. Dependent variables of DM forage consumed per ha and DM forage consumed daily were analyzed using a general linear model with independent variables of forage type, heifer group and the interaction between forage type and heifer group. Ryegrass had significantly greater disappearance (722 ± 33 kg/ha) than fescue or rye (453 ± 58; 428 ± 41 kg/ha, respectively). Overall, it was shown that properly managed forages with favorable growing conditions (Jan: -2/8 C; Feb: 2/13 C; Mar: 8/19 C) can produce sufficient forage mass for developing replacement heifers.

Table 013. Cumulative ADG(kg/d) and WDA (kg/d) of Sand Mountain Elite Heifers

	Day 28		Day 58		Day 90		Day 154	
Group	ADG	WDA	ADG	WDA	ADG	WDA	ADG	WDA
1	0.28[a]	0.79[a]	0.77[a]	0.82[a]	0.87[a]	0.83[a]	0.83[a]	0.83
2	0.34[a]	0.79[a]	0.80[a]	0.82[a]	0.86[a]	0.82[ab]	0.79[a]	0.80
3	0.99[b]	0.73[b]	1.03[b]	0.74[b]	1.10[b]	0.77[b]	0.98[b]	0.77

Values within a column with different subscripts are significantly different from one another $P<0.05$.

013 Sand Mountain Elite Heifer Development Program II: Heifer Performance.

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The Sand Mountain Elite Heifer Development program was established to demonstrate to northeast Alabama commercial cattle producers recommended methods for replacement heifer development. In Autumn 2015, 16.2 ha of novel endophyte tall fescue (*Schedonorus* phoenix) ,rye (*Secale* cereale L.) and ryegrass (*Lolium perenne* L.**)** were established or stockpiled. Heifers (n = 48) were delivered in early January. Heifers were weighed (initial weight = 280.3 ± 37.2 kg) and measured for height (118.1 ± 5.3 cm) at delivery and divided into 3 groups. Weights and heights were taken every 28 d from January through April and when heifers were checked for pregnancy in June. Heifers gained 0.85 kg/d from January to June. Weight per day of age was 0.83 kg/d with and average frame score of 5.6. A repeated mixed model analysis was used for ADG, gain, WDA, and frame score with independent variables of group, time (28, 58, 90 and 154 d on grazing), sire breed and interaction of group and time. Heifer was considered random. There was a significant group by time interaction for ADG, gain and WDA. Cumulative average daily gains of heifers in group 3 significantly ($P < 0.05$) outgained heifers in groups 1 and 2 throughout the development program. Average daily gains for heifers in groups 1 and 2 did improve after d 28, but were never able to recover from an initial poor start. Even with the poor ADG performance of groups 1 and 2 during the first 28 days, WDA of heifers in groups 1 and 2 were very close to their final ADG. This indicates they were on a fairly steady or even growth pattern from birth. Heifers in group 3 had a significantly lower ($P < 0.05$) WDA than the other 2 heifer groups until they had been in the development program for 90 days. Perhaps some of the continued differences in growth were due to compensatory gain. However, no significant differences existed between groups for final weight.

014 Sand Mountain Elite Heifer Development Program III: Heifer Reproductive Performance and Program Costs.

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The Sand Mountain Elite Heifer Development program was established to demonstrate to northeast Alabama commercial cattle producers recommended methods for replacement heifer development including use of artificial insemination (AI) with a timed AI protocol. In Autumn 2015, 16.2 ha of novel endophyte tall fescue (*Festuca arundinacae,* Schreb),rye (*Secale* cereale L.) and ryegrass (*Lolium perenne* L.**)** was established or stockpiled. Heifers (n=48) were delivered in early January. Heifers were weighed (initial weight = 280.3 ± 37.2 kg) and measured for height (118.1 ± 5.3 cm) at delivery and divided into 3 groups. Heifers were rotationally stocked through the paddocks ensuring each group grazed each forage type the same number of days. Heifers were allowed continuous access to water and mineral supplementation. Prior to breeding, reproductive tract scores (RTS) and pelvic area measurements were taken. Average RTS was 3.25 ± 1.2 units and average pelvic area was 1022.8 ± 236.0 cm^2 . In early April, estrous in heifers were synchronized using a Select-Synch plus CIDR protocol. After CIDR removal, heifers were visually observed for standing heat. Heifers in standing heat were AI bred 12 hours later. Heifers not observed in standing heat were bred AI 72 hours after CIDR removal. There were 34 heifers observed in standing heat and 14 heifers bred at 72 hours. At the time of breeding, heifers averaged 63.5% of their mature body weight, with a range of 52 to 75%. Average age was 435 ± 43 days. Ten days post-breeding, a clean up bull was turned out and remained with the heifers for 57 days. A licensed veterinarian palpated the heifers to determine pregnancy. It was determined 35% (17 heifers) were AI bred and 50% (24 heifers) were bred by the clean up bull. Of heifers bred by the clean up bull, 17 (71%) were bred on the first cycle and 7 (29%) were bred on the second cycle. Seven heifers remained open. During the inaugural year of the Sand Mountain Elite Heifer Development Program, heifers were developed only on forage and minerals from January through June. Cost of grazing was $99.50/heifer or $34.90/ha. Heifers remained healthy throughout the program with only routine vaccinations, deworming and fly control needed. Management practices were performed that could be performed by any cow/calf producer in northeast Alabama. Overall, the cost to enroll heifers in the program was $450/heifer resulting in a cost of gain of $0.68/kg.

015 Evaluating the Post-Course Application of the Livestock Education and Certification for Agricultural Law Enforcement (LECALE) Extension Curriculum.

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Many law enforcement and government agencies have dedicated law enforcement officers (LEOs) who respond to agricultural crime, inspection, urban/rural interface issues, and livestock neglect cases. We developed a training and certification program for LEOs in the field of animal science. Three classes were offered to 52 individuals in a 12-month period. Instruction used a combination of classroom and experiential learning sessions. Daily homework assignments and quizzes were administered to enhance retention. Final assessment to achieve certification included six hands-on exercises to demonstrate proficiency and a written, multiple-choice examination. A total of 94% of the participants passed the certification requirements and overall subject matter knowledge increased by 36%. Likert scale responses (1 to 5 = very little to very much) regarding knowledge of 14 subject matter topics before (2.89 ± 0.11) and after (3.83 ± 0.07) indicated a mean increase of 0.91 ± 0.09 units (UNIVARIATE procedure of SAS, v9.2). Topics with a >1 unit increase included: cattle and equine BCS, equine behavior and learning lab, and nutrition. Our objective was to evaluate the post-course application of the LECALE curriculum. An online survey instrument was developed (Qualtrics[TM]) and distributed to LECALE attendees (n = 50) in June 2016. Twenty-five attendees participated in the survey (50% response rate) providing representation from all three courses (n = 12, 5, 8). Time between completion of the course and administration of the survey was 15, 6, and 3 months, respectively. The majority of attendees agreed that as a result of the topics presented in the LECALE course, they have been and continue to be better prepared when responding to livestock calls (animal identification = 92%, cattle behavior = 96%, equine behavior = 92%, cattle and equine BCS = 94%, euthanasia and disposal = 92%). Attendees indicated they often refer to the information provided during the course regarding horses (66.7%) and cattle (58.3%). Attendees agreed they have been and continue to be better prepared to respond to livestock calls as a result of field trips provided during the course (equine retirement home and beef cattle research unit visits = 91.6%). 33.3% indicated they have utilized the eXtension Horses Body Condition Score app since attending the course. Results indicate that the LECALE program improved the ability of LEOs to perform their job duties. Post-course survey responses are also being utilized to further enhance the LECALE curriculum.

016 Assessment of an Online Management Course for Southeastern Beef Producers.

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Extension educators across the country now use a combination of both online decision tools and on-site trainings to deliver scholarly information to end users (Rusche and Renelt, 2014). Diversifying the delivery of educational content to stakeholders through both live and online training platforms may improve the reach of Extension information to clientele. In January 2016, Beef Basics, a free online beef cattle management course, was launched by the Alabama Cooperative Extension System in response to increased interest in web-based educational resources, and a need for targeted programming for beginning farmers. The course was designed to be completed in eight weeks, and structured into eight modules using the Canvas Catalog software platform. After enrollment, student participants had access to video lectures, quizzes, and additional links to educational resources in the areas of forage management, nutrition, herd health, breeding, genetics, and meat science. Six months after release, exit survey data was compiled from participants who completed the online training (n = 72) and summarized. Of the course graduates, 72% owned or managed 0 to 30 head of beef cattle, 15% had 30 to 60 head, and only 13% had more than 60 head. Participants were asked to rank which topic areas from the course were mostly likely to help them become more profitable in their operation. The topics were ranked as: 1) forages, 2) nutrition, 3) herd health, 4) breeding and genetics, 5) goal setting, 6) costs and returns, and 7) consumer perceptions of the beef industry. Overall, 82% of the participants were highly likely to adopt some of the information presented on these topics in the next 12 months. In terms of economic savings, 36% of survey respondents estimated that they would save between $0 to 50, 26% indicated $50 to 100 per head, 24% responded $101 to 200, and for 14% more than $200 per head in savings based on the information received in this course. These early use data demonstrate that online coursework may be an effective method for Extension program delivery alternatives. Annual assessment of course usefulness will provide further information on potential improvements and future tiered course development phases.

017 UF Beef Cattle Economics Webinar Series.

C. G. Prevatt[*]

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Beef cattle producers in the U.S. saw record feeder calf prices and profits during 2013, 2014, and 2015 that changed the dynamics of the cow-calf industry. In addition, the U.S. cattle industry entered into an expansion phase of the cattle business cycle as of January 1, 2015. To meet the needs of today's cattle and forage producers a series of webinars were developed to inform producers of the challenging agricultural environment by providing timely production and economic information to help them operate in the volatile marketplace. The five webinars presented were Beef Cattle Market Outlook, Marketing Opportunities for Feeder Calves, UF/IFAS Beef Cow-Calf Budget, Projecting Cow-Calf Profitability, and Replacement Heifer Economics. These presentations were designed to help producers increase herd production, performance, and profitability by exposing some of the potential risks in the cattle market and presenting possible profit opportunities for the years ahead. A total of 117 cattle and forage producers from across the Southeast USA were registered for the event, and a total of 183 participants attended the series. Participants included both large producers (500+ cows) and small producers (less than 100 cows). Participants completed an evaluation survey of the series: 86% found the information received to be excellent or good, 93% said it was useful or very useful, 74% had knowledge greatly improved, 85% will definitely make changes to management as a result, and 77% will use recommended decision-aid tools. The value of the program information was estimated at $10 to $75 per head, averaging $41.10 per head. Based upon the distribution of herd sizes for participants the economic return of the program was estimated at over $190,000.

018 An Economic Analysis of Grazing Cool-Season Annual Forages.

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Producers throughout the Southeastern United States usually feed hay and other stored feedstuffs during the autumn, winter, and early spring due to limited forage availability and lower forage quality. Feeding during this time period could last for 90 to 180 d based on management programs and weather conditions. Regardless of why and how long we choose to feed cattle, most cattle producers will agree this is a very costly activity and greatly reduces the profitability of the cowherd. Over-seeding cool-season annual forages into dormant warm-season pastures allows producers to utilize acres that would normally be non-productive during the winter. Although cool-season annual forages are costly to establish ($250-$740/ha), depending on planting method and fertilization, their nutritive values are high in total digestible nutrients (TDN) and crude protein (CP). The high nutritive value of cool-season annual forages can provide some cattle producers with a less costly substitute for supplementing their herd's nutritional needs. During the winter of 2015-2016, six cattle producers planting and grazing cool-season annual forages were identified. They were evaluated based on level of forage production, utilization or consumption of forage, and cost of forage production. Enterprise budgets were developed for each individual producer to determine the estimated cost of forage production. Values for estimated level of forage production and utilization of forage were obtained from each producer. Estimated cost of forage production, level of forage production, and utilization of forage ranged from $334 to $778/ha, 1,345 to 9,080 kg/ha, and 30% to 75%, respectively. These values allowed us to estimate the cost of forage consumed on a dollars per metric ton basis. The cost of the forage consumed for these producers ranged from $46 to $318/MT. The economic results of the study revealed that four out of six producers evaluated planted and grazed cool-season annual forages economically when compared to the cost of feedstuffs consumed with similar nutritional values. The economic results of this study are sensitive to the levels of forage production, cost of forage production, and the utilization of the forage grazed. Changes in these parameters will significantly affect the estimated cost of forage consumed. After the first year of study, our analysis suggests that grazing cool-season annual forages can be a viable economic option for producers who can control their costs while getting adequate production and utilization.

019 Relationships between Producer Characteristics and Production Practices of Kentucky Beef Cattle Producers Participating in the UK Beef IRM Farm Program.

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The University of Kentucky Beef IRM team has developed a project-based educational program (UK IRM Farm Program) designed to instigate long-term changes in adoption of production practices and examine its impact on productivity and profitability of cow-calf operations. Our current objective is to elucidate relationships between producer characteristics and their use of various production practices. Beef cattle producers (n = 72) from 27 counties in Kentucky were selected to participate

in the program. Each participant completed a survey to assess their current level of management and to obtain historical and current production data. Survey data was analyzed using Spearman's nonparametric correlations in JMP v11. Spearman's rho (sr) values of 0.10 to 0.249, 0.25 to 0.50, and 0.50 and greater were classified as low, moderate, and strong respectively. Production practices (n = 67) were classified into five categories; general management (MGT, n = 13), reproduction (REPRO, n = 7), nutrition (NUT, n = 19), genetics (GEN, n = 5), and health (HEA, n = 23). Operations were evaluated based upon age, farming status, number of cattle, factors valued in their operations, and why they farm. As producers age, their farming status increases from part-time to full-time (sr = 0.39, P = 0.001). Producer age was not related ($P > 0.10$) to number of cows, level of enjoyment of having cattle, or the value of greater returns to the farm. Farm status and number of cows were related for both commercial and seedstock operations, (sr = 0.36 and 0.74 respectively, $P < 0.01$) indicating that full-time farmers owned more cattle. Full-time producers tended to have a better nutrition program, (sr = 0.22, $P = 0.07$) but farm status did not impact any other production category. Increases in the number of practices classified as general management (ex. adequate facilities, ID cows/calves, production records), were associated with increases in the number of practices for all other management groups; REPRO, HEA, NUT, GEN (sr = 0.63, 0.32, 0.54, 0.27 respectively $P < 0.05$). As the number of commercial cows in the herd increases, an increase in average weaning weight is observed along with a more complete health program (sr = 0.35 and 0.3 respectively, $P < 0.05$). We conclude that age and/or farming status impacts number of cows, number of calves weaned, average weaning weight, and incorporation of standard production practices. Also, establishing basic management appears to be the cornerstone for adoption of all management practices.

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020 Fescue Summit Brings Together Industry and Academia at Southern Section ASAS.

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Fescue toxicosis is a complex multi-factorial syndrome that impacts a large number of beef cattle in the Southern Region of the USA, and in other countries around the world. Kentucky-31 tall fescue fescue [Lolium arundinaceum (Schreb.) Darbysh] was released and rapidly adopted before discovery of the fescue endophyte and the toxicosis caused by the ergot alkaloids it produces. Introduction of endophyte-free fescue in the 1980s was promoted as the solution to the problem, but poor agronomic performance resulted in many stand failures and made producers resistant to other potential solutions to the problem. While our understanding of the problem and potential solutions has improved, adoption of alternative forages including non-toxic infected fescue, warm season grasses, and annuals has been slow. Additionally, research often shows severe problems that appear somewhat different than those experienced by producers in commercial production settings. As part of the Southern Section of ASAS annual meeting in 2015 a pre-conference meeting, the Fescue Summit, was held and included discussion with producers, allied industry, university faculty and graduate students. The program was designed to complement the Bill Kunkle Interdisciplinary Beef Symposium which was focused on fescue toxicosis. The program included informal presentations to introduce the issues, and discussion with invited panels of producers and allied industry representatives followed. After the afternoon program a social was held to stimulate discussion and relationship building among the group. On the following morning groups balanced across participants discussed major issues including producer education, research and funding sources. Participants included 10 forage agronomists, 6 extension animal scientists, 11 research animal scientists, 17 graduate students, 8 farmers and 7 members of allied industry. Key approaches identified by the group included a need for regional educational programming for producers, need for a survey to determine and communicate research and extension efforts ongoing in the region, need for on-farm demonstrations with workshops, producer education via video and web, more multi-state interdisciplinary collaborative research, need for updated economic analysis of the problem and possible solutions, and development of a national strategy to guide future work. The need for an interdisciplinary consortium including producers and allied industry was identified to move work in the area ahead, and potential participants were identified. The activity has spawned collaborative educational and research approaches across the region and is a model for future efforts of the Southern Section of ASAS to enhance industry interactions and improve research and extension outcomes with complex industry problems.

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021 Do Beef Cattle Producers Understand the Economics of Natural Production?

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Consumer demand for "natural" beef has increased over the past decade driven by the erroneous perception of improved health benefits. This has led many beef producers to modify their production systems to manage their calf-crop to meet

requirements for certification as natural. Natural certification programs typically require that calves have never received growth promoting hormones, antibiotics, or animal by-products. For such programs, there is not a set premium that the producers receives, rather the perceived "premium" is the potential increase in price solely based on the willingness of a buyer(s) to pay more for a group of natural cattle. Therefore, in order for a producer to increase profitability through a natural program, one must understand the cost of lost animal performance from adopting the practices. Essentially, they need to quantify the lost production (kg of calf BW), in order to determine the minimum additional revenue needed to add value to the system. Technologies, such as utilizing growth-promoting hormone implants that are known to increase gains of beef calves prior to weaning, have been abandoned by many producers in order to meet a natural market. A 2016 study showed that calves implanted 100 d and 30 d prior to weaning with a progesterone and estradiol benzoate gained more ($P < 0.05$) at weaning compared to non-implanted calves (19.6 kg). A 2-yr study conducted in NW GA compared calves raised naturally (no hormone and no antibiotics) and conventionally (receiving implant and treated with antibiotics when needed). Over the 2 yr, natural calves gained less ($P < 0.05$) than conventional calves (15 kg). Respectively, this results in a loss, or premium needed, of $65/calf and $49/calf, for not adopting this technology. The profit/loss of these systems are dependent on market fluctuations, however. This information can be useful to extension educators and industry representatives when helping producers decide what type of production system to utilizing in their operations.

022 Effects of Gradual Reduction on Frequency of Energy Supplementation on Growth and Immunity of Stressed Calves.

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This study evaluated the effects of gradual reduction on frequency of energy supplementation following vaccination on growth and measurements of innate and humoral immunity of beef steers. At 14 d post-weaning (d 0), Angus steers (n = 42; 200 ± 5 kg of BW; 175 ± 4 d of age) were stratified by BW, and randomly assigned to 1 of 14 drylot pens (3 steers/pen). From d 0 to 42, steers were provided ground tall fescue hay *ad libitum* (57% TDN, 13% CP of DM) and supplemented with concentrate at 1% of BW (50:50 soybean hulls and corn gluten feed; 71% TDN, 15% CP of DM; DM basis). Treatments were randomly assigned to pens, and consisted of similar weekly concentrate DM offer (1% of BW times 7 d) that was divided and offered daily from d 0 to 42 (**7X**; 4 pens), 3 times weekly from d 0 to 42 (**3X**; Monday, Wednesday, and Friday; 5 pens), or daily from d 0 to 14, and then 3 times weekly from d 15 to 42 (**7-3X**; 5 pens). Steers were vaccinated against infectious bovine rhinotracheitis (IBR), bovine viral diarrhea virus (BVDV), parainfluenza-3 (PI-3), *Mannheimia haemolytica* and *clostridium* on d 0 and 15. Individual BW was measured before feeding on d 0 and 42, following 12 h of feed and water withdrawal. Blood samples were collected via jugular venipuncture 4 h after concentrate supplementation on d 0, 1, 2, 3, 7, 15, 16, 17, 18, 22, and 42. Mean BW, ADG, G:F, hay DMI, and total DMI over the 42-d period did not differ among treatments ($P \geq 0.26$). Plasma concentrations of cortisol and mean serum BVDV-1 titers also did not differ among treatments ($P \geq 0.35$), but overall plasma haptoglobin concentrations were greater for 3X vs. 7-3X and 7X steers ($P \leq 0.05$; 0.44, 0.37, and 0.33 ± 0.026 mg/mL, respectively). Also, 3X steers had less mean serum IBR titers ($P \leq 0.05$; 0.29 vs. 0.88 and 0.79 ± 0.179 $\log_2$, respectively) and less seroconversion to PI-3 virus on d 15 than 7-3X and 7X steers ($P \leq 0.05$; 36.0 vs. 76.6 and 57.8 ± 8.24%, respectively). In summary, a gradual reduction on frequency of energy supplementation during a 42-d preconditioning period did not impact growth, but alleviated inflammation and prevented detrimental effects on vaccine response against BVDV and PI-3 compared to steers fed 3 times weekly during the entire study.

023 Pre-Weaning Injections of Bovine Somatotropin Enhanced Puberty Attainment of Bos Indicus-Influenced Beef Heifers.

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A 3-yr study evaluated the effects of three 14-d apart injections of bovine somatotropin (bST) to suckling beef heifers on pre-weaning (yr 1, 2 and 3) and post-weaning (yr 1 and 2) growth and puberty achievement. On d 0 of each yr, Angus × Brangus heifers (n = 15 heifers/treatment/yr; BW = 147 ± 20 kg; Age = 134 ± 11 d) were stratified by BW and age, and randomly assigned to receive s.c. injections of saline (**SAL**; 5 mL; 0.9% saline) or half-dose of **bST** (250 mg of sometribove zinc; Posilac, Elanco, Greenfield, IN) on d 0, 14 and 28. Cow-calf pairs were allocated to 4 bahiagrass (*Paspalum notatum*)

pastures (7 to 8 pairs/pasture/yr) from d 0 until weaning (d 127). Unshrunk BW and blood samples were collected on d 0, 14, 28 and 127. From d 127 to 346, heifers were pooled by treatment and allocated to bahiagrass pastures (1 pasture/treatment/yr) and fed blackstrap molasses-based concentrate at 1.1% BW (DM basis). Post-weaning blood samples were collected every 9-10 d to determine plasma progesterone (P4) concentrations. Heifers were considered pubertal when 2 consecutive plasma samples had $P4 \geq 1.5$ ng/mL. Effects of treatment × yr and treatment × yr × time were not detected for any variable measured in the study ($P \geq 0.69$). During pre-weaning phase, bST heifers had greater pre-weaning mean plasma IGF-1 concentrations (115 vs. 102 ± 3.8 ng/mL; $P = 0.02$; yr 1 and 2 only) and ADG from d 0 to 42 (1.15 vs. 1.07 ± 0.026 kg/d; $P = 0.03$), but had less ADG from d 42 to 127 than SAL heifers (0.74 vs. 0.80 ± 0.022 kg/d; $P = 0.04$). Hence, BW at weaning did not differ between bST and SAL heifers (261 vs. 259 ± 1.3 kg, respectively). During post-weaning phase, bST heifers had similar ADG from d 127 to 347 (0.17 vs. 0.12 ± 0.07 kg/d; $P = 0.11$), and BW and age at puberty (290 vs. 291 ± 6.9 kg and 395 vs. 419 ± 14 d, respectively; $P \geq 0.15$), but greater puberty achievement at start of breeding season (63 vs. 44 ± 7.9%) compared to SAL heifers. Hence, three half-dose injections of bST administered to suckling beef heifers at 14-d intervals, between 135 and 163 d of age, may be a feasible management practice to enhance puberty attainment at the start of the breeding season.

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024 Whole Cottonseed Supplementation Improves Performance and Reduces Emission Intensity of Grazing Cattle.

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The objective of this experiment was to determine the effect of whole cottonseed (**WCS**) supplementation on average daily gain (**ADG**) and enteric methane (**CH4**) production of steers grazing native range during spring. Steers (n = 18; body weight = 317 ± 5.5 kg) were adapted to an in-pasture CH4 measurement device (GreenFeed (**GF**); C-Lock Inc., Rapid City, South Dakota) for one week. Steers were stratified by adaptation-period use of GF and randomly assigned to treatments within stratifications. Treatments were either 0, 0.9, 1.8, 2.7, 3.6, or 4.5 kg of WCS (as-fed) per day offered in individual feeding stanchions. Orts were measured and actual WCS intake was used in the analysis. Unshrunk body weight was measured weekly before feeding for the duration of the experiment. Mean supplement intake per animal ranged from 0.89

to 2.86 kg per day. Total fat content of the diet (WCS + forage) at the greatest WCS intake was estimated to be 6.4%. Animal performance increased linearly as WCS intake increased ($P = 0.02$). Two of the three steers assigned to the 0 WCS treatment refused to use GF, and therefore CH4 emissions were unavailable. Because only one observation was available at 0 WCS, and the Cook's Distance of this point was greater than one (Di ≥ 7.48), the 0 WCS observation was excluded from further analysis. There tended to be a quadratic relationship between daily methane production (g of CH4 per animal per day) and WCS intake ($P = 0.057$), and there was a significant quadratic relationship between emission intensity (g of CH4 per kg of ADG) and WCS intake ($P = 0.011$) indicating minimum CFP at 2.0 kg WCS intake. The increased animal performance associated with WCS supplementation decreased emission intensity at moderate levels of supplementation. If ranchers choose to feed WCS to minimize emission intensity of steers grazing spring native range, they should feed approximately 2.0 kg per day of WCS.

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025 Evaluating Heat Detector Patch Response to Determine Gonadotropin-Releasing Hormone Use at Split-Timed Artificial Insemination on Pregnancy Rates in Beef Cattle.

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This study evaluated using an estrus detection patch as a simple, cost-effective reproductive management tool to identify animals that have been or are in standing heat at split-timed AI (STAI) and the necessity of the second gonadotropin-releasing hormone (GnRH) injection at STAI synchronized with a 7-Day CO-Synch + controlled intravaginal drug release (CIDR) protocol for beef cattle. Multiparous lactating crossbred beef cows (n = 216) were stratified by age, BW, BCS, and post-partum interval (PPI) to 2 treatment groups: CTRL = timed-AI (TAI) at 72 h post CIDR removal (n = 67), or TRT = STAI at 72 or 84 h post CIDR removal (n = 149). All females received GnRH plus a CIDR insert on d 0, prostaglandin $F_{2\alpha}$, CIDR removal, and an Estrotect heat-detector patch on d 7. Beginning at 72h post-CIDR removal, a patch score (PS) was given (1 = < 50% removed; 2 = $\geq$ 50% removed) to cows from both treatment groups and all cows in the CTRL group received a second GnRH injection, regardless of PS, at TAI. Cows in the TRT group with a PS of 2 only received no GnRH at TAI. At 84 h TAI, the remaining TRT cows not inseminated at 72 h were given a second PS and cows with a PS 1 received a second GnRH injection and cows with a PS of 2 did not. Blood samples for Progesterone (P4) concentration were col-

lected from all cows on d-11 and 0 to determine percent of cows cycling. Data were analyzed using Proc Genmod with treatment and AI technician (2 technicians) as fixed effects, sire (2 sires) as a random effect, and BW, BCS, age, and PPI as covariates. There was no treatment × AI technician interaction ($P = 0.97$); therefore, all data were pooled for main effects. Timed-AI pregnancy rates were similar ($P = 0.83$) between the CTRL (45%) and TRT (45%) groups. The percentage of cows cycling in each treatment group was similar ($P = 0.10$) and averaged 77%. Pregnancy rates were greater ($P < 0.01$) for cows with a PS of 2 (50%) compared with a PS of 1 (21%), regardless of treatment. However, by extending TAI to 84 h in unresponsive cows, 82% of the TRT cows did not receive a second injection of GnRH at TAI. Using a heat-detector can reduce the percentage of cows that require GnRH at TAI without compromising pregnancy rates.

026   The Effects of Moisture at Baling and Wrapping Delay on Storage Characteristics of Annual Ryegrass Round Bale Silage.

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Silage baling process has the benefit of eliminating unknowns, such as rainy weather that can negatively affect the quality when trying to cure hay. However, the moisture content and the amount of time from baling to wrapping can have significant impacts on the overall quality of the silage. The objective of this study was to observe the effects of wrapping delays on nutritional quality of annual ryegrass (*Lolium multiflorum*) silage bales at two levels of moisture ($30 \pm 9.5\%$ or $74 \pm 0.8\%$ moisture). A single field of fully headed annual ryegrass was divided into quadrants and cut with a mower conditioner and allowed to cure for 72 hr (DRY) or cut and baled on the same d (WET). Individual silage bales randomly selected from each field quadrant were wrapped with 4 layers of 25-μm plastic film following delays of 0, 1, 2 or 3-d after baling. DRY (n = 18) and WET (n = 20) bales were assigned as replicates and wrapped by pasture quadrant, then stored for 85-d. All bales were sampled pre- and post-storage to compare the nutritional quality changes during storage. Data was analyzed using the Mixed Procedure of SAS (SAS Inst. Inc., Cary, NC) with fixed effects of moisture, wrapping delay and their interaction and bale as a random effect. Contrasts were used to test the linear and quadratic effects of wrapping delay. Over the storage period, weight of DRY bales increased 23 ± 8.1 kg, whereas weight of WET bales decreased 22 ± 7.8 kg ($P <$

0.01). Pre-storage TDN of the WET bales decreased linearly ($P < 0.01$) with delay from $56.0 \pm 0.30\%$ with no delay to $54.4 \pm 0.30\%$ with 3-d delay. Following storage, pH of DRY (5.7 ± 0.13) was greater than WET (4.6 ± 0.13) and pH tended ($P = 0.07$) to increase with increasing delay. In WET, lactic acid concentration decreased ($P < 0.01$) while acetic, propionic, and butyric acids increased ($P < 0.01$) with increasing delay. Organic acids were not affected ($P \geq 0.13$) by wrapping delay in DRY. Changes in the fermentation profile of WET bales with delays in wrapping indicate a clostridial fermentation which will result in reduced shelf life and possible reductions in DMI by livestock. Based on these results, ryegrass fermentation patterns and nutritional quality show a decline with each day delayed before wrapping with WET silage, especially with a delays ≥ 24 hr.

027   Milk Production Responses to Beef Cow Energy Intakes.

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Breed association genetic trends indicate that the genetic potential for milk yield in several popular breeds has dramatically increased over the past 25 years. However, little data are available characterizing the dynamic relationship of milk yield, milk composition and calf performance to energy intake. Therefore, the objective of this experiment was to determine the milk yield and milk composition responses of lactating beef cows over a range of feed energy intake. Two experiments were conducted in consecutive yr using a total of 80 beef cow/calf pairs (40 per yr). Each yr, 8 cow/calf pairs were assigned to one of 5 energy intake levels (135, 159, 176, 200, and 223 kcal NEm·kg BW$^{-0.75}$·d^{-1} for 111 d until weaning in yr one and 142, 159, 177, 193, and 212 kcal NEm·kg BW$^{-0.75}$·d^{-1} for 125 d until weaning in yr two). Each pen of 8 cows and their calves were managed together as contemporaries and group fed. The range of feed energy intakes was accomplished by varying the amount of feed provided to the cows, while the calves had ad libitum access to the same diet in a creep area. Calves did not have access to the cows' feed. Cow body weight, body condition, milk yield and composition, and calf BW gain and creep feed intake were measured. Dependent variables were regressed on linear and quadratic terms of energy intake. The mixed model included year as a random effect and treatment energy level as a fixed effect. Quadratic regression models were not significant ($P > 0.05$). Milk yield *(P = 0.004)*, milk fat percentage *(P = 0.017)*, milk urea nitrogen ($P = 0.028$), milk protein percentage *(P = 0.005)*, and solids non-fat *(P =*

0.002) increased linearly with increasing cow energy intake. Each additional kcal of NEm·kg BW$^{-0.75}$·d^{-1} resulted in 0.41 g of additional milk yield ·kg BW$^{-0.75}$·d^{-1}. Not accounting for energy partitioned to maternal tissue gain, efficiency of conversion of cow energy intake to milk energy production was 0.36. Under these conditions, increasing cow energy intake to increase milk energy production was not efficient.

028 Using Pregnancy-Associate Glycoprotein (PAG) on Day 24 as Marker for Pregnancy on Beef Cattle.

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The United States beef industry estimates that reproductive failure results in annual losses of $600 million. Early embryonic mortality between days 7 to 28 range from 20% to 30%. Late embryonic loss (after day 28 of gestation) may account for 3.2% to 42.7% of all pregnancy failures. Bovine pregnancy-associated glycoproteins (PAG) have been identified as an accurate marker of pregnancy around day 30 of gestation. Pregnancy associated glycoproteins have also been shown to increase in circulation in pregnant cattle as early as day 22 to 24 of gestation. The primary objective of this experiment is determine if circulating PAG concentrations on day 24 can be used as marker of pregnancy. Cows (n = 80) and heifers (n = 22) were synchronized using the 7-day CO-Synch + CIDR protocol and bred using fixed time AI. Blood samples were collected via coccygeal vein on day 14 and day 24 after TAI for PAG analysis. Final pregnancy diagnosis was performed on day 54 by transrectal ultrasound. Day 14 PAG concentration was used as a base line and the difference between day 14 and day 24 concentration was used for statistical analysis. Cows diagnosed as pregnant on day 54 had higher PAG concentration on day 24 compared with cows that were diagnosed as non-pregnant (1.69 ± 0.15 ng/ml vs 0.28 ± 0.18 ng/ml, respectively; $P < 0.0001$). Based on ROC curve analysis, PAG concentration higher than 2.05 ng/ml on day 24 have 95% accuracy in detecting pregnant cows on day 54. Conversely, PAG concentration lower than 0.06 ng/ml on day 24 is 95% accurate in detecting non-pregnant cows. Based on these results, PAG concentration on day 24 might be an early indicator of identifying pregnancy status in cattle; however, more work is needed to determine the efficacy of this test.

029 An Economic Comparison between Limit-Fed and Conventional Cow-Calf Production Systems During Periods of Reduced Forage Availability.

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Weather risk and land values challenge the economic sustainability of cow-calf systems. Intensified systems reduce a producer's dependence on forage production and (or) allows them to more efficiently use forage resources. However, delivery of limit-fed, total mixed rations brings greater fixed costs and creates logistical challenges, preventing smaller producers from capturing benefits associated with intensified systems. Therefore, we evaluated three management scenarios: 1) *ad libitum* hay (HAY), representing conventional drought management in Southeast Texas; 2) a limit-fed total mixed ration (TMR) requiring significant investment in equipment; and 3) a management system where forage and concentrate in the TMR are not mixed but rather fed separately (SEP), decreasing need for investment in equipment. Within TMR and SEP systems four feeding levels to provide 70, 85, 100, and 115% of requirements (NRC, 1996) were considered. Net returns were estimated using a stochastic simulation model based on a 200 cow operation. Stochastic variables included weaning weights, calf prices, and feed ingredient prices. Production responses were based on empirical data from studies evaluating feeding strategy or level. Ingredient and calf prices were estimated from multivariate empirical distributions, which incorporates historical variability and correlation in stochastic forecasted prices. Enterprise budgets for each system were developed and simulated 500 times, drawing stochastic variables from their respective distributions to estimate a distribution of net returns for each strategy and feeding level combination. Net returns for limit-fed systems at intake levels of 70, 85 and 100% ranged from $93.00 to $155.30 per cow and were greater than HAY ($72.41 per cow). However, HAY had greater net returns than TMR at 115% intake level ($62.95 per cow), but HAY had lower net returns compared to SEP at 115% intake level ($95.58 per cow). Reductions in feed costs for limit-fed systems ranged from $29.90 to $116.59 per cow compared to HAY, offsetting increases in other costs. Probability of a negative net return was 0.35 for HAY, slightly less than the negative net return probability observed for TMR at 115% (0.37). All other probabilities for negative returns ranged from 0.13 (SEP at 70%) to 0.30 (SEP at 115%). The CV of net return for HAY (272) was greater than that of any limit-fed system (mean CV = 144). Limit-feeding is preferred to ad libitum hay feeding, and separate delivery of forage and concentrates is the most profitable and least risky of the intensive cow-calf strategies tested.

030 Effects of Dietary Omega-3 Fatty Acids on Growth and Reproduction in Gilts Farrowed By Sows Fed Diets Rich in Omega-3 Fatty Acids.

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The objective of this experiment was to determine the effects of menhaden oil (MO), a rich source of omega-3 fatty acids, on growth and puberty onset in gilts farrowed by sows fed diets also containing MO. Yorkshire x Landrace sows (n = 44) received: 1) control gestation and lactation diets, or 2) diets that included 4% MO (Virginia prime; Omega Protein, Inc., Houston, TX). Control and MO diets were isocaloric and isolysinic. At weaning, 84 gilts farrowed by control or MO sows were placed in pens of three gilts each and provided ad libitum nursery and then grow-finish control or 4% MO diets. After grow-finish, gilts received daily boar exposure and were sacrificed 8 to 11 d after puberty onset for reproductive tract evaluation. Nursery, grow-finish and overall ADG, ADFI and Feed:Gain (F:G) were similar ($P > 0.21$) for gilts farrowed by control or MO sows. Nursery, grow-finish, and overall ADG were also similar ($P > 0.24$) for gilts fed control or MO diets. Compared to controls, however, gilts fed MO diets tended to consume less feed in the nursery (1.18 ± 0.08 vs. 0.98 ± 0.08 kg; $P = 0.09$) and overall (1.83 ± 0.04 vs. 1.72 ± 0.04 kg; $P = 0.06$). Thus, overall F:G was greater (2.52 ± 0.03 vs. 2.33 ± 0.03; $P < 0.01$), and nursery (2.12 ± 0.04 vs. 1.80 ± 0.14; $P = 0.10$) and grow-finish (3.07 ± 0.19 vs. 2.58 ± 0.19; $P = 0.08$) F:G tended to be greater, for control compared with MO gilts. Age at puberty was greater ($P = 0.02$) for gilts farrowed by MO sows (205.1 ± 3.2 d) compared to gilts farrowed by controls (193.9 ± 3.2 d). Age at puberty tended to be greater ($P = 0.09$), however, for control gilts (203.5 ± 3.2 d) compared to gilts fed MO (195.5 ± 3.2 d). Ovulation rate was greater ($P = 0.03$) for gilts farrowed by controls (14.9 ± 0.7) compared to gilts farrowed by MO sows (12.6 ± 0.7). In summary, feeding gilts MO diets enhanced feed conversion efficiency and hastened puberty onset. In contrast, puberty was delayed and ovulation rate decreased in gilts farrowed by sows that consumed MO during gestation and lactation.

Table 031. LS Means (± SE) of Weights and Carcass Traits of Freemartin and Intact Heifers

Variables	Freemartin (FM)	Heifers (HF)	P Values
Weaning Weight (kg)	184.7 ± 5.8	184.5 ± 7.7	0.98
Yearling Weight (kg)	409.2 ± 8.9	402.8 ± 11.9	0.57
Harvest Weight (kg)	470.7 ± 12.2	477.7 ± 16.4	0.65
Carcass Weight (kg)	304.0 ± 6.7	306.4 ± 9.0	0.78
Ribeye Area (cm^2)	69.8 ± 1.6	72.3 ± 2.2	0.22
Adjusted Fat Thickness (cm)	1.19 ± 0.09	1.16 ± 0.12	0.77
Marbling Score	619.8 ± 28.6	556.2 ± 38.6	0.08
Yield Grade Score	3.22 ± 0.16	3.07 ± 0.21	0.43

031 Comparison of Post-Weaning Weights and Carcass Traits between Freemartin and Twin-Heifer Calves.

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The freemartin condition occurs in cattle when a heifer is born twin to a male where the early exposure of testosterone impairs female tract and gonadal development resulting in infertility. Loss of gonadal development and function could have implications in future performance. Over two seasons, growth and carcass traits were compared between freemartins (FM; n = 48) and intact heifers that were born twin to another heifer (HF; n = 21) from a selected population of beef cows selected for twinning at the U.S. Meat Animal Research Center (MARC; Clay Center, NE). Heifers were weaned at an average of 173 days of age and were placed directly into a feedlot. Calves were fed a starter diet, which was gradually adjusted to a high concentrate finishing diet (3.19 Mcal ME/kg DM, 88.29% TDN, and 13.02% CP). Heifers were harvested at an average of 462 days of age at MARC. Data were analyzed using the mixed procedure of SAS with sex and dam age as fixed effects and age as a covariate. Means for weights and carcass traits, with the associated P-values, of FM and HF are presented in Table 031. Weaning, yearling, and harvest weight for FM (184, 409, and 470 kg respectively) and HF (184, 402, and 477 kg respectively) were not different ($P > 0.05$). Carcass weight (304 vs. 306; $P > 0.05$), ribeye area (69.8 vs. 72.3; $P > 0.05$), fat thickness (1.19 vs. 1.16; $P > 0.05$), and yield grade scores (3.22 vs. 3.07; $P > 0.05$) were not different between FM and HF, respectively; however, numerical marbling scores tended to be greater ($P = 0.082$) for freemartins. The data in our study showed that weights and carcass traits were similar for freemartin and intact twin-heifer calves managed equally.

032 Use of Triptorelin Acetate for Inducing Ovulation and Facilitating Fixed Time Artificial Insemination of Sows Weaned on Small-Scale and Niche Market Pig Farms.

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Developing a single fixed-time artificial insemination (FTAI) protocol would benefit small-scale and niche market pork producers by decreasing semen costs and labor associated with detection of estrus. The objective of this study was to test the efficacy of an AI breeding system using triptorelin acetate, a GnRH agonist (OvuGel; JBS United Animal Health, LLC, Sheridan, IN) that induces ovulation. A total of 92 sows (parity, 3.5 ± 0.2; BCS, 2.5 ± 0.08) were weaned (h 0) after a 25.0 ± 0.6 d lactation on five participating small pig farms and allocated to one of four treatment groups: 1) OvuGel applied intravaginally at h 96 and AI at h 120 (n = 23); 2) P.G. 600 (400 IU eCG and 200 IU hCG, Merck Animal Health, Inc., De Sota, KS) applied i.m. at weaning, OvuGel at h 96 and AI at h 120 (n = 23); 3) AI at 0 and 24 h after first detection of estrus (n = 23); and 4) P.G. 600 at weaning, and AI at 0 and 24 h after onset of estrus (n = 23). Treatments 1 and 2 were FTAI protocols with sows being inseminated without regards to estrus onset. Treatments 3 and 4 were consistent with current industry AI practices. The proportion of females displaying estrus by day 7 post-weaning was greater ($P = 0.02$) for sows that received OvuGel ($93.9 \pm 0.07\%$) compared to sows that did not ($81.0 \pm 0.07\%$). There were no effects ($P > 0.05$) of P.G. 600 or P.G. 600 x Ovugel on females displaying estrus by day 7. Weaning to estrus interval was decreased ($P = 0.04$) for sows that received P.G. 600 (4.9 ± 0.4 d) compared to sows that did not (5.4 ± 0.4 d). There were no effects ($P > 0.05$) of Ovugel or P.G. 600 x Ovugel on the weaning-to-estrus interval. There were no effects of P.G. 600, Ovugel or P.G. 600 x Ovugel ($P > 0.1$) on pregnancy rate (59%), total litter size (11.8), born live (10.8), or born dead (0.9). These results suggest that FTAI protocols may be employed on small-scale pig farms without compromising reproductive performance.

033 Effect of Supplementation Method on Protein Supplement Intake and Performance of Individual Beef Steers Grazing Native Range.

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The objective of this study was to determine the effects of supplementation method (hand-fed 3 days per week vs. ad-libitum access) on protein supplement intake and performance of beef steers grazing dormant native range. The experiment was conducted for 56 days in late winter in central Oklahoma. Cross-bred steers (n = 40; BW = 242.6 ± 7.2 kg) grazed dormant native range pastures and were randomly assigned to one of two supplementation methods: 1) hand-fed (HF) or 2) self-fed (SF). Both treatments received a protein supplement consisting of 80% soybean meal, 20% soybean hulls (TDN = 76.6 %, CP = 43.9 %; DM basis). In the HF treatment, steers received either 0, 0.39, 0.78, 1.17, or 1.56 kg per day, fed 3 days per week in individual stanchions. Eight steers were chosen at random to receive 0 kg of supplement per day and four were assigned to the remaining HF supplementation amounts. The remaining 16 steers were assigned to the SF group, and received supplement via the SmartFeed system (C-Lock Inc., Rapid City, South Dakota). The SmartFeed is a portable, self-contained system designed to measure individual feed intake. Supplement was available ad libitum, but salt was added to the supplement until mean SF supplement intake approximated mean HF intake (approximately 1 kg per d). Intake of supplement in SF ranged from 0 to 1.42 kg per steer per day. Average daily gain was regressed on supplement intake and supplementation method. At greater supplement intakes, intake improved ADG more in HF than in SF (interaction P = 0.04). In production systems with more than minimal supplement requirements, directly managing supplementation may be more efficient than relying on traditional, salt-based intake-limiting approaches.

034 Effect of Creep Feeding on Meat Goat Kid Traits at Weaning.

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The purpose of this three year study was to observe the effects of creep feeding on the growth, survivability, conformation score, market value and FAMACHA scores for 509 spring born kids. Straightbred Savanna (n = 10), Kiko (n = 8), Spanish (n = 8) and Myotonic (n = 3) bucks were bred to straight-

bred and crossbred does (n = 168). At 30 d, kids were split into two contemporary groups (creep and non-creep). Their 30-d and 90-d (weaning) weights were recorded and the ADG was calculated from 30 d to 90 d. Conformation scores were assigned by USDA graders, and market values were calculated using local market prices around the date of weaning. FAMA-CHA was recorded at weaning. The effects of treatment, sire breed, doe breed, doe age, kid sex, and litter size were analyzed as sources of variation. Sire breed, doe breed, doe age, litter size, and kid sex affected ($P < 0.05$) 30-d weights. Creep and non-creep fed kids had similar ($P > 0.05$) 30-d weights. Doe breed, doe age, litter size and kid sex affected ($P < 0.05$) weaning weight and ADG. The creep fed kids were heavier ($P < 0.05$) at weaning (16.11 ± 0.6 vs. 15.28 ± 0.6 kg) and had higher ADG (0.13 ± 0.01 vs. 0.12 ± 0.01 kg) when compared with the non-creep kids. Sire breed, treatment x sire breed, doe breed, and treatment x doe breed had an effect ($P < 0.05$) on kid survival rate from birth to weaning. Creep feed did not affect ($P > 0.05$) kid survival rate. Sire breed, litter size and kid sex affected ($P < 0.05$) conformation score. Creep feed did not affect ($P > 0.05$) conformation score. Doe breed, doe age, litter size, and kid sex affected ($P < 0.05$) the market value. Creep kids had higher values ($P < 0.05$) than non-creep kids at market ($\$58.12 \pm 2.35$ vs. $\$54.92 \pm 2.31$). The weighted average cost of creep feed per kid was $\$2.00$. Sire breed, litter size, and treatment x litter size affected ($P < 0.05$) the FAMACHA score. FAMACHA scores of creep fed kids were lower (better; $P < 0.05$) than non-creep kids (1.16 ± 0.08 vs. 1.24 ± 0.08). Creep feeding was shown to be beneficial for kid performance under the prevailing study conditions.

035 Effects of Moxidectin/Oxfendazole and Long-Acting Eprinomectin Treatment on Fecal Egg Counts and Performance in Newly Received Stocker Calves.

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The objectives of this study were to evaluate effects of various anthelmintic treatments on fecal egg counts (FEC) and performance of newly received stocker calves. Upon arrival to the Murray State University Beef Unit, steers (n = 66) were allowed a 7 d adjustment period prior to allocation of treatment. Steers were randomly allocated to treatment based on BW (296.41 ± 23.67 kg) and FEC (13.67 eggs/gram; EPG). Treatments included: control (n = 10; no anthelmintic administration; CON); moxidectin/oxfendazole combination (n = 28;

COMBO); and long-acting eprinomectin (n = 28; LAE). Steers were comingled and grazed mixed grass pastures with rotation based on forage availability. Paddock size ranged from 0.40 to 0.81-ha with an average stocking density of 47,255.4 kg/ha. Fecal samples, BW, BCS, and hair coat scores (HCS) were collected on d 0, 13, 27, 56, 90, and 101. Fly counts were performed from an all-terrain vehicle while steers grazed on d 14, 31, 61, 91, and 100. Statistical analysis was performed using the MIXED procedure of SAS (experimental unit = steer, repeated measure = day). Two preplanned orthogonal contrasts were used to evaluate effects and included comparisons of: 1) CON vs treated steers; and 2) COMBO vs LAE steers. Controls differed from treated steers for EPG ($P = 0.05$) and LAE steers differed from COMBO steers ($P < 0.01$). A treatment $\times$ d interaction ($P < 0.01$) was detected for EPG. The highest EPG were observed in the COMBO steers on d 101, 90, 56 (62.57, 47.34, and 44.73 EPG, respectively) with the fewest EPG observed on d 13 (COMBO = 1.56, LAE = 2.02 EPG). Body weight and ADG were similar between treatments throughout the study ($P > 0.09$) except for ADG from d 13 to 27, in which CON steers exhibited a higher ADG ($P = 0.04$) compared to treated steers (1.03 vs 0.24). Greater ($P = 0.06$) BCS were observed for CON versus treated steers on d 27 (5.5 vs 5, respectively); however, BCS were similar ($P > 0.1$) throughout the rest of the study. Fly counts were not affected ($P = 0.78$) by treatment, but were affected ($P < 0.01$) by d with the highest fly counts occurring on d 100 and the fewest flies on d 31 (19.49 and 6.14, respectively). Data suggest anthelmintic use may reduce FEC without improving performance in stocker calves under management intensive grazing systems.

036 Effect of Acute or Chronic Water Restriction on Hematological Variables, Rectal Temperature and Performance in Parenteral or Intranasal Modified-Live Viral Vaccinated Beef Calves.

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The study objective was to determine if acute or chronic water restriction affected hematology or performance in beef calves with parenteral or intranasal vaccination. A total of 60 crossbred beef steer (n = 28) and heifer (n = 32) calves were used. On d -7, calves within sex were assigned randomly to 1 of 6 treatments arranged in a 3×2 factorial. Water restriction treatments (Factor A) were applied at the origin ranch via 3 different models: A_1) Control, no water restriction except during transport to the feedlot (CON), A_2) Acute, consisting of 48 h water restriction prior to transport to the feedlot (ACU), or A_3) Chronic, consisting of alternating 24 h periods of water access

and restriction, over a 7-d period prior to transport to the feedlot (CHR). Upon feedlot arrival (d 0), 2 respiratory vaccine treatments were applied (Factor B): B_1) parenteral administration of a pentavalent modified-live virus (MLV) respiratory vaccine (2 mL s.c. in the neck; EX), or B_2) intranasal administration of a trivalent MLV respiratory vaccine (1 mL/naris; IN). Blood was collected on d -7, -5, -3, -1, 0 , 1, 3, 5, 7 and weekly thereafter through d 56 to determine complete blood count via automated hemocytometer and packed cell volume (PCV). Individual BW and rectal temperature (RT) was recorded on the same days blood sampling occurred. The PCV was greatest ($P \leq 0.01$) for CHR on d -5 and -3. Similarly, hematocrit differed ($P \leq 0.01$) between CON (36.4), ACU (33.5) and CHR (39.7%) on d -3. The IN group had increased total white blood cell count (P=0.009); specifically, lymphocytes ($P < 0.001$) and monocytes ($P = 0.002$) were increased for IN on d 5 and 3 and d 5, respectively. Eosinophils decreased (day effect; $P < 0.01$) transiently after transport to the feedlot on d -1. Rectal temperature was increased for IN on d 7 and 14 ($P \leq 0.04$). The BW of ACU and CHR treatments decreased 9.5 and 9.7 kg, respectively, from d -7 to -1; however, the CON treatment gained 5.5 kg during the same time ($P < 0.001$). The ACU and CHR treatments had reduced ADG from d 0 to 14 compared with CON ($P \leq 0.04$), regardless of vaccine treatment. Compared to IN, EX had a greater body weight (BW) change from d 42 to 56 ($P = 0.01$). Chronic water restriction increased PCV and hematocrit and decreased ADG during and 14-d after the restriction period; whereas, intranasal vaccination increased rectal temperature and some white blood cell differentials.

GRADUATE STUDENT COMPETITION: PhD DIVISION

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037 Zinc Source and Concentration Altered Physiological Responses of Beef Heifers during a Combined Viral-Bacterial Respiratory Challenge.

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Three treatments were evaluated in feedlot heifers to determine the effects of zinc supplementation on the immune response to a combined viral-bacterial respiratory disease challenge.

Thirty-two beef heifers (255 ± 15 kg) were subjected to a 30d period of Zn depletion, then randomly assigned to one of three treatment diets fed for 30d before the challenge: 1) Supplementation with 100 mg of Zn from Zn sulfate/kg of DM (Zn100), 2) Supplementation with 200 mg of Zn from Zn sulfate/kg of DM (Zn200), and 3) Supplementation with 80 mg of Zn/kg of DM from zinc methionine (ZinMet® Global Animal Products, Inc., Amarillo, TX) and 20 mg of Zn from Zn sulfate/kg of DM (ZinMet). All heifers were fitted with indwelling vaginal temperature (VT) devices and intra-nasally challenged with 1×10^8 PFU bovine herpesvirus-1 on d -3, and then allowed to rest in outdoor pens for 3d. On d0, each heifer was challenged intra-tracheally with an average dose of 2.38×10^7 CFU *Mannheimia haemolytica* (MH), fitted with an indwelling jugular catheter, then moved into individual stanchions in an environmentally-controlled enclosed barn. Whole blood samples were collected at 1-h (serum) or 2-h (complete blood counts) intervals from 0 to 8h, and at 12, 24, 36, 48, 60, 72, 168 and 360h relative to MH challenge. Data were analyzed using the MIXED procedure of SAS specific for repeated measures with fixed effects of treatment, time and their interaction. There was a treatment effect ($P < 0.01$) for VT such that Zn200 heifers had greater VT than Zn100 and ZinMet heifers. There was a trend ($P = 0.10$) for a serum cortisol treatment effect with Zn100 heifers having greater cortisol than ZinMet heifers. Total leukocytes and lymphocytes were greater ($P \leq 0.008$) in Zn100 heifers than Zn200 and ZinMet heifers, while monocytes were less ($P = 0.05$) in ZinMet heifers than Zn100 and Zn200 heifers. Concentrations of IL-6 were greater ($P = 0.02$) in ZinMet heifers than Zn100 and Zn200 heifers. Concentrations of IFN-γ were greater in Zn200 heifers than ZinMet heifers at 0h, and Zn100 heifers from 0 to 12h post-MH challenge (trt x time $P = 0.02$). Serum haptoglobin was not affected by treatment or treatment x time ($P \geq 0.36$), but increased over time ($P < 0.001$). There was a trend ($P = 0.11$) for ZinMet heifers to have less severe nasal lesion scores than Zn100 heifers. The observed differential physiological responses in this study indicate that zinc source and concentration may alter the response to a bovine respiratory challenge in heifers.

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038 Effect of Genetic Response to Fescue Toxicity on Body Weight, Body Temperature, Hair Coat, Hair Shed and Body Condition Score in Angus Cows.

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Research on host genetic response to fescue toxicosis (FT), a major disease in cattle, is scarce in the literature. The objective of this study was to evaluate the effect of genetic response to FT on body weight (BW), body temperature (BT), and hair coat (HCS), hair shedding (HSS) and body condition (BCS)

scores. Weekly data on 149 multiparous purebred pregnant Angus cows were collected for 13 weeks (April to July) at two locations in NC (Butner and Reidsville). Forty cows with contrasting performance were classified as either high tolerant (HT) or low tolerant (LT) to FT. Animals were selected based on their average weekly gain (regression of BW on weeks) after adjustment for fixed-effects of parity, location, and initial body weight, with 20 cows in each group balanced by location. Data on selected animals was analyzed as repeated measures over time including the fixed-effects of tolerance to FT (genotype), location, weeks, all interactions between these effects, parity, and initial measurement of the trait analyzed as covariate, and the random effect of animals in first order autoregressive covariance structure in SAS. Genotype*Location was significant ($P < 0.05$) for HCS and HSS, where LT-Reidsville cows had greater HCS (2.72 ± 0.14) and HSS (3.00 ± 0.15) than HT-Reidsville, LT-Butner and HT-Butner cows, with 1.91 ± 0.13 and 2.18 ± 0.15, 2.10 ± 0.14 and 2.30 ± 0.15, and 1.87 ± 0.14 and 2.35 ± 0.15, respectively. Genotype*Location was significant ($P < 0.05$) for BCS, where LT cows had lower BCS (5.38 ± 0.08) than HT cows (5.83 ± 0.08) within Reidsville. However, LT-Reidsville cows were not different ($P > 0.05$) to HT (5.58 ± 0.08) and LT (5.64 ± 0.08) cows at Butner. The BT of HT-Reidsville cows ($38.16 \pm 0.24°C$) was lower ($P < 0.05$) than that of HT-Butner (39.06 ± 0.25^0C), LT-Butner ($38.96 \pm 0.24°C$) and LT-Reidsville (39.27 ± 0.24^0C) cows within week 2. Overall, BT of HT cows ($38.68 \pm 0.09°C$) was lower ($P < 0.05$) than LT cows ($38.89 \pm 0.09°C$). Genotype*Location*Week was significant ($P < 0.05$) for BW. In the first six weeks, LT-Reidsville cows had lower ($P < 0.05$) BW than all other groups. After 7 weeks, we had three distinct groups ($P < 0.05$), with HT-Butner having greater BW than all others, and HT-Reidsville and LT-Butner having the same BW, but greater than LT-Reidsville cows. At the end of the trial, BW averaged 578.69 ± 4.46kg, 524.76 ± 4.51kg, 551.47 ± 4.55kg, and 489.54 ± 4.76kg for HT-Butner, LT-Butner, HT-Reidsville, and LT-Reidsville cows respectively. These results suggest that animals with contrasting genetic response to FT have differences in phenotypic performance in Angus cows. We also observed a genotype-by-environmental interaction, indicating that the level of fescue toxicity might play a role in the expression of FT.

039 The Consumer Cold-Chain: A Survey on Consumer Handling Behaviors on Fresh Beef Products during Vehicular Transport from Retail to Residence.

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Unlike the controlled and highly regulated systematic steps in the production and handling of a fresh red meat product prior to purchase, a consumer's handling behavior cannot be controlled after the product has left the retail setting. A critical problem in the field of meat science is the lack of understanding of consumer handling practices during transport from retail to residence. A 13 item questionnaire utilizing the Qualtrics survey platform was randomly distributed across the United States through electronic media. A 43 day response period generated 1,554 responses with 1,484 completed questionnaires yielding a 95.5% response rate. All data was analyzed using IBM SPSS Statistics 22. The survey revealed 46.9% of respondents shop between 5:00 P.M. and 8:59 P.M. Exactly 42.5% of respondents' checkout between 11 and 20 minutes after fresh beef product selection and placement. Upon checkout, 79.6% of respondents return home from the grocery store in 20 minutes or less. Fresh beef products are most commonly placed in either the rear seat/floor of the vehicle or the trunk/cargo space for transport. Of the 25.8% of respondents who ran errands with a fresh beef product left in the vehicle, 60.6% admitted to leaving the fresh beef product in the vehicle between 6 and 20 minutes. Approximately, 55.7% do not use an insulted-product to transport fresh beef products. An insulated bag is most commonly used for temperature abuse protection during vehicular transport. The questionnaire revealed age influenced the time of day grocery shopping occurred, time between fresh beef product selection and checkout, transport time from grocer to residence, fresh beef product placement in vehicle during transport, occurrence of running errands with a fresh beef products left sitting in vehicle, and the use and type of an insulted product to prevent temperature abuse ($P < 0.05$). Sex type influenced the time of day grocery shopping occurred, time between fresh product selection and checkout, fresh beef product placement in vehicle during transport, and the use and type of an insulted product to prevent temperature abuse ($P < 0.05$). Ethnicity influenced the time between fresh beef product selection and checkout in addition to the occurrence and period of time running errands with a fresh beef product left sitting in the vehicle ($P < 0.05$). Level of attained education influenced transport time from grocer to residence ($P < 0.05$). Results indicate the continued need for consumer outreach and research of handling behaviors for meat.

040 Ergot Alkaloids from Endophyte-Infected Tall Fescue Alters Ovarian Follicle Growth and Development in Beef Heifers.

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Fescue toxicosis is a disease common in cattle grazing tall fescue [*Lolium arundinaceum* (Schreb.) Darbysh]. containing an endophytic fungus (*Epichloë coenophiala)* that produces ergot alkaloids. Previous research from our lab demonstrated that chronic exposure of ergot alkaloids reduced ovarian

and uterine blood flow, which could alter ovarian function. Therefore, the objective of this study was to determine if ergot alkaloids from endophyte-infected tall fescue reduces follicle numbers, or suppresses follicular development resulting in poor embryo growth. Angus X Senepol heifers (n = 30) were blocked by weight and genotype [Slick (S) or Normal (N)] were placed in Calan gates then randomly assigned to receive either endophyte-infected fescue seed (EI) or non-infected fescue seed (EF; control) for 63d. Weekly measurements were collected to monitor physiological responses during exposure to ergot alkaloids. Following 30d of exposure to ergot alkaloids, heifers were synchronized and inseminated to examine reproductive measurements, including daily follicle mapping, AI pregnancy rate, and embryo development. Data were analyzed using repeated measures in the PROC MIXED procedure of SAS. ADG was decreased in EI-N heifers (0.48 kg/d) compared to other heifer groups ($P < 0.05$; 0.63, 0.62, 0.58 kg/d for EI-S, EF-N, and EF-S, respectively). BCS were greater for EF-S, EI-N and EI-S (5.6, 5.6 and 5.7, respectively) compared to EI-N (5.5; $P < 0.05$). Hair shedding scores were lower for EF-S and EI-S (1.5 and 2.2, respectively) compared to EF-N and EI-N (2.5 and 2.6, respectively; $P < 0.05$). The number of recruited (2-4mm) follicles was significantly greater in EI-N heifers (13.7) and significantly lower in EF-N heifers (10.6) compared to other heifer groups ($P < 0.05$; 11.1, 12.2 follicles for EI-S, and EF-S, respectively). No differences were observed ($P > 0.05$) in the number of selected (5 to 8mm) follicles. Whereas, the number of dominant (> 9mm) follicles was reduced in EI-N heifers (0.52) compared to other heifer groups ($P < 0.05$; 0.85, 0.87, 0.93 follicles for EI-S, EF-N, and EF-S, respectively). AI pregnancy rates were decreased in EI-N heifers (0%) compared to other heifer groups ($P < 0.05$; 86, 50, 43% for EI-S, EF-N, and EF-S, respectively). No differences were observed in early embryo growth and development. Based on these data, ergot alkaloids from endophyte-infected tall fescue alter ovarian follicular development, specifically during the selection to dominant stage, potentially contributing to the poor reproductive performance in infected cattle. However, the slick hair genotype appears to aid in offsetting the physiological symptoms associated with fescue toxicosis, resulting in improved pregnancy rates.

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041 Chronic Exposure to Ergot Alkaloids Suppresses Growth Hormone in Beef Steers.

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Tall fescue [*Lolium arundinaceum* (Schreb.) Darbysh] is the predominant grass that cattle graze throughout the southeastern United States. Due to its association with the fungus, *Epichloë coenophiala,* the grass becomes endophyte-infected and produces ergot alkaloids. Ergot alkaloid exposure causes a whole host of physiological problems in cattle including increased body temperature and heart rate, as well as decreased growth and blood flow to the extremities. Together, these symptoms are called fescue toxicosis and the exact pathway by which it occurs is not well understood. Crossbred Angus steers (n = 8) were placed in Calan gates and were randomly assigned to receive either endophyte-infected fescue seed (EI) or non-infected fescue seed (EF; control) for 60d. Weekly measurements and blood samples were taken to monitor the steer's physiological responses during exposure to ergot alkaloids. Data were analyzed using repeated measure in the MIXED procedure of SAS. Statistical significance was determined at $P < 0.05$ and a tendency at $0.05 < P < 0.10$. Upon completion of the feeding period, animals were euthanized and tissue harvested to analyze impact on organ weight. Respiration rate, rectal temperature, surface temperature assessed by thermal camera, temperament, hair coat and shedding scores (1 to 5 scale) did not differ between treatment groups ($P > 0.05$). Systolic and diastolic blood pressure as well as caudal vein diameter were not different ($P > 0.05$). However, there was decreased heart rate (67.43 vs. 73.72 beats/min) and increased caudal artery diameter (35.58 vs. 34.38 mm^2) in EI animals compared to EF ($P < 0.05$). Body weight and average daily gain (BW 425.8 vs 409.5 kg; ADG 0.99 vs 1.14 kg/d) tended to increase in the EF group compared to EI ($P = 0.09$). Body condition score tended to be greater in the EF group compared to EI (5.46 vs, 5.39; $P = 0.07$). Hematocrit was not different between treatment groups ($P > 0.05$). Heart, liver, spleen, kidney and pancreas weights did not differ between treatment groups ($P > 0.05$). Circulating luteinizing hormone (LH) concentrations were no different between treatment groups ($P > 0.05$) during chronic exposure to ergot alkaloids whereas, circulating growth hormone (GH) concentrations were reduced in the EI 1.3 ng/ml) group when compared to the EF controls (7.2 ng/ml; $P < 0.05$). Growth hormone could play an important role in the reduced weight gain that is seen in animals that are chronically exposed to ergot alkaloids. Determining exactly how ergot alkaloids are functioning along the hypothalamic-pituitary axis to alter GH production could help to further elucidate the mechanisms that leads to losses associated with fescue toxicosis.

042 Effects of Roughage Inclusion and Particle Size on Digestion and Ruminal Fermentation Characteristics of Beef Steers.

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Mechanically processed roughage is typically used in finishing diets to improve mixing characteristics and rumen digestibility. Roughage is fed to enhance rumen function and prevent digestive upset; however, inclusion rates are limited due to the cost per unit of energy. Measuring rumination behavior may be a means to standardize the appropriate roughage inclusion rate in beef cattle finishing diets, and increasing particle size of roughage may contribute to the buffering capacity of the rumen. Therefore, an experiment was conducted to determine the effects of roughage inclusion and particle size in finishing diets on digestibility, rumination behavior, and ruminal fermentation characteristics of beef steers. Four ruminally cannulated steers were used in a 4×4 Latin square experiment. Treatments were arranged as a 2×2 factorial with treatments consisting of 5% inclusion of a short-grind roughage (5SG), 10% inclusion of a short-grind roughage (10SG), 5% inclusion of a long-grind roughage (5LG), and 10% inclusion of a long-grind roughage (10LG). Differences in roughage particle size were obtained by grinding corn stalks once (LG) or twice (SG) using a commercial tub grinder equipped with a 7.62 cm screen and quantified using the Penn State Particle Separator (PSPS) to estimate physically effective NDF (peNDF). Each period included 14 d for adaptation and 4 d for diet, fecal and ruminal fluid collections. Animals were outfitted with rumination monitoring collars to continuously measure rumination activity. The 10LG treatment diet had a greater ($P < 0.01$) percentage of large particles (retained on the top three sieves of the PSPS) compared to the other treatment diets. This resulted in a greater ($P < 0.01$) percentage of estimated peNDF for the 10LG diet compared to the others. Feeding diets containing 5% roughage tended to increase ($P \leq 0.09$) DM, NDF, and starch total tract digestibility compared to diets containing 10% roughage. Cattle consuming LG treatments had greater ($P < 0.01$) rumination time, which increased ($P < 0.01$) ruminal pH compared to diets containing SG roughage. Diets containing 5% roughage had greater ($P < 0.01$) total VFA concentrations and increased ($P < 0.01$) proportions of propionate compared to diets containing 10% roughage. Overall, feeding a lower inclusion of roughage with a larger particle size may stimulate rumination and aid in ruminal buffering similar to that of a higher inclusion of roughage with a smaller particle size, without negatively impacting digestibility and fermentation.

043 Evaluation of Statistical Process Control Procedures to Monitor Feeding Behavior Patterns and Detect Onset of Bovine Respiratory Disease in Growing Bulls.

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The objective of this study was to evaluate the effectiveness and accuracy of monitoring feeding behavior patterns using cumulative summation (**CUSUM**) procedures to predict the onset of bovine respiratory disease (**BRD**). Growing bulls (N = 231) consigned from independent producers for the purpose of evaluating growth efficiency during a 70-d trial were used in this study. Within a 10-d period, 30 bulls were treated for BRD based on observed clinical symptoms and elevated rectal temperature (> 39.5 C); all remaining bulls (n = 201) were deemed to be healthy. The clinically ill and healthy bulls were used to evaluate the sensitivity and specificity of CUSUM models, respectively. Frequency and duration of bunk visit (**BV**) events, head down (**HD**) duration and DMI were continuously monitored during the trial. All data were standardized prior to generating CUSUM charts in a daily accumulative manner. CUSUM charts were constructed with PROC CUSUM (SAS 9.4). Accuracies (average of sensitivity and specificity) of these single-trait CUSUM models for detection of BRD were 81.6, 80.3, 82.8 and 80.2%, respectively, and average day of detection prior ($P < 0.05$) to observed symptoms of BRD were 4.4, 3.5, 4.5 and 2.6 d, respectively. In addition, factors derived from a principal component analysis (PCA) of all 4 traits were monitored using similar CUSUM procedures. This 4-trait PCA-based model was more accurate (84.7 %) than any of the 4 single traits and signaled ($P < 0.05$) 3.7 d prior to observed symptoms of BRD. When DMI was removed from the full PCA model, accuracy of prediction (84.3% vs. 84.7%) and signal day prior to observed symptoms of BRD (3.3 vs. 3.7 d) were minimally altered, demonstrating the validity of monitoring feeding behavior traits for early BRD detection. These results demonstrate that the use of PCA-derived factors in CUSUM charts was more accurate compared to single-trait CUSUM charts. Moreover, due to the multivariate aspect of PCA, the use of PCA-based CUSUM charts to monitor feeding behavior patterns should be more robust in applications for preclinical detection of BRD. Results from this study demonstrate the potential value of using CUSUM procedures to monitor electronic feeding-behavior systems to enable more accurate preclinical detection of BRD in feedlot cattle.

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As competition from alternative uses for grazing land increases, enhancing productivity per hectare is important to maintain and increase beef production. This multi-year study evaluates whether restricted grazing of small grains and summer annuals (INT) can reduce total land required for cow-calf production compared with an extensive production system using only native range (EXT). Cows in the EXT treatment had continuous access to native range stocked at 5.39 hectares/cow-calf pair/year. Cows in the INT treatment grazed annual forages during strategic periods to reduce total land usage to 3.56 hectares/cow-calf pair/year. During the restricted grazing period (Dec-Mar), INT had access to wheat pasture for an average of 9 hours per week, continuous access for graze out (Mar-May), then had continuous access to native range during early summer (May-Jul) and fall (Aug-Dec); and 4 hours restricted grazing per day on summer annuals during Late Summer (Jul-Aug). Cow BW and body condition score (BCS) were similar at the start of the trial and after the late summer grazing period ($P > 0.11$) but INT were greater at all other points ($P < 0.02$). INT calf weight was greater at all time points ($P < 0.04$) with the exception of initial weight ($P = 0.90$). Calf ADG was greater in INT calves during the wheat grazing periods ($P < 0.02$) but EXT was greater during the early summer ($P = 0.01$). Utilizing partial confinement during strategic periods of the year calf gains were increased and total land area for beef production was decreased.

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A 3-year study was conducted to evaluate forage production, animal performance and carcass merit from forage-finished steers grazing four warm-season annual forages. The grazing trial was conducted in 2014, 2015, and 2016 (70, 63 and 56-d, respectively). The length of the grazing season varied based on forage availability. Sixteen pastures (0.81-ha) were assigned to one of four forage treatments in a randomized complete block design. Forage treatments were brown midrib sorghum x sudangrass [BMR; *Sorghum bicolor var. bicolor*bicolor var. sudanense*], sorghum x sudangrass [SS], pearl millet [PM; *Pennisetum glaucum* (L.)R.Br.], or pearl millet planted with crabgrass [PMCG; *Digitaria sanguinalis* (L.) Scop.]. Each year, British-cross beef steers ($n = 32$; 429±22 kg) were stratified by weight and randomly assigned to one of the 16 pastures for forage finishing. Each pasture was subdivided into two 0.405-ha paddocks for rotational grazing and a put and take stocking method was used to maintain a forage allowance of 1500-3000 kg/ha. Shrunk BW was recorded at initiation, middle and end of each grazing season. Once forage became limited, steers were harvested, hot carcass weight (HCW) was measured immediately before chilling, and chilled carcasses (24-h) were evaluated for yield grade (YG) and quality grade (QG). Statistical analysis was conducted using the MIXED procedure in SAS 9.4 (Cary, N.C.) with main effects of treatment, year and the interaction. Total seasonal DM yield had a tendency ($P < 0.07$) to be higher for BMR compared to PMCG, with SS and PM as intermediates (14.57, 12.02, 13.32 and 13.34 Mg/ha, respectively). ADG of steers had a tendency to be higher for BMR and PMCG compared to SS and PM (0.99, 0.97, 0.86 and 0.85 kg/d, respectively). Similarly, REA had a tendency ($P = 0.098$) to be highest in PM steers compared to PMCG and SS with BMR fed steers as an intermediate (71.02, 67.85, 66.97 and 70.08 cm², respectively). However, the tendency for treatment differences in REA disappeared when REA was expressed on a per cwt live and per cwt HCW basis ($P = 0.20$; $P = 0.29$, respectively). No treatment differences were detected for carcass variables HCW, DP, KPH, 12-th rib back fat, marbling score, YG and QG ($P > 0.05$). These findings suggest that cattle on BMR, SS, PM, and PMCG perform similarly, giving producers the option to match a forage type based on the availability, cost, and their production system.

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OBJECTIVE: Studies have suggested single embryo transfer (SET) could prevent risks from multiple gestations resulting from ART. However, embryos are currently selected by morphological appearance and developmental rate, which have been shown inadequate to ensure success after SET. Because multiple embryos are created during IVF, SET often leads to

cryopreservation of super numeral embryos for later transfer attempts. However, cryopreservation has its own inherent risks to embryo viability. The objective of this study was to identify if embryo density can be used to detect cryodamage.

DESIGN: Culture based study.

MATERIALS AND METHODS: Previous research from this lab suggested embryo weight could detect cryodamage in sheep. To further examine this observation, mice embryos were cultured to blastocysts. Fresh blastocysts were analyzed using a modified specific gravity technique (MSGT). Blastocysts were then frozen using global® Blastocyst Fast Freeze® Kit. Embryos were stored in cryotanks for a minimum of two weeks. Embryos were thawed with global® Blastocyst Fast Freeze® Thawing Kit. Thawed blastocysts were then re-evaluated using the MSGT. Blastocysts were cultured for 48 hours. Survival was determined by blastocysts hatching out of zona pellucida.

RESULTS: Data from an earlier sheep study suggest a difference in the density of embryos in sheep that conceived verses those who did not ($P < 0.046$). Embryos with average to slow descent times (low density) blastocysts established more pregnancies that survived to term than faster descending blastocysts, which often did not establish pregnancy at all. Post-thaw mice embryo data supported sheep study with embryos with average to slow descent times hatching at a higher rate than embryos that descended rapidly thru the MSGT ($P < 0.029$). Mice embryos embryos that showed fewer differences, which had similar weights pre-freeze and post-thaw survived at a greater rate than embryos with large differences in weight ($P < 0.016$).

CONCLUSION: Embryo density could suggest biochemical information that cannot be determined from morphological assessment. Cryodamage can be detected by variability of embryo density, possibly because damaged embryos have lost the ability to osmoregulate themselves due to membrane disruption, making them denser. Current studies are examining if MSGT can determine embryo sex due to weight differences in X and Y chromosomes. This data continues to support the use of MSGT as a noninvasive means of assessing embryo quality.

MEATS

047 Inclusion of Bull and Cow Beef in Patty Formulation Results in Persistent Pinking in Cooked Beef.

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To test the effects of bull/cow blend proportions on the color stability of precooked ground beef patties, 9.23 kg of either beef knuckles (K) and/or bull/cow blend (BC) were mixed with 2.11 kg of 50:50 beef trim in 11.34-kg batches of five treatments: 0%BC/100%K (A), 25%BC/75%K (B), 50%BC/50%K (C), 75%BC/25%K (D), and 100%BC/0%K (E) in 6 replicates. Patties (151g) were prepared using an automatic patty machine and measured for fresh color (L*, a*, and b*) after a 30-min bloom. Eighteen patties from each replicate were stored in refrigeration overnight and cooked on a gas-fired, air impingement oven to 71°C, chilled in an ice bath, and six from each replicate were external and internal cooked color were measured on 6 patties from each replicate. Twelve cooked patties were frozen and stored until reheated by either microwave oven, electric griddle, or gas-fired char grill to 71°C, then chilled in an ice bath and measured for cooked color. As the percentage of the BC increased, pH of fresh patties tended to increase (Linear, $P = 0.053$), and L*, a*, and b* values of fresh patties decreased (Linear $P < 0.001$). Both the internal and external color of cooked patties became darker (lower L*), less red (lower a*), and less yellow (lower b*) as the proportion of BC increased (Linear $P < 0.001$) in the ground beef. After reheating, patties with more BC beef had lighter external cooked color (Linear $P < 0.001$) and lighter (Linear $P = 0.028$), more red, and more yellow (Linear $P < 0.001$) internal color. When comparing cooking methods there were no differences in the external color of the patties. However, patties that were recooked in the microwave oven were lighter, more yellow, and had a greater saturation index ($P < 0.001$) than patties cooked on the electric griddle or gas-fired char grill. The inclusion of BC beef in ground beef formulations resulted in lighter, redder, more yellow cooked color in beef patties even after reheating. It is not clear if this persistent pinking is due to an increase in fresh pH or increased myoglobin concentration in the BC beef.

048 Carcass Composition and Meat Quality Assessment of Pork Fed Poultry Fat, Flaxseed Oil and Supplemented with Vitamin E.

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The objective of this research was to understand carcass and meat quality characteristics of pigs fed a combination of poultry fat, flaxseed oil and Vitamin E. Yorkshire pigs (n = 96) weighing 50kg were allocated to pens based on weight and sex (2 gilts or 2 barrows per pen). Forty-eight pens were randomly assigned to 8 dietary treatments in a 4x2 factorial arrangement. Corn-soybean meal finisher diets (n = 2; 1-50 to 80kg, 2-80 to 110kg) contained 0, 2, 4 or 6% lipids and 11 or 220 IU Vitamin E/kg (VE). 1% flaxseed oil was included in all diets with lipids and remaining lipids supplied by poultry fat. Pigs were harvested at an average pen weight of 110 ± 3kg. Carcass characteristics including: last rib fat thickness (LRFT), tenth rib fat thickness (TRFT), loineye area (LEA), muscle score (MS), percent fat-free-lean (FFL), color (L*, a*, b*), pH ham (pHH) and loin (pHL), National Pork Producers Council color (NPPCCol) and marbling score (NPPCMar) were determined on the loineye at the 10th/11th rib after chilling 24h at $4 \pm 2°C$ prior to carcass fabrication. Pork chops (2.54-cm) were fabricated, individually vacuum packaged, and frozen at $-20 \pm 2°C$ for further analysis. Belly firmness, skin-side up (SSU) and skin-side down (SSD) was determined following carcass fabrication. Chops were thawed at $4 \pm 2°C$ for analysis of drip loss (DL), vacuum purge loss (VP), marinade uptake (MU), marinade cook loss (MCL), cook loss (CL) and WBS. Statistical analysis was conducted with Proc GLM in SAS (2002) using pen as experimental unit. Lipid and VE had no effect ($P > 0.05$) on; LRFT, LEA, MS, FFL, L*, a*, b*, pHL, pHH, NPPCCol, SSD, SSU, VP, MU, MCL, CL or WBS. VE concentration affected ($P < 0.05$) TRFT and NPPCMar. There was a Lipid*VE interaction for TRFT ($P = 0.0483$) and FFL ($P = 0.0309$); Trial*VE interaction for pHH ($P = 0.0350$) and DL ($P = 0.0460$). Feeding low levels of VE in combination with low levels of fat increases FFL by decreasing TRFT. Trial 1 had higher ($P < 0.001$) values of pHH (5.84 vs. 5.53), pHL (5.65 vs. 5.45), and NPPCMar ($P < 0.05$) (1.90 vs. 1.48). Trial 2 had higher ($P < 0.05$) values for NPPCCol (3.21 vs 2.81) and DL (4.10 vs. 3.36). There was an abnormal temperature fluctuation during the month pigs from trial 1 were harvested. A feeding program utilizing poultry fat in combination with flaxseed oil, and VE at these levels will not negatively affect meat quality but further analysis is needed before producer recommendation can be made.

049 Marination of Chicken Using Sodium Carbonate as a Processing Aid.

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Texture profile analysis (TPA), Allo-Kramer shear force (AK) and sensory panel were performed to evaluate the use of sodium carbonate as a processing aid in marination of chicken breast strips, *pectoralis major*, and tenders, *pectoralis minor*. Breast strips and tenders were marinated to 10% pick-up with two different solutions; $NaCO_3$ (6.1% water, 1% salt, 0.4% sodium phosphate, 2.0% seasoning and 0.5% sodium carbonate) and CONT (6.6% water, 1% salt, 0.4% sodium phosphate, and 2.0% seasoning) for a 2x2 factorial design. In the $NaCO_3$ treatment, $NaCO_3$ was first added to the water to adjust the pH to 10.5 before addition of the additional ingredients. Three 2.27 kg bags from each marination treatment and each product type were randomly selected from one day's production in duplicate for a total of 24 bags of product. TPA, AK, and a triangle test were performed on both baked (177°C for 20 min) and fried (177°C for 5.5 min) unbreaded, unseasoned meat using three randomly selected pieces for each test from each bag for a total of 9 pieces tested for each marination treatment and each product type in duplicate. For baked strips, there was no difference ($P > 0.05$) in peak force, area under the curve, hardness, springiness, gumminess or chewiness for CONT or $NaCO_3$. Baked strips with $NaCO_3$ had greater cohesiveness ($P = 0.0005$) and resilience ($P = 0.0029$) than CONT, only in rep 1. For baked tenders, there was no difference ($P > 0.05$) in hardness, springiness, gumminess, cohesiveness, resilience or chewiness for CONT or $NaCO_3$. Baked tenders from rep 2 had greater peak force ($P = 0.0061$) and area under the curve ($P = 0.0019$) than rep 1. Fried strips in rep 1 had less springiness ($P = 0.0054$) when marinade included $NaCO_3$, there were no other differences in attributes tested. Fried tenders had a lower peak force ($P = 0.0027$) area under the curve ($P = 0.0062$) for tenders marinated in $NaCO_3$ for rep 1. Fried tenders with CONT had lower cohesiveness values ($P = 0.0041$) for rep 1, but all other values were similar. Thirty consumers participated in a triangle test for fried cooking method for each marination and product. Of 30 panelists, 2 were able to correctly identify the sample that was different in the triangle test, one for strips and one for tenders. Marination using $NaCO_3$ does not negatively affect the combined overall product quality for TPA, Allo-Kramer or sensory panel for chicken tenders or strips.

050 Endophyte-Infected Tall Fescue Seeds Had No Effect on Carcass Characteristics of Beef Cattle.

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The objective of this study was to investigate the effects of feeding endophyte-infected tall fescue seeds on carcass characteristics including dressing percentage, ribeye area, backfat thickness, percentage of KPH fat, pH, objective lean color, marbling score, and intramuscular fat content. Twelve Angus steers of the same preconditioning operation entering the stocker phase at Mississippi State University H. H. Leveck Animal Research Center were selected and blocked by BW into 3 groups: light (4 animals, 205.5 ± 7.4 kg), medium (5 animals, 231.3 ± 8.2 kg), and heavy (3 animals, 272.7 ± 8.4 kg). A control (KY32 or E–; 0.9 kg) and a treatment (KY31 or E+; 0.8, 0.9, or 1.0 kg for light, medium, or heavy steers, respectively, to provide 20 µg of ergovaline per kg of BW) were randomly assigned to animals within blocks (n = 6) by using Calan® gates. Seeds were mixed with soybean, corn gluten pellets at 2% of BW in the Calan® gates during two trials of 70 d (Summer 2015) and 56 d (Winter 2016). Upon the completion of the second trial, steers were implanted with one dose of Ralgro® and finished to a slaughter weight of approximately 499 kg. During the entire study, steers had ad libitum access to the same annual and perennial summer grass pasture, alfalfa hay supplementation, minerals, and water. Hot carcass weight and dressing percentage were recorded at slaughter, whereas all other data were collected at 72 h post mortem on the right side of the carcasses. Statistical analysis was performed by the GLIMMIX procedure of SAS with significance level of 0.05. There was no difference in carcass characteristics between the E- and E+ treatments ($P > 0.199$). Carcasses from steers fed KY31 and KY32 seeds had dressing percentage of 48.7 to 49.8%, ribeye area of 62.9 to 64.4 cm², backfat thickness of 0.41 to 0.46 cm, KPH fat of 1.2 to 1.3%, lean pH of 5.6 to 5.7, L* value of 39.35 to 39.75, a* value of 35.43 to 36.04, b* value of 31.75 to 32.74, and a marbling score of 226.7 to 236.7. Ultrasound prediction of steers before slaughter indicated an intramuscular fat content of 4.1 to 4.2%, agreeing with marbling score evaluation. Results suggested that ingestion of endophyte-infected tall fescue seeds followed by a withdrawal period might not have residual effects on carcass characteristics of grass-finished beef cattle.

PASTURES AND FORAGES

051 The Effect of Stocking Rate on Steer Performance Grazing 'Nelson' Ryegrass.

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'Nelson' annual ryegrass (*Lolium multiflorum*, Lam.) is a tetraploid cultivar developed for high forage production; hence, it may support greater stocking rates than diploid cultivars. Annual ryegrass has proven to be a reliable high nutritive value winter annual forage for stocker cattle in the deep south. On three consecutive years, 78 crossbred steers (272.9 ± 6.2 kg) were weighed and allotted to 4 fixed stocking rates (SR): 3.76 (SR1), 4.51 (SR2), 5.26 (SR3), and 6.01 (SR4) steers per hectare in a complete randomized design with 3 replicates. Steers were weighed and forage data collected on d 0 and every 15 d thereafter. Data were analyzed using PROC REG to determine the effect of SR on the response variables. The correlation between forage allowance (FA) and ADG was determined by a nonlinear minimization procedure using PROC NLP. There was a linear effect ($P < 0.0001$) of SR on ADG (1.14, 0.98, 0.72, and 0.51 kg), gain/ha (403, 371, 254 and 187 kg/ha), and grazing days (94, 85, 68, and 62 d) for SR1, SR2, SR3, and SR4, respectively; however, steer grazing d[-1] was similar ($P = 0.68$) between treatments (354, 381, 360, and 371 d for SR1, SR2, SR3, and SR4 respectively). Forage mass (2.432, 1.541, 1.091, and 719 kg DM/ha, respectively) linearly decreased ($P = 0.002$) as SR (SR1 to SR4) increased. By design, FA on d 0 decreased linearly ($P = 0.001$) across treatments (2.57, 2.26, 1.89, and 1.69 kg DM/kg BW for SR1, SR2, SR3, and SR4, respectively). On average, grazing was terminated when forage height and mass were 7.5 ± 1.5 cm and 800 ± 164 kg DM/ha, respectively. Final FA also decreased linearly ($P < 0.01$) as SR increased (0.70, 0.52, 0.42 and 0.40 kg DM/kg BW for SR1, SR2, SR3, and SR4, respectively). Average daily gain increased with increasing FA up to 2.1 kg DM/kg BW and remained constant at approximately 0.96 kg when FA was greater than 2.1 kg DM/kg BW. This relationship supports the fact that the major factor affecting gains at high SR was forage mass. Lesser SR allowed for greater ADG and gain/ha although steer grazing d[-1] did not differ among SR. Further research comparing diploids and tetraploids cultivars of annual ryegrass is warranted.

052 Evaluation of Nitrogen Delivery Methods for Stocker Cattle Grazing Annual Ryegrass.

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A 140-d grazing experiment was conducted to evaluate efficacy of replacing N fertilizer with either interseeded legumes or protein supplementation for stocker cattle grazing annual ryegrass (*Lolium multiflorum*). Ninety steers (initial BW, 225 ± 10 kg) were assigned to the following N-delivery methods, with or without monensin fed in a free-choice mineral supplement: ryegrass fertilized with 112 kg N/ha (NFERT); ryegrass interseeded with crimson clover (CC, *Trifolium incarnatum*); ryegrass interseeded with arrowleaf clover (AC, *Trifolium vesiculosum*); ryegrass plus dried distillers grains plus solubles (DDGS) supplemented at 0.65% BW daily; and ryegrass plus whole cottonseed (WCS) supplemented at 0.65% BW daily. Steers were weighed every 28 d, and forage mass (FM) was measured concurrently using the destructive harvest/disk meter double-sampling method. Each of thirty 0.81-ha paddocks was stocked initially with 3 steers, and stocking density was adjusted using put-and-take steers based on changes in FM and steer BW in order to maintain a forage allowance (FA) of 1 kg DM/kg steer BW. Grazing was discontinued on May 11, 2016. Data were analyzed by PROC MIXED for a completely randomized design with pasture (n = 3/treatment) as the experimental unit. Overall mean FM (kg DM/ha) was greatest ($P < 0.001$) for NFERT (1,012), intermediate for CC (924), DDGS (964) and WCS (935), and least ($P < 0.001$) for AC (741). Monthly mean FM decreased ($P < 0.001$) from December (1,068) to March (540), and increased ($P < 0.001$) from April (874) to May (1,237). Average daily gain (kg/d) of DDGS-supplemented cattle (1.37) was greater than ($P = 0.10$) CC (1.09) and AC (1.11), and tended *($P = 0.11$)* to be greater than NFERT (1.19) and WCS (1.20). Stocking density (steers/ ha) was greater ($P = 0.005$) for NFERT (6.7), DDGS (6.4) and WCS (6.4) than CC (5.7) and AC (5.6). Grazing days/ha for NFERT (444), DDGS (433) and WCS (433) were greater ($P < 0.01$) than CC (341) and AC (329). Total gain (kg/ha) tended ($P = 0.14$) to be greater for DDGS-supplemented cattle (599) than NFERT (489), CC (467) and AC (426), but not WCS (516). Monensin increased ($P = 0.07$) total gain by 80 kg (540 vs 460 kg/ha). Results are interpreted to mean that annual ryegrass pasture supplemented with either DDGS or WCS supported ADG, stocking densities, grazing days/ha and total gain/ha that were similar to or greater than annual ryegrass amended with N fertilizer or interseeded with annual legumes.

053 BMR-6 Forage Sorghum Silage as an Alternative to Corn Silage for Growing Cattle.

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Brown midrib-6 (BMR-6) forage sorghum varieties used as silage can be a viable alternative to corn silage (CS) with its improved drought tolerance compared to CS and its improved nutritive value compared to traditional forage sorghum. Research was conducted to compare a full season (110-115 days to maturity) BMR-6 brachytic dwarf forage sorghum (FS; Alta Seed AF7401), an early maturing (85-89 days to maturity) BMR-6 brachytic dwarf forage sorghum (ES; Alta Seed AF7102) and a CS containing 9.5% CP, 70.1% TDN for growing cattle. Silages were grown in a replicated field trial, these results will be reported elsewhere. Silages contained 25.5, 29.3, 31.1% DM, and 8.5, 8.6 and 9.5% CP for FS, ES and CS, respectively. Thirty-three Angus and Angus cross steers (initial BW 297 ± 5.33 kg) were blocked by BW for pen assignment and randomly assigned to one of the three diets. Steers were fed ad libitum by Calan gates for an 84-d growing period. Diets (balanced to 14% CP) consisted of 75% FS, ES or CS and 25% corn and SBM-based concentrate (DM Basis). At d 85 steers began a 113 d finishing period with a diet of 15% CS and 85% concentrate. Steers were shipped to Pennsylvania for harvest and to collect carcass data following the finishing period. During the growing period steer DMI did not differ ($P > 0.74$; 9.33 kg/d), nor did steer ADG differ ($P > 0.40$; 1.70 kg/d). Similar results were noted in the finishing period, with DMI not differing among treatments ($P > 0.59$; 12.44 kg/d), but ADG across treatments for the finishing period tended ($P > 0.08$) to be greater for FS (1.90 kg/d) compared to ES (1.66 kg/d) and did not differ from CS (1.86 kg/d). Gain:feed during the finishing period tended ($P > 0.06$) to be higher for FS (0.146) compared to ES(0.133) and did not differ from CS (0.146). Total DMI, overall ADG and feed:gain did not differ ($P > 0.11$.). Steer carcass data did not differ ($P > 0.13$) for hot carcass weight (400.0 kg), backfat (1.51 cm), loin eye area (91.5 cm^2), yield grade (3.16) and quality grade (17.7, where 17 = low choice and 18 = mid choice) across all treatments. Brown midrib-6 forage sorghum silages did not limit performance of steers in comparison to corn silage, while FS tended to have a higher gain:feed and ADG during the finishing period in comparison to ES.

054 Evaluating Yield and Nutritive Value of Tifton-85 Bermudagrass and Tifton-85 Bermudagrass-Alfalfa Mixtures as Baleage in the Southeast.

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Bermudagrass is the primary perennial warm-season forage produced in the Southeast; however, its moderate forage quality makes large amounts of fertilization and additional supplementation necessary. By interseeding bermudagrass with a legume, many of these concerns can be reduced. Legumes, such as alfalfa, have the ability to fix N, thus reducing the need for commercial N fertilizer. Alfalfa also improves the relative forage quality (RFQ) of alfalfa-bermudagrass mixtures by 30+ points, thereby reducing the need for additional supplementation. The production of alfalfa-bermudagrass baleage can further improve profitability by reducing losses due to poor weather conditions or leaf shatter associated with traditional hay production. The objective of this research is to compare the forage quality and yield of bermudagrass harvested as baleage with and without alfalfa interseeded, and the associated 'change over time' across the season. This study was conducted on an established field of 'Tifton 85' (T85) bermudagrass (*Cynodon dactylon*) at the University of Georgia Coastal Plains Experiment Station in Tifton, Georgia. Ten 0.5-acre plots were randomly assigned to either T85 or T85 interseeded with 'Bulldog 805' alfalfa (*Medicago sativa*). T85 bermudagrass-only treatments received nitrogen fertilization (84 kg N ha^{-1}) four times throughout the growing season, and both treatments were irrigated (2.5 to 5 cm per week) to supplement rainfall, as needed. Plots were harvested at early bloom stage every 28 to 35 days throughout the growing season, baled at 40-60% moisture, and individually wrapped. Plots were evaluated at each harvest for botanical composition and forage yield. Bales were sampled prior to wrapping for nutritive value analysis. Botanical composition revealed that the bermudagrass-only treatment contained 82.3 ± 3.8 % bermudagrass and 18.2 ± 3.9% weed and/or bare area while the alfalfa-bermudagrass treatment comprised 21.7 ± 4.2% alfalfa, 47.6 ± 3.5% bermudagrass, and 30.5 ± 4.2% weed and/or bare. In both treatments, the percent weed vegetation increased ($P = 0.0004$ and $P < 0.0001$ for bermudagrass and alfalfa-bermudagrass, respectively) in the August harvest. The bermudagrass-only treatment had a significantly greater ($P = 0.018$) dry matter yield (DM) than the alfalfa-bermudagrass mixture (2932.1 ± 185.3 kg ha^{-1} and 2190.2 ± 231.1 kg ha^{-1}, respectively). Although bermudagrass-only DM did not increase significantly ($P = 0.23$), both treatments had greater yields in the late-season cuttings. Alfalfa-bermudagrass yields

055 Development of a Conceptual Model for Integration of the Forage-Animal Interface as a Foundation for Decision Support Systems.

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The forage-animal interface is a vital component of agricultural systems that is often overlooked by both agronomy and animal science programs. As such, current grazing models do not always provide a satisfactory understanding of how forage species and/or cultivars respond to livestock interaction in both production and physiology, how forage can influence the animal, and how the nexus of these two entities may affect the environment. The objective of this effort was to develop a conceptual framework of a dynamic model that combined the forage and ruminant livestock interactions, and to provide the initial parameterization of a model for bermudagrass pastures. The systems dynamic methodology was used. The causal loop diagram (CLD) was first envisioned based on the hypothesis that not only can forage factors affect performance and behavior of the grazing animal, but the grazing animal, through its herbivorous behavior and selective intake, can affect and alter the physiology, growth, and performance of the forage and the pasture. Generation of a preliminary stock-and-flow diagram (SFD) with variable flight simulators was also performed. The main CLD was a composite of four sub-models that represented the agronomic, animal, atmospheric, and soil subsystems. The limitations of this model existed in the lack of meta-analytical publications in which necessary equations have been summarized that could be used in model programming. The parameterization of the model suggested that forage allowance was the driving factor in animal ADG, and forage growth rate was governed by a combination of evapotranspiration, defoliation, soil N, and precipitation. Our simulation of the bermudagrass scenario suggested that under these production conditions, most portions of the model operated in a traditional goal-seeking fashion. The initial results provided the documentation of the interface concept for the benefit of forage agronomy and animal nutrition programs as well as the foundation for advancements of the model to eventually serve as potential decision aid in production-economic strategies.

056 Response of Growing Cattle to a Cumulative Management Strategy Including an Implant, Ionophore, and Byproduct Feed Supplementation While Grazing Tall Fescue Pastures with Varying Toxicity.

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The objective of this study was to evaluate the growth response of steer calves to a combination management strategy while grazing low- to high-toxicity tall fescue (*Festuca Arundinacea*) pastures. Two short-term grazing seasons included fall 2015 for 91 d and spring 2016 for 84 d were studied. Sixteen pastures, 8 low- and 8 high-toxicity within season were used. Steers (n = 80) weighing 197.01 ± 15.43 kg and 116.93 ± 4.88 were stocked at 2.45 and 4.1 calves/ha in fall and spring, respectively. Within each of low- and high-toxicity pasture types, 4 pastures were allocated to a control, mineral (MIN) only management (MGMT) and 4 were allocated to the cumulative MGMT(CM) including Component TE-G implant, 150 mg/calf daily equivalent Rumensin, and 1% BW 50:50 corn gluten feed:soybean hull pellet supplement. Interim pasture ergovaline (EV) was measured within season. Data were analyzed within season. Pasture was the experimental unit and the statistical model included EV as a continuous covariate, MGMT as a fixed covariate and the EV x MGMT interaction. Reduced models were applied in the absence of interactions ($P > 0.05$). For fall and spring, the EV concentration was $1,476 \pm 883.2$ ppb and $1,173 \pm 620.6$ ppb, respectively. Mean forage allowance (forage DM/BW, kg/kg) was not affected by MGMT in the fall (4.5 ± 0.146) but increased with toxicity in spring (Forage Allowance = $2.17 + EV(0.0004)$, $P = 0.04$). In fall, there was no EV × MGMT interaction ($P = 0.19$) for BW gain. Fall ADG was negatively affected by increasing level of pasture toxicity ($P = 0.01$). In the fall, MIN calves gained 0.31 ± 0.027 kg/d, whereas, CM gained 0.95 ± 0.027 kg/d ($P < 0.001$). In the spring, there was an EV × MGMT interaction ($P = 0.03$) for ADG. For MIN, ADG = $0.7959 - EV(0.000278)$; whereas CM ADG = $0.936 + 0.000001835(EV)$ indicating CM improved ADG response as EV increased. Rectal and tail temperatures were not different ($P > 0.20$) among EV; rectal temperatures were not different ($P > 0.20$) for MGMT, however, fall final and spring interim and final tail temperatures were greater for CM compared to MIN ($P \leq 0.05$). In conclusion, BW gain and skin temperatures may be increased by CM in steers grazing toxic fescue and the beneficial effects of CM on ADG are greater as plant toxicity increases.

057 Effects of Selenium-Form Phenotypes on Steers Grazing Endophyte-Infected Tall Fescue.

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The goal of this study was to determine if the form of selenium (Se) [inorganic (ISe, sodium selenite), organic (OSe, Se-enriched yeast, SEL-PLEX®), or a 1:1 mix of ISe and OSe (MIX)] in vitamin-mineral mix (Se phenotype) affects metabolic parameters and performance of growing steers grazing endophyte-infected mixed pasture. Predominately-Angus steers (BW = 183.4 ± 32.8 kg) were randomly selected (n = 8) from each of their cow-calf Se phenotypic herds (managed under a typical forage-based, fall-calving, cow-calf production regimen) and assigned to summer-long strip-grazing of a common endophyte-infected mixed pasture (1.27 ppm total ergovaline; 17.5 ha). Steers were fed their respective Se treatment by top-dressing 85 g of a common basal vitamin-mineral mix that contained 3 mg Se/d onto 0.23 kg soyhulls, using in-pasture Calan gates. The PROC MIXED procedure of SAS was used to assess effect of Se phenotype on whole blood Se (ng/mL) and serum prolactin (ng/mL) at d 1, 21, 42, 63, and 84, and caudal arterial area (mm^2) at d -7, 42, and 84. After slaughter (d 92 to d 118), the effect of Se phenotype on liver glutathione content (mg/g wet tissue) and glutamine synthetase (GS) activity ($nmol \cdot mg^{-1}$ wet tissue$\cdot min^{-1}$) was assessed using the PROC GLM procedure of SAS. Fisher's protected LSD procedure was used to separate treatment means. Blood Se increased ($P < 0.01$) for all treatments from d 1 to 21 and then plateaued and was greater ($P \leq 0.06$) for MIX and OSe steers. Serum prolactin decreased over time ($P < 0.01$) and was greater ($P < 0.05$) for MIX and OSe steers. Liver GSH abundance did not differ ($P = 0.15$) among Se phenotypes, whereas GS activity differed ($P \leq 0.03$, MIX > OSe > ISe). ADG (ISe, 0.44 kg/d; OSe, 0.55 kg/d; MIX, 0.48 kg/d) was not affected ($P = 0.36$) by Se phenotype. Caudal artery area was greater ($P < 0.01$) on d 42 for all Se phenotypes, but was not affected ($P \geq 0.36$) by Se phenotype. These data indicate that consumption of 3 mg Se/d as OSe or MIX forms of Se in vitamin-mineral premixes increase (a) whole blood Se content, an indicator of greater whole-body Se assimilation; (b) serum prolactin, the reduction of which is a hallmark of fescue toxicosis; and (c) hepatic assimilation of acinar ammonia. However, (d) these positive effects on metabolic parameters were not accompanied by increases in peripheral vascular or growth performance.

058 Summer-Long Grazing of Endophyte-Infected Tall Fescue by Growing Beef Steers Inhibits Expression of Genes Responsible for Prolactin and ACTH Synthesis.

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The objective was to test the hypothesis that the selective content of mRNA encoding proteins responsible for prolactin and ACTH synthesis would be reduced in the pituitaries of beef steers randomly assigned to graze (89 to 105 d) either high toxic endophyte-infected tall fescue (HE; 0.746 µg/g ergot alkaloids; 5.7 ha; n = 10; BW = 267 ± 14.5 kg) or low toxic endophyte tall fescue–mixed pasture (LE; 0.023 µg/g ergot alkaloids; 5.7 ha; n = 9; BW = 266 ± 10.9 kg). As previously reported, HE steers had lower final BW (7.4%), ADG (31%), and serum prolactin concentrations (90%) than LE steers, and greater capacity for hepatic amino acid-derived gluconeogenesis. From these same steers, total RNA was isolated from whole pituitaries, semi-quantitative reverse-transcription PCR analyses (RT-PCR) were conducted, and the relative content of mRNA for proteins associated with prolactin and ACTH synthesis was compared by ANOVA using the GLM procedure of SAS. The mRNA content of 3 selected reference genes (*ACTB*, beta-actin; *PPIA*, peptidylprolyl isomerase A; and *UBC,* ubiquitin C) was not affected by treatment ($P \geq 0.42$) and the geometric mean of their content was used for normalization of targeted mRNA. Regarding prolactin synthesis, mRNA content of *DRD2* ($P < 0.01$; dopamine receptor D2), *POU1F1* ($P < 0.05$; POU class 1 homeobox 1, a.k.a. *PIT-1*, a transcription factor of *PRL* expression) and *PRL* ($P < 0.01$; prolactin) was reduced in HE vs. LE steers, whereas *l-PRLR* ($P < 0.07$; long-form of the prolactin receptor) mRNA content tended to be reduced and mRNA content of *s-PRLR* (short-form of the prolactin receptor) was not affected ($P = 0.21$). Moreover, mRNA content of *GAL* and *VIP* (galanin and vasoactive intestinal peptide, respectively; both involved in stimulation of prolactin release) was decreased ($P < 0.05$) in HE steers. Regarding ACTH synthesis, *POMC* (proopiomelanocortin, precursor polypeptide for ACTH) and *PCSK1* (proprotein convertase subtilisin/kexin type 1, cleaves ACTH from POMC) were both reduced ($P < 0.01$) in HE steers. We conclude that summer-long grazing of endophyte-infected tall fescue inhibits expression of genes responsible for prolactin and ACTH synthesis by the pituitaries of growing beef steers.

059 Effects of Ergot Alkaloids during Mid-to-Late Gestation on Uteroplacental Sufficiency and Fetal Growth.

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The objective of this study was to evaluate uteroplacental sufficiency, fetal growth, and development in ewes consuming ergot alkaloids found in endophyte-infected tall fescue [*Lolium arundinaceum* (Schreb.) Darbysh; *Schedonorus phoenix* (Scop.) Holub] seed at two stages of gestation. Thirty-six Suffolk ewes (78.24 kg ± 9.5) estimated to be carrying twins at d 35 of gestation were randomly assigned to one of two treatments: endophyte-free tall fescue seed (E-; 0.0 µg ergovaline + ergovalinine/g) or endophyte-infected tall fescue seed (E+; 4.14 µg ergovaline + ergovalinine/g) from d 35 – d 85 and d 86 – d 133 of gestation creating four unique dietary treatments: E-E-, E-E+, E+E-, and E+E+. Endophyte-infected tall fescue seed was fed at a level to provide 1772 µg of ergovaline + ergovalinine/hd/d for E+ treatments while an equal weight of endophyte-free seed (0.0 µg ergovaline + ergovalinine) was fed for E- treatments. Ewes were pair-fed across treatments in order to maintain equal DMI. Fetal and maternal necropsies were performed at d 133 of gestation. Muscle, organ, and placental samples were weighed and stored at -20°C and -80°C for later analysis. Data were analyzed as a randomized block design using a 2 x 2 factorial with alkaloid consumption (E- or E+), gestational time period (d 35 – d 85 or d 86 – d 133), and interaction as fixed effects. There was no significant difference ($P > 0.05$) in actual placental or fetal weights based on E+ or E- treatment between d 35 – d 85. A significant ($P = 0.036$) interaction between treatment and time was observed wherein the placentome weight to BW ratio was highest for E+E- ewes. Ewes receiving E+ treatment between d 86 – d 133 had lower ($P = 0.003$) uterine weights and lower ($P = 0.0005$) placentome weights. Cotyledon and caruncle tissue weights were reduced ($P < 0.002$) in ewes on E+ treatment between d 86 – d 133 compared to E- treatment. Cotyledon and caruncle weights were reduced by 25% and 19%, respectively. Overall fetal weight was decreased ($P = 0.002$) by 10% for ewes on E+ treatment compared to E- treatment between d 86 – d 133. Ergot alkaloid exposure during late gestation induces uteroplacental insufficiency and leads to reduced fetal growth.

PHYSIOLOGY

060 Ronald D. Randel Lectureship Part I: Who influenced you?

W. M. Moseley*

Zoetis, Inc., Kalamazoo, MI, Positively Mose, LLC, Kalamazoo, MI.

Think back in your life … who had a significant impact on your life, personally and professionally? For me, it is Dr. Ron Randel, aka. "Doc"! He took a risk on me, believed in me, challenged me, trained me and encouraged me to think for myself and strive for excellence. His passion for science, agriculture, cattle and practical applications of research was contagious and inspirational. Under his guidance, both my MS and PhD programs were designed and conducted with course work on campus and research at off-campus research centers. This blend of educational and experiential time solidified my career decisions. Interactions with researchers from Academic institutions, Pharmaceutical Companies and Technical Service Consultants (PhDs and DVMs) convinced me that there was a fascinating pathway and opportunity as a Research Scientist in Industry vs Academia. It was these experiences with Doc that provided the foundation for my entire career and philosophy for success. Your aptitude, attitude, passion, persistence, confidence and communication skills combined will determine your trajectory. Your career is your responsibility. As we train Undergraduate and Graduate students, let's connect them with extremely important and exciting opportunities in Agriculture, Science, Research, Teaching, Education and Outreach in Food Producing and Companion Animals globally. Let's bridge and collaborate between Universities, Extension, Government and Industry to fully engage our talent base. Bringing ideas and people together to create solutions is Doc's philosophy that has been instilled in all his students and will be his enduring legacy!

061 Effect of Omega-3 Polyunsaturated Fatty Acid (n-3 PUFA) Supplementation to Lactating Sows on Growth and Indicators of Stress in the Post-Weaned Pig.

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Dietary n-3 PUFA are precursors for lipid metabolites that reduce inflammation. Two experiments were conducted to test the hypothesis that enriching the sow diet in n-3 PUFA during late gestation and throughout lactation reduces stress and inflammation, and promotes growth in weaned pigs. A protected fish oil product (PFO; Gromega™) was used to enrich the diet in n-3 PUFA. Experiment 1, time-bred gilts (n = 14) were fed a gestation and lactation diet supplemented with 0 (control; n = 5), 0.25 (n = 4), 0.5 (n = 4) or 1% (n = 5) PFO from 101 ± 2 d of gestation to d 16 of lactation. Adding 1% PFO to the diet increased the n-3:n-6 PUFA ratio in colostrum and milk compared to controls (P = 0.05). A subsequent experiment was performed to determine if supplementing the sows' diet with 1% PFO improved growth and reduced circulating markers of acute inflammation and stress in their offspring. Plasma was harvested from piglets (16 /treatment group) on d 0 (d of weaning) and d 1 and 3 postweaning. Pigs from the 1% PFO treatment group weighed more (P = 0.03) on d 3 postweaning and had a greater (P < 0.01) n-3:n-6 PUFA ratio in plasma on each day sampled compared to 0% PFO controls. There was an overall treatment effect (P = 0.02) on plasma total cortisol, with lesser concentrations in pigs on the 1% PFO diet. Plasma corticosteroid-binding globulin (CBG) concentrations were not different between treatment groups but were lesser (P < 0.001) on d 1 and 3 when compared to d 0. The resultant free cortisol index [FCI (cortisol/CBG)] was lesser (P = 0.02) on d 1 and 3 for pigs from the 1% treatment group compared to the controls. An ex vivo lipopolysaccharide (LPS) challenge of whole blood collected on d 0 and 1 was used to determine if 1% PFO attenuated release of inflammatory cytokines (IL-1β, IL-6, and TNF-α). Pigs from the 1% PFO treatment group tended (P = 0.098) to have a lesser mean concentrations of TNF-α in response to LPS compared to controls. These results suggest that providing a PFO supplement as 1% of the diet to sows beginning in late gestation and during lactation can increase the n-3:n-6 PUFA ratio in their offspring, which may improve growth and reduce the acute physiological stress response in the pigs postweaning.

062 Factors Affecting Antibody Mediated Immune Response in Weaned Brahman Calves.

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Factors affecting antibody mediated immune response in weaned Brahman calves

Immune function could be a tool to select healthier cattle. The hypothesis of this study was that sex, BW, body condition score (BCS), or weaning temperament [e.g., (pen score (PS), exit velocity (EV), and temperament score (TS)] would influence antibody-mediated immune response (AMIR) in weaned Brahman calves. Bulls (n = 55; BW = 199 ± 10 kg; BCS = 5.4 ± 0.08) and heifers (n = 57; BW = 178 ± 10 kg; BCS = 5.3 ± 0.08) were administered *Salmonella* Newport Extract vaccine (2 mL subcutaneously; Zoetis, Florham Park, NJ) at a mean of 264 d of age (Day 0). Blood samples were collected by jugular venipuncture on Days 0 and 15. Harvested serum samples were stored at -20C until analyzed for vaccine specific IgG by a double sandwich, enzyme linked immunosorbent assay (AMIR). Data were analyzed using PROC MIXED procedures specific for repeated measures (SAS v9.3). Calf sex, sire, and their interaction were independent variables, and AMIR response and weaning temperament were dependent variables. Day 0 BW was greater ($P = 0.0003$) in bulls (199.77 ± 10.19 kg) than heifers (177.90 ± 10.30 kg). Both PS and TS were greater ($P < 0.01$) respectively in heifers (2.38 ± 0.13 and 2.49 ± 0.14) than in bulls (1.68 ± 0.13 and 2.01 ± 0.14). The AMIR was not different ($P > 0.8$) between bulls (0.49 ± 0.05) and heifers (0.48 ± 0.05). Low (L), medium (M), and high (H) immune response classes were determined by ½ SD from AMIR response means: bulls ($P < 0.01$, L = 0.12 ± 0.04; M = 0.46 ± 0.04; H = 1.1 ± 0.05) and heifers ($P < 0.01$; L = 0.18 ± 0.0; M = 0.44 ± 0.03; H = 0.93 ± 0.32). Response class was used as the independent variable in a mixed model analyses with growth and temperament measures as dependent variables. In response class data there were no significant effects of growth or temperament traits on AMIR ($P > 0.10$). We must accept the null hypothesis that neither sex, BW, BCS, nor weaning temperament affected AMIR in weaned Brahman calves.

063 Clostat® Reduces the Negative Impacts of a Salmonella Challenge in Weaned Holstein Steers.

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To evaluate the effects of a patented *Bacillus subtillus* probiotic (CLOSTAT®), weaned Holstein steers, (n = 200; ~90kg) were supplemented (CLO) or not (CON) with CLOSTAT® (13 g/hd/d; Kemin Industries, Des Moines, IA) in a starter ration at a calf ranch for 35 d (n = 50 head per pen; 2 pens/ trt.). A subset of 40 calves was selected for an oral *Salmonella* challenge based on body weight, treatment records, and lack of *Salmonella* shedding. The calves were transported to Lubbock, TX (105 km) and assigned to 1 of 4 treatments in a 2x2 factorial design with CLO and CON calves that were orally administered *Salmonella* (STM) or not (CLOSTM, CLONoSTM, CONSTM, CONNoSTM). Calves assigned to receive *Salmonella* were challenged with 1.6 x 10^6 *Salmonella* Typhimurium (resistant to 50μg/ml nalidixic acid) in 1 L of milk replacer on d 0. Blood samples for serum and hematology were collected via jugular catheters every 8 h for 96 h, and body temperature was collected every 5 min via indwelling rectal temperature recording devices. Five calves from each treatment were harvested 48 h post-challenge, and the remaining calves were harvested 96 h post-challenge. During necropsy, tissues were collected for the isolation and quantification of the inoculated STM from various tissues. The CLO group had reduced STM concentrations in the jejunum, ileum, and transverse colon 48 h after the challenge ($P \leq 0.03$) and numerically reduced STM concentrations in all gastrointestinal tissues 96 h post-challenge. There was a difference in rectal temperature ($P < 0.001$) in which CLOSTM calves displayed decreased rectal temperatures after the challenge when compared to CONSTM calves. White blood cells and lymphocytes were increased ($P \leq 0.05$) in CLOSTM calves after the challenge in comparison to other treatments. Calves in the CLO treatment maintained greater numerical BW throughout the study; however, there was no difference ($P = 0.89$) in BW change during the study. In calves given STM, the CLO group had greater feed disappearance before and after the challenge ($P = 0.006$) in comparison to the CON group. Increased serum IL-6 and IFNγ was observed in the CONSTM group compared to other treatments. There was no difference ($P = 0.42$) in circulating cortisol between the treatments. Overall, CLO reduced *Salmonella* presence and concentrations in gastrointestinal tissues while simultaneously reducing the severity of the salmonellosis as indicated

by blood parameters and the reduced febrile response.

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064 Factors Affecting Growth of Berkshire Pigs in Alternative Production Systems.

H. S. Park[*], S. H. Oh

North Carolina A&T State University, Greensboro.

The objective of the present study was to investigate the effects of farrowing month (FM), parity and sex on the growth performance of Berkshire swine raised in alternative production systems. A total of 40 farrowing records from 27 sows and 1,258 body weight (BW) records from 274 piglets collected over a two-year period were used for the analysis. Body weights were recorded at birth, weaning (28 d), 56, 84, 112 and 140 days. Any BW not recorded on schedule was recalculated to conform the days of age among corresponding BW records, using growth curves drawn with polynomial functions whose power was determined by the number of existing observations for each individual. The mean parity ($\pm$ SD) of the sows was 3.42 ± 2.14. The highest average number of pigs born alive and number of pigs weaned were found in the fall, specifically September and October. The lowest average number of pigs born alive and number of pigs weaned were found in the late spring and summer from May to July. Farrowing month did not affect birth and wean weights, but affected BW measured on 56, 84, 112 and 140 days of age. However, piglets farrowed in June had noticeably higher birth weight and continued to have the highest average BW until 140 day of age, except on 112 day of age. On 112 day of age, there was no significant difference between the BW of piglets farrowed in June and that of piglets farrowed in October. Piglets farrowed in October had the lowest birth weight due to the sow heat stress during gestation. However, rearing in the fall and finishing in the winter allowed for superior growth performance for piglets farrowed in October. Nonetheless, best month for farrowing was found to be June according to the highest birth and finishing weights. Taking into account both the reproductive performance of the sows and the growth performance of the piglets affected by season, the fall months result in the best productivity. Parity and sex did not have an effect on the growth performance of the piglets.

065 Factors Affecting Growth and Body Dimensions of Pigs Reared in Alternative Production.

H. S. Park[*], S. H. Oh

North Carolina A&T State University, Greensboro.

Research on factors affecting the growth performance (GP) of purebred Berkshire pigs reared outdoors is scarce, especially when measurements other than the body weight (BW), such as girth, length, and front and rear leg heights are considered. The objectives of the present study were to investigate the environmental factors, such as the farrowing month (FM), affecting body dimensions (BD) of purebred Berkshire pigs reared outdoors, measured in terms of girth, length and the leg heights, and to study the correlation between the ratios of BD and other growth performance measurements such as the body weight and backfat thickness. A total of 274 Berkshire purebred pigs from 27 sows, with a BW record of 1,573 and measurement records of 1,159 for each trait were used for the study. GP measurements were recorded at birth and every four weeks until 20th week for all traits. Any advancements or postponements in GP measurements were adjusted using polynomial functions with respective powers to conform the age at which the measurements were recorded. In addition, backfat (BF) thickness was measured at the shoulder, in the middle and at the back with an ultrasound prior to slaughter, resulting in a total of 150 average BF records, 146 of which were adjusted at a desired weight of 220 lbs. for a more accurate analysis. Least square means of GP traits were estimated with Proc Mixed in SAS 9.3 for fixed effects such as sex, parity, FM and FM by day of age (DOA) interaction. Sex and parity did not have a significant effect on GP. FM and FM by DOA showed that pigs farrowed in June were born the heaviest and the largest and finished the heaviest and the largest at 20th week, with the largest girth, length and leg heights, closely followed by pigs farrowed in October. The smallest pigs were found in those farrowed in September. The correlation between ratios of BD and BW showed a negative correlation between Girth:Length and BW at 16th week; however, no prominent trend in correlation between BW and BD ratios was found. The correlation between ratios of BD and BF were the strongest for length to leg height ratios. Pigs with shorter length and taller legs at 8th week have leaner backfat at 220 lbs.

Table 066. Mean and SE of the calving groups BW (Early, Intermediate, Late) at specific time points, proportion of mature BW at conception, ADG from weaning to 365d and ADG from 365d to conception.

| | Calving Group | | | |
| | Early (n = 88) | Intermediate (n = 72) | Late (n = 82) | |
Variable				*P*-value
Weight at Weaning (kg)	191.12 ± 3.46	192.30 ± 3.49	182.98 ± 3.29	0.018
Weight at 365d (kg)	275.75 ± 3.76	270.12 ± 3.64	262.87 ± 3.51	0.0088
Weight at Conception (kg)	342.99 ± 6.73	380.98 ± 6.82	443.99 ± 7.48	<0.0001
Mature Weight (kg)	508.42 ± 10.42	501.76 ± 10.06	513.41 ± 9.04	0.5406
Proportion of Mature BW	0.662 ± 0.017	0.757 ± 0.017	0.845 ± 0.018	<0.0001
ADG Weaning-365d (kg)	0.451 ± 0.018	0.414 ± 0.018	0.418 ± 0.017	0.1294
ADG 365d-Conception (kg)	0.635 ± 0.023	0.558 ± 0.023	0.482 ± 0.026	<0.0001

066 Relationship of Growth on Age at First Calving in Brahman Heifers.

R. A. d'Orey Branco[*1], D. A. Neuendorff[1], T. H. Welsh[2], R. D. Randel[1]

[1]Texas A&M AgriLife Research, Overton, [2]Department of Animal Science, Texas A&M University, College Station.

As some Brahman heifers can calve at 2 yr of age the objective of this study was to determine the relationship of BW at specific time points relative to age at first calving. We hypothesized that heifers capable of calving at younger ages would be heavier at weaning and at 365 d of age (365d) of age. Yearling heifers (n = 242) born from 2005 to 2011 were placed into continuous breeding herds until they became pregnant. Heifers were weighed at weaning and at 28-d intervals until pregnancy was determined. Weights were calculated at 365d of age and at conception. Mature BW was defined as BW at or near weaning of at least their 3rd calf. Based on their age at 1st calving the females were assigned to the Early (≤ 800d; n = 88), Intermediate (≥ 801d ≤ 1000d; n = 82), or Late (≥ 1001d; n = 82) calving groups. Data were analyzed using Proc Mixed, with sire and yr of birth as random variables. Sire affected (*P* < 0.05) weight at both weaning and conception. Birth yr affected weight at 365d of age, proportion of mature BW at conception, and ADG from weaning to 365d, as well as, ADG from 365d of age to conception. The Late group was the lightest at weaning (*P* < 0.05). ADG from weaning to 365d of age did not differ (*P* > 0.05) among groups. At 365d of age the Early group was heavier (*P* < 0.05) than the Late group (Table1). ADG from 365d of age to conception was greatest (*P* < 0.05) in the Early group. Proportion of mature BW at conception was lower (*P* < 0.05) in the Early group, but mature BW was similar (*P* > 0.05) among the groups (Table 066). Brahman heifers that calve first at younger ages have different growth patterns compared with those calving first at older ages. Mature BW was not affected by age at first calving.

067 Ronald D. Randel Lectureship Part II: Interferons during Early Pregnancy and Fetal Response to Viral Infection.

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Interferons (IFN) are cytokines induced in cells by viral infections that provide a first line of defense against other viral infections. These cytokines are derived from a multi-gene family and classified as Type I IFNs (IFN-I; a,b,j) and Type II IFNg. A pregnancy- and ruminant-specific IFN-I called IFNT was discovered in the late 1980's through cDNA sequencing and is the major protein secreted from the expanding ruminant blastocyst. Like other Type I IFNs, IFNT has strong antiviral activity. However, IFNT is not strongly upregulated in response to viral infection. IFNT also is specifically released from trophoblast cells and has unique critical action on the endometrium through inducing IFN stimulated genes (ISGs) and altering the release of prostaglandin F2a, thereby rescuing the corpus luteum (CL) of early pregnancy. In addition, IFNT induces ISGs in peripheral blood mononuclear cells, CL and liver, which confers resistance of the CL to luteolysis and provides a supportive endocrine role for primary paracrine actions in the endometrium. Induction of maternal ISGs in PBMC and other tissues may facilitate rapid upregulation of type I IFN innate immune responses to infection during pregnancy. The impact of maternal bovine viral diarrhea virus (BVDV) infection on IFNs, ISGs and fetal development was examined during pregnancy. Impaired induction of IFN-I and immune tolerance have been cited as critical to establishment of persistent infection (PI) of the fetus with non-cytopathic (ncp) BVDV. Infection of pregnant cows (d75) with ncpBVDV induces a rapid innate immune response (IFN-I and ISGs) that decreases viral replication and leads to the induction of adaptive immune responses that clears the virus in ~ 3 weeks. Seven to 14 days after maternal inoculation, ncpBVDV crosses the placenta and induces fetal viremia. Activation of fetal ISGs occurs shortly after fetal exposure to the virus and is accompanied by activation of adaptive immune responses mediated by IFN-γ at the peak of fetal viremia (22 days after

the maternal infection). The collective actions of the innate and adaptive immune responses causes a significant decrease in fetal viremia, but fails to eliminate the virus. Clarifying the mechanisms of fetal BVDV persistence in the face of activated IFNs will lead to better management tools, detection, biocontainment and antiviral treatments. Cattle may also be selected that are resistant to BVDV and other viral infections. Likewise, a better understanding of IFNT action during early pregnancy may lead to strategies designed to better manage infertility in ruminants.

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068   Hair Shedding Score and Hair Coat Color Affect Body Temperature during Heat Stress in Weaned Beef Heifers.

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[1]*Mississippi State University, Prairie, [2]USDA-ARS, Livestock Issues Research Unit, Lubbock, TX.*

The study objective was to evaluate the effects of hair shedding score and hair coat color on vaginal temperature (VT) of calves during heat stress. Weaned *Bos taurus* beef heifers (n = 32; BW = 282 ± 6.4 kg) were assigned to a hair coat color class (BLACK; RED; or LIGHT, where LIGHT = yellow or gray) and evaluated for hair shedding score. Hair coat was subjectively scored on a 1 to 5 scale (1 = slick summer coat, 5 = no shedding). Vaginal temperatures were recorded at 5-min intervals during a 19-d study in July and August 2016. Calves were randomly assigned to one of four 2.02-ha pastures in Prairie, MS with equivalent shade allotment and balanced by hair color and shedding score. Environmental temperature and humidity data loggers were placed in each pasture. Temperature data were evaluated using the PROC MIXED procedure of SAS specific for repeated measures with LSMEANS separation evaluated at α = 0.05 using the PDIFF option. Throughout the study, the mean environmental temperature was 27.75°C, and mean relative humidity was 82.81%. There was an interaction between color and hair shedding score (*P* = 0.02). There was no difference between hair score 1 and 2 (*P* = 0.39) but there was a difference between hair scores 1 and 3 (*P* < 0.0001) and hair scores 2 and 3 (*P* < 0.0001) for all hair colors. In animals having a hair score of 1, RED animals had elevated VT compared to BLACK (*P* = 0.0003). There was a tendency for increased VT in RED animals compared to LIGHT (*P* = 0.07). In heifers with a hair score of 2, there was a tendency for increased VT in RED heifers compared to LIGHT (*P* = 0.08) and an increase in VT in RED compared to BLACK (*P* = 0.0012). There was no difference between LIGHT and RED heifers in hair score 3 (*P* = 0.14); however, they had elevated VT in comparison to BLACK (*P* < 0.0035). Future research endeavors are warranted to further explore the observed in-

teractions of hair coat color and shedding score on beef calf body temperature in the Southeastern United States.

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069   Evaluation of the Effect of Hot Iron Branding on Cortisol and Cortisol Binding Globulin Concentrations in Young Senepol Cattle.

R. W. Godfrey[*1], S. R. Joseph[1], J. A. Martinez[2], H. C. Nelthropp[1], S. A. Lakos[1], R. L. Stanko[2,3], H. G. Kattesh[4], S. A. Lockwood[4], B. E. Gillespie[4]

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The objective was to evaluate the impact of hot iron branding on plasma cortisol and corticosteroid- binding globulin (CBG) concentrations of Senepol heifers and bulls (n = 15/sex; 14 mo of age). On d 1 and 14 calves were put in the chute and after applying squeeze a blood sample was collected by coccygeal vessel puncture (PRE). After 1 min to mimic the time it takes to brand a second blood sample was collected (POST). The calf was released from the chute. On d 7 calves were put in the chute and after applying squeeze to immobilize the calf a blood sample was collected by coccygeal vessel puncture (PRE). The calves were hot branded with a single digit (number 5) using an electric branding iron. A second blood sample was collected after branding was completed (POST). The calf was released from the chute and returned to the pen of same sex cohorts. Plasma was harvested from blood samples and stored at -20 °C until assayed for cortisol and CBG by RIA and ELISA, respectively. Free cortisol index (FCI) was determined as the ratio of total cortisol/CBG. Data was analyzed using SAS (9.3) with sex, week and time of sampling in chute as the main effects. Cortisol was higher (*P* < 0.0001) in heifers than in bulls (101.44 ± 3.99 vs. 74.88 ± 3.97 nmol/L, respectively). In bulls cortisol was lower on d 7 compared to d 1 and 14 (50.97 ± 6.88 vs. 87.19 ± 6.88 vs. 86.48 ± 6.88 nmol/L, respectively) but there was no difference (*P* > 0.10) in heifers over time. Cortisol was lower (*P* < 0.05) in the PRE than in the POST sample (82.45 ± 3.99 vs. 93.87 ± 3.97 nmol/L, respectively). Heifers had higher (*P* < 0.0002) CBG than bulls (0.81 ± 0.04 vs. 0.62 ± 0.04 mg/L, respectively). There was no difference in CBG across days or between PRE and POST samples (*P* > 0.10). On d 7 FCI of bulls was lower (*P* < 0.0005) than on d 1 and 14 (83.14 ± 17.54 vs. 157.64 ± 17.54 vs. 195.62 ± 17.54 nmol/mg, respectively). In heifers there was no difference (*P* > 0.10) in FCI across days or between PRE and POST. These results show that hot branding elicits a slight, acute cortisol response

(13.8 % increase) in Senepol cattle but there was no residual impact 7 d after branding.

070 Evaluation of the Effect of Hot Iron Branding on Pen Score, Chute Score, Exit Velocity and Flight Distance in Young Senepol Cattle.

R. W. Godfrey[*1], S. R. Joseph[1], J. A. Martinez[2], H. C. Nelthropp[1], S. A. Lakos[1], R. L. Stanko[2,3], H. G. Kattesh[4], S. A. Lockwood[4]

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The objective of the study was to evaluate the impact of hot branding on behavior of Senepol heifers and bulls (n = 15/sex; 14 mo of age). On d 1 and 14 calves were evaluated for pen score (PS; 1 = calm to 5 = aggressive) in same sex groups of 5 prior to being placed in the chute (PS1). Calves were held in the chute without catching their heads and no squeeze applied to record chute score (CS; 1 = calm to 5 = extremely agitated). After applying squeeze for 1 min to mimic the time it takes for branding calves were released from the chute and exit velocity (EV) was measured. A second PS was collected (PS2). On d 7 data was collected similar to d 1 with the addition of branding using a hot iron. On d 7 and 14 flight distance (FD) was measured with PS1 and PS2 (FD1, FD2) using a rangefinder. Data was analyzed using SAS (9.3) with sex, day and time relative to being in chute as the main effects. There was no difference in PS between bulls and heifers (1.2 ± 0.1 vs. 1.2 ± 0.1, respectively). Pen score on d 1 was higher than on d 7 or 14 (1.5 ± 0.1 vs. 1.1 ± 0.1 vs. 1.1 ± 0.1, respectively). On d 7 PS2 was higher ($P < 0.03$) than PS1 in bulls (1.3 ± 0.1 vs. 1.0 ± 0.1, respectively) but there was no difference ($P > 0.10$) in heifers. Heifers had higher ($P < 0.002$) CS than bulls on d 1 (2.1 ± 0.1 vs. 1.5 ± 0.1, respectively), but there was no difference ($P > 0.10$) on d 7 or 14. There was no difference ($P > 0.10$) in EV between bulls and heifers (2.03 ± 0.11 vs. 2.12 ± 0.11 m/s, respectively). Heifers had higher EV ($P < 0.03$) on d 7 than d 1 with d 14 being intermediate (2.48 ± 0.19 vs. 1.89 ± 0.18 vs. 1.98 ± 0.19 m/s, respectively) but there was no difference in bulls ($P > 0.10$). There was no difference in FD between bulls and heifers (2.29 ± 0.08 vs. 2.50 ± 0.08 m, respectively) or between day 7 and 14 (2.47 ± 0.08 vs. 2.32 ± 0.08 m, respectively). These results show that Senepol cattle have mild dispositions and the stress of branding does not alter their behavior.

071 Evaluation of the 14-d CIDR-PG and 9-d CIDR-PG Protocols for Synchronization of Estrus in Bos indicus-Influenced and Bos taurus Beef Heifers.

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Two long-term estrus synchronization protocols were evaluated among *Bos indicus*-influenced and *Bos taurus* beef heifers on the basis of estrous response and pregnancy rate resulting from fixed-time artificial insemination (FTAI). Estrus was synchronized for 1139 heifers in three locations, and heifers were assigned to one of two treatments within each location based on reproductive tract score (RTS; 1-5 scale). Heifers assigned to the 14-d CIDR-PG protocol received a controlled internal drug release (CIDR) insert (1.38 g progesterone) on Day 0 with removal on Day 14, administration of prostaglandin $F_{2\alpha}$ (PG; 25 mg im) on Day 30, and administration of gonadotropin-releasing hormone (GnRH; 100 µg im) concurrent with FTAI 66 h after PG. Heifers assigned to the 9-d CIDR-PG protocol were administered PG concurrent with CIDR insertion on Day 5, PG concurrent with CIDR removal on Day 14, PG on Day 30, and GnRH concurrent with FTAI 66 h after PG. Estrus detection aids were applied at CIDR removal and PG to evaluate estrous response. Mean RTS differed ($P < 0.0001$) based on biological type, with higher rates of estrous cyclicity (RTS 4 and 5) among *Bos taurus* heifers (72%) than *Bos indicus*-influenced heifers (27%). The proportion of heifers expressing estrus following CIDR removal was greater ($P = 0.01$) among heifers assigned to the 14-d CIDR-PG (88%) compared to the 9-d CIDR-PG protocol (83%). Estrous response following CIDR removal was higher ($P < 0.0001$) among *Bos taurus* (95%) compared to *Bos indicus*-influenced (75%) heifers. Rate of estrous response prior to FTAI did not differ based on treatment but was higher ($P < 0.0001$) among *Bos taurus* heifers (60%) than *Bos indicus*-influenced heifers (45%). However, biological type did not affect estrous response when RTS was included in the model, as RTS affected ($P < 0.0001$) the rate of estrous response at CIDR removal and prior to FTAI. Heifers that expressed estrus prior to AI achieved higher ($P < 0.0001$) AI pregnancy rates than heifers failing to express estrus. Pregnancy rates to FTAI did not differ significantly based on treatment in either biological type. Higher rates of estrous cyclicity among *Bos taurus* heifers resulted in higher FTAI pregnancy rates among *Bos taurus* (51%) compared to *Bos indicus*-influenced heifers (39%). However, pregnancy rates of respective RTS did not differ based on biological type. In summary, long-term CIDR-based protocols provide a simple, effective method of estrus synchronization in *Bos indicus*-influenced and *Bos taurus* beef heifers.

072 Reproduction in Gilts and Sows Fed Gestation and Lactation Diets Containing Menhaden Fish Oil.

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Previous research demonstrated that dietary omega-3 fatty acids enhance early embryonic survival in gilts and increases litter size in sows. The objective of this experiment was to determine the effects of menhaden oil (MO), a rich source of omega-3 fatty acids, on reproductive performance in Yorkshire x Landrace gilts (n = 12) and sows (n = 32). After AI, females received: 1) control gestation and lactation diets, or 2) gestation and lactation diets that included 4% MO (Virginia Prime; Omega Protein, Inc., Houston, TX). Control and MO diets were isocaloric and isolysinic. Farrowing rates were not affected ($P > 0.1$) by parity or diet ($P = 0.75$) and overall was 65.9%. Total litter size and the number of pigs born alive were affected ($P < 0.01$) by parity x diet. Primiparous sows fed the gestation diet containing MO had greater ($P < 0.05$) total litter size (13.6 ± 1.3 vs. 8.0 ± 1.3) and pigs born alive (12.4 ± 1.3 vs. 7.3 ± 1.3) compared to primiparous controls. In multiparous sows, however, there were no effects ($P > 0.05$) of diet on these response variables. Consistent with these findings, total and live born pigs farrowed by primiparous controls were heavier ($P < 0.05$) compared to pigs farrowed by primiparous sows fed the MO diet, while in multiparous sows, there were no effects ($P > 0.05$) of diet on these response variables (parity x diet, $P < 0.01$). Sow feed intake during lactation, the number of pigs weaned, and pig weaning weights were not affected ($P > 0.1$) by diet, parity, or diet x parity. Pig ADG during the suckling phase, however, was affected ($P = 0.05$) by diet x parity. Pigs farrowed by multiparous control sows grew faster ($P < 0.05$) than pigs farrowed by multiparous sows fed the MO diets. Pigs farrowed by primiparous control or menhaden oil-fed sows grew similarly ($P > 0.05$). In summary, these preliminary results suggest that inclusion of MO in the diets of primiparous sows may have beneficial effects on reproductive performance.

073 Prostaglandin at Initiation of 7-d CO-Synch + Cidr Protocol Improves Estrus Response but Not Pregnancy Rate in a Modified Split-Time AI Program.

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We evaluated the effect of an additional prostaglandin $F_2\alpha$ ($PGF_2\alpha$) treatment at the initiation of a 7-d CO-Synch + CIDR synchronization of estrus protocol in a Split-time AI program. Our objective was to determine if estrus response and fixed-time AI (FTAI) pregnancy rate could be enhanced by eliminating existing corpora lutea at the beginning of synchronization. Postpartum (>80d), multiparous commercial Angus cows (n =100) on a large ranch in West Texas were randomly allocated by age (5.31 ± 2.15 yr) to one of two treatments: 1) cows (n = 52) received $PGF_2\alpha$ (25 mg) + GnRH (100 μg) and a 7-d CIDR (+PG) on d0 or 2) cows (n = 48) received GnRH (100 μg) and a 7-d CIDR (Control) on d0. All females received $PGF_2\alpha$ (25 mg) and Estrotect® patch for evidence of estrus at CIDR removal (d7). All animals were gathered and worked through a chute at random, beginning 70 h post-CIDR removal. Cows were considered estrual (EC) when either the majority (> 50%) of patch showed color or if the patch was absent. Estrual cows received FTAI 70 to 73 h after CIDR removal. Non-estrual cows received GnRH (100 μg) 70 to73 h after CIDR removal and were FTAI 78 to 79 h after CIDR removal. Beefmaster sires (n=4) were equally represented across treatment and technician at FTAI. Pregnancy to FTAI was determined utilizing real-time ultrasound 35 d after FTAI. Data were analyzed using PROC FREQ of SAS. Overall, FTAI pregnancy rate and estrus response were 58% and 68%, respectively. Pregnancy rate for Control EC was greater (80.78%) than +PG EC cows [66.67%, ($P < 0.05$)]. Pregnancy rates for non-estrual cows were similar ($P > 0.05$) among +PG (50%) and Control treatments (40.91%). Pregnancy rates across sires were similar ($P > 0.05$). Estrus response to treatment was analyzed using PROC GLIMMIX of SAS. Estrus response was greater ($P < 0.02$) for +PG cows (76.92 ± 5.84%) than for control cows (54.17 ± 7.19%). These results indicate that, $PGF_2\alpha$ administration at CIDR insertion and removal in a7-d CO-Synch + CIDR protocol for a Split-time AI program improved estrus response. However, pregnancy rates were lower and may have been influenced by the timing modification of FTAI to the Split-time AI program implemented.

074 Effect of Acute or Chronic Water Restriction on Acute Phase Protein and Antibody Responses in Parenteral or Intranasal Modified-Live Viral Vaccinated Beef Calves.

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The study objective was to determine if acute or chronic water restriction affected haptoglobin (Hp) and serum and mucosal antibody concentration in beef calves after parenteral or intranasal vaccination. A total of 60 crossbred beef steer (n = 28) and heifer (n = 32) calves were used. Animals were previously unvaccinated and confirmed seronegative for antibodies against infectious bovine rhinotracheitis virus (IBRV), bovine viral diarrhea virus (BVDV), and parainfluenza-3 virus (PI3V) from sera collected at weaning (d -28; 183 days of age). On d -7, calves within sex were assigned randomly to 1 of 6 treatments arranged in a 3 × 2 factorial. Water restriction treatments (Factor A) were applied at the origin ranch via 3 different models: A_1) Control, no water restriction except during transport to the feedlot (CON), A_2) Acute, consisting of 48 h water restriction prior to transport to the feedlot (ACU), or A_3) Chronic, consisting of alternating 24 h periods of water access and restriction, over a 7-d period prior to transport to the feedlot (CHR). Upon feedlot arrival (d 0), 2 respiratory vaccine treatments were applied (Factor B): B_1) parenteral administration of a pentavalent modified-live virus (MLV) respiratory vaccine (2 mL s.c. in the neck; EX), or B_2) intranasal administration of a trivalent MLV respiratory vaccine (1 mL/naris; IN). Sera was collected weekly from d 0 to 56 for antibody titer analyses, and d -7, -5, -3, -1, 0, 1, 3, 5, 7 and 14 to determine Hp concentration. Nasal swabs were collected on d 0, 3, 7, 14, 21, 28, 35, 42, 49 and 56 to determine presence of bovine respiratory syncytial virus (BRSV)-specific mucosal antibodies. Data were analyzed using Proc Mixed with repeated measures. Overall, haptoglobin was increased on d -7, decreased before feedlot transport on d -1, and increased after arrival (day effect; $P < 0.001$). An A × B × day interaction ($P = 0.004$) existed for Hp such that CON-EX and ACU-IN were greatest on d 5 ($P \leq 0.04$). The BRSV ($P \leq 0.002$) and IBRV ($P \leq 0.04$) antibody titer was greater for IN vs. EX from d 14 to 56 and d 21 to 35, respectively. The EX treatment had increased BRSV-specific mucosal antibodies on d 3 and 7 ($P \leq 0.03$); however, these were greater for IN from d 35 to 56 ($P \leq 0.05$). In this study, water restriction did not clearly alter Hp or antibody responses to parenteral or intranasal vaccination

but BRSV and IBRV antibody was increased for IN vs. EX.

075 The Efficacy of Norgestomet Implants on Performance and Preventing Pregnancy in Grazing Postpubertal Beef Heifers.

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The pharmacological use of progesterone compounds in beef heifers inhibits the release of gonadotropins from the pituitary to suppress cyclicity. A 240 d study was conducted to assess the efficacy of long-acting, erodible implants containing Norgestomet (11β-methyl-17α-acetoxy-19-norprogesterone) on performance and preventing pregnancy in grazing postpubertal beef heifers. Crossbred postpubertal beef heifers (n = 240) were stratified by BW (346 ± 3.40 kg) and assigned to 80 blocks (3 heifers per block). Blocks were randomly allocated to 5 pastures (48 heifers per pasture). Heifers were assigned randomly within block to receive 1 of 3 implants (randomized complete block design) containing 0 (control), 100, or 150 mg Norgestomet and confirmed nonpregnant by ultrasonography (d 0). Heifers grazed mixed fescue-bermudagrass pastures with ad libitum access to mineral-vitamin mix. Heifers were exposed to fertility-checked bulls from d 7 to 200 at a rate of no less than 1 bull per 25 heifers. Bull breeding soundness evaluations were conducted d 0, 50, 100, and 150. Heifer BW was recorded d 0, 50, 100, 150, 200 and 240. Pregnancy status was diagnosed by ultrasonography d 50, 100, 150, 200 and 240. Orthogonal contrasts were used to assess the effects of control vs. 100 and 150 mg Norgestomet, and 100 vs. 150 mg Norgestomet. Heifers that received 100 or 150 mg Norgestomet trended ($P = 0.14$) to weigh more than control heifers at the conclusion of the study. Moreover, control heifers gained weight slower ($P < 0.05$) when compared to heifers that received 100 or 150 mg Norgestomet (0.38 vs. 0.47 and 0.48 kg/d, respectively). Implants did not eliminate pregnancy at any Norgestomet dosage. Pregnancy rates were 90.0 [95% CI = (81.8, 95.0)], 8.8 [95% CI = (4.2, 17.6)], and 12.5% [95% CI = (6.8, 21.8)] for heifers that received 0, 100, or 150 mg Norgestomet, respectively. Heifers that received 100 or 150 mg Norgestomet experienced lower ($P < 0.0001$) pregnancy rates than control heifers. By d 150, 81.3% of control heifers were pregnant, and 88.8% were pregnant by d 200. Administration of 100 or 150 mg Norgestomet prevented pregnancy in greater than 93.8% of heifers for at least 200 d. Pregnancy rates of heifers that received 100 or 150 mg Norgestomet were not different ($P = 0.46$). These data suggest that implants containing 100 and 150 mg

Norgestomet increased rate of gain and prevented pregnancy in grazing postpubertal beef heifers.

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076 Manipulation of Neonatal Leptin Profile via Exogenous Cortisol in Beef Calves.

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Ruminant animals exhibit a neonatal surge in leptin important for the programming of the hypothalamic center responsible for appetite regulation. Postnatal leptin concentrations have been shown to be influenced by maternal diet and elevated circulating cortisol. It has not yet been established whether postnatal leptin concentrations can be manipulated by exogenous glucocorticoids in cattle. The objective of this study was to investigate the effects of exogenous cortisol on the leptin profile of newborn calves. Angus crossbred cows (n = 31) were blocked by parity, BCS, and age and bred via natural service. Upon parturition (d 0), calf BW was recorded and each calf was infused with either a hydrocortisol sodium succinate solution (HC) at a dosage of 3.5 μg/kg of BW or a similar volume of saline solution (CONT). Each calf was given an additional infusion of its treatment 24 hours post partum at 1.5 μg/kg of BW. Calf treatment was blocked by sex, dam BCS, and dam age. The CONT group consisted of 8 females and 7 males, while the HC group consisted of 8 males and 8 females. Blood samples were taken via jugular venipuncture before each infusion, daily from d 0-5, then every other day up to d 17. Serum samples were stored at -20°C until hormone analysis. Serum leptin and cortisol levels were analyzed via previously validated radioimmunoassay. Dam age, dam BCS, calf birth BW, and serum leptin and cortisol concentrations were analyzed using the MIXED procedure of SAS. Age was similar ($P = 0.81$) among dams of HC and CONT calves (4.9 ± 0.5 and 4.7 ± 0.5, respectively). Dam BCS was similar between groups (5.7 ± 0.2 and 5.6 ± 0.2 units HC and CONT, respectively; $P = 0.66$). There was no significant difference in calf birth BW between treatments ($P = 0.87$), with HC calves weighing 38.5 ± 1.4 kg and CONT calves weighing 38 ± 1.4 kg. There was a tendency ($P = 0.09$) for HC calves to display reduced cortisol concentrations on d 1 and 2. Calves that received the HC treatment showed significantly reduced ($P = 0.03$) leptin concentrations on d 1-13. These data indicate that exogenous cortisol can be used to suppress neonatal leptin levels in cattle. This could be utilized as a management tool to increase voluntary intake of calves and impact overall production efficiency.

077 Comparison of Tulathromycin and Gamithromycin on Growth Performance, Morbidity, and Treatment Cost in High-Risk, Newly Received Beef Calves.

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Metaphylactic treatments are used in cattle enterprises to mitigate bovine respiratory disease (BRD). Crossbred bull beef calves (n = 207; BW = 290.5 ± 5.5 kg) were blocked by arrival date (n = 5) and assigned randomly to 1 of 2 metaphylactic treatments. Upon arrival, calves were ear tagged, vaccinated for respiratory and clostridial pathogens, dewormed, tested for the prevalence of persistent infection with BVDV, and administered either 1.2 mL/50 kg BW of tulathromycin with a strict 7-d post-metaphylactic interval (PMI) or 2 mL/50 kg BW of gamithromycin with a strict 5-d PMI. Cattle were observed daily for signs of morbidity and a Clinical Attitude Score (0 [normal] to 5 [morbid]) was recorded. Calves that scored a 1 or greater and were PMI eligible were pulled and rectal temperatures were recorded; if temperature exceeded 40°C, calves on both treatments were given enrofloxacin with a 2-d post-treatment interval (PTI). If the calf was pulled a second time and met the criteria for another antibiotic, ceftiofur was the final antibiotic administered. Performance data and cost analysis were analyzed using the MIXED procedure of SAS. Binary morbidity response variables (morbidity, treated with second antibiotic, relapse, and chronic) were analyzed using the GENMOD and FREQ procedures of SAS with Chi-square probability determining significance. Least squares means were separated at 5% via the PDIFF option. Initial BW, final BW and overall ADG did not differ between treatments ($P \geq 0.15$). Percentage BRD morbidity (28 vs. 13%) was greater ($P = 0.009$) in the gamithromycin treatment for calves that were treated once with enrofloxacin after initial metaphylactic administration. Percentage BRD morbidity for calves retreated with ceftiofur after previously being treated with enrofloxacin following a 2 d PTI was greater ($P = 0.004$) in gamithromycin calves (16 vs. 4%). There were no differences in percentage chronic, relapses, and mortalities due to treatment ($P \geq 0.11$). Initial antibiotic costs were greater ($P < 0.0001$; $31.54 vs. $23.85) in cattle administered tulathromycin compared to gamithromycin treated calves. First and second treatment antibiotic cost for cattle were greater ($P \leq 0.004$) in gamithromycin treated calves. However, there were no differences in terms of overall medical cost ($P = 0.96$; $36.07, tulathromycin vs. $35.97, gamithromycin), exclusive of labor or chute charges. The use of tulathromycin decreased percentage morbidity in high-risk beef calves, however, overall costs of metaphylactic treatments did not differ between tulathromycin and gamithromycin treated calves.

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Steers are often implanted with an androgenic hormone to repartition nutrients to increase protein synthesis and fat deposition while increasing feed efficiency and profitability. Long-acting implants with 200 d of activity are available that may simplify multi-implant regimens and reduce labor costs and cattle handling. The purpose of this study was to determine if steers grazing wheat pasture for 180 d and implanted with Synovex LA containing 150 mg trenbolone acetate and 21 mg estradiol benzoate in a novel, coated formulation would increase growth performance compared to steers implanted with either Ralgro or Revalor G. All cattle experienced at least a 14 d acclimation to pasture period before the start of the study. Crossbred beef steers (n = 345; BW = 252 ± 1.9 kg) were stratified by BW and randomly allocated to 1 of 3 implant treatments (Synovex LA, Ralgro, or Revalor G) based on d −1 BW in a one factor completely randomized design. On d 0, calves were administered the treatment implant according to label. Steers were grazed as a single group and rotated according to forage availability for 180 d on wheat pastures. Body weights were recorded on d −1, 0, 90, 180, and 181 to assess growth performance. Data were analyzed using the MIXED procedures of SAS with calf serving as the experimental unit with significance declared at $P \leq 0.05$. Mean BW on d 90 was numerically less (P = 0.29; SE = 1.9 kg) in Synovex LA (302 kg) steers compared to either Ralgro (307 kg) or Revalor G (307 kg) implanted steers. Final BW were not different (P = 0.26; SE = 2.7 kg) but were numerically greater in Synovex LA (406 kg) steers than either Ralgro (400 kg) or Revalor G (401 kg) steers. Average daily gain from d 0 to 90 tended to be greater ($P \leq 0.07$) in Ralgro and Revalor G steers compared to Synovex LA implanted steers. Average daily gain of Synovex LA (1.14 kg/d) implanted steers from d 90 to 180 was greater (P < 0.0001; SE = 0.02) than Ralgro (1.02 kg/d) or Revalor G (1.04 kg/d) steers. Overall, ADG tended to be greater (P = 0.06) in Synovex LA implanted steers compared to conventional implant treatments. The use of Synovex LA improved steer growth performance from d 90 to 180 while BW were similar for all implant treatments for the duration of the study.

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Diet digestibility typically increases with intake restriction, but an interaction between intake and diet composition affecting this response could cause substantial overprediction of feeding requirements in limit-fed systems. Feed costs are typically the greatest variable cost associated with cow-calf production, especially in intensive management systems; overprediction of requirements unnecessarily increases costs. Twenty crossbred (3⁄4 Angus × 1⁄4 Nellore) cows were used in a 20 × 6 incomplete Latin square to describe effects of dietary energy concentration and intake level on nutrient digestion and apparent energy availability. Treatments were arranged as 5 × 4 factorial. Diets differing in energy concentration were constructed by substituting dry rolled corn for wheat straw in a total mixed ration; such that corn concentration in the diets was 0% (1.090 Mcal NEm/kg), 16% (1.335 Mcal NEm/kg), 32% (1.580 Mcal NEm/kg), or 48% (1.825 Mcal NEm/kg). Each diet was fed at 5 levels of intake. Minimum intake levels for each diet were designed to meet 75% of NRC estimates of energy requirements for a 454-kg mature, dry, open cow. Maximum levels of intake were estimated to meet energy requirements for a 390-kg primiparous cow at peak lactation (6.09 kg/d) gaining 0.14 kg/d. Intermediate intake levels were evenly spaced between the minimum and maximum for each respective diet. All levels of intake for all diets met or exceeded projected protein requirements. Experimental periods were 14 d, (10 d for adaptation to treatments, 4 d for measurement of digestion). A diet × intake interaction (P < 0.01) was observed for apparent DE concentration. Apparent DE concentration decreased (P < 0.01) with increasing intake of 32 and 48%, tended to decrease (P = 0.09) as intake of 16% increased, and was not affected (P = 0.29) by intake of 0%. Although a diet × intake^2 interaction was not observed (P = 0.45) for apparent total DE intake, there was a tendency (P = 0.11) for the rate of increase to decline with intake of 48%. Apparent diet DE concentration increased with intake restriction, with the extent and rate of improvement increasing with dietary energy density. Data suggest that energy delivery is under predicted in limit-fed, high energy diets, especially at low intakes.

080 Evaluation of Angus Cattle Hair Coat Length and Its Associations with Tolerance to Fescue Toxicosis.

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Fescue toxicosis negatively impacts cattle productivity. Variation in response to endophyte-infected tall fescue within breed indicates differences in genetic tolerance to fescue toxins. The objective of this study was to determine if cattle exhibiting a short hair coat have increased tolerance to physiological symptoms associated with consuming endophyte-infected tall fescue compared to animals with longer hair coat. Purebred Angus cows, 2 to 4 yr old, at 2 locations grazed endophyte-infected tall fescue for 13 wk starting mid-April. Cattle ($n = 40$) were selected based on hair coat score, and designated as either slick (S) or rough (R). Weekly measurements were collected to monitor animal performance while consuming endophyte-infected tall fescue. Blood samples were collected for fescue tolerance genotyping using T-Snip. Genotype scores range from 0 to 5, with 5 being most tolerant, defined by the manufacturer. Data on hair coat score, body condition score (BCS), rectal temperature, and body weight were analyzed as repeated measures with the MIXED procedure of SAS. Frequency of T-Snip genotypes across hair groups was analyzed with a chi-square test in SAS. As expected, hair coat scores (1 to 5 scale) were significantly ($P < 0.05$) lower for cattle with S (1.7) compared to R hair coat (3.2). Additionally, shedding scores were lower ($P < 0.05$) for cattle with S (1.8) compared to R (3.6) hair coats. In 2 yr old cattle at both locations, body weight was greater ($P < 0.05$) in cattle with S hair coat (601.9 and 475.7 kg; location 1 and 2, respectively) compared to cattle with R hair coat (453.9 and 434.4 kg; location 1 and 2, respectively); this difference was not observed in the other age groups. In 2 yr old cattle, BCS were greater ($P < 0.05$) for cattle with S (5.9) compared to R (5.1) hair coats, however this difference was not observed in the other age groups. No difference ($P > 0.05$) was observed in rectal temperature during weekly collection days, however daily fluctuations in body temperature varied among treatment groups ($P < 0.05$). There was a significant ($P < 0.05$) deviation from the expected number of T-Snip genotypes between hair coat groups. The number of animals classified as 1, 2, and 3 for the T-Snip test was 1, 14, and 4, for S and 8, 9, and 3, for R hair coat, respectively. Based on these data, cattle with the ability to shed hair display improved productivity, a better thermoregulatory capacity and potential to be more tolerant to the negative effects associated with fescue toxicosis.

081 Sire Effect on Pregnancy Associated Glycoprotein (PAG) Concentrations in Nelore Beef Cows.

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Understanding the causes of embryonic mortality (EM) is fundamental to developing management strategies that decrease economic loss in cattle. Though late EM (after d 28 of gestation) represents a smaller proportion of reproductive failure compared to early gestation EM (~10% vs. ~35%), economic consequences are reported to be disproportionately greater due to delayed conception date which limits cow productivity. Placental insufficiency is considered to be a major cause of late EM and bovine pregnancy-associated glycoproteins (PAG) have been used as a marker of placental function. Although the functional role of PAG is unclear, it has been shown that many factors affect PAG concentrations including pregnancy stage, breed, parity, sire, and fetal sex. Limited data have been reported on sire effects on PAG concentration, however, based on the influence sire has on placental development, we were interested in this potential relationship. The objectives of this study were to determine how breed and fertility of sire influences PAG concentration at d 30. Postpartum Nelore beef cows ($n = 1228$) were artificially inseminated at a fixed time (d 0) after synchronization of ovulation. A subset of cows ($n = 492$) were inseminated with commercially available Angus or Nelore semen, and another subset ($n = 736$) were inseminated with 6 Angus bulls of unknown fertility. Pregnancy diagnosis by ultrasound was performed and serum samples were collected on Day 30. Serum concentrations of PAG were quantified using an in house PAG ELISA with antibodies raised against PAGs expressed early in gestation. Overall pregnancy rate was 53.75% (range 36.52% to 67.92%). Late EM was 6.21% (range from 1.53% to 11.69%). Serum concentration of PAG were significantly higher in cows gestating a pregnancy sired Angus compared to Nelore bulls (Nelore 9.67 ± 0.48 ng/ml vs. Angus 11.87 ± 0.52 ng/ml; $P = 0.0023$). Late EM occurred in 41 cows that had a viable embryo on Day 30 of gestation but failed to maintain pregnancy until d 100. Three sires in this experiment accounted for more than 70% of the late embryonic mortality and had lower PAG compared to other 3 bulls (8.5 ± 0.35 ng/ml vs. 9.48 ± 0.36 ng/ml; $P = 0.0562$). These data indicate that pregnancies from bulls with high embryonic loss had lower PAG concentration on d 30, suggesting PAG may serve as a novel marker for bull fertility.

082 The Effects of Feeding Monensin to Bred Heifers Fed in a Drylot on Nutrient and Energy Balance.

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Intensification of beef cow systems may be a viable production method when forage availability is limited. Confined cows receiving limit-fed diets containing monensin may benefit from decreased methane production, increased feed efficiency, and greater nutrient utilization. The objective of this study was to evaluate the effect of monensin on duration and magnitude of methane reduction and digestible and metabolizable energy intake. Sixteen pregnant MARC III (1/4 Angus, 1/4 Hereford, 1/4 Red Poll, 1/4 Pinzgauer) composite heifers (482 ± 7 kg initial BW) were used in a 161-d completely randomized design. Heifers were randomly assigned to 1 of 2 treatments, 250 mg monensin per d (MON) or no monensin (CON). Diets consisted of corn stalks (80%), corn silage (10%), and wet distillers' grains with solubles (7%). Monensin was delivered in a pelleted supplement that was top-dressed at 3% of the diet. Pellets not containing monensin were fed to CON at 3% of the diet. Heifers were limit-fed 100% of estimated ME_m requirements, with amounts recalculated for the first, second, and third trimesters. Total fecal and urine collections were conducted over 96 h to determine digestion and energy metabolism. Collection periods occurred on d 14, 42, and 161 of feeding monensin, corresponding to the first, second, and third trimesters of gestation. Gas exchange was measured on d 0, 3, 14, 28, 42, and 161 using portable headbox calorimeters designed on the concepts of open-circuit calorimetry. Individual heifer oxygen consumption, carbon dioxide production, and methane production were determined over a 24 h period. There were no significant differences ($P > 0.05$) in DM intake as a result of feeding monensin (6.60 kg/d vs. 6.61 ± 0.09 kg/d; CON and MON, respectively). Diet digestion did not differ ($P > 0.05$) between treatments, averaging 44%. On d 42 there was a tendency ($P = 0.09$) for MON heifers to consume 1.12 ± 0.64 Mcal/d more DE and 1.19 ± 0.63 Mcal/d more ME ($P = 0.06$) compared to CON heifers. Monensin resulted in a significant reduction ($P < 0.01$) in methane production from 1.58 L/kg MBW for CON to 1.47 ± 0.03 L/kg MBW for MON. The magnitude of methane reduction was consistent across time, suggesting monensin is a viable production option for reducing methanogenesis long-term.

083 Pregnancy Associated Glycoprotein (PAG) Concentrations at Day 24 Gestation from Dairy Heifers Predicted to Maintain Pregnancy.

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The ability to diagnosis and identify successful pregnancies early in gestation has important economic and management applications for cattle producers. Currently, producers are essentially limited to d 30 of gestation as the earliest time point for pregnancy diagnosis due to the effectiveness of most ultrasound and chemical based methods. Pregnancy associated glycoproteins (PAG) are produced by the ruminant placenta and can be used to accurately detect pregnancy as early as d 28 of gestation using commercially available tests. Recent data from our lab suggests pregnancy status can be determined by PAG as early as d 24. Data also indicates that circulating PAGs may be a marker of embryonic viability and predictive of embryonic mortality. The objective of the current study was to determine if early gestation circulating PAG levels could be used to predict heifers likely to maintain pregnancy. Our hypothesis was Day 24 PAG levels could be predictive of pregnancy maintenance until d 60 if a threshold PAG level was achieved. In vitro produced embryos were transferred into synchronized virgin, predominantly Holstein heifers (n = 226) using timed embryo transfer (TET). Blood was collected at d 24 for PAG analysis as well as d 31 for confirmation of pregnancy. Final pregnancy confirmation occurred on d 60 via transrectal ultrasound. Serum concentrations of PAG were quantified using an in house PAG ELISA with antibodies raised against PAGs expressed early in gestation. Following TET, there were 134 heifers identified pregnant on d 31 of gestation (59%) using ultrasound and PAG testing. Only heifers that were pregnant at d 31 were analyzed in this study. Between d 31 and 60, 25 heifers experienced pregnancy loss. Circulating concentrations of PAG were significantly higher ($P < 0.05$) at d 24 of gestation in heifers that maintained pregnancy until d 60 (n = 109; 2.82 ± 0.22 ng/mL) than heifers that lost pregnancy between d 31 and 60 (n = 25; 0.737 ± 0.166 ng/mL). However, a receiver operating characteristic (ROC) curve was inconclusive at identifying a predictive cutoff value for diagnosing pregnancy, likely due to the specific antibody's specificity. In summary, early gestation circulating PAG concentration may have application in predicting embryo loss in heifers; however, sensitivity and specificity of current assays should be refined for this purpose.

084 The Effects of Late Gestation Nutrient Restriction on Heifer Offspring Feed Intake and Metabolites and Hormones During a Feeding Challenge.

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It has previously been shown that late gestation nutrient restriction results in altered postnatal endocrine regulation and growth in newborn calves. The objective of this study was to determine if nutrient restriction during late gestation affected heifer offspring's DMI, BW gain, and endocrine regulation during a 10 wk feeding trial. During the last 100 d of gestation, control (CON, $n = 11$) dams were fed to increase BCS by 0.6 ± 0.1. Whereas, nutrient restricted dams (NR, $n = 10$) and NR dams offered protein supplement three d/wk (NRS, $n = 13$) were fed to decrease BCS by 1.2 ± 0.2. After parturition, all cow-calf pairs were moved to a common pasture and fed at or in excess of requirements until weaning. After weaning, all heifers were maintained as a single group. At 15 mo of age, heifers were randomly sorted into 2 pens and adjusted to a pelleted TMR over a 2 wk period. Blood samples and BW were taken at initiation of feeding and on a biweekly basis for the duration of the feeding trail. Feed intake was monitored for 10 wk using a GrowSafe System. After 10 wk, an intravenous glucose tolerance test (IVGTT; dose: 0.3g dextrose/kg BW) was performed on 21 randomly subsampled heifers. The NR heifers consumed more feed ($P = 0.01$) than CON and NRS (1328 ± 49, 1110 ± 45 and 1197 ± 41 kg, respectively). Heifers from NR dams tended ($P = 0.07$) to increase BW compared to NRS and CON heifers when adjusted for initial BW (26 ± 2, 23 ± 2 and $20 \pm 2\%$, respectively). Heifers from NR and NRS dams had a greater increase ($P < 0.01$) in BCS compared to heifers from CON dams (1.4 ± 0.2, 1.2 ± 0.1, and 0.7 ± 0.1, respectively). Plasma glucose and insulin concentrations during the feeding trial increased ($P < 0.03$ and $P < 0.0001$, respectively) in NR heifers compared to the other groups beginning at 2 and 4 wks, respectively. Plasma leptin concentrations were increased ($P = 0.045$) in the NR and NRS heifers compared to the CON heifers beginning at 4 wks of feeding. During the IVGTT at the conclusion of the feeding challenge, plasma glucose and insulin were increased ($P = 0.02$ and $P < 0.001$) in NR heifers compared to other treatment groups. These results show that nutrient restriction during late gestation alters appetite and endocrine regulation in heifer offspring.

085 Impact of Three Weaning Strategies on Calf Activity and Behavior at Weaning and Productivity after Weaning.

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Weaning is a stressful time in a calf's life. Stress has been linked to reduced feed intake and diminished immune response predisposing calves to illness and poor gain. Applying anti-suckling nose flaps, to separate loss of milk from loss of contact with the dam, may reduce weaning stress. The goal of this study was to compare nose flaps (N) inserted 7 d before weaning, with abrupt weaning (A), and late weaning (L, 49 d later). Calves ($n = 120$, BW = 270 ± 18 kg) were blocked by hair coat quality (slick or normal at birth, as a part of a separate trial) and BW 28 d before traditional weaning and randomly assigned to treatment (10/treatment/year, 4 yr). Accelerometers were placed on 5 calves' necks/treatment/year to record relative activity 7 d prior to placement of nose flaps (A and N) or weaning (L). After collar placement, behavioral observations were made over 4 d per week for 1-h intervals beginning at 0730, 1130, and 1530h. At weaning, nose flaps were removed, A and N calves placed in a dry lot, dams of A and N relocated out of sight, and L calves with their dams relocated to a separate pasture for 49 d. Weaning age for A, N, and L was 249, 245, and 300 d (± 11), respectively. Data were analyzed with Proc Mixed of SAS. Accelerometer output showed similar activity patterns between treatments with a tendency for greater activity when calves were grazing in the absence of hay, than when hay was offered on pasture or during confinement ($P = 0.07$). Vocalizations were similar across treatments prior to weaning (2.6/steer/h; $P > 0.26$). Vocalizations were higher on d 1 and 2 after weaning for A (33 and 26/steer/h) and L (27 and 15/steer/h) steers as compared to N (6 and 3/steer/h, treatment $P < 0.01$), suggesting reduced stress. Vocalizations for A and L returned to preweaning levels by d 3 after weaning. Pacing comprised 19 and 20% of observations for A and L, respectively, during the same period and 14% for N ($P < 0.01$), also suggesting reduced stress. While N calves appeared less stressed at weaning, 42-d post-weaning ADG were greater for A and L (0.56 and 0.67 kg/d, respectively) than N (0.41 kg/d; $P < 0.01$). Of the calves that retained their flaps, 17 of 33 developed nasal ulcers from the flaps. While nose flap insertion reduced calf behavioral signs of stress, it also reduced post-weaning growth performance.

086 Pre-Conditioning Beef Calves with High-Moisture Stored Forages or Hay and Co-Product Feeds.

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A 45-d backgrounding study was conducted at the E.V. Smith Research Center in Shorter, AL to determine animal performance differences of pre-conditioned beef calves fed annual ryegrass (*Lolium multiflorum*) baleage, bermudagrass (*Cynodon dactylon*) hay, or corn (*Zea mays*) silage-based diets. Annual ryegrass (cv. Marshall) was harvested for baleage on 22 Apr 2015 at the late boot stage of maturity. The forage was allowed to wilt for 48 h until it achieved 60% moisture, baled and wrapped. Tifton 85 bermudagrass used for the study was harvested at a 4 to 5 wk interval in early summer 2015. Corn silage was harvested at the full dent stage of maturity on 15 Jul 2015, chopped, and stored until the initiation of the feeding trial. Forage concentrations of CP, ADF, and NDF (% DM) were 11.3, 35.6, and 57.2 for annual ryegrass baleage, 13.5, 35.8, and 63.9 for bermudagrass hay, and 5.8, 23.6, and 41.0 for corn silage, respectively. Based on forage quality, calves were supplemented with an energy-protein based ration (50:50 soybean hulls and corn gluten feed for baleage and hay treatments, and 85% corn, 15% cottonseed meal mix for corn silage treatments) to target 0.9 kg/day ADG according to NRC (2000) recommendations. The 45-d background trial began on 9 September 2015 after animals were sorted and acclimated to the diets. 108 weaned calves [heifers ($n = 54$; mean initial BW 283 kg) and steers ($n = 54$; mean initial BW 284 kg)] were placed into nine pens ($n = 12$/pen, 3 pens/treatment). Sex was distributed evenly across treatments. Animals were weighed on d 0, 22, and 44, and the study concluded on 23 October 2015. Animal performance measures were analyzed using PROC Mixed in SAS 9.4 as a completely randomized design, and pen was the experimental unit. Mean initial and final BW of the animals did not differ ($P = 0.50$ and $P = 0.99$, respectively) across treatments. Average daily gain for annual ryegrass baleage, bermudagrass hay, and corn silage-based diets were 0.61 kg/day, 0.72 kg/day, and 0.72 kg/day, respectively, and did not differ across treatments ($P = 0.57$). Based on these results, these forage options achieved a similar level of gain when supplemented for preconditioning beef calves. However, an economic analysis is needed to determine feasibility and potential break-even costs for using these options in beef operations.

087 Effect of Feeding Method on Performance of Mid-Gestation Cows.

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Intensified cow-calf systems may reduce exposure to weather risk and land costs. Perceived costs and managerial requirements may prevent some producers from capturing benefits associated with intensified systems. This study evaluated differences in production response to management strategies for intensive cow-calf systems. Ninety-five mid-gestation cows (503 ± 151 kg) were stratified by weight, BCS, age, and days of gestation and assigned to 1 of 12 pens for a 112-d randomized complete block design experiment. Treatments were: limit-fed, total mixed ration (TMR), roughage and concentrate portions of the limit-fed TMR separated and fed 12 h apart (SEP), and ad libitum bermudagrass hay (7.7% CP, 1.19 Mcal NE_m/kg; HAY). Treatments were applied prior to calving; following 112 d application, all cows were placed on common pasture and managed uniformly. Limit-fed treatment diets were wheat straw (35%), cracked corn (29%), dried distiller's grains (27%), and premix (9%) formulated to contain 1.56 Mcal NE_m/kg and fed to deliver 80% of NRC (2000) predicted NE_m requirements. Requirement for MP was exceeded by 141 g/d (TMR and SEP) and 455 g/d (HAY). Body weight, BCS, and back fat measures were made every 28 d. Treatment did not affect final BW (518.4 kg; $P = 0.72$), BCS (5.6; $P = 0.67$), or back fat thickness (0.70 cm; $P = 0.45$). Weight changes from d 0 to 112 did not differ ($P = 0.17$) and were 8.1, 16.6, and 22.9 kg for HAY, SEP, and TMR, respectively. However, weight change for cows fed SEP and TMR were different from zero ($P \leq 0.01$). Cows fed HAY lost BCS (−0.25) from d 0 to 112, while cows fed SEP and TMR gained BCS (0.12 and 0.09, respectively; $P < 0.01$). Limit-fed strategies resulted in greater RE than HAY ($P = 0.06$; 137.1, 98.9, and −14.6 Mcal for TMR, SEP, and HAY, respectively). No differences were observed between treatments for cow BCS at calving (5.0; $P = 1.00$) or calf birth weight (33.7 kg; $P = 0.36$). By 45 d after calving, cow BW, cow BCS, and calf BW were not significantly different ($P > 0.66$) and averaged 486.4 kg, 4.8, and 74.2 kg, respectively. Limit-feeding a TMR or separate delivery of roughage and concentrate sustained cow performance compared to ad libitum hay consumption, and these results can be used to develop economic models to aid producers in decision making.

088 Effects of Prenatal Transportation Stress on Days of Age at First Calving in Brahman Heifers and Their Calves' Growth and Temperament at Weaning.

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The objective of this experiment was to examine the effects of prenatal transportation stress (PNS) on days of age at first calving in Brahman heifers; as well as, to examine growth and temperament of those heifers' suckling calves at weaning. Mature Brahman cows were assigned to either control (n = 44; not transported) or stressed (n = 41; 2 h of transportation at 60, 80, 100, 120, and 140 ± 5 d of gestation) treatment groups. Heifers (n = 20 PNS; n = 16 control) from that calf crop were exposed to a Brahman bull for a breeding season in 2013 (May 15 through December 15) and in 2014 (May 15 through August 1). Additionally, we evaluated the influence of heifers' prenatal experience on their calves' (n = 36) growth and temperament traits. Birth weight (kg) as well as weaning weight (kg), pen score (PS; 1 = calm and 5 = excitable), exit velocity (EV; m/sec) and temperament score [TS; (PS+EV)/2] were recorded. Non-proportional data were analyzed using Mixed Models procedures of SAS. Days of age at first calving was analyzed with treatment as a fixed effect and sire as a random effect. Neonatal death loss was assessed using chi square analysis (JMP Pro). Calf data were analyzed with treatment and sex as fixed effects and sire as a random effect. There was no difference (P = 0.62) in days of age at first calving between PNS (1,028.43 ± 43.57 d) and control (1,053.39 ± 46.97 d) heifers. There was no difference (P = 0.60) in death loss between calves born to PNS dams compared to control dams. There was a tendency (P < 0.1) for birth weight to be lower in PNS (33.11 ± 0.93 kg) than control (35.53 ± 1.04 kg) calves and males (35.53 ± 1.00 kg) to be heavier than females (33.11 ± 0.97 kg), but there was no interaction (P = 0.81). The 180-d adjusted weaning weight was not influenced by treatment (P = 0.33), sex (P = 0.23), or the interaction (P = 0.96). Neither PS, EV, nor TS were influenced by treatment (P = 0.47, 0.75, and 0.59; respectively), sex (P = 0.13, 0.75, and 0.23; respectively), or the interaction (P = 0.50, 0.99, and 0.62; respectively). Prenatal stress had no effect on days of age at first calving in Brahman heifers. Furthermore, prenatal transportation stress incurred by the calves' dams had limited effect on their growth and no effect on their temperament at weaning.

089 Effect of Concentration of Starch in Pasture-Finished Beef Cattle Supplementation on Growth, Carcass Traits, and Meat Quality.

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The effect of starch supplementation on carcass characteristics in pasture-finished beef cattle is not known. An experiment was conducted to compare a fiber-based concentrate with a supplement containing starch from corn on performance and carcass characteristics. Angus and Angus x Simmental cross-bred yearling cattle (heifers n = 6; steers n = 30) were separated into 4 groups balanced by weight and sex before each group was randomly assigned to 1 of 2 treatments. Treatment 1 (T1) received a concentrate pellet of 50% soybean hulls and 50% corn gluten feed while treatment 2 (T2) received a concentrate composed of 50% T1 pellets and 40.5% ground corn and 8.5% soybean meal. Supplements were isonitrogenous and fed at 1% of BW. Supplement offered was adjusted on BW every 28 d. Groups were randomly allotted to predominately fescue pastures and rotationally grazed for an average of 180 d. Cattle were slaughtered on 4 dates between October and November. The progressively heaviest 2 or 3 animals/group were selected for each slaughter date. An average of 1,886 kg/ha biomass with 14.7% CP and 66.7% TDN was available throughout the finishing period. Hot carcass weights were recorded at slaughter and back fat, marbling score, and ribeye area were obtained between the 12th and 13th rib after 11 d of dry aging. Two 2.5 cm thick strip steak at the 13th rib were collected from each carcass, vacuum sealed, and frozen at −16°C prior to slice shear force and subcutaneous fat color analyses. Data were analyzed using GLM procedures in SAS. Starting and final BW and ADG were not affected by treatment (318.0 and 318.5 kg, 493.3 and 494.9 kg, and 0.96 and 0.98 kg/d for T1 and T2, respectively; P > 0.10). Initial and change in BCS did not differ (5.47 and 5.52; 0.83 and 0.80 for T1 and T2, respectively; P > 0.10). Adding starch to concentrate supplement of pasture-finished cattle did not affect (P > 0.10) carcass characteristics. Overall, carcasses averaged 285 kg, were low choice, yield grade 2.5, and marbling score of 5.3. The L* and B* color spectrum of subcutaneous fat was similar between treatments (72.08 and 71.64, 16.14 and 14.56 for T1 and T2, respectively; P > 0.10), however, A* differed (1.01 and 2.64 between T1 and T2, respectively; P < 0.05). Starch supplementation did not alter meat tenderness (18.7 and 17.0 kg for T1 and T2, respectively; P > 0.10). Adding starch to a fiber-based concentrate may not impact growth, carcass characteristics, or meat quality of pasture-finished beef.

090 Associations Among Bovine Melatonin Receptor 1A and Dopamine D2 Receptor Gene Mutations, Hair Coat Scores, and Calving Rates in Beef Cattle.

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Hair coat scores of beef cattle have been associated with productivity traits. Our objective was to determine relationships among single nucleotide polymorphisms (SNP) in bovine melatonin receptor 1A (MTNR1A), dopamine D2 receptor (DRD2), and cattle hair coat shedding and productivity traits. Genomic DNA was isolated from buffy coat samples of fall-calving Angus-based crossbred cows ($n = 104$). Purified DNA was amplified using specific primers for an 845-base segment of MTNR1A [forward (5'-TAGTTA-ACGATGGGTGGAGC-3') and reverse (5'-AAATGAGTA-AGGCTTGGAGC-3')], and a 793-base segment of DRD2 [forward (5'-TATAGCCCCATTCCTGATTC-3') and reverse (5'-CCCATGCTCTACAACACACG-3')]. Amplicons were forward strand sequenced using Eurofins SimpleSeq (Louisville, KY); sequences were compared using *MEGA* version 6 for polymorphism identification and genotype assignment. Three years (2012, 2013, and 2014) of production data were used to determine associations between genotypes, and calving rate and hair shedding score. Hair coat scores were determined each year over 4 mo (April, May, June, and July). Relationships were determined using mixed model ANOVA with main effects of year, month, and genotype. For MTNR1A, five transition SNP (minor allele frequency) were identified [A541G (4.8%), G575A (4.8%), A583G (46.2%), T679C (4.8%), and C721T (4.8%)], and one transition SNP was identified for DRD2 [A534G (46.6%)]. Homozygous cows at A583G had increased ($P < 0.05$) calving percentage when compared with heterozygous cows (97, 99, and 88%, respectively,

for AA, GG, AG). At A583G, AA cows shed winter hair coats earlier and had lower ($P < 0.05$) hair coat scores than AG and GG cows in May. Genotype at DRD2 (A534) tended ($P = 0.09$) to affect hair coat score, but did not affect ($P > 0.7$) calving rates. Results suggest that MTNR1A mutation A583G may be a useful tool for selecting replacement cattle that will have increased calf crops.

091 Effects of *Saccharomyces cerevisiae* Cncm l-1077 Supplementation on Feeding Behaviors and Growth Efficiency in Crossbred Beef Steers Fed a High-Grain Diet.

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The aim of this study was to evaluate the effects of Levucell SC (*Saccharomyces cerevisiae* CNCM l-1077) supplementation on growth efficiency, ruminal temperature and feeding behavior traits in yearling steers. Crossbred beef steers ($N = 48$), blocked by source and initial BW (441 ± 30.8 kg), were used in a completely randomized block design. Steers were assigned to 1 of 2 treatments (2 pens per treatment); Levucell SC (10×10^9 cfu/hd/d) or control (carrier only) in a high-grain diet (ME = 2.84 Mcal/kg DM). This trial was conducted for 70 d in pens equipped with a GrowSafe feed intake monitoring system during the summer months in McGregor, TX. There were no statistical differences detected among treatments in DMI, ADG, feed conversion ratio or ruminal temperature. However, supplementation with live yeast tended to reduce bunk visit (BV) frequency (−9%, $P = 0.07$) and increase BV duration (+22%, $P < 0.05$) and head down duration (+41%, $P < 0.05$), which resulted in an 18% reduction ($P < 0.05$) in BV eating rate. Meal criterion was 47% greater ($P < 0.01$) for animals fed live yeast, which resulted in reduced meal frequency (−13%, $P = 0.07$) and increased meal duration (+13%, $P < 0.05$) and average meal length (+27%, $P < 0.05$). Steers supplemented with live yeast spent more time feeding, although similar DMI was consumed compared to control steers, resulting in a reduction of meal eating rate (−10%, $P < 0.05$). Additionally steers supplemented with live yeast began feeding 25 min earlier ($P < 0.001$) than control steers following feed truck delivery. Steers supplemented with live yeast spent more time eating, ate less often and at a reduced rate compared to control steers. Live yeast supplementation could potentially aid in mitigating metabolic stress in steers fed high-grain diets by altering their feeding behavior patterns in a manner that is more favorable for microbial fermentation.

092 Effect of Pre- and Postnatal Trace Mineral (TM) Sources on Post-Weaning Sexual Development in Angus and Brangus Bulls.

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A 2 × 2 factorial design evaluated breed (Angus vs. Brangus) and prenatal/postnatal TM source (inorganic vs. organic) effects on bull sexual development. Bulls (241 ± 2 d, 249 ± 4 kg, $n = 32$, 8 per TM × breed) born to dams supplemented with Co, Cu, Mn, Se, and Zn as inorganic (Se selenite or salt sulfates) or organic (Se-yeast and proteinates) TM sources starting 82 ± 2 d pre-calving. At weaning, calves were assigned to 1 of 4 pens based on treatment, receiving the same TM supplement as their dams. All bulls were fed a high energy/protein diet to gain approximately 1.14 kg/d with TM source delivered in a pellet based on manufacturers recommendations. Bi-weekly semen collection, scrotal circumference (SC) and BCS (scale 1 to 9) were recorded. Semen collection was initiated when SC was 26 cm. Puberty was defined as an ejaculate with sperm concentrations $\geq 50 \times 10^6$ cells/mL, with $\geq$ 10% motility. Sexual maturity was defined as two consecutive semen collections with SC ≥ 30 cm, sperm motility $\geq 30\%$, and normal sperm $\geq 70\%$. Data were analyzed with PROC MIXED with fixed effects of TM source, breed, and interaction for puberty and sexual maturity data. Results are presented as LSM ± SE. At puberty ($n = 27$), no effect ($P > 0.05$) of TM source, breed, or interaction for age (337 ± 7 d), BCS (4.8 ± 0.1), motile (33.0 ± 2.3%) or normal sperm (48.7 ± 4.5%) occurred. However, Brangus (172.4 ± 28.2 × 10^6 cells/mL) had greater ($P = 0.05$) sperm concentration than Angus (96.9 ± 23.3 × 10^6 cells/mL). A TM source × breed effect ($P = 0.01$) occurred for SC at puberty; Brangus inorganic (33.5 ± 0.9 cm) were greater ($P < 0.05$) than Brangus organic (30.3 ± 0.9 cm), while Angus inorganic (29.9 ± 0.7 cm) and organic (31.2 ± 0.7 cm) were similar ($P > 0.05$). At sexual maturity ($n = 15$), organic (351 ± 18 d) were numerically ($P = 0.14$) younger than inorganic (391 ± 16 d), while BCS (5.2 ± 0.1), SC (33.6 ± 0.7 cm), sperm concentration (156.5 ± 24.9 × 10^6 cells/mL), motile (47.3 ± 2.7%), and normal (76.4 ± 1.0%) did not differ ($P > 0.05$) by TM source, breed, or interaction. Pubertal traits were affected by breed but not TM source. However, TM source may decrease bull age at sexual maturity.

093 Effect of Pre- and Postnatal Trace Mineral (TM) Sources on Growth, Body Composition, Performance, and Liver Mineral Status in Angus and Brangus Bulls.

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A 2 × 2 factorial design investigated growth, performance, and liver TM status in Angus ($n = 16$) and Brangus ($n = 16$) bulls born to cows supplemented with either inorganic ($n = 16$, 8/breed, Se selenite and salt sulfates) or organic ($n = 16$, 8/breed, Se-yeast and proteinates) TM sources of Co, Cu, Mn, Se, and Zn. The TM supplement was initiated 82 ± 2 d pre-calving. At weaning, calves were assigned to 1 of 4 pens based on treatment, receiving the same TM supplement as their dams. All bulls were fed a high energy/protein diet to gain approximately 1.14 kg/d with the TM source delivered in a pellet based on manufacturers recommendations. Bull BW, BCS, and hip height (HH), were collected every 28 d. Liver biopsies for TM status and ultrasound body composition measurements of LM area (LMA), 12th rib fat thickness (FAT), and LM intramuscular fat percentage (IMF) for body composition were collected every 56 d. Data were analyzed as repeated measures using PROC MIXED with bull as experimental unit and fixed effects of TM, breed, time, and appropriate interactions. Results are presented as LSM ± pooled SE. All growth, body composition, and liver TM measurements were affected ($P < 0.02$) by time. There was no effect ($P > 0.05$) of TM source on body composition or liver TM concentrations. Inorganic had greater ($P = 0.01$) mean ADG (1.35 vs. 1.20 ± 0.04 kg/d) but lesser ($P = 0.01$) mean BCS (4.8 vs. 4.9 ± 0.03) than organic. Pooled across time, Brangus had greater ($P < 0.05$) LMA (64.95 vs. 60.43 ± 1.46 cm²), HH (119.3 vs. 114.6 ± 0.65 cm), BW (359 vs. 340 ± 6.0 kg), and BCS (4.9 vs. 4.8 ± 0.03) but lesser ($P < 0.05$) IMF (2.70 vs. 3.60 ± 0.14), than Angus, respectively. Liver Cu and Se were affected by breed × time ($P < 0.05$). On d 0, breeds were similar ($P > 0.05$) for Cu (109 ± 24.3 µg/g) and Se (0.94 ± 0.06 µg/g). Whereas, at d 168, liver Cu (297 vs. 148 ± 26.1 µg/g) and Se (1.76 vs. 1.42 ± 0.07 µg/g) were greater ($P < 0.05$) in Brangus than Angus, respectively. Prenatal and postnatal TM source had no effect on liver TM status of bulls.

094 Utilization of Exogenous Enzymes As Enhancers of Creep Feeding Rations.

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An in vitro experiment was conducted to investigate if some exogenous enzymes customarily used in rations of monogastric animals would be effective when included in a creep feed (CF) for nursing beef calves. The tested enzymes were included in the experimental treatments both individually and in combination. The treatments consisted of: 1) Bermuda grass (BER); 2) a mixture of 75% Bermuda grass and 25% CF (BERCF); 3) BERCF enhanced with xylanase (XYL); 4) BERCF enhanced with β-1,3-glucanase (BGLUC); 5) BERCF enhanced with α-amylase (AMYL); 6) BERCF enhanced with a combination of xylanase, β -1,3-glucanase and β -1,4-glucanase (COMB1); or 7) BERCF enhanced with a combination of xylanase, β -1,3-glucanase, β -1,4-glucanase and α-amylase (COMB2). Two rates of inclusion of these enzymes were tested: the dose normally used in rations of monogastric animals (i.e., the label dose of 300 g/t DM for XYL, 400 g/t DM for BGLUC, 650 g/t DM for AMYL, 200 g/t DM for COMB1, and 850 g/t DM for COMB2) and a dose 10 times greater (10x). Five replications per treatment were used. Incubations were performed for 24h using rumen fluid collected by esophageal tubing from 10 6-mo-old nursing calves. Analysis of variance was conducted as a completely randomized design using fermentation bottle as the experimental unit with treatments and replications as factors. Digestibility of ADF was lowest ($P = 0.02$) for BER, however, it was greater for BERCF, and it was maximal for BGLUC 10x (48.8, 52.3, and 56.3%, respectively). Similarly, IVDMD was lowest ($P = 0.02$) for BER and highest for XYL 10x (27.4 vs. 41.3%). Total production of VFA was also minimal for BER, and it was greatest for COMB2 10x (82.0 vs. 97.4 mM; $P < 0.01$). The acetate:propionate ratio was greatest for BER (3.63; $P = 0.01$). No differences were found regarding molar proportion of propionate, however, molar proportion of butyrate was smallest for BER (11.4 mol/100 mol; $P < 0.01$). Total gas produced per g of incubated DM, and concentration of methane per g of incubated DM were both lowest for BER (84.6 mL and 0.88 mmol/g of incubated DM, respectively; $P < 0.01$). Overall, the inclusion of the studied enzymes improved important traits such as IVDMD, ADF digestibility, and production of VFA. These improvements were more evident when a dose 10 times greater than the label dose was used, suggesting that this would be their optimal level of inclusion in creep feeds.

095 Weather Influences Daily Feed Intake in Developing Beef Bulls in Spring and Summer.

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The objective of this study was to evaluate the effects of daily weather parameters on feed intake in developing beef bulls. Weaned Angus bulls ($n = 12$; initial BW = 255.6 ± 5.6 kg) were acclimated to consuming a grain-based diet in a GrowSafe Model 6000 feed intake monitoring system in Prairie, MS. Then weather data were recorded each minute on-site by an automated system during a 70-d feeding period starting on May 16, 2016. Daily minimum and maximum temperature, relative humidity, and barometric pressure data were classified into LOW (< −0.5 SD), MODERATE (−0.5 to 0.5 SD), and HIGH (> 0.5 SD) levels. Precipitation data were classed as no rain or rain based on the presence or absence of daily precipitation. Data were evaluated using the PROC MIXED procedure of SAS specific for repeated measures with LSMEANS separation evaluated at a = 0.05. Daily feed intake was affected by the interaction of daily maximum temperature and maximum relative humidity ($P < 0.01$) such that, unexpectedly, bulls consumed 1.7 kg more feed at the HIGH levels of both maximum temperature (> 34.2°C) and relative humidity (> 98.1%) versus the LOW levels (< 31.2°C and < 93.1%, respectively) of these variables. The interaction of daily minimum temperature and minimum humidity ($P < 0.01$) followed a similar feed intake pattern in which bulls consumed 1.3 kg more feed at the HIGH levels of both minimum temperature (> 21.8°C) and relative humidity (> 48.2%) as compared to the LOW levels (< 18.8°C and < 38.8%, respectively) of these variables. Feed intake increased ($P = 0.01$) (9.4, 10.0, and 10.7 kg) as maximum barometric pressure level decreased, respectively, from > 765.7, 763.7 to 765.7, and < 763.7 mm Hg. Feed intake was comparable between the HIGH and MODERATE daily minimum barometric pressure levels but was 1.2 kg less ($P < 0.01$) at the LOW level (< 760.5 mm Hg) relative to the HIGH (> 762.5 mm Hg) and MODERATE (760.5 to 762.5 mm Hg) levels. On days when it rained, feed intake was depressed ($P < 0.01$) by 0.9 kg. These data suggest that environmental conditions contribute to daily feed intake fluctuations in growing cattle and that a combination of several weather parameters are involved in shifts in feeding behavior responses.

SMALL RUMINANT PRODUCTION

096 Limit Feeding Hay to Ewes.

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Hay is often provided to ewes when pasture is limited in winter months. Hay resources can be a major component of feed costs and waste is often high. The objective of this study was to investigate the economic and production impacts of restricting ewe access to hay. Sixty-four ewes were blocked by breed, age, weight, and pregnancy status (open or early pregnancy) and then allotted to four groups. Groups were then randomly assigned to one of two treatments: continuous (CONT) or limited (LIMIT) access to round-bale grass hay for 56 d starting in early January. Each group of ewes was managed on a 0.7 ha dry-lot pasture with ad libitum access to water and mineral without any supplemental concentrate feed. The CONT maintained 24 h/d access to hay, while LIMIT were provided access to hay for 2 h/d starting at 0700 for the first 28 d (period 1) and then an additional 2 h/d at 1500 for the remaining 28 d (period 2). Ewe BW and BCS (adjusted 4 point scale) were recorded every 14 d. Weight of hay offered (8.8% CP, 45.4% ADF) and orts were recorded. Data were analyzed using PROC MIXED with repeated measures in SAS. During period 1, CONT had positive while LIMIT had negative ADG (0.16 ± 0.05 kg/d and -0.10 ± 0.05 kg/d, respectively; $P < 0.0001$) and BCS (0.23 ± 0.09 and -0.38 ± 0.09 scores, respectively; $P < 0.0001$). However in period 2, both treatments had negative ADG (-0.16 ± 0.04 and -0.15 ± 0.04 kg/d for CONT and LIMIT, respectively; $P < 0.0001$) and BCS (-0.27 ± 0.10 and -0.21 ± 0.09 scores for CONT and LIMIT, respectively; $P < 0.0001$). Throughout the study, BCS of open ewes was not affected by feeding treatment but pregnant CONT had greater BCS ($P < 0.05$) than LIMIT (3.62 ± 0.1 and 3.24 ± 0.1, respectively). Furthermore, there was a breed by treatment interaction ($P < 0.05$). Limiting ewe access to hay during a 56 d winter feeding period reduced total hay used per ewe (0.64 ± 0.02 and 1.14 ± 0.03 kg/d; $P < 0.05$) and cost of hay per ewe ($2.36 and $4.21; $P < 0.05$) when compared to continuous access to hay. While restricting ewe access to hay was economically viable for reducing the amount of hay used; the impact of BW and BCS loss during early gestation may limit this practice with low quality hay.

097 Grazing Behavior and Distribution Patterns of Kiko Wethers in Southern-Pine Silvopastures.

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There is increasing interest in developing pine silvopasture systems in the Southeast. Goats are a common species used to graze understory vegetation in pine silvopasture systems. Understanding grazing/browsing behavior, animal distribution patterns and damage to pine trees by goats is required to better design silvopasture systems. The objectives of this study were to 1) determine the grazing behavior and distribution patterns of goats in Southern-pine silvopastures, 2) evaluate the possible damage inflicted by goats on different pine species. Cool-season forages [annual ryegrass (*Lolium multiflorum*), rye (*Secale cereale*), MaxQ tall fescue (*Schedonorus arundinaceus*), arrowleaf clover (*Trifolium vesiculosum*), crimson clover (Trifolium incarnatum), white clover (*Trifolium repens*), hairy vetch (*Vicia villosa*), and chicory (*Chicorium*)] were planted in separate subplots within each plot in mixed-pine silvopasture systems (3 plots, 0.4-ha each). Trees in the silvopasture consisted of longleaf (*Pinus palustris*) and loblolly pine (*Pinus taeda*) species (longleaf:loblolly ratio 0.81) with 113 trees per acre; the trees were 10 yr old (DBH: 12 ± 0.2 cm; height: 7 ± 0.1 m). Thirty Kiko wethers (4 to 6 mo old, BW– 24.3 ± 0.64 kg) were rotationally stocked in the silvopasture plots, beginning early April 2015. Forage subplots within each plot were virtually divided with colorful flags to monitor goats' distribution patterns. Goats had free access to fresh water, mineral supplements, and shelters. After an adjustment period of 2 d, the diurnal grazing behavior (grazing, browsing, loafing, lying, and debarking) and distribution (subplots) patterns of goats were monitored from dawn to dusk from an observation station using binoculars for 2 consecutive d. Observations were recorded on pre-formatted sheets. For data analysis, observation periods were divided into morning (dawn to 11:00 AM), mid-day (11:15 AM to 3:00 PM), and afternoon (3:15 PM to dusk). Data were analyzed in SAS 9.4 using GLM procedure (explanatory variables: observation period, plot, and season). Goats' loafing behavior was the highest (44%) in the morning, and the grazing behavior was dominant during mid-day and afternoon hours (40%). Goats also showed some debarking behavior (2%), which mostly occurred on longleaf pine (98%). Debarking began at 23.9 ± 1.52 cm from the base of the tree and reached up to 70.4 ± 2.62 cm from the initial debarking point. Nine percent of the debarked trees were severely damaged. The study showed that longleaf pine trees can be susceptible to possible damage by Kiko goats during cool-season grazing even when the trees are 10 yr old, and terminal buds are beyond the reach of grazing animals.

098 Effects of Replacing Corn and Soybean Meal with Dried Distillers Grains with Solubles on Blood Metabolites, Milk Composition and Fatty Acid Profile of Dairy Goats Consuming Eastern Gamagrass Hay During Late Lactation.

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In the southern USA warm season grasses make up the bulk of the roughage consumed by livestock including small ruminants. Digestibility of grasses generally declines with maturity, such that these forages may not always provide the necessary nutrients to support optimal animal performance or maintain product quality. Supplementation with protein and moderate level of grain generally increases forage intake and digestibility. The diversion of corn away from human and animal feed for biofuel production has created a need for alternative energy supplements. Dried distillers grains with solubles (DDGS), high in bypass protein and digestible fiber, is a good alternative to replace corn and soybean meal (SBM) in small ruminant diets. The objective of this study was to determine intake, blood metabolites and milk composition of dairy goats (Alpine), in late lactation, consuming ground eastern gamagrass (EG; *Tripsacum dactyloides* L.) hay supplemented with DDGS or corn and SBM. The does were stratified based on milk yield and allotted to 4 groups. The groups were randomly assigned to 1 of 2 treatments (10 does/trt). The groups were housed in 4 pens equipped with Calan gate feeders (American Calan, Inc.) and fed once daily to allow ad libitum intake. Hay was fed ad libitum after the supplement was completely consumed. The trial lasted 14 d with sampling on the last day. Blood plasma samples from each animal were analyzed for plasma urea nitrogen (PUN), glucose, and NEFA concentrations. Morning milk samples were analyzed for protein, fat, lactose, and total solids. Milk fat was extracted and analyzed using the fatty acyl methyl ester (FAME) method. Data were analyzed as a mixed model for a completely randomized design using SAS. Replacing corn and SBM with DDGS did not ($P > 0.05$) affect total DMI (1.12 ± 0.208 kg), plasma glucose, NEFA, or milk composition but significantly increased ($P < 0.05$) PUN (20.4 and 15.2 ± 1.31 mg/dL for DDGS and corn plus SBM supplemented does, respectively). The inclusion of DDGS decreased ($P < 0.05$) the concentration of C12:0 (5.7% and 3.4%), C14:0 (11% and 6%), C16:0 (25.3% and 21.3%), but levels of C18:0 (7.5% and 13.9%), C18:3n6 (0.33% and 0.43%) and C20:1n9 (1.6% and 0.5%) increased. DDGS can replace corn and SBM (59% of diet) over a short feeding period without adverse effects on DMI or milk composition during late lactation.

099 Effect of Dietary Immunomodulator on Captive White-Tailed (*Odocoileus virginianus*) Breeding Doe Performance and Hematological Variables.

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Stress in captive white-tailed breeding does may compromise their performance, alter immunity and increase death loss; a potential method to mitigate stress-induced losses in deer may be dietary inclusion of a supplement known to have immunomodulatory effects in other species (OmniGen-AF, Phibro Animal Health). This study was conducted over an 84-d period (15DEC15 to 8MAR16) at a private deer breeding facility in Texas. The 2 treatment diets were offered ad libitum via self-feeders located in each treatment pen (experimental unit) and consisted of a commercial deer breeder diet (AntlerMax, Purina Animal Nutrition) with no additive (CON) or the same breeder diet with OmniGen-AF included to achieve consumption of 6 g/doe/d (OG). The treatment feeding regimen began on d 2. On d 0, white-tailed does ($n = 72$) were assigned randomly to treatment pens of equal size ($n = 3$ pens/treatment) according to their chute entry order. A randomly selected subset population (6 does/pen) was used to determine body condition score (BCS) and complete blood count (CBC) on d 0, 42, and 84 and BW was determined for all deer on these days. The BCS was determined by palpating the ribs and a subjective score was assigned using a 1 to 5 scale. Blood was collected via jugular venipuncture into evacuated tubes containing EDTA and analyzed within 4-h using an automated hemocytometer to determine CBC variables. Data were analyzed with PROC MIXED and a repeated statement (day) was used for CBC variables to evaluate effects of treatment, day, and their interaction. There was a tendency ($P = 0.10$) for the OG treatment to have greater BW on d 84; however, both OG and CON lost BW from d 0 to 42 and d 42 to 84. Nevertheless, OG treated does had a greater ($P = 0.05$) BCS on d 42. There were no treatment differences ($P \geq 0.32$) for CBC variables; however, day effects were observed for several CBC variables. Total leukocytes, neutrophils and neutrophil:lymphocyte (NLR) decreased with time (day effect; $P \leq 0.02$). Total leukocytes were 7.58, 4.55, and 5.34 K/μL on d 0, 42, and 84, respectively. The NLR was 1.76, 1.21, and 0.78 on d 0, 42, and 84, respectively. Supplementation with OmniGen-AF had limited effect on BW and did not alter CBC variables measured in white-tailed breeding does used in this study. Overall, there were decreases in total leukocytes and other CBC variables and these data may provide a foundation for CBC reference range in captive white-tailed does.

100 Growth Rate and Fitness of Purebred and Crossbred Hair Sheep Lambs Gradually Removed from Soy Hull Supplementation Before Harvest.

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Soy hull-supplementation of purebred and crossbred hair sheep lambs significantly increased gain and reduced parasite load. However, lambs receiving pasture only were preferred in consumer taste tests and had a more favorable fatty acid composition. The objective of this study was to evaluate effects of supplement removal prior to harvest on growth and gastrointestinal parasitism of lambs grazing pastures in the late fall and winter. Thirty-six, 6-mo old purebred hair (Barbados Blackbelly and St. Croix) and crossbred wool (Dorset) x hair sheep lambs rotationally grazed predominantly stockpiled tall fescue (13.3 to 19.4% CP) and annual ryegrass (16.5% CP) pastures from the middle of October to the middle of December. Lambs were allocated to four supplementation treatments (no supplementation; and supplementation until 42, 21, and 0 d before harvest). Treatment groups were balanced by breed type. Lambs grazed as a single group and supplement was provided at 2% BW daily at individual feeding stations. Lambs were on trial for 63 d. Body weight, fecal egg counts (FEC) and packed cell volume (PCV) were recorded in 21 d intervals. Data were analyzed with breed type and supplement duration as main effects, and starting BW as covariate; FEC was analyzed after log conversion. Final BW and ADG were higher ($P < 0.01$) in crossbred than purebred lambs (28.8 vs. 25.7 kg, and 110 vs. 62 g/d), but FEC (979 eggs/g) and PCV (34.4%) were not different between breed types. Continued supplementation linearly increased ($P < 0.05$) final BW (25.1 to 29.8 kg) and ADG (51 to 127 g/d). There was no consistent effect of supplement duration on FEC and PCV, but rather a curvilinear response ($P < 0.05$) associated with higher FEC and lower PCV in lambs removed from supplementation 42 d before the end of the trial. Variations in forage quality during the trial significantly influenced ADG, especially when lambs grazed the annual ryegrass sections during the last weigh period of the trial, resulting in compensatory growth in the non-supplemented lambs. There were no breed type by supplementation interactions for either BW, ADG, FEC or PCV. Discontinuing supplementation before lamb harvest reduced final BW proportional to the time lambs were removed from supplement, with a limited effect on indicators of gastrointestinal parasitism.

101 The Effects of Olive Pomace As a Wintering Supplement When Analyzing Weight Gain, Consumption Trends, and Costs in Capris Aegagrus Hircus.

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In the feeding industry, the cost of feed is one of the highest variables affecting production. A producer's goal is to find a least cost feedstuff that is effective in meeting nutrient requirements of livestock, especially during winter months. A by-product of the olive oil industry, olive pomace, could be considered as a potential livestock feedstuff to be used as an energy supplement since it contains 15% fat, post oil extraction. The objective of this study was to determine at what levels the olive pomace is the most effective in maintaining a healthy weight as well as reducing the cost of feed per animal. Twenty-eight Spanish influence goats were fed (2% of body weight, BW) varying amounts of fermented pomace with a protein pellet to meet maintenance requirements. The four test groups ($n = 7$) consisted of a 3:1, 1:1, and 1:3 olive pomace to feed ratio (O:F) as well as a control containing no pomace. All groups received molasses at 0.5% BW to improve the palatability of the feed and to discourage selective eating of the mixture. The does were fed in herring bone style pens every morning for 49 d. By using ANOVA, a cost efficiency was established. The average daily gain (g/d) for the groups were: 0.0370, 0.0166, 0.0119, and 0.0262 kg/d for the 1:3, 1:1, 3:1 and control groups, respectively ($P > 0.88$). The lack of statistical difference suggests that pomace can be an effective feed additive to reduce feed costs. A significant difference ($P < 0.0001$) in consumption rate between treatments was observed with the 3:1 group consuming an average of 0.785 kg/d and the control 0.694 kg/d. Olive pomace can be considered as a cost effective supplement to reduce costs for maintenance rations. Ration costs were formulated at $0.153/kg (3:1 ration) and $0.6386/kg (pelleted control ration). On average, feeding olive pomace can reduce a producer's cost of feed by $13.53 over 49 d maintenance feeding period ($P < 0.0001$). Further research is needed to determine at what levels the pomace is most effective.

102 Affect of Ram Semen Extenders and Supplements on Computer Assisted Sperm Analysis Parameters.

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A study evaluated the effects of ram semen extender and extender supplementation on computer assisted sperm analysis (CASA) parameters positively correlated with progressive motility. Semen collected from 5 rams was distributed across treatment combinations consisting of either TRIS citrate (T) or milk (M) extender supplemented with 5 or 20% (v/v) egg yolk (EY) $\pm$ 1% ethylene glycol (EG) and $\pm$ 20 μL penicillamine, 10 μL hypotaurine and 2 μL epinephrine (PHE). Semen from each ram was distributed across treatment combinations, diluted to a final concentration of 300 million sperm/mL, cooled slowly to 4°C, and evaluated daily for 3 d, using CASA. Multivariate analysis indicated that progressive motility was positively correlated with straight line velocity (VSL; $r = 0.715$; $P < 0.01$), as well as departure of the average (STR; $r = 0.706$; $P < 0.01$) and actual (LIN; $r = 0.773$; $P < 0.01$) sperm path from a straight line. Repeated measure data were analyzed using the mixed model for main effects of extender, supplements, and their interactions on VSL, STR and LIN. Regardless of extender supplementation, VSL, STR and LIN were greater in M than T extender ($P < 0.01$). Addition of EG to extender reduced ($P = 0.02$) VSL, but had no effect ($P > 0.05$) on STR or LIN. An interaction occurred where EG increased LIN of sperm stored in T but decreased LIN in M extender ($P < 0.01$). Addition of PHE increased ($P = 0.01$) VSL, STR and LIN. The percent EY in extender had no effect ($P > 0.05$) on VSL, STR or LIN. Based on CASA parameters measured, milk is superior to TRIS based extender for ram chilled semen storage. Addition of PHE improved the sperm motility parameters while the EY percentage had no effect. Further study is needed to correlate CASA parameters with pregnancy rate.

103 Use of Liquid Semen Artificial Insemination in Katahdin Sheep in a Commercial Farm Setting.

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Liquid semen vaginal artificial insemination (AI) with short-term stored semen provides a low-cost approach for moving germplasm between hair sheep flocks. Here we evaluated simulated shipping (12 h) of chilled liquid semen on pregnancy rate of purebred Katahdin ewes in an on-farm environment. Ewes in a purebred Katahdin flock ($n = 100$) managed under an annual breeding cycle were estrus synchronized by inserting CIDR devices for 12 d. Implants were removed 48 h before initial AI. For AI, ewes were allocated to be bred to one of five 5 to 9 mo-old Katahdin ram lambs using semen collected and processed within 2 h of AI or after storage for 12 h at 5°C in a portable refrigerator. Balanced by sire and storage time, ewes were inseminated either once by simple vaginal timed AI at 48 h after CIDR removal, or again 6 h after initial AI with semen from the same collection. Semen was collected and processed on site using an artificial vagina, extended to 250 million sperm/ml in a simple UHT skim milk and egg yolk (5% v/v) extender, and packaged into 0.5 mL straws. Ewes were exposed to natural mating 11 d after AI to the same sire used for AI. Pregnancy was determined by transrectal ultrasonography 41 d after AI. Data were analyzed by Chi-square for the effect of storage time, insemination frequency, ram, and ewe age. Sperm motility in straws at the end of the second AI session (27 h of storage) ranged from 60 to 80% in individual rams. Pregnancy rate to AI (14.1%) was lower than anticipated, but tended to be higher ($P = 0.09$) in fresh compared to 12 h stored semen (20.0 vs. 8.1%). Similarly, pregnancy rate tended to be higher ($P = 0.09$) following a double than a single insemination (20.9 vs. 8.9%). There was no effect ($p = 0.88$) of ram on AI pregnancy rate. Ewe age tended to effect ($P = 0.09$) pregnancy rates, being highest in 2 yr (30.8%), 3 yr (18.2%) and 4 yr old (18.2%) ewes, while no pregnancies were observed in ewes older than 4 yr. In contrast, pregnancy rate after clean-up mating was not affected by ewe age. Fetal numbers were no different in pregnancies resulting from AI or clean-up matings (64.3 and 71.6% multiples, respectively). Results confirm our earlier observations that insemination frequency, ewe age and storage time greatly impact the outcome of liquid semen AI.

104 Evaluation of Pre-Weaning and Grazing Performance of Terminal Sire Breeds for Hair Sheep Production Systems.

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Profitability of hair sheep enterprises may be enhanced with the use of terminal sires which improve growth performance while maintaining parasite tolerance in crossbred progeny. Katahdin (KT, $n = 2$), Suffolk (SU, $n = 2$), and Texel (TX, $n = 2$) rams were randomly mated to KT ewes ($n = 82$) at the Virginia Tech Southwest Agricultural Research and Extension Center. Post– lambing until weaning (80-d age), ewes and lambs were managed on fescue pasture. At weaning, lambs were moved to an ungrazed fescue pasture and provided a concentrate pel-

let (13% CP, 75% TDN) at 2.0% BW as fed daily for an 84-d summer grazing trial. During this summer grazing trial, BW, strongylid egg count (FEC), FAMACHA scores and packed cell volume (PCV) were collected every 14-d. FAMACHA score ≥ 3 was utilized as the basis for deworming. All statistical analyses were conducted using SAS (SAS Institute Inc., Cary, NC) PROC mixed for repeated measures analysis and PROC GLM. Tukey's test was used for comparative means analysis. Adjusted (birth type, dam age, sex) BW at birth was greater for SU– sired lambs (5.4 kg) than KT– sired (4.8 kg, P < 0.01) and TX– sired (5.0 kg, P < 0.05). There were no differences in adjusted (dam age) number of lambs born or weaned per ewe. Adjusted (birth/rear type, dam/lamb age, sex) BW at weaning was lightest for KT– sired lambs (20.3 kg, n = 71) compared to both SU–sired (22.7 kg, P < 0.01, n = 35) and TX–sired (21.9 kg, P < 0.05, n = 43). BW, ADG, FEC, FAMACHA and PCV varied over time (P < 0.01) during the summer grazing trial with no sire breed effects for ADG, FEC or PCV. BW and FAMACHA tended to be affected by sire breed. SU– sired lambs tended to require fewer days until first deworming than TX–sired lambs (28 vs. 50 d, P = 0.051). At the time of deworming, SU– sired had the lowest FEC (1,726 egg/g) compared to both KT– sired (3,578 eggs/g, P < 0.05) and TX– sired lambs (3,690 eggs/g, P < 0.05). These results indicate the potential of TX–sired lambs to increase preweaning BW while maintaining parasite resistance similar to the KT–sired lambs through a summer grazing trial.

105 Sire's Estimated Breeding Value (EBV) for Fecal Egg Count (FEC) Influences BW, FEC, and Anemia Measures of Offspring in Katahdin Sheep.

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Gastrointestinal nematode (GIN) infection of lambs is a major health issue that can cause anemia, reduced weight gains, poor performance, mortality and discouragement to farmers. Anthelmintic resistance limits the control of GIN by available dewormers, and most alternatives to dewormers have some drawbacks and failures. Because of the moderate heritability of parasite resistance, opportunities exist to improve parasite resistance through programs such as the National Sheep Improvement Program (NSIP). The objective of this study was to determine the association between the fecal egg count (FEC) EBV of the sire on FEC and the FEC, packed cell volume (PCV), and FAMACHA score at 90 and 120 d of age, and BW at birth, 60, 90, and 120 d of age of offspring. Between 2004 and 2015, data were collected from the ARS Katahdin research flock on 1096 lambs from 25 sires having at least 19 offspring/sire. An average FEC of > 500 eggs/g was required for lambs

born in a year and season to be included in the analyses. The EBV of sires was determined by Sheep Genetics (Australia) in July 2016. Data were analyzed by Proc GLM (SAS) and included effects of year, gender, and rearing type (single, twin, triplet) as discrete variables. The post-weaning FEC (PFEC) EBV of the sire and the age of the lamb were fitted as continuous variables. The FEC were log transformed. There was a positive effect of PFEC on FEC and FAMACHA score, and negative effect of PCV on offspring at 90 (P < 0.001, P < 0.02, P < 0.001, respectively) and 120 (P < 0.001 for all variables) d of age. Thus, as PFEC decreased (indicating greater GIN resistance), FEC and FAMACHA decreased and PCV increased. However, as WFEC decreased, BW at birth (P < 0.001), 60 (P < 0.001) and 90 (P < 0.001) d also decreased; no relationship was found at 120 d of age (P = 0.14). There was a significant effect of year, gender, and rearing type in all BW analyses (P < 0.001); year significantly affected all GIN measures; and in some models, gender, rear type and age influenced GIN measures. Genetic resistance to parasite resistance is arguably the best means of GIN control, and can be achieved through selection of sires with favorable EBVs, which reflected lower FEC and higher PCV in offspring.

106 Effect of Sire Breed on Gain, Carcass Characteristics and Parasite Resistance of Katahdin Crossbred Feedlot-Finished Lambs: Year 2.

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Improvement of carcass merit while maintaining parasite resistance is critical to retain profitability in Katahdin sheep. In year 2 of this study different Katahdin (KT), Suffolk and Texel (TX) sires were used to mate Katahdin ewes. Lambs were born and raised in confinement until weaning, then shipped to the West Virginia University Animal Science Farm. Lambs were transitioned onto a complete pellet (16% CP) and were fed ad lib throughout the study. After transition all lambs (n = 7 KT, 13 SU, 11 TX) were infected with 10,000 *Haemonchus contortus* larvae and weight, blood and fecal samples were collected weekly for the duration. After 5 wk all lambs were treated with levamisole (8mg/kg) and lambs were challenge infected 3 wk later with 10,000 *H. contortus* larvae. Ultrasonic determination of REA and fat depth occurred 1 wk prior to the end of the 77 d study. Upon study completion 5 lambs from each sire group were randomly selected for carcass analysis at the Virginia Tech Meats Laboratory. Analysis of parasitological data indicated no effect of sire during the primary infection however sire effects were observed during challenge infection as SU-sired lambs had a greater fecal egg count (FEC) (269

eggs/g) compared to KT-sired lambs (116 eggs/g; $P = 0.04$) whereas FEC of TX-sired lambs was not different from either sire group (170 eggs/g) $P > 0.05$. Upon slaughter no differences in worm burden of representative sire groups were observed. No significant differences were found in growth data between the sire groups, however, SU-sired lambs tended to have higher ADG (0.34 kg/d) vs. KT (0.25 kg/d; $P = 0.051$) but no advantage compared to TX-sired lambs (0.28 kg/d). Analysis of REA using ultrasound and direct carcass measurements revealed no sire effect (SU 15.19 cm^2; TX 14.91 cm^2, KT 12.71 cm^2; $P > 0.05$). Leg score favored SU (11.6) and TX (11.2) lambs vs. KT-sired lambs (10.4) $P < 0.05$. A consistent trend can be observed across years, however there is a significant amount of sire variation which has the potential to impact performance of Katahdin crossbred lambs. These data indicate a need to further evaluate variation within the Texel breed to better identify superior rams.

TEACHING AND UNDERGRADUATE EDUCATION

107 Teaching a Stocker-Backgrounding and Feedlot Cattle Production Course in Northwest Tennessee.

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Tennessee is ranked 12th in the United States with respect to beef cow inventory thus many University of Tennessee at Martin (UTM) undergraduate agriculture students are familiar with cow-calf production. An upper division beef production course has long been taught at the university, but the course has primarily focused on the cow-calf segment. Recently, a new upper division course entitled "Stocker and Feedlot Cattle Production" was developed in response to expressed student interest and expertise of new faculty. Given the limited access to intensive post-weaning production systems in the local area, there were valid concerns about the ability to provide weekly experiential laboratory activities. These concerns led to the implementation of a required travel study to the Southern High Plains. The requirement for the travel study was included in the official course description and catalog. Visits to commercial feedlots, packing plants, feed mills, and research facilities were included in the travel itinerary. An additional requirement of the course was for students to manage a set of newly received, high-risk feeder calves throughout the semester with the UTM farm manager and supporting faculty providing guidance as needed. Managing calves required students to spend time outside of regularly scheduled class hours. Expectations regarding the trip and out-of-pocket expenses as

well as the experiential learning outside of scheduled class meeting times were clearly discussed with students prior to registration and on the initial course meeting. A total of 13 students completed the course. The UTM travel study department administered an anonymous post-travel study evaluation to enrolled students ($n = 13$). When asked "did the travel study activities offer you a meaningful learning experience"? 100% of students responded favorably. Moreover, a university-wide course evaluation was administered at the end of the semester and 13 of 13 students (100%) completed it. Additional written comments were submitted by 10 of 13 students (77%) with all reporting an enhanced learning experience as a result of managing their own set of calves and participating in the travel study. Creativity and innovative teaching activities were essential to the success of this new course and students' understanding of post-weaning cattle production.

108 No, I'm Not a Veterinarian! Increasing Student Awareness of Career Diversity within the Animal Sciences.

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The question is simple enough. "What do you do"? The answer is simple enough. "I teach animal science." More often than not the comeback is "so, you're a vet." The general public has long been uninformed about the breadth of careers available in the animal sciences (ANSC). However, fewer students raised in production agriculture coupled with more students raised in suburban and urban areas have resulted in many uninformed undergraduate ANSC majors as well. Animal science faculty members at the University of Tennessee at Martin recently developed four new program-wide student learning outcomes (SLO), one of which reads, "Students will identify interests in animal science careers, and identify courses and experiential learning opportunities that are needed to attain the career of their choice in the regional, national, or global community." To assess this SLO, students ($n = 56$) enrolled in 1 of 2 sections of the introductory ANSC course during the spring 2016 semester were administered a pre- and post-survey during the first and last week of class, respectively, to gauge their awareness of ANSC careers. A monthly seminar series was developed in which ANSC professionals were invited to campus to speak about their respective industries and career paths. Additional guest speakers and faculty were also invited to speak during regular lecture periods. With regards to the pre-survey, 56 students (100%) responded. Of those, nine (16.1%) were unsure of their career goal, 19 (33.9%) could list 5 ANSC careers, and 26 (53.6%) listed at least 1 ANSC course related to their intended career. Only 36 students (64.3%) completed the post-survey. Of those, five (13.8%) were unsure of their

intended career, 29 (80.6%) were able to list 5 ANSC careers, and 22 (61.1%) listed at least 1 ANSC course related to their career goal. Thirty-four students (94.4%) stated they were more aware of career opportunities as a direct result the seminar series and guest speakers. Based on survey results and student responses, ANSC faculty members will continue to host an industry speaker seminar series and keep students aware of current issues and career opportunities.

109 Student Demographics in an Introductory Animal Science Course at a Regional Public University.

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The change in agriculture student demographics has been well established. More and more students pursuing agriculture fields at land-grant institutions are female and from an urban background. Little to no research has been reported on student populations at regional institutions in the agriculture field. Our objective was to measure demographics of students in our introductory animal science course at Morehead State University (MSU). This course is taken by all majors in the Department of Agricultural Sciences at MSU, located in Eastern Kentucky. One semester, Spring 2014, was measured. Students ($n = 68$) were asked to complete a survey at the end of the semester using Survey Monkey (www.surveymonkey.com). Submissions were anonymous, however, students did have to leave their name to denote completion. Out of the 68 students surveyed, females represented 85.3% of the class compared to males at 14.7%. As for their background, we found that 61.2% were from a rural area. Most regional institutions enroll primarily in-state students and MSU was no different. We found that 64.2% of respondents were from Kentucky. The ethnicities represented in the course were overwhelmingly singular as 95.5% of students reported to be white, with no Hispanic heritage. Another interest was to determine what experiences the student had with agriculture-related youth organizations (4-H and FFA) as these students have traditionally pursued agriculture degrees. We found that 52.2% of respondents had been involved in 4-H, whereas 56.7% were active in FFA. Also surveyed, was the student's experience with various livestock species. We found: beef cattle– 16.4%, dairy cattle– 1.5%, sheep– 0%, goat– 8.9%, swine– 3%, poultry– 10.4%, and equine– 13.4%. Students also responded to the length of time they expected to stay at MSU to finish their degree. We noted 70.4% of students designated 4 yr, whereas 14.9% expected to graduate in 5 yr. As more and more students take college or dual credit courses prior to high school graduation, we surveyed students on how many hours they had completed prior to attendance at MSU. We found that 26.9% had no credit hours completed versus 10.4% had already completed more than 36 h. Only 10.4% of students had taken an animal science course in high school. Overall, we gained valuable insight into our incoming freshman and are better able to tailor course material to students as a result of understanding their background.

110 Changes in Student Perceptions Following Completion of an Introductory Animal Science Course at a Regional Public University.

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Students pursuing agriculture degrees have changed in recent years as there has been a shift from rural male to urban female students. Hence, student perceptions have also reflected this transition. One of the main goals in undergraduate teaching should be the education of future generations of agricultural professionals. Through instruction, faculty are able to influence and improve critical thinking skills. Our objective was to measure perceptions of students in our introductory animal science course on current agriculture issues. This course is taken by all majors in the Department of Agricultural Sciences at Morehead State University (MSU), located in Eastern Kentucky. One semester, Spring 2014, was measured. Students (pre-course $n = 79$; post-course $n = 68$) were asked to complete a survey at the beginning and end of the semester using Survey Monkey (www.surveymonkey.com). Pre- and post-survey responses differed due to changes in enrollment. Submissions were anonymous, however, students did have to leave their name to denote completion. Using the post-course survey population, the average student was white, non-Hispanic, female, rural, normal diet (only 2 people denoted they were vegan or vegetarian). Students were given 5 options for each statement (strongly agree, disagree, neutral: neither agree nor disagree, agree, strongly agree). When asked if the media portrays the agriculture community in a positive light, 40.5% of students at the beginning of the course were neutral compared to 37.3% at the end. Whereas, 27.9% initially disagree with that statement compared to 34.3% at the end of the course. Student perceptions on harvest practices in livestock, also showed that with all information given, more students were understanding of the humane practice (pre-course: 39.2% agree; post-course: 41.8% agree). A similar trend occurred when asked if they believe livestock producers use antibiotics properly (pre-course: 51.3% agree; post-course: 55.2% agree). It is important to note that an improvement (removal of bias) was not observed in every question asked. We asked students if they believe genetically modified foods were considered safe. We found that 40.5% disagreed at the beginning of the course compared to 40.3% at the completion of the course. We observed that when given the information, students typically made more educated decisions where bias was

less prevalent. We believe that agriculture education should be a critical point in all levels of education to create a better educated consumer.

UNDERGRADUATE STUDENT COMPETITION

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111 Factors Affecting Cell-Mediated Immune Response in Weaned Brahman Calves.

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The objective of this study was to determine if sex, BW, body condition score (BCS), or weaning temperament [e.g., (pen score (PS), exit velocity (EV), and temperament score (TS)] influenced cell-mediated immune response (CMIR) in weaned Brahman calves. Bulls (n = 55; BW = 195 ± 5 kg; BCS = 5.5 ± 0.08) and heifers (n = 57; BW = 173 ± 5 kg; BCS = 5.3 ± 0.09) were administered a 25×10^3 protein nitrogen units (PNU)/mL subcutaneous (neck) sensitization dose of Candida albicans (CA; Greer Labs, Lenoir, NC) with 750µg of Quil-A (InvivoGen) adjuvant in 2.5mL buffer on d 0; BW and BCS were recorded prior to injection. On d 14 after sensitization tail skin fold thickness (SFT) was measured using a Harpenden caliper prior to interdermal injection of 5×10^3 PNU/mL of CA into 0.5mL in the skin fold. On d 15 the injection site SFT was measured. Response was determined by the difference of SFT from d 15 (post injection) and d 14 (pre-injection). Data were analyzed by using PROC MIXED procedures specific for repeated measures (SAS v9.3). Calf sex, sire, and their interaction were independent variables, and SFT response and weaning temperament were dependent variables. Response classes were divided into: low (L), medium (M) and high (H) determined by 1/2 SD from SFT response means within gender. Response class was used as the independent variable in a mixed model analyses with temperament measures as dependent variables. Response in CMIR was greater (P < 0.02) in bulls (5.77 ± 0.52) compared to heifers (3.88 ± 0.57). Bulls TS (1.98 ± 0.14) was lower (P < 0.01) compared to heifers (2.58 ± 0.02). As expected, SFT were different (P < .0001) across response classes for bulls (L = 2.34 ± 0.36; M = 5.10 ± 0.36; H = 9.97 ± 0.38) and heifers (L = 1.85 ± 0.27; M = 3.44 ± 0.31; H = 6.20 ± 0.27). However, TS did not differ (P > 0.5) between response classes in bulls (L = 1.82 ± 0.20; M = 2.08 ± 0.21; H = 2.02 ± 0.21) or heifers (L = 2.36 ± 0.21; M = 2.49 ± 0.23; H = 2.60 ± 0.20). Bulls had a greater CMIR than heifers and temperament

was not significantly associated with CMIR within gender.

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112 Natural Antibody Profiles during Early to Mid-Lactation in Jersey Cows.

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Suppression of the immune system can occur during lactation in dairy cattle as the animal's resources are allocated to producing high quantities of milk instead of maintaining other physiological processes. The first half of lactation, which includes the onset of and peak lactation, results in major physiological stress on the dairy cow which leads to this immunosuppression. Natural antibodies (NAb) can be one of the body's first lines of defense against invading pathogens, but if suppressed, leave the animal more vulnerable to infection. The purpose of this study was to profile (NAb) concentrations from early to mid-lactation in Jersey cattle to determine any time points when this first line of defense may be suppressed. Coccygeal venipuncture was performed to collect serum from Jersey cows (n = 24) starting on the day of calving and continuing weekly for 20 wk (140 d). NAb titers for isotypes IgM, IgG, IgG1, and IgG2 binding keyhole limpet hemocyanin (KLH) were measured by enzyme-linked immunosorbent assay. Data was analyzed using two way repeated measures ANOVA with parity (primiparous vs. multiparous) and week as variables. There was a parity by week interaction for IgM (P = 0.009) and IgG2 (P < 0.001) isotypes, but parity alone had no effect on NAb titers for any of the isotypes. Differences in NAb titers across the 20 wk were significantly different for all isotypes (P < 0.001). This data identifies time points during the first half of a lactation cycle where cows may become more susceptible to infections. Additional studies are needed to use this information to improve herd health during lactation.

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113 Evaluating the Accuracy of a New Commercial Genetic Test for Response to Fescue Toxicosis in Cattle.

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Most tall fescue in the Southeastern states contains an endophyte that causes fescue toxicosis in grazing animals, a serious disease that causes $1 billion in economic losses to the US beef industry. Recently, a new genetic test, T-Snip (AgBotanica, LCC, Columbia, MO), has been developed with the objective of identifying animals with genetic variation for fescue

toxicosis tolerance. The aim of this study was to ascertain the accuracy of this new genetic test. Over 13 wk, weekly body weight (BW) data were collected on 148 pregnant purebred Angus cows at 2 locations (Butner and Reidsville, NC) where infected fescue was the only source of feed. Blood cards were collected in every animal for genotyping for T-Snip. This test provides 2 scores: tolerance index and rating, ranging from 0 to 50 and 0 to 5 respectively, with lower scores representing less tolerant animals. In our data, a total of 33, 89, 25, and 2, had ratings of 1, 2, 3, and 4, respectively. Tolerance index averaged 13.2, 21.1, 29.6, and 36, for ratings 1, 2, 3, and 4, respectively. At the end of the trial, average weekly gain (AWG) was calculated as the slope of the linear regression of BW on weeks. AWG was analyzed in a model including the fixed effects of location, parity, and initial body weight (covariate), and the random additive genetic effect (3-generation pedigree with 2,532 animals) in ASReml4. Pre-adjusted phenotypes (AWG* = additive genetic + residuals) were used for subsequent analysis. The accuracy of the T-Snip was determined using Spearman's rank correlation between AWG* with both T-Snip scores in R. This was done in 3 scenarios: all animals, and only animals in each location separately. Correlations between AWG* and T-Snip scores using all animals were −0.002 and 0.01 for the tolerance index and rating, respectively. For one location (Butner) correlations were positive low, with 0.34 (index), and 0.36 (rating). However, at Reidsville, correlations were negative low, with −0.29 (index), and −0.23 (rating). Interestingly, levels of toxic fescue are historically higher at Reidsville compared to Butner, which contrasts with results obtained in this study assuming a high accuracy of this genetic test for fescue toxicosis. Thus, these results suggest that the T-Snip test does not accurately identify animals with genetic potential for response to fescue toxicosis in Angus cows. Studies using other breeds are needed to test the accuracy of this test in different breeds.

114 Effect of Body Condition Score on Fatty Acid Composition of Equine Visceral Adipose Tissues.

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Body condition score (BCS) is routinely used to assess overall fat coverage in horses for both management considerations and research studies. However, BCS has not previously been associated with fatty acid (FA) composition of visceral adipose tissues. This study was aimed to determine FA composition of abdominal (leaf– LF) and mesenteric (MF) adipose tissues. Stock type horses with BCS of 4 ($n = 5$), 5 ($n = 9$), and 6 ($n = 5$) were slaughtered and LF and MF samples were collected, directly derivatized to FA methyl esters, and analyzed by gas chromatography (Agilent Technologies, Santa Clara, CA) with internal standard calibration. Statistical analysis was performed by the GLIMMIX procedure of SAS 9.4 (SAS Institute Inc., Cary, NC) and statistical significance was determined at $P \leq 0.05$. Percentage of 18:2 n6 in MF was 13.52% for BCS 4 horses, greater than those of BCS 5 and 6 ($P = 0.05$). The percentage of 16:1 n7 in BCS 6 horses (4.69%) was greatest ($P \leq 0.03$), so was that of 18:0 in BCS 5 horses (6.21%, $P \leq 0.01$). In the LF of BCS 5, percentages of 17:0, 17:1 n8, and 18:0 were 0.65, 0.88, and 7.1%, respectively, greater than those of BCS 4 and BCS 6 ($P \leq 0.04$). Percentage of 16:1 n7 in LF was similarly greatest for BCS 6 horses (4.02%; $P = 0.02$). Collectively, saturated FA (SFA) percentage (37.6%) was greater in LF than in MF (35%; $P = 0.02$), leading to greater SFA (37.60%) than monounsaturated FA (MUFA; 32.72%; $P \leq 0.001$) in LF but not in MF (MUFA = 34.72%, SFA = 35%; $P = 0.60$). Both LF and MF had more SFA and MUFA than polyunsaturated FA (PUFA; 29.69 and 30.28%, respectively; $P < 0.001$). These data indicate that greater BCS increases the saturation of LF more than it does that of MF.

115 Effect of a Pre-Synchronization Protocol on Beef Heifer AI Pregnancy Rates.

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Success of a cow-calf operation starts with proper development of replacement heifers. Advancements in reproductive technologies have improved pregnancy rates in replacement heifers. There are several estrous synchronization protocols available to achieve acceptable AI pregnancy rates for beef heifers; however, undesirable consequences leading to reduced fertility can occur if heifers are prepubertal or not responsive to hormonal stimulation. Greater pregnancy rates have been observed in heifers exhibiting 3 estrous cycles prior to insemination compared to pubertal heifers. In effort to improve fertility, the objective of this project was to compare the effectiveness of a presynchronization program prior to the 5d CO-Synch+CIDR FTAI protocol. Angus and SimAngus heifers approximately 60% of mature BW ($n = 95$) at 2 locations were randomly assigned to be synchronized using the 5d CO-Synch+CIDR protocol (control) or to receive a presynchronization program consisting of 2 injections of PGF2α administered 25 and 11 d prior to the start of the 5 d CO-Synch+CIDR protocol (treatment). All heifers were artificially inseminated 60 h after CIDR removal. Heifer BW, age,

BCS, Reproductive tract scores (RTS) and pelvic area were measured at 25 d prior to the start of the 5 d CO-Synch+CIDR protocol. Blood samples were collected 3 consecutive times at 7 d intervals to determine the onset of puberty via analyzing serum progesterone concentrations. Pregnancy status was assessed by ultrasonography 30 d post-insemination. Data were analyzed using a MIXED procedure of SAS and examined for effects of treatment, RTS, pelvic area, BCS, location, and age. Statistical significance was determined at $P < 0.05$ and a tendency at $0.05 < P < 0.10$. While there was no difference between treatments, more heifers were cycling prior to the start of the estrous cycle at location 1 compared to location 2 (78.6% vs. 50%, respectively). Implementing a pre-synchronization program prior to the 5d CO-Synch+CIDR protocol significantly reduced AI pregnancy rates ($P < 0.05$) compared to controls (34.9%, 58.5%, respectively). Heifer BW, age, breed, BCS, pelvic area or location did not affect ($P > 0.05$) AI pregnancy rates. Heifers with a RTS of 3 or 5 at the start of the 5d CO-Synch+CIDR protocol had greater AI pregnancy rates ($P < 0.05$) compared to heifers with a RTS of 4 (48.2%; 62.4% and 29.5%, respectively). The addition of the presynchronization program disrupted cyclicity in treated heifers without noticeable changes in the development of the reproductive tissues. Based on the data, incorporating pre-synchronization breeding programs is not recommended for improving pregnancy success in replacement heifers.

116 Effects of Moxidectin/Oxfendazole and Long-Acting Eprinomectin Treatment on Fecal Egg and Fly Counts, Adg, and Blood Parameters in Newly Received Stocker Calves.

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The objectives of study were to evaluate effects of various anthelmintic treatments on fecal egg counts (FEC), ADG, fly counts, and blood parameters in newly received stocker calves. Upon arrival to the Murray State University Beef Unit, steers ($n = 30$) were allow a 1 wk adjustment period prior to allocation of treatment. Steers were randomly allocated to treatment based on BW (297.77 ± 16.53 kg) and FEC (43.10 eggs/gram; EPG). Treatments included: control ($n = 10$; no anthelmintic treatment; CON); moxidectin/oxfendazole combination ($n = 10$; COMBO); and a long-acting eprinomectin ($n = 10$; LAE). Steers were comingled and allowed to grazed mixed grass pastures with rotation occurring based on forage availability. Body weight, fecal and blood samples were collected on d 0, 27, 56, and 101 and the following blood parameters evaluated: white blood cell count (WBC), platelets (PLA), neutrophils (NEU), lymphocytes (LYM), monocytes (MON), basophils (BASO), and eosinophils (EOS). Fly counts were estimated on d 0, 31, 61, and 100. Data was analyzed using the PROC MIXED procedure of SAS with steer as the experimental unit and d as a repeated measure. Two preplanned orthogonal contrasts were used to determine effects and included comparisons between: 1) CON vs. treated steers, and 2) COMBO vs. LEA steers. Strongyle EPG were similar between CON and treated steers ($P > 0.1$) but EPG were higher ($P = 0.02$) for COMBO vs. LAE steers (22.97 vs. 5.61 EPG, respectively). A treatment x d interaction was found for EPG ($P = 0.02$). Body weight and ADG was similar ($P > 0.1$) between treatments; however, ADG from d 27 to 56 was greater ($P = 0.04$) for LAE vs. COMBO steers (1.29 vs. 0.54). An effect of d ($P < 0.01$) was observed for fly counts and the following blood parameters: WBC, NEU, LYM, MON, BASO, and EOS. Esonophils were greater ($P = 0.03$) in LAE vs. COMBO steers (0.32 vs. 0.19, respectively) while MON tended to be greater ($P = 0.06$) for LAE and COMBO steers (0.82 vs. 0.65, respectively). Data suggests that anthelmintic use may have affected FEC, ADG, and blood parameters in newly received stocker calves.

117 Effect of Internal Parasites on Meat Goat Reproductive Traits.

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Internal parasitism is a significant problem in meat goat production systems. Reproductive output is a primary factor in determining the profitability and sustainability of a meat goat enterprise. This study investigated the relationships between internal parasite burdens and reproductive performance in fall-bred meat goat does. Doe records ($n = 1,134$) across 7 yr from the Tennessee State University research herd were processed which included 488 purebred and crossbred does sired by over 100 bucks representing Boer, Kiko, Myotonic, Savanna, and Spanish breeds. Does ranged from 2 to 12 yr of age. Doe records included fecal egg counts (FEC) measured at breeding, kidding and weaning and litter sizes at kidding and weaning. Doe reproductive values were set at '1' if kids were produced and '0' if no kids were produced at the kidding

and weaning recording periods. For FEC at breeding, does were classified as low (LOWB) if FEC < 500 epg and high (HIGHB) if FEC ≥ 500 epg. Kidding and weaning rates per doe exposed were greater ($P < 0.01$) for LOWB does (66.6 ± 8.7%, 51.6 ± 6.6%) compared with HIGHB does (46.1 ± 9.9%, 35.3 ± 6.3%). Litter size born and weaned were greater ($P < 0.01$) for LOWB does (1.01 ± 0.14 kids; 0.70 ± 0.09 kids) compared with HIGHB does (0.75 ± 0.11 kids; 0.50 ± 0.07 kids). For FEC at kidding, lactating does were classified as low (LOWK) if FEC < 1,000 epg and high (HIGHK) if FEC ≥ 1,000 epg. Litter size born and weaned were smaller ($P < 0.05$) for LOWK does (1.53 ± 0.07 kids; 1.04 ± 0.08 kids) compared with HIGHK (1.65 ± 0.06 kids; 1.15 ± 0.08 kids). No difference ($P = 0.98$) was found for weaning rates between LOWK and HIGHK does (79.9 ± 5.6 vs. 79.8 ± 5.2%). Lactating does with low weaning FEC (< 1,000 epg) had smaller weaning litter sizes ($P < 0.01$) than high FEC (≥ 1000 epg) does (1.31 ± 0.06 vs.1.44 ± 0.06 kids). Preliminary findings of this study suggested that does with high internal parasite burdens during fall breeding, as indicated by elevated FEC, would have reduced reproductive performance measurements at kidding and weaning. However, lactating does with higher FEC at kidding or weaning had larger litter sizes, demonstrating the potentially adverse relationship of increased litter size with increased internal parasite loads in meat goat dams.

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118 Effects of Two-Stage Weaning Duration on Beef Cattle Growth and Vocalizations.

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Stress during weaning is two-fold, physical separation of the calf and dam along with the alteration of the calf's nutrition due to the prevention of nursing. At weaning, the calf will exhibit increased vocalizations and decreased appetite which typically results in a decrease in average daily gain. There are a few different methods which can be utilized to reduce the stress at weaning. One way is to use a two-stage weaning method, whereby an anti-suckling device is placed in the nostrils of the calf for 4 to 7 d prior to weaning. The use of this device has been shown to reduce stress on the calf, however, it has also be found to negatively impact the calf's growth rate. The objective of our study was to determine if utilizing anti-suckling devices could be an effective method for beef producers and if 2 d was long enough to impact calf performance and vocalizations. Forty-eight registered Angus heifer and bull calves (initial weight = 273 ± 8 kg) were utilized in a completely randomized design. Calves were assigned to 1 of 3 treatments; control (CON), 2 d with device prior to weaning (2D) or 4 d with device prior to weaning (4D). All calves were weaned utilizing fence-line weaning on d 0. Calf growth

performance was taken from 1 wk prior to weaning through 21 d post-weaning, with vocalizations being measured for 6 d pre- and post-weaning. A linear effect ($P < 0.01$) was observed for post-weaning average daily gain, as CON calves displayed the highest rate of gain, and 4D calves exhibited the lowest growth rate. No other growth parameters were affected ($P > 0.50$) by treatment. A treatment by day interaction ($P < 0.01$) was seen for vocalizations as CON calves vocalized more starting on the day of weaning and continued for 3 d after compared to either two-stage treatments. Interestingly, we did see a trend ($P < 0.09$) for the 4D calves to increase vocalizations for a day after devices were placed compared to other treatments. Our results suggest that the two-stage method can be effectively utilized to reduce stress prior to weaning, however growth rate may be negatively impacted.

SYMPOSIUM ABSTRACTS

BILL E. KUNKLE INTERDISCIPLINARY BEEF SYMPOSIUM: ADVANCES IN PROTEIN NUTRITION FOR BEEF CATTLE

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119 Using Bypass Amino Acids and Proteins to Meet the Requirements of Beef Cows Consuming Low-Quality Forage.

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A literature search was conducted to review studies evaluating supplemental bypass protein or amino acids in cattle fed low-quality forages (≤ 6% CP) on forage intake, digestibility, N flow to the duodenum, and cow and calf performance. Protein supplementation regardless of degradability increased DM and/or OM digestibility (80% of studies), NDF digestibility (50% of studies), and total N flow to the duodenum (100% of studies) compared with negative control. However, protein supplementation increased forage intake in C4 forages (100% of studies; average 19.5 g/kg $BW^{0.75}$), but not in any studies using C3 forages. Replacing RDP with RUP in isonitrogenous supplements had little effect on DM or NDF digestibility (9% of studies), hay intake (opposite effects in 2 of 7 studies), or total N flow to the duodenum (0% of studies). Addition of RUP to RDP supplements also had little effect on DM or NDF digestibility (33% studies), or hay intake (0% of studies), but increased total N flow to the duodenum (1 of 1 studies). Protein supplementation regardless of degradability improved body weight and body condition score change in multiparous beef cows (75% of studies; 38.6 kg and 0.40 units, respectively) compared with a negative control. Replacing RDP with RUP or adding RUP to RDP supplements

had little effect on BW or BCS change in beef cows (20 and 33% of studies, respectively). Pregnancy rate, milk yield, and calf weaning weight were minimally affected by protein supplementation in the 7 studies reviewed. Addition of DL-methionine regardless of encapsulation to RDP supplements had little effect on intake or DM digestibility of low-quality forage, or cow BW or BCS change in 3 of 3 studies, but addition of methionine hydroxy analog reduced forage intake in the one study reviewed. Addition of hydroxyl-methyl-thiobutanoic acid to an RDP supplement did not affect cow BW or BCS change even though energy-corrected milk yield was increased, but improved feed efficiency in fetal-programmed calves in the one study reviewed. In conclusion, RUP may replace RDP in supplements without negative consequences on forage intake and digestibility or cow BW and BCS change. Addition of RUP to RDP supplements has little benefit on forage utilization or cow performance. Research on bypass amino acids in beef cows fed low-quality forage is scarce, but available studies suggest possible benefits.

120 Protein Supplementation of Beef Cattle to Meet Human Protein Requirements.

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Protein supplementation to beef cattle is practiced to ensure an adequate level of performance. Cattle fed a basal diet that fails to provide a sufficient supply of either degradable intake protein or metabolizable protein are often supplemented. Development of relatively cheap sources of protein in the form of byproducts from energy and human food production (most commonly distillers' grains from ethanol and corn gluten feed from wet milling) have to a large extent ensured that growing and finishing diets are more likely to contain excess metabolizable protein than insufficient. Meeting metabolizable protein requirements may not ensure adequate ruminal nitrogen for optimal ruminal fermentation; however, endogenous nitrogen recycling or the addition of highly degradable non-protein nitrogen are capable of meeting ruminal requirements at no or relatively little cost, respectively. Diets including byproducts demonstrate the ability of beef cattle production systems to convert low-value protein sources into high-quality sources of human edible protein. Cattle as protein quality enhancers is often discussed but has not been extensively quantified. Accordingly, our aim is to determine the value of beef cattle production systems as convertors of human-inedible protein sources into a high-quality source of human edible protein, beef. Evaluation of diets relative to their ability to use cattle as augmenters of protein quality may have the advantage of demonstrating to consumers and regulatory bodies the value of beef cattle production systems in meeting the growing de-mand for high-quality human food protein. Furthermore, such an evaluation sheds light on a relatively untapped explanation of how beef cattle contribute to sustainable food production.

121 Opportunities and Challenges of Applying Recent Advances in Dairy Cattle Protein Nutrition to Beef Cattle Nutrition.

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Ruminant protein nutrition is greatly affected by the fermentation in the rumen because the microbial population in the rumen converts a majority of protein provided in the diet to microbial protein. This has both positive and negative consequences on ruminant protein nutrition. On one hand, the ruminant can survive and thrive under conditions of poor protein quality, even with low concentrations of true protein in the diet. On the other hand, this can lead to reduced efficiency of nitrogen utilization and requires a more complicated approach for precisely meeting the amino acid requirements of the ruminant animal compared to non-ruminants. Because of the inefficiency of nitrogen utilization associated with milk protein production, high cost of high-protein feedstuffs, and the negative consequences of excess environmental nitrogen, a significant focus in the protein nutrition of dairy cattle in recent years has been to reduce dietary crude protein levels. Therefore, the goal is to reduce crude protein intake while maintaining high levels of milk production. To achieve this goal, dairy cattle nutritionists have increasingly used ration formulation models to predict microbial and rumen undegradable protein flow to meet a predicted metabolizable protein requirement. In addition to formulating for metabolizable protein, dairy cattle nutritionists are increasingly formulating for essential amino acids. The essential amino acids that are attracting the most attention are primarily methionine and lysine since these have been shown to be first-, second-, or co-limiting in a wide range of diets. There are also commercial options available to supplement for these limiting amino acids beyond formulating with complementary feedstuffs. The use of these approaches can result in reduced dietary nitrogen intake while maintaining or increasing productivity under commercial conditions; however, the most successful application comes when farms have excellent management and when farm managers and nutritionists agree to embrace this formulation philosophy. Although there are large differences in dairy and beef production systems, there could be important areas of overlapping understanding that could inform both dairy and beef cattle nutritional management. While there is much still to learn about dairy cattle protein nutrition, recent advances will be reviewed and the opportunities and challenges that exist in applying these nutritional

approaches to beef cattle nutrition will be discussed.

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122 Environmental Consequences of Overfeeding Protein to Beef Cattle.

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Reactive nitrogen (Nr) emissions from beef cattle production can contribute to both air and water pollution. However, Nr (biologically available N) is also essential for the growth of plants and animals. Feed N intake is the major driver of total Nr excretion by beef cattle and most feed N is in the form of dietary protein. Beef cattle excrete Nr into the environment in 2 main ways: the feces and urine. Most fecal N is excreted in an organic form and sources can include undigested feed N, microbial N, and endogenous N. Urinary N is excreted mostly as urea, but also includes compounds such as purine derivatives and creatinine. As N intake of cattle increases, both fecal N and urinary N excretion will increase; however, urinary N is excreted at an increasing rate as compared to fecal N. Once excreted from the animal, urinary N, and especially urea-N, can undergo several transformations that can lead to an increase in Nr in the environment. Specifically, urinary urea-N can be converted to ammonium/ammonia and then be emitted to the atmosphere as ammonia gas through volatilization. Ammonia can lead to particulate matter formation, acidification of terrestrial and aquatic ecosystems, and eutrophication of water bodies once deposited. Alternatively, ammonium can undergo the biological process of nitrification in soil leading to the production of nitrate (NO_3^-), which may be used by plants or microorganisms or leached into groundwater. Nitrate can undergo the biological process of denitrification, thereby leading to the production of nitrogen gas (N_2). During the denitrification process, nitric oxide (NO) and nitrogen dioxide (NO_2) can be emitted (collectively known as NOx) as can the potent greenhouse gas nitrous oxide (N_2O). Emissions of NOx can lead to particulate matter formation and can drive the production of tropospheric ozone. In addition to being a greenhouse gas 265 times more potent than carbon dioxide at trapping heat in the Earth's atmosphere on a 100-yr time scale, N_2O emissions can also lead to the destruction of stratospheric ozone. Thus, feeding dietary protein at concentrations above animal requirements can lead to an increase Nr emissions from beef cattle production and negative environmental sustainability outcomes.

SERA 41 SYMPOSIUM: FORAGE SYSTEMS TO EXTEND THE GRAZING SEASON IN THE SOUTHEASTERN US

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123 Overview of Forage Nutritive Quality and Availability in Relation to Cattle Needs during the Fall Transition Period in the Southeastern US.

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Forages in the Southeastern US are affected by both latitude (Lat.) and longitude (Long.) climate gradients. Predominant forages in the most western reaches (west of 37W Lat.) are native warm-season (NWSG) and introduced bunch grasses. Tall fescue (*Lolium arundinaceum* [Schreb.] Darbysh.) is the predominate pasture forage east of 36W Lat. and north of 33N Long. Sod-forming introduced warm-season grasses are characteristic of pastures south of 35N Long. The prevailing forage type within these three broadly defined geographic zones contribute to gaps in forage availability or nutrient deficiencies during different portions of the year for growing calves and brood cows. Managed introduced warm-season grasses normally have greater CP than NWSG, yet seasonal changes in forage nutritive quality and relative forage growth rates follow similar patterns throughout the year. During the late spring and early summer, CP is usually greatest and fiber concentrations the least. Fiber and CP decline throughout summer into autumn. Tall grass species of NWSG have a more pronounced decline in nutrient content than introduced grasses, decreasing from 15% CP (DM basis) in the early summer to ≤ 7% CP (DM basis) during the late summer in Oklahoma. Protein content of bahiagrass (*Paspalum notatum*) grown in southern Arkansas in June was 13% CP (DM basis), only declining to 11% CP (DM basis) by August; likewise, bermudagrass (*Cynodon dactylon*) grown in southern Arkansas did not have appreciable reductions in CP from early summer (13% CP DM basis) to late summer (12% CP DM basis). Accumulation of bermudagrass DM during the late fall (September and October) are frequently < 25% of accumulations measured during the peak growth rate in July. Tall fescue has much greater CP and lesser fiber concentration during the fall and early spring than during late spring and summer, following stem elongation and seedhead emergence. However, tall fescue accumulation rates are much greater during the spring than during the fall. Gaps in forage availability for beef production are a result of slowing forage growth rates and decreasing forage quality in warm-season

forages and slow growth rates of cool-season grasses. Forage management and complementary forages are necessary to sustainably fill these gaps to create year-round grazing systems.

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formation helping to predict nitrogen responses based on expected soil N availability is needed with both forage species.

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124 Fall Stockpiling Options and Management for Extending the Grazing Season.

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Beef producers can reduce winter feeding costs by stockpiling forage in the autumn for grazing during winter. Both major forage species in the southern region, tall fescue [*Lolium arundinaceum* (Schreb.) Darbysh] and bermudagrass (*Cynodon dactylon*), have great potential for stockpiling, making this approach accessible to a large percentage of producers. Crude protein and forage mass will respond to fertilization with N, depending on the potential release of residual soil N. Recommended N fertilization rate is 44 to 88 kg/ha during late summer about 60 d before the end of the growing season (August 15 to September 15 depending on latitude and elevation). Stockpiled tall fescue maintains nutritive value well into winter, and reduction in fungal alkaloids by midwinter supports deferring grazing until late in the season. High variation in yield, nutritive value, and animal gain has been reported and is a factor of available forage, grazing management, and forage nutritive value. Research shows that growing animals respond to protein and energy supplements, with a greater response to protein supplementation expected when serum urea nitrogen is low. Despite high nutritive value, performance in unsupplemented growing cattle is suboptimal while performance in brood cows is usually acceptable without supplementation. Bermudagrass also responds to late season fertilization, recommended N level is 44 to 88 kg/ha, and N application generally occurs 2 to 4 wk earlier than would be the case for tall fescue. Grazing is generally initiated in late October, with most studies evaluating grazing during November and December. As with tall fescue, despite apparently adequate protein level animals show a positive response to supplementation. When cows received supplements (0.9 kg/d) with CP concentration ranging from 12.5 to 37.5% there was no response in November, but there was a positive response in December and January. Maintaining a high level of forage harvest efficiency will result in more grazing days per ha, but will result in reduced performance due to low forage intake compared to a more liberal forage allowance. Temporary electric fencing and use of adaptive grazing are important tools for producers to reach production goals while grazing stockpile. Economics will favor stockpiling these forages when rainfall is adequate resulting in high forage yield, when hay price is high, and/or when N fertilizer prices are low. Additional in-

125 Cool-Season Annual Grasses and Grass-Legume Mix Options and Management for Extending the Fall Grazing Season.

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Cool-season annuals may fill gaps in seasonal forage availability and reduce stored feed needs for beef cattle producers in the Southeast. These forages can be established during the autumn via sod-seeding or broadcasting on warm-season perennial grass pastures such as bermudagrass and bahiagrass or planted into a prepared seedbed. Opportunity exists to use small grains that vary in their individual growth distribution to extend the grazing season. Small grains adapted to the region include cereal rye (*Secale cereale*), wheat (*Triticum aestivum*), oats (*Avena sativa*), and triticale (*×Triticosecale*). These species provide bimodal forage dry matter (DM) production during the autumn and early winter months, and can be grown in monocultures or mixtures. Cereal rye generally provides forage DM earliest in the season, followed by triticale, wheat, and oats. Fall production potential of these species is primarily dependent on planting method, seeding date, fertility, and variety selection. These species provide high quality forage DM that may support animal performance in stocker and cow-calf operations with minimal supplementation, and can be grown in combination with annual ryegrass and/or legumes to further lengthen the window of grazing. Annual ryegrass and legumes in the Southeast includes cold-tolerant and rust-resistant diploid and tetraploid varieties of ryegrass, and adapted true clover (*Trifolium sp.)* varieties. Autumn-planted ryegrass and/or clovers including primarily crimson, arrowleaf, ball, and white clover, provide minimum to nonexistent forage mass for grazing during the fall. Naturally reseeding ryegrass or clovers will often provide earlier forage mass; however, DM is usually not adequate for stocking until late-January through May. With appropriate levels of N fertilization, ryegrass produces more forage DM, and thus allows for earlier stocking and greater stocking rates compared to clovers. Tetraploid varieties of ryegrass, when seeded into prepared seedbed, can provide adequate forage mass for fall grazing. Earliness of forage mass for stocking of clover ranges from crimson (earliest), to arrowleaf and ball (mid), to white clover (latest). White clover, however, in adapted soils and with adequate spring-summer rainfall and proper stocking rate, can provide grazing during early to mid-summer months. From the first frost event in late fall through the early spring months, cool-season annual forages provide actively growing

forage to extend fall and spring grazing for cow-calf and/or stockers during winter dormancy of perennial grass pastures.

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126 Developing a Grazing Management Plan That Matches Forage Systems to the Nutrient Needs of Cattle.

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Matching forage systems with livestock nutrient needs shouldn't be a difficult or impossible task. What is required is basic knowledge of when adapted forages grow, when those forages can be managed to provide grazing, and the nutrient needs of the classes of cattle being grazed. These parameters are somewhat fixed, at least within certain ranges, and can be factored into decisions on seasonal forage management. An important aspect is that once these parameters are known for a given system, management decisions should always be made at least one season ahead of the intended grazing period to assure forage availability. For stocker calves, the recommended forage allowance of winter annual grasses is 2–3 kg per kg of animal bodyweight with 1320 kg available forage DM per hectare. That requires August/September planting to provide fall grazing and October/November planting to provide late winter grazing in the Southeast. Cow nutrient needs are at the lowest point in mid to late gestation and increase sharply at calving and remain high through normal rebreeding. Warm-season and cool-season perennial grasses can be stockpiled beginning in August or September, respectively, to provide grazing from October through February. Research and demonstration work in Arkansas has shown that grazing seasons can be extended to 300+ days per year using planned management practices with perennial and complementary annual forages and stockpiled forages. That approach was successful for spring and fall-calving beef herds, but can also be implemented for stocker or heifer development programs. Cost savings from stockpiled forages averaged $50 per animal unit (AU). Savings from winter annual forages averaged $83 per AU during "normal" winters, but were over $200 per AU during drought years when forage and hay were scarce. Weather can play a negative or positive role in seasonal forage availability, but adequate planning always plays a positive role regardless of weather conditions.

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127 Impact of DDGS Supplementation of Cattle Grazing Bermudagrass on the Plant-Animal-Environment Nexus.

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Supplementation of cattle on pasture is a well-known viable strategy for increased performance per animal and per ha. Ethanol has been proclaimed as a sustainable alternative to fossil fuels, and the vast supply of dried distillers' grains with solubles (DDGS) generated from ethanol production provides opportunities for addition to feedlot rations and supplementation of grazing cattle. A large percent of the cattle in the United States are located in the Southeast, where bermudagrass is the primary introduced forage species. Since relatively few research studies have been conducted using DDGS as a supplementation on actively-growing warm-season pastures, this research represents a significant and critical knowledge database for the pasture-beef industry. The first objective of this research was to evaluate performance of stocker calves grazing 'Tifton 85' (TIF) bermudagrass with varying rates of DDGS supplementation. Steers ($n = 112$, 364 ± 3.5 kg BW) were stratified by BW and allocated randomly to each of 16 pastures (0.7 ± 0.01 ha) across 2 years (2014, 2015). The TIF pastures were allocated randomly to each of 4 rates of DDGS: 0, 0.25, 0.5, or 1% BW hd^{-1} d^{-1}. Average daily gain was greatest ($P < 0.05$) from steers offered 1% BW (1.3 kg/d), and least from non-DDGS steers (0.8 kg/d), with 0.25 and 0.5% BW intermediate (1.1 and 1.2 kg/d, respectively). There were supplemental feed to additional gain ratios of 3.7, 6.0 and 9.0, respectively, for 0.25, 0.5 and 1% BW. The second objective was to evaluate performance of *Bos indicus* versus *B. taurus* stocker calves grazing 'Coastal' (COS) bermudagrass with varying rates of DDGS. Steers within a breed type ($n = 117$, 343 ± 4.5 kg BW) were stratified by BW and allocated randomly to each of 9 pastures (1.3 ± 0.17 ha) across 2 years (2014, 2015). Pastures were allocated randomly to each of 3 rates of DDGS: 0, 0.25, or 1% BW hd^{-1} d^{-1}. Across breed types, ADG was greater ($P < 0.05$) from steers offered 1% BW (1.0 kg/d) than either from non-DDGS steers or 0.25% BW (0.7 kg/d each). There was no difference ($P = 0.70$) in ADG between breed types. The third objective of the study was to evaluate any carryover effects in long yearling stock-

ers previously stocked on TIF or COS with varying rates of DDGS. Following the pasture × DDGS phase in the first 2 objectives, steers were shipped 693 km to a commercial feedlot for an approximate 140-d finishing phase. At finishing, animals were transported 59 km and harvested at a commercial abattoir. There was no effect ($P \geq 0.36$) of DDGS for either TIF or COS during the feedlot phase. Likewise, there was no effect of DDGS on percent Low Choice for TIF ($P = 0.74$) or COS ($P = 0.86$). The fourth objective was to evaluate in vitro digestion kinetics and methane production potential of TIF or COS with varying rates of DDGS. Hand-plucked plant parts of TIF and COS were mixed independently with DDGS to represent the intake of cattle at various rates of DDGS (0, 0.25, 0.5 or 1% for TIF; 0, 0.25 or 1% for COS) in each of the first 2 objectives. Newly-generated laboratory samples were incubated in an in vitro anaerobic fermentation chamber. In vitro true degradation (IVTD) and in vitro NDF degradation (IVNDFD) were greater ($P < 0.05$) from TIF (69% IVTD, 57% IVNDFD) than from COS (62% IVTD, 44% IVNDFD). Treatment of DDGS did not differ ($P > 0.05$) within TIF for IVTD, but 1% DDGS was greater ($P < 0.05$) than 0%, with 0.25% DDGS intermediate to the 2 for COS. Concentration of CH4 was also greater ($P < 0.05$) TIF (14 mM) than COS (12 mM), and CH4:H2 ratio was less ($P < 0.05$) from TIF (3:1) than from COS (2:1). The fifth and final objective was to evaluate the ruminal in situ digestion kinetics of TIF as affected by forage seasonality and DDGS. Samples of TIF were harvested in June, August and October 2014. Ruminally-fistulated steers ($n = 6$) were stratified by BW to 3 pens, and pens were allocated randomly to 1 of 3 rates of DDGS: 0, 0.25, or 1% BW hd-1 d-1. Samples were incubated for 2, 4, 8, 12, 24, 72, and 96 h. A trend of decreasing degradation of DM, NDF, and ADF was observed with both increasing seasonality ($P \leq 0.01$) and increasing DDGS ($P \leq 0.04$). The undegraded fraction (UDG) of DM from TIF was least ($P < 0.05$) from June (19%), followed by August (34%), and greatest from October (41%). The UDG from TIF DM was not different ($P = 0.47$) based on DDGS , and averaged 31%. Low rates of DDGS may be feasible using TIF but not COS at our vegetational region. Rate of DDGS on pasture did not affect feedlot performance nor carcass characteristics. Increased rates of DDGS may increase forage digestibility and decrease CH4 production, but this was cultivar-dependent. Reduction of DM degradation was dependent upon seasonality more so than DDGS rate. Overall, DDGS represented a viable option for stocker production systems, and economic assessments for each specific operation-location will be required prior to implementation of a supplementation program..

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1995	G. L. Cromwell	Kentucky
1994	G. E. Mitchell, Jr.	Kentucky
1993	L. E. McDowell	Florida
1992	J. Fontenot	Virginia
1991	R. Totusek	Oklahoma
1990	V. Hays	Kentucky
1989	F. Baker	Arkansas
1988	C. B. Ammerman	Florida
1987	L. E. Walters	Oklahoma
1986	L. Goode	North Carolina
1985	O. M. Hale	Georgia
1984	L. C. Ulberg	North Carolina
1983	C. J. Brown	Arkansas
1982	W. C. McCormick	Georgia
1981	E. R. Barrick	North Carolina
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1979	M. Koger	Florida
1978	T. J. Marlowe	Virginia
1977	S. Hansard	Tennessee
1976	J. C. Hillier	Oklahoma
1975	J. K. Riggs	Texas
1974	T. J. Cunha	Florida
1973	O. D. Butler	Texas
1972	G. W. Litton	Virginia
1971	R. H. Dutt	Kentucky
1970	R. C. Carter	Virginia
1969	H. H. Leveck	Mississippi
1968	W. P. Garrigus	Kentucky
1967	B. L. Southwell	Georgia
1966	C. S. Hobbs	Tennessee

EXTENSION AWARD RECIPIENTS

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2015	M. Hersom	University of Florida
2014	L. Anderson	University of Kentucky
2013	C. Richards	Oklahoma State University
2012	M. S. Gadberry	University of Arkansas
2011	R. D. Coffey	University of Kentucky
2010	M. T. See	North Carolina
2009	E. van Heugten	North Carolina
2008	T. McCollum	Texas A&M University
2007	M. H. Poore	North Carolina
2006	A. F. Harper	Virginia
2005	G. Selk	Oklahoma State University
2004	R. L. McCraw	North Carolina
2003	D. Bullock	Kentucky
2002	W. Gill	Tennessee
2001	W. R. Burris	Kentucky
2000	T. R. Troxel	Arkansas
1999	G. V. Davis, Jr.	Arkansas
1998	G. L. M. Chappel	Kentucky

1997	S. H. Umberger	Virginia
1996	C. D. Lane, Jr.	Tennessee
1995	J. T. Johns	Kentucky
1994	D. W. Freeman	Oklahoma
1993	J. R. Jones	North Carolina
1992	J. B. Neel	Tennessee
1991	K. Lusby	Oklahoma
1990	J. Hughes	Oklahoma
1989	H. Webster	Clemson
1988	D. R. Gill	Oklahoma
1987	H. J. Gerken, Jr.	Virginia
1986	M. K. Cook	Georgia
1985	W. G. Luce	Oklahoma
1984	C. Cooper	Virginia
1983	C. W. Absher	Kentucky
1982	C. M. Triplett	Georgia
1981	A. N. Huff	Virginia
1980	A. L. Eller, Jr.	Virginia

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2016	Texas A&M University
2015	Oklahoma State University
2014	Texas A&M University
2013	Oklahoma State University
2012	Texas A&M University
2010	University of Florida
2009	University of Georgia
2008	University of Kentucky
2007	Texas A&M University
2006	Texas A&M University
2005	North Carolina State University
2004	University of Kentucky
2003	Texas A&M University
2002	University of Florida
2001	University of Kentucky
2000	Texas A&M University
1999	University of Kentucky
1998	University of Kentucky
1997	Oklahoma State University
1996	Oklahoma State University
1995	Virginia Tech University
1994	Oklahoma State University
1993	Texas A&M University
1992	Oklahoma State University
1991	University of Kentucky
1990	Virginia Tech University
1989	Oklahoma State University
1988	Texas A&M University
1987	University of Georgia
1986	University of Georgia
1985	University of Kentucky
1984	Texas A&M University

YOUNG ANIMAL SCIENTIST AWARD RECIPIENTS

2016[1]	C. E. Huntington	Auburn University
2016[2]	N. DiLorenzo	University of Florida
2015[1]	C. Bratcher	Auburn University
2015[2]	K. Urschel	University of Kentucky
2014[1]	K. Stutts	Sam Houston State University
2014[2]	C. Bratcher	Auburn University
2013[1]	E. Wagner	Auburn University
2013[2]	M. C. Satterfield	Texas A&M University
2012[2]	S. Suman	University of Kentucky
2012[1]	D. VanOverbeke	Oklahoma State University
2011[2]	J. C. Brooks	Texas Tech University
2011[1]	J. C. Brooks	Texas Tech University
2010[2]	T. J. Wistuba	Morehead State University
2010[1]	D. L. VanOverbeke	Oklahoma State University
2009[2]	M. L. Looper	USDA, ARS
2009[1]	G. Hilton	Oklahoma State University
2008[2]	J. Escobar	Virginia Tech University
2008[1]	J. A. Sterle	Texas A&M University
2007[2]	S. W. Kim	Texas Tech University
2007[1]	L. Anderson	University of Kentucky
2006[2]	S. T. Willard	Mississippi State University
2006[1]	M. L. Looper	USDA, ARS
2005[2]	C. Krehbiel	Oklahoma State University
2004[1]	M. T. See	North Carolina State University
2004[2]	T. Van Kempen	North Carolina State University
2003[1]	S. Jackson	Texas Tech University
2003[2]	T. Spencer	Texas A&M University
2002[1]	J. Yelich	University of Florida
2002[2]	B. Kegley	University of Arkansas
2001[1]	S. Ramsey	Texas A&M University
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1998[1]	M. F. Miller	Texas Tech University
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1997[1]	T. Marshall	University of Florida
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1995[2]	J. D. Armstrong	North Carolina State University
1994[1]	D. K. Aaron	University of Kentucky
1994[2]	P. J. Hansen	University of Florida
1993[1]	K. Pond	North Carolina State University
1993[2]	R. Geisert	Oklahoma State University
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1992[2]	J. L. Sartin	Auburn University
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1991[2]	W. Greene	Texas A&M University
1990[1]	J. W. Mabry	University of Georgia
1990[2]	T. H. Welsh	Texas A&M University
1989	J. W. Spears	North Carolina State University
1988	S. B. Smith	Texas A&M University
1987	D. L. Thompson, Jr.	Louisiana State Univ.
1986	G. J. Hausman	USDA, ARS, Athens, GA
1985	J. W. Savell	Texas A&M University
1984	D. R. Notter	Virginia Tech University
1983	T. S. Stahly	University of Kentucky
1982	D. N. Marple	Auburn University

[1] Education
[2] Research

NPB SWINE INDUSTRY AWARD RECIPIENTS

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2015	P. R. Broadway	Texas Tech University
2014	M. D. Johnson	Texas A&M University
2013	J. R. Donaldson	Mississippi State University
2012	M. Estienne	Virginia Tech University
2011	M. Estienne	Virginia Tech University
2010	J. A. Carroll	ARS, USDA
2009	E. Van Heugten	NC State University
2008	S. W. Kim	North Carolina State Unversity
2007	C. O'Gormon	Texas A&M University
2006	J. A. Carroll	USDA, ARS
2005	Z. B. Johnson	University of Arkansas
2004	J. Apple	University of Arkansas
2003	T. van Kempen	North Carolina State University
2002	K. Cole	University of Arkansas
2001	G. E. Conatser	University of Tennessee
2000	*Not Given*	
1999	*Not Given*	
1998	R. A. Cushman	North Carolina State University
1997	M. T. See	North Carolina State University
1996	W. L. Flowers	North Carolina State University
1995	M. T. See	North Carolina State University
1994	R. Dove	University of Georgia

EMERGING SCHOLAR AWARD RECIPIENTS

2016	*Not Given*	
2015	D. Rosero	The Hanor Company
2014	A. Mays	University of Arkansas
2013	A. P. Foote	University of Kentucky
2012	J. Hicks	North Carolina State University
2011	R. S. Fry	North Carolina State University
	J. T. Richeson	University of Arkansas
2010	C. Taylor-Edwards	University of Kentucky

JOSEPH P. FONTENOT STUDENT TRAVEL SCHOLARSHIP RECIPIENTS

2016	D. Price	University of Florida
2015	B. Littlejohn	Texas A&M University
	K. Sharon	Texas Tech University
2014	S. DeGeer	Auburn University
2013	L. Jury	Mississippi State University
	D. Price	University of Florida
2012	A. Mays	University of Arkansas

GRADUATE STUDENT PAPER AWARD RECIPIENTS

2016	C. L. Bayliff	Oklahoma State University
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2015	K. Sharon	Texas Tech University
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2013	P. Moriel	University of Florida
2012	L. M. Wiley	Texas A&M University
2011	L. A. Smith	Tennessee State University
2010	J. S. Fry	North Carolina State University
2009	S. J. Winterholler	Oklahoma State University
2008	S. L. Hansen	North Carolina State University
2007	P. Williams	Texas A&M University-Kingsville
2006	L. R. Legleiter	North Carolina State University
2005	M. Bowman	University of Arkansas
2004	E. G. Brown	Texas A&M University
2003	C. Realini	University of Georgia
2002	J. A. Parish	University of Georgia
2001	J. Montgomery	Texas Tech University
2000	M. R. Stivarious	University of Arkansas
1999	T. E. Engle	North Carolina State University
1998	C. Barnett	University of Tennessee
1997	D. H. Crews, Jr.	Louisiana State University
1996	*Not Given*	
1995	E. B. Kegley	North Carolina State University
1994	R. D. Coffey	University of Kentucky
1993	D. K. Bishop	Oklahoma State University
1992	R. L. Stanko	North Carolina State University
1991	G. A. Rohrer	Texas A&M University
1990	K. A. Meurer	Mississippi State Univ.
1989	G. M. Davenport	University of Kentucky
1988	M. J. Esteinne	University of Georgia
1987	T. W. Burnell	University of Kentucky
1986	M. J. Wylie	Texas A&M University
1985	M. W. Richards	Clemson University
1984	J. C. Betts	Texas A&M University
1983	J. B. Lutz	University of Georgia
1982	K. R. Pond	Texas A&M University
1981	L. W. Greene	Virginia Tech University
1980	D. K. Aaron	University of Kentucky
1979	T. W. Robb	University of Kentucky
1978	E. F. Gray	University of Kentucky
1977	T. A. Puglisi	University of Georgia
1976	D. L. Thomas	Oklahoma State University
1975	J. C. Cornwell	Louisiana State University
1974	D. M. Hallford	Oklahoma State University
1973	A. C. Mills	University of Florida
1972	C. McLellan, Jr.	Oklahoma State University
1971	C. L. Fields	University of Kentucky
1970	A. R. Bellve	North Carolina State University
1969	W. L. Brown	Auburn University
1968	W. E. Powell	Auburn University
1967	F. W. Bazer	North Carolina State University
1966	D. G. Ely	University of Kentucky
1965	R. D. Goodrich	Oklahoma State University
1964	C. K. Vincent	North Carolina State University
1963	C. B. Ramsey	University of Tennessee
1962	J. R. Crockett	University of Florida

UNDERGRADUATE STUDENT PAPER AWARD RECIPIENTS

2016	F. W. Pohlman	University of Arkansas
2015	T. Rocha	Texas A&M University
2014	K. M. Doran	Berry College
2013	A. Arellano	Texas A&M University
2012	W. B. Smith	Auburn University
2011	J. Tyus	Tennessee State University
2010	W. N. Tapp III	University of Arkansas
2009	C.M. Ballou	North Carolina State University
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2007	K. Starkey	University of Arkansas
2006	D. Sykes	Mississippi State University
2005	N. Burdick	Texas A&M University-Kingsville
2004	J. L. Roberts	Oklahoma State University
2003	M. Seitz	Mississippi State University
2002	B. Spader	University of Missouri
2001	R. Horsley	Virginia Tech University
2000	B. Robbins	Virginia Tech University
1999	J. L. Bardugone	Virginia Tech University
1998	S. F. Flohr	Virginia Tech University
1997	T. M. Weick	Louisiana State University
1996	K. J. Goodson	Texas A&M University
1995	B. C. Bloom	Auburn University
1994	B. Good	Oklahoma State University
1993	C. J. Kirby	North Carolina State University

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