

11 Molecular genetic mapping of imprinted QTL for gestation length in *Bos taurus* x *Bos indicus* cross cattle produced by embryo transfer. Ikhide Imumorin^{1,4}, Dirk-Jan De Koning², James Sanders¹, Scott Davis¹, Johan van Arendonk², JongJoo Kim^{1,3}, and Jeremy Taylor¹, ¹Texas A&M University, College Station, TX USA, ²Wageningen University, Wageningen, The Netherlands, ³University of Liege, Liege, Belgium, ⁴Valdosta State University, Valdosta, GA.

A genome-wide search of quantitative trait loci (QTL) affecting gestation length (GESL) in beef cattle was undertaken using 614 F2 and backcross Angus x Brahman cattle according to the standard line-cross regression interval mapping procedure combined with a model modified to estimate parent-of-origin (imprinting) effects. The study was done with a crossbred cattle population produced by surrogate dams using multiple ovulation and embryo transfer (MOET) and a sex-averaged map based on 414 microsatellite DNA markers spanning 2645 cM or 95% of the bovine genome. Results did not show any significant genome-wide Mendelian QTL effects but revealed two maternally expressed QTLs of modest effects on chromosomes 11 and 16 influencing GESL ($P < 0.01$), and the estimated additive effects showed increases of 4.4 days and 4.1 days respectively. Although little is known of imprinted genes in cattle, the putative conservation of imprinting on Bta11 was supported by correspondence to imprinted homologues in human and mouse genomes and point to the existence of imprinted genes in these regions that may influence GESL. We hypothesize further that the use of recipient dams genetically unrelated to the calves in the MOET program, may exert influences that modify gene expression during fetal development with possible concomitant effects on the physiological signals for the onset of parturition.

Key Words: Genomic Imprinting, Imprinted QTL, Gestation Length

12 Reproductive and maternal performance of F1 Brahman-, Senepol-, and Tuli-Angus cows bred to Charolais bulls as 3- to 8-yr-olds. D. G. Riley¹, C. C. Chase, Jr.¹, T. A. Olson², A. C. Hammond³, and S. W. Coleman¹, ¹USDA, ARS, STARS, Brooksville, FL, ²University of Florida, Gainesville, ³USDA, ARS, SAA, Athens, GA.

Reproductive and maternal performance of 3- to 8-yr-old crossbred cows ($n = 126$) sired by Brahman (B), Senepol (S), and Tuli (T) bulls and out of Angus cows were compared. Cows were born in 1993 and 1994; they were exposed to Angus bulls for their first calves. After their first calves were born, they were exposed to Charolais bulls to calve in the spring of each year (1996 to 2001; $n = 640$). Model effects included (when significant) year, cow age, calf age at weaning, and breed. Random effects were sire of cow within breed and cow within both sire and breed. Birth weight of calves from S crossbreds (38.4 kg) was heavier ($P < 0.05$) than that of calves from B and T crossbreds, 34.9 and 35.9 kg, respectively (SE = 0.9 kg). Weaning weight, hip height, and body condition score of calves born to B crossbreds (268.9 \pm 4.0 kg, 114.7 \pm 0.6 cm, and 6.3 \pm 0.04) were greater ($P < 0.05$) than that of calves born to S (245.0 \pm 4.2 kg, 111.6 \pm 0.7 cm, 6.1 \pm 0.04) and T (233.4 \pm 4.0 kg,

110.4 \pm 0.7 cm, and 6.2 \pm 0.04) crossbred cows. Brahman crossbreds had a higher ($P < 0.01$) percentage of unassisted births (98.7 \pm 2.3%) than did T crossbreds (91.7 \pm 2.2%). Senepol crossbreds had lower ($P < 0.05$) calf crop born and weaned (76.9 \pm 3.3%, 70.2 \pm 3.8%) than B (89.0 \pm 3.0%, 86.1 \pm 3.7%) and T (94.7 \pm 3.0%, 86.5 \pm 3.5%) crossbred cows. Calf survival to weaning was 96.2 \pm 2.1%, 91.2 \pm 2.4%, and 91.1 \pm 1.8% for B, S, and T crossbreds, respectively. A significant breed \times year interaction for calf crop born and weaned was evidenced by lower ($P < 0.001$) calf crop born and weaned means for S crossbreds in 1998, 1999, and 2001, and lower ($P < 0.001$) calf crop born and weaned for B crossbred cows in 1999. Weaning weight per cow exposed for B, S, and T crossbreds was 223.0 \pm 8.5, 162.8 \pm 9.2, and 197.1 \pm 7.7 kg; all means differed ($P < 0.05$). Performance of T, but not S, crossbred cows was similar to B crossbreds except for lower calf survival rate and weaning weight.

Key Words: Brahman, Senepol, Tuli

13 Evaluation of F1 cows sired by Brahman, Boran, and Tuli for reproductive and maternal performance. K.L. Key¹, A.E. Ducoing², J.O. Sanders¹, and D.K. Lunt¹, ¹Texas A&M University, College Station, ²Universidad Nacional Autonoma de Mexico.

Birth weight (BW) ($n=846$) and weaning weight (WW) ($n=792$) of their calves, calving rate (CR) ($n=966$), weaning rate (WR) ($n=960$), and cow's weight at palpation (PW) ($n=1,124$) were evaluated from 1994 to 2001 in 143 F1 cows sired by Brahman (B), Boran (Bo), and Tuli (T) bulls and out of Hereford and Angus cows. The fixed effects of sire breed of dam, dam breed of dam, and calf's birth year/age of dam and the random effects of dam's sire within sire breed and dam within dam's sire within sire breed were included in the model used to evaluate CR, WR, and PW. The additional effect of calf's gender was added to the previous model to evaluate BW and WW. All two-way interactions were tested for significance. Calf's birth year/age of dam was important for all variables ($P < 0.05$). Adjusted means for BW for calves out of cows by B, Bo, and T sires were 35.53 \pm 0.31, 34.78 \pm 0.48, and 35.49 \pm 0.41 kg, respectively, and were not different ($P > 0.05$). Adjusted WW means of calves out of B, Bo, and T sired cows were 229.6 \pm 2.3, 214.6 \pm 3.0, and 200.4 \pm 2.5 kg, respectively. Calves out of B sired cows were heavier ($P < 0.05$) than those out of Bo and T sired cows. Calves out of Bo sired cows were heavier ($P < 0.05$) than those out of T sired cows. Male calves had higher values ($P < 0.05$) than females for both BW and WW. CR adjusted means for B, Bo, and T sire breeds were 0.863 \pm 0.016, 0.927 \pm 0.020, and 0.890 \pm 0.017. The Bo sire group mean was higher ($P < 0.05$) than the B sire group. The adjusted means for WR were 0.808 \pm 0.019, 0.874 \pm 0.024, and 0.837 \pm 0.020 for B, Bo, and T sire breeds, and no differences ($P > 0.05$) were found among them. Adjusted means for PW in mature cows (8 and 7 years of age, respectively, for the cows born in 1992 and 1993) were 600.7 \pm 7.4, 513.7 \pm 9.7, and 512.9 \pm 8.2 kg for B, Bo, and T sired groups, with cows sired by B heavier ($P < 0.05$) than cows sired by the other breeds.

Key Words: Brahman, Boran, Tuli

Extension

14 RE-Cycle: recipe for waste-free swine production. T van Kempen¹, J Koger¹, P Burnette¹, D Ali¹, J Spivey¹, A Wossink¹, A Fassbender², and P Loeffler³, ¹North Carolina State University, ²ThermoEnergy, ³Sam Houston State University.

A novel swine production system was developed that has the potential to be profitable while substantially reducing waste. At the basis is a modified housing design. Instead of urine and feces mixing in a pit, they are collected separately using an inclined conveyor belt placed in the pit. With the belt sloped 4%, urine (1.5 \pm 0.4 l per pig per day, data for 80 grower pigs) runs off the belt into a collection gutter, which takes it out of the building into a closed storage container. Subsequently, ammonia is extracted by chemisorption using a zinc-sulfate column. Efficiency of ammonia extraction was 99.7% when the column is first used, decreasing to 90% as the column became saturated, at which time the column is regenerated and ammonia is recovered. This ammonia is then processed into ammonium sulfate fertilizer. Feces are passively dried on the belt and are harvested at 6 am each day at 54 \pm 9% dry matter.

On a dry matter basis, 17 \pm 2% of feed consumed was harvested as feces. Cross-contamination of the urine and feces was estimated at less than 1% based on mineral profiles. As a result of separating urine and feces, ammonia emission was 1.0 \pm 0.2 kg per pig place per year. Dried feces can be converted to green energy using a steam reforming gasifier. Feasibility tests carried out in conjunction with MTCI (MD) and EPI (ID) showed that fecal material performed well as a gasifier feedstock. Tests with a gasifier built by BK Technologies (CO) yielded a product gas with 28% H₂, 25% CO, 23% alkanes, 11% N₂, and 12% CO₂. This product gas can be used for the production of electricity or for chemical synthesis of diesel or ethanol. Ash derived from gasification contains approximately 11.5% Ca and 13% P. The solubility of these minerals at pH 2 was 79 \pm 0.2 and 85 \pm 0.6%, respectively. Digestibility for P in vivo was 88 \pm 2.7% of that of dicalcium phosphate. Thus, this ash may be used as a feed ingredient in pig diets. In summary, the RE-Cycle

system addresses environmental concerns that face the swine industry while supplying green, or renewable, energy.

Key Words: Swine, Manure, Belt

15 Growth performance in weanling pigs fed diets with elevated copper levels from two copper sources. A. F. Harper^{*1}, W. A. Selby¹, C. M. Wood¹, M. J. Estienne¹, J. P. Fontenot¹, and L. A. Kuehn¹, ¹*Virginia Polytechnic Institute and State University*.

Crossbred weanling pigs (n = 210, 18 to 27 d of age) were used in a growth experiment to determine response to elevated dietary copper from an organic copper complex (BioPlex[®] copper, Alltech Inc., Nicholasville, KY) or copper sulfate. Pigs were assigned from groups based on weight, ancestry and sex to five dietary treatments including: a diet with no added copper beyond that provided in the trace mineral premix (control), a diet with 100 ppm added copper from BioPlex (BP-100), a diet with 200 ppm added copper from BioPlex (BP-200), a diet with 100 ppm added copper from copper sulfate (CS-100), and a diet with 200 ppm added copper from copper sulfate (CS-200). Each of nine treatment replications consisted of two pens assigned to the control diet and 1 pen assigned to each elevated copper treatment. Four pigs were housed in each pen except for one replication with three pigs per pen. Diet complexity and nutrient density were adjusted in three phases over the 5-wk trial. Feed and water were available ad libitum. During wk 1 post-weaning, pigs fed elevated dietary copper grew faster and more efficiently than those fed the control diet (P < 0.04). During wk 1 ADG was 167, 208, 189, 172, and 219 g (SD = 41) and gain/feed was 0.58, 0.67, 0.60, 0.62, and 0.70 (SD = 0.1) for the control, BP-100, BP-200, CS-100, and CS-200 treatments, respectively. There was a copper source by dietary level interaction (P < 0.04) during wk 1 in which the greater copper response for ADG and gain/feed with the BP source was with 100 ppm added copper but the greater response with the CS source was with 200 ppm added copper. By the end of the 5-wk trial, there were no significant responses (P > 0.08) to elevated dietary copper. Mean ADG for the total 5-wk period was 454, 484, 468, 463, and 460 g (SD = 43) and gain/feed was 0.59, 0.61, 0.60, 0.61, and 0.58 (SD = 0.03) for the control, BP-100, BP-200, CS-100, and CS-200 treatments, respectively. Elevating dietary copper was effective in promoting growth in pigs during the first wk after weaning and a lower level (100 ppm) was more effective from the BP copper source than from the CS source. However, for the overall 5-wk trial, performance was similar across treatment groups.

Key Words: Pigs, Copper, Performance

16 The Kentucky "Master Cattleman" program. R. Burris^{*}, L. Anderson, J. Bicudo, D. Bullock, J. Henning, J. Johns, G. Lacefield, L. Meyer, B. Mikel, and P. Scharko, *University of Kentucky*.

The Kentucky "Master Cattleman" program is a multi-disciplinary Extension education program for cattle producers which is delivered by the University of Kentucky. It is funded with a grant of \$249,000 from state tobacco settlement monies through the Kentucky Beef Network. Extension associates were hired to coordinate the development and delivery of the program and to develop graphics and presentations. Subject matter specialists were responsible for content of the program. A pilot program was conducted in one multi-county area in 2000 with 35 producers and 3 areas in 2001 with 105 producers. It was re-worked and expanded to 12 multi-county groups of 420 cattle producers in 2002. Eleven 4-hr training sessions were developed complete with instructional CD's and notebooks for support material. These sessions consisted of (1) management skills, (2) forages, (3) nutrition, (4) facilities and animal behavior, (5) environmental stewardship and industry issues, (6) genetics, (7) reproduction, (8) herd health, (9) end product, (10) marketing and profitability, and (11) an optional "hands-on" session for each group. Program delivery has been through Extension specialists or other Extension personnel which received training by specialists. This program will be expanded to 15 multi-county locations across Kentucky in 2003 based on additional producer interest.

Key Words: Extension, Beef, Training

17 Using a value-added study tour and workshop to develop county based Integrated Resource Management programs. K. D. Bullock^{*}, L. H. Anderson, W. R. Burris, J. C. Henning, P. B. Scharko, W. B. Mikel, D. W. Shepherd, J. Akers, J. Hunter, and A. Smith, *University of Kentucky*.

Beef cattle Integrated Resource Management (IRM) is a large part of many states' beef producer educational program. How IRM is incorporated into a state's program is varied from state to state. In Kentucky, the IRM program is primarily an educational program that is focused on empowering producers with the tools necessary to make a difference in the cattle industry nationally, statewide, locally and at home. One program that is used for this purpose is a Value-added Study Tour. This is a multi-tiered program that begins with a commitment by the county agriculture agent to participate in an eleven day intensive in-service training on all aspects of beef cattle production. At the completion of the training the agent distributes a beef production survey in their county to collect baseline information on the dynamics of the county's beef herd and practices used. The agent then selects two potential or existing beef leaders within the county to participate in the tour and workshop. Additionally, the Family and Consumer Sciences agent from each county is invited to participate and is offered an in-service training on the basics of beef production and terminology. The number of county teams for each tour is limited to twelve to ensure good communication and some individual attention. Extension faculty from Animal Sciences, Agronomy, Ag Economics, Ag Engineering and Vet Sciences actively participate in the tour and workshop. The tour portion of the program is centered around value-added concepts, that includes working examples of delivery from farm to plate. The workshop portion is designed to get the county groups working together to improve the beef industry as a whole and within to develop a customized IRM program for their respective counties. The county programs are focused on the needs identified in the base-line survey. Forty two county teams have participated in this tour and workshop. Over 75% of those counties have developed county IRM programs that are focused on improving the profitability of the county's beef producers. Additionally, the Kentucky Cattlemen's Association adopted the ideas developed at the first two study tours to develop their plan for enhancing the state's beef production through the tobacco settlement funds.

Key Words: Beef, Integrated Resource Management, Educational Program

18 The Louisiana Calf-to-Carcass Program: Influence of sire breed. H. D. Chapman, J. E. Devillier^{*}, and D. E. Franke, *Louisiana State University Agricultural Center*.

The Louisiana Calf-to-Carcass Program was initiated in 1991 and is administered by the LSU Agricultural Center Cooperative Extensive Service. A total of 1,533 fall weaned feeder steers were processed through the program from 1992 to 1998. Steers were assembled at three locations within the state for shipment to a commercial feedlot. Upon arrival at each location, steers were identified, weighed, assigned a feeder calf grade, and breed of sire recorded. Of interest in this report is the influence of breed of sire on feedlot and carcass traits. Sire breeds represented were Angus, Hereford, Simmental, Limousin, Gelbvieh, Braunvieh, Charolais, Brahman, Beefmaster, Brangus, and Braford. Because of small numbers of steers sired by several of the sire breeds, steers were grouped into British- (24%), European- (44%), and American-sired (24%) groups (8% unknown). Growth and carcass traits were analyzed with a linear fixed model that included year, location, and breed group of sire. Interactions were not important. Averages for all steers were 268 kg for initial weight, 1.4 kg/d for average daily gain, 347 kg for carcass weight, 84.8 cm sq for ribeye area, 1.1 cm for fat thickness, average Slight for marbling score, and 2.7 for yield grade. Sire breed group influenced (P < .01) variation in ribeye area, fat thickness, yield grade and marbling score. European-sired steers had 4.5 and 3.6 cm sq greater ribeye area (P < .01), .46 and .49 lower yield grade (P < .01), and .25 and .31 cm less fat thickness (P < .01) than American- and British-sired steers, respectively. British-sired steers had 15 and 14 higher marbling score points (P < .01) than American- and European-sired steers, respectively. These data suggest European sires produced higher yielding carcasses and British sires produced higher quality carcasses. Overall, yield traits appear acceptable but carcass quality is below industry standards.

Key Words: Beef Cattle, Sire Breeds, Carcass Traits

19 Using advanced reproductive technology to determine estrus in estrous-synchronized beef heifers. T.W. Wilson*¹, J.E. Rossi², and M.E. Pence², ¹University of Georgia, Statesboro, ²University of Georgia, Tifton.

In an effort to utilize advanced estrous-detection technology at the University of Georgia's Heifer Evaluation and Reproductive Development (HERD) program, the computerized estrous-detection tool HeatWatch[®] (HW) was utilized. Yearling heifers were fed to reach 65% of their mature weight at 15 mo, estrus was synchronized using a melengestrol acetate (MGA[®])/Lutalyse[®] protocol, and were bred by AI. Heifers were divided into two groups and were bred 2 d apart to facilitate efficient use of labor at breeding (Group 1, n=87; Group 2, n=86). Transmitters were applied to heifers immediately after receiving an injection of Lutalyse and data were recorded for the duration of the AI breeding season. Standing heat reports were printed twice daily to identify heifers that had exhibited signs of estrus. Group 1 had 58 (66.7%) heifers determined in estrus by HW and confirmed pregnant from 1st service AI, with 52 (59.8%) of these heifers bred by h 120. A total of 11 (12.6%) heifers were detected and bred on 2nd service AI by HW. Group 1 had a total of 69 (79.3%) heifers confirmed pregnant by AI. Fourteen (16.1%) heifers were detected in estrus by HW but did not settle to AI, and 4 (4.6%) heifers were not detected by HW in estrus. Group 2 had fewer heifers (47; 54.7%) detected in estrus by HW and a lower synchronization rate (40; 46.5%) by h 120 compared to Group 1. Eight (9.3%) heifers were detected in estrus and bred on 2nd service AI by HW. Group 2 had a total of 55 (64%) heifers confirmed pregnant by AI that were detected in estrus by HW. Twenty-one (24.4%) heifers determined in estrus by HW were not pregnant to AI, and 3 (3.5%) heifers were not detected in estrus. In Group 2, 7 (8.1%) heifers were determined in estrus and bred from visual observation without detection by HW, with 4 (4.7%) settling to AI. These results of this demonstration indicate that the computerized estrous-detection tool HeatWatch[®] is a useful tool that can be used to detect estrus in estrous-synchronized beef heifers.

Key Words: Estrous detection, Heifers, Artificial Insemination

20 Effect of Brahman-influence on cattle grazing fescue pastures. R. Burris*, L. Anderson, D. Bullock, P. Scharko, and J. Randolph, University of Kentucky.

Forty Angus-based cows with varying amounts (0, 3/16 or 3/8) of Brahman breeding were allotted to either low (<5%) or high (>95%) endophyte infected fescue pastures. Objectives of the 3-year trial were to study the effect of Brahman breeding on (1) cow-calf performance on fescue pastures and (2) feedlot performance of calves with varying levels of Brahman-influence. Cows were bred to Hereford bulls which were rotated among the two pasture groups at weekly intervals during the breeding season. Pregnancy rates tended to be higher for cows on low endophyte (LE) pastures but did not differ (P<.10). Cows of 3/8 Brahman breeding tended to calve later (avg. birthdate March 17 vs. March 6) than those with no Brahman breeding. Actual weaning wt was higher (P<.05) for calves on LE with no Brahman-breeding than for all calves on high endophyte (HE) pasture, with calves of Brahman breeding on LE being intermediate. Adjusted weaning wts (AWW) were lower (P<.05) for HE than LE calves. Calves on HE pasture from 0 Brahman cows had lower AWW (P<.10) than calves from 3/8 Brahman cows (227 vs. 243 kg). Steer calves from the resultant matings did not differ (P<.10) in feedlot performance or carcass characteristics.

Key Words: Brahman, Fescue, Endophyte

21 Survey of production and marketing practices of cattle producers in the Southeastern United States. J.E. Rossi*¹, M.E. Pence, and R.C. Lacy, ¹University of Georgia, Tifton.

A survey was completed by 293 beef cattle producers from 17 states at the Sunbelt Agricultural Exposition at Moultrie, GA on October 16, 17, and 18, 2001. Questions were asked pertaining to herd size, production practices, and marketing strategies. Producers operations were divided into categories by herd size, which was identified by the number of breeding-aged females (less than 25, 25 to 75, 76 to 199, and 200 or more). Producers operations were primarily cow/calf (77%) with fewer than 200 breeding-aged females. A controlled breeding season was used by 67% of producers and did not differ (P > 0.68) by herd size. Producers that individually identified cows was greater (P < 0.01)

for producers with 76 to 199 (82%) and > 200 (93%) breeding-aged females compared with 63 and 67% for producers with <25 and 25 to 75 breeding-aged females; respectively. Percentage of producers that vaccinated for respiratory diseases was greater (P < 0.01) for producers with > 200 breeding-aged females (89%), and similar (P > .05) for producers with < 25 (60%), 25 to 75 (53%), and 76 to 199 (69%) breeding aged females. Most producers (58%) marketed cattle a few at a time at an auction barn and did not differ (P = 0.08) among herd sizes. The percentage of producers retaining ownership of calves throughout the backgrounding and finishing phase was greater (P < 0.01) for producers that had greater than 200 breeding-aged females (3, 3, 9, and 28% for producers with <25, 25 to 75, 76 to 199, and > 200 breeding-aged females; respectively). Approximately one-third of producers surveyed are not using recommended management practices such as individual identification, a controlled breeding season, and completion of pre-condition procedures. Omission of these management practices will limit profitability in value-based production systems that require cattle to be produced to exact specifications.

Key Words: Survey, Cattle, Marketing

22 Overview of West Nile Virus in horses in Tennessee. O. F. Harper*, F. Hopkins, and E. L. Tipton, The University of Tennessee.

West Nile Virus (WNV), an encephalitis, is a new viral disease that first appeared in the United States in 1999. It can infect birds, humans and horses. WNV is transmitted by mosquitoes from wild birds to non-infected birds, humans and horses. Humans and horses are incidental but dead-end hosts. In three years, West Nile Virus has spread from the East coast to the West coast. A multi-faceted Extension program was initiated in 2001 to educate and keep Extension agents, horse owners, agribusiness leaders and the general public abreast of the current status of WNV in horses in Tennessee. WNV was first diagnosed in Tennessee in 2001 in wild birds and one horse. As of mid-October 2002, 109 horses and more than 760 birds have been diagnosed positive for WNV in the state. Thirty horses have died or have been euthanized. Six human deaths have also occurred from WNV. There is no treatment for WNV. The USDA has conditionally approved a WNV vaccine for horses. A five-point Extension program was developed in 2002 for Tennessee horse owners: 1) Do not panic; 2) Be aware of clinical signs of WNV so horses can be monitored and tested; 3) Consider vaccinating in consultation with your veterinarian; 4) Eliminate mosquito breeding areas around horses; and 5) Use labeled, effective insecticides on horses and facilities. Extension agents have been kept updated on the WNV situation by periodic e-mails noting the county location of WNV-positive birds and horses and by articles in the Department of Animal Science Update, an in-house, monthly publication. A WNV Webpage was developed as a part of the Department of Animal Science Website at <http://www.agriculture.utk.edu/ansci>. More than 10,000 brochures about the WNV facts for horse owners have been distributed to 56 county Extension offices, the Tennessee Department of Agriculture and the USDA Veterinary Service in Tennessee. Other farm animal owners have expressed concern about WNV. While other farm animals may become infected by mosquitoes, there is no current evidence that they become clinically sick or have a role in the proliferation of WNV.

Key Words: Equine, West Nile Virus, Tennessee

23 Impact of a new livestock program for youth in Worth County, Georgia. H.M. Harris*¹, W.R. Getz², and T.E. Cary¹, ¹University of Georgia, Sylvester, GA, ²Fort Valley State University, Fort Valley, GA.

Local extension programming is affected by change. A positive response brings vitality to extension efforts. Youth livestock projects most often involve cattle, swine, sheep and horses. At one time Worth County was a hotbed for market hog projects. With reduced availability of feeder pigs, prices becoming excessive, and expenses of other livestock projects continuing to escalate, the extension coordinator took a chance and organized a market goat program. Results have been positive. We illustrate the outcome, discuss lessons learned, and provide implementation guidelines resulting from steps into the unknown. Goats are small and easy to match with the size of the participant. They require a small amount of space and provide a meaningful livestock experience in a short time. They can be fed and cared-for without expensive facilities or equipment. Cost of animals and feed is relatively low. The

program began in 1999 with 4 exhibitors and 6 goats. It has grown to involve 33 exhibitors and 52 goats, and now represents a significant portion of all market goats and participants at the Georgia National Fair live and carcass show. Success indicators include: 1) number of program participants, 2) location of goats in suburban backyards as well as rural areas, 3) strong parental involvement while egos are kept in check, 4) involvement of a diverse clientele of various income brackets and cultural backgrounds, 5) placing in the top bracket of local and state shows using goats from commercial herds, and 6) returns on investment being reasonable. Georgia does not yet have a statewide 4-H market goat program. The agents in Worth County took bold steps to use this animal as a tool in youth development and adult education. Critical program elements include: 1) availability of good quality commercial goats, 2) reasonable and affordable prices, 3) insistence that parents be involved, 4) clinics for instruction and practice, and 5) active involvement of extension staff.

Key Words: Extension Programs, Market Goats, Youth

24 Determining the value of preconditioned feeder cattle. T.R. Troxel*, University of Arkansas Cooperative Extension Service, Little Rock, AR.

The objective of this study was to evaluate the health performance of preconditioned feeder cattle. To qualify for the preconditioned sale, cattle were weaned 45 d prior to the sale, dewormed and vaccinated for blackleg, IBR, BVD, PI3, BRSV, *Pasteurella haemolytica* and *Haemophilus somnus* 2 to 4 wk before weaning (killed vaccines). Calves were revaccinated at weaning (modified live vaccines). Bulls were castrated and all cattle were dehorned or tipped. Seventeen buyers that purchased 656 hd. Eighty-one percent of the buyers, which purchased 88% of the cattle, were surveyed. Ninety percent of the feeder cattle were transported the same day of the sale. The cattle were hauled an average of 94 ± 105.6 km, and 82% of the cattle were unloaded into a dry lot. Thirty-two percent of the buyers said they commingled the preconditioned calves with calves not preconditioned. One-third of the buyers did not treat any calves for sickness during the first two-week period after the sale whereas 66% of the buyers did. Thirty-four calves (6%) were treated for sickness during this period. Seventy-one percent of the buyers, that treated calves, treated only one or two head. One calf died of pneumonia during the first two weeks following the sale (0.2% death loss). During the second two-week period following the sale, 90% of the buyers did not treat any cattle for sickness and no calves died. Overall, 70% of the buyers reported that the preconditioned calves had less sickness than normal sale barn cattle, but 20% reported about the same sickness. Fifty-five percent of the buyers believed the preconditioned calves took to feed and water faster than sale barn cattle. When comparing ($P < 0.01$) the actual morbidity (6%) and mortality (0.2%) rates to expected morbidity (23%) and mortality (3.2%) rates, a 226 kg preconditioned calf was worth \$50 more than a "normal" sale barn calf. It was concluded that the majority of the buyers were very pleased with the cattle purchased at this sale.

Key Words: Precondition, Morbidity, Mortality

25 Assessment of timing of castration and other factors that affect performance of calves in a 45-day conditioning program. J.B. Neel*, A.E. Fisher, W.W. Gill, C.D. Lane, Jr., B.D. Sims, and M.D. Davis, University of Tennessee, Knoxville.

Cattle that were part of an existing study, comparing the performance of steers of differing body types in a conditioning program, were weighed and assigned a body condition score (BCS), a castration score (CS), a hair score (HS) and were graded either large frame (LF) or medium frame (MF) at the onset of the study. They were weighed and assigned a BCS, a CS and a HS again at day 45. The BCS system is a 1-9 scale, with 1 being thin and 9 being obese. The CS system is a 1-2 scale with a castration score 1 (CS1) being a calf castrated prior to purchase while a castration score 2 (CS2) is a calf castrated after purchase. The HS system is a 1-5 scale with 1 being a healthy coat appearance with no detectable problems and 5 being a clearly dead, brittle hair coat with discoloration. Of the 122 steers assessed, 97 were classified CS1 and 25 were classified CS2. Weight and gain data were analyzed using the MIXED procedure of SAS and differences were determined at $P < 0.05$. The CORR procedure of SAS was used to establish valid correlations at $P < 0.05$. There were no differences in initial weights of CS1 and CS2 steers. Castration score 1 calves gained 0.2 kg per day more than CS2 calves. The LF CS1 calves gained more than any other group. A valid

positive correlation was found between end weight and ADG, end weight and end BCS, end weight and BCS increase, ADG and BCS increase and BCS increase and HS decrease. A valid negative correlation was found between CS and ADG, end weight and end HS, end BCS and end HS and BCS increase and end HS. Timing of castration has a significant impact on future productivity of feeder calves. The HS system may be a valid indicator of nutritional status and subsequent performance.

Table 1.

	Initial Weight (kg)	ADG (kg)
LF	272 _A	1.16 _A
MF	255 _B	1.08 _A
CS1	264 _A	1.22 _A
CS2	264 _A	1.02 _B
LF CS1	273 _A	1.33 _A
LF CS2	271 _{AB}	1.00 _B
MF CS1	255 _C	1.12 _B
MF CS2	256 _{BC}	1.05 _B

Key Words: Feeder Calves, Castration, Hair Score

26 Effect of frame size and supplementation on performance of newly received beef steers. W.W. Gill*¹, J.B. Neel¹, C.D. Lane, Jr.¹, A.E. Fisher¹, T.M. Steen², B.D. Sims¹, M.D. Davis¹, and C.J. Richards¹, ¹University of Tennessee, Knoxville, ²Tennessee Farmers Cooperative.

Steers (141) were purchased from three sale barns over a 14-day period (day -14 to day 0) and fed a commercial receiving ration plus hay for a minimum of 8 days before initiating the experiment. After weighing on d-0, 128 steers were blocked by frame size and randomly allotted to treatment. Large frame (LF) cattle were typical of Continental/English crossbreds and medium frame (MF) cattle were typical of English breeds. Throughout the experiment, steers had free choice access to medium quality grass hay and received one of two supplemental treatments at 1% of initial body weight. Supplemental treatments consisted of a 14% CP highly digestible fiber based commercial supplement (DF) or a 1:1 mixture of an 18% CP DF and whole shelled corn (DFC), to make the diets isonitrogenous. Steers were weighed on days 0, 21 and 45 with period 1 (P1) as days 0-21 and period 2 (P2) as days 22-45. Nine steers and their respective measures were removed from study due to death or illness. Supplemental cost of gain (COG) was calculated by dividing total supplement cost by total gain. All data were analyzed using the MIXED procedure of SAS and differences were determined at $P < 0.05$. The LF pens had a higher morbidity/mortality rate than MF pens (12% vs. 3%, respectively). Initially, there was no difference in treatment weights, but LF steers were heavier than MF steers. Large frame steers gained more weight than MF steers during P2 and the entire experiment. Steers on DF gained more weight than DFC steers during the P1 and entire experiment. There were no differences in COG throughout the experiment. These data indicate that frame size and ration formulation affect performance of newly weaned cattle.

Table 1.

	Initial Weight (kg)	ADG (kg/d)	P1ADG (kg/d)	P2ADG (kg/d)	COG (\$/kg)	P1COG (\$/kg)	P2COG (\$/kg)
LF	273 _A	1.3 _A	1.5 _A	1.1 _A	0.31 _A	0.28 _A	0.41 _A
MF	255 _B	1.1 _B	1.3 _A	0.9 _A	0.35 _A	0.32 _A	0.47 _A
DF	266 _A	1.3 _A	1.6 _A	1.0 _A	0.34 _A	0.30 _A	0.50 _A
DFC	262 _A	1.1 _B	1.2 _B	1.0 _A	0.33 _A	0.30 _A	0.39 _A
LF DF	276 _A	1.4 _A	1.7 _A	1.0 _A	0.34 _{AB}	0.27 _A	0.52 _A
LF DFC	270 _A	1.2 _A	1.3 _A	1.2 _A	0.30 _B	0.29 _A	0.31 _A
MF DF	256 _B	1.2 _A	1.4 _A	1.0 _A	0.35 _A	0.32 _A	0.47 _A
MF DFC	255 _B	1.0 _B	1.2 _B	0.8 _A	0.35 _A	0.31 _A	0.48 _A

Key Words: Feeder Calves, Body Type, Supplementation

27 Effects of age at first calving and age within contemporary group on calving intervals in beef cattle. J. A. Parish*¹ and M. S. Andrews¹, ¹University of Arkansas Cooperative Extension Service.

Early age at first calving has been shown to increase the overall lifetime efficiency of a beef cow. However, many beef cattle producers manage heifers to first calve at 30 months or older instead of as 2-yr olds. In addition, many producers select heifers born earlier in the calving season as replacements since these cattle often reach heavier weights than younger contemporaries by breeding time. The objectives of the present study were to determine the effects of age at first calving and birth date within the calving season on first calving interval, second calving interval, and mature calving interval defined as the average of the third and subsequent calving intervals. Data were collected from 437 calving records spanning an 11-yr period from 1991 to 2001 at Harmony Meadows Ranch in Bee Branch, AR. Salers and Salers x Angus crossbred heifers were born at Harmony Meadows Ranch, retained as replacements, and managed under uniform conditions. Natural mating was used within controlled breeding seasons. First calving interval was longer ($P < 0.01$) in heifers that first calved at 24 months of age or less (410 ± 9 d) than in heifers that calved at 25 to 30 months of age (379 ± 9 d) or greater than 30 months of age (378 ± 10 d). No significant differences were found in second calving interval, mature calving interval, adjusted 205-d calf weaning wt, or adjusted 205-d calf wt / cow wt among these groups. There were no significant differences for age at first calving, first calving interval, or mature calving interval among heifers born in the first 30 d of the calving season, the second 30 d of the calving season, or beyond 60 d into the calving season. Second calving interval was longer ($P < 0.01$) in heifers (444 ± 15 d) born in the first 30 d than heifers born in the second 30 d (368 ± 10 d) of the calving season. These results indicate that managing heifers to calve at earlier ages may increase first calving intervals without negatively impacting subsequent calving intervals.

Key Words: Cow-calf Management, Calving Interval, Age at First Calving

28 Mineral problem provides opportunity to develop Extension model for partnerships in Tennessee. W.W. Gill*, A.E. Fisher, C.D. Lane, Jr., D.K. Joines, and J.B. Neel, University of Tennessee, Knoxville.

Over the years, progressive beef producers in Montgomery County, Tennessee observed brood cows not shedding winter hair coats and experiencing decreased reproductive rates. Extension agents and beef specialists were consulted to analyze the problem. The problem was first believed to be the result of consuming the tall fescue endophyte, *Neotyphodium coenophialum*. Since the visual symptoms (rough hair coats) were indicative of a copper (Cu) deficiency, forage analyses were made to determine mineral levels, primarily Cu and Cu antagonists (sulfur (S), iron, molybdenum (Mb)). With the help of the University of Tennessee Forage Testing Lab and the Tennessee Farmers Cooperative, a commercial laboratory conducted the mineral analysis. In 1999, 11 forage samples were collected and Cu, S and Mb averaged 6.4 PPM, 0.31% and 1.1 PPM, respectively. Twenty forage samples were taken in 2000 and Cu and S averaged 6.9 PPM and 0.25%, respectively. A grant was secured to collect forage samples over a 2-year period in order to determine if the mineral imbalance was a statewide problem. Extension agents were asked to collect 1-2 forage samples from a suspect herd in their county. In 2001, 182 forage samples were gathered from 47 counties and experiment stations. The data were reported at county meetings and field days in every region of the state. Over \$4000 was raised to support forage and blood analysis in 2002. In 2002, 72 counties and experiment stations submitted 419 forage samples. The FREQ procedure of SAS with chi-square analysis was used to determine if a yearly difference exists between the total number of samples and the number of county/experiment stations. In 2002, more samples ($P < 0.01$) were submitted from more county/experiment stations ($P < 0.03$). The interest of this program increased from 2001 to 2002 primarily because every sector played a key role in conducting the project. The cooperation between Extension agents, specialists and industry generated data that is very important and timely to the beef industry in Tennessee.

Key Words: Extension, Partnerships, Minerals, Beef Cattle

29 Mineral study reveals imbalances in Tennessee forage systems. A.E. Fisher*, W.W. Gill, C.D. Lane, Jr., D.K. Joines, J.B. Neel, and C.J. Richards, University of Tennessee, Knoxville.

A 2-year study was conducted to determine the mineral levels of Tennessee (TN) forage systems and if seasonal differences exist. Since tall fescue is the predominate forage used for pasture and hay production in TN, Extension agents across the state were asked to collect 1-2 tall fescue samples from their county in the spring and fall. These samples were taken during the first 10 days of May and August. Of the samples collected, 50 per season were determined to be from the same farm in spring 2001 (S1), fall 2001 (F1) and spring 2002 (S2). They were ground and sent to a commercial laboratory for analysis via a standard ICP analyzer system. Additionally, 15 samples from F1 and 15 samples from S2 were selected randomly for selenium (Se) analysis. All data were analyzed using the MIXED and FREQ procedures of SAS and differences were determined at $P < 0.05$. The means and associated standard errors are listed in Table 1. Copper (Cu) was marginally deficient or deficient in 74%, 84% and 100% of samples in S1, F1 and S2, respectively. Sulfur (S) was classified antagonistic to Cu in 80%, 92% and 94% of samples in S1, F1 and S2, respectively. Zinc was marginally deficient or deficient in 92%, 68% and 90% of samples in S1, F1 and S2, respectively. Potassium was classified antagonistic to magnesium in 24%, 30% and 38% of samples in S1, F1 and S2, respectively. Copper decreased across seasons while S was the highest in F1 and was higher in S2 than S1. Selenium was lower in S2 than F1.

Table 1.

	Spring Mean	2001 SE	Fall Mean	2001 SE	Spring Mean	2002 SE
Calcium, %	0.48 _B	0.02	0.55 _A	0.02	0.47 _B	0.02
Phosphorus, %	0.33 _B	0.01	0.38 _A	0.01	0.38 _A	0.01
Sodium, %	0.00 _B	0.00	0.00 _B	0.00	0.02 _A	0.00
Magnesium, %	0.21 _C	0.01	0.31 _A	0.01	0.24 _B	0.01
Potassium, %	2.65 _A	0.09	2.67 _A	0.09	2.82 _A	0.08
Sulfur, %	0.24 _C	0.01	0.31 _A	0.01	0.28 _B	0.01
Manganese, ppm	99.74 _{AB}	7.28	110.88 _A	7.28	88.48 _B	7.14
Copper, ppm	8.56 _A	0.34	6.92 _B	0.34	5.31 _C	0.33
Zinc, ppm	22.68 _A	2.89	28.14 _A	2.89	24.10 _A	2.83
Selenium, ppm	.	.	0.077 _A	0.006	0.053 _B	0.006

Key Words: Forage Minerals, Copper, Sulfur

30 Serum copper and selenium levels of selected Tennessee cattle. C.D. Lane, Jr.*¹, A.E. Fisher¹, W.W. Gill¹, J.B. Neel¹, R.B. Wilson², F.M. Hopkins¹, and F.D. Kirkpatrick, ¹University of Tennessee, Knoxville, ²C.E. Kord Animal Disease Diagnostic Laboratory.

Recent work in Tennessee (TN) has shown mineral deficiencies and imbalances in TN forages. These imbalances have been low copper (Cu), high sulfur (S) levels in spring and fall, as well as low magnesium, high potassium levels in the spring. Limited analysis has also shown low forage selenium (Se) levels. Little information is known about the blood mineral status of TN cowherds or if and to what extent a link exists between forage and animal mineral levels. Bulls brought in for the University of Tennessee Central Bull Test were weighed, assigned a hair score (HS), had body temperature (BT) measured and randomly selected to have blood drawn. Ninety bulls received in July were classified Senior and 63 bulls received in September were classified as Junior. The HS system is a 1-5 scale with 1 being a healthy coat appearance with no detectable problems and 5 being a clearly dead, brittle hair coat with discoloration. Blood serum samples were analyzed for Cu and Se (only for Senior bulls) levels by the state diagnostic laboratory. All data were analyzed using the MIXED procedure of SAS and differences were determined at $P < 0.05$. The data are listed in Table 1. The CORR procedure of SAS was used to establish valid correlations at $P < 0.05$. A valid positive correlation was found between BT and HS, BT and weight and weight and blood Se. A valid negative correlation was found between weight and blood Cu while BT and blood Cu tended ($P = 0.12$) to be negatively valid. The differences in weight, BT and HS between Senior and Junior bulls are related to age and possibly more to seasonal variation. It is recognized that serum mineral analyses are of limited value in assessing total mineral status, however the differences noted in this study warrant consideration and point toward the need for additional assessment.

Table 1.

	Senior Bulls			Junior Bulls		
	Mean	SE	Range	Mean	SE	Range
Weight, kg	365 _A	5	256-464	310 _B	6	196-428
BT, °C	40.1 _A	0.1	38.8-41.8	39.2 _B	0.1	38.6-40.6
HS	1.9 _A	0.1	1-5	1.3 _B	0.1	1-2
Copper, ppm	0.54 _A	0.02	0.32-0.78	0.56 _A	0.02	0.35-1.15
Selenium, ppm	0.09	0.03	0.03-0.19	.	.	.

Key Words: Beef Cattle, Serum, Copper

31 Evaluation of blood mineral levels of beef cows and heifers. M.S. Gadberr^{*1}, T.R. Troxel¹, and G.V. Davis¹, ¹University of Arkansas, Cooperative Extension Service.

The objective of this study was to evaluate serum mineral and whole blood Se levels to determine the occurrence of mineral deficiencies in AR beef cattle. Each herd was provided a free choice mineral supplement. Blood samples were collected from mature cows (22 farms) and replacement heifers (5 farms). Cow and heifer samples were not collected from the same farms. An average of 13 cows and 12 heifers were sampled per farm, representing 17% of the cows and 74% of the heifers. Fifty-nine heifer samples were analyzed for Ca, P, Na, K, Mg, Fe, Zn, Cu, and

Se; and 106 cow samples were evaluated for all listed minerals except for Cu (n=316) and Se (n=350). Michigan State University suggested blood levels were used to categorize samples as below adequate, adequate, or excessive. Chi-square analysis was used to determine if heifer or cow samples differed in category. Mineral levels of heifers versus cows were analyzed using farm as the experimental unit and animal within farm as the model error term. Serum Cu averaged 0.72 0.07 and 0.67 0.03 ppm for heifers and cows and did not differ (P = 0.51). Blood Se averaged 0.13 0.02 and 0.11 0.01 ppm for heifers and cows and did not differ (P = 0.46). The percent farms with heifers or cows that was adequate (80% and 54.6%) or below adequate (20% and 45.4%) for Cu was not different (P = 0.30). The percent farms with heifers or cows adequate (20% and 36.4%) or below adequate (80% and 63.6%) for Se was not different (P = 0.48). Farm averages for heifers and cows were adequate for Na and Mg and excessive for K. Calcium and P were adequate on all heifer farms but below adequate on 8.3% cow farms; however, percent heifer and cow farms adequate or below adequate were similar (P = 0.51). Zinc was adequate for all farms. Producers should provide mineral supplements containing adequate trace mineral levels and monitor and adjust intake of free choice supplements to ensure consumption.

Key Words: Beef Cattle, Copper, Selenium

Graduate Student Paper Competition

32 Exogenous γ -glutamyl cycle compound supplementation to *in vitro* maturation medium and effects on subsequent *in vitro* fertilization, culture, and viability of porcine oocytes and embryos. B. D. Whitaker^{*1} and J. W. Knight¹, ¹Virginia Polytechnic Institute and State University, Blacksburg VA/USA.

High concentrations of intracellular glutathione (GSH) enhance *in vitro* production of porcine embryos. Objectives were 1) to study the effects of γ -glutamyl cycle compound supplements to the *in vitro* maturation (IVM) medium on *in vitro* fertilization (IVF) and *in vitro* culture (IVC) and 2) to evaluate embryo viability. Porcine oocytes were matured in NCSU 23 medium supplemented with either L-cysteine (3.3 mM), L-cysteamine (150 mM), L-cysteine and L-cysteamine, L-glycine (1, 2.5, or 5 mM), L-glutamate (1, 2.5, or 5 mM), L- α -aminobutyrate (3.3 mM), β -mercaptoethanol (25 mM), L-cysteine and β -mercaptoethanol, or L- α -aminobutyrate and β -mercaptoethanol. After IVM, concentrations of intracellular GSH were determined using the DTNB#GSSG reductase recycling assay. Significant (P < 0.05) increases in GSH concentrations were observed using L-cysteine (n = 42), 1.0 mM L-glutamate (n = 109), L- α -aminobutyrate (n = 57), and L- α -aminobutyrate with β -mercaptoethanol (n = 47). Oocytes matured with L- α -aminobutyrate and β -mercaptoethanol had a lower (P < 0.05) occurrence of polyspermy during IVF compared to controls and a greater percentage (P < 0.05) of embryos reaching the blastocyst stage compared to other treatment groups. For objective 2, oocytes were matured in NCSU 23 (n = 150) or NCSU 23 supplemented with L- α -aminobutyrate with β -mercaptoethanol (n = 180). Supplementation had no effect on the time of cell death. The times at which embryo mortality was greatest (P < 0.05) were between 24 to 42 h post-IVF with the greatest occurrence around 36 h. In conclusion, supplementing 3.3 mM L- α -aminobutyrate and 25 mM β -mercaptoethanol into the IVM medium increases the intracellular GSH concentrations, decreases the occurrence of polyspermy during IVF, and increases embryo development parameters during IVC but does not have an effect on cell death during embryo development. The onset of cell death appears to occur between 24 to 42 h post-IVF with the greatest occurrence around 36 h post-IVF.

Key Words: Embryo Cell Death, Glutathione, Porcine

33 Supplementing bahiagrass hay with molasses or molasses-urea with or without soybean hulls. M. J. Kostenbauder^{*2}, S. W. Coleman¹, C. C. Chase, Jr.¹, W. E. Kunkle², M. B. Hall², and F. G. Martin², ¹USDA, ARS, STARS, Brooksville, FL, ²Univ. of Fla., Gainesville.

Two experiments were conducted to evaluate the effect of molasses or molasses-urea fed with or without soybean hulls on digestibility, intake and animal performance of cattle fed bahiagrass hay (8% CP). In exp. 1, Holstein steers were fed one of six diets: 1) hay only; 2) hay plus

molasses (0.75% BW); 3) hay plus molasses-urea (3% of molasses); 4) hay plus soybean hulls (0.75% BW); 5) hay plus soybean hulls-molasses; and 6) hay plus soybean hulls-molasses-urea. Diet digestibility was increased with added molasses (P < 0.05) or soybean hulls (P < 0.01) but estimated hay and neutral detergent fiber digestibility were depressed with added molasses (P < 0.05). Neutral detergent fiber digestibility increased with added urea (P < 0.10) or soybean hulls (P < 0.05). Acid detergent fiber digestibility increased with soybean hulls supplementation (P < 0.01), decreased with molasses (P < 0.01), and was unaffected by urea supplementation. Nitrogen absorbed and retained, as a percentage of intake, were not affected by supplementation. Concentrations of plasma urea nitrogen, non-esterified fatty acid, and blood-glucose were not affected by diets. In exp. 2, the same diets as in exp. 1 were fed to 36 beef calves in Calan headgates for 43 d (6 calves/diet). Average daily gain was improved (0.2 vs. 0 kg/d; P < 0.01) with added soybean hulls, and also with urea (0.2 vs. -0.1 kg/d; P < 0.01). Plasma urea nitrogen (PUN) was higher with added soybean hulls and urea (P < 0.01 for day 20; P < 0.10 for day 43, respectively). Molasses decreased PUN concentrations at day 20 (P < 0.01). Blood-glucose was increased by added soybean hulls (P < 0.05) and urea (P < 0.10) both on day 20 and day 43. Soybean hulls can improve gains when used to supplement marginal quality hay without depressing digestibility of hay. Molasses depressed fiber digestibility, but adding urea restored digestibility and improved gains.

Key Words: Soybean Hulls, Molasses-urea, Bahiagrass Hay

34 Effect of supplementation on nutrient digestion and retention by steers consuming bermudagrass hay. A.S. Webb^{*}, B.J. Rude, and D.G. St. Louis, ¹Mississippi State University.

Cattle consuming low quality forage often need supplementary energy. The objective of this study was to evaluate digestibility of nutrients and retention of protein and energy when supplementing corn or soybean hulls to cattle fed low-quality bermudagrass hay. Twelve steers (184 ± 14.2 kg BW) were fed in metabolism crates for 11 d. Steers were randomly assigned to three treatment groups: 1) Bermudagrass hay only (control); 2) Corn supplemented to bermudagrass hay (corn); 3) Soybean hulls supplemented to bermudagrass hay (hulls). Soybean meal was added to meet NRC protein requirements based on dietary ME content. Corn was supplemented at 0.5 % BW and soybean hulls were supplemented at 1.0 % BW. Steers were allowed *ad libitum* access to hay and consumed respective supplements once daily. Forage intake was similar (P > 0.05) for all treatments ranging between 2.06 and 2.37 kg/d (1.15 and 1.32 % BW/d). Total DMI was increased (P < 0.01) when steers were supplemented with hulls (2.37 % BW/d) compared to steers receiving control or corn diets (1.31 and 1.66 % BW/d, respectively). Both DM and OM digestibility were increased (P < 0.05) when corn