Mississippi State University

Animal and Dairy Sciences

Department Report • 2012

MISSISSIPPI STATE UNIVERSITY
College of Agriculture and Life Sciences

MISSISSIPPI STATE UNIVERSITY
EXTENSION SERVICE

MISSISSIPPI MAFES AGRICULTURAL & FORESTRY EXPERIMENT STATION

Editors: J. A. Parish, S. H. Ward, L. L. Jury

Division of Agriculture, Forestry and Veterinary Medicine
Mississippi State University
October 2012

October 11, 2012

To: Livestock Producers, Industry Leaders, Alumni, Friends of the Department and Others

The Faculty in the Animal and Dairy Sciences Department present to you this annual report in order to inform you of recent research, teaching, and extension efforts of our department and hope this report will be useful to you. This report is available on the departmental website at www.ads.msstate.edu. We encourage you to visit the ADS website often to learn more about the department of Animal and Dairy Sciences at Mississippi State University.

As you review the accomplishments reported for 2012, your input and involvement in the department are welcomed as we work to address the current and future livestock industry concerns through educational programs, research and training of students. I want to recognize and congratulate the following graduate students who have completed their program of study and graduated this past academic year: Ph.D. Life Sciences (Physiology) - Jamie Curbelo, (Dr. Ryan); Master of Science, Agriculture – Heather Duoss (Dr. Schmidt), Amanda Frahm (Dr. Hill-Ward), Landon Marks (Dr. Parish), Kevin Necaise (Dr. Ryan), Katie Pfeiffer (Dr. Larson), Daniel Smith (Dr. Hill-Ward), Amanda Youngblood (Dr. Rude), and Ellen Haas (Dr. Willard), non-thesis. We appreciate the research of each student and their faculty advisor and their scholarly contribution to the livestock industry.

This past year, we have been fortunate to welcome into our faculty Dr. Shengfa Liao, Non-ruminant Nutrition; Dr. Caleb Lemley, Reproductive Physiology; and Jessica Graves, Instructor Undergraduate Coordinator. Currently, the Department is seeking to fill additional positions for Department Head, Instructor Judging Coach, Extension Equine Specialist, and Beef Herder. We look forward to the contributions the new faculty and staff will make to accomplish the mission of our Department.

In 2013, our Department will have new leadership and with your support, our faculty and staff will remain dedicated and work hard to serve the livestock industry of our state through teaching students, research and extension livestock programs. Our Faculty appreciates the resources available to our department and the spirit of collaboration with other departments and centers at Mississippi State University. Research and extension centers are located strategically throughout the state. Animal research facilities at the Leveck Animal Research Center, Ballew Hall MSU Meat Lab, Bearden Dairy Cattle Research Center, Prairie Research Unit, Brown Loam Research Station, and the White Sands Unit give faculty opportunities to investigate the issues and challenges facing the livestock industry.

Feel free to contact individual faculty members if you have questions or desire additional information. We value your interest and support for our department and welcome you to visit the department anytime.

Mark Crenshaw, Ph. D.
Interim Department Head

Departmental Scholarships

C. E. Huntington
Department of Animal and Dairy Sciences, Mississippi State, MS

Teaching Summary

The Department of Animal and Dairy Sciences has always had the rich tradition of presenting scholarships to a large number of worthy students. Scholarships awarded for the 2012-2013 academic year were no exception due to generous alumni and former faculty members. Incoming and current students submitted applications which were reviewed and scholarships were awarded at the Animal and Dairy Sciences' Spring Banquet.

Introduction

Scholarship applicants answered a variety of questions about interests, activities, goals and academic performance. The various scholarships the department offered have a variety of specifications, so the scholarship committee worked hard to match the scholarship with the most deserving student. The majority of scholarships were awarded to current undergraduate students, but several were presented to incoming students and graduate students.

Procedures

Both incoming students and current students were eligible to apply for departmental scholarships. Application forms, located on the departmental website, were completed by students and submitted either electronically or by hard copy to the scholarship chairperson. Scholarship applications were due March 15, after that date the scholarship committee, composed of departmental faculty, reviewed and evaluated the applications. Recipients were announced at the Animal and Dairy Sciences' Spring Banquet.

Results

The department awarded over $25,000 in scholarship money to both undergraduate and graduate students. Twenty-four undergraduate scholarships and one graduate scholarship were awarded. The following list is the scholarships awarded and recipients:

- *Bryan and Nona Baker Endowed Scholarship* – Allison Vidak and Michael Pruden
- R*ev. and Mrs. William Page Brown Memorial Scholarship* – Jordan Craig
- *Miles Carpenter /Bill McGee-Higgins Endowed Scholarship* – Colby Hardin
- *Billy Gene Diggs Memorial Scholarship* – Cori Webb
- *Janice McCool Durff and Alma McCool Liles Scholarship* – Lyndsey Sen, Alexis Tentler, Samantha Eder, Molly Nail, Taylor Poe
- *Fuquay Endowed Scholarship* – Rebecca Broome

- *Henry H. Leveck Memorial Scholarship* – Liesel Grossner, Ryan Kennedy, Rachel Montgomery
- *Glenn McCullough Scholarship* – Chelsea Meyer
- *Enoch Norton Endowed Scholarship* – Taylor King, Kaitlyn Hardin
- *W. L. Buddy Richmond*- Jennifer Merkle
- *Sherry Levin Memorial Scholarship*- Emerald Barrett

Implications

Scholarships provide deserving students the funds necessary to pay tuition, purchase books and help defray living expenses. As the cost of education continues to rise, scholarships play a critical role in paying for higher education. Also, scholarships offer a way to compensate students for their hard work in the classroom and their involvement on campus.

MSU Dairy Club 2012 Activities

S. H. Ward
Department of Animal & Dairy Sciences, Mississippi State, MS

Teaching Summary

The MSU Dairy Club had a very eventful and successful year in 2012. The club participated in several collegiate events and competitions, bringing home honors for MSU at all of them.

Introduction

The MSU Dairy Club is open to all students on campus, but is made up primarily of students from the College of Ag and Life Sciences. In 2011-12, the dairy club had approximately 20 members, which has grown exponentially in the last three years. While the primary goal of the club is to provide students with extra-curricular dairy experiences, the students often participate in collegiate competitions such as North American Intercollegiate Dairy Challenge, at both the southern regional competition and the national competition. In addition, in the fall of 2011, dairy club students halter broke and prepared a show string for the Mississippi State Fair Dairy Open Show. As a member of dairy club, $5 of the $10 required dues pays for membership in the American Dairy Science Association- Student Affiliate Division. Being a member of this organization, gives student exposure to the dairy industry on a national and international stage. In the spring of 2012, dairy club students attended the ADSA-SAD Southern Regional Meeting, where they competed in undergraduate paper competitions, quiz bowl, and overall chapter activities events. In the summer of 2012, four of those students traveled to Phoenix, AZ to attend the national American Dairy Science Association meetings and interacted with dairy scientists and industry representatives from across the globe.

Procedures

Dairy Show String

About three weeks prior to the MS State Fair Open Dairy Show, the students picked both heifers and cows from the MSU Bearden Dairy Center population. The more experienced showmen worked with the lactating cows and advised and mentored less experienced students on halter breaking and fitting dairy heifers. Twelve animals in total, 4 cows and 8 heifers were transported to Jackson, MS for the fair. This was a rewarding experience for students in two ways: first, students who had dairy showing experience were able to teach others what they had learned and build lasting relationships with their classmates and second, students who had never shown livestock before gained a great deal of confidence and pride in their abilities by the time Fair arrived. This was a great team building exercise for the dairy club and they plan to do it again in the fall of 2012.

ADSA-SAD Southern Meeting

During the summer of 2011, several of the dairy club students chose to stay in Starkville and participate in undergraduate research. One dairy student, Rachel Howell, received funding from the Shackouls Honor College to complete summer undergraduate research and her fellow dairy club

colleagues opted to help her with that project. The students learned about experimental design, data collection and analysis. The objective of the study was to evaluate different types of shade on growth and performance of Holstein heifers. In preparation for the ADSA-SAD Southern Regional Meeting, the students decided to submit a paper for the Original Undergraduate Research Competition, presented by Rachel Howell. Other papers were also submitted in both the Dairy Foods (presented by Rebecca Broome) and Dairy Production (presented by Chelsea Meyer) categories. The club members also competed in the Dairy Quiz Bowl, Chapter Activities Symposium, and Overall Club Chapter evaluation sections.

Results

Dairy Show String

In October of 2011, The MSU Dairy Club took 12 show animals to the Mississippi State Fair. The club members spent many hours during the fall semester halter breaking their heifers and cows and preparing them for show. The students, several who had never shown livestock before, spent at least three hours per week and many weekends preparing their animals. The weekend before the MS State Fair, the students received expert instruction from Mrs. Joanne Nicholson of Newton, MS on proper ways to fit their dairy animals for show. The students traveled with the animals and cared for them while attending the fair. Several animals placed first in their respective age division (class): Junior Champion Holsteins; Senior Champion Holsteins; and Grand Champion Holstein who was also the Best Uddered Cow in the show.

Pictured L to R, 1st row: Rachel Howell, Sr; Kellie Kaletsch, Sr; Rebecca Broome, Jr; Chelsea Meyer, Jr; Stephanie Opp, Jr. **2nd row:** Kristin Barnett, Sr; Melissa Steichen, So; Kaitlyn Hardin, Sr; Ashleigh Thomas, Sr; Haley Kerr, Jr. **Standing:** Paige Nicholson, Sr; Patrick Hughes, Sr; Colby Hardin, Jr. Also pictured: Dairy Open Show Grand Champion.

ADSA-SAD

At the ADSA-SAD Southern Meeting, the MSU Dairy Club won first place in the Dairy Quizbowl (team: Kaitlyn Hardin, Jr; Chelsea Meyer, Jr; Ashleigh Thomas, Sr; Rachel Howell, Sr). In the undergraduate paper competitions, Rebecca Broome won first place in the Dairy Foods Division with a paper titled: Goat Milk: Changing the Game for Those with Cow Milk Allergies and Rachel Howell placed second in the Original Undergraduate Research Competition with her paper titled: Mitigating heat stress in young dairy calves. The club members are pictured below at the awards banquet, with their awards. The meeting was hosted in Raleigh, NC by the NC State Dairy Club. In the spring of 2012, the ADSA-SAD Southern Regional meeting will be hosted by the MSU Dairy Club, inviting over 150 students from the Southeast region to come and learn about the MS dairy industry.

National ADSA-SAD

Four dairy club members traveled to Phoenix, AZ in July 2012 to attend the Joint Annual Meeting of ADSA and ASAS. While there, students interacted with other collegiate dairy club chapters from all over the nation, toured a large dairy operation in central AZ, attended scientific meetings, and attended the SAD business meetings. Kaitlyn Hardin was elected President of the Southern SAD regional officer board. The students also had time to do some sightseeing and took a day trip with some of the ADS graduate students to the Grand Canyon.

Pictured L to R: Stephanie Opp, Melissa Steichen, Kaitlyn Hardin, and Chelsea Meyer at the Phoenix Convention Center, Joint Annual Meeting 2012.

Pictured L to R: Chelsea Meyer, Melissa Steichen (behind), Rebecca Broome (front), Rachel Howell, Ashleigh Thomas, Haley Kerr (behind) and Kaitlyn Hardin (front).

Pictured L to R: Melissa Steichen, So; Stephanie Opp, Jr; Babatunde Oloyede, MS student; Hector Sanchez, PhD student; Kaitlyn Hardin, Sr; Chelsea Meyer; Sr.

ADS 4990/6990 Special Topics: Advanced Horsemanship II

M. C. Nicodemus
Department of Animal & Dairy Sciences, Mississippi State, MS

Teaching Summary

ADS 4990/6990 Special Topics: Advanced Horsemanship II was offered in the 2012 spring semester at Mississippi State University as a one credit hour special topics course that was open to any undergraduate and graduate student. The course met once a week at the Horse Park for a two hour laboratory with additional time spent outside of the laboratory for the purpose of developing horsemanship skills working with various horses in different settings and working with the instructor in developing their equine teaching techniques. The nine students enrolled in the course spent the semester working on training horses for various activities and various levels of riders and developing their teaching skills for educating students in the techniques of horse handling and riding. Students were involved in lesson planning of introductory riding courses and critiquing the introductory students during their laboratories. At the end of the semester students were responsible for preparing University horses for youth horse demonstrations and less advanced horsemanship courses to be offered in the following semester.

Introduction

Over the past decade, the Mississippi State University Animal & Dairy Sciences department has offered yearly nine undergraduate equine courses including ADS 1132 Intro to Horsemanship, ADS 2102 Equine Conformation & Performance Evaluation, ADS 2122 Advanced Equine Evaluation, ADS 2212 Equine Behavior & Training, ADS 2312 Advanced Horsemanship, ADS 3223 Horse Management, ADS 3233 Equine Assisted Therapy, ADS 4112 Equine Reproduction, and ADS 4333 Equine Exercise Physiology. Only two of those courses, 6112 Equine Reproduction and ADS 6333 Equine Exercise Physiology, are split level courses so that graduate students can take the course for graduate credit. Over the years the demand for additional horsemanship courses have increased with only three courses currently offered with a riding laboratory and three other courses that are offered with some type of horse ground handling during the laboratories. Only one course focuses on the development of teaching techniques and this section of the course is limited. None of the current graduate equine courses offer any type of riding laboratory. With many of the equine students wanting to go into a career requiring some type of equine handling and several of those wanting to go into a career where they will be educating other equine students, ADS 4990/6990 Special Topics: Advanced Horsemanship II was offered at the Mississippi State University Starkville campus and taught by associate professor Dr. Molly C. Nicodemus and graduate teaching assistant Ms. Shannon Lindsey for the first time in the spring 2012 semester.

Procedures

ADS 4990/6990 Special Topics: Advanced Horsemanship II was set up as a one credit hour special topics course where the students met every week at the Horse Park for a riding laboratory. Students could select from a Tuesday or Wednesday laboratory meeting from 3:00 to 4:50 pm each week. During the two hour laboratory students discussed training goals concerning their assigned horses with their instructors and assisted with evaluation and instruction of the introductory riding students. Students were required to journal their training progress with their assigned horses as they worked to prepare their assigned horses for their introduction into other, less advanced horsemanship courses.

In addition to the riding and horse training, twice during the semester students were required to teach a full, two hour riding lesson, and thus, were required to meet with the instructors outside of laboratories to develop lesson plans and their teaching techniques. After each lesson they taught, the student teachers met with the instructors to get suggestions on how they may improve on their teaching techniques.

Additional time outside of the course was also spent training and working with younger horses at another facility on the MAFES South Farm. This additional training experience helped the students understand horse behaviors associated with age and different environmental settings. The goal of this section of the course was to prepare the younger horses for introducing them into a future ground handling course. During this section students were to teach the other members of the course a specific handling technique with each student getting evaluated by their peers on how effective their teaching techniques were.

At the end of the semester students were able to display the progress of their training of the horses they worked with throughout the semester by presenting them at the Mississippi Future Farmers of America Horse Judging Contest. The horse judging contest held at the Mississippi Horse Park and hosted by the Animal & Dairy Sciences department required Future Farmers of America youth members to judge both halter and performance classes with scores given to contestants for how well they placed the classes according to judging officials. Before the contest, students worked to prepare their horses for halter and performance classes including grooming for the specific show classes they were showing their horses in. During the event each student enrolled in the special topics course was required to handle their assigned horses as the horses were utilized during the judging contest with horse performance judged and ranked by local judging officials and the youth judging contestants.

Results

Seven undergraduate students and two graduate students were enrolled this past spring in ADS 4990/6990 Special Topics: Advanced Horsemanship II. Although ADS 2312 Advanced Horsemanship I was a prerequisite for the course, only three undergraduates and two graduate students had taken the first advanced

course, but all nine of the students had taken other horsemanship courses and had proven during those courses that they had advanced skills in handling horses and a past experience with riding lessons. Only two of the students were not working towards an Animal & Dairy Sciences degree. All of the undergraduate students were upperclassmen with five of the seven undergraduate students classified as seniors.

All students took prior to the start of the course a horsemanship confidence survey to determine the student's confidence level in performing various ground handling and riding techniques using various levels of horses and various types of horse breeds. Students scored their confidence level a number from "1" meaning *minimal confidence* to "5" meaning *strong confidence* for each technique described on the survey. While none of the students scored over 3 for their confidence in saddle breaking a horse that has never been ridden before, 100% of the students scored 3 or higher on all other questions indicating a high level of confidence for performing all aspects of the required activities for this course. Students were assigned horses according to their surveys and their past performance in other horsemanship classes.

Students were given goals on a weekly basis on what they needed to accomplish with their assigned horses to prepare these horses for other, less advanced horsemanship courses. Students worked with their assigned riding horses during the scheduled laboratory at the Horse Park, and unlike other horsemanship courses, students were allowed to work with their horses outside of the Horse Park arenas to assist in desensitizing their assigned horses to all types of stimuli. In addition, students worked outside of their laboratories with the instructors with assigned unbroke yearling stallions at the MAFES Physiology Unit at the South Farm. By the end of the semester, the students' progress with their horses was evaluated by their instructors and their peers with all students scoring above average for their success in meeting their training goals for their assigned horses. To further demonstrate the success of their training with their assigned horses, students were to present their assigned horses during the Mississippi Future Farmers of America Horse Judging Contest at the Horse Park in April. The contest was scheduled on a Friday morning at the main arena of the Horse Park with FFA youth members traveling from all over Mississippi to compete in the youth horse judging contest. Judging contestants were to judge three halter classes and two performance classes and the horses used in the special topics course were the horses judged in these classes. Students were to present their horses in the halter and performance classes for the FFA youth contestants to judge.

Students were responsible for the grooming and clipping of the horses prior to the contest in preparation for showing their horses during the contest. All of the horses were successfully shown at the contest. Students were also able to get critiqued by local judging officials that assisted with the judging contest. Critiques were all positive with minimal flaws reported such as "rough lead departures" during the canter or lope and "needing to work on a more relaxed frame" across the topline of the

Advanced Horsemanship II student preparing to present her assigned horse in a western pleasure class at the MS FFA Horse Judging Contest. Picture provided by MSU Ag Communications.

horse. FFA volunteers and coaches were also complementary towards the students and their horses with comments given such as "horses met the quality of that seen at the national judging contest" and "handler and riders were very professional". Besides training more advanced horses, what separated this course from other horsemanship courses was the opportunity to work with introductory riding courses assisting the riding instructor, and further in the semester, students were responsible for teaching two riding lessons on their own under the supervision of the instructors. Students were required to develop a lesson plan prior to their lessons and have the lesson plans evaluated by the instructors. All of the students scored high marks on their creativity, organization, and flow of their lesson plans. During the lessons, the student teachers were scored by their instructors on the safety, organization, and flow of the lesson and the students' ability to meet the goals of the lesson. Those participating in the introductory riding course were also able to provide comments and suggestions after the lesson. All student teachers scored high on the instructor evaluations and comments from the introductory students were all positive and included such remarks as "the lesson was fun" and the "approach of the student teacher made (the riders) feel at ease". The most common suggestion from the introductory students was the student teachers needed to "speak louder".

Advanced Horsemanship II students riding their horses on a trail ride through the MAFES South Farm.

Implications

ADS 4990/6990 Special Topics: Advanced Horsemanship II enabled students to develop their advanced horse handling and riding techniques and their ability to teach introductory riding lessons. While the students enrolled in the course benefited off of the instruction in horse handling and riding and in teaching techniques, the horses used in the course benefited off of the training performed by the students and FFA youth judging contestants benefited off of the quality of the class horses used in the Mississippi Future Farmers of America Horse Judging Contest. The horses used in the course will be well prepared for the horsemanship courses offered in the fall 2012 semester.

Due to the positive outcome of the students' training and teaching and the positive responses from the students

concerning their activities during the course, the course is scheduled to be proposed as a permanent course in the equine curriculum at Mississippi State University. A special topics course titled *Advanced Horsemanship III* will be offered in the following year building off of the skills and techniques covered in the current course.

Equine Teams Representing Mississippi State University

M. C. Nicodemus
Department of Animal & Dairy Sciences, Mississippi State, MS

Teaching Summary

A complementary part of the equine program at Mississippi State University is the equine extra-curricular activities that include the competitive equine teams. The equestrian and horse judging teams make the equine program at Mississippi State University unique from other Mississippi schools with the equestrian team being the longest running equestrian team in Mississippi and the only stock seat team in the state and the horse judging team boasting the only collegiate horse judging team in Mississippi and one of only a few collegiate horse judging teams in the Southeast that hold multiple grand and reserve grand championships. During the 2011-2012 show season Mississippi State University was represented by the equestrian team at four Intercollegiate Horse Show Association competitions starting in October 2011 and completing the regular season in March 2012 with the hunt seat team consisting of seven undergraduate riders and the stock seat team consisting of five undergraduate riders. As for the horse judging team, their competition this year consisted of traveling to American Quarter Horse Association World Championship Show in the fall of 2011 where the team spent four days competing in Oklahoma City, Oklahoma bringing home multiple Top Ten honors. The horse judging team consisted of five team members with four of the members being graduating seniors. Both teams consisted of undergraduates from all majors with the majority of the team members taking multiple equine courses offered by the Animal & Dairy Sciences department that assisted in preparing the team members for competition.

Introduction

Since 2001 Mississippi State University has been proudly represented at collegiate competitions each year by the equestrian team and the horse judging team, and this year was no different. The equestrian team was the first collegiate equestrian team in Mississippi and has continued to be the only collegiate team in Mississippi to compete in stock seat competitions. The equestrian team has qualified members for Regionals, Zones, Semi-Finals, and Nationals and has been the only Mississippi equestrian team to compete at a National Collegiate Athletic Association sanctioned varsity invitational horse show. It has remained throughout it's tenure a club sport competing in Region 1 of Zone 5 of the Intercollegiate Horse Show Association. This coming year the team will be moved to a new region, Region 2 of Zone 5, which includes schools from Georgia, South Carolina, and Alabama.

The horse judging team has remained the only collegiate horse judging team in Mississippi and has won multiple team and individual national

championships since 2001. It is sponsored by the Animal & Dairy Sciences department through Alumni donations and has traveled to Grand National & World Championship Morgan Horse Show, American Quarter Horse Association World Championship Show, U.S. National Arabian & Half-Arabian Championship Horse Show, National Reining Horse Association Futurity & Championship, American Paint Horse Association Intercollegiate Horse Judging Spring Sweepstakes, and National Appaloosa Horse Show & World Championship Appaloosa Youth Show. Both teams are open to any full-time undergraduate student and are coached by Dr. Molly C. Nicodemus, associate professor in the Animal & Dairy Sciences department.

Procedures

Requirements for Team Members

Tryouts are not required for either teams, but being a full-time undergraduate of Mississippi State University is a requirement. Level of experience does not deter membership as all levels of experience are accepted in both teams. Through mandatory practices under the supervision of the coach and coaching staff, team members are prepared for competitions. Equestrian team members must be active members of the Horseman's Association, an equine collegiate club. Along with attending membership meetings every other Tuesday night, active membership of the Horseman's Association also includes volunteering at the Palmer Home therapeutic riding program in Columbus, Mississippi, Dixie Nationals Quarter Horse Show at the Mississippi Fairgrounds in Jackson, Mississippi, and at the Bulldog Classic Spring Quarter Horse Show at the Mississippi Horse Park in Starkville, Mississippi; participating in the Animal and Dairy Sciences Welcome Back Picnic; and organizing fundraisers including a bake sale and horse basket raffle. In addition to active membership in the Horseman's Association, if team members are not enrolled in a University riding course, they must practice with local trainers that are selected members of the coaching staff. Team members do not have to own a horse or own their own tack as they practice with either school or trainer horses, and at competitions, the host college provides the horses and tack.

Stock seat team members Amanda Havard and Emma Stamps volunteering at the Palmer Home therapeutic riding program. Picture provided by Tim Methvin.

As for the horse judging team, team members are required to enroll in a horse judging course, ADS 2102 Equine Conformation & Performance Evaluation, ADS 2122 Advanced Equine Evaluation, or ADS 4990 Directed Individual Study in Advanced Horse Judging Techniques. During the course, judging team members practice judging various horse show classes using school horses and horses from local training barns. Team members practice giving oral reasons that explain their ranking of the horse show classes.

Both teams participate in a mock competition prior to the start of the

competition season that is hosted by local barns. During the mock competition, team members are required to go through the competition practice as if they were at a true competition and are judged by local equine experts. This year's mock competition for the equestrian team was hosted by local trainer Betsy Ball at her training facilities, Rosebud Stables, and the horse judging mock competition was organized by assistant coach Amanda Youngblood at C-Bar Stables, a local horse boarding facility.

The Competition Process

The coach and coaching staff determine a team member's readiness for competition and select competitions that the teams will attend. As the coach of both the hunt and stock seat teams, Dr. Nicodemus was assisted by undergraduate team captains Emerald Barrett, Samantha King, Katie Downs, and Tara Trask and by local trainers Betsy Ball and Patrick First in preparing equestrian team members for this year's competitions. The horse judging team, coached by Dr. Nicodemus, also benefited off of the coaching of assistant coaches Shannon Lindsey and Amanda Youngblood, both former members of the horse judging team and current graduate students in the Animal & Dairy Sciences department. Both Ms. Lindsey and Mrs. Youngblood have assisted with the horse judging team for several years after graduating with their undergraduate degrees in Animal & Dairy Sciences and finished off their coaching careers at Mississippi State University this year as they completed their Masters of Science degree.

The teams travel with the coach or the coaching staff to their competitions. Team members at competitions work to gain both points for team and individual awards. Hosts of the competitions provide the supplies including the horses and equipment with team members only required to provide their own competition attire.

Results

Both equine teams brought home numerous awards as they proudly represented the University outside of the state of Mississippi. The equestrian team competed at both hunt and stock seat competitions this year. The hunt seat team traveled to two shows hosted by Sewanee: The University of the South in Sewanee, Tennessee and Maryville College in Maryville, Tennessee with both shows being two day shows. The team brought home a total of one 2nd place ribbon, one 3rd place ribbon, five 4th place ribbons, two 5th place ribbons, and two 6th place ribbons. The hunt seat team was ranked in the Top Ten for Region 1 of Zone 5 of the 2011-2012 hunt seat show season.

Hunt seat team member Nikki Jacoutot in her over fences class during the fall show season.

The stock seat 2011-2012 competition season was dedicated to former member Shauna Burton. Ms.

Burton was a member of the stock seat team proudly representing Mississippi State University last year where she won 1st place in the walk/trot division at her first show as a team member. Ms. Burton lost her battle with cancer last summer before the start of the competition season, but her memory lived on in her team members. The stock seat team traveled to two shows hosted by Murray State University in Murray, Kentucky and Middle Tennessee State University in Murfreesboro, Tennessee with both shows being two day shows. The team brought home a total of one 2nd place ribbon, two 4th place ribbons, four 5th place ribbons, and one 6th place ribbon. The stock seat team was ranked in the Top Ten for Region 1 of Zone 5 of the 2011-2012 stock seat show season.

Stock seat team members (left to right): Amanda Havard, Emerald Barrett, Rebecca Duke, Emma Stamps, and Samantha King.

The horse judging team continued the winning tradition as they traveled to the American Quarter Horse Association World Championship Show this past November in Oklahoma City, Oklahoma. This was the first time since 2001 that the Mississippi State University horse judging team has competed at an AQHA sanctioned collegiate horse judging competition. The team was named Top Ten Finalist in every category of the limited division ranking 7th in the Overall division, 5th in the Reasons division, 7th in the Performance division, and 7th in the Halter division. Individual team member Sarah Taylor ranked 9th in the Performance category of the individual limited division.

Horse judging team member Brianna Tisdale competing at AQHA World Championship Show.

Implications

While last year demonstrated great success for the equine teams, the 2012-2013 competition season promises to bring additional successes for Mississippi State University. The equestrian team will be headed by some new faces this coming year with pre-vet student Emerald Barrett taking over as head captain of the team and PhD candidate Toree Bova taking over as assistant coach of the team. Ms. Bova is the former assistant coach of the Missouri State University equestrian team in Springfield, Missouri. She recently accepted a teaching assistantship position at Mississippi State University Animal & Dairy Sciences department where she will be assisting with the equine courses and

helping with the coaching responsibilities of the equestrian and horse judging teams. This year will also mark the beginning of the *captain in training* program for the equestrian team where new members can sign up to learn about the role of the team captains as they prepare to take over captain responsibilities in the following show season. The 2012-2013 *captains in training* will be Taylor Poe for the hunt seat team and Emma Stamps for the stock seat team. The new additions to the coaching staff will be helpful as the team begins the new show season in a new region, Region 2 of Zone 5. The team is scheduled for a total of 8 shows for each seat in the new region.

The horse judging team will also be strengthened by new faces for the 2012-2013 competition season with Ms. Bova dedicating a portion of her teaching assistantship working with the horse judging team. In addition, senior Animal & Dairy Sciences major and former judging team member Brianna Tisdale will also be assisting with the coaching responsibilities as she helps in coordinating practices and traveling with the team. Ms. Tisdale was a member of the national championship horse judging team of 2010-2011 with her bringing home her own individual grand championship award. Ms. Tisdale along with her other team members have gone on to assist with the FFA State Horse Judging Contest hosted by Mississippi State University and with judging local horse shows sanctioned by the State of Mississippi Horse Show Association.

This summer, prior to the competition season, the coach and coaching staff of both teams are working hard to recruit new members for the teams and donations for the teams including horses and equipment. Individuals interested in donating to the equine teams should contact the Animal & Dairy Sciences department. Potential team members wanting more information about the teams and equine scholarships can contact the coach, Dr. Molly C. Nicodemus.

Using a Hands-on Laboratory to Teach Reproductive Management Skills

J. E. Larson
Mississippi State University, Mississippi State, MS

Teaching Summary

Undergraduate students in ADS 4611, Practices in Physiology of Reproduction, gain practical experience by using a hands-on approach to learning. As many institutions of higher learning increase enrollments while receiving less funding support, the tradition is to increase class sizes and decrease costly labs or hands on activities. The Department of Animal and Dairy Sciences strives to maintain small class sizes and labs in order to meet the needs of our students. ADS 4611 accompanies ADS 4613 (Physiology of Reproduction) which is the lecture-based, text book type learning about reproduction. As students learn in the classroom about the principles and the facts, they also learn about the practical application of these principles in the field. Students spend a significant amount of time learning to artificially inseminate cows, they also use transrectal ultrasonography to detect pregnancies, thaw and handle frozen semen, observe breeding soundness exams in bulls and stallions, and observe male and female reproductive tracts of several species in the lab. Both courses are a requirement of students with a major in Animal and Dairy Science, and student evaluations at the end of each semester indicate this is one of their favorite labs in their college careers. Hands on activities with animals are usually a priority among students and the more of these types of activities we can expose them to, the more they value the experience.

Introduction

Much that is learned as a student in Animal and Dairy Sciences can be learned from a textbook and discussions in a classroom setting. However, a significant amount of what we strive to teach can only really be taught by hands-on activities. These lessons cannot be replaced by traditional lecture-based classes and are an important part of what sets our major apart from others in the University. In the Department of Animal and Dairy Sciences, approximately half of the courses we offer have a laboratory component. These labs allow students to see, touch and do, which emphasizes what we discuss in the classroom. It also allows the practical application of techniques we discuss and perhaps most importantly it allows these students the opportunity to do what many of them love to do – get out on the farm and work with animals!

Procedures

ADS 4611 (Practices in Physiology of Reproduction) is a laboratory-based course offered each semester. This course is required for all students in ADS and they take it concurrently with ADS 4613 which is the classroom-based portion of the course. There are two sections of the lab to ensure a small class size and it meets for 2 hours each week. Students start the semester meeting in the lab to look at and dissect male and female reproductive tracts from cattle, pigs, horses, and goats. Students identify structures and the functions of those structures, as well as practice passing an

artificial insemination (AI) rod through the cervix in bovine tracts. This is important practice for the next thing they learn to do, which is to pass the AI rod through the cervix of a live cow. Students learn it is much easier to pass the rod in a tract sitting on a lab bench than it is in the live cow!

Students then learn about the technique of AI and also the process of semen storage, thawing techniques and how to load a dose of semen into the AI rod. Students practice this procedure using real semen that is frozen in liquid nitrogen. The importance of proper semen handling to avoid cold or heat shock is stressed.

Most labs from this point on meet at the Bearden Dairy Research Center. A herd of cows are maintained to be used for teaching purposes. This is a luxury we have and our students appreciate the availability of this herd as it allows them more hands-on activities than would otherwise be afforded. These cows have been culled from the lactating herd for various reasons and we use them to practice the techniques of AI. Students begin by palpating and locating the cervix as this is oftentimes the biggest challenge. Then they begin practicing with a plastic rod as they become more familiar with the process. This is easier on the cows than the typical metal rods. As students become more experienced, they use typically AI rods.

Students receive a lot of one-on-one assistance from me as well as teaching assistants and we all offer advice, encouragement, and check progress. Students must successfully pass 5 rods throughout the semester to get full credit for this portion of their grade. Although many students doubt their abilities initially, they become better as they practice and nearly all students achieve these 5 passes. More than anything, this portion of the lab teaches students about perseverance and focus. They often comment about how proud they are of themselves for not giving up and having patience. In addition to practicing the process of AI, students gain more practice handling and thawing semen. They use an ultrasound to diagnosis pregnancy and look at images of the uterus and ovaries. One lab each semester meets at the College of Veterinary Medicine's large animal clinic. Veterinarians show students how to conduct breeding soundness exams on bulls and they view spermatozoa under the microscope. They learn about electro-ejaculation in this lab and also the importance of herd bulls passing the exam. Veterinarians collect semen from a stallion using a phantom mare and artificial vagina and this is an important lesson in behavior and also differences in male qualifications in the beef industry versus the horse industry.

Veterinarians also conduct a lab on obstetrics and calving difficulties. Students learn about normal and abnormal calving positions, when to assist in calving and how to properly use chains or other mechanisms to extract a calf. This is a favorite lab among the students and they learn a great deal about the importance of diligent calving management.

Results

Students in this course are graded by their attendance (25%), their success in achieving 5 AI passes (20%), quizzes (15%), assignments (15%), and a final exam (25%). Most students do very well in this course and it is designed to be a more fun and exciting component to learn reproductive techniques. Students appreciate this challenging but fun environment to learn in, as a break from some of the more difficult classroom-based courses they take. Student

evaluations indicate high marks for the amount they learn and how it emphasized important concepts. Many state that this lab was their favorite lab to date in their college careers. This indicates that students put a significant amount of value in laboratories and we need to prioritize these events and continue to offer them whenever possible.

Implications

Students in ADS 4611 participate in hands-on activities to gain experience and knowledge on reproductive techniques. Students value the access to animals and the opportunities to work with livestock. It is evident these types of skills are important to students and the success of their future education or careers.

Student Experiential Learning Establishes Long-term Memory and Improves Scientific Communication

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Teaching Summary

Graduate students in PHY 8133, Endocrine Secretions, did a comprehensive literature search on endocrine control of male fertility with a focus on bulls, and critically read the most relevant scientific articles. The students presented the articles, and developed a review article which has been published as a book chapter. This student centered learning experience is expected to have high intellectual merits and broader impacts.

Introduction

Students learn new concepts and gain skills when they gain knowledge which is a long-term memory of the subject learned. In order to establish long-term memory, students need to be active learners where they should be engaged in searching the information they need to find out more about, read peer reviewed quality articles on the subjects, and then present and discuss the current knowledge and critical gaps in the knowledge base. Students also need to relate how the theory they learn on a subject can directly be applied to solve a major real-world problem.

Effective learning also involves learning the accepted truth, discussing it with peers and experts, and challenging the dogma. Furthermore, when students work as part of a cohesive team with a common goal, they are more likely to accomplish their goals, and feel part of a community and ownership of their work. Finally, the students improve their skills in scientific communication skills when they search literature, critically read and present articles and develop synthesis of the topic.
The objective of this student experiential learning project was to promote better learning experiences for graduate students in Endocrine Secretions class through active engagement, and development of a scientific article on the subject learned.

Procedures

Eight graduate students in the Endocrine Secretions class set out to develop a comprehensive review article on endocrine control of bull fertility. To accomplish this goal, students worked as groups of two on specific aspects of hormones that control male fertility in mammals. The students did a literature search, critically read key articles, gave an oral presentation on one of the articles they read, and summarized their learning form the literature as a section of a review article. The students reviewed the entire review article.

The students worked under the guidance of the course instructor who has reviewed the student accomplishments at every step of the project, i.e., list of abstracts from the literature search, presentations, and sections written. In addition, the instructor collaborated with two experts from academia and industry who have reviewed

the outputs and provided their critical reviews.

The students earned points for doing literature search, giving presentations, and for developing the review article. There were also mid-term and final exams that students took to demonstrate their learning outcomes of contemporary endocrinology.

Results and Implications

The scholarly article that the students developed has been accepted as a book chapter in the book "Cattle: Domestication, Diseases and the Environment" (Editor: George Liu, Nova Publishers, Inc.; copied abstract below). All of the students were credited by being equally contributing first authors. In addition, two of the students showcased their learning experiences and importance of endocrine control of fertility in animal agriculture in the "Farm and Family Radio" which was aired at Mississippi Public Radio (member of National Public Radio) through Mississippi State University's Extension Service. The results are expected to improve students' effective learning, as well as their skills in scientific communication, team work, and critical-creative-applied thinking. Intellectual merits and broader impacts of the results are significant because the students learned vital aspects of advanced endocrinology and the knowledge was disseminated to public as well.

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Implant Management for Pre- and Post-weaned Beef Calves, Year 1

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Research Summary

Fifty-one head of crossbred (primarily *Bos taurus*) beef steers (BW = 365.97) were used to evaluate effects of growth implants on performance. Calves were implanted either at calfhood vaccination (approximately 3.5 mo. old) with 100 mg of progesterone and 10 mg estradiol benzoate and again at weaning with 40 mg of trenbolone acetate and 8 mg of estradiol (CALF), at weaning with 40 mg of trenbolone acetate and 8 mg of estradiol (WEAN), or not implanted at all (NONE). Cattle were weighed at weaning, and subsequently on d 28, 45, and 80 post weaning. On d 80, all steers were ultrasounded to measure longissimus area (LMA), intramuscular fat (IMF), and rib fat thickness. At weaning, steers implanted at calfhood, had greater pre-weaning ADG compared to non-implanted steers (2.46 vs 2.20 lb, respectively; $P = 0.04$). At 28 d post weaning, no differences were detected among groups. Additionally, at 45 d post weaning, no differences were noted for BW; however, a difference was noted in ADG from weaning to d 45 between CALF and NONE (1.34 vs. 1.05 lb, respectively, $P < 0.10$). Surprisingly, no difference was detected between NONE and WEAN (1.05 vs 1.15, lb respectively). Moreover, a tendency was noted ($P = 0.14$) between NONE and both implanted groups for the period between weaning and d 80 (1.81, 1.99, and 1.99 lb, respectively). Overall, ADG was greater ($P < 0.10$) for cattle that were implanted compared to untreated controls (1.94, 2.16 and 2.03 lb/d for NONE, CALF and WEAN, respectively). Ultrasound measurements noted a tendency for increased LMA in CALF group ($P = 0.12$), and a tendency for decreased IMF for the CALF and WEAN compared to controls ($P = 0.12$). Results suggest that use of growth promoting implants may be of benefit to cattle producers; however, producers should exercise caution in the timing of implants in relation to weaning period length.

Introduction

The use of growth promoting implants to improve beef cattle productivity are well documented (Kuhl, 1996). Early studies conducted it the 1970's showed growth promoting implants to increase live weight gain up to 20 lbs in grazing cattle (Sewell, 1990), and anywhere from 10 to 16% improvement in average daily gain (Elanco Animal Health, 1982; Lusby and Gill, 1985; and Gill et al., 1995). In addition, Selk (1996), determined that implanting suckling beef calves can increase ADG 0.1 lb/d in steers and 0.12 to 0.14 lb/d in heifers from implanting (pre-wean) to weaning. Despite these benefits, the 2008 National Animal Health Monitoring System reported that only 11.9% of cow/calf operations implanted their calves at any point prior to and at weaning. Factors such as not understanding the actual benefit of implanting calves, and negative perceptions may influence Mississippi producers' decisions not to implant their cattle.

Therefore, the objective of the following study was to evaluate different management options for pre- and post-weaned beef calves.

Procedures

All procedures were approved by the Institutional Animal Care and Use Committee of Mississippi State University.

The original study design was for two years, data generated in this report are from the first year. Forty-four steer crossbred beef calves (predominantly *Bos Taurus*) were used from the White Sand Branch Unit breeding herd to examine the effects of three management options for implanting calves. Calves were stratified by birthdate and within strata assigned to one of three treatments: 1) NONE: no implant; 2) WEAN: implant only at weaning (40 mg trenbolone acetate + 8 mg estradiol); 3) CALF: implanted twice once at calfhood (100 mg progesterone + 10 mg estradiol) and at weaning (40 mg trenbolone acetate + 8 mg estradiol). Calves were born starting in December 2010 and finishing by early February 2011. Calves were vaccinated for IBR-PI3-BVD, 7-Way *Clostridial*, and dewormed at branding (approximately 3 to 4 mo. of age), which is typical management at White Sand Branch Unit. Additionally, an individual weight was obtained for each calf. During this period, calves in the CALF group were administered their first round of implants (100 mg progesterone + 10 mg estradiol). Following processing calves were returned to their dams and grazing.

Due to extremely dry conditions in South MS, it was determined by personnel at the White Sand Branch Unit to early wean the calves in an effort to extend forage base for the cows. Normally, calves are weaned in August; however they were weaned in June. At weaning calves were physically separated from their dams, re-vaccinated for IBR-PI3-BVD, 7-way Clostridial, and those in the WEAN and CALF groups were implanted with 40 mg trenbolone acetate + 8 mg estradiol. Following processing, calves were collectively moved to a dry lot where they had free-choice access to hay and a weaning ration (Table 1). Calves were weighed on d 28, 45, and 80, and at d 80 ultrasound measurements of longissimus muscle area, rib fat, and intramuscular fat were obtained.

Statistics.

Data were analyzed as a linear model in SAS, with animal as the experimental unit. When the model was considered significant ($P < 0.10$), means were separated using the PDIFF option in SAS.

Results

Results are presented in Table 2. No differences were noted in BW at weaning ($P = 0.52$), however calves implanted at branding had greater ADG than NONE or WEAN groups. No differences among treatments were noted in the 28 d post-weaning BW, nor the 28 d post wean ADG ($P = 0.52$). Loyd et al. (2011) demonstrated that weaned calves do not consume sufficient feed to meet their NE_m requirements for up to 21 d. Moreover, the stress associated with weaning can lead to increased cortisol (Hickey et al., 2003), which can negatively affect growth hormone (Nicolet et al., 1996). Perhaps the compounded effects led to the lack of treatment effects noted in the first 28 d post weaning. Average daily gain was increased for cattle administered the CALF treatment compared to the NONE and WEAN group ($P < 0.09$) at 28 to 45 d post weaning and

Table 1. Physical and chemical composition of hay and mixed diet fed to weaned calves

Ingredient	% Composition, DM
Cotton Gin Mote	26.88
Soybean Hull Pellets	38.72
Distillers Solubles, Syrup	10.75
Dried Distiller's Grains with Solubles	23.65

Nutrient Content	% Composition, DM[a]
Hay	
Dry Matter	93.65
Crude Protein	9.74
Acid Detergent Fiber	40.70
Total Digestible Nutrients	56.11
Mixed Diet	
Dry Matter	86.91
Crude Protein	14.80
Crude Fat	5.81
Acid Detergent Fiber	40.70
NE_m, Mcal/lb	0.81
NE_g, Mcal/lb	0.55

[a] All values except dry matter are on a dry matter basis

Table 2. Performance and ultrasound measurements of calves managed under different implant protocols.

	Treatments[a]				
Item	NONE	CALF	WEAN	SE[b]	*P* value[c]
Body weight, lb					
Branding	366.5	365.3	368.7	15.6	NS
Weaning	492.4	506.5	497.2	15.9	NS
Post-weaning, 28 d	511.7	523.5	508.3	16.6	NS
Post-weaning, 45 d	539.8	567.8	544.9	15.9	NS
Post-weaning, 80 d	637.7	665.9	651.6	17.6	NS
Daily gain, lb/d					
Pre-weaning[d]	2.21[x]	2.47[y]	2.16[x]	0.45	0.02
Post-weaning, d 0-28	0.71	0.62	0.57	0.10	NS
Post-weaning d 28-45	1.63[x]	2.60[y]	2.14[x]	0.40	0.09
Post-weaning d 0-45	0.99[x]	1.37[y]	1.15[x]	0.11	0.04
Post-weaning d 45-80	2.80	2.82	3.04	0.18	NS
Post-weaning d 0-80	1.83[x]	1.98[y]	1.98[y]	0.09	0.12
Total[d]	1.94[x]	2.16[y]	2.03[x]	0.07	0.10
Ultrasound Data					
LMA, in[2e]	6.67[x]	7.09[y]	6.59[x]	0.23	0.12
IMF, %[f]	3.54[x]	3.23[y]	3.24[y]	0.14	0.12
Rib fat, in.	0.17	0.17	0.18	0.12	NS

[a]NONE = no implant given; CALF= implanted at branding (100 mg progesterone + 10 mg estradiol) and again at weaning (40 mg trenbolone acetate + 8 mg estradiol); WEAN = implanted only at weaning (40 mg trenbolone acetate + 8 mg estradiol).
[b]Standard error to LS Means.
[c]Probability value.
[d]Prewean = daily gain calculated from branding until weaning (58 d)
[e]Longissiums muscle area.
[f]Intramuscular fat.
[xyz]Least square means within row with uncommon subscripts differ.

for 0 to 45 d post weaning. No differences ($P = 0.30$) were noted with BW at 45 d. From d 45 to 80 no differences ($P = 0.30$) were noted in ADG, nor were differences ($P = 0.26$) noted in BW at d 80. A tendency ($P = 0.12$) was noted in ADG for cattle receiving any implant (CALF or WEAN) to have greater ADG than NONE. Overall, from branding to 80 d post weaning, cattle receiving two implants had greater ADG ($P = 0.10$) than WEAN or NONE. Although cattle in the WEAN group performed similarly to the CALF group ($P = 0.68$) for an 80 d post-weaning period, the initial

increase in performance noted with CALF (pre-weaning) was sufficient to increase performance throughout the study.

Body weight, while numerically greater (Table 2), was not significant, perhaps due to the variation. As noted previously, this was the first year of a two year project, and perhaps by increasing experimental units, variation can be decreased.

Calves in the CALF group tended ($P = 0.13$) to have greater longissimus muscle area (LMA) than those in NONE and WEAN groups. Additionally, cattle in both WEAN and CALF had lesser percentages of intramuscular fat ($P = 0.13$) than NONE. Foutz et al., (1997) demonstrated that use of growth promoting implants increased rib-eye area and decreased marbling when administered to market cattle. It is unclear why the cattle in WEAN did not show an increase in LMA. Perhaps this also demonstrates that the WEAN group did not utilize the implant as efficiently as CALF. No differences were noted regarding rib fat among treatments.

Implications

The use of implants in cow-calf operations can increase performance of these animals from pre-weaning up to 80 d post weaning. However, producers who retain ownership for a backgrounding phase may wish to keep the cattle longer than 45 d in order to maximize return of the implant.

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Determination of Anti-Müllerian Hormone During a Synchronized and a Natural Bovine Estrous Cycle

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Research Summary

Concentrations of anti-Müllerian hormone (AMH) have been correlated with indicators of fertility. However, the effects of hormones utilized in an estrus synchronization protocol on AMH have not been evaluated. Therefore, the purpose of this experiment was to determine if concentrations of AMH at estrus differed between a synchronized and a natural estrous cycle. Heifers (11 to 15 mo; n = 68) consisting of Angus (n = 19), Charolais (n = 5), Holstein (n = 34) and Jersey (n = 10) breeds were synchronized using the Select Synch + CIDR protocol (GnRH+CIDR-7 d-CIDR removal+$PGF_{2\alpha}$). Heifers were observed for synchronized estrus every 6 h until 84 h after the conclusion of the synchronization protocol. At estrus, follicles on the ovary were evaluated using transrectal ultrasonography and blood samples were collected and analyzed for concentrations of AMH. Detection of the subsequent estrus, considered natural estrus, occurred every 6 h from d 16 to 24 after synchronized estrus. The number of days between synchronized and natural estrus was 20.05 ± 1.60 (mean ± SD). Concentrations of AMH between natural and synchronized estrus were positively correlated ($r = 0.67$, $P < 0.001$). The mean concentration of AMH did not differ ($P > 0.05$) between the natural (0.0543 ± 0.0076 ng/mL) or synchronized (0.0428 ± 0.0076 ng/mL) estrous cycles. In conclusion, concentrations of AMH were similar between a natural and a synchronized estrous cycle. Concentrations of AMH in a natural and a synchronized estrous cycle were highly correlated within individual heifer and varied among heifers with beef heifers having increased ($P < 0.05$) concentrations of AMH compared to dairy heifers (0.0638 ± 0.01 and 0.0402 ± 0.01 ng/mL, respectively).

Introduction

Ovarian dynamics of cattle are becoming increasingly relevant as indicators of fertility. The concept of the ovarian reserve has been established to both quantify and qualify the ovary similar to the relationship of scrotal circumference and production of spermatozoa in the bull (Ireland et al., 2011). The ovarian reserve has been defined as the number of healthy follicles contained in the ovary (Ireland et al., 2009) and is associated with fertility in cattle (Jimenez-Krassel et al., 2009). Advancing understanding of the ovarian reserve would demonstrate the effect of follicle variation on ovarian function allowing for diagnostic methods to be developed to predict the follicular population of breeding females (Ireland et al., 2011).

Difficulty in quantification has delayed the advancement and implementation of the ovarian reserve as an indicator of fertility. With the introduction of ultrasonography, it became possible to measure follicles on the ovary and determine antral follicle count (AFC). Antral follicle

count is considered the total number of follicles greater than or equal to 3 mm in diameter per pair of ovaries (Jimenez-Krassel et al., 2009) and is positively correlated to ovarian reserve. The establishment of a correlation between AFC and pregnancy in beef heifers (Cushman et al., 2009) and dairy cows (Mossa et al., 2010) signifies the need for additional research in reproductive performance and response to estrus synchronization.

The use of AFC has provided a basis for exploration of the ovarian reserve as an indicator of fertility, but the increased management and expertise required to determine AFC with ultrasonography is not optimal in a production setting. Recent discovery of the positive association of concentrations of anti-Müllerian hormone (AMH) with AFC allows for further development and quantification of the ovarian reserve (Jimenez-Krassel et al., 2009).

Concentrations of AMH are positively associated with the total number of follicles and oocytes contained in the ovary (Ireland et al., 2011). Variations in the concentration of AMH are independent of follicular dynamics occurring in the bovine estrous cycle allowing for determination through the collection of a single blood sample (Rico et al., 2009). Changes in concentrations of AMH in plasma have not been evaluated between a natural estrous cycle and an estrous cycle synchronized using exogenous hormones. Additional research is necessary to establish the significance of gonadotropins in secretion of AMH (Rico et al., 2011) in addition to the other hormones utilized in an estrus synchronization protocol.

Procedures

Animal care, handling, and protocols used in this study were approved by the Mississippi State University Institutional Animal Care and Use Committee.

Animals.

This experiment occurred prior to the fall breeding season (October to December) of 2011. Beef heifers (n = 24), consisting of Angus (n = 19) and Charolais (n = 5) breeds, were managed at the Mississippi Agricultural and Forestry Experiment Station's Leveck Animal Research Center. Beef heifers averaged 385.1 ± 24.5 (mean ± SD) with a range of 330 to 426 d of age at the initiation of estrus synchronization. Body weight was determined at the initial blood sampling and averaged 750 ± 67 with a range of 663 to 930 lb. Reproductive tract scores (RTS; scale of 1 to 5; 1 = immature < 20 mm diameter, no tone and no palpable follicles and 5 = > 30 mm diameter, good tone, erect and > 10 mm follicles, corpus luteum present; Anderson et al., 1991) were determined at the time of the initial blood sample by the veterinarian at either the beef or dairy research center. The average RTS of beef heifers was 4.6 ± 0.5 with a range of 4 to 5.

Dairy heifers (n = 44), consisting of Holstein (n = 34) and Jersey (n = 10) breeds, were managed at the Joe Bearden Dairy Research Center. Dairy heifers averaged 423.9 ± 25.7 with a range of 378 to 463 d of age at the initiation of estrus synchronization. Body weight was determined at the initial blood sampling and averaged 764 ± 53 with a range of 520 to 984 lb. Reproductive tract scores were determined at the time of the initial blood sample and averaged 1.1 ± 0.3 (mean ± SD) with a range of 1 to 3 in dairy heifers.

Experimental Protocol.

Selection of heifers for this experiment was based on the establishment of estrous cyclicity. Two blood samples were obtained and analyzed for concentrations of progesterone (P4) prior to the initiation of the estrus synchronization protocol. Select Synch + CIDR protocol was used to synchronize estrus in all dairy heifers and in beef heifers that were determined to be estrous cycling (≥ 1 blood sample with progesterone ≥ 1 ng/mL). Heifers received a controlled internal drug release (CIDR; Pfizer Animal Health, New York, NY) vaginal insert and an injection of GnRH (100 μg, i.m.; Fertagyl, Intervet Inc., Millsboro, DE). Seven d later the insert was removed and heifers received an injection of $PGF_{2\alpha}$ (25 mg, i.m.; Lutalyse; Pfizer Animal Health). Heifers were observed for expression of synchronized estrus every 6 h until 84 h after the injection of $PGF_{2\alpha}$.

Concentrations of hormones and follicles on the ovaries were evaluated on heifers detected in standing estrus or with an activated heatmount detector (Estrotect Heat Detector, Spring Valley, WI) and secondary signs of estrus. Blood samples were collected at estrus (± 6 h) and analyzed for AMH. Transrectal ultrasonography (10.0 to 5.0-MHz linear-array transducer, MicroMaxx, SonoSite, Inc., Bothell, WA) was utilized to measure follicles. Fourteen days after synchronized estrus, additional blood samples were collected and analyzed for P4 during the luteal phase of the synchronized estrous cycle.

Visual detection of the subsequent estrus, considered natural estrus, occurred every 6 h from d 16 to 24 after synchronized estrus. Blood samples were collected at estrus (± 6 h) and analyzed for AMH during natural estrus along with transrectal ultrasonography was used to measure follicles. Fourteen days after the occurrence of the natural estrus additional blood samples were collected for determination of P4 during the luteal phase of the natural estrous cycle.

Statistical Analysis.

The GLM and CORR procedures of SAS (SAS Inst. Inc., Cary, NC) were used to analyze data. Least squares means (LSMeans) were analyzed and separated when a protected F test of $P \leq 0.10$ was detected. Differences were determined to be significant when $P \leq 0.05$ value and tendencies was reported at values of $P > 0.05$ and $P \leq 0.10$

Results

Concentrations of AMH in Natural and Synchronized Estrous Cycles.

Mean concentration of AMH did not differ ($P > 0.10$) between natural (0.0543 ± 0.01 ng/mL) or synchronized (0.0428 ± 0.01 ng/mL) estrous cycles (Table 1). Concentrations of AMH between natural and synchronized estrus were positively correlated ($r = 0.67$, $P < 0.001$; Figure 1). Although concentrations of AMH have not been established after estrus synchronization, changes in AMH have been evaluated during a natural estrous cycle in cows. Concentrations of AMH were similar between estrus and the subsequent estrus in Holstein cows (Rico et al., 2011). Mean follicle diameter did not differ ($P > 0.10$) between the natural (11.97 ± 0.38 mm) or synchronized (12.72 ± 0.38 mm) estrous cycles (Table 1). Mean concentrations of P4 did not differ ($P > 0.10$) between the natural (5.74 ± 0.34 ng/mL) or synchronized (5.84 ± 0.34 ng/mL) estrous cycles (Table 1). Concentrations of P4 between natural and

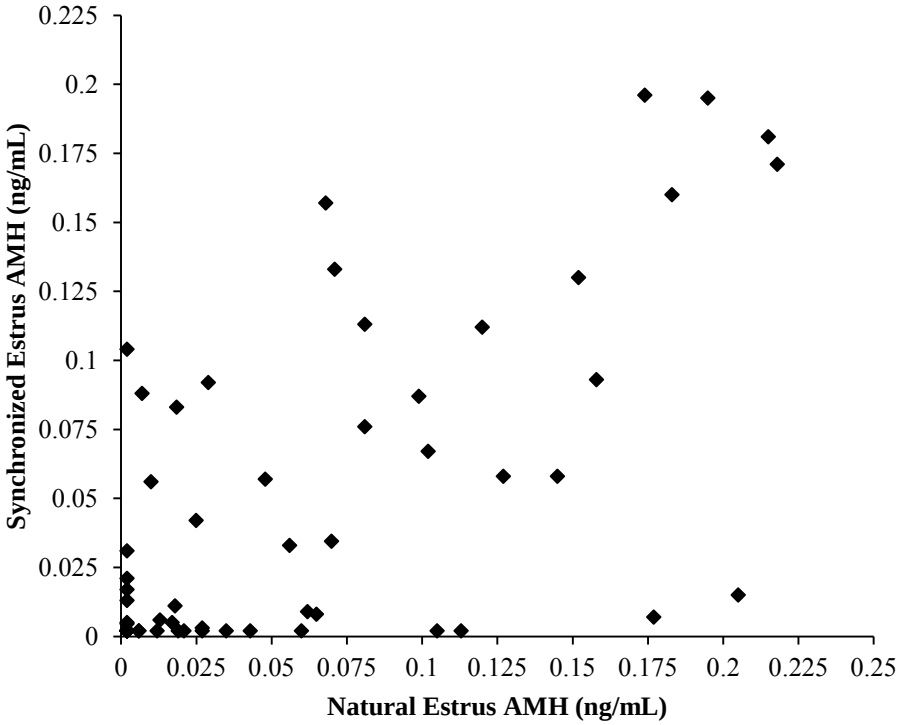

Figure 1. Correlation of anti-Müllerian hormone (AMH) between a natural and a synchronized estrus.

Table 1. Anti-Müllerian hormone (AMH) and progesterone (P4) and follicle diameter between natural and synchronized estrus[1].

	Estrus				
Parameter	Natural	Synchronized	*P*-Value	*r*	*P*-Value
AMH, ng/mL	0.0543 ± 0.01	0.0428 ± 0.01	0.2908	0.67	< 0.001
P4, ng/mL	5.74 ± 0.34	5.84 ± 0.34	0.8328	0.31	0.0114
Follicle Diameter, mm	11.97 ± 0.38	12.72 ± 0.38	0.1657	0.11	0.3671

[1]Data are presented as LSMeans ± SEM

synchronized estrus were positively correlated ($r = 0.31$, $P < 0.05$; Figure 2). No correlations ($P > 0.10$) existed between concentration of AMH and concentration of P4, concentration of AMH and follicle diameter, or concentration of P4 and follicle diameter in either the natural or synchronized estrus.

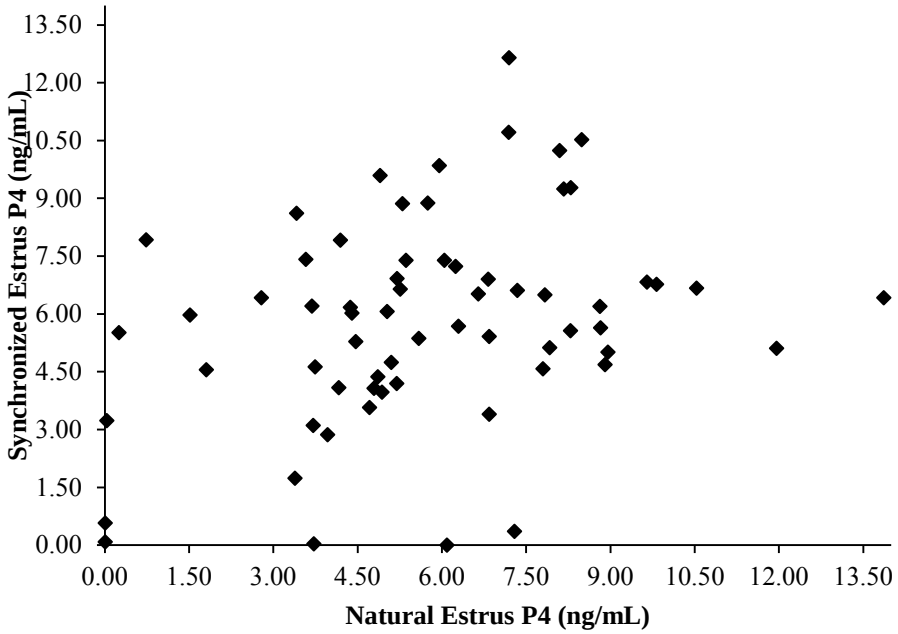

Figure 2. Correlation of progesterone (P4) between a natural and a synchronized estrus.

Table 2. Anti-Müllerian hormone (AMH), progesterone (P4) and follicle diameter between beef and dairy heifers[1].

	Heifers		
Parameter	Beef	Dairy	*P*-Value
AMH, ng/mL	0.06 ± 0.01	0.04 ± 0.01	0.0355
P4, ng/mL	5.56 ± 0.40	5.92 ± 0.30	0.4646
Follicle Diameter, mm	10.99 ± 0.43	13.08 ± 0.32	0.0002

[1]Data are presented as LSMeans ± SEM

Concentrations of AMH, P4 and follicle diameter between beef and dairy heifers.

Beef heifers had an increased ($P < 0.05$) concentrations of AMH compared to dairy heifers (LSMeans ± SEM; 0.0638 ± 0.01 and 0.0402 ± 0.01 ng/mL, respectively; Table 2). This could be attributed to the increased RTS of beef heifers, signifying their increased ovarian development, compared to dairy heifers.

However, concentrations of progesterone were similar ($P > 0.10$) between beef and dairy heifers (5.56 ± 0.40 and 5.92 ± 0.30 ng/mL, respectively; Table 2). Follicle diameter at estrus was smaller ($P < 0.001$) in beef (10.99 ± 0.43 mm) compared to dairy (13.08 ± 0.32 mm) heifers (Table 2).

Concentrations of AMH in Beef Heifers.

Concentrations of AMH did not differ ($P > 0.10$) between Angus and Charolais heifers (0.0703 ± 0.01 and 0.0406 ± 0.02 ng/mL, respectively). Heifers with a RTS of 4 tended ($P = 0.06$) to have increased concentrations of AMH compared to heifers with a RTS of 5 (0.0868 ± 0.01 and 0.0462 ± 0.01 ng/mL, respectively). With both scores of 4 and 5 representing pubertal heifers, only minimal differences are detected in regards to reproductive development between these scores. Concentrations of AMH did not differ ($P > 0.10$) among age categories of heifers, with heifers < 12, 12 to 13, and > 13 mo having similar concentrations of AMH (0.0677 ± 0.02, 0.0800 ± 0.02, and 0.0228 ± 0.03 ng/mL, respectively). Concentrations of AMH did not differ ($P > 0.10$) among weight categories of heifers (0.0312 ± 0.03, 0.0718 ± 0.01, and 0.0684 ± 0.02 ng/mL for < 682, 682 to 770, and > 770 lb, respectively). Minimal variation in age and weight of beef heifers resulted in no differences in concentrations of AMH among heifers classified by age or weight.

Concentrations of AMH in Dairy Heifers.

Concentrations of AMH did not differ ($P > 0.10$) between Holstein and Jersey heifers (0.0382 ± 0.01 and 0.0464 ± 0.01 ng/mL, respectively). An increase in mean RTS tended ($P = 0.07$) to result in an increase in concentrations of AMH (0.0045 ± 0.03, 0.0372 ± 0.01, 0.0351 ± 0.01, 0.0441 ± 0.02, and 0.0758 ± 0.02 ng/mL for 1, 1.5, 2, 2.5, and 3, respectively). Although all heifers in this experiment were considered cycling based on concentrations of progesterone, the decreased RTS signified decreased reproductive tract development. In addition, a positive correlation ($r = 0.31$, $P < 0.05$) was established between mean RTS and mean concentration of AMH in dairy heifers. The establishment of a correlation between these variables requires further development. Concentrations of AMH did not differ ($P > 0.10$) among age categories of heifers at the initiation of synchronized estrus, with heifers < 13.00, 13.00 to 14.75, and > 14.75 mo having similar concentrations of AMH (0.0531 ± 0.01, 0.0356 ± 0.01, and 0.0426 ± 0.01 ng/mL, respectively). Concentrations of AMH did not differ ($P > 0.10$) among heifers in differing weight categories (0.0374 ± 0.01, 0.0412 ± 0.01, 0.0373± 0.01 ng/mL for < 660, 660 to 880, and > 880 lb, respectively).

Implications

In conclusion, concentrations of AMH at estrus were similar between a natural and a synchronized estrous cycle but differed between beef and dairy heifers. Concentrations of AMH at estrus in a natural and a synchronized estrous cycle were highly correlated within individual heifer and variable among heifers in this experiment. Results indicate that the use of this estrus synchronization protocol did not have an effect on concentration of AMH. This allows for further applicability of AMH in future fertility trials in which estrus synchronization can be utilized, allowing for further assessment of females with differing follicular populations.

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Effects of Temporary Calf Removal Prior to Fixed-time AI (TAI) on Pregnancy Rates and Subsequent Calf Performance in Suckled Beef Cows

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Research Summary

Two experiments were conducted to determine the effect of calf removal (CR) on pregnancy rate (PR) and calf performance of suckled beef cows at 6 locations. Cows in both experiments were synchronized with the 7-day CO-Synch + CIDR protocol (d 0 = CIDR removal). Cows were assigned to one of two treatments in Exp. 1; 1) control (Control; n = 156); 2) calves were separated from their dams between d 0 and 3 (CR72; n = 168); and one of four treatments in Exp. 2; 1) Control (n = 103); 2) CR72; n = 104); 3) CR between d 0 and 2 (CR48A; n = 95); and 4) CR between d 1 and 3 (CR48B; n = 53). All cows received timed AI (TAI) on d 3. In Exp. 1, PR at one location tended (P = 0.06) to be greater in cows exposed to CR72 (53%) than Control (38%). Overall PR did not differ (P = 0.58) between treatments in the other 2 locations in Exp.1 and averaged 53%. In Exp. 2, PR were similar among all 3 locations (49%; P = 0.15). Young (-4.8 ± 0.6%) and medium (-3.0 ± 0.5%) calves lost a greater (P < 0.01) percent body weight (PBW) during CR than old (-1.4 ± 0.6%) calves within the CR72 treatment. Calves exposed to CR48 (-2.2 ± 0.6%, -1.1 ± 0.6%, and -2.4 ± 0.6% PBW change for young, medium, and old, respectively) lost more weight than calves in the Control group (3.7 ± 0.4%, 1.7 ± 0.5%, and 2.1 ± 0.5% PBW change for young, medium, and old, respectively). We conclude that CR may be used as a tool to enhance fertility in beef cows, stimulating follicle growth and, although inconsistent results, increasing PR to TAI. However, CR had a negative impact on subsequent calf performance, which differed depending on the duration and age of the calf when exposed to CR.

Introduction

Suckling by a calf extends the number of days postpartum (DPP) to resumption of cyclicity in beef cows (Wagner and Oxenreider, 1971; Mukasa-Mugerwa et al., 1991; Viker et al., 1989, 1993; Lamb et al., 1997, 1999). Suckling inhibits secretion of GnRH and LH (Gordon et al., 1987) which are necessary for resumption of estrous cycles. Decreasing the frequency of suckling or temporarily withdrawing the suckling stimulus improved LH secretion (Williams et al., 1987, 1995; Silveira et al., 1993), shortened the interval from calving to first ovulation (Graves et al., 1968; Oxenreider, 1968), and increased pregnancy rates (PR) earlier in the breeding season (Vasconcelos et al., 2009).

An improvement in PR to TAI in beef cows when exposed to temporary calf

removal (CR) occurs (Geary et al., 2001; Baruselli et al., 2004; Duffy et al., 2004; Meneguetti et al., 2009; Sá Filho et al., 2009a; Small et al., 2009; Vasconcelos et al., 2009; Sá Filho et al., 2010). However, additional reports indicate that CR may (McCartney et al., 1990; Sá Filho et al., 2009b) or may not (Beck et al., 1979) affect subsequent calf performance.

Two experiments were designed to evaluate the effect of CR on cow fertility and calf performance. Our objective was to evaluate duration (48 vs. 72 h) of CR on plasma concentrations of estradiol (E), growth of the pre-ovulatory follicle, and PR at TAI. In addition, we evaluated the effect of CR on subsequent calf performance by assessing calf weight.

Procedures

Experimental Protocol.

Six hundred seventy-nine suckled beef cows and their calves were enrolled in the study. Exp. 1 was conducted during the 2008 and 2009 breeding seasons at 3 locations (1, 2, 3) and Exp. 2 was conducted during the 2011 breeding season at 3 locations (4, 5, 6). Both experiments were conducted with the Institutional Animal Care and Use Committee approval.

In Exp. 1, 324 cow and calf pairs were stratified by parity, DPP, and calf gender and then assigned to 1 of 2 treatments to be applied immediately after CIDR removal (d 0) of the CO-Synch + CIDR synchronization protocol: 1) no calf removal (CR; Control; n = 156), or 2) calf removed from dam on d 0 for 72 h (CR72; n = 168).

In Exp. 2, 355 cow and calf pairs were stratified as in Exp. 1 and assigned to 1 of 4 treatments: 1) Control (n = 103); 2) CR72 (n = 104); 3) CR for 48 h from d 0 to 2 (CR48A; n = 95); and, 4) CR for 48 h from d 1 to 3 (CR48B; n = 53). In both experiments, calves were weighed on d 0, 3, 33, and 63 and calves were confined with free access to water and hay and were located no closer than 330 ft from their dams during the period of separation.

Ultrasonography and Blood Collection.

Transrectal ultrasonography was used in locations 1 (d 0, 3, and 10) and 4 (-14, -7, 0, 1, 2, 3, and 4) to monitor growth of the dominant follicle and corpus luteum (CL) volume. At all locations, ultrasonography was used to detect pregnancy status on d 33 and 63 after AI.

In Exp. 1 at location 1 and in Exp. 2 at all locations, blood samples were collected from all cows on d -14, -7, 0, 3, and 10. Blood plasma was analyzed for concentrations of progesterone (P4) and E.

Statistical Analyses.

Pregnancy rates, follicle diameters, concentrations of P4, and CL volume were analyzed using the GLIMMIX procedure of SAS (SAS Inst. Inc., Cary, NC). Data were blocked by location. Calf weights were analyzed using repeated measures in the MIXED procedure of SAS with initial body weight used as a covariate. Calf age was categorized as young (25 to 60 d of age), medium (61 to 80 d of age), and old (> 80 d of age). Pregnancy rates are reported as means and all other data are reported as LSMeans. Means were separated using LSD and significance was set at $P \leq 0.05$ and tendencies were determined if $P > 0.05$ and ≤ 0.10.

Results

Exp. 1.

Overall PR is summarized in Table 1. Pregnancy rates at Loc-2 tended (P = 0.06) to be greater in cows exposed to CR72 treatments at Loc-1 (P = 0.28) and at Loc-3 compared to cows in the Control treatment. However, PR did not differ between (P = 0.42). Cows nursing old (56%) and medium (54%) age calves had greater (P = 0.01) PR than cows with young (29%) calves. Follicle diameter did not differ (P = 0.21) between treatments on d 0 or on d 3 (P = 0.11; Table 1); however, follicle growth rate between d 0 and 3, tended to be greater (P = 0.06) for cows exposed to CR72 compared to those exposed to Control (Table 1).

Table 1. Pregnancy rate, follicle diameter and follicle growth rate in Exp.1, and pregnancy rate in Exp. 2.

	Treatments[a]				
Item	Control[b]	CR72	CR48A	CR48B	Overall mean
Exp. 1		---------- no./no. (%) ----------			
Pregnancy rate					
Location 1	14/46 (30.4)	20/53 (37.7)	----	----	34/99 (34.3)^{z}
Location 2	20/53 (37.7)^{x}	29/55 (52.7)^{y}	----	----	49/108 (45.4)^{z}
Location 3	42/57 (73.7)	38/60 (63.3)	----	----	80/117 (68.4)^{w}
Overall	76/156 (48.7)	87/168 (51.8)	----	----	163/324 (50.3)
Follicle diameter		---------- mm ----------			
d 0	12.9 ± 0.4	12.1 ± 0.4	----	----	----
d 3	12.7 ± 0.4	13.2 ± 0.3	----	----	----
		---------- mm/d ----------			
Follicle growth rate[c]	0.02 ± 0.15^{x}	0.42 ± 0.15^{y}	----	----	----
Exp. 2					
Pregnancy rate		---------- no./no. (%) ----------			
Location 4	22/52 (42.3)	19/53 (35.8)	21/48 (43.7)	19/53 (35.8)	81/206 (39.3)^{z}
Location 5	17/26 (65.3)	14/27 (51.8)	11/22 (50.0)	----	42/75 (56.0)^{w}
Location 6	17/25 (68.0)	18/24 (75.0)	16/25 (64.0)	----	51/74 (68.9)^{w}
Overall	56/103 (55.7)	51/104 (49.0)	48/95 (50.5)	19/53 (35.8)	174/355 (49.0)
Exp. 1 and 2					
Pregnancy rate	132/259 (50.9)	138/272 (50.7)	----	----	270/531 (50.9)

[a]Calves were assigned to be separated from their dams for 72 h between d 0 and 3 (CR72), 48 h between d 0 and 2 (CR48A), 48 h between d 1 and 3 (CR48B), or no separation (Control).

[b]Calves were separated into ages from Young to Old as follows: young = 20 to 60, medium = 61 to 80, and old > 81 d of age)

[c]Follicle growth rates were calculated by the difference between follicle diameter on d 0 and 3 divided by 3.

[wz]Means within a column without a common superscript differ (P < 0.05).

[xy]Means within a row with different superscript tend to differ (P = 0.06).

Table 2. Percentage of body weight (PBW) change, calf body weight (BW) and average daily gain of calves associated with temporary calf removal (Exp. 1).

	Treatments[a]					
	Control[b]			CR72[b]		
Item	Young	Medium	Old	Young	Medium	Old
PBW[c], %						
d 0 to 3	4.6 ± 0.3[w]	2.1 ± 0.3[y]	2.0 ± 0.3[y]	-3.9 ± 0.3[x]	-1.6 ± 0.3[z]	-3.1 ± 0.4[x]
Calf BW[d], lbs						
d 0	174 ± 4	256 ± 4	295 ± 4	179 ± 4	249 ± 4	298 ± 4
d 3	183 ± 4[w]	260 ± 4[w]	200 ± 4[w]	172 ± 4[y]	247 ± 4[y]	289 ± 4[y]
d 33	256 ± 4[w]	326 ± 4[w]	362 ± 4[w]	240 ± 4[y]	324 ± 4[w]	351 ± 4[y]
d 63	313 ± 4[w]	388 ± 4[w]	417 ± 4[w]	293 ± 4[y]	390 ± 4[w]	401 ± 4[y]
ADG[e], lb/d	1.94 ± 0.04	2.09 ± 0.07	2.01 ± 0.07	1.92 ± 0.07	2.09 ± 0.07	2.03 ± 0.07

[a]Calves were assigned to be separated from their dams for 72 h (CR72) or not (Control) between d 0 and 3.
[b]Calves were separated into ages from Young to Old as follows: young = 20 to 60, medium = 61 to 80, and old > 81 d of age.
[c]Percentage of body weight change, calculated from the weight gained or lost during CR divided by initial weight on d 0. [d]Calf live weight.
[e]Average daily gain from d 3 to 63.
[wyxz] Means within a row and within agth different superscript letter differ ($P < 0.05$).

Concentrations of P4 were greater ($P = 0.01$) in noncycling cows exposed to CR72 (3.14 ± 0.29 ng/mL) than noncycling cows exposed to Control (2.02 ± 0.33 ng/mL) treatments. There were no differences ($P = 0.26$) in concentrations of P on d 10 between cycling cows exposed to CR72 (4.45 ± 0.82 ng/mL) and cycling cows exposed to Control (5.60 ± 0.63 ng/mL).

Calf performance was analyzed by change in PBW, BW, and average daily gain (ADG) during and after CR. Calf performance data are summarized in Table 2. During the period of CR, calves exposed to CR72 had a decrease of 6.2 ± 0.7 lb, whereas calves in the Control treatment had an increase of 6.4 ± 0.7 lb in the same period. There was a treatment × age interaction ($P < 0.01$) on PBW change during the CR period. Young and old calves lost a greater ($P < 0.001$) PBW during CR than medium age calves exposed to CR72. There was a three-way interaction of treatment × age × day ($P < 0.01$) for calf BW. Body weight of calves differed ($P < 0.01$) on d 33 for young calves exposed to the CR72 and Control treatments and also differed ($P < 0.01$) for old calves exposed to the CR72 and Control treatments; however, the BW of medium calves exposed to Control and CR72 were similar ($P > 0.1$). In addition, BW of calves differed ($P < 0.01$) on d 63 for young calves exposed to the CR72 and Control treatments and also differed ($P < 0.01$) for old calves exposed to the CR72 and Control treatments; however, the BW of medium calves exposed to CR72 and Control were similar ($P > 0.1$; Table 2). Average daily gain was affected ($P = 0.03$)

by calf age measured from d 3 to 63. Medium calves had greater (P = 0.009) ADG than young calves, whereas old calves had intermediate ADG.

Exp. 2.

Pregnancy rates differed by location (P < 0.001), but were not affected by treatment (Table 1). Cows with BCS ≥ 5 (52%) had greater (P < 0.01) PR than cows with BCS of < 5 (21%). Moreover, cows with old (59%) and medium (60%) age calves had greater (P < 0.0001) PR than cows with young calves (35%).

Concentrations of E were greater (P = 0.02) at 24 h after PG for cows exposed to the CR72 (14.6 ± 1.6 pg/mL) compared to Control (7.4 ± 1.4 pg/mL), CR48A (8.4 ± 1.6 pg/mL), and CR48B (7.7 ± 1.6 pg/mL) treatments.

The effect of CR on calf performance was analyzed combining the treatments CR48A and CR48B (CR48). Calves from Loc-6 received creep feed prior to and after CR, therefore the calf performance analysis were conducted separately for Loc-6 and combined for Loc-4 and Loc-5. Calves at Loc- 4 and 5 assigned to CR48 (-6.8 ± 0.7 lb) and CR72 (-7.3 ± 0.7 lb) lost weight between d 0 and 3, whereas calves exposed to the Control (3.8 ± 0.7 lb) gained weight; however at Loc-6 there was no weight loss between d 0 and 3 (5.3 ± 4.0, 3.1 ± 3.1, and 10.4 ± 3.8 lb weight gain for CR48, CR72 and Control, respectively). There was a treatment × day × age × location interaction (P < 0.01) for BW on d 33 and 63. Calves at Loc-4 and 5 performed similarly during and after CR. At these two locations, on d 33 and 63, young and old calves exposed to CR72 were lighter (P < 0.05) compared to younger and older calves exposed to Control, respectively. Young calves exposed to CR48 (258 ± 2 and 315 ± 2 lb BW on d 33 and 63, respectively) were lighter than Control (265 ± 2 and ± 322 ± 2 lb on d 33 and 63, respectively) calves. Medium and old calves exposed to CR48 had similar (P > 0.10) weight on d 33 and 63 compared to Control. Weights for medium age calves did not differ (P > 0.1) among treatments or days. Calf age tended (P = 0.07) to affect ADG from d 3 to 63. Medium (2.1 ± 0.07 lb/d) calves had greater (P < 0.001) ADG than young calves (1.9 ± 0.07 lb/d), while old calves (2.05 ± 0.07 lb/d) had intermediate ADG. At Loc-6, calves did not lose weight between d 0 and 3, regardless of treatment. No differences in BW among treatments or ages were found on d 33 and 63, indicating creep feeding may be a practical way to mitigate effects of temporary weaning on calves.

Implications

In this study, CR for 72 h tended to increase PR at TAI at one location but had no effect at the other five locations. However, follicle growth rate was increased during the period of CR and concentrations of E were greater at 24 h after CIDR removal for cows exposed to CR72 compared to other treatments. Therefore, CR may be an alternative tool to enhance PR and improve follicle development.

The effect of CR on calf performance was determined by the PBW change during CR and the subsequent gain in BW. Young calves exposed to CR72 had greater PBW loss during the period of CR compared to medium and old calves within the same treatment or exposed to CR48. Young and old calves exposed to CR72 were lighter on d 33 and 63 compared to contemporary calves exposed to the Control treatment.

In conclusion, calf removal increases concentrations of E after 24 h, and increases growth rate of the dominant follicle from d 0

to 3, but did not increase the diameter of the pre-ovulatory follicle on d 3. Calf removal tended to enhance PR but was not consistent among locations. Calf performance was negatively affected by CR, and young calves had the greatest weight loss during CR. Young and old calves exposed to CR72 were lighter on d 63 compared to Control calves. Medium aged calves exposed to CR lost weight during CR, but did not differ in BW on d 33. Therefore, CR had inconsistent results, enhancing PR in only one location in this study. In addition CR had a negative impact on subsequent calf performance, which differed depending on age of the calf when exposed to CR.

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Comparison of Fatty Acid Content in Homogenized and Non-homogenized Milk from Holstein and Jersey cows

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Research Summary

The objective of this study was to investigate fatty acid concentrations of homogenized and non-homogenized milk from Jersey and Holstein cows. Twenty-two, lactating Holstein (n=11) and Jersey (n=11) cows were fed the same ration twice daily. Feed offered was adjusted daily according to the amount of orts from the previous day. Body weight and measurements, blood, and ruminal samples were collected weekly as were feed and orts samples. Ruminal fluid was collected from 6 Holstein and 6 Jersey cows weekly (n=42). Milk weights were collected daily and samples were taken at 0300 and 1500 h and pooled by week. No differences were observed in fatty acid concentrations in feed, refusals, or rumen fluid. Fatty acids C16, C18, and C18:1, were found in the greatest concentrations in all types of milk. In this study, these three fatty acids made up approximately 60% of the total fatty acids in milk across breeds and treatments. Fatty acid C16 was greater in milk than other fatty acids and there was a trend for greater C16 in milk from Jersey cows than in Holstein cows (30.6% vs. 28.5%; $P < 0.06$). Fatty acid C12 was greater in milk from Jersey cows than in Holstein cows (8.04 vs. 7.42%; $P < 0.04$). Milk from Holstein cows had greater proportions of C16:1(1.81 vs. 1.24, respectively; $P < 0.03$), C18:1 (20.7 vs. 17.1 respectively; $P < 0.01$) and C18:3 (2.39 vs. 0.09, respectively; $P < 0.01$) than milk from Jersey cows. Homogenized milk had greater proportions of C10 ($P < 0.04$), but lower proportions of C18:1 ($P < 0.01$) compared to non-homogenized milk. There appear to be more differences in fatty acid types in milk between different breeds of cows than due to processing.

Introduction

As the cost of milk production has increased, many producers have found a niche market of processing milk on farm. Their product is typically pasteurized, but not homogenized. This has gained popularity with consumers for several reasons: perhaps because of nostalgia, because they perceive these products to be healthier, or they are able to identify and better understand where and how dairy products are made. Consumers have also reported longer shelf life and a better, creamier taste of the non-homogenized milk. Several anecdotal reports claim that customers of these creameries have improved heart health since increasing consumption of on-farm processed, non-homogenized milk (Middleton, 2006).

Several studies have shown that adding milk to the diet can help maintain healthy weights (Witteman et al., 1989; Ascherio et al., 1996), reduce risk for

cardiovascular disease (Bostick et al., 1999; Ness et al., 2001), and reduce insulin resistance (Pereira et al., 2002), leading to fewer cases of Type 2 diabetes. It is possible that consumers prefer the flavor of locally processed milk and chose it over other beverages with greater sugar concentrations, resulting in reported improved health. While homogenized milk seems to be more digestible than untreated milk (Michalski, 2006), there is little published data evaluating the difference in quality of pasteurized, homogenized milk compared to that of non-homogenized milk. It is possible that concentration of fatty acids, proteins, minerals and other components may be different, due to homogenization. When milk is homogenized, the fat globules are broken down from 3 to 0.8 μm and often increase 100-fold (Jensen, 2002). During this process, the globule becomes coated in casein, though not completely. According to Deeth et al., (2006) the physical changes caused by homogenization can also cause lipolysis and increase oxidation of SCFA. Oxidation of fat in milk occurs at the interface of the water and lipid phases and homogenization increases the amount of surface area exposed at this interface, likely increasing the amount of oxidation. Pereda et al. (2008) studied the effect of ultra high pressure homogenization (**UHPH**) of milk on fatty acid concentration, lipolysis, and oxidation of fat. The authors investigated UHPH as an alternative to pasteurization, since heat treatment of milk can alter the flavor and the nutritional quality of milk. Pereda et al., (2008) reported an increase in FFA when milk was homogenized at 200 MPa and increased products of oxidation when milk was homogenized at 300 MPa compared to raw milk. Thus, the objective of this study was to determine any differences in fatty acid concentrations between homogenized and non-homogenized milk from Holstein and Jersey cows.

Procedures

Experimental Design

Twelve Holstein and 12 Jersey cows (150 ± 10 DIM, balanced for parity) were used for this trial. Two cows were removed; one Holstein was removed due to health issues and one Jersey cow was removed due to inability to use Calan® gate (American Calan®, Inc., Northwood, NH). Animals were balanced by parity (1 to 4). Cows were housed at Bearden Dairy Research Center and fed using Calan® gates for 42 d. Animals were fed a TMR. Cows were fed twice daily, each animal fed for 10% refusals. If refusals were greater than 4.5 kg for 3 consecutive d, feed was decreased by 4.5 kg. Refusals were weighed each morning before new feed was offered.

Blood, feed and ruminal samples were collected weekly. Feed and feed refusal samples were collected and dried in a forced air oven at 60°C. Proximate analysis was conducted on feed and refusal samples at Essig Nutrition Laboratory (Mississippi State University). Samples were analyzed for total DM, total Kjeldahl nitrogen, NFD, ADF and OM (ash). Blood samples were obtained by jugular venipuncture into serum separator tubes (15mL, vacutainer). Samples were placed on ice until centrifugation at 4330 x *g* for 10 min; serum was separated, removed and placed in microcentrifuge tubes (in triplicate). Samples were then stored at -20°C until analysis was completed. Ruminal fluid was collected from 6 Holstein and 6 Jersey cows weekly (n=42). A small subset of cows was randomly selected each week, to prevent weekly repeated puncture on all cows. Rumenocentesis was performed by a veterinarian from the Mississippi State

University College of Veterinary Medicine. A 16 ga needle was injected into the rumen wall to obtain the samples. Approximately 4 mL from each animal was obtained, pH was determined immediately after ruminal fluid was obtained. Ruminal samples were kept on ice during the sampling process until samples were centrifuged. Ruminal samples were centrifuged at 4330 x *g* for 10 min. The portion of the sample that contained no particulate matter was removed and placed in microcentrifuge containers and stored at -20°C until analysis was completed.

Milk samples were obtained twice weekly for a total of 4 milkings. Daily samples were pooled into one 500-mL vial. Samples were subdivided equally for homogenization. Homogenization was achieved by using a Kinematic homogenizer (Kinematica, Bohemia, NY). Milk samples were removed from refrigerator, heated to 66°C, and homogenized. Non-homogenized samples were not heated to 66°C before separation and freezing. Samples were then pipetted into microcentrifuge tubes (in triplicate) and placed into a -20°C freezer until analysis.

Analytical Analysis

Fatty Acids Extraction

Milk-o-Scan and gas chromatography mass spectrometry (**GCMS**) have been used in previous studies to both quantify and qualify fatty acids (Jahreis et al., 1999). One gram of freeze dried sample was mixed with 3.5g of hydromatrix. Hydromatrix served as a drying agent, removing excess moisture from the sample. The sample was placed in an Accelerated Solvent Extractor (**ASE**; Dionex, 1228 Titan way, Sunnyvale, CA) and then placed in the ASE machine. The samples were heated to 120°C and flushed at a rate of 60% hexane, at a kPa of 10,342. Each sample was subjected to this for 3 cycles of 15 minutes for each flush. The tubes containing oil and solvent were placed in a turbo-vap, which removed hexane until <0.5mL oil remained.

Transesterification

To begin the fatty acid methyl ester (**FAME**) esterification process, a subsample of 10µl of oil was mixed with 2mL of 1% H_2SO_4 in MeOH, heated at 60°C for 2 h. Next, $NaHCO_3$ was added to increase pH and thereby halt the reaction. Once a pH of 8 was achieved, 2mL toluene (dichlorobenzene and BHT) was added as an antioxidant. Toluene caused a separation of the mixture into two distinct layers after several minutes. When layers were distinguished, toluene layer (top layer) was removed and placed in a scintillation vial. This step was repeated to ensure a majority of the toluene and oil had been removed and placed in the scintillation vial. Once samples were placed in vials, FAME analysis was conducted. The samples were transferred from scintillation vials to auto sampler vials and analyzed.

Gas Chromatography Mass Spectrometry

In this study, a Varian Start 3600 GC (Varian Chromatography Systems, Walnut Creek, CA) coupled with the Varian Saturn 2000 GC/MS was used to analyze for fatty acid, utilizing a Restek Stabilwax®-DA column (30 m X 0.25 mmID) with a 0.25µm film thickness. A standard and a blank were placed after every ten samples to flush the column, thereby minimizing sample contamination. A blank was run at the end of the sample list to ensure that the column was cleaned.

Standard solutions were prepared with 14 fatty acids; caprylic, capric, lauric, myristic, palmitic, palmitoleic, stearic, oleic,

linoleic, linolenic, arachidic, behenic, erucic, and lignoceric. The 14 fatty acid standard was diluted with BHT 5 times creating a 5-point dilution. All chemicals used for this trial were purchased from Sigma Aldrich (St. Louis, MO).

The GCMS conditions for this trial were as follows: injector temperature: 260°C. Column oven temperature began at 50°C, held there for 2 min, increased by 10°C/min until 250°C was reached, and held for eighteen min for a total run time of 40 min per sample. External electrochemical ionization (**EI**) was used to ionize samples. From time zero to 7.5 min the MS was turned off, starting at time 7.5 min the MS was turned on, until the end of the 40 min. Full scan was utilized and was scanned from 50 through 400 m/z.

Statistical Analysis

Data were subjected to ANOVA using Mixed Procedures of SAS (2008) with treatment (homogenization), week, breed, and all interactions used as dependent variables. Ruminal, milk and serum data analysis did not use treatment because all animals were in both treatments.

Dry matter, body measurements, hip height, wither height, average daily gain (ADG) and milk yield were recorded and analyzed. Significance was set at $P < 0.05$. Model used: $Y_{ikj} = T_i + B_j + W_k + e_{ijk}$ With Ti representing treatment, Bj representing breed effects, and Wk representing week effects.

Results

Dry matter intake was greater for Holstein cows compared to Jersey cows (62 kg/d vs. 52 kg/d, respectively; $P<0.01$) as expected. There was no difference between Holstein cows and Jersey cows in FE (2.39 vs. 2.02, respectively; $P<0.41$) or MY (30.1 kg/d vs. 26.7 kg/d, respectively; $P<0.21$). No differences ($P>0.05$) were observed in fatty acid concentrations in feed, refusals, or rumen fluid (Table 1). Linoleate (C18:2) was the most abundant fatty acid found in the diet followed by C18:1 and C16. Given the reducing environment of the rumen, it is likely that the large amount of C18:2 in the diet was reduced to C18:1 and further to C18:0 in the rumen, as C18:2 was found in the smallest amount in the rumen where C18:1 and C18 increased, though not significantly. Palmitate (C16) was found in the greatest amounts in the rumen fluid of both Holstein and Jersey cows as well as in the serum (Table 1). Total fatty acid concentrations in milk from Holstein cows and Jersey cows were 1,939 ug/mL and 1,750 ug/mL, respectively, and were not different ($P = 0.32$). Homogenized milk samples contained numerically less total fatty acids per mL of milk (1779 ug/mL) compared to non-homogenized (1911 ug/mL), but these were not significantly different. Differences in individual fatty acids, as a percent of total fatty acids, are reported in Table 2. There is a great deal of variation in fatty acid concentrations presented in the literature, however, there are many similarities between the data reported here and elsewhere. Similarly to O'Donnell (2010), Mansson (2008), Pereda et al., (2008), and White et al., (2001), C16, C18, and C18:1, were found in the greatest concentrations in all types of milk. In this study, these three fatty acids made up approximately 60% of the total fatty acids in milk across breeds and treatments. C16 was also greater in milk than other fatty acids and there was a trend for greater C16 in milk from Jersey cows (30.6%) than in Holstein cows (28.5%, $P < 0.06$, Table 2). C12 was

Table 1. Fatty acid concentrations in the diet, rumen fluid, serum from Holstein and Jersey Cows

Fatty Acid	Diet, ug/g	Rumen, ug/mL				Serum, ug/mL			
		Holstein	Jersey	SEm	P <	Holstein	Jersey	SEm	P <
Octanoate (C8:0)	0	0.55	1.77	0.71	0.23	0.01	0.007	0.06	0.97
Caprate (C10:0)	0	80.2	94.0	11.4	0.40	9.31	31.8	23.0	0.50
Laurate (C12:0)	77.8	59.4	75.7	7.59	0.14	23.6	26.8	14.5	0.88
Myristate (C14:0)	87.6	48.9	75.7	14.2	0.19	11.6	20.20	7.23	0.41
Palmitate (C16:0)	517.9	133.6	170.2	23.9	0.28	159	147	16.8	0.63
Palmitoleate (C16:1)	134.4	2.22	3.20	1.12	0.05	0	0	N/A	N/A
Stearate (C18:0)	189.1	38.26	59.3	14.4	0.31	139	113	13.3	0.17
Oleic (C18:1)	660.0	20.22	65.8	19.6	0.11	31.5	28.5	4.3	0.63
Linoleate (C18:2)	998.6	3.55	5.70	1.96	0.45	216	160	39.5	0.33
Linolenate (C18:3)	215.7	0	0	0	N/A	7.90	6.15	0.70	0.10
Arachidate (C20:4)	0	0	0	0	N/A	0	0	N/A	N/A

also greater in milk from Jersey cows than in Holstein cows (8.04 vs. 7.42%, $P < 0.04$). Milk from Holstein cows had greater amounts of C16, C18:1 and C18:3 ($P < 0.05$, Table 2) than milk from Jersey cows. These results are similar to that of White et al., (2001) who also noted that Jersey cows produced 13% less C18:1 than Holstein cows. Medrano et al., (1999) presented preliminary data that suggested breed differences in the concentration of stearoyl coenzyme A desaturase. This enzyme in primarily responsible for oxidation of C16 and C18 to C16:1 and C18:1, respectively, in the mammary gland. Further research is needed, however, to determine why fatty acid composition is different between breeds, especially when they are managed in the same environment. Differences in milk fatty acid composition could have an impact on further product development and may offer producers an opportunity for 'value added' products, especially if consumers are interested in consuming less trans fatty acids (C18:1). Mozaffarian and Clarke (2009) ranked types of fatty acids in order of decreasing risk of heart disease, starting with trans fatty acids, followed by saturated fats, then mono- and poly-unsaturated fatty

Table 2. Fatty acid composition (% total FA) in milk from Holstein and Jersey cows and in milk that was homogenized or not.

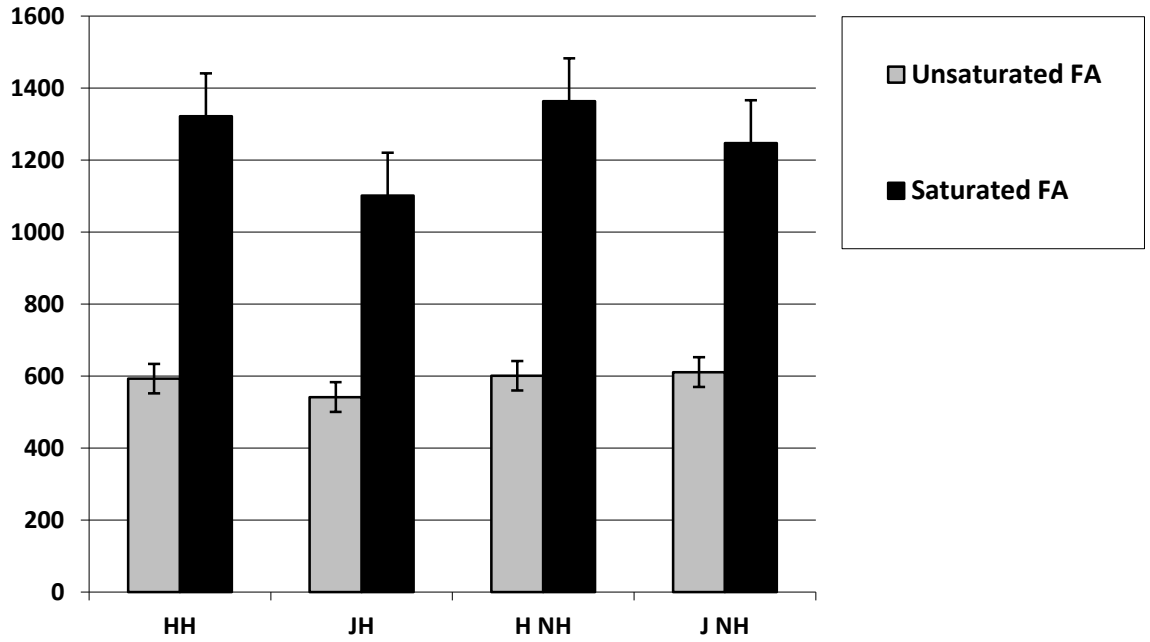
	Holstein	Jersey	SEm	P <	Homogenized	Non-Homogenized	SEm	P <
Octanoate (C8:0)	0.63	0.75	0.05	0.09	0.65	0.73	0.05	0.12
Caprate (C10:0)	7.46	7.55	0.22	0.76	7.81	7.19	0.21	0.04
Laurate (C12:0)	7.42	8.04	0.21	0.04	7.77	7.70	0.21	0.81
Myristate (C14:0)	15.5	16.1	0.26	0.09	15.8	15.7	0.23	0.82
Palmitate (C16:0)	28.5	30.6	0.80	0.06	30.1	29.0	0.70	0.19
Palmitoleate (C16:1)	1.81	1.24	0.18	0.03	1.58	1.48	0.16	0.62
Stearate (C18:0)	13.5	14.8	0.51	0.10	13.9	14.4	0.40	0.23
Oleic (C18:1)	20.7	17.1	0.76	0.01	17.7	20.1	0.70	0.01
Linoleate (C18:2)	4.06	3.65	0.43	0.50	4.35	3.36	0.43	0.10
Linolenate (C18:3)	2.39	0.09	0.03	0.01	0.18	0.15	0.03	0.34
Arachidate (C20:4)	<0.01	<0.01	<0.01	0.30	0.01	<0.01	<0.01	0.13
Saturated FA	73.2	77.9	0.96	0.01	76.2	74.9	0.86	0.21
Unsaturated FA	26.8	22.1	0.95	0.01	23.8	25.1	0.86	0.22

acids. While milk from Jersey cows has been shown to be lower in C18:1 (trans fat), in this study and others (O'Donnell et al., 2010; Mansson, 2008) saturated fatty acids were found in greater concentrations than unsaturated fatty acids in both Holstein and Jersey milk as well as homogenized and non-homogenized milk. In this study, milk from Jersey cows had greater concentrations of saturated fatty acids compared to milk from Holstein cows ($P< 0.01$, Figure 1), but homogenization did not affect the concentrations of saturated or unsaturated fatty acids. Homogenized milk had greater amounts of C10, but lower amounts of C18:1 compared to non-homogenized milk ($P < 0.05$, Table 2). This could indicate that less oxidation of the fat globule occurs when milk is not homogenized, but more data is needed to appropriately make this conclusion.

Implications

Based on this data, non-homogenized milk has similar total fat and fatty acid composition to homogenized milk. However, very little data exists in the literature comparing homogenized and non-homogenized milk, thus it is difficult to make any conclusion about possible improvement in health conditions when

Figure 1. Saturated and unsaturated fatty acid concentration in homogenized and non-homogenized milk from Holstein and Jersey cows. HH = Holstein homogenized milk, JH = Jersey Homogenized milk, H NH = Holstein non-homogenized milk, J NH = Jersey non-homogenized milk.



consuming non-homogenized milk. There appear to be more differences in fatty acid types in milk between different breeds of cows. This could impact the fatty acid composition of dairy products if they are produced from milk from specific breeds of cows.

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Effects of By-pass Protein on Performance of Beef Heifers Fed Ryegrass Baleage

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Research Summary

Twenty one beef heifers (BW = 546 lb) were used to evaluate the effects of two by-pass protein sources on performance and feed intake of ryegrass baleage. Heifers were fed ryegrass baleage for a period of 21 d to allow for adaptation to the baleage, after which they were stratified by BW and randomly assigned to one of three treatments within strata (d 0): no supplemental feed (Control); 1.35 lb of a by-pass soybean meal/dried distillers grains mix (SBM); or 1.76 lb of dried distillers grains with soluble (DDGS). Supplemental feed was fed three times a week individually. Cattle were weighed on d 0, 28, and 51, and following d 51 weights, cattle were dosed daily a rumen-intert marker to asses intake for 10 d (5 d adaptation, followed by a 5 d fecal collection). Feces were analyzed for this marker to determine DMI. Supplement type had no effect on BW during the study; however, cattle supplemented with SBM had greater ADG during the first 28 d compared to the other treatments ($P < 0.05$), moreover, cattle fed DDGS had greater ADG compared to the other two groups from d 28 to 51. Overall, cattle fed either SBM or DDGS had greater daily gain compared to animals in the control group. A tendency was noted ($P < 0.15$) for cattle fed SBM to have less DMI compared to the other treatments. Beef cattle consuming ryegrass baleage may benefit from supplemental by-pass protein.

Introduction

Ruminants have requirements for both rumen degradable protein (RDP; , required for rumen and microbial health) and for rumen undegradable protein (RUP; utilized by the animal itself). Ryegrass baleage is an important commodity in south Mississippi. There are 613,000 acres of ryegrass planted in Mississippi (Lemus, 2009) and producers have found that by baling and wrapping ryegrass hay, they can better preserve the quality of the hay without losses incurred through conventional baling, drying and storage. McCormick et al. (2002) suggested that by preserving the quality of ryegrass via ensiling, dairies could reduce the amount of grain fed while maintaining productivity. In some situations beef cattle producers require increased quality forages (growing cattle or lactating cows), and while the usefulness of baleage in dairies has been documented, data are lacking regarding beef cattle production. Moreover, due to the very digestible nature of ryegrass baleage (McCormick, 2002) and the increased digestibility of protein found in ryegrass silage (VanVuuren et al., 1990), it is hypothesized that growing beef cattle may have a requirement for by-pass protein.

Procedures

All procedures were approved by the Institutional Animal Care and Use Committee of Mississippi State University.

Ryegrass.

Annual ryegrass (*Lolium multiflorum)* was drilled into prepared seed beds in December, 2010. On April 19, 2011 the crop was harvested at the late boot stage, baled and wrapped via a tube wrapping apparatus. At harvest prior to wrapping, samples of the hay were taken and submitted for analysis to determine proper amount of supplementation needed. Prior to feeding, samples were obtained, composited by period, and submitted for nutrient analysis to a commercial laboratory (Midwest Labs, Omaha, NE). Forage quality results are presented in Table 1.

Cattle.

Twenty five heifers were selected from the calf herd at White Sand Branch Unit. Heifers had been weaned for approximately 30 d prior to their selection. Calves were predominantly English cross bred (some *Bos Indicus* influence, 20%) cattle and weighed approximately 520 $\pm$ 28.7 lb. These heifers were maintained in a dry lot and given free choice access to ryegrass baleage. Additionally, cattle were handled daily for approximately 1 h. During this time, each animal was individually penned, and hand fed a mix of soybean hulls and DDGS so that they would become accustomed to being handled and fed daily. At the initiation of the study, the 21 easiest handling animals were selected, individually weighed, stratified by BW and randomly assigned to one of three treatments; no supplemental feed (Control); 1.35 lb of a by-pass soybean meal/dried distillers grains mix (SBM); or 1.76 lb of dried distillers grains with soluble (DDGS). Supplemental feed was fed three times a week individually. Supplements were formulated to deliver similar RUP concentrations, based upon RUP of ryegrass baleage. Ryegrass baleage was fed at the discretion of personnel at White Sand Unit, however, bales were never left in the feeder more than 3 d. Prior to being placed into the drylot, the bale was weighed and a sample obtained for DM analysis. Samples were weighed and dried in a forced air oven at 104^{o}F for 72 h. For each weigh period, dried samples were analyzed for proximate analysis (Table 1).

Table 1. Nutrient composition of ryegrass baleage.

Item	Period 1[a]	Period 2[b]	Cr_2O_3 Period[c]
DM, %	48.3	49.9	47.6
CP, %,[d]	15.3	15.6	14.9
TDN, %[d]	61.4	63.1	60.8
ADF, %[d]	36.1	34.7	35.3
IVDMD[e]			76.3

[a] Period 1: Day 0 to 28.

[b] Period 2: Day 28 to 51.

[c] Cr_2O_3 Period: Day 51 to 61 when cattle were dosed with Cr_2O_3.

[d] All values except DM are on a DM basis.

[e] In vitro dry matter digestibility was conducted on the samples during the Cr_2O_3 period to calculate DMI based upon Cr recovery.

Cattle were individually weighed on d 28 and 51 of the study. Weights were used to calculate ADG for those periods and for the overall study. On d 51 cattle were given an individual bolus containing 10 g of a rumen-inert substance (Cr_2O_3) which allows the measurement of DMI. This was repeated for the next 5 d. On d 6, following the dosing, fecal grab samples were obtained from each animal. This was repeated for the next 5 d. Fecal samples were dried (forced air oven at 104°F), composited and ground through a 2 mm screen. Following grinding they were analyzed for Chromium, the rumen-inert substance. Samples of baleage were obtained daily for this 10 d period, dried, composited and subsequently assayed for in vitro dry matter digestibility IVDMD. The IVDMD was used in conjunction with Cr recovery to calculate feed intake.

Statistical Analysis.

Data were analyzed as a randomized complete block design using PROC GLM of SAS. Animal was the experimental unit, and fixed effects included treatment. When the overall model was significant ($P \leq 0.10$) means were separated using the PDIFF option of SAS.

Results

Performance data are presented in Table 2. No treatment effects ($P > 0.10$) were noted for BW at any point in the study. However, cattle fed SBM had greater ADG ($P < 0.05$) during the first 28 d compared to the other two treatments. This effect was reversed somewhat during the 29 to 51 d period, with cattle fed DDGS having greater ADG than the other two groups ($P < 0.05$). Overall

Table 2. Performance of beef heifers supplemented with different protein sources while fed ryegrass baleage.

Item	Control[a]	DDGS[a]	SBM[a]	SE[b]	P-value
Initial BW, lb	540.0	549.0	549.0	24.25	NS
Day 28 BW, lb	544.0	555.0	567.0	22.40	NS
Day 51 BW, lb	565.0	602.0	595.0	23.50	NS
ADG, lb/d					
Day 0-28	0.14[c]	0.19[c]	0.60[d]	0.20	0.10
Day 28-51	0.98[c]	2.15[d]	1.28[c]	0.14	0.05
Day 0-51	0.50[c]	1.04[d]	0.90[d]	0.12	0.05
DMI, lb/d					
Cr_2O_3[e]	7.37[c]	7.95[c]	6.90[d]	0.52	0.14

[a] Control= no supplement; DDGS = Distillers dried grains with solubles fed at rate of 1.76 lb three days per week; SMB = by-pass soybean meal mixed with DDGS (32.49% SBM and 67.5% DDGS) fed 1.37 lb three d per wk.

[cd] Treatments with different superscripts differ.

[d] Calculated DMI based upon Cr_2O_3 recovery.

both supplemental treatments increased ($P < 0.05$) daily gain compared to Control groups. In contrast, Vendramini et al. (2011) did not show an improvement when RUP was supplemented to cattle grazing ryegrass pastures. It should be noted however that the amount of crude protein in the pastures used in the study by Vendramini et al. (2011) were much greater than those in the present study (22% versus 15.4% CP), and when there is excessive RDP, there is diminished response to RUP (Bargo et al., 2001). Perhaps the CP content of the baleage used in the present study was not adequate and the cattle did respond to RUP. Aikre et al. (2005) demonstrated that when fed a lesser quality hay there was a linear increase in ADG as RUP supplementation increased.

Dry matter intake based upon Cr_2O_3 recovery was similar for Control and DDGS cattle, however a tendency was noted ($P < 0.15$) for cattle supplemented with SBM to have lesser DMI (Table 2). Both Vendramini et al. (2011) and Aikre et al. (2005) noted decreased DMI with supplemental feeding, however this may be a forage substitution effect and does not explain why heifers in the present study fed DDGS did not have a decrease in DMI. It is hypothesized that perhaps the SBM is meeting more specific amino acid requirements by these growing cattle, thereby resulting in decreased intake.

Implications

Baleage is an important commodity in south Mississippi. Based upon the results of the present study, feeding baleage alone to growing beef cattle may result in a RDP deficiency. The addition of supplements that meet RDP resulted in improved ADG, and may decrease DMI. Producers who use baleage as part of their program for growing cattle may need to incorporate some type of RDP supplement especially if CP in the baleage is less than requirements.

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Soybeans as a Summer Alternative Crop Following Annual Ryegrass

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Research Summary

A demonstration project was undertaken in Summer of 2011 to examine the use of soybeans as an alternative summer crop following ryegrass. This would allow producers to diversify, and perhaps increase farm income. The option of planting row crops following winter grazing of ryegrass has been discussed in previous years, but none have evaluated the planting methodology. However it is not known how difficult it would be to implement such a program, nor is it clear what pitfalls producers might encounter in doing such a program. Twenty acres of land at the White Sand Branch Unit outside of Poplarville, MS that had been previously used for ryegrass production were planted with soybeans in May 2011 using a modified strip-till system (Plant-o-vator) or a no-till drill system. Average yield for the soybeans was 26 bu/acre for a total of 520 bu with no differences between planting type; however, difficulty was encountered from weather related events at harvesting and in locating a harvester and securing transportation to a grain elevator. Once all inputs were accounted for, net return was approximately $150/acre. Soybeans might be an alternative crop for summer production; however producers should ensure that the infrastructure (availability of harvesting equipment, and transport) are available before beginning such an endeavor.

Introduction

Diversification of income and reduction of inputs are two factors that can increase sustainability of beef cattle production systems. Reganold, et al. (1990) suggest that diversification of products is one option for agricultural producers. This would allow the producer not to be dependent upon sales of one commodity for their long term survival. One potential answer may be the incorporation of soybeans. Soybeans are typically planted in the late spring, and are harvested in early fall, which would allow ample time for planting of ryegrass for grazing purposes. In addition, soybeans are legumes, thereby greatly reducing N requirements for winter grazing. Moreover, the market price of soybeans is usually inversely related to beef cattle prices (Becker, 2008), thereby reducing the operations exposure to poorer market conditions in one commodity. In some diversified operations in South MS, producers have shown returns as much as $600 to $800/acre, however it should be noted that these operations were truly diversified, in that the operations had all equipment required for agronomic crop production (tractors, sprayers, combines). It is unclear to what extent soybeans can reduce input costs since they will require inputs (weed and pest control), nor is it clear to what extent a un-diversified producer (one lacking all the aforementioned equipment) can benefit from this type of program.

Procedures

Annual ryegrass (*Lolium multiflorum)* was mechanically harvested and removed from 20 acres in mid April 2011. Following removal of ryegrass soybeans were planted with a modified low till system (Plant-o-vator) that created a seed bed without major disturbance of the existing sod. Soybeans were planted at the rate of 42 lb/acre. Moreover, 50 lb/acre of 0-46-46 fertilizer was applied at the time of planting. A weed control program was established, and closely followed, until mid-August of 2011, it was deemed that at this time the equipment at White Sand Branch Unit would cause more damage to the soybeans than lack of weed control, therefore weed control was suspended at this time. It was determined that optimal harvest would be mid-September, however, on September 2-5, 2011, Tropical storm Lee hit the region which resulted in 14 inches of rain, thereby delaying the harvest until October 5, 2011. This delay greatly reduced the yield especially with the modified strip-till soybeans since they were about three weeks earlier in their reproductive state than the no-till system. Soybeans were mechanically harvested, weighed and transported to Mobile, AL, where they were sold. Following harvest, pastures were subsequently prepared and planted in annual ryegrass (*Lolium multiflorum).*

Results

Average yield for soybeans was approximately 26 lb/acre. No differences were noted among planting type. It was estimated that the yield would have been higher, however damaged soybeans from tropical storm Lee as well as weed invasion may have resulted in a lower yield. The White Sand Branch Unit was chosen for this particular pilot study since most of the equipment found at the station would be indicative of what would be found at a beef cattle producer's operation, since the aim of this project was to see how feasible this management would be at an "average" cattle producer operation. One thing encountered was the difficulty in weed control. High-clearance sprayers allow row crop producers to enter into fields with minimal damage to the crop, however, most cattle producers do not have access to this type of equipment; therefore, they would face the same dilemma encountered at White Sand Unit, the difficulty of spraying weeds once plants have reached a certain height. Additionally, some difficulty was encountered securing a combine and operators to harvest the crop, which might be another dilemma faced by cattle producers, based upon their geographic location. Based upon the condition of the soybeans, the commodity brokers offered $13.26/bu. This resulted in a total return of $6895/acre. When the seed cost, fertilizer cost, weed control cost, harvesting and hauling fees were subtracted a total of $3000 was left as net return, which when divided among the 20 acres left a return of $150/acre. Subsequent soil tests determined a small difference in N requirement compared to pastures which were not planted in soybeans, which would equate to about $2000 for the 20 acres. It is unclear what the potential yield may have been had the soybeans been harvested at their determined time.

Finally, while this was not noted in the demonstration study, legumes such as soybeans are sensitive to some broadleaf weed control chemicals used in grazing pastures, and use of such chemicals (Picloram) may harm or damage the soybean crop.

Implications

Based upon the results of this demonstration, soybeans may be an option for cattle producers to use to diversify their income, however difficulty may be encountered in weed control, due to lack of proper equipment, which might reduce yield. Moreover, cattle producers might face a challenge in securing harvesting and hauling options for their crop. While soybeans may reduce the need for N fertilization, and might provide additional income for a cattle operation, producers are encouraged to examine and determine if the infrastructure is available (harvesting and hauling) prior to adopting such an endeavor. Additionally, producers must examine whether this type of investment will have sufficient return that they make a capital investment in purchasing equipment.

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Evaluation of Different Methods of Cattle Hip Height Data Collection

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Research Summary

Reporting accurate cattle hip height is important for calculation of frame score and expected progeny differences. The objectives of this study were to 1) evaluate the accuracy of the following hip height collection methods: visual appraisal using a pre-measured board placed on the opposite side of the animal from the observer (VIS), measurement of the difference in distance down to the hips from the distance down to the floor with a descending tape placed above the animal (TPE), and measurement using an altitude stick (STK); 2) determine if head restraint affects hip height data accuracy; and 3) assess reproducibility of hip height measurements using different observers. Hip heights were collected on cows (n = 329) and calves (n = 341). Cow hip height was greater ($P < 0.01$) for TPE than VIS and STK (53.3, 52.7, and 52.7 ± 0.08 in, respectively). There was a significant interaction for restraint × chute score (CS) for cows ($P < 0.01$) and calves ($P < 0.03$). Hip height was greater ($P < 0.01$) for calves with heads unrestrained (43.4 ± 0.08 in) compared to restrained (42.6 ± 0.08 in) in a squeeze chute. As CS increased (1, 2, 3), calf hip height (43.5 ± 0.04; 43.2 ± 0.08; 42.4 ± 0.12 in, respectively) decreased ($P < 0.01$). Pearson correlation coefficients between observers were significant ($P < 0.01$) and all 0.86 or greater indicating that the measurements were quite reproducible. Hip height measurements can vary due to collection method, head restraint, and CS.

Introduction

Accurate cattle hip height reporting is important for accurate calculation of frame score and yearling and mature height expected progeny differences. Hip height is converted to frame score, a categorical trait (1 to 9; small to large) that describes skeletal size in beef cattle (Vargas et al., 2000). Frame size is defined by hip height at a particular age (Vargas et al., 1999) and is related to growth rate and slaughter weights at which cattle should grade USDA Choice (USDA-Agricultural Marketing Service, 2000). Hip height is also related to heifer age at puberty, beef female productivity, and scrotal circumference (Vargas et al., 1998, 1999).

Frame size influences cattle marketing. Studies of cattle sales reveal that frame size affects prices for feeder calves marketed in the U. S. Southeast and Southern Plains (Troxel and Barham, 2007; Reuter et al., 2011; Troxel et al., 2011), bulls (Atkinson et al., 2010), and market cows (Troxel et al., 2002). One analysis showed that a 1-unit increase in frame score increased the sale price of bulls by $93, all else equal (Atkinson et al., 2010).

Measurement method can affect data accuracy as demonstrated by Parish et al. (2009) for calf birth weight. The recommended site for hip height measurement is a point directly over the hooks (Beef Improvement Federation, 2010). However, no other guidelines regarding measurement technique are provided, and multiple techniques are utilized. Currently little information exists

regarding the accuracy of various hip height measurement methods. There is also a dearth of information on the effect of head restraint on hip height measurement. This warrants investigation to refine hip height data collection recommendations. The objectives of this study were to 1) evaluate the accuracy of the following hip height collection methods: visual appraisal using a pre-measured board placed on the opposite side of the animal from the observer (VIS), measurement of the difference in distance down to the hips from the distance down to the floor with a descending tape placed above the animal (TPE), and measurement using an altitude stick (STK); 2) determine if head restraint affects hip height data accuracy; and 3) assess reproducibility of hip height measurements using different observers.

Procedures

The cattle in this study were managed under protocol 11-072 approved by the Mississippi State University Institutional Animal Care and Use Committee. Hip height estimates and measurements were collected on cows (n = 329) and calves (n = 341) during routine pre-weaning or weaning processing. Data collection dates were September 13 to 14, 2011 at the Mississippi Agricultural and Forestry Experiment Station Prairie Research Unit (Prairie, MS) (n = 117 cows; n = 115 calves); September 16, 2011 at the Mississippi Agricultural and Forestry Experiment Station Leveck Animal Research Center (Mississippi State, MS) (n = 57 cows; n = 54 calves); September 26 and 29, 2011 at Cain Cattle Company (Pickens, MS) (n = 123 cows; n = 120 calves); and October 3, 2011 at Calyx Star Ranch (Shuqualak, MS) (n = 32 cows; n = 52 calves).

Breed composition of cattle evaluated at the Leveck Animal Research Center included Angus, Charolais, Hereford purebred calves and crossbred calves representing predominantly Angus and Polled Hereford sire breeds. Cattle evaluated at the Prairie Research Unit were crossbred using the following sire breeds: Angus and Horned Hereford. Cattle evaluated at Cain Cattle Company were Angus, Brangus, and crossbred cattle sired by Angus and Brangus bulls. Cattle evaluated at Calyx Star Ranch were Brangus and predominantly Brangus-influence crossbred cattle. Parities of dams in the current study ranged from first parity to sixteenth parity. Calves were derived from combinations of embryo transfer, artificial insemination, and natural service breeding programs. Squeeze chutes utilized at each location were as follows: SILENCER Commercial Pro Model Hydraulic Squeeze Chute (Moly Manufacturing, Inc., Lorraine, KS) at Prairie, MS; Model 450 Squeeze Chute with Model 30 Headgate (For-Most Livestock Equipment, Hawarden, IA) at Mississippi State, MS; Beefmaster XL Straight Chute (W-W Manufacturing, Thomas, OK) at Pickens, MS; and C-III CATTLEAC SPECIAL Squeeze Chute (Cattleac Cattle Equipment & Acc. Inc., Weatherford, OK) (for handling cows) and SILENCER Ranch Model Hydraulic Squeeze Chute (Moly Manufacturing, Inc., Lorraine, KS) (for handling calves) at Shuqualak, MS.

Care was taken to ensure that cattle were standing on a level surface with proper posture for measurements. For each animal hip height was first visually estimated by a trained observer looking level across the hips of the animal at a fixed-position board marked with 0.5-in measurement increments and placed free-standing adjacent to the squeeze chute on the opposite side of the animal from the observer. This board was

positioned in advance of cattle handling and confirmed to be in appropriate position by using a measuring tape to calibrate the board markings with actual measurements. The board was fastened to be immobile and checked again with a measuring tape at the conclusion of each data collection session to confirm proper placement. Hip height was then collected using a telescoping measuring stick (Altitude Stick, Nasco, Fort Atkinson, WI).

A bubble-containing level on the horizontal cross bar of the Altitude Stick was utilized to obtain proper positioning of the device for measurements. A second perpendicular to the first level could have been used to ensure that the Altitude Stick was level; however, only the level contained in the Altitude Stick was utilized for hip height measurement to best reflect industry practice. The trained observers were instructed to take care to position the Altitude Stick so that it appeared level. A third observation was next recorded by extending a retractable measuring tape downward and perpendicular to the ground from a fixed distance above the squeeze chute and recording the distance from the fixed position to the top of the animal's back between the hips. This distance was then subtracted from the distance to the floor of the squeeze chute that was determined prior to cattle handling using the same apparatus.

These hip height data were taken on cattle confined to a squeeze chute with the squeeze mechanism engaged but their heads unrestrained (UNRESTR). The first observer then repeated the 3 measurement methods with cattle confined to a squeeze chute with the squeeze mechanism engaged and their heads restrained (RESTR). After hip height data were recorded using observations by the first observer, a second experienced observer replicated these observations in the same manner as the first observer, first taking the VIS, STK, and TPE measurements in sequence on each animal with its head unrestrained and then taking these measurements in the same sequence using the head restraint. Thus, a total of 12 hip height measurements were recorded for each animal, with 6 observations by each observer using 3 methods (VIS, STK, and TPE) and 2 restraint options (UNRESTR and RESTR). Although both observers were present in the cattle handling area for all measurements, they were instructed to ignore the measurement processes of each other and collect the hip heights independently. Reproducibility was defined as the closeness of agreement between measurement results of the same measure that were measured under different conditions (Taylor and Kuyatt, 1994). In this case, the different conditions were the different observers.

Chute score (CS) was recorded for each animal during hip height measurements, once with head restrained and again with head unrestrained. Chute score was assessed by 2 technicians and averaged based on a 5-point scale (adapted from Voisinet et al., 1997), where 1 = calm, no movement; 2 = restless shifting; 3 = constant shifting with occasional shaking of the chute; 4 = continuous movement and shaking of the chute; and 5 = violent and continuous struggling. Unique animal identification, sex, birth date, and breed composition were recorded or acquired from herd records.

The GLM Procedure in SAS (SAS Inst. Inc., Cary, NC) was used to estimate least squares means for the response variable hip height with a model including the fixed effects of hip height method, head restraint, and chute score and their interactions. Location was excluded from the model

because it was descriptive of herd frame size, and any impact of chute design was confounded with herd frame size. Because of inherent frame size differences between mature and growing cattle, cow data were analyzed separately from calf data. Standard deviation estimates were calculated from the STK hip height data and were used to classify cows into the following 3 hip height level groups: low (< 52.0 in, < -0.5 SD), moderate (52.0 to 53.5 in, -0.5 to 0.5 SD), and high (> 53.5 in, > 0.5 SD).

After determining that hip height method was a significant effect for the cow data, these data were then evaluated using the GLM Procedure in SAS with a model including the fixed effects of hip height method, hip height level, and their interaction. In addition, SD estimates were calculated from the STK hip height data and were used to classify calves into the following 3 hip height level groups: low (< 42.3 in, < -0.5 SD), moderate (42.3 to 44.3 in, -0.5 to 0.5 SD), and high (> 44.3 in, > 0.5 SD). After determining that restraint method and CS were significant effects for the calf data, these data were then evaluated using the GLM Procedure in SAS with a model including the fixed effects of restraint method, hip height level, and their interaction and another model including the fixed effects of CS, hip height level, and their interaction. Least squares means were separated at $P < 0.05$. Reproducibility of measurements was assessed with Pearson correlation coefficients between observers using the CORR Procedure in SAS.

Results

Several methods are available for collecting cattle hip heights. To minimize cattle handling and processing time, many producers visually assess hip height using the VIS method. Possible sources of measurement error with this method include variation in the height of the observer's eyes relative to the animal's hips and any visual obstructions between the observer and the pre-measured board. For example, if an observer is viewing the marked measurement gradients on the board from above the animal's hip height, then there may be a tendency to underestimate hip height using the VIS method, and vice-versa if an observer is viewing the measurement gradients on the board from below the animal's hip height.

The accuracy of the VIS method may also be influenced by the distance increments between the marks on the reference board. For instance, marking the reference board with 0.5-in as opposed to 1.0-in measurement increments could improve the accuracy of the resulting hip height measurements using this technique. Minimizing the distance the observer stands away from the reference board might also reduce error with this method. For this study, each observer stood approximately 1.0 ft. away from the squeeze chute on the side opposite to the reference board placement.

Hip heights can also be measured using the STK method. For this trial, the STK method was considered the standard to which the other 2 methods were compared. Ensuring that the altitude stick is level and touching both the floor of the chute and the animal directly across the hips is essential to reduce measurement error. Some chutes have floors that include raised bars or other items at set intervals to reduce slipping of hooves. It is critical that the animal's hooves and the altitude stick base be placed directly on the floor surface and not on any raised items on the floor surface for accurate hip height measurement.

The TPE method was the third hip height data collection method evaluated in this study. Personnel responsible for data collection noted that the measurement apparatus needed to be positioned above each animal such that it was directly above the point of measurement. Otherwise, the tape would either contact the animal in an improper position for measurement or descend at an angle that was not exactly perpendicular to the floor giving an inflated value of the distance from the apparatus to the animal. In the latter instance, the resulting hip height calculation would be less than it would have been if the tape was descended to the animal at a 90-degree angle to the floor.

Another possible source of human error noted when utilizing the TPE method involved the metal clasp at the end of the retractable measuring tape. As is common with these types of measuring tapes, this clasp hinged at its base and could contact the animal at its end, lying flush on its side against the animal, or at an angle in between these positions. To avoid introducing bias into hip height calculations with the TPE method, persons collecting hip height data must be consistent in the positioning of this clasp for each animal measured and for measurements down to the floor of the chute.

Animal structure, posture, and movement may also impact hip height measurement accuracy. Differences in animal skeletal structure or muscling that create protrusions or indentations at the measurement site on the animal could create measurement differences among cattle using the various measurement methods. For example, an indentation at the measurement site might be captured in the distance recorded for the TPE method but not for the other 2 methods if adjacent structures hold the altitude stick above this indentation or affect the view across the hips for the VIS method. With regard to animal posture, although every effort was made to ensure that cattle were standing level in the proper posture at the time of hip height measurement, it was noted that cattle appeared to pull backwards against the head restraint when their heads were caught in the chute head restraint device. In this position, the rear legs of the cattle sometimes moved under the animal towards the head so that the hips were slightly lowered. If this occurred during hip height measurement, then the resulting data would undervalue actual hip height. Calf movement was assessed via CS to account for the effect of this on hip height measurements.

Descriptive statistics for cattle hip height collection and restraint methods by animal class appear in Table 1. Pearson correlation coefficients between observers for all combinations of animal class, hip height data collection method, and head restraint were significant ($P < 0.01$). In addition, they were all 0.86 or greater indicating that the hip height measurements were quite reproducible. Significant Pearson correlation coefficients ($P < 0.01$) between observers were found for VIS (r = 0.88, r = 0.94), TPE (r = 0.89, r = 0.92), STK (r = 0.90, r = 0.94), RESTR (r = 0.90, r = 0.93), and UNRESTR (r = 0.87, r = 0.93) for cows and calves, respectively. Henderson et al. (1966) demonstrated with bovine LM area measurements that errors in measuring due to different operators were greater than those for 1 operator making duplicate measurements. In the current study, the reproducibility of measurements between observers was quite good.

Table 1. Descriptive statistics and observer correlations for cattle hip height collection and restraint methods by animal class[1]

Animal class and hip height data collection method[2]	Head restraint[3]	Mean hip height, in	SD, in	Variance, in	Minimum, in	Maximum, in	Pearson correlation coefficient between observers[4]
Cow							
VIS	RESTR	52.7	1.6	6.2	48.0	56.5	0.88
STK	RESTR	52.7	1.6	6.0	48.0	56.5	0.92
TPE	RESTR	53.2	1.5	6.1	48.0	57.5	0.93
VIS	UNRESTR	52.8	1.6	6.4	48.5	57.0	0.87
STK	UNRESTR	52.8	1.6	6.3	49.0	57.0	0.89
TPE	UNRESTR	53.3	1.6	6.5	48.0	57.5	0.86
Calf							
VIS	RESTR	109.5	2.2	11.9	32.0	48.0	0.94
STK	RESTR	109.4	2.0	9.8	32.0	48.0	0.94
TPE	RESTR	109.2	2.1	11.7	32.0	49.0	0.91
VIS	UNRESTR	110.5	2.2	11.8	32.0	48.5	0.94
STK	UNRESTR	110.7	2.0	1.0	32.0	47.5	0.94
TPE	UNRESTR	110.9	2.0	10.8	33.0	49.0	0.93

[1]Data represent hip heights collected by both observers and is not separated by observer.
[2]Hip height data collection method: VIS = visual estimation by a trained observer looking level across the hips of the animal at a fixed-position board marked with 0.5-in measurement increments and attached to the squeeze chute on the opposite side of the animal from the observer; STK = telescoping measuring stick (Altitude Stick, Nasco, Fort Atkinson, WI); TPE = retractable measuring tape extended downward and perpendicular to the ground from a fixed distance above the squeeze chute, distance from the fixed position to the top of the animal's back between the hips subtracted from the distance to the floor of the squeeze chute determined prior to cattle handling using the same apparatus.
[3]Head restraint: RESTR = head restrained in squeeze chute; UNRESTR = head unrestrained in squeeze chute. Cows: n = 329; Calves: n = 339 RESTR, n = 341 UNRESTR.
[4]Observers: n = 2; $P < 0.01$.

Of the CS assigned, only 13 UNRESTR and 4 RESTR cattle were assigned scores of 4, and none were given scores of 5. This lack of variation in CS greater than 3 did not lend the data to analysis of potential differences in CS 4 and 5 within hip height data collection and restraint methods. Therefore, CS data are presented for CS 1 to 3 only. Significant Pearson correlation coefficients ($P < 0.01$) between observers of cows tended to decrease as CS increased (CS 1, r = 0.91; CS 2, r = 0.86; CS 3, r = 0.83). This is logical because as CS increases, movement of cattle within the squeeze chute increases. This increased animal locomotion could have made it more difficult for the observers to obtain accurate and reproducible

measurements. Phillips and Dawson (1936) reported that accurate measurements of swine were difficult to take because the animal's position changed frequently. Significant Pearson correlation coefficients ($P < 0.01$) between observers of calves in this study tended to be less for CS 2 and 3 relative to CS 1 (CS 1, r = 0.95; CS 2, r = 0.87; CS 3, r = 0.90). Thus, it appears that calf hip height measurements tended to be most reproducible when calves were relatively still in the chute, and even the slight movements associated with CS 2 may have lessened reproducibility.

As was seen with calf birth weight (Parish et al., 2009), measurement method affected cow hip height. Cow hip height was greater ($P < 0.01$) for TPE than VIS and STK (53.3, 52.7, and 52.7 ± 0.8 in, respectively) (Table 2). The range of the difference between TPE and STK least squares means was also numerically greater than that between VIS and STK least squares means. Therefore, the VIS method produced comparable results for cow hip height to the STK method, whereas the TPE method overestimated hip height values relative to the STK method and tended to be more variable compared with the VIS method. Parish et al. (2009) also documented that data collection methods can underestimate and overestimate values relative to a standard method and that the range of measurement differences from a standard method can vary by measurement method.

Table 2. Cow hip height (in) least squares means, SE, and descriptive statistics for hip height data collection methods

Hip height data collection method[1]	Least squares means ± SE	Least squares means minus STK least squares mean	Least squares means minus STK least squares mean range
VIS	52.7[b] ± 0.8	0.0	-2.5 to 2.0
STK	52.7[b] ± 0.8	0.0	0
TPE	53.3[a] ± 0.8	0.6	-4.5 to 3.5

[a,b]Means with different superscripts within column differ ($P < 0.05$).

[1]Hip height data collection method: VIS = visual estimation by a trained observer looking level across the hips of the animal at a fixed-position board marked with 0.5-in measurement increments and attached to the squeeze chute on the opposite side of the animal from the observer; STK = telescoping measuring stick (Altitude Stick, Nasco, Fort Atkinson, WI); TPE = retractable measuring tape extended downward and perpendicular to the ground from a fixed distance above the squeeze chute, distance from the fixed position to the top of the animal's back between the hips subtracted from the distance to the floor of the squeeze chute determined prior to cattle handling using the same apparatus.

Table 3 presents cow hip heights by hip height level and collection method. At the low hip height level (< 52.0 in), there was no difference in collection method. However, at the moderate hip height level, the TPE method resulted in greater ($P < 0.05$) cow hip heights than the other 2 methods; at the high hip height level, the TPE method was the greatest ($P < 0.05$), the STK method intermediate ($P < 0.05$), and the VIS method least ($P < 0.05$) for cow hip height measurements. The positive values for the difference between TPE and STK measurements reveals that the TPE method tended to overestimate cow hip height relative to the STK method, particularly at moderate and high hip height levels where this difference was greatest ($P < 0.05$). The

negative values for the difference between VIS and STK measurements at low and high hip height levels indicates a tendency for the VIS method to undervalue cow hip heights in comparison to the STK method.

Table 3. Cow hip height (in) least squares means and SE for hip height level by hip height data collection method

	Hip height level[1]		
Hip height data collection method[2]	Low	Moderate	High
VIS	50.7^{f} ± 0.04	52.7^{e} ± 0.04	54.6^{c} ± 0.04
STK	50.8^{f} ± 0.04	52.7^{e} ± 0.04	54.7^{b} ± 0.04
TPE	50.8^{f} ± 0.04	52.9^{d} ± 0.04	54.9^{a} ± 0.04
VIS – STK	-0.1^{hi} ± 0.08	0.0^{h} ± 0.04	-0.2^{i} ± 0.04
TPE – STK	0.0^{h} ± 0.08	0.2^{g} ± 0.04	0.2^{g} ± 0.04

[a,b,c,d,e,f]Means with different superscripts within rows and columns differ ($P < 0.05$).
[g,h,i]Means with different superscripts within rows and columns differ ($P < 0.05$).
[1]Hip heights were divided into 3 groups by using the SD estimates from the STK hip height data: Low = < 52.0 in (< -0.5 SD); Moderate = 52.0 to 53.5 in (-0.5 to 0.5 SD); High = > 53.5 in (> 0.5 SD).
[2]Hip height data collection method: VIS = visual estimation by a trained observer looking level across the hips of the animal at a fixed-position board marked with 0.5-in measurement increments and attached to the squeeze chute on the opposite side of the animal from the observer; STK = telescoping measuring stick (Altitude Stick, Nasco, Fort Atkinson, WI); TPE = retractable measuring tape extended downward and perpendicular to the ground from a fixed distance above the squeeze chute, distance from the fixed position to the top of the animal's back between the hips subtracted from the distance to the floor of the squeeze chute determined prior to cattle handling using the same apparatus.

There was no effect of head restraint ($P = 0.76$) or CS ($P = 0.10$) on cow hip height. However, there was a significant interaction for restraint × CS for cows ($P < 0.01$) and calves ($P < 0.03$) (Table 4). Because CS was assigned for UNRESTR and again for RESTR, individual animals may have been assigned 2 numerically different CS based on their response to head restraint. For both cows and calves, UNRESTR animals with a CS of 1 had greater ($P < 0.05$) hip heights than cattle with a CS of 3. Likewise with RESTR calves, hip height progressively decreased ($P < 0.05$) as CS increased. In the UNRESTR cattle and the RESTR calves, the increased animal locomotion associated with the numerically greater CS resulted in hip heights being undervalued relative to cattle with lower CS. Thus, using additional time and care in obtaining hip height measurements in cattle with greater CS may be warranted. Within CS 1, both UNRESTR cows and calves had greater ($P < 0.05$) hip heights than RESTR cattle indicating that in calm cattle head restraint reduced hip height measurements. Further, UNRESTR calves with CS of 2 and 3 had greater ($P < 0.05$) hip heights than their RESTR counterparts. However, head restraint made no difference in hip heights between cows within CS 2 ($P = 0.14$) and 3 ($P = 0.81$). Thus, regardless of

CS, head restraint reduced hip height measurement in calves but did so in cows only when assigned a CS of 1. This suggests that the likely animal movement in the chute of the CS 2 and 3 cattle influenced calf hip height measurements to a greater degree than cow hip height measurements.

Table 4. Cow and calf hip height (in) least squares means and SE by chute score and restraint method

	Cow restraint method[2]		Calf restraint method[2]	
Chute score[1]	RESTR	UNRESTR	RESTR	UNRESTR
1	$52.8^{b} \pm 0.04$	$53.1^{a} \pm 0.04$	$43.2^{b} \pm 0.08$	$43.7^{a} \pm 0.08$
2	$53.1^{a} \pm 0.08$	$52.9^{ab} \pm 0.08$	$42.7^{c} \pm 0.12$	$43.6^{a} \pm 0.08$
3	$52.8^{ab} \pm 0.24$	$52.7^{b} \pm 0.12$	$42.0^{d} \pm 0.20$	$42.8^{c} \pm 0.16$

[a,b,c,d]Means with different superscripts within cattle age class and within rows and columns differ ($P < 0.05$).

[1]Chute score: 1 = calm, no movement; 2 = restless shifting; 3 = constant shifting with occasional shaking of the chute.

[2] Restraint method: RESTR = cattle confined to a squeeze chute with their heads restrained; UNRESTR = cattle confined to a squeeze chute with their heads unrestrained.

There was no effect ($P = 0.91$) of hip height collection method on calf hip height, nor were any of the interactions involving collection method significant ($P = 0.45$). Calf hip height was greater ($P < 0.01$) for UNRESTR (43.4 ± 0.08 in) compared to RESTR (42.6 ± 0.08 in) (Table 5). Yet within individual calf hip height levels, head restraint did not influence ($P = 0.13$) hip height. The 0.8-in difference between UNRESTR and RESTR calves across all hip height levels may be explained by calf posture in response to head restraint. Observers noted calves pulling backward against the head restraint when RESTR, and this may have meant that their rear legs were set forward of the hips instead of directly underneath the hips. This would have lowered the hips in the RESTR calves and resulted in reduced hip height measurements relative to UNRESTR calves. Grandin (1998) noted that handling of the head appears to be more aversive than carefully applied body restraint. Even animals that are handled routinely respond with abnormal or agitated behavior when they are held in a headgate because their flight zone has been invaded (Grandin, 1993). This helps explain why the cattle responded to head restraint by pulling backward.

As CS increased (1, 2, 3), calf hip height (43.5 ± 0.04; 43.2 ± 0.08; 42.4 ± 0.12 in, respectively) decreased ($P < 0.01$) (Table 6). Within calf hip height levels, there was no difference in hip height between CS 1 and 2 for moderate ($P = 0.88$) and high ($P = 0.20$) hip heights. However, within the low hip height level, calf hip heights were greater ($P < 0.05$) for CS 2 than for CS 1. Similarly, there was no difference in calf hip height between CS 2 and 3 for the moderate ($P = 0.76$) and high ($P = 0.10$) hip height levels, but calf hip heights were greater ($P < 0.05$) for CS 2 than for CS 3 at the low hip height level. In comparing calves with CS 1 and 3, hip heights were greater ($P < 0.05$) for animals assigned CS 1 at the low and high hip height levels; and no difference ($P = 0.82$) was found at the moderate hip height level.

Table 5. Calf hip height (in) least squares means and SE for hip height level by calf restraint method

Calf restraint method[2]	Hip height level[1] Low	Moderate	High	All levels
RESTR	40.8^{d} ± 0.04	43.3^{b} ± 0.04	45.5^{a} ± 0.04	42.6^{c} ± 0.08
UNRESTR	40.8^{d} ± 0.04	43.3^{b} ± 0.04	45.6^{a} ± 0.04	43.4^{b} ± 0.08
RESTR – UNRESTR	0.0^{f} ± 0.08	0.04^{f} ± 0.04	0.08^{f} ± 0.04	0.7^{e} ± 0.12

^{a,b,c,d}Means with different superscripts within rows and columns differ ($P < 0.05$).
^{e,f}Means with different superscripts within row differ ($P < 0.05$).
[1]Hip heights were divided into 3 groups by using the SD estimates from the STK hip height data: Low = < 42.3 in (< -0.5 SD); Moderate = 42.3 to 44.3 in (-0.5 to 0.5 SD); High = > 44.3 in (> 0.5 SD); All levels includes Low, Moderate, and High.
[2]Restraint method: RESTR = cattle confined to a squeeze chute with their heads restrained; UNRESTR = cattle confined to a squeeze chute with their heads unrestrained.

Table 6. Calf hip height (in) least squares means and SE for hip height level by chute score

Chute score[2]	Hip height level[1] Low	Moderate	High	All levels
1	40.7^{h} ± 0.04	43.3^{d} ± 0.04	45.6^{a} ± 0.04	43.5^{c} ± 0.04
2	41.1^{g} ± 0.04	43.3^{d} ± 0.04	45.5^{ab} ± 0.04	43.2^{e} ± 0.08
3	40.4^{l} ± 0.12	43.4^{cd} ± 0.12	45.2^{b} ± 0.16	42.4^{f} ± 0.12
2 – 1	0.4^{j} ± 0.08	0.0^{k} ± 0.08	-0.08^{kl} ± 0.08	-0.3^{m} ± 0.08
3 – 1	-0.3^{lm} ± 0.12	-0.04^{kl} ± 0.12	-0.4^{m} ± 0.16	-1.06^{n} ± 0.12

^{a,b,c,d,e,f,g,h,i}Means with different superscripts within rows and columns differ ($P < 0.05$).
^{j,k,l,m,n}Means with different superscripts within row differ ($P < 0.05$).
[1]Hip heights were divided into 3 groups by using the SD estimates from the STK hip height data: Low = < 42.3 in (< -0.5 SD); Moderate = 42.3 to 44.3 in (-0.5 to 0.5 SD); High = > 44.3 in (> 0.5 SD); All levels includes Low, Moderate, and High.
[2] Chute score: 1 = calm, no movement; 2 = restless shifting; 3 = constant shifting with occasional shaking of the chute.

Essentially, calf hip heights were undervalued for CS 3 calves relative to CS 1 calves, particularly at low and high hip height levels. Overall, hip height measurements in the low hip height level calves were most impacted by CS. Shorter stature calves were likely smaller in other physical dimensions and may have been held less securely in the squeeze chute, possibly allowing greater mobility. Additionally, observers may have been less likely to bend down further to view shorter stature calves level across the hips for the VIS and STK methods. With the TPE method, the tape had to be descended further for measurement of the shorter stature calves, and any deviation from a perpendicular angle to the floor would have been increasingly magnified in the distance recorded from the tape apparatus to the

calf's hips as calf stature decreased. Therefore, there appears to have been more potential to introduce bias into calf hip height measurements at the low hip height level, and this could have been compounded as CS increased.

Implications

Collection method, head restraint, and CS all affect hip height measurements. Cow hip heights may be overvalued with the descending tape and undervalued with the visual approach relative to measurement using an altitude stick. Cattle confined to a squeeze chute for hip height measurement should have their heads unrestrained for this measurement or risk undervaluing hip heights. Extra time and care in technique may be justified when cattle move during measurement. Despite a high degree of reproducibility, operator error could influence hip height measurements. Inaccurate cattle hip height data could affect expected progeny differences using this information in their calculations. A given hip height measurement error will impact the calculated frame score of older cattle more so than younger cattle due to the interaction term between hip height and animal age in frame score equations. Selection, management, and marketing decisions considering frame scores may be improved with accurate hip heights.

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Metabolic Differences in Cattle with Excitable Temperaments Can Influence Productivity

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Research Summary

Temperament can negatively affect various production traits, including live weight, ADG, DMI, conception rates and carcass weight (Fordyce et al., 1985; 1988; Burrow and Dillon, 1997; Petherick et al., 2003). Three research studies are summarized which indicate the potential influence of temperament on metabolism. In Brahman heifers, (n=12) the 6 most temperamental and 6 most calm were utilized for a glucose tolerance test. Calm heifers were able to clear glucose at a faster rate than temperamental heifers. Additionally, a study in Brahman calves, utilized calm (n=8), intermediate (n=8), and temperamental (n=8) bulls, selected based on temperament score, in order to determine their response to an immune challenge (i.e. lipopolysaccharide, LPS). Temperamental bulls had the smallest increase in rectal temperature (i.e. relative to baseline values) compared to calm or intermediate bulls ($P < 0.01$). Also, the data from this study suggest that temperamental cattle may display limited behavioral signs of illness which may prevent proper medical intervention, and increase the risk of transferring pathogens to healthy cattle. Furthermore, blood urea nitrogen and NEFA concentrations in these bulls suggest that temperamental bulls did not have to metabolize muscle protein in order to provide energy during the immune challenge, as did intermediate and calm bulls. Collectively, these data suggest that temperamental cattle may be utilizing NEFA rather than glucose for energy, which may have influenced their response to the LPS challenge. Thus, collectively these data suggest that clear metabolic differences exist between calm and temperamental bull calves and that alternative management strategies for temperamental cattle may decrease input costs for producers.

Introduction

Many factors may adversely affect the growth and productivity of livestock. These include stressors associated with management practices, such as weaning, handing relative to transportation, and vaccination, which can modulate growth through the production of stress-related hormones (e.g., cortisol, epinephrine, and norepinephrine; Crookshank et al, 1979; Rulofson et al., 1988; Lay et al., 1992; Carrasco and Van de Kar, 2003; Charmandari et al., 2005; Buckham Sporer et al., 2008). As the cost of cattle production continues to increase, it is essential for producers to find ways to decrease input cost to potentially increase profit. Temperament is an additional factor that can influence the productivity of cattle. Temperament is defined as the manner in which cattle react to humans or novel environments (Fordyce et al., 1988). Various methods are used to measure temperament, with the two most commonly

used by our laboratories being pen score and exit velocity (see Burdick et al., 2011b for review). Pen score is a subjective method to measure temperament. For the measurement, cattle are separated in groups of 3 to 5 animals and their reactivity to a human observer is ranked on a scale of 1 to 5 (Hammond et al., 1996). Exit velocity, also referred to as flight speed, is emerging as a more objective measurement of temperament in cattle (Fell et al., 1999; Curley et al., 2006; Müller and Von Keyserlingk, 2006; Vann et al., 2008). Exit velocity (Curley et al., 2006; Burrow et al., 1988) is defined as the rate (in meters/second) at which an animal traverses a specified distance after exiting a squeeze chute. As different aspects of behavior may be evaluated by different systems for measuring it (Curley et al., 2006), we calculate an average of pen score and exit velocity to create temperament scores. Based on temperament score, cattle can be ranked into temperament groups (e.g. calm, intermediate, and temperamental). A recent study has reported the heritability of pen score (0.44), exit velocity (0.28), and temperament score (0.41) in Brahman cattle (Loyd et al., 2011).

Previous research has demonstrated that temperament can negatively affect various production traits, including live weight, average daily gain, dry matter intake, conception rates, milk yield, carcass weight, tenderness, rib fat, and bruise score (Hafez and Lindsay, 1965; Fordyce et al., 1985; Fordyce et al., 1988; Burrow and Dillon, 1997; Breuer et al., 2000; Petherick et al., 2003; Prayaga and Henshall, 2005; King et al., 2006; Müller and von Keyserkingk, 2006; Hoppe et al., 2010; Café et al., 2011). Additionally, cattle temperament has been linked to stress responsiveness. Specifically, cattle that are more temperamental have greater circulating concentrations of the stress hormones cortisol and epinephrine (Curley et al., 2006; Burdick et al., 2009). Cortisol is a glucocorticoid, which binds to the glucocorticoid receptor present in most animal cells. In regards to metabolism, cortisol is known to inhibit the uptake of glucose into adipose and muscle tissue, stimulate gluconeogenesis in the liver, and stimulate the breakdown of fat in adipose tissue. Due to the greater stress hormone concentrations circulating in temperamental cattle, temperament may influence their metabolic responses. The interaction between temperament and metabolism is one area that has yet to be studied in sufficient detail. Herein, we discuss three studies aimed at elucidating the potential influence of temperament on metabolism.

Results and Discussion

A study was designed to determine the effect of temperament on the metabolic response of calves to a glucose tolerance test. During a glucose tolerance test, cattle are administered glucose, and the glucose and insulin responses to this challenge are monitored. The test is utilized to determine the time it takes for insulin to clear the exogenous glucose, as well as to monitor the relationship between insulin and glucose in order to determine insulin sensitivity or insensitivity. While the test has been utilized in humans as a test for type 2 diabetes, it has also been used in the dairy cattle industry in order to understand the influence of stress and nutrition on dairy cow milking traits (Lemosquet and Faverdin, 2001). Cortisol plays a major role in glucose metabolism, as discussed above; therefore, it has been hypothesized that the greater basal concentrations of cortisol secreted by temperamental cattle may alter the glucose and insulin responses to a glucose tolerance test. Temperament score

was determined for 36 Brahman heifers, from which the 6 most temperamental and 6 most calm heifers were utilized for a glucose tolerance test (Bradbury, 2011). During the 90-min period following cannulation and prior to the onset of the glucose tolerance test, temperamental heifers maintained greater plasma concentration of glucose and cortisol compared to calm heifers ($P < 0.01$ for both glucose and cortisol). Following administration of the glucose tolerance test, temperamental heifers maintained greater concentrations of cortisol ($P = 0.03$) and glucose ($P < 0.01$; Figure 1) compared to calm heifers. Additionally, there was a time by temperament interaction such that calm heifers had significantly greater concentrations of insulin than temperamental heifers from 10 to 60 min following administration of the glucose tolerance test ($P < 0.01$; Figure 2). Overall, time to peak insulin concentration, glucose half life concentration, and glucose half life time were all greater in temperamental heifers than calm heifers ($P < 0.01$ for all variables). Yet, peak insulin concentration was greater in calm than temperamental heifers ($P = 0.04$). In general, these data demonstrate that temperamental cattle have greater concentrations of cortisol, which remain elevated during periods of stress. Additionally, these data demonstrate that calm heifers were able to clear glucose at a much faster rate than temperamental heifers. Insulin is responsible for increasing the uptake of glucose into adipose and muscle tissue (Hocquette and Abe, 2000). Therefore, temperamental cattle may be more resistant to insulin compared to calm cattle, thus decreasing the amount of glucose that the cattle can absorb and store in muscle, fat, and the liver. As temperament modifies metabolic regulatory responses in heifers, this altered metabolism may partially explain their decreased productivity.

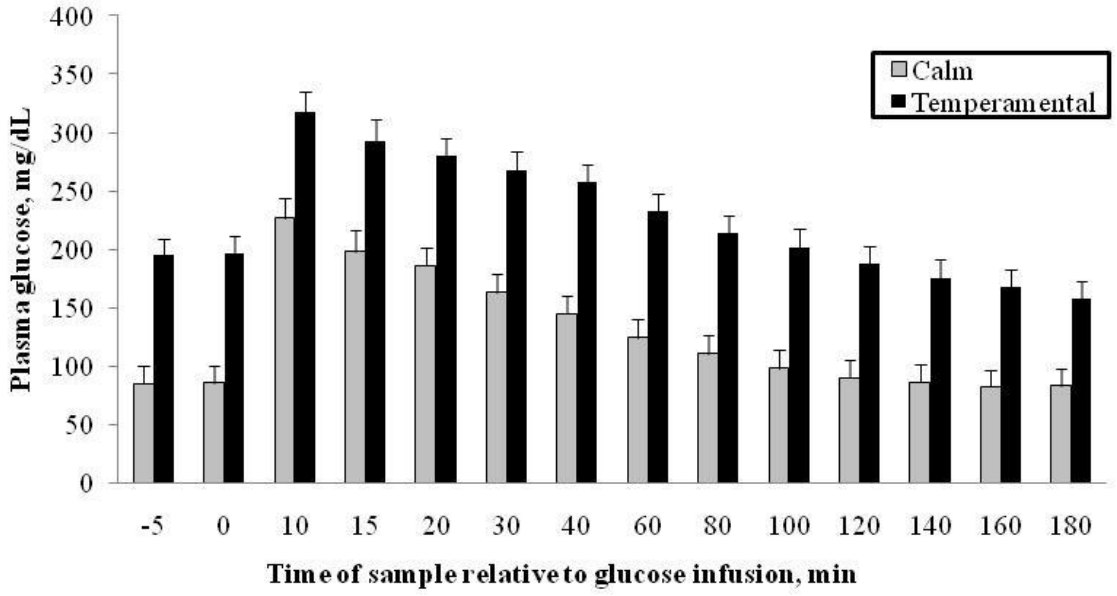

Figure 1. Plasma glucose response to administration of a glucose tolerance test in calm and temperamental Brahman heifers (Bradbury, 2011).

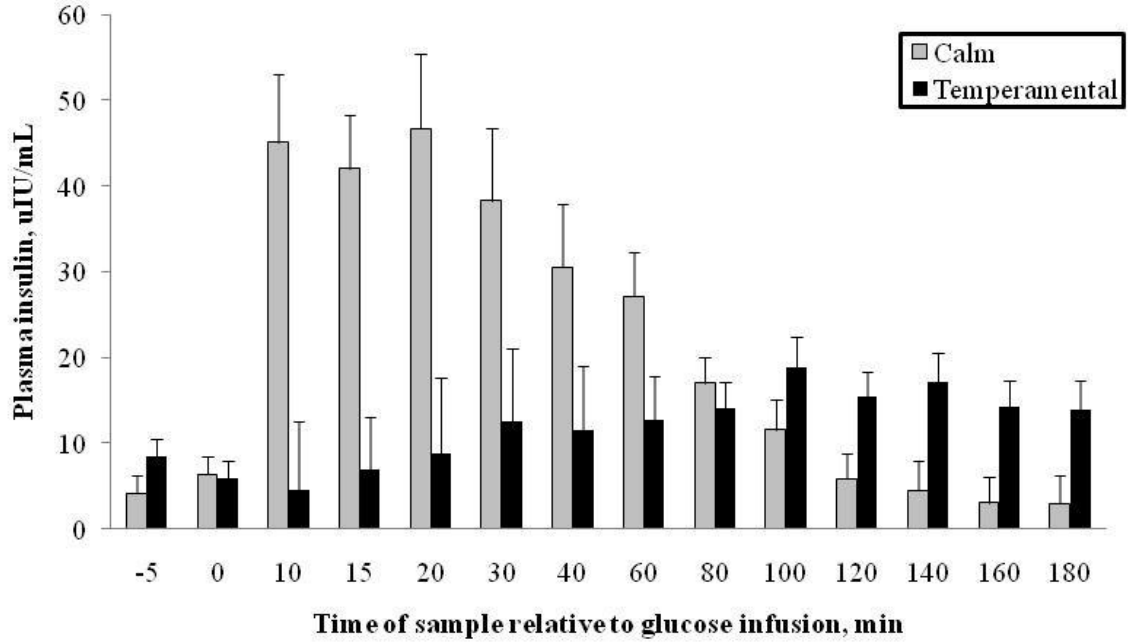

Figure 2. The insulin response to administration of a glucose tolerance test in calm and temperamental Brahman heifers (Bradbury, 2011).

In addition to influencing metabolism, cortisol can also influence the immune response. Elevated cortisol concentration, induced by acute stress (exposure to a stressor for a short duration of time) is not necessarily detrimental to an animal's health, and may actually enhance immune function. However, chronic stress, or stress extended over a prolonged period of time, can be detrimental to the health and well being of livestock. Therefore, it was hypothesized that temperament cattle would have an altered response to an immune stimulus compared to calm cattle. The study utilized calm (n = 8), intermediate (n = 8), and temperamental (n = 8) Brahman bulls, selected based on temperament score from a pool of 60 bulls, in order to determine their response to an immune challenge (lipopolysaccharide, LPS, a component of the cell wall of gram negative bacteria such as *E. coli*; Burdick et al., 2011a). Prior to administration of LPS, temperamental cattle had greater rectal temperature ($P < 0.01$), and cortisol ($P < 0.01$) and epinephrine concentrations ($P < 0.01$). Following administration of LPS, rectal temperature increased in all bulls, with temperamental bulls producing the smallest increase in rectal temperature (relative to baseline values) compared to calm and intermediate bulls ($P < 0.01$). Sickness behaviors, measured on a scale of 1 (normal maintenance behaviors) to 5 (head distended and lying on side with labored breathing) were also lower in temperamental bulls than intermediate and calm bulls ($P < 0.01$; Figure 3). Therefore, these data suggest that temperamental cattle may display limited behavior signs of illness, which may prevent proper medical intervention, and increase the risk of transferring pathogens to healthy, calmer cattle. While absolute cortisol concentrations were not different between temperament groups following LPS administration ($P = 0.80$), the change in cortisol relative to baseline concentration (measured from -2 to 0 h prior to LPS

administration) was greater in calm and intermediate bulls than temperamental bulls ($P < 0.01$; Figure 4). The greater cortisol concentrations in temperamental bulls prior to LPS administration may have resulted in the blunted cortisol response following LPS administration, which is similar to the results observed by Curley et al. (2008) in which cortisol secretion was stimulated by exogenous administration of adrenocorticotropic hormone (ACTH). Concentrations of plasma epinephrine also remained elevated in temperamental bulls following administration of LPS ($P < 0.05$; Figure 5). In summary, differences exist in the physiological (rectal temperature and sickness behavior) as well as endocrine (cortisol and epinephrine) responses of temperamental cattle to an LPS challenge.

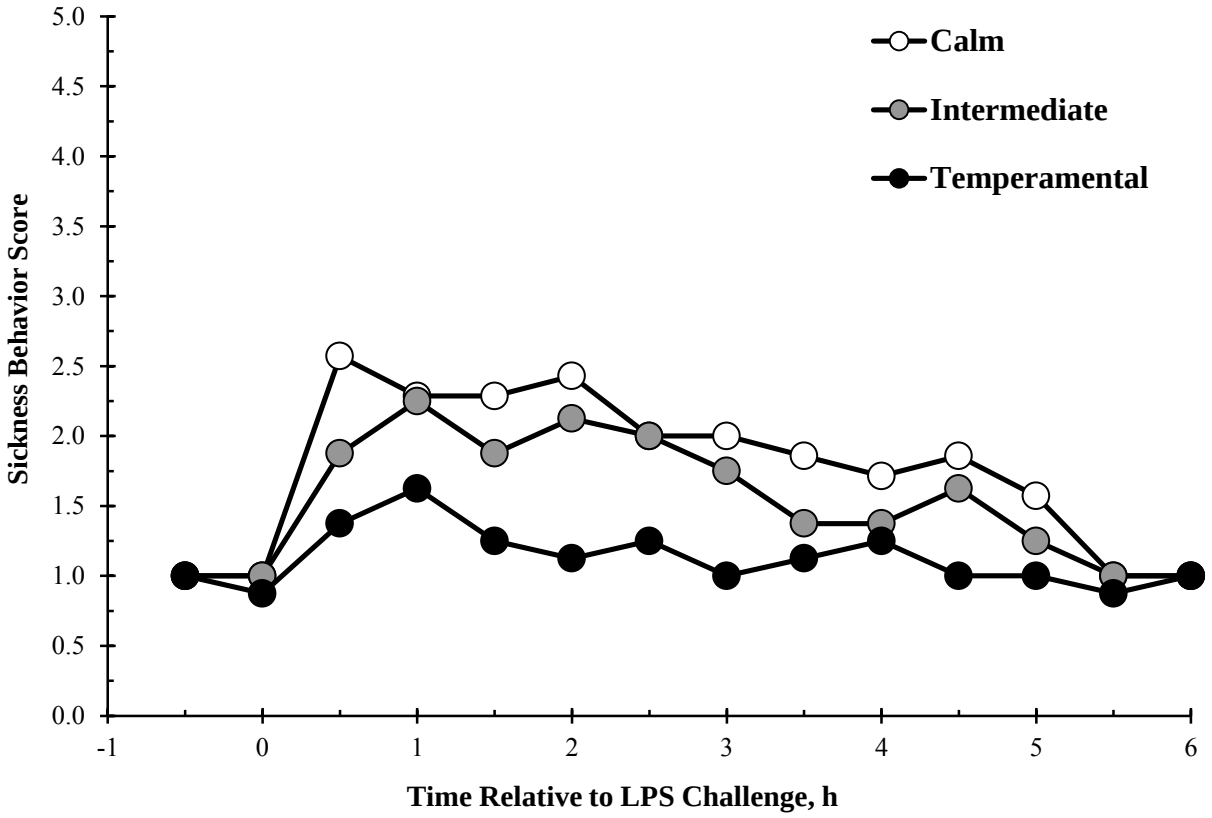

Figure 3. Sickness behavior response to administration of lipopolysaccharide (LPS) in calm, intermediate, and temperamental Brahman bulls (Burdick et al., 2011a).

The immune system has a high energy demand when activated. It has been estimated that to increase body temperature 1°C an animal must increase its metabolic rate by 10 to 13% (Carroll and Forsberg, 2007). Aside from increasing body temperature, there are additional energy requirements for other immune functions, such as the production of antibodies and acute phase proteins. As demonstrated in the first study, temperament can influence metabolic parameters, including glucose and insulin. These data, together with the immune response data, led us to hypothesize that differences observed in response to an immune challenge are due to differences in energy availability between calm and temperamental cattle.

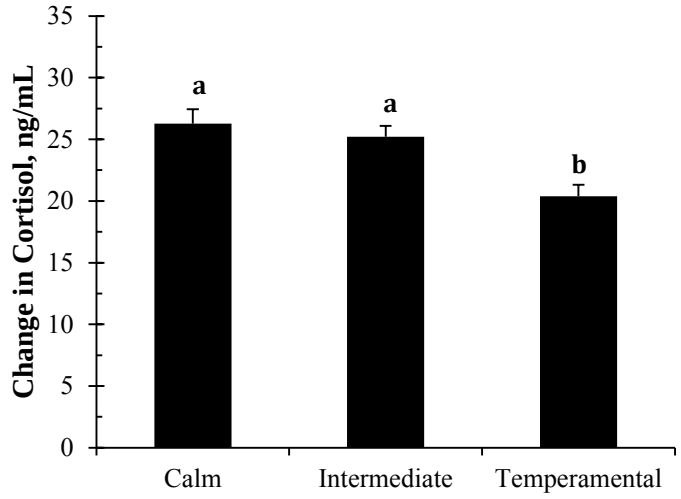

Figure 4. Average change in serum cortisol concentration (relative to an average of baseline cortisol concentrations) following administration of lipopolysaccharide (LPS) in calm, intermediate, and temperamental Brahman bulls (Burdick et al., 2011a). Unlike superscripts represent differences between temperament groups (*P* < 0.05).

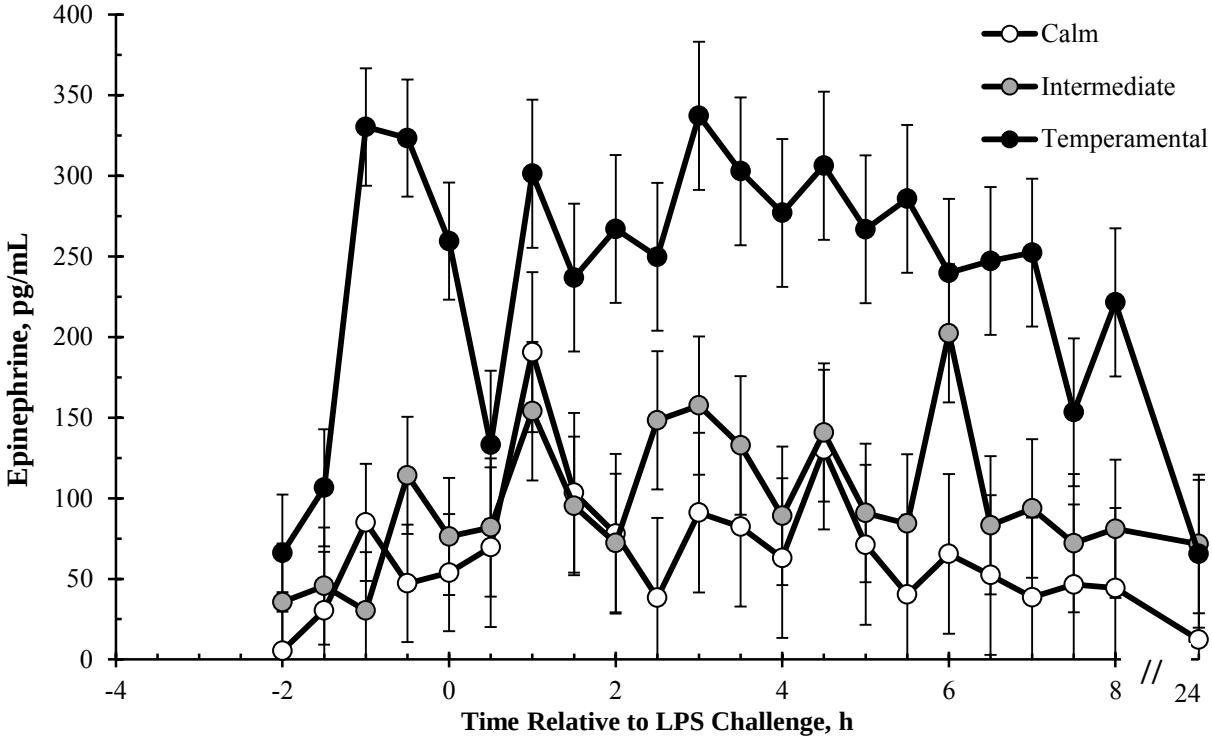

Figure 5. Plasma epinephrine response to administration of lipopolysaccharide (LPS) in calm, intermediate, and temperamental Brahman bulls (Burdick et al., 2011a).

To test this hypothesis samples from the LPS challenge described above were analyzed for various metabolic parameters. Results from this study indicate that temperamental bulls had an altered metabolic response compared to intermediate and calm bulls (Carroll et al., 2011). Specifically, there was a time by temperament interaction ($P < 0.01$) such that concentrations of glucose increased in response to LPS challenge in calm and intermediate bulls, but there was no increase in glucose concentration observed in temperamental bulls (Figure 6). Additionally, insulin, released in response to increasing blood glucose concentrations, was greater in calm bulls than intermediate and temperamental bulls following administration of LPS ($P < 0.01$). Due to the high concentrations of glucose and insulin observed in calm bulls, it is possible that the calm bulls became insulin resistant, and therefore were unable to properly uptake glucose from the circulation and into tissues that required it, which may partially explain the greater amount sickness behaviors observed by calm bulls. Studies performed in the 1930s by Long et al. (1940) found that removal of the adrenal gland, and subsequent decreases in cortisol, caused a decrease in glucose concentrations and a decrease in the ability to store glucose as glycogen in the liver and muscle. It is possible that greater cortisol concentrations observed in the temperamental bulls may make them more resistant to cortisol, as suggested earlier, which may have reduced their subsequent glucose and insulin responsiveness following LPS administration. This is supported by the initial study described above, in which temperamental heifers failed to produce an insulin response to a glucose tolerance test, while maintaining greater concentrations of cortisol compared to calm heifers (Bradbury, 2011).

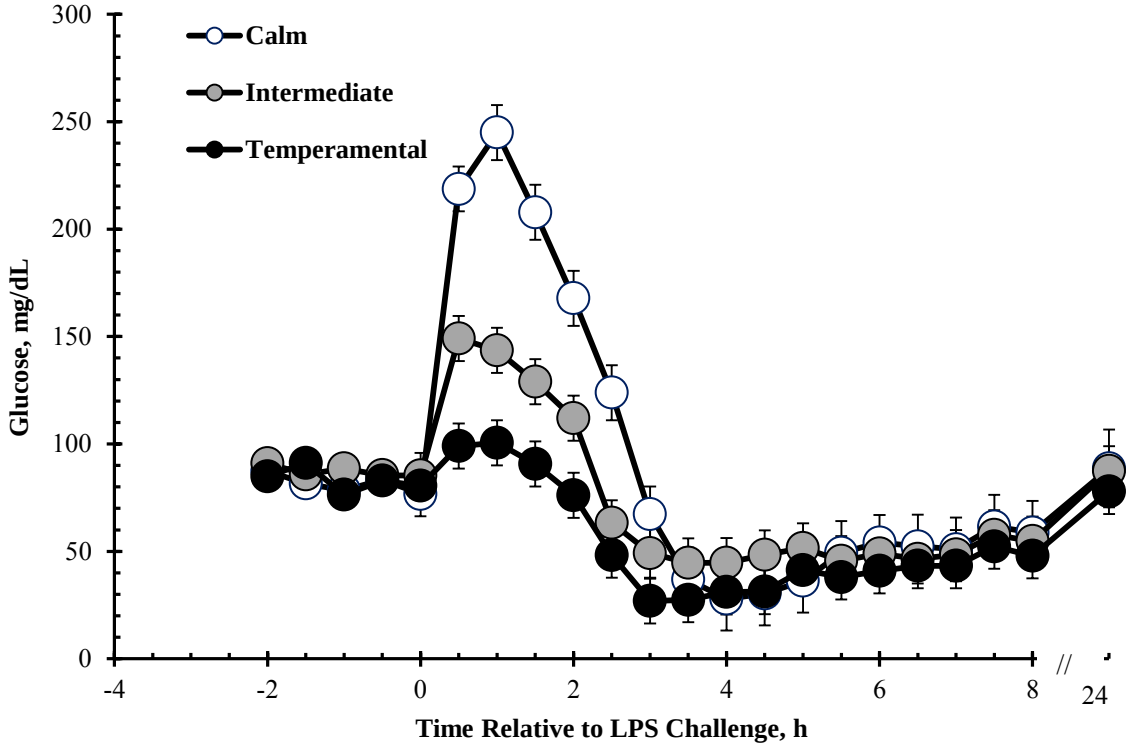

Figure 6. Serum glucose response to administration of lipopolysaccharide (LPS) in calm, intermediate, and temperamental Brahman bulls (Carroll et al., 2011).

Temperament also influenced the availability of non-esterified fatty acids (NEFA), or free fatty acids that are not linked to a glycerol molecule. Specifically, temperamental bulls maintained greater concentrations of NEFA both prior to and following administration of LPS ($P < 0.01$; Figure 7). A greater concentration of NEFA supports a previous report which found that temperamental cattle fail to deposit adequate amounts of fat, and suggests an influence of temperament on adiposity (Nkrumah et al., 2007). We concluded that temperamental cattle were utilizing NEFA for energy in the presence of low glucose concentrations, thus preventing the incorporation of fatty acids into triglycerides inside fat cells. It is interesting to note that greater concentrations of NEFA have been linked to insulin resistance (Lam et al., 2003). Additionally, NEFA concentrations were negatively associated with insulin and glucose concentrations during the LPS challenge, suggesting a negative relationship between insulin and NEFA concentrations. Temperamental cattle also had lower concentrations of blood urea nitrogen (BUN), an indicator of protein break down ($P = 0.01$). This suggests that temperamental bulls did not have to break down muscle protein in order to provide energy during the immune challenge, as did intermediate and calm bulls. These data suggest that temperamental cattle may be utilizing NEFA rather than glucose for energy, which may have influenced their response to the LPS challenge.

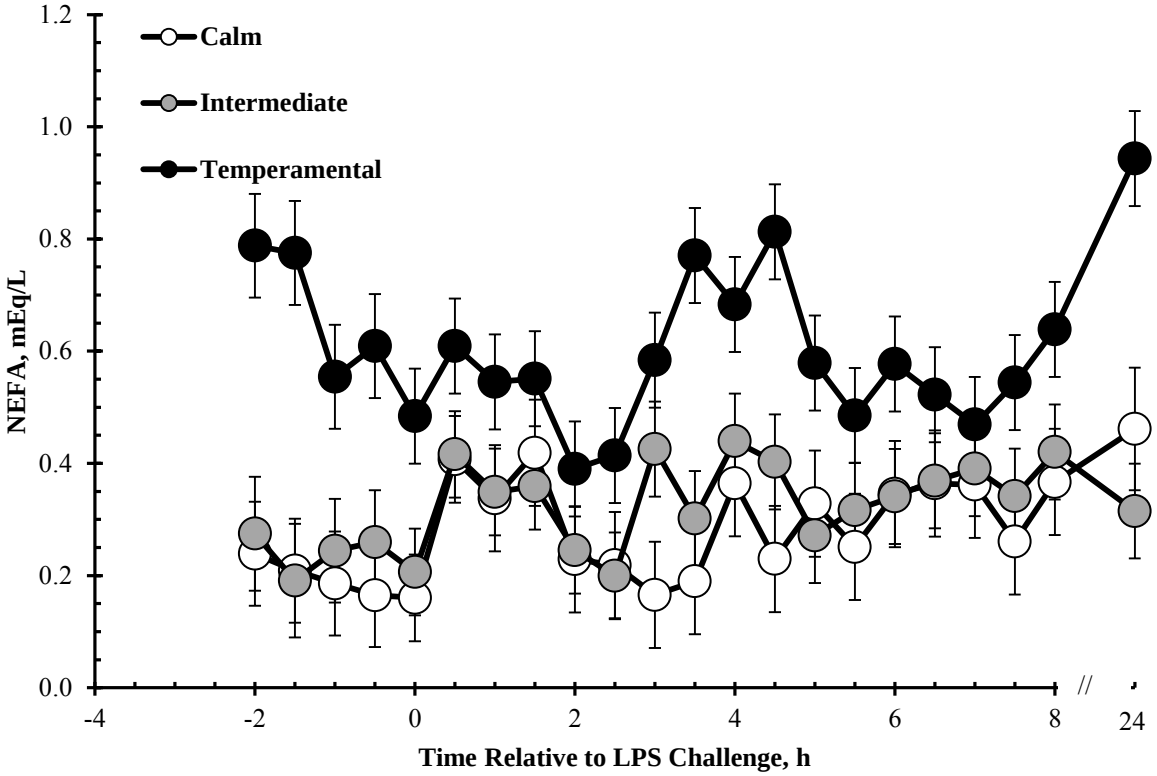

Figure 7. Serum non-esterified fatty acid (NEFA) response to administration of lipopolysaccharide (LPS) in calm, intermediate, and temperamental Brahman bulls (Carroll et al., 2011).

Implications

These data suggest that clear metabolic differences exist between calm and temperamental Brahman calves. The decreased ability to utilize glucose, likely due to high concentration of cortisol, supports the potential for temperamental cattle to utilize an alternate source of energy when glucose concentrations are low. Therefore, it is likely that cattle utilize free fatty acids, resulting from the continuous lipolysis of adipose tissue, to fuel tissues and organs that can utilize other energy sources rather than glucose. As temperamental cattle do not deposit fat at the same rate as do calm cattle (Nkrumah et al., 2007), producers may want to feed temperamental cattle differently as they may not reach the same quality grade as calmer cattle. These data go against treating 'all cattle the same', as alternative management for temperamental cattle may decrease input costs. Future research by our collaborative team is focused on determining if alternative management strategies for calm versus temperamental cattle can increase profitability through reducing input costs.

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Historical Price Relationships to Performance Characteristics and Genetic Merit of Bulls Sold in Mississippi Beef Cattle Improvement Association and Hinds Community College Bull Test Sales

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Research Summary

Herd sires are an important investment for beef cattle producers. The objective of this study was to evaluate bull price determinants in Mississippi consignment bull sales that emphasized beef cattle improvement. The study was conducted using data from the Mississippi Beef Cattle Improvement Association and Hinds Community College Bull Test (**HCC**) bull sales from 1991 to 2011. A hedonic pricing analysis was employed to assess the impact of sale, bull, and market attributes on the actual sale price for each bull. Several performance measures as well as genetic predictors proved significant for explaining bull price. As adjusted 205-day weaning weight, weight at sale, visual score, and feeder calf prices increased ($P < 0.01$), bull price followed suit. Bull buyers discriminated ($P = 0.04$) against bulls with actual birth weights greater than 90 lb in their pricing decisions. Breed effects ($P < 0.01$) on bull price were also noted. Bulls sold earlier ($P < 0.01$) in the HCC sale garnered premiums over bulls sold further down in the sale order.

Introduction

State Beef Cattle Improvement Association (**BCIA**) sales have established a reputation of upholding a very strong marketing relationship between seedstock producers and commercial bull buyers. Bull test programs allow cattle producers the opportunity to compare their cattle directly to the cattle of other breeders (Mills, 2002). This analysis addresses the purchasing and selling of herd sires. Bulls have a major impact on economic returns for cow-calf producers. Above its salvage value, the monetary value of a bull is determined by its expected contributions to the production of live calves and the genetic makeup of those calves. Bulls are an important investment for cow-calf producers because, over time, they introduce most of the genetic attributes into typical beef cow herds. Therefore, heritable bull traits should affect bull purchase prices.

Bulls possess a large number of traits to consider in pricing (Dhuyvetter et al., 1996). Historically, commercial cattle producers selected bulls predominantly based on visual appraisal (Corah et al., 1987). Visual-based selection is subjective and does not necessarily indicate genetic or performance potential of a bull's progeny.

Purebred breeders are the principal bull suppliers. They need to be aware of the value of physical and genetic characteristics affecting bull prices to make informed economic decisions regarding the characteristics of bulls produced and offered for sale. Because genetic changes take time to accomplish, seedstock breeders must be mindful of the various aspects of bull demand over time.

Clary et al. (1984), using a net present value approach, found that the bid

price for breeding bulls increased with the genetic merit of the bull. Dhuyvetter et al. (1996) discovered that a variety of characteristics influence bull prices, including both EPD and simple performance measures. Holt et al. (2004) concluded that buyers were interested in bulls that were heavy in both weaning and yearling weights, and possessed quality expected progeny difference measurements.

The objective of this study was to examine the relationship between performance traits, EPD, and characteristics of bulls in relation to the effect they have on the bull's final auction price when sold in Mississippi consignment sales. Specific eligibility guidelines were followed to qualify bulls for sale. It is important to examine the effects that individual bull characteristics have on bull prices in Mississippi to demonstrate to producers the historical value placed on these attributes by bull buyers.

Procedures

Market Characteristics.

All data from this study were collected on bulls sold through Mississippi Beef Cattle Improvement Association (**MBCIA**) and Hinds Community College Bull Test (**HCC**) sales. Records from 995 bulls sold through the MBCIA or HCC sales were used in this analysis. The MBCIA sale model included the years 1993 to 1995, 1998, 1999, and 2003 to 2011. The HCC sale model included the years 1991, 1994 to 2002, and 2009. Bulls that were not structurally sound, exhibited poor disposition, or that did not meet qualifications for sale were removed from their respective sales. Bulls that were "pulled out" or "no sale" were removed from the analysis. Bulls with missing price values were also removed from the analysis. All bulls were sold through public, competitive bidding and sold individually.

Explanatory Variable Categories.

Variables believed to influence a buyer's decision to purchase a bull were used in 2 different hedonic pricing models. These variables were also chosen because they were consistent with economic theory or used in previous bull price determinant studies. Explanatory variables were categorized into 3 general areas: bull-specific, economic, and sale-specific variables (Lillywhite and Simonsen, 2008). Bull-specific variables included variables that identified performance and genetic characteristics of a particular bull. Included in this category were the following: sale order percentile (**SOP**), age in days (**AID**), adjusted 205-day weaning weight (**WW**), final body weight at sale (**FW**), visual score (**VS**), birth weight EPD (**BWEPD**), yearling weight EPD (**YWEPD**), and breed (**BBRD**). The economic variable was: average weekly feeder cattle price for 500- to 600-lb calves sold at public auction in Oklahoma City, OK (**WFCP**). The sale-specific variable was: individual sale. Beyond the variables defined here, there were other variables that were available for the bull buyers; however, they were removed due to insufficient observations, multicollinearity, and confounding with other variables.

Bull-specific Variables.

The SOP was derived from the actual sale order of the bulls. Sale order was specified with the variable indicating the percentile rank of the sale order for each sale. This correction follows a previous study (Parcell et al., 2006). The percentile ranking specification accounts for different lot numbers across sales. Actual birth weight (**ABW**) was grouped into 3 categories (light, moderate, and heavy) based on BWLT being less than 70 lb and BWHV being greater

than 90 lb. This process was completed for each of the sales. Light (**BWLT**) and heavy (**BWHV**) ABW categories were analyzed as 2 binary variables using dummy variables compared to the default moderate birth weight category. Weaning and final weights each illustrated a nonlinear relationship with bull price and were therefore transformed logarithmically. Breed was categorized by sale. Each sale was evaluated for the best representation of breeds in each sale, and the most represented breeds were categorized for the analysis as binary dummy variables. All remaining breeds were categorized as other breeds and set as the default. Visual scores were recorded for the MBCIA sales. All VS utilized were standardized to a 1 to 10 scale, with 1 representing the least favorable score and 10 representing the most favorable score. Visual score depicted a nonlinear relationship and was transformed to a logarithmic form for correction. The EPD independent variables included for the MBCIA sale were BWEPD and YWEPD. The EPD values ranged from negative to positive values, which cause problems with model specification when values are transformed. To allow for use of the negative values, a constant was added to all EPD values to make all these values positive and preserve the variance (Parcell et al., 2006). The BWEPD was nonlinear and thus transformed as logarithmic. The YWEPD also illustrated a nonlinear relationship with bull price and was subjected to logarithmic transformations.

Economic Variables.

The WFCP was utilized as the economic variable to account for market characteristics over time and price inflation. The WFCP was chosen because of the availability of the historical data and its representation of general cattle market trends (Livestock Meat and Wool Market News, 2012). The feeder calf price used in the analysis was the average weekly Oklahoma City, OK 500 to 600-lb steer price immediately preceding each bull sale. Producer price index for all farm products was originally included in the analysis as a second economic variable but was removed due to correlation and multicollinearity with WFCP.

Sale-specific Variable.

Each sale was categorized as a binary dummy variable in the general model with the MBCIA sale as the default. After further analysis of the original model, it was determined that allowing each sale a separate model as depicted by Turner et al. (1991) explained the data more efficiently considering the differences in the individual sale markets. Thus, due to the inherent differences among individual sales (markets, promotion, sale management, and time span of data), each sale was analyzed in a separate pricing model.

Pricing Model.

The basic premise of the hedonic pricing method is the price of a marketed good is related to its characteristics. Hedonic modeling refers to the theoretical and practical application of assigning economic value to each characteristic of a bundle of characteristics that is marketed as one product (Parcell et al., 2006). Prices used in the models represent the price per head for individual bulls. Hedonic price determination followed the framework (Rosen, 1974; Ladd and Martin, 1976) of earlier studies. Recent bull price studies (Turner et al., 1991; Dhuyvetter et al., 1996; Chvosta et al., 2001; Dhuyvetter et al., 2005; Jones et al., 2008; Lillywhite and Simonsen, 2008) set the outline for models developed in this analysis. A general model of bull price was developed by eliminating variables based on multicollinearity and exhibiting inadequate observation numbers.

Definitions of explanatory variables and their expected signs are provided in Table 1. Each sale was assigned a binary variable. Combining the sales as one model inaccurately described the data because of differences in variable representation and years being represented. Therefore, this general model was then used to derive unique models for each sale depending on the data availability for each sale. The general bull price regression model was as follows:

Price Model: BP = f (SALE, SOP, BWLT, BWHV, WW, FW, BWEPD, YWEPD, WFCP, VS, BBRD).

Where:
BP = actual bull price per head in dollars;
SALE = series of binary variables 0 or 1, with MBCIA as default;
SOP = sale order percentile;
BWLT = birth weight category less than 70 lb;
BWHV = birth weight category greater than 90 lb;
WW = adjusted 205-day weaning weight;
FW = final body weight at sale;
BWEPD = birth weight EPD with constant added;
YWEPD = yearling weight EPD with constant added;
WFCP = average weekly price for 500- to 600-lb calves sold at public auction in Oklahoma City, OK;
VS = visual score of bulls on the day of the sale as determined by 3 trained observers;
BBRD = series of binary variables 0 or 1 with other breeds as default.

Data were analyzed using PROC REG and PROC CORR in SAS (SAS Inst. Inc., Version 9.2; Cary, NC) to estimate the regression coefficients of the explanatory variables and to determine the expected sign of the Pearson correlation between the dependent variable, BP, and the individual explanatory variables. The bull sales were modeled separately by location because each sale had a unique market environment. The models were developed using OLS regression with both actual and logarithmic transformed BP. A likelihood ratio test indicated rejection of the linear form of BP in favor of the log form at the 0.05 level for each model. Consequently, the reported models explain the logarithm of BP. Residual analysis consisted of regressing the error term of the variable under consideration. Statistically significant parameter estimates indicated problems associated with the functional form of the variables being examined. Quadratic, square-root, logarithmic, and reciprocal transformations were engaged in a trial and error approach to adjust the functional form of individual variables as the residual analysis indicated was necessary to properly form to the linear regression line. Graphically the variables were plotted and evaluated for normality. Statistically the rule of thumb that says a variable is reasonably close to normal if its skewness and kurtosis have values between -2.0 and 2.0 (Gujarati and Porter, 2009). Residual analysis indicated that logarithmic transformations were necessary for the following variables: BP, SOP, WW, FW, YWEPD, VS, and WFCP.

Table 1. Definitions of explanatory variables and their expected signs

Variable	Definition	Expected Sign
BBRD	Breed binary variables = 1 if bull is the breed; otherwise = 0 Other breeds category (default), Angus, Charolais Hereford, Simmental	?
VS	Subjective visual score obtained by 3 trained technicians (1 = poor to 10 = best)	+
AID	Age in days of bulls on sale day	+
BWLT	Actual birth weight (lb) category less than 70 lb	-
BWHV	Actual birth weight (lb) category greater than 90 lb	-
WW	Adjusted 205-day weaning weight (lb)	+
FW	Final sale weight (lb)	+
FSSM	Frame score (1 = short to 10 = tall) less than frame score 5	-
FSLG	Frame score (1 = short to 10 = tall) greater than frame score 7	+
BWEPD	Birth weight expected progeny difference (lb)	-
YWEPD	Yearling weight expected progeny difference (lb)	+
SALE	Sale binary variable = 1 if bull was sold in sale, otherwise = 0	?
SOP	Percent within the sale order in which bull sold	-
WFCP	Average weekly price ($/100 lb) for feeder calves sold at public auction in Oklahoma City, OK.	+

Regression model dependent and independent variables were tested for normality by evaluating skewness and kurtosis values using PROC UNIVARIATE in SAS. The regression models were tested for the presence of heteroscedasticity using White's Test. The heteroscedasticity-consistent covariance matrix method 3 was used in all models for correction (MacKinnon and White, 1985; Long and Ervin, 2000). Regression models were also examined for existence of autocorrelated error terms. First, residuals of each variable were plotted against the dependent variable, and then the Durbin-Watson test statistic was used to test for autocorrelation in each model. When autocorrelation was detected, the specifications of the model were then re-evaluated and variables were transformed to correct for autocorrelation. The Durbin-Watson test statistic used to test for first-order autocorrelation fell within the inconclusive range for autocorrelation for all models. Residual analysis performed on the models corrected for possible autocorrelation and revealed no functional form specification problems. To address multicollinearity, correlation coefficients > 0.7 and variance inflation factors > 5.0 were utilized to determine the presence of multicollinearity. If multicollinearity presented a problem, the models and variables were re-evaluated and either variables were removed from the models or allowed to stay in the models as in the case of categorical binary dummy variables. Extreme outliers for all variables were determined using a box-plot in SAS. After outliers were detected they were removed from all models. Statistical significance was defined at a $P < 0.05$ value, and tendencies were reported at values of $P > 0.05$.

The individual sale models were as follows:

MBCIA Model:

$$\text{Log } BP = \beta_0 + \beta_1 \times \log SOP + \beta_2 \times \log WW + \beta_3 \times \log FW + \beta_4 \times \log BWEPD + \beta_5 \times \log YWEPD + \beta_6 \times \log VS + \beta_7 \times \log WFCP + \beta_8 \times BBRD(\text{Angus}) + \beta_9 \times BBRD(\text{Charolais}) + \beta_{10} \times BBRD(\text{Hereford}) + \beta_{11} \times BBRD(\text{Simmental}) + \varepsilon$$

HCC Model:

$$\text{Log } BP = \beta_0 + \beta_1 \times \log SOP + \beta_2 \times BWLT + \beta_3 \times BWHV + \beta_4 \times \log WW + \beta_5 \times \log FW + \beta_6 \times \log WFCP + \beta_7 \times BBRD(\text{Angus}) + \beta_8 \times BBRD(\text{Charolais}) + \beta_9 \times BBRD(\text{Hereford}) + \beta_{10} \times BBRD(\text{Simmental}) + \varepsilon$$

Results

MBCIA Sale Pricing Model.

There were numerous variables that affected BP in the MBCIA model. Variables impacted by BP include SOP, WW, FW, BWEPD, VS, WFCP, and BBRD-Angus, BBRD-Simmental (Table 2). The MBCIA model explained approximately 57% of the variation of individual BP. Sale order percentile was significant ($P < 0.01$) and negatively affected BP. A 1.0% increase in SOP resulted in a 0.04% decrease in BP. Performance measures (WW and FW) remained significant ($P < 0.01$) and positively impacted BP. A 1.0% increase in WW resulted in a 0.34% increase in BP. A 1.0% increase in FW resulted in a 0.82% increase in BP. The BWEPD was significant ($P < 0.05$) and negatively impacted BP. A 1.0% increase in BWEPD resulted in a 1.67% decrease in BP. The YWEPD were not significant ($P = 0.65$) in describing BP. Visual score was significant ($P < 0.01$) and positively affected BP. A 1.0% increase in VS resulted in a 0.14% increase in BP. The WFCP was significant ($P < 0.01$) and positively associated with BP. A 1.0% increase in WFCP resulted in a 0.52% increase in BP. Angus and Simmental ($P < 0.01$) bulls were different from the other breeds category. Angus bulls garnered a premium of 7.11% compared to the other breeds category. Simmental bulls were discounted 10.61% compared to the other breeds category.

Table 2. Estimated coefficients associated with Mississippi Beef Cattle Improvement Association bull sale price determination model

Independent variable	Transformation	Unit	Parameter estimate	SE	*t*-value	*P*-value
Intercept	-	-	2.42435	1.31321	1.85	0.0654
Percent sale order	Log	%	-0.04450	0.01493	-2.98	0.0030
Adjusted 205-day weaning weight	Log	lb	0.74426	0.21738	3.42	0.0007
Final sale weight	Log	lb	0.1.8068	0.15113	11.96	0.0001
Birth weight EPD[1]	Log	lb	-3.69036	1.47121	-2.51	0.0124
Yearling weight EPD[1]	Log	lb	-0.11277	0.25514	-0.44	0.6587
Visual score	Log	Subjective rating (1 = poor to 10 = best)	0.13931	0.05003	2.78	0.0056
WFCP[2]	Log	$/100 lb	0.52226	0.06150	8.49	0.0001
BBRD-Angus[3]	Linear/none	Binary	0.07106	0.02100	3.38	0.0008
BBRD-Charolais[3]	Linear/none	Binary	0.04450	0.02601	1.71	0.0876
BBRD-Hereford[3]	Linear/none	Binary	-0.06178	0.03294	-1.88	0.0612
BBRD-Simmental[3]	Linear/none	Binary	-0.10613	0.02998	-3.54	0.0004
n		527				
R^2		0.5698				

[1]EPD: expected progeny differences
[2]WFCP: average weekly price for 500- to 600-lb feeder calves sold at public auction in Oklahoma City, OK
[3]BBRD: binary variable representing breed of bull

HCC Sale Pricing Model.

Variables that explained BP included: BWLT, BWHV, WW, FW, WFCP, and BBRD (Table 3). The HCC pricing model explained 54% of the variation in individual BP. Sale order percent was not significant ($P = 0.76$) in determining BP. The BWLT category was not different ($P = 0.25$) from the moderate ABW category. The BWHV category ($P < 0.05$) negatively impacted BP and resulted in a 2.31% decrease in BP compared to the moderate ABW category. As expected, WW was significant ($P < 0.01$) and positively affected BP. A 1.0% increase in WW resulted in a 0.50% increase in BP. Final weight was significant ($P < 0.01$) and positively impacted BP. A 1.0% increase in FW resulted in a 1.08% increase in BP. The WFCP was significant ($P < 0.01$) and positively affected BP. A 1.0% increase in WFCP resulted in a 0.47% increase in BP. Angus ($P < 0.01$) and Charolais ($P < 0.01$) bulls differed from the other breeds category, resulting in a 6.29% and 8.32% premium, respectively, compared to the other breeds category. Hereford ($P = 0.56$) and Simmental ($P = 0.47$) bulls did not differ from the other breeds category.

Table 3. Estimated coefficients associated with Hinds County Community College Bull Test Sale price determination model

Independent variable	Transformation	Unit	Parameter estimate	SE	*t*-value	*P*-value
Intercept	-	-	-2.03810	0.24995	-8.15	0.0001
Percent sale order	Log	%	0.00443	0.01452	0.30	0.7606
BWLT[1]	Linear/none	Binary	0.01591	0.01392	1.14	0.2540
BWHV[1]	Linear/none	Binary	-0.02313	0.01110	-2.08	0.0376
Adjusted 205-day weaning weight	Log	lb	1.10363	0.20763	5.32	0.0001
Final sale weight	Log	lb	2.38298	0.21502	11.08	0.0001
WFCP[2]	Log	$/100 lb	0.46837	0.05684	8.24	0.0001
BBRD-Angus[3]	Linear/none	Binary	0.06291	0.01495	4.21	0.0001
BBRD-Charolais[3]	Linear/none	Binary	0.08324	0.01598	5.21	0.0001
BBRD-Hereford[3]	Linear/none	Binary	0.01537	0.02660	0.58	0.5637
BBRD-Simmental[3]	Linear/none	Binary	-0.01574	0.02156	-0.73	0.4657
n		468				
R^2		0.5417				

[1]BWLT and BWHV: binary variables for light and heavy actual birth weight, respectively, compared to moderate actual birth weight

[2]WFCP: average weekly price for 500- to 600-lb feeder calves sold at public auction in Oklahoma City, OK

[3]BBRD: binary variable representing breed of bull

Bull-specific Variables.

Several studies have evaluated bull sales within a single breed (Greer and Urick, 1988; Dhuyvetter et al., 2005; Jones et al., 2008; McDonald, 2010) and among multiple breeds (Cassady et al., 1989; Dhuyvetter et al., 1996; Holt et al., 2004; Parcell et al., 2006; Smith and Foster, 2007; Lillywhite and Simonsen, 2008) to analyze effects of different explanatory variables on cattle sale price. Breed has been shown to produce premiums and discounts compared to a default category (Dhuyvetter et al., 1996). For both sales in this study, BBRD was significant. Angus bulls in both sales and Charolais bulls in the HCC sale sold for premiums relative to the other breeds category. Hereford and Simmental bulls sold for discounts relative to the other breeds category in the MBCIA sale.

Sale order has been included as an independent variable when explaining BP by many researchers (Dhuyvetter et al., 1996; Jones et al., 2008; McDonald, 2010). It has been noted to positively affect price as sales progress (Schroeder and Graff, 2000) as well as depress sale prices for bulls sold at the end of sales (Vanek et al., 2008). Sale order percent was significant and negatively affected BP for the MBCIA sale but not the HCC sale. One explanation for SOP not being significant is that the HCC sale traditionally grouped the SOP based on breed. This could have an impact on SOP knowing that better performing and quality

bulls could be later in the sale order because their breed is not first to sell.

Bulls classified into BWLT or BWHV categories were expected to receive discounts because of the qualities associated with extremely light or heavy actual birth weight. Bull actual birth weight has traditionally resulted in negative effects on price because of warranted values associated with low actual birth weight bulls. Dhuyvetter et al. (1996) reported an increase in actual birth weight to have a significantly negative effect with BP for 4 of 7 breeds evaluated in the study. The BWLT and BWHV categories were evaluated in the HCC model. The BWLT category did not affect BP relative to the moderate actual birth weight category. Even though discounts were expected for the BWLT category, it is not surprising to find no discount associated with light weight calves because of widespread extension educational efforts over many years favoring light actual birth weight calves to reduce calving difficulty. The BWHV category was expected to also be associated with discounts because of potential for heavier birth weight calves. The BWHV category negatively impacted BP. Bull buyers from this study might have been seeking bulls with actual birth weights less than the BWHV threshold.

Adjusted 205-day weaning weight has been noted for positively impacting BP (Dhuyvetter et al., 1996). Performance measures indicative of growth should traditionally have a positive effect on BP. For both models, WW positively impacted BP as expected.

As expected, FW was significant and positively affected BP for both models. This result suggests bull buyers are consistently appraising bulls for FW and condition of bulls on sale day, and this can be a major factor in determining BP. Results from this study correspond with literature for BP determinants noting that general eye-appeal is a significant factor in bull purchasing decisions (Commer et al., 1990).

The BWEPD was significantly negatively associated with BP in the MBCIA model. This result was consistent with other studies (Dhuyvetter et al., 1996, 2005; Jones et al., 2008). The YWEPD was also represented in the MBCIA model, and unexpectedly negatively impacted BP. A possible explanation for this is that buyers focused more on actual simple performance measures rather than EPD as evidenced by FW being significant and positively associated with BP. Jones et al. (2008) reported YWEPD as significant and resulted in a $613 premium above the mean for BP.

The VS has been reported to have significant value when determining BP (Warren, 1957; Corah et al., 1987; Commer et al., 1990). Visual scores were available for the MBCIA model and resulted in a positive impact on BP. Dhuyvetter et al. (1996) concluded that conformation, muscle, and disposition influenced BP. Results from the present study again suggest that bull buyers value quality genetics and general eye-appeal as well.

Economic Variable.

The economic variable WFCP was added to both models to account for fluctuations and trends in the feeder calf market over time. The WFCP was expected to have a positive relationship with BP; WFCP in both models had a strong ($P <$ 0.01) positive impact on BP. This finding is logical because if calves are being sold for increased premiums, then cow-calf producers may have additional money to spend on quality bulls. They may also want

to increase future calf weights to capitalize on relatively greater calf prices and believe purchasing herd sires from BCIA or HCC sponsored sales is a means to achieve greater pounds of calf to be marketed in the future. This is consistent with Greer and Urick, (1988) when they described breeding BP to be sensitive to calf prices and cow herd inventory.

Sale-specific Variable.

Individual sales were analyzed separately to capture specific marketing attributes that each sale represented. Significant explanatory variables and comparable R^2 values to other BP determinant studies infers model specifications and variable transformations were appropriate and evaluated each of the models correctly. The overall analysis of data was not designed to make strong comparisons across models because of differences associated with each one of the models and sale locations. Additionally, sale years were not equally represented, and observation numbers differed for explanatory variables.

Implications

This study characterized how purchasers of bulls sold through beef cattle improvement-oriented consignment bull sales in Mississippi over the last 2 decades valued various bull characteristics. Growth traits and general market conditions were key determinants of bull prices. Producers of bulls intended for use as herd sires can utilize the results of this study to produce bulls that better fit market demands or work to educate buyers as to the merits of various performance levels for specific traits so as to influence future valuations of these traits.

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Tools for Assessing Temperament in Beef Cattle

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Introduction

Temperament in cattle has been defined as the reactivity, or fear response, to humans (Fordyce et al., 1988). Many production practices such as weaning, ear tagging, branding, castration and vaccination have been reported to be stressful to cattle (Burdick et al., 2010). Other factors such as social mixing and transportation were also reported to be capable of being stressful. Temperamental cattle have been reported to be more easily stressed than are their calmer herd mates (Curley et al. 2006a, b, 2008). Temperament, the behavioral response to handling, can negatively affect management and beef production as more temperamental cattle can increase the risk to both the handler and the animal (Burrow, 1997). Furthermore, temperamental cattle have reduced growth rates, carcass traits and immune function (Voisinet et al., 1997; Fell et al., 1999; Mondal et al., 2006; Oliphint et al., 2006). Reduction of stress in a herd of cattle should result in improved productivity and therefore profit. Selection of cattle with more easily managed temperaments will result in less stress as well as reduced risk in handling the cattle for routine management. Methods for scoring temperament were developed as early as the 1960s (Strickin and Kautz-Scanavy, 1984). There are several tools available for beef cattle producers to evaluate their cattle for temperament. It is important to remember that temperament is a complex mixture of behaviors, and therefore each method has some limitations due to the way each is designed.

Docility Score (Chute Score)

The Beef Improvement Federation guidelines include a method termed docility score which is designed to evaluate temperament when cattle are processed in a squeeze chute. Many refer to this method as "chute score". This system is recommended to be used at or near weaning as the animal's behavior can be altered by past experiences. The animal should be evaluated with its head caught but without the squeeze applied. The scoring system is presented in Table 1.

One positive factor in using docility of chute score is that it is easy to use as calves are routinely handled for management at weaning. This score is positively correlated ($r \geq 0.35$, $P < 0.005$) with other measures of temperament to be discussed later in this paper. However chute score was not correlated ($r = 0.09$, $P = 0.46$) with cortisol concentrations in the blood (Curley et al., 2006a). The lack of a correlation with the stress hormones reduces the utility of this measurement of temperament. More excitable cattle which are temperamental have greater amounts of the hormone, cortisol, in their blood (Stahringer et al., 1990; Burdick et al., 2010).

Table 1. BIF Guidelines – Docility Score (Chute Score)

Score 1	Docile. Mild disposition. Gentle and easily handled. Stands and moves slowly during processing. Undisturbed, settled, somewhat dull. Does not pull on headgate when in chute. Exits chute calmly.
Score 2	Restless. Quieter than average, but may be stubborn during processing. May try to back out of chute or pull back on headgate. Some flicking of tail. Exits chute promptly.
Score 3	Nervous. Typical temperament is manageable, but nervous and impatient. A moderate among of struggling, movement and tail flicking. Repeated pushing and pulling headgate. Exits chute briskly.
Score 4	Flighty (Wild). Jumpy and out of control, quivers and struggles violently. May bellow and froth at the mouth. Frantically runs fence line and may jump when penned individually. Exhibits long flight distance and exits chute wildly.
Score 5	Aggressive. May be similar to Score 4, but with added aggressive behavior, fearfulness, extreme agitation, and continuous movement which may include jumping and bellowing while in chute. Exits chute frantically and may exhibit attack behavior when handled alone.
Score 6	Very Aggressive. Extremely aggressive temperament. Thrashes about or attacks wildly when confined in small, tight places. Pronounced attack behavior.

Pen Score

The Beef Improvement Federation guidelines include another measurement of temperament termed pen score. As with docility or chute score the recommendation is to evaluate pen score at or near weaning. This is to avoid the adaptation of the animals to repeated handling (Curling et al., 2006a). For this measurement a small group ($n^2 = 5$) of calves are penned in a small lot (approximately 2 feet x 24 feet) and approached by two observers. The individual calf is scored for its response to the approach of two observers on a 1 to 5 scale (Table 2).

Table 2. BIF Guidelines – Pen Score

1 = Non-aggressive (docile)	Walks slowly, can be approached closely by humans, not excited by humans or facilities
2 = Slightly Aggressive	Runs along fences, will stand in corner if humans stay away, may pace fence
3 = Moderately Aggressive	Runs along fences, head up and will run if humans move closer, stops before hitting gates and fences, avoids humans
4 = Aggressive	Runs, stays in back group, head high and very aware of humans, may run into fences and gates even with some distance, will likely run into fences if alone in pen
5 = Very Aggressive	Excited, runs into fences, runs over humans and anything else in path, “crazy”

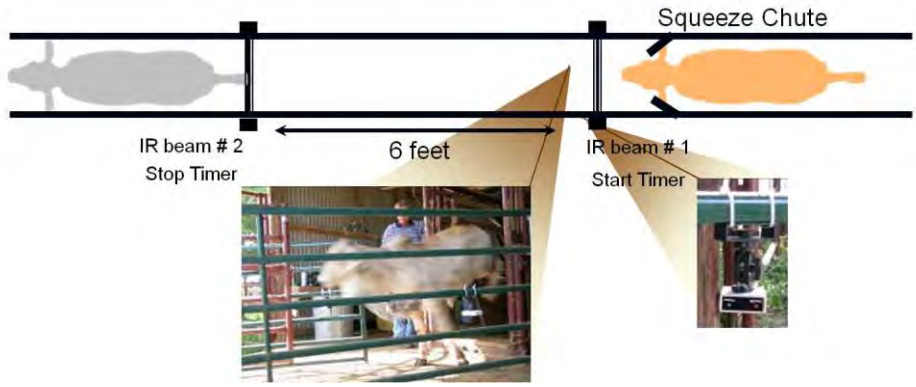
Pen score measures different behaviors than those measured by the docility or chute score. These behaviors are more highly correlated with cortisol concentrations in the blood ($r = 0.29$, $P < 0.05$) than the docility or chute score. It is correlated ($r \geq 0.35$, $P < 0.005$) with other measurements of temperament (Curley et al., 2006a). Repeated measurements of pen score over several months were correlated ($r - 0.25$; $P < 0.05$) with each other and with cortisol concentrations in the blood. The first pen score rank was predictive of later pen score rank even after the animals were more adapted to human handling.

Exit Velocity (Flight Speed)

An objective method to evaluate temperament in cattle is to determine exit velocity or flight speed (Burrow et al., 1988; Curley et al., 2006a). This method determines the velocity at which an animal leaves a squeeze chute. The standard distance to measure velocity is over 6 feet. The first electronic trigger is placed in front of the squeeze chute at a reasonable distance and the second trigger 6 feet from the first. The elapsed time is converted to velocity by dividing the distance by the elapsed time. The method uses infrared light beams in a timing system developed for competition horse events (Figure 1).

Figure 1. Exit velocity (Flight speed)

Exit Velocity is the time in feet/second that it takes the calf to travel 6 feet (Burrow et al., 1988).



One positive attribute for exit velocity is that it is an objective measurement of temperament. There is no observer bias as it is a measure of time elapsed for the animal to travel 6 feet after being restrained in a chute. Exit velocity is correlated ($r \geq 0.35$; $P < 0.005$) with chute score or pen score. Exit velocity is correlated ($r = 0.26$; $P < 0.005$) with concentrations of cortisol in the blood (Curley et al., 2006a). Exit velocity can be measured as early as 3 weeks of age in calves. Exit velocity increases as day of age increases from 3 weeks of age through weaning (Burdick et al., 2011). Temperamental calves exit velocity increased at a faster rate with age ($P < 0.001$; estimated to be 0.011 ± 0.0009 feet/second daily) compared with intermediate (0.0067 ± 0.0011 feet/second daily) and calm calves (0.0016 ± 0.0011 feet/second daily). Temperamental calves

increase their rate of speed more rapidly than their calmer herd mates and can be identified before weaning. There are some aspects of temperament such as aggression which are not measured by exit velocity. The principal behavior measured by exit velocity is likely fear and dislike of being restrained and apart from other cattle.

McGregor Genomics Project Temperament Scoring System

An in depth temperament system has been developed for use by the McGregor Genomics Project (Herring et al., 2005). In this system 4 evaluators assign disposition scores post-weaning. Two evaluators are located at each end of an alley that is approximately 12 feet wide and 75 feet long. The evaluators are approximately 50 feet apart. Calves are kept in a pen near the evaluation alley and 2 calves at a time are evaluated in the alley. After 2 minutes an animal is returned to the holding pen and the remaining animal is scored and released into another holding pen. Each animal is scored on a 1 to 9 scale for aggression, nervousness, flightiness, gregariousness and overall temperament (Table 3).

Table 3. McGregor Genomics Project Temperament Scoring

Aggressiveness willingness to hit evaluators	1 = nonaggressive	9 = extremely aggressive
Nervousness animals pacing, running, shaking, vocalizing	1 = completely calm	9 = extremely nervous
Flightiness attempt to escape from handlers	1 = totally quiet	9 = extreme flight
Gregariousness desire to return to the herd	1 = totally willing to be separate	9 = extreme desire to return to the herd
Overall Disposition (scored as a separate trait and not an average of component traits)	1 = completely docile	9 = crazy

The advantages of the McGregor Genomics Project System reside in the evaluation of multiple aspects of behavior which make up the complex behavior we know as temperament or disposition. The overall disposition score is very similar to the pen score but it has a wider scale from 1 to 9. The precision of this system is appropriate for research purposes.

Systems in Use (Breed Associations)

Some breed associations are using the 1 to 6 scoring system of BIF. Some are recording docility scores at weaning, some at yearling and some at both ages. Other associations are using a docility or pen scoring system recorded from 1 to 5 (Table 4).

Table 4. Docility or Temperament Scores

Breed	System	Range	Age
Angus	BIF Docility	1 – 6	yearling
Brangus	BIF Docility	1 – 6	weaning and yearling
Simmental	BIF Docility	1 – 6	weaning and yearling
Limousin	BIF Docility	1 – 6	weaning and yearling
Brahman	Pen Score	1 – 5	weaning
Saler	Docility Score	1 – 5	weaning and yearling

Markers for Temperament

Genetic markers for temperament or docility are available from commercial DNA laboratories. These markers are usually marketed in conjunction with markers for carcass or efficiency traits. Data regarding the correlation between these markers and behavior is not available in the literature as it is regarded as a commercial secret and may be covered by patents. Therefore it is difficult to determine the predictive value of these markers. They may be extremely valuable if a producer's cattle match the types of cattle the markers were developed for. If animals are not similar to the population used to develop the markers the predictive value will be lower.

Heritability of Temperament

Flight speed has been estimated to have a heritability of 0.37 for weaned Australian cattle (Prayaga and Henshall, 2005). Weaning heritability estimates for Brahman and Brahman influenced cattle in the United States for pen score and exit velocity were 0.48 and 0.29, respectively (Loyd et al., 2011). When a combination of pen score and exit velocity was calculated (pen score + exit velocity / 2) to develop a temperament score the estimated heritability of the combined temperament score was 0.43. These estimates of heritability fit well with the statement in the BIF guidelines that temperament is a moderately heritable trait.

Summary

Temperament is a heritable trait which will respond to selection similarly to growth traits. Several methods are available for use by breeders which measure different aspects of behavior related to temperament. All of these measurements change as cattle are exposed to human handling. One principal factor is that these measurements must be done as early in the production process as possible. The evaluation of temperament should be done at or near weaning from a practical viewpoint. The docility or chute score is less robust than the other systems as it is not correlated with the stress hormones. Both pen score and exit velocity are correlated with concentrations of cortisol in the blood making them more robust than the docility or chute score. From a research standpoint measurement of as many behaviors as possible is appropriate. However, from a practical production view selection of a system for evaluating temperament must be relatively simple and inexpensive. The pen scoring system has the highest heritability and does not require purchase of equipment. It is correlated with the stress hormones and stress responsiveness. If only one system is to be employed the pen score system should be used.

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25th Annual Dixie National Intercollegiate Livestock Judging Contest

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Extension Summary

Livestock judging contests help students develop critical thinking and decision making skills, as well as teach students to defend their decisions in a logical manner. Students who participate in livestock judging programs develop skills that last a lifetime, and aid them in any career path they choose to take. The 25th annual Dixie National Intercollegiate Livestock Judging Contest was held on February 11, 2012. The contest saw competitors from across the country including 68 competitors from 9 senior colleges and 74 competitors from 8 junior colleges.

Introduction

Livestock judging contests help students develop critical thinking and decision making skills, as well as teach students to defend their decisions in a logical manner. Students who participate in livestock judging programs develop skills that last a lifetime, and aid them in any career path they choose to take. The Dixie National Contest is unique in that contestants judge only cattle, as compared to other intercollegiate contests, which include hogs, sheep, and/or goats as well. This year marked the 25th anniversary of the contest.

Procedures

The contest itself consists of 12 classes of cattle, divided into 4 different divisions. The divisions included: Market steers, Brahman influenced breeding cattle, English influenced breeding cattle, and Continental influenced breeding cattle. Cattle for the contest were provided by the Mississippi State University Animal and Dairy Science Department, ClearWater Cattle, Bouie River Beefmasters, 4G Farms, Reeves Beefmasters, Jumping J Beefmasters, Holland Farms, Crimson Springs, G13 Angus Ranch, Wood Angus, Legacy Cattle Services, Bennett Farms, Dogwood Farms, and Andy Braswell.

Participants were given 12 minutes to evaluate each class of 4 animals before turning in their placing to be scored. Afterwards, contestants were required to defend their placing in 8 of the 12 classes by giving a set of oral reasons.

The contest was made possible with tremendous support from many individuals who volunteered their time as officials, card runners, computer experts, group leaders, cattle handlers, and supervisors. The Mississippi State University Block and Bridle Club acted as cattle handlers and group leaders for the contest.

Results

The 2012 contest saw 142 contestants from 9 Senior Colleges and 8 Junior Colleges. Contestants came from Oklahoma State University, the University of Missouri, Michigan State University, the University of Nebraska, Oklahoma

Panhandle State University, the University of Georgia, Fort Hays State University, the University of Tennessee, Auburn University, Redlands Community College, Allen Community College, Hutchinson Community College, Fort Scott Community College, Lakeland College, Seward County Community College, Coffeyville Community College, and Eastern Oklahoma State College.

In the Senior College Division, Oklahoma State University earned top honors as the high point team followed by the University of Missouri, the University of Georgia, the University of Nebraska, and Michigan State University. The high individual was Jake Warntages of Oklahoma State University, followed by Chandler Atkins from the University of Georgia, Ethan Lake from Auburn University, Jamie Bloomberg of Oklahoma State University, and Elaine Martin from the University of Missouri.

In the Junior College Division, Redlands Community College was awarded the high point team award, followed by Allen Community College, Lakeland College, Coffeyville Community College, and Fort Scott Community College. The top 3 individuals were all from Redlands Community College, Tyler Boles, Colin Listen, and Shelbi Kantz. Seth Diem from Allen Community College was 4th high individual, followed by Emily Limes of Lakeland College.

Implications

Skills developed through competing in livestock judging contests stick with students throughout a lifetime. The 25th anniversary of the Dixie National Intercollegiate Livestock Judging Contest brought together college students from across the country to compete in this unique cattle only contest. This competition enabled future leaders in the livestock industry to test their skills against fellow students from many colleges and universities.

Feeder Calf Board Sales

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Extension Summary

Two Mississippi Feeder Calf Board Sales were held in 2012 where beef cattle producers marketed farm-fresh and assembled stocker cattle. The 4th annual "Cattlemen's Exchange Producer Sale" held on April 3rd in Winona produced 28 truck-load lots while the 5th annual "Homeplace Producers Board Sale" held on August 6th at the Southeast Mississippi Livestock Auction in Hattiesburg generated 26 truck-load lots.

These sales were a collaborative effort among producers, livestock marketers, Mississippi State University Extension Service, Mississippi Farm Bureau Federation, Mississippi Beef Cattle Improvement Association, and the Mississippi Cattlemen's Association. With this type of auction format, cattle were not present at the sale facility. Video clips and descriptions of each load were posted prior to the sale and broadcasted during the sale for prospective buyers. This type of auction offered both the buyer and the seller flexibility in arranging future delivery dates, and offered the sellers the opportunity to market cattle in load lots and command premium prices. For example, the 2012 Homeplace sale saw 700-800 lb steers bring $13.63/cwt over average Mississippi sale barn prices that same week.

Introduction

Since mid-July of 2007, beef cattle producers and commodity support groups have been working to provide a new marketing option for Mississippi feeder cattle. This is a collaborative effort of the Mississippi Cattlemen's Association, Mississippi Farm Bureau Federation, Mississippi State University Extension Service, and Mississippi Beef Cattle Improvement Association. After many meetings and input from interested parties, the group developed the annual Mississippi Homeplace Producers Sale in Hattiesburg and the Cattlemen's Exchange Sale in Winona were established where beef cattle producers could market their feeder cattle.

Procedures

Auctions are managed as board sales by marketing cattle while they were not on site. Each lot was represented by video or picture of the cattle posted on the Internet. Detailed descriptions of cattle type, weight, and management were also posted on the website and distributed to perspective buyers prior to the sale. The same videos and pictures were presented during the auction. Arrangements for delivery from the farm of origin to the buyer's location were made after the sale.

These sales accommodated a large number of feeder calves with the flexibility to arrange for future delivery. Cattle were offered in load-lots made up of single or multiple consignments of uniform calves. Consignments were received from across the state, and loads were assembled with regard to region and type of cattle. Other advantages included reduced shrink, handling, and comingling prior to shipping.

The sales also enabled producers to establish reputations that could attract the same buyers year after year, willing to pay more for calves from producers whose cattle performed well in the past.
It was extremely important for the integrity of these sales that all cattle were represented truthfully and accurately. It was also essential that each consigner remained committed to the sale after completing a consignment form. This commitment was not only to the management and buyers but, more importantly, to the other beef cattle producers marketing cattle in this sale. The sales were open to various breed types, cattle weights, and management systems. Implementation of quality breeding programs and best management practices were strongly encouraged for all consignors to help enhance sale results and the reputation of Mississippi feeder calves. Health management and preconditioning were primary concerns with these types of sales. Consignors were encouraged to complete Mississippi Beef Quality Assurance training. These sales did not require a single preconditioning and vaccination protocol. However, calves that have been managed similarly were grouped in the same load. For example, consignors who vaccinated their cattle with the same products and preconditioned calves for a similar amount of time were grouped together and represented as such.

The first annual Mississippi Homeplace Producers Sale was held in 2008, and continues to be held on the first Monday in August each year. The first annual Cattlemen's Exchange Producer Sale was held in 2009, and continues to be held on the first Tuesday in April each year. Several different livestock markets have represented cattle in these sales over the years, and future sales are open to interested Mississippi livestock markets and cattle producers.

Results

The Cattlemen's Exchange Board Sale was held on Tuesday, April 3, 2012 in Winona, MS. The total receipts from the sales approached $1.9 million. Twenty-eight pot-loads of cattle sold (all prices quoted $ per cwt) and all loads sold with a 2 percent shrink (except 1 pot-load with no shrink) and a $4-5 per cwt slide. Mixed loads quote steer weight first, followed by the heifer weight. Steer price is quoted on the mixed loads, while heifer price was $6 per cwt less than the steers.

Feeder Steers:
Bulk Medium and Large 1 and 2:
4 pot-loads 875 lbs 136.50;
5 pot-loads 800 lbs 140.50-143.75;
1 pot-load 725 lbs 146.25.

Feeder Heifers:
Bulk Medium and Large 1 and 2:
2 pot-loads 800 lbs 132.50;
1 pot-load 700 lbs 140.60;
3 pot-load 780 lbs 133.00;
1 pot-load 740 lbs 135.25;
2 pot-loads 700 lbs 141.00-141.25;
1 pot-load 625 lbs 140.50;
1 pot-load 525 lbs 162.00.

Mixed Feeder Steers and Heifers:
Bulk Medium and Large 1 and 2:
1 pot-load 750 lbs/750 lbs 135.50;
1 pot-load 675 lbs/625 lbs 145.50;
1 pot-load 675 lbs/650 lbs 146.00;
1 pot-load 570 lbs/550 lbs 161.00;
1 pot-load 660 lbs/600 lbs 147.50.

The fourth annual Mississippi Homeplace Producers Feeder Cattle Board Sale was held at Southeast Mississippi

Livestock Exchange in Hattiesburg, MS on Monday, August 6, 2012. The sale generated over $1.6 million in total receipts. Twenty-seven pot-loads of cattle sold (all prices quoted $ per cwt) and all loads sold with a 2 percent shrink (except 3 pot-loads with no shrink) and a $5 per cwt slide. Mixed loads quote steer weight first, followed by the heifer weight. Steer price is quoted on the mixed loads, while heifer price was $6 per cwt less than the steers.

Feeder Steers:
3 pot-loads 600-699 lbs 129.75-131.25;
5 pot-loads 700-799 lbs 132.75-137.50;
3 pot-loads 800-899 lbs 129.50-131.50.

Feeder Heifers:
3 pot-loads 600-699 lbs 125.25-128.85.

Mixed Feeder Steers and Heifers (steer prices listed):
9 pot-loads 600-699 lbs 125.00-136.50;
2 pot-loads 700-799 lbs 125.00-130.50;
1 pot-load 800-899 lbs 123.50.

Implications

The Mississippi Feeder Calf Board Sales have been successful in bringing together cattle producers and livestock marketers to improve the profitability of both sectors of the beef production chain. Since 2008, more than 18,600 head of cattle in 290 loads have been marketed in these board sales. Together, the receipts from these sales have exceeded $14 million. For more information on these sales visit: *msucares.com/livestock/beef/feedercalf.html.*

2012 Deep South Stocker Conference

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Extension Summary

The fourth annual "Deep South Stocker Conference" was held at the Riley Center located in downtown Meridian on August 10, 2012. This conference is a joint effort between the Mississippi State University Extension Service, Alabama Cooperative Extension System, and the University of Georgia Cooperative Extension Service. It is held in each cooperating state on a triennial rotation. The concept is based on the successful Triennial Stocker Conference held at Auburn University. The conference was a one day event that included a tradeshow with 20 industry groups representing various segments of the beef industry, as well as an educational seminar. This year's conference was well attended by producers, extension agents, and industry professionals from MS, AL, GA, and FL.

Introduction

The 2012 Deep South Stocker Conference returned to Mississippi after previous years in Georgia and Alabama. Beef producers from several states were treated to a one day event which included a tradeshow, educational seminars, lunch, and a tour of an order buying facility. The conference topics covered many segments of the stocker industry such as forages, nutrition, animal health, and economics.

Procedures

Approximately100 people participated in the 2012 conference. Participants had the opportunity to attend an educational seminar, tradeshow, as well as a tour of a local order buyer's processing facility. As participants arrived, and at several intermissions, they had the opportunity to visit with over 20 trade show exhibitors, whose products represented many segments of beef industry. These trade show exhibitors and conference partners covered industry segments from animal health to nutrition to seed and weed control.

Several speakers were invited to present information regarding the various topics. Dr. Vanessa Corriher, Forage Extension Specialist at Texas A&M University's Overton Research Station, began the program with a discussion of forage production systems for southeastern stocker producers. Dr. Corriher gave the group a good understanding of expected yields and quality of forages in several classes including: cool season annuals, legumes, cool season perennials, warm season annuals, and warm season perennials. Topics such as fertilization rates, grazing management, and expected calf performance were also covered for each forage system.The second speaker, Dr. Darrell Rankins, Extension Beef Specialist at Auburn University, covered the use of by-product feeds for stocker production. Over a 20 year period at Auburn University, Dr. Rankins and co-workers have conducted

numerous by-product feeding trials. Topics included various roughage sources as well as several co-product feeds that may be available throughout the southeast. After lunch, topics shifted towards parasite control, health, and economics. Dr. James Hawkins, a parasitology consultant, gave some thoughts on strategic parasite control for stocker cattle. His discussion covered common internal and external parasites, treatment strategies, and anthelmintic resistance. Dr. Daniel Scruggs, a consulting veterinarian, followed next with several health management strategies for high-risk calves. Dr. Scruggs discussed common diseases of concern, and what should be considered in a health plan. His talk emphasized the importance of tailoring a health and management plan based upon individual needs and concerns, emphasizing that programs may vary from load to load. The educational seminar concluded with Dr. John Michael Riley, Extension Ag Economist at Mississippi State University, offering an analysis of Mississippi Feeder Calf Board Sales. Dr. Riley compared the results from 4 years of board sales to local auction process, and also examined how certain lot characteristics impacted price. The day concluded with a tour of Miller Cattle Company's processing facility. Mr. Justin Sciple led the group through the facility, and discussed several of their standard procedures and answered many of the group's questions about the business.

Results

Based upon responses to evaluations, participants felt the conference would be useful to their operation, and comments indicated that the conference was informative and well organized. None felt the educational program was too long, and one even indicated that the program could have been longer.

On a 1 to 5 scale, with 1 being "poor" and 5 being excellent, the conference overall received an average rating of 4.45. The ratings for individual topics ranged from 4.1 to 4.7, and indicated that the conference was well received. Participants gave excellent ideas for topics for future Deep South Stocker Conferences.

Implications

The 2012 Deep South Stocker Conference provided participants with information to improve their stocker operations though educational seminars, a tradeshow with a variety of industry personnel, and a tour and insights into an order buyer's receiving facility. Producers who attended were encouraged to take the provided information home and apply it to their individual productions systems to meet their needs.

Beef Cattle Boot Camps

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Extension Summary

The Mississippi State University Extension Service (MSU-ES) Beef Cattle Boot Camps were initiated in 2010 to provide an interactive, hands-on educational opportunity for beef cattle producers on Mississippi Agricultural and Forestry Experiment Station (MAFES) stations. Based upon positive feedback from producers, the program has been continued as an annual event. Boot Camp topics in 2012 included implants, heifer development, newborn calf feeding, vaccinations, fertilizer planning, making hay and baleage, troubleshooting reproduction, mycotoxin management, and input purchasing. Participants rated the presentations highly and provided suggestions for future Boot Camps. A set of Boot Camps is now scheduled to be held on an annual basis each April at rotating locations.

Introduction

The Mississippi State University Extension Service (MSU-ES) Beef Cattle Boot Camps were initiated in 2010 to provide an interactive, hands-on educational opportunity for beef cattle producers on Mississippi Agricultural and Forestry Experiment Station (MAFES) stations. They were held at the MAFES Prairie Research Unit in Prairie, MS and MAFES Brown Loam Branch Experiment Station near Raymond, MS. Based upon the positive feedback received from these inaugural Boot Camps, it was determined that subsequent Boot Camps be conducted each year. In 2012, the Beef Cattle Boot Camps were conducted at the MAFES Leveck Animal Research Center on the Mississippi State University main campus and the MAFES White Sand Branch Unit, in Poplarville, MS.

Procedures

Many MSU-ES beef cattle educational programs focus on complex problems or topics, with the target audience being established beef cattle producers with experience in cattle production. Rather than focus on that target audience, the Boot Camps offered a new approach. They focused on novice producers, who may not have the experience or knowledge of longer established producers. The goal of the Boot Camps was to provide basic information to producers in a hands-on, applicable manner. While the novice group was the ideal target, the Boot Camps also offered the opportunity to established producers to refresh themselves on basic cattle production skills and information.

The Boot Camps were advertised through the *Cattle Business in Mississippi* magazine, on the Internet, and via local Extension offices. The same program was offered at two locations on different dates to allow participants to choose their preference for program location and date. Boot Camp topics in 2012 included implants, heifer development, newborn calf feeding, vaccinations, fertilizer planning, making hay and baleage, troubleshooting reproduction, mycotoxin management, and input purchasing. Live animal demonstrations and

interactive participant exercises were included in the program. Following the program each participant was encouraged to complete and submit a course evaluation.

Each Boot Camp program began at 9:00 a.m., included lunch, and concluded at 4:00 p.m. Registration fees covered the cost of lunch, refreshments, Boot Camp notebooks, and other Boot Camp materials. Both MSU-ES and MAFES personnel were involved in the Boot Camp planning and program implementation.

Results

All participants completing evaluations of the 2012 Boot Camps (n=22) indicated that the information presented would be useful on their operations. They also all indicated that the length was appropriate. On a 1 to 5 scale, with 1 being "poor" and 5 being "excellent", the average rating for all Boot Camp presentations was 4.6, up slightly from 4.5 the previous year. These ratings for individual topics ranged from 4.4 to 4.8. This feedback indicates that the selection of topics for 2012 was appropriate. The topics selected for the 2012 Boot Camps were planned in large part from the suggestions on the participant evaluation forms and verbal feedback from the 2011 Boot Camp attendees. Suggestions from the 2012 Boot Camps for future topics include topics such as crossbreeding programs, feeding calves, cattle handling facilities, bull selection, heifer development, and expected progeny differences. These suggestions are also used in planning additional Extension programming efforts beyond the Boot Camps, such as specialized short courses.

Implications

Hands-on learning experiences are considered valuable to beef cattle producers, especially novice producers who may require more hands-on experiences to understand basic practices. The Beef Cattle Boot Camps provide opportunities for these experiences while also highlighting MAFES beef cattle research activities. In addition, they facilitate MSU-ES and MAFES personnel interactions with beef cattle producers.

Acknowledgements

Appreciation is extended to the MAFES and departmental staff who assisted in Boot Camp preparations and implementation.

Cattle Operation Facilities Workshop

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Extension Summary

The Mississippi State University Extension Service (MSU-ES) Beef Cattle Operation Facilities Workshop was conducted in March of 2012. The goal of the project was to provide producers with practical information to plan new facilities or modify existing ones. Topics covered in the workshop included: cattle handling facilities; fencing, watering, and shade systems; and feed storage structures. Based upon evaluations submitted by participants, the overall program was rated highly, and various suggestions for future beef cattle workshops were included.

Introduction

Producers often inquire about cattle handling facilities and other structures that are used on beef cattle operations. Whether constructing new facilities or modifying existing facilities, many questions arise as to efficient and effective designs and systems. In order to address these questions, the MSU-ES conducted a Beef Cattle Operation Facilities Workshop. The purpose of this workshop was to provide an educational opportunity for producers to learn practical information to plan new facilities or modify existing ones.

Procedures

The Beef Cattle Operation Facilities Workshop was tailored toward a Mississippi beef cattle producer audience. The workshop was advertised through the *Cattle Business in Mississippi* magazine, on the Internet, with printed brochures, and via local Extension offices. The program was held on March 13, 2012, at Mississippi State University in Starkville, MS. It was broadcast live over the MSU-ES interactive video system to Raymond, Biloxi, and Oxford, MS. The program began at 9:30 a.m., included lunch, and concluded at 3:30 p.m. Registration fees covered the cost of lunch, refreshments, and notebooks that were given to the participants. Attendees also received copies of Dr. Temple Grandin's book, *Humane Livestock Handling,* which included livestock handling guidelines and handling facility design plans.

Topics that were covered in the Beef Cattle Operation Facilities Workshop included: cattle handling facilities; fencing, watering, and shade systems; and feed storage structures. The cattle handling facilities topic was presented in three sections that addressed designing efficient and functional cattle handling facilities with animal behavior and low stress handling in mind, a virtual video tour and interactive critique of various beef cattle handling facilities, and design and construction considerations.

Following the program each participant was encouraged to complete and submit course evaluations. Additionally, persons interested in the workshop but who were unable to attend the live presentations were provided with the course materials at cost upon request. This method of educational information distribution was advertised in the Mississippi Cattlemen's

Association's weekly email newsletter, Monday Memo.

Results

Based upon the responses to the evaluations (n = 27), all respondents felt the course provided information that would be useful for their operation, with the exception of one respondent answered maybe on this question. The vast majority of participants (95.6%) felt the course length was appropriate. On a 1 to 5 scale, with 1 being "poor" and 5 being "excellent", the average rating for all Workshop presentations was 4.4. These ratings for individual topics ranged from 4.0 to 4.6.

A key suggestion for future workshop was to provide on site tours of cattle handling facilities. This indicates a desire for hands-on learning activities. Topics suggested for future beef cattle Extension programs included forages, weed control, estate taxes, heifer selection, cow nutrition, hay storage, internal parasite control, calf preconditioning, and calving season selection.

Implications

Cattle operation facilities are an area of particular interest to beef cattle producers, regardless of operation type or size. The diversity of operations represented by participants at the workshop was evidence of this. Feedback emphasized that obtaining hands-on learning experiences are considered valuable to cattle producers and that a wide range of educational topics are desired by local producers.

2012 Mississippi 4-H Congress

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Extension Summary

Mississippi 4-H Congress is an annual event where senior 4-H youth are given opportunities to compete in educational contests involving livestock. Over the course of a 3-day period, youth compete in visual presentation contests, judging contests, quiz bowl competitions and poster contests. Winning teams in the Meats Judging Contest and Dairy Quiz Bowl advance to represent Mississippi in national competition. Though youth enjoy their time during 4-H Congress, they are very competitive and display knowledge and abilities in a variety of contests.

Introduction

Mississippi 4-H Congress is an annual state event designed to supplement county 4-H programs. This event provides positive leadership and educational opportunities for senior 4-H members from across the state in an effort to develop these young people to their full potential, allowing them to become productive citizens and catalysts for positive change and ready to meet the needs of a diverse and changing society. In late May, on the campus of Mississippi State University, senior 4-H members (age 14 to18 yr) are given opportunities to compete in a variety of livestock-related contests. Senior 4-H members give Visual Presentations related to Beef, Sheep, Swine, Goats, Dairy Animals, and Dairy Foods. There are Meats and Dairy Products Judging Contests in addition to Meats and Dairy Quiz Bowls. State Congress provides 4-H members with friendly competition and opportunities to meet 4-H'ers from across the state, attend educational workshops, and have a lot of fun during their visit to the campus. Therefore, the objective of the Mississippi 4-H Congress is to improve youth's knowledge and skills through experiential learning, life skills training, and leadership development opportunities. In addition, winners in state competitions are selected.

Procedures

At 4-H Congress, a variety of competitions are offered to senior youth. The Visual Presentation contest is divided into several areas, including Beef, Sheep/Swine/Meat Goat, Dairy Foods, and Dairy Animals Visual Presentations. Youth present on a topic of their choice, using posters or Microsoft PowerPoint to supplement their presentation. In Meats Judging, individuals and teams judge 4 classes of meat product, identify 25 retail cuts of beef, pork and lamb and present 2 sets of oral reasons on 2 placing classes. The winning senior Meats Judging team advances to national competition in Denver, CO. Dairy Products Judging includes scoring samples of milk, cottage cheese, cheddar cheese, and ice cream, rating each sample for overall impression and scoring any taste defects. Two quiz bowls are offered, a Dairy Quiz Bowl and Livestock Quiz Bowl. Dairy Quiz Bowl involves a multi-phase event with a scored quiz and rounds of questions asked to each team. The winning senior Dairy Quiz Bowl team advances to national competition in Louisville, KY. The Livestock Quiz Bowl

is a Jeopardy-style contest with questions written from source books about cattle, sheep, swine, meat goats, and dairy goats. The final competition available to youth is a Dairy Poster Contest where youth, ages 8 to 18 yr, design a poster based on the national dairy mo motto for that yr.

Results

There was quality participation in the educational contests held during 4-H Congress this past year. In the visual presentations, there were a total of 13 participants (2 in Sheep/Swine/Meat Goat; 6 in Beef; 3 in Dairy Foods; and 2 in Dairy Animals). In Meats Judging, there were 6 teams and 24 youth that competed in the contest. Dairy Products Judging had 7 teams and 31 total youth judging the dairy product samples. In the quiz bowl competitions, Dairy Bowl had 2 teams and 8 youth while Livestock Bowl had 4 teams and 17 youth. A total of 40 youth submitted posters in the Dairy Poster Contest using the theme "Dedicated to Dairy – Make Mine Milk". In this contest, there were 12 participants in the 8 to 10 yr old division, 9 participants in the 11 to 13 yr old division and 9 participants in the 14 to 18 yr old division. Altogether, 133 youth competed in livestock-related educational contests during 4-H Congress.

Implications

Many people think of livestock shows when the 4-H Livestock Program is mentioned. It is important to emphasize the valuable characteristics youth can learn by giving presentations, judging meats and dairy products and justifying their decisions with oral reasons, and using their knowledge of livestock in quiz bowl competitions. These are productive contests that allow youth to exercise their true capabilities and understandings of what they have learned with their own animals. Participation is always encouraged to allow youth to develop the self-confidence to speak to a group of people about a livestock topic of their interest. It should be noted that for the past 3 years, the Mississippi 4-H State Presidents' main project interests have been the livestock program. These livestock-related educational contests held during 4-H Congress are critical to the 4-H Livestock Program as they allow youth to gain needed experiences in communication and decision-making that will enable them to be successful in life.

2012 Dixie National Junior Round-Up

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Extension Summary

In early February, 4-H youth brought their livestock projects to Jackson for the Dixie National Junior Round-Up Livestock Shows. This show is the showcase for Mississippi 4-H Livestock Programs and site of the largest junior market livestock show in Mississippi. Those animals that received a blue ribbon at their District Livestock Show qualified for the Dixie National Junior Round-Up. Despite difficult economic times, 2,302 animals were exhibited by 1,458 youth, making this the largest Dixie National Junior Round-Up livestock show in the past decade. These data further support the strength of Mississippians and the dedication and interest that still existed in showing livestock when economic times were challenging for many.

Introduction

The Dixie National Junior Round-Up is the largest junior livestock show held in Mississippi. Youth and their families begin preparing for this show many months in advance. Much thought and decision goes into selecting the animal for show, and then the process starts to provide the animal with proper nutrition, care, and training of the animal in preparation for show. Through this process, youth learn about aspects of nutrition, reproduction, genetics, selection, and exhibition with their livestock. This enables youth to be competitive in education contests held in conjunction with the Dixie National Junior Round-Up, where scholarships can be won to help with their educations when they reach college. Therefore, the objective of the Dixie National Junior Round-Up livestock shows is to offer youth with the opportunity to showcase the progress they have made with their livestock project in the show ring while providing them with opportunities to obtain monies through education contests to aid them as they pursue postsecondary instruction.

Procedures

Qualification for Dixie National Junior Round-Up.

In order to show livestock at the Dixie National Junior Round-Up, youth compete with their animals at 1 of 5 district shows, depending on their county of residence. At these shows, all animals that received a blue ribbon qualified for the Junior Round-Up. In the market shows at the district competition, youth were allowed to show up to 6 market hogs, 6 market goats, 6 market lambs, and 3 market steers. From these animals that qualified, youth were allowed to weigh-in and show 2 market animals in those species at the Dixie National Junior Round-Up. For breeding animals, youth were allowed to enter and show up to 6 beef cattle, 6 dairy cattle, 6 dairy goats, and 6 commercial meat goat does at the Dixie National Junior Round-Up. For the education contests, youth enter competition by submitting applications that were scored prior to on-site competition. In addition, their performance in the remaining aspects of the contests held during the livestock shows contribute to overall rankings.

Results

One thousand, four-hundred fifty-eight 4-H and FFA youth exhibited 2,302 animals at the 2012 Dixie National Junior Round-Up, which was the largest show held as compared to the past decade. The following is a breakdown of the number of entries in 2012 along with the change in number of animals shown from 2012 to 2011 shows in parenthesis: 797 beef cattle (+36); 147 dairy cattle (+20); 710 market hogs (+22); 193 market lambs (-42); 198 market goats (+15); 190 commercial meat goat does (+33); and 67 dairy goats (-31). Exhibitors of market animals were able to show 3 market animals, as long as 1 of the 3 market animals was Mississippi Bred. This change was made for Mississippi producers to be better able to market their animals for shows.

The education contests at the 2012 Dixie National Junior Round-Up had good participation. At the Premier Exhibitor contests, there were 32 participants in the beef division, 7 in the dairy division, 6 in the lamb division, 13 in the swine division and 21 in the goat division, totaling 79 youth who participated in these contests. In the Academic Scholarship Program, awarded by the Sale of Junior Champions Promotion Committee, 40 applications were received from which the 25 scholarships valued at $1,500 each were awarded. In addition, the Dixie National Booster Club awarded 6 $1,000 scholarships to the highest placing graduating senior for each species in showmanship.

Implications

The Dixie National Junior Round-Up was a successful event on a number of levels. Many of the species had increased numbers shown compared to 2011. The valuable information that youth learn about their livestock project enables them to be competitive in the education contests and scholarship program, and the growing number of participants is encouraging. These data show that Mississippi youth are resilient, hard-working individuals who enjoy the challenges associated with showing livestock and competing for scholarship monies.

2012 Dixie National Sale of Junior Champions

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Extension Summary

The Dixie National Junior Round-Up Livestock Show is the site of the largest junior market livestock show in Mississippi. Each year, the champions and reserve champions in the junior market shows are selected to participate in the Sale of Junior Champions. Of the 1,457 market animals exhibited at 1 of 5 District Livestock Shows, 44 market animals qualified for the 43rd Sale of Champions auction in 2012. These animals sold for $299,352.50, with 80% of the money going to the exhibitor and 20% into a scholarship fund and to pay expenses of the sale. In addition, 34 youth were recognized for their academic accomplishments and successes with breeding animals, and $51,500 was awarded to these individuals. Even though this was a difficult year from a financial standpoint for many buyers and contributors, the hard work of the promotion committee paid off with the monies raised for Mississippi youth.

Introduction

The Dixie National Junior Round-Up is the largest junior livestock show held in Mississippi. This show culminates each year with the Sale of Junior Champions, where the champion and reserve champion exhibitors in the market shows earn the privilege to sell their animal in a live auction. Youth and their families begin preparing for this show many months in advance in hopes of qualifying an animal for the sale. Much thought and decision goes into selecting the animal for show, and then the process starts to provide the animal with proper nutrition, care, and training of the animal in preparation for show.

Membership on the Sale of Champions Promotion Committee includes adults, businesspeople, and the Extension 4-H Livestock Specialist who are interested in promoting the junior livestock program in Mississippi. These members work diligently to bring potential buyers and contributors to the sale each year to invest in the future of Mississippi youth. The committee seeks to 1) promote the 4-H and FFA livestock program in Mississippi; 2) promote economic, educational and personal development opportunities for youth; and 3) to motivate and increase interest in the junior livestock program. Not only are youth recognized for qualifying their animal for the sale, but other youth exhibitors are rewarded for their achievements in education contests and with their breeding animals.

Procedures

The Sale of Junior Champions Promotion Committee met several times in the latter part of 2011 and early 2012 to discuss potential buyer and contributor lists. Each committee member was challenged with contacting these businesses and individuals to encourage them to participate in the upcoming sale. The number of animals qualifying for the sale varies each year, with approximately 41-44 animals being sold annually. Youth receive 80% of the sale of the animal, while 15% of the money goes into the scholarship fund and 5% covers the expense of the sale. Money

in the scholarship fund was used to recognize youth winning education contests (Premier Exhibitor contests), being a graduating senior without qualifying an animal for the sale (Academic Scholarships), and for exhibiting animals that won supreme awards (Supreme Animal Scholarships).

Results

One thousand, four-hundred fifty-seven market animals were exhibited at one of five District Livestock Shows in an attempt to qualify for the Dixie National Junior Round-Up. Of these market animals, 1,210 animals were exhibited at the Junior Round-Up from which 44 market animals qualified for the Sale of Junior Champions. The sale included 9 market steers, 13 market hogs, 13 market lambs and 9 market goats. These 44 animals sold for a record total of $299,352.50, making it the 18th consecutive year the sale grossed over $100,000. To date, the 43 combined sales have grossed a very impressive $4.8 million dollars.

While the exhibitor is allowed to keep 80% of the money from the proceeds of the animal, 15% of that money is used in the scholarship program. Twenty-five Academic Scholarships (each worth $1,500) were awarded to graduating seniors who did not have an animal that qualified for the sale (totaled $37,500). Forty applications were received for the Academic Scholarships in 2012. In addition, the Premier Exhibitor contest recognized the winner of each of the 5 species shown (beef, 32 entries; dairy, 7 entries; sheep, 6 entries; swine, 13 entries; and goat, 21 entries) with $2,000 scholarships, totaling $10,000. Finally, the exhibitor of the Supreme Beef Bull, Supreme Beef Female, Supreme Dairy Cattle Female and Supreme Dairy Goat Female received a $1,000 Supreme Animal Scholarship, totaling $4,000. Altogether, $51,500 in scholarships was awarded to 34 youth by the Sale of Champions Promotion Committee. The scholarship program was initiated in 1993, and to date, 433 scholarships have been awarded for a total of $497,700.

Implications

Committee members worked diligently in preparing for the 2012 Sale of Junior Champions and were pleased with its outcome and for recognizing the large number of animals that qualified for the sale. Despite difficult economic times, buyers and contributors gave generously and the number of youth served in this program was substantial. These data demonstrate the generosity of Mississippians when it comes to helping put youth in a position to be successful later in life. That is the goal of the Sale of Champions, to work toward the personal development of youth who participate in livestock programs.

Beef Cattle Genetics Learn at Lunch

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Extension Summary

The Mississippi State University Extension Service (MSU-ES) Beef Cattle Genetics Learn at Lunch was conducted in September of 2011 in cooperation with the Alabama Cooperative Extension System (ACES) and the Mississippi and Alabama Beef Cattle Improvement Associations (BCIA). The goal of this webinar series was to provide practical knowledge that could be used for genetic improvement in commercial and seedstock operations. Topics covered in the series included: records for genetic improvement, computerized record keeping, genetic selection tools, improving female genetics, bull buying decisions, stocker cattle genetics, industry trends and lessons, and new genetic tools. Website analytics reveal that the program continues to reach producers to present day.

Introduction

Genetic improvement in beef cattle herds is a common objective of the MSU-ES, ACES, and Mississippi and Alabama BCIA. A recent survey sponsored by the Mississippi BCIA showed an educational gap in beef cattle genetic improvement topics in the region. In response to this educational need, the beef cattle specialists with MSU-ES and ACES worked jointly to coordinate a Beef Cattle Genetics Learn at Lunch webinar series. The purpose of this educational series was to present practical knowledge that could be used for genetic improvement in commercial and seedstock beef cattle operations.

Procedures

The Beef Cattle Genetics Learn at Lunch was sponsored by the Mississippi and Alabama BCIA. It was advertised through the state cattlemen's association magazines in both states, on the Internet, with printed brochures, and via local Extension offices. The webinars were conducted as a series of eight live sessions on Tuesdays and Thursdays during the noon hour throughout September 2011. These 1-hour webinars were broadcast live over the internet to personal computers using Scopia Desktop software and also over the MSU-ES interactive video system. The webinars were immediately archived on the MSUcares beef cattle website at *msucares.com/livestock/beef/beefsc.html* for anytime viewing where they remain to date.

Topics that were covered in the Beef Cattle Genetics Learn at Lunch included: records for genetic improvement, computerized record keeping, genetic selection tools, improving female genetics, bull buying decisions, stocker cattle genetics, industry trends and lessons, and new genetic tools. Presenters from seven different land-grant universities were utilized in the program. With the delivery system used, presenters were able to deliver their respective presentations from their work locations, which even included a remote cattle operation with internet access for one presenter. Following the program, website analytics information was obtained from the MSUcares website to further assess participation in the webinar series.

Results

The live webinar broadcasts averaged 17 viewing sites per session. In addition, some of these viewing sites hosted multiple participants. The archived sessions averaged 40 views per week during September 2011. Views of archived sessions typically peaked 2 to 4 days after each live broadcast. Time of day for views of archived sessions included early morning, midday, and late night views.

Implications

These results indicate that educational program participation can be increased by offering programs over electronic media such that participants can access these programs at their leisure. This format also provided an economically efficient means to utilize presenters from outside of Mississippi and Alabama and to offer programming that limited travel and time requirements of participants. Continued tracking of archived session views will follow to further assess program reach.

2012 4-H/FFA Beef Heifer Replacement Contest

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Extension Summary

4-H and FFA livestock projects have been successful at teaching youth and their families about responsibility and care for their livestock. The Replacement Beef Heifer Development Contest is a 10-mo event where the contestant is personally responsible for the daily management of their heifers. During the contest, youth maintain records about their project to justify management decisions. At the end of the contest, they turn in a record book (30% of the contest), have their heifers evaluated (20% of the contest), and make a presentation about their project during an interview (50% of the contest). In the fourth year of competition, 13 entries were received in November the contest will be completed in August. It is anticipated that youth in this contest will be able to educate adult beef cattle producers about management practices and become good stewards of their cattle.

Introduction

Livestock shows have always been popular among Mississippi youth. Showing livestock provides youth with a variety of avenues to learn about their animals, including aspects of nutrition, reproduction, genetics, selection, and exhibition. As youth grow in the program, they are better able to utilize and understand this information to make enhanced decisions regarding their livestock projects. A common misconception about livestock shows is that the most successful youth are those who have unlimited resources from which high-quality livestock and equipment can be obtained for shows. This has been known to discourage some youth and families from participating in livestock shows. Some youth, regardless of whether they show cattle, are integral parts of family cattle operations and have obtained experiences that will enable them to make sound heifer management decisions. Therefore, the objective of the Replacement Beef Heifer Development Contest is to recognize those youth that have a true passion for raising beef cattle. In doing so, youth will learn about proper heifer development practices and procedures and can be a positive influence on adult producers involved in raising cattle.

Procedures

Contest Design

The 4-H and FFA Heifer Development Contest is a 10-mo project that started on November 1, 2011, and will conclude August 10-11, 2012. Contestants must be 4-H or FFA members who compete as individuals unless 2 or more brothers or sisters (each at least 14 yr of age but not over 18 yr of age as of January 1 of the year in which the contest begins) of a family constitute a joint entry. If the entrant is in college, he/she must personally manage and care for their heifers on a daily basis by commuting to and from home and school. It is not permissible to have someone else care for contest heifers while away at school.

The heifer development project must consist of 3 heifers (purebred or commercial) that are either autumn born

from the previous year or spring born of the year in which the contest begins. While not mandatory, the heifers can be exhibited in junior shows. Heifers can be purchased from a purebred or commercial producer or be selected from operations of an immediate family member (parent, stepparent, brother, sister, half-brother, half-sister, grandparent, or legal guardian). This contest is designed to evaluate the youth producer's ability to manage the heifers rather than the genetic makeup of the heifers. Therefore, participants using purebred and commercial heifers will be judged together without preference given for breed or breed type. Contestants will be judged on all managerial aspects of their heifer development project. Participants were encouraged to take advantage of Extension agents, advisors, and experienced producers in selecting quality heifers and discussing production costs.

Evaluation System

Youth submitted entry forms with a description of the 3 heifers they entered in the contest by November 1, 2011, to the Extension 4-H Livestock Specialist. Initial criteria to be included on the entry form included each animal's age, weight, breed, and starting value (purchase price). In addition, each entrant submitted their goals for the project. If registered heifers were used, the entry included a photocopy of that animal's(s') registration paper.

Heifers chosen for the contest must have been born in the autumn of 2011 or the spring of 2012. Any heifer with a sign of 3-yr-old teeth were eliminated at the contest site, regardless of a registered or printed birth date for that heifer. Upon arrival to the contest site, all entered heifers were checked to confirm that the heifer was entered in the contest.

The 4-H and FFA Heifer Development Contest consists of 3 components: a visual appraisal of the heifers, a record keeping system, and an interview process.

Visual Evaluation: A committee of judges evaluated each group of 3 heifers managed by youth. Criteria evaluated included weight, frame score, growth, body condition score, health, structural/skeletal soundness, and reproductive ultrasound evaluation. In addition, each entrant was judged on their salesmanship skills and overall knowledge of phenotypic characteristics of their heifers. *This component of the contest was worth 20%.*

Records: Youth were required to submit records kept throughout the project by August 1, 2012. At the start of the project, contestants were asked to list short- and long-term goals for their heifer project. During each mo of the project, contestants should have recorded management practices performed on his/her heifers. Examples include recording the amount of feed, hay or other nutritional supplements purchased or fed, veterinarian expenses and other health-related costs, breeding decisions, rotational grazing of pastures, a complete budget/expense sheets and any other management issue in which the youth made a decision for the continued development of his/her heifers. At the conclusion of the project, youth should have addressed whether they achieved their goals set at the start of the project. These records were judged on their completeness and exactness during the contest year. *This component of the contest was worth 30%.*

Interview: A committee of judges interviewed the exhibitor on their individual production practices. Exhibitors gave a 10

to 15 minute presentation (Microsoft PowerPoint slides or other visual aids) to summarize his/her heifer development project. This presentation included anything relevant to the contestant's project (goals for project and if they were accomplished, pictures to illustrate the project, etc). Each exhibitor then answered questions from the committee in regard to their project, such as the process used to select the heifers, record keeping system used, nutrition program, bull used for breeding purposes, health records and any production practices utilized by the exhibitor during this contest. *This component of the contest was worth 50%.*

Judges for this contest were chosen from Extension area livestock agents, cattle producers, Extension specialists, and cattle association members. All ties were to be broken using the interview score followed by the record book.

Results

In the fourth year of this contest, 13 entries were received. The contest has not been concluded this year to date. Throughout the year, several educational opportunities were made available to youth to assist them with their heifer project.

This contest is a big endeavor for youth, and it was important to reward them justly. While the education and knowledge learned about heifer development will benefit youth long-term, it was important to provide valuable prizes for winning. To date, prizes to be awarded for the Replacement Beef Heifer Development Contest include a bumper-pull livestock trailer, laptop, truck/trailer hitches, cash prizes, and complementary artificial insemination school registrations for all participants, courtesy of the Mississippi State University Extension Service. The announcement of winners and awarding of prizes will take place during the Mississippi State Fair and the winner will present what they learned about heifer development at the 2013 Mississippi Cattlemen's Association annual convention.

Implications

The Replacement Beef Heifer Development Contest provides an authentic experience for youth that choose to participate. Not only do youth learn valuable information that they can use for a lifetime, but the cattle industry benefits as young cattlemen and cattlewomen will be educated producers in the future. These youth can be a positive influence on their own family's cattle production system and share their insights with other cattle producers around the state, causing adults to think more about their own management decisions.

Beef Cattle Herd Health Management Short Course

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Extension Summary

The Mississippi State University Extension Service (MSU-ES) and College of Veterinary Medicine (CVM) Beef Cattle Herd Health Management Short Course was conducted in December of 2011. The goal of the project was to provide producers with practical information on beef cattle herd health management. Topics covered in the short course included: Mississippi cattle health benchmarks, diseases, parasite control, vaccination, management practices, and medical management. Based upon evaluations submitted by participants, the overall program was rated highly, and various suggestions for future beef cattle short courses were included.

Introduction

Managing herd health is a key component to running a successful beef cattle operation. Topic requests for presentations at county Cattlemen's Association meetings often involve herd health concepts. In response to this information demand, the MSU-ES and CVM conducted a Beef Cattle Herd Health Management Short Course. The purpose of this short course was to provide an educational opportunity for Mississippi beef cattle producers to learn relevant, current information about herd health management. The short course was also intended to provide a forum for producer inquiries about specific herd health questions and to promote the role of local veterinarians in herd health management program design and implementation.

Procedures

The Beef Cattle Herd Health Management Short Course was tailored toward a Mississippi beef cattle producer audience and contained information relevant to both cow-calf and stocker cattle operations. The workshop was advertised through the *Cattle Business in Mississippi* magazine, on the Internet, with printed brochures, and via local Extension offices. The program was held on December 1, 2011, at Mississippi State University in Starkville, MS. It was broadcast live over the MSU-ES interactive video system to Raymond, Biloxi, and Oxford, MS. The program began at 9:30 a.m., included lunch, and concluded at 3:30 p.m. Registration fees covered the cost of lunch, refreshments, and notebooks that were provided to the participants.

Topics that were covered in the Beef Cattle Herd Health Management Short Course included: Mississippi cattle health benchmarks, diseases, parasite control, vaccination, management practices, and medical management. Local veterinarians were on hand at each participant site to assist in answering participant questions and interacting with participants throughout the day. Following the program each participant was encouraged to complete and submit course evaluations.

Results

Based upon the responses to the evaluations (n = 33), all respondents indicated that the course provided information that would be useful for their operation. The vast majority of participants (96.9%) noted that the course length was appropriate. On a 1 to 5 scale, with 1 being "poor" and 5 being "excellent", the average rating for all short course presentations was 4.5. These ratings for individual topics ranged from 4.1 to 4.8.

Participant suggestions for future programs included a follow up to this short course with more in-depth information on vaccinations and medical management. Hands-on learning activities were also requested. Topics suggested for future beef cattle Extension programs included forages, implants, marketing, cattle breeding, genetic selection and culling, pregnant cow management, calving management, and record keeping.

Implications

Proper cattle herd health management is vital to successful cattle production. Producers expressed interest in continued educational efforts to address herd health management as well as a wide range of beef cattle educational topics. The role of veterinarians in herd health management program development and implementation was recognized as very important.

2012 Mississippi 4-H Horse Championships

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Extension Summary

The highlight of the yr for youth interested in the 4-H Horse Program is the Mississippi 4-H Horse Championships. Many of these youth had to qualify for this show by placing well at one of 4 district horse shows held across the state. In 2012, 613 youth competed at district shows on 1,051 horses, with a total of 2,841 total entries in these shows. Overall, 66 counties had youth represented at the district shows. At the state horse show, 397 youth (representing 60 counties) competed on 618 horses, with a total of 1,299 entries being shown. The district and state shows offered numerous opportunities for junior and senior youth to compete in education contests. Altogether, 265 youth competed in these education contests. In our creative contests, Horse Art, Horse Photography and County T-shirt Design, there were 262 youth entered and 17 counties that submitted entries. The Mississippi 4-H Horse Program was well represented by youth at national contests, attesting to the quality of the youth involved in this program.

Introduction

The State 4-H Horse Championships is the largest 4-H horse show held in Mississippi. Youth and their families begin preparing for this show many months in advance. Much time and effort goes into training and working with the horse and rider to make them best suited for competition. During this process, youth gain valuable insight regarding proper nutrition for their horse and preparation for the district and state horse shows. In addition to an understanding of nutrition, youth learn about aspects of reproduction, genetics, selection, and exhibition with their horses, thereby enabling them to be competitive in education contests held in conjunction with the State 4-H Horse Championships, where senior winning individuals and teams are selected to represent Mississippi in national contests. Therefore, the objective of the State 4-H Horse Championships is to offer youth the opportunity to showcase the progress they have made with their horses in competition while providing opportunities to use their knowledge and training about horses in educational contests.

Procedures

There are 2 types of classes offered through the Mississippi 4-H Horse Program: District Only classes where youth must qualify their horses to advance to state competition and State Only classes where youth compete on their horses at the state show without having to qualify for that class. State Only classes require some equipment that all district shows are not able to obtain, such as jumps and fences for over fences classes. At the district horse shows (Northeast: Verona, MS; Northwest: Batesville, MS; Southeast: Meridian, MS; Southwest: Jackson, MS), all junior (age 8 to 13) educational contests are held, with the top 3 teams and/or individuals (depending on the contest) advancing to compete at the

state show against other winning juniors. Senior 4-H youth compete at the state competition held during the state horse show. During the state horse show, all education contests are held prior to the horse classes. Education contests offered at these shows include Horse Public Speaking, Horse Individual Demonstration, Horse Team Demonstration, Horse Bowl, Horse Judging, and Hippology (senior-only event). In addition, creative contests are offered for youth to compete in as individuals and as a county, including Horse Art, Horse Photography, County T-shirt Design Contest, and County Stall Decoration/Display Contest. Winners are announced at the Opening Ceremony. Of the classes offered during the state horse show, 50 horses were chosen to advance to the Southern Regional 4-H Horse Championships. Winners of the senior educational contests received some travel support to compete at the Western National 4-H Roundup in the Horse Classic in Denver, Colorado.

Results

At the District 4-H Horse Shows held in 2012, 613 youth rode 1,051 horses with a total of 2,841 entries. Overall, 66 counties had youth represented at the 4 district shows. At the state horse show, 397 youth (representing 60 counties) competed on 618 horses, with a total of 1,299 entries being shown. At the state show, senior 4-H participation increased in all educational contests. Altogether, 265 youth competed in these educational contests at the district and state horse shows. In our creative contests, 140 youth had exhibits in Horse Art, 122 youth had exhibits in Horse Photography, 17 counties entered the County T-shirt Design Contest and 7 counties entered the County Stall Decoration/Display Contest.

Implications

It is important for youth to learn communication skills in 4-H. The Mississippi 4-H Horse Program provides many opportunities for youth to gain valuable experiences in educational contests that will help them as they progress towards college. Competition in these events is friendly but fierce, similar to what is seen in our classes. Mississippi youth performed well at regional and national contests, demonstrating the depth of the quality of youth at these district and state shows.

Mississippi State University Extension Service Cattle Artificial Insemination School

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Extension Summary

The Mississippi State University Extension Service (MSU-ES) Cattle Artificial Insemination (AI) School was initiated in 1997 to provide an applied, practical educational program for beef and dairy cattle producers. The topics covered, location, and instructors have changed over the last decade, but the dedication to delivering a quality educational program has remained strong. Currently, the topics offered in the school include economics of AI, reproductive anatomy, estrous cycle, estrus synchronization, application of the Estrus Synchronization Planner program, AI equipment, AI technique practice with bovine reproductive tracts, heat detection, heat detection aids, nutritional programs for AI success, sire selection, reproductive heard health, biosecurity, semen handling, and AI technique practice with live cattle. Question and answer sessions and individual interaction with instructors are important parts of the course. The MSU-ES Cattle AI School is held twice annually in the spring and autumn of the year and continues to attract participants from across the U.S. Participant evaluations indicate that the program is achieving its educational goals.

Introduction

Beef and dairy cattle producers utilize AI to introduce superior genetics into their herds and increase profitability. The MSU-ES Cattle AI School was initiated in 1997 to support producer demand for an applied, hands-on educational program about cattle AI. The MSU-ES Cattle AI School started as an annual program taught at the Mississippi Agricultural and Forestry Experiment Station (MAFES) Prairie Research Unit in Prairie, MS. The school moved to the Mississippi State University (MSU) main campus in 2007 to better utilize the cattle, facilities, and faculty available on campus. It is currently conducted at the MAFES Bearden Dairy Research Unit, MAFES Leveck Animal Research Unit (South Farm Beef Unit), and in Animal and Dairy Sciences department classrooms. Registration fees cover the cost of AI supplies, notebooks, a mid-day meal, and refreshments for the participants. Instructors for the school include MSU faculty, Extension agents, staff, and graduate students with expertise in relevant subject areas. Both MSU-ES and MAFES personnel are involved in program implementation.

Procedures

Objectives of the MSU-ES Cattle AI School are to 1) provide a cost-efficient program to educate producers on reproductive management; 2) introduce the basics of cattle reproductive management including hormonal regulation, cattle reproductive anatomy, nutrition, genetics, health, etc.; 3) familiarize participants with AI tools including equipment and protocols; and 4) provide hands-on AI and semen handling experience. The course is offered twice a year in spring and autumn, and

limited to 40 participants per course. The participant capacity was expanded in 2012 from the previous capacity of 25 with the addition of the Beef Unit for live animal training. Program advantages include classroom, lab, and live animal training by MSU topic experts, individual instruction time for all participants, and up-to-date reference materials, record sheets, and management tools provided as part of the course.

The MSU-ES Cattle AI School is unique from most other AI training programs in that it consists of 7 hours of classroom training. Hands-on laboratory handling of bovine female reproductive tracts is included in the classroom training. The program requires a minimum of 8 hours of hands-on experience with semen handling and cattle insemination technique. Near the conclusion of the course, participants are required to make a cervical pass in a mature cow with an AI rod to be checked for accuracy by instructors. The course begins on a Thursday evening taking place from 6:00 p.m. to 9:45 p.m., continues on Friday from 8:00 a.m. to 5:00 p.m., and concludes on Saturday from 8:00 a.m. to 12:00 p.m. The classroom training runs through Friday at noon, followed by the technique training, which occupies the remainder of the course time.

Results

All participants enrolled in the MSU-ES Cattle AI School are requested to complete a course evaluation. The evaluation asks the participant to rank each of the topics and speakers for each subject area on a 1 to 5 Likert-type scale, where 1=poor and 5=excellent. Across all of the MSU-ES Cattle AI Schools that have been offered to date, the overall rating for speakers was a 4.74 and the overall rating for topics was a 4.67.

Questions are included on the evaluation forms to better assess program design, content, and delivery. Questions address the usefulness of the information presented, program length, likelihood of recommending the course to others, course expectations, use of classroom time, and live animal sessions. For the Spring 2012 School, only positive responses to these questions were received.

The presentations and interactive demonstrations for the MSU-ES Cattle AI School continue to be modified based on suggestions from the participant evaluation forms and verbal feedback from the attendees. Previous changes made to the program based on participant comments included inclusion of more MSU faculty and students in instructional roles, creation of a course website, development of MSU-ES authored publications for inclusion in course reference manuals, addition of an instructional session highlighting the Beef Reproductive Task Force's free Estrous Synchronization Planner program, enhancement of laminated chute side notes for participants to keep, and distribution of maps providing directions from the classroom location to the live animal location. In 2012 additional modifications to the school included expansion of the course to include live animal instruction at the Beef Unit in addition to the Dairy Unit and breakout laboratory sessions in which groups are rotated among reproductive tract handling, AI equipment and semen handling practice, and introduction to estrous synchronization software and breeding box design.

There remains strong demand for the MSU-ES Cattle AI School. The course is

marketed to prospective participants via the MSUcares website and printed brochures disseminated by MSU-ES personnel, and it consistently fills to participant capacity at each offering. Course participation has expanded from primarily Mississippi-based attendees to producer representation from 18 additional U.S. states in the program. In excess of 900 persons have completed the MSU-ES AI School since its inception in 1997.

Implications

Participants completing the MSU-ES Cattle AI School are exposed to classroom, laboratory, and live animal instruction and provided with a certificate of completion. Course graduates are encouraged to continue AI practice to become highly skilled, accurate technicians. Goals for future AI schools are to keep it updated with current AI recommendations, follow up with past participants to assist them in their educational needs, provide supplemental material after course completion, and use participant input to better the program. Current course information is online at *msucares.com/livestock/beef/aischool.html*.

Acknowledgements

Appreciation is extended to the departmental and MAFES staff who assisted in the MSU-ES Cattle AI School preparations and implementation.

Abbreviations List

Physical Units
°F = Degree Fahrenheit
cal = calorie
Da = dalton
Eq = equivalent
fl oz = fluid ounce
ft = foot(feet)
gal = gal
Hz = hertz
IU = international unit
in = inch(es)
J = joule
lb = pound(s)
lx = lux
M = molar (concentration; preferred over mollL)
MPH = miles per hour
mol = mole
N = normal (concentration)
RPM = revolutions per minute
T = ton(s)
V = volt
W = watt
yd = yard(s)

Units of Time
s = second(s)
mm = minute(s)
h = hour(s)
d = day(s)
wk = week(s)
mo = month(s)
yr = year(s)

Statistical Symbols and Abbreviation
ANOVA = analysis of variance
CV = coefficient of variation
df = degree(s) of freedom
F = F-distribution (variance ratio)
LSD = least significant difference
LSM = least squares means
MS = mean square
n = sample size
NS = nonsignificant
p = probability
r = simple correlation coefficient
r^2 = simple coefficient of determination
R = multiple correlation coefficient
R^2 = multiple coefficient of determination
S^2 = variance (sample)
SD = standard deviation (sample)
SE = standard error
SED = standard error of the differences of means
SEM = standard error of the mean
SS = sums of squares
t = *t*- (or Student) distribution
α = probability of Type I error
β = probability of Type II error
μ = mean (population)
σ = standard deviation (population)
σ^2 = variance (population)
χ^2 = chi-squared distribution

Other Abbreviations
AA = amino acid(s)
ACTH = adrenocorticotropic hormone
ADF = acid detergent fiber
ADFI = average daily feed intake
ADG = average daily gain
ADIN = acid detergent insoluble nitrogen
ADL = acid detergent lignin
ADP = adenosine diphosphate
AI = artificial insemination
AIA = acid insoluble ash
AMP = adenosine monophosphate
AOAC = Association of Official Analytical Chemists International
ARS = Agricultural Research Service
ATP = adenosine triphosphate
ATPase = adenosine triphosphatase
Avg = average
BCS = body condition score
BLUP = best linear unbiased prediction
Bp = base pair
BHBA =β-hydroxybutyrate
BSA = bovine serum albumin
bST = bovine somatotropin
BTA = *Bos taurus* chromosome
BUN = blood urea nitrogen
BW = body weight
cDNA = complementary deoxyribonucleic acid
cRNA = complementary ribonucleic acid
CIEBP = CAAT-enhancer binding protein
cfu = colony-forming unit
CLA = conjugated linoleic acid
CoA = coenzyme A
CN = casein
CNS = coagulase-negative staphylococci
Co-EDTA = cobalt ethylenediaminetetraacetate
CP = crude protein (N x 6.25)
D = dextro
DCAD = dietary cation-anion difference
diam. = diameter
DE = digestible energy
DEAE = (dimethylamino)ethyl (as in DEAEcellulose)
DFD = dark, firm, and dry (meat)
DHI = Dairy Herd Improvement
DHIA = Dairy Herd Improvement Association
DIM =days in milk
DM = dry matter
DMI = dry matter intake
DNA = deoxyribonucleic acid
DNase = deoxyribonuclease
EBV = estimated breeding value
eCG = equine chorionic gonadotropin
EBV = estimated breeding value
ECM = energy-corrected milk
EDTA = ethylenediaminetetraacetic acid
EFA = essential fatty acid
EIA = enzyme immunoassay
ELISA = enzyme-linked immunosorbent assay
EPD = expected progeny difference
ETA = estimated transmitting ability
Eq. = Equation(s)
Exp. = experiment
FCM = fat-corrected milk
FDA = Food and Drug Administration
FFA = free fatty acid(s)
FSH = follicle-stimulating hormone
G = gravity
GAPDH = glyceraldehyde 3-phosphate dehydrogenase
GC-MS = gas chromatography-mass spectrometry
GE = gross energy
G:F = gain-to-feed ratio
GLC = gas-liquid chromatography
GLM = general linear model
GnRH = gonadotropin-releasing hormone
GH = growth hormone
GHRH = growth hormone-releasing hormone
h_2 =heritability
hCG = human chorionic gonadotropin
HCW = hot carcass weight
HEPES = *N*-(2- hydroxyethyl)piperazine-*N* -2ethanesulfonic acid)
HPLC = high-performance (pressure) liquid chromatogram
HTST = high temperature, short time
i.d. = inside diameter
Ig = immunoglobulin
IGF = insulin-like growth factor
IGFBP = insulin-like growth factor-binding protein(s)
IL = interleukin
IFN = interferon
IMI = intramammary infection
IVDMD = in vitro dry matter disappearance
IVTD = in vitro true digestibility
kb = kilobase(s)
KPH = kidney, pelvic, heart fat
L = levo
LA = lactalbumin
LD_{50} = lethal dose 50%
LG = lactoglobulin
LH = luteinizing hormone
LHRH = luteinizing hormone-releasing hormone
LM = longissimus muscle
LPS = lipopolysaccharide
mAb = monoclonal antibody
mRNA = messenger ribonucleic acid
ME = metabolizable energy
MIC = minimum inhibitory concentration
Misc. = miscellaneous
Monogr. = monograph
MP = metabolizable protein
MUFA = monounsaturated fatty acid
MUN = milk urea nitrogen
NAD = nicotinamide adenine dinucleotide
NADP = nicotinamide adenine dinudeotide phosphate
$NADPH_2$ = reduced nicotinamide adenine dinucleotide phosphate
NADH = reduced form of NAD
NAN = nonammonia nitrogen
NDF = neutral detergent fiber
NDM = nonfat dry milk
NDIN = neutral detergent insoluble nitrogen
NE = net energy
NE_g = net energy for gain
NE_l = net energy for lactation
NE_m = net energy for maintenance
NFC = nonfiber carbohydrates
NEFA = nonesterified fatty acid
No. = number
NPN = nonprotein nitrogen
NRC = National Research Council
NSC = nonstructural carbohydrates
o.d. = outside diameter
OM = organic matter
PAGE = polyacrylamide gel electrophoresis
PBS = phosphate-buffered saline
PCR = polymerase chain reaction
PG = prostaglandin
$PGF_{2\alpha}$ = prostaglandin $F_{2\alpha}$
PMSG = pregnant mare's serum gonadotropin
PMNL = polymorphonuclear neutrophilic leukocyte
PPAR = peroxisome proliferator-activated receptor
PRL = prolactin
PSE = pale, soft, and exudative (meat)
PTA = predicted transmitting ability
PUFA = polyunsaturated fatty acid(s)
QTL = quantitative trait locus (loci)
RDP = rumen-degradable protein
REML = restricted maximal likelihood
RFLP = restriction fragment length polymorphism
RIA = radioimmunoassay
RNA = ribonucleic acid
RNase =ribonuclease
rRNA = ribosomal ribonucleic acid
RQ = respiratory quotient
RUP = rumen-undegradable protein
SCC =somatic cell count
SCM = solids-corrected milk
SCS = somatic cell score
SDS = sodium dodecyl sulfate
SFA = saturated fatty acid
SNF = solids-not-fat
SNP = single nucleotide polymorphism
SPC = standard plate count
ssp. = subspecies
ST = somatotropin
spp. = species
SSC = *Sus scrota* chromosome
TCA = trichloroacetic acid
TDN = total digestible nutrients
TDS = total dissolved solids
TLC = thin layer chromatography
TMR = total mixed ration(s)
Tris = tris(hydroxymethyl)aminomethane
TS = total solids
TSAA = total sulfur amino acids
USDA = U.S. Department of Agriculture
UF = ultrafiltration, ultrafiltered
UHT = ultra-high temperature
UV = ultraviolet
VFA = volatile fatty acid(s)
Vol = volume
vol/vol = volume/volume
vs. = versus
wt = weight
wt/vol = weight/volume
wt/wt = weight/weight
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