BEEF & FORAGE CENTER

UTIA INSTITUTE OF AGRICULTURE
THE UNIVERSITY OF TENNESSEE

University of Tennessee Institute of Agriculture

Beef and Forage Center Annual Research Report

Volume 4, 2023

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December 11, 2023

10:00 am ET	Welcome and Introductions	Dr. Bruno Pedreira
10:05-10:35	Updates in Beef & Forage	Dean Ashley Stokes | UT Extension
		Dean Hongwei Xin | UT AgResearch
		Associate Dean David Anderson | CVM
		Schrick | Bates | Johnson
10:35 - 10:55	Forage Management: Spending the Right Dollars	Dr. Bruno Pedreira
10:55 - 11:15	Dealing with Nitrates in Forages	Dr. Katie Mason
11:15 - 11:35	Sustainable Pest Management and Developing Data-driven Decisions for Livestock Pests	Dr. Rebecca Trout Fryxell
11:35 – 11:55	Persist II Orchardgrass as an Alternative to KY-31 Tall Fescue Pastures	Dr. Renata Oakes
12:00 - 1:00	Lunch/Poster Session	
1:00 - 1:20	Managing Risk with Livestock Risk Protection	Dr. Chris Boyer
1:20 - 2:00	UTBFC Panel	
	Forage In-service: a Successful Program	Mr. Brian White |Ms. Tracey Sullivan
	Open Discussion with Agent Input	Dr. Bruno Pedreira
2:00 - 2:15	Break	
	Listening Session	
2:15 - 2:45	Keynote Speaker: Current Trends and Perspectives in Precision Animal Health	Dr. Fernando Di Croce, Director of the Livestock Genetics and Precision Animal Health | Zoetis
2:45 – 3:05	Genomics of Forage-based Cow Efficiency	Dr. Troy Rowan
3:05 - 3:25	Beef and Forage Research Priorities	Mr. Joe Elliot
3:25 – 4:10	Discussion	Dr. Bruno Pedreira
4:10 – 4:40	UTBFC Update Session	Dr. Bruno Pedreira | Mr. David McIntosh
4:40 – 5:00	Advisory Council Input	
5:00 pm ET	Adjourned	

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Edited and Organized by Phillip Myer

Welcome

2023 UT Beef and Forage Center Annual Research Report

Welcome to the fourth volume of the UT Beef and Forage Center Annual Research Report. The mission of the Center is to facilitate research and communication of science-based information to advance the Tennessee beef and forage industry. The Center functions as an “information hub” serving all in the Tennessee beef and forage industries. The Center also serves as a focal point and catalyst for research, Extension, and teaching efforts related to issues facing beef and forage systems in Tennessee. The report aims to build on this vision by providing an opportunity to highlight the current work related to the Center to producers and stakeholders across the state. Although abbreviated this year, future volumes of the report will provide comprehensive material to convey new knowledge and technology to improve the management, efficiency and production of high-quality beef cattle.

The Beef and Forage Center would like to thank the contributors to the report and to the staff and students who help with the research, teaching and Extension activities on beef cattle and forages. Finally, thanks to the funders of the grants that help fund the research projects and students/staff working on the projects. We truly appreciate your contributions to our research programs because without this support, the research would not be possible.

Should have any questions about the work reported in this report, please do not hesitate to contact the UT Beef and Forage Center or any of the authors of the individual reports. Thank you for your encouragement and support of beef and forage research in Tennessee.

Sincerely,

The University of Tennessee Beef and Forage Center
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Poster Number 801

Price Risk Management Use Impact on Technical Efficiency for Cattle Producers

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The use of price risk management among beef cattle producers has historically been limited despite price declines being one of the primary causes of economic losses to the United States (US) cattle industry. Several tools are available to producers to manage price risks, such as options contracts, futures contracts, and livestock risk protection (LRP) insurance. This research examines how price risk management, specifically, LRP, futures contracts, and options contracts, impact operational efficiency in beef cattle firms. Using a two-stage Data Envelopment Analysis (DEA) on a dataset of 536 firms, we analyze income and input metrics in the first stage and then efficiency scores and risk management tools in the second. Results show that firms using options contracts demonstrate the highest efficiency (0.361), followed by LRP (0.350) and futures contracts (0.345). The parameter estimates from the regression suggest positive effects for options contracts (0.518) and LRP (0.359) on efficiency. Experience also positively affects efficiency (0.0090). This research contributes insights into the relationship between risk management tools and efficiency in beef cattle operations.

Keywords: Beef cattle, risk management, operational efficiency, Data Envelopment Analysis.

Poster Number 802

Yield and Quality of Stockpiled Tall Fescue for Winter Grazing

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Pastures in Tennessee comprise mainly tall fescue [*Schedonorus arundinaceus* (Schreb.) Dumort.], a cool-season perennial grass. Producers in Tennessee feed hay for an avarage of 143 days per year, there an opportunity to practice forage stockpiling to extend the grazing season (Boyer, 2020). Although this practice has been proven to reduce hay needs (Freeman et al., 2019), it is vital to maintain current recommendations using data from across the southeastern US to inform nutritional management decisions. The objective of this study was to determine the nutritive value and dry matter yield of stockpiled tall fescue across plant hardiness zones 7 and 8. In September 2021, three exclusion cages (4 ft × 4 ft) were constructed at fourteen sampling sites, forage was clipped to a 4-cm height, and plots were fertilized at a rate of 67 kg. N/ha. During years 2021-2022 and 2022-2023, samples were clipped at a 2-inch height from a 1 ft^2 quadrat monthly from October through February. Data were analyzed using PROC GLIMMIX for a generalized complete block design. Results indicate that plant hardiness zone did not have a significant effect on forage yield ($P = 0.2098$). Dry matter yield increased over the length of the stockpiling period ($P < 0.0001$) from 2,354 lbs. DM/ac to 4,391 lbs. DM/ac. Crude protein (CP) and total digestible nutrients (TDN) concentrations decreased ($P < 0.0001$ and $P = 0.0358$, respectively) throughout the stockpiling period; however, ranges were still within those needed to support the nutritional needs of a lactating cow with CP ranging from 15 – 17% and TDN ranging from 68 – 70%. As expected, neutral detergent fiber (NDF) and acid detergent fiber (ADF) concentrations increased over the stockpiling period ($P = 0.0029$ and $P = 0.0145$, respectively) as plants matured. Results from this study conclude that stockpiled tall fescue in plant hardiness zones 7 and 8 can support the nutritional requirements of mature cows at all stages of production through the winter months. Results will be used to inform Extension recommendations to assist producers in making management decisions that increase grazing days and reduce supplemental feed input costs.

Poster Number 803

Establishing Alfalfa Hayfields Combining Boron and Herbicide Management to Control Glyphosate-Resistant Palmer Amaranth

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Alfalfa (*Medicago sativa* L.) is the most valuable forage crop grown in the world and providing adequate fertilization is essential to successfully ensure establishment. Alfalfa has a high demand for boron, and its deficiency has been recognized for many years. In addition, weeds such as Palmer amaranth (*Amaranthus palmerii* S. Watson) have been identified as no longer controlled by glyphosate and ALS inhibitors herbicides. Our objective is to quantify the effects of boron fertilization and herbicide management on forage yield and nutritive value in a Roundup Ready® alfalfa hayfield in the presence of glyphosate-resistant Palmer amaranth. The research is being carried out at ETREC/Holston Unit, Knoxville, TN, where the Roundup Ready® alfalfa field was established in September 2023. The experimental design is a randomized complete block with three replicates of a 3 × 3 factorial arrangement of three boron rates (0, 2, and 4 lb. of boron/acre/year) and three herbicide management levels (control – no herbicide application, 26 oz/ac of glyphosate 3 times per year, and 4 oz/ac of imazethapyr per year) in 10- by 30-ft plots. The response variables will be hay yield, nutritive value, and botanical composition. Yield will be quantified as the average of forage accumulated during a 42d interval between harvests. The botanical composition will be evaluated as the percentage of alfalfa and weeds weight per sample and compared with two indirect methods: visual rating and a model that will examine pictures and rate the percentage of weeds and alfalfa plants. Based on the results, we expect to improve the alfalfa establishment through boron and herbicide management to achieve a profitable program.

Poster Number 804

Enhancing Annual Ryegrass Yield with *Azospirillum brasilense* Inoculation

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Annual ryegrass (*Lolium multiflorum* Lam.) is recognized as a high-quality cool-season forage. Due to higher fertilizer costs and environmental concerns new strategies are necessary to reduce the use of synthetic non-renewable fertilizers. In this context, the use of plant growth-promoting bacteria such as *Azospirillum brasilense* is being considered as an excellent alternative. Our objective is to determine the effect of *A. brasilense* inoculation on forage yield, nutritive value, and root morphological traits of annual ryegrass. The experiments are being carried out in a randomized complete block design with four replications in two sites (Greeneville and Crossville, TN). The trials were established in October 2023 with plots planted with non-inoculated or inoculated seeds (*A. brasilense*, $2x10^8$ UFC/mL); and, all treatments received 60 lb N/acre. In February 2024, six treatments will be applied: 0, 45, and 60 lb N/ac on the non-inoculated plants, and 0, 45, and 60 lb N/ac with the inoculated plant treatments also receiving a foliar application of *A. brasilense* ($2x10^8$ UFC/mL). Soil cover will be evaluated using CANOPEO®. For root analysis, three soil samples will be taken per plot and washed to estimate root volume determining diameter, length, weight, and any other specific observations. Plots will be harvested from March to June, where the yield will be determined. Samples will be analyzed for nutritive value using NIRS (Near-infrared spectroscopy). Based on the results, we aim to improve annual ryegrass nutritive value and yield by utilizing *A. brasilense* to establish a profitable and sustainable fertility program.

Poster Number 805

Feedlot Willingness to Pay for Genomic Tested Feeder Cattle

A.G. Hagan[1], K.L. DeLong[1]*, A.P. Griffith[1], C.N. Boyer[1], C.C. Martinez[1], K.L. Jensen[1], and S.M. Schexnayder[2]

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Genomic tests for feeder cattle provide sores on the genetic potential for terminal traits such as carcass quality, weaning weight, and fat thickness through DNA analyzation from tissue samples. Genomic tests provide results on a 1-10 scale with 10 being the best for an overall Terminal Feeder Cattle Index Score that categorizes cattle into Choice, Premier, and Elite. Results show that feedlots are, on average, willing to pay 0.07% more for Choice, 2.7% more for Premier, and 4.59% more for Elite branded cattle versus untested cattle. Feedlots reported they were most interested in using genetic test information to determine how to market their finished cattle and decide which cattle sellers to buy from in the future. They reported they had a “Poor” level of knowledge on genomic tests and associated costs and that tests are currently too expensive if they had to pay for them. The results from this study provide insights that are beneficial to cow-calf producers and stocker operators as they consider which genetics to incorporate into their herds. Further implications of the study include the potential to increase economic opportunities in rural communities with cattle operations.

Poster Number 806

Uncovering Host Genetic Control of the Rumen Microbiome

M.T. Henniger[1], J.E. Beever[1,2,3], T.N. Rowan[1,2,3], J.E. Wells[4], L.A. Kuehn[4], B.H. Voy[1], and P.R. Myer[1]*

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The rumen microbiome converts low quality feedstuffs into usable energy and provides approximately 70% of energy required for its ruminant host through fermentation byproducts. Due to microbial impacts on host health and productivity, several studies have associated microbiome variation with important sustainability phenotypes, such as feed efficiency and methane emissions. While diet has been considered to be the primary driver for composition and structure of the rumen microbiome, recent studies have indicated the microbial communities present in the rumen are under low-to-moderate host genetic control. However, these studies are plagued by small sample sizes, high management and breed heterogeneity, and low resolution for classifying microbial communities. To determine the heritability of the rumen microbiome, we enrolled 400 Angus steers in a 70-day feed efficiency trial, where real-time dry matter intake was measured with a GrowSafe system. We collected weights throughout the trial (days 0-1, 35-36, 69-70) to calculate average daily gain and feed efficiency. On day 70 of each trial, we obtained 50 mL of rumen fluid from steers using orogastric tubing for collection of microbial communities. Metagenomic DNA was used to assess ruminal bacterial composition. Genomic DNA isolated from whole blood was used to perform low-pass whole genome sequencing for use in downstream heritability estimates and variant association analyses. Diversity indices and relative abundances of microbial communities were used as microbial phenotypes. Initial work suggests that few microbial taxa abundances are under low-to-moderate host control and there are several loci that appear to influence microbial composition. Ongoing work is exploring the phenotypic and genetic correlations between heritable microbial communities and feed efficiency phenotypes. Understanding the host genetic control of the rumen microbiome may empower downstream applications to enhance genomic and phenotypic predictions for feed efficiency and other sustainability traits in beef cattle.

This work is supported by the Agriculture and Food Research Initiative Competitive grant no. 2020-67015-30832 from the USDA National Institute of Food and Agriculture.

Poster Number 807

Rumen Bacterial Community Establishment in Angus Calves

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The calf digestive system undergoes significant physiological changes from birth to weaning, which includes developing a functional rumen with colonization of microorganisms essential for digestion and absorption of nutrients. Bacteria within the rumen will undergo temporal changes in composition and diversity as the rumen develops and diet changes. The objective of this study was to determine shifts in bacterial diversity and community structure in calves while also observing rumen fermentation parameters over time. To meet our objective, rumen fluid was sampled monthly via orogastric tubing from Angus calves (n = 13) from birth to five months of age. Ruminal pH was measured to represent fermentation parameter. Genomic DNA was used to generate amplicon libraries of the V4 region of the 16S rRNA gene and sequenced on an Illumina MiSeq. Analyses were conducted in R using packages ‘phyloseq’ and ‘dada2’ to call amplicon sequence variants (ASVs). Microbial diversity was different between month 1 and months 3, 4, and 5, indicating that most changes in composition occur by month 3 ($P < 0.05$). Several bacterial genera differed by month, where most differences in genera were seen by month 3. Many *Bacteroidales* increased by the third month ($Q < 0.05$), whereas by month 5, both *Prevotella* and *Succinivibrionaceae* had doubled in abundance ($Q < 0.05$). Rumen pH had the greatest change between month 1 and 3, however was not statistically different ($P = 0.06$). Shifts in bacterial composition appear to align to diet changes as the calf develops. By identifying microbiome establishment, productivity and gastrointestinal development in calves can be improved through management techniques.

Poster Number 808

Optimizing Organic Corn Production Under Different Living Mulch Systems

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The demand for organic grain production for both human consumption and animal feed has increased in recent years. As organic product demand increases, more research is needed to understand and maximize production for effective organic growing systems. Growing corn (*Zea mays* L.) organically, can be very complex and high due to the abstinence of certain inputs, such as fertilizers and herbicides, which are not allowed to be used in these systems. Living mulches, which are plants grown simultaneously with a cash crop, can support the growth of organic corn through increased nutrient availability, adding nitrogen, and aiding in weed control. While living mulch systems offer many benefits, they can affect corn yield negatively through inter-species competition. However, legume living mulches in concert with corn systems, generally result in stable or increased corn yield. This project aims to develop management recommendations to produce organic corn under different legume living mulch systems. This study will utilize data from field experiments at Middle Tennessee Research and Education Center (Spring Hill, TN) and East Tennessee Research and Education Center (Knoxville, TN) from September 2023 to September 2025. The treatments are: 1) No – LM; 2) hairy vetch – cover crop; 3) white clover – LM; 4) red clover – LM; 5) hairy vetch – LM, and 6) crimson clover – LM. The experimental design is a randomized complete block with six treatments with four replications, totaling 24 experimental units. The results should help educate and aid producers in economic decision making of the adoption of this production system in the Southeastern United States.

Poster Number 809

Developing and Validating a S.M.A.R.T. Surveillance Platform for Fly and Tick Detection on Beef Cattle

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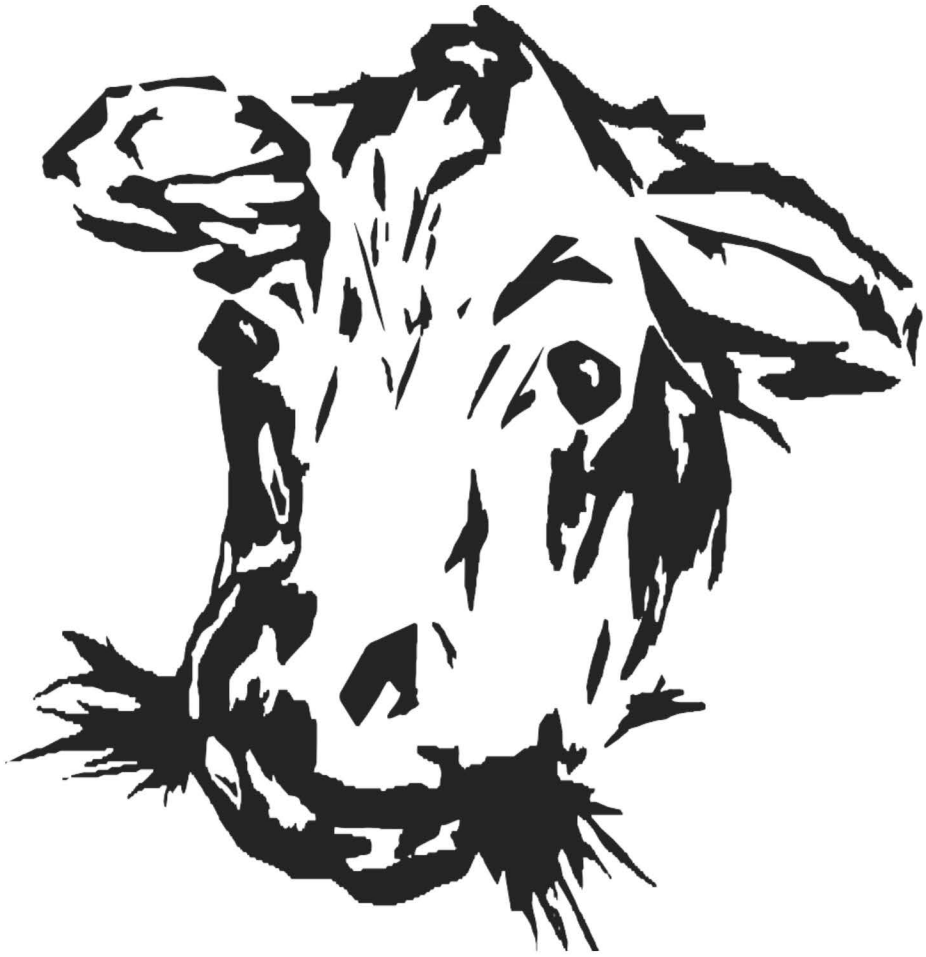
The United States cattle industry loses an estimated $5.7 billion USD to fly and tick feeding annually. These ectoparasites blood feed on their bovine hosts, causing blood loss, reduced feed efficiency, reduced milk quality and quantities, hide damage, and pathogen transmission. Diseases associated with these pests include pink eye, mastitis, theileriosis, and bovine anaplasmosis. Traditional methods of fly and tick surveillance are time consuming and often unsafe for producers; therefore, we are aiming to automate that process. We hypothesize that the development and validation of a neural network will provide stakeholders with a rapid, accurate, and safe method of detecting flies and ticks on beef cattle and will help to improve the overall efficiency and accuracy of pest detection when used in combination with manual (e.g., visual and hands-on) inspection methods. The objective of this project is to develop and validate a S.M.A.R.T. (sensors, monitoring, analysis, and reporting technologies) surveillance platform for fly and tick detection in beef cattle production systems using an automated computer vision system. A neural network will be developed using ~1,000 volunteer-submitted and human-annotated images of flies and ticks on cattle. To evaluate the reliability of the network, we will use additional images and counting results of multiple human scorers. The intended outcome of this project is to use the developed neural network to create an effective, user-friendly digital pest monitoring system (app and/or web-based platform) that would allow users to upload images of their pest-infested cattle and obtain an instantaneous pest population estimate.



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