

Multistate Research Activity

Accomplishments Report

Project Number: NC-1201

Project Title: Methods to Increase Reproductive Efficiency in Cattle

Period Covered: July 12th, 2022 to August 4th, 2023

Date of This Report: September 21st, 2023

Annual Meeting Dates: August 3rd and August 4th, 2023

Meeting Participants: Pedro Fontes (pedrofontes@uga.edu) - University of Georgia; Paul Fricke (pmfricke@wisc.edu) -University of Wisconsin; Kyle McLean (kmclea10@utk.edu) and Saulo Zoca (szoca@utk.edu) – University of Tennessee; George Perry (george.perry@ag.tamu.edu) – Texas A&M University; Richard Pursley (pursleyr@msu.edu) – Michigan State University; Shelly Rhoads (rhodesm@vt.edu) – Virginia Tech; George Smith (smithge7@msu.edu) -Administrative Advisor; Fabio Lima (Falima@ucdavis.edu) – UC Davis; Jordan Thomas (ThomasJor@missouri.edu) – University of Missouri; Nicholas Dias (diasnw@ksu.edu) Kansas State University

Brief summary of minutes of annual meeting:

The 2023 Annual Meeting was held in person at the University of Tennessee Middle Tennessee Research and Education Center (MTREC) in Spring Hill, TN; however, some members participated remotely through Zoom. The meeting was called to order by Kyle McLean at 8:30 am August 3rd, 2023. The meeting began with welcomes from Drs. Hongwei Xin and Neal Schrick as well as the MTREC station director Kevin Thompson. Introductions of attendees and online participants were done next. The business meeting was started at 9:30 am. The group discussed where the meeting should be held next year and the limited turnout at this year's meeting. The group also discussed who would be good potential recruits to ask about joining the group. It was decided to hold next year's meeting in Athens, GA around the end of April. Fabio Lima, the current secretary, will become the chair next year. Victor Leon was elected as the incoming secretary. The business meeting concluded at 10:00 am. and station report presentations began. Station reports from Missouri (Thomas), Wisconsin (Fricke), and Michigan (Pursley) were presented. The group then broke for lunch. Following lunch, station reports from Georgia (Fontes) and Virginia (Rhoads). In-person participants on the first day included George Perry (TX), George Smith (MI), Richard Pursley (MI), Paul Fricke (WI), Pedro Fontes (GA), Shelly Rhoads (VA), Saulo Zoca (TN), and Kyle McLean (TN). Online participants included Jordan Thomas (MO) and Fabio Lima (CA). First day of meeting was then adjourned by Kyle McLean. Meeting was called to order on the second day at 8:30 am August 4th, 2023 by Kyle McLean. Steven Smith provided an update from USDA-NIFA. Station reports from Texas (Perry) and California (Lima) were presented. In-person participants on the second day included George Perry (TX), George Smith (MI), Richard Pursley (MI), Paul Fricke (WI), Pedro Fontes (GA), Saulo Zoca (TN), and Kyle McLean (TN). Online participants included Jordan Thomas (MO), Fabio Lima (CA), and Nicholas Dias (KS). The station report from TN was not presented; however, a report was submitted and included herein. Meeting was then adjourned by Kyle McLean.

Impacts Nuggets:

- Cows that conceive to artificial insemination (AI) but experience late embryonic and early fetal mortality (LEEFM) are less likely to conceive within the breeding season, calve later during the calving season, and produce fewer pounds of calf at weaning compared with cows that maintain their AI pregnancy and cows that failed to conceive to AI. • Earlier removal of progesterone failed to alter estrus expression and fertility in presynchronized postpartum beef cows. (Georgia, Virginia, and Mississippi)
- Feeding mature bulls a highly anabolic diet for 67 day period increased adiposity but did not affect sperm morphology and kinematics (CASA) Feeding mature bulls a highly anabolic diet increased post-thaw acrosome damage and tended to increase the percentage of early necrotic sperm (flow cytometry) Feeding mature bulls a highly anabolic reduced the ability of sperm to generate blastocyst-stage embryos (reported in previous NC1201 annual report) without impacting blastocyst cell allocation and gene expression of markers associated with blastocyst developmental capacity (Georgia, Tennessee, and Texas)
- The labor associated with estrus detection may be offset by the proportion of calves subsequently born earlier within the calving season, allowing for improvements to profitability, especially in larger herds. (Texas and Tennessee)
- Estrual cows prior to embryo transfer (day 0 to 7) had greater pregnancy success during conceptus attachment, and tended to have greater embryo/fetal survival to day 90 compared to non-estrual cows. (Texas and Tennessee)
- Differences in embryo development are likely due to differences in methylation patterns impacting developmental processes, as semen characteristics were mainly similar between bulls with good versus poor embryo development. (Texas and Tennessee)

Accomplishments (Research; Objective 1):

Objective 1: Increase the efficiency and predictability of sustainable reproductive technologies and management programs for cattle.

Dairy cattle

No collaborative effort to report

Beef cattle

- Cows that conceive to fixed-timed artificial insemination and experience late embryonic and early fetal mortality have decreased performance compared not only to cows that maintain the pregnancy, but also cows that failed to conceive to fixed-timed artificial insemination. (Georgia, Virginia, and Mississippi)
- Cows exposed to the 7&7 Synch tended to have larger follicle diameter at PG2 compared with 7&6 Synch cows; however, there were no differences in follicle diameter on at fixed-timed artificial insemination. Cows that expressed estrus tended to have larger follicle diameter at fixed-timed artificial insemination compared with cows that failed to express estrus. Follicular growth between the second prostaglandin and fixed-timed artificial insemination, percentage of cows with a corpus luteum at the second prostaglandin, and ovulation seven days after fixed-timed artificial insemination were not impacted by estrus synchronization method. There were no differences between estrus synchronization method (7&7 Synch or 7&6 Synch) for estrus expression and pregnancy rates to fixed-timed artificial insemination. (Georgia and Tennessee)

- Estrus response was greater in females assigned to the 6d compared to the 7d protocol; however, pregnancy success was similar among treatment groups. (Texas and Tennessee)
- At the observed estrus response and pregnancy rate for each treatment group, the 6d protocol resulted in a decreased cost per pregnancy compared to the 7d protocol. Additionally, using the same parameters, the 6d protocol resulted in an increased profit per pregnancy compared to the 7d protocol. (Texas and Tennessee)
- These results suggest that labor associated with estrus detection may be offset by the proportion of calves subsequently born earlier within the calving season, allowing for improvements to profitability, especially in larger herds. (Texas and Tennessee)
- There was no effect of estrual status on percent pregnant on day 19, day 55, or day 90. Percent pregnant tended to differ between estrual status on day 24 and differed on day. As a repeated measure, there was no effect of estrual status by day, while there were significant effects of treatment and day on pregnancy. (Texas and Tennessee)
- Pregnancy survival tended to differ between treatments from day 7 to 90. Estrual cows prior to embryo transfer (day 0 to 7) had greater pregnancy success during conceptus attachment, and tended to have greater embryo/fetal survival to day 90 compared to non-estrual cows. (Texas and Tennessee)

Accomplishments (Research; Objective 2):

Objective 2: Evaluate mechanisms that regulate reproductive processes impacting production efficiency in cattle.

Dairy cattle

No collaborative effort to report

Beef cattle

- Feeding bulls a high-gain diet did not affect sperm morphology or motility, but increased adiposity and reduced the ability of sperm to generate blastocyst-stage embryos without impacting gene expression of markers associated with blastocyst developmental capacity. (Georgia and Texas)

Accomplishments (Research; Objective 3):

Objective 3: Disseminate reproductive management information to stakeholders to improve sustainability of cattle enterprises.

- The utilization of an online newsletter increased stakeholder engagement and resulted in greater producer outreach through the UGA beef extension website. (Georgia)
- A producer survey on what producers view are important as it pertains to PLF and water intake behavior data. (Tennessee)
- Bovine ultrasonography hands-on training (July, 2023). In: University of Tennessee Bovine Ultrasound Training. Spring Hill, TN (Georgia and Tennessee).
- Fetal aging through ultrasonography (July, 2023). In: University of Tennessee Bovine Ultrasound Training. Spring Hill, TN (Georgia and Tennessee).

Breakdown of Stakeholder, Industry, and Professional Presentations

Type of Presentation	Stakeholder	Industry	Professional	Total
Statewide	42	10	3	55
Regional	16	12	2	30
National	6	5	4	15
International	0	7	25	32
	64	34	34	132

Digital Outreach

- **Developed and launched “The Repro Spot.”** A YouTube channel that aims to distribute unbiased information about applied strategies to achieve reproductive excellence and efficiency by interviewing renowned dairy cattle reproductive physiologists about real dairy reproduction scenarios across the U.S.
 - Episode 1: Fertility programs with Dr. Paul Fricke (UW-Madison) and Dr. Richard Pursley (Michigan State University)
 - Episode 2: Body condition score with Dr. Jeff Stevenson (K-State)
 - Episode 3: Genomics and Reproduction with Dr. Fabio Lima (UC Davis)
 - Episode 4: Economics of repro programs with Dr. Victor Cabrera (UW-Madison)
 - Episode 5: Embryo losses in dairy with Dr. Amin Ahmadzadeh (University of Idaho)
 - Episode 6: Heifer genomics and repro programs with Dr. Joe Dalton (University of Idaho)
- Mizzou Repro Facebook Page. 3,070 Page Followers. Available at: <https://www.facebook.com/MizzouRepro>
- Mizzou Repro YouTube Channel. 2,000 Subscribers. >250,000 total views. Available at: <https://www.youtube.com/c/MizzouRepro>
- Herd Quitter Podcast. Jordan Thomas. July 31, 2023. Available at: <https://pharocattle.com/2023/07/130-jordan-thomas/> National Center for Applied Reproduction and Genetics. Webinar: Predetermining the sex of commercial beef calves with sex-sorted semen. June 22, 2023.
- Casual Cattle Conversations Podcast. Selecting quality replacement females for your cow herd. April 19, 2023. Available at: Casual Cattle Conversations Podcast. Is your calving season too long? January 2, 2023. Available at: <https://www.casualcattleconversations.com/casual-cattle-conversationspodcast-shownotes/ogyd7x9vrp26g29ypbp2cj2q046kne>
- Cattleman U. Management of natural service breeding programs. October, 2022. Available at: <https://cattlemanu.com>
- American Hereford Association. Hereford heifers recruited for genomics research. Webinar. September 6, 2022.
- Herd Quitter Podcast. Cattle reproduction and profitability. August 15, 2022. Available at: <https://pharocattle.com/2022/08/80-jordan-thomas/>

Outputs:

This group combined for 116 publications including 58 peer-reviewed journal articles, 30 abstracts, 9 extension publications, and 19 popular press articles last year. Several papers are from institutions with multiple investigators that are members of this group. Articles that are not peer-reviewed focused on extending research findings to stakeholders throughout the U.S. and the world and contain numerous collaborations among the group that should progress to peer-reviewed publication status. Additionally, this

group has given 132 presentations to academia, stakeholders, and industry individuals in line with objective 3.

Activities:

The Missouri Show-Me-Select Replacement Heifer Program continues to provide an educational conduit for beef producers and allied industry in Missouri, resulting in the enhanced adoption of reproductive and genetic/genomic technologies across the state.

Milestones:

This group of reproductive biologists and reproductive management specialists have now become the leaders in the creation of new knowledge relating to the manipulation of ovarian development to enhance fertility and reproductive management of cattle and the translation of that information to key stakeholders in the U.S. This is evident in the combination of the numbers of publications, presentations, and grants funded in this report. While the overarching goal of multistate research is collaboration across stations (highlighted in this report), projects conducted independently at various stations also contribute collectively to the body of knowledge driving development of new reproductive management programs applied within beef and dairy industries.

Funding:

Collaborative Funding

- Fontes, P. L. P. and G. A. Perry. USDA – AFRI (Pi) 2021-2026 \$650,000. Paternal origins of offspring fetal and postnatal development
- Perry, G. A. and P. L. P. Fontes. USDA – AFRI (COPI) 2022-2027 \$650,000. Unraveling the benefits of omega-6 fatty acids to pregnancy establishment and maintenance in beef females
- McLean, K. J., A. P. Snider, and C. R. Dahlen. Value = \$299,884.00. The effects of nutritional plane in bulls on female response to seminal plasma, spermatozoa, or the entire ejaculate. Grant to USDA-NIFA AFRI. 2022.

Other Funding

Other funding within this group that was acquired on a more individual basis but will still be utilized to progress the objectives of the group is over \$39 million.

Publications:

Refereed Journal Articles

- Soffa, D.R.*, J.W. Stewart*, E.D. Pack, A.G. Arneson*, R. De Vita, J.W. Knight, D.W. Fausnacht, R.P. Rhoads, S.G. Clark, D.G. Schmale and M.L. Rhoads. 2023. Short-term consumption of the mycotoxin zearalenone by pubertal gilts causes persistent changes in the histoarchitecture of reproductive tissues. *J Anim Sci.* 2023 Jan 3;101:skac421. doi: 10.1093/jas/skac421. PMID: 36574505.
- Nix J., M.A. Marrella, M.A. Oliver, M. Rhoads, A.D. Ealy and F.H. Biase. 2023. Cleavage kinetics is a better indicator of embryonic developmental competency than brilliant cresyl blue staining of oocytes. *Anim Reprod Sci.* 2023 Jan;248:107174. doi: 10.1016/j.anireprosci.2022.107174. Epub 2022 Dec 7. PMID: 36502760.
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