

## NC1201 ACCOMPLISHMENTS REPORT

**Project Number:** NC1201

**Project Title:** Methods to Increase Reproductive Efficiency in Cattle

**Period Covered:** 08/05/2023 to 04/24/24

**Date of Report** 09/16/24

**Annual Meeting Dates:** 04/24/2024 to 04/25/2024

**MEETING PARTICIPANTS:** Carl Dahlen (Carl.Dahlen@ndsu.edu) – North Dakota State University; Fabio Lima (Falima@ucdavis.edu) – UC Davis; Felipe Alves Correa Carvalho da Silva (falvesc@ncsu.edu) – North Carolina State University; George Perry (george.perry@ag.tamu.edu) – Texas A&M University; George Smith (smithge7@msu.edu) - Administrative Advisor; Jordan Thomas (ThomasJor@missouri.edu) – University of Missouri; Kyle McLean (kmclea10@utk.edu) – University of Tennessee; Michelle Rhoads (rhodesm@vt.edu) – Virginia Tech; Nicholas Dias (diasnw@ksu.edu) – Kansas State University; Pedro Fontes (pedrofontes@uga.edu) – University of Georgia; Richard Pursley (pursleyr@msu.edu) – Michigan State University; Rick Funston (rfunston2@unl.edu) – University of Nebraska; Saulo Zoca (szoca@utk.edu) – University of Tennessee; Victor Gomez-Leon (vgomezleon@ksu.edu) – Kansas State University.

### **BRIEF SUMMARY OF MINUTES OF ANNUAL MEETING:**

*Welcome and introductions:* The 2024 Annual Meeting was held at the University of Georgia in Athens (UGA), Georgia. The meeting started with a general welcome from Pedro Fontes and Francis Fluharty (head of the Animal and Dairy Science Dept at UGA).

*Business meeting and general updates:* Fabio Lima (chair of the 2024 meeting) opened the floor to discuss next year's meeting details. The group approved:

- Victor Gomez-Leon and Nicholas Dias as the 2025 president and secretary, respectively.
- The 2025 annual meeting to be held in Manhattan, KS.
- Next year's annual meeting dates from 6/4/25 to 6/5/25. This date should avoid conflict with classes and major scientific meetings.
- More time to go over station reports and collaboration opportunities by removing farm tours from next year's meeting.
- Pedro Fontes and George Perry will lead efforts to organize a symposium, potentially during the ASAS meetings in 2026.

*USDA update:* Mark Mirando sent via email the USDA report, which includes the NIFA staff updates (fully staffed now) and contact information, the NIFA budget, and information on 3 RFAs released (Foundational and Applied Science, Sustainable Agricultural Systems, and Education Workforce Development).

*Other notes:* Chair and secretary need to ensure the meeting information is shared with all NC1201 participants – List of participants are in the NIMSS system. The group could also develop a sharable document with the information of the NC1201 participants.

## **ACCOMPLISHMENTS:**

Conducting timed insemination studies and fertility trials requires substantial time, which, in several cases, represents a challenge for collaborations among research stations. Moreover, collective funding for multiple research stations and allocating those resources also represents a challenge for replicating studies among different states. Nonetheless, the results from individual studies collectively advance the body of knowledge, contributing to improvements in reproductive strategies or advancing the understanding of the mechanisms controlling reproduction, which are key objectives of the NC1201 project. Examples of such advancements are summarized for objectives 1 and 2 in the categories below. Finally, several collaboration opportunities were discussed as part of the annual meeting.

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

### *Association of estrus expression with luteal blood flow and pregnancy rates:*

- Beef cows that failed to express estrus prior to fixed-time embryo transfer had decreased luteal area, luteal diameter, and pregnancy rates compared with cows that expressed estrus. Moreover, beef embryo recipients classified as having high and medium luteal blood perfusion had greater pregnancy rates compared with embryo recipients classified as having low luteal blood perfusion. **(GA)**
- Deep learning algorithms to evaluate luteal color Doppler ultrasonography for pregnancy diagnosis in beef cattle successfully predicted pregnancy status and had comparable performance to human-trained individuals. **(GA)**
- ~80% of dairy heifers ovulated spontaneously in a 24 h window without the need for GnRH at the end of a CIDR synch protocol. Evidence indicates an association of estrus expression with greater fertility and utilization rate in recipients of IVP embryos. **(KS)**
- Twice-daily detection of estrus and AI is more optimal than once-daily detection and yielded similar fertility to TAI because insemination with sexed semen occurred at a more optimal time relative to ovulation in estrus dairy heifers. **(WI)**

### *Strategies to enhance reproductive efficiency of cattle submitted to TAI:*

- Multi-sire pooled semen appears to enhance conception rates with conventional and sexed semen. **(NE)**
- Decreased chute scores were observed at CIDR out and timed-artificial insemination for acclimated heifers when compared to control heifers. **(KS)**
- Administering FSH and/or LH did not increase day 36 pregnancy rates; however, animals with a CL on d-12 had greater FG and estrus expression improved pregnancy rate. **(TX)**
- Extending MGA feeding from 14 to 18 days does not appear to impact estrus response or conception rates, but may allow flexibility in the MGA/PGF synchronization protocol. **(NE)**
- Pregnancy rate improvements observed with the 7&7 Synch protocol can partially be attributed to improving the pregnancy rates of cows with estrus >24 h before AI. **(ND)**
- Treatment with GnRH after AI to induce a CL did not improve pregnancy survival of lactating dairy cows. Cows that ovulate to a previous GnRH were more likely to ovulate following treatment, but ovulation rate to the 1st GnRH of Ovsynch did not differ between treatments. Cows with conceptus attachment were less likely to respond to GnRH treatments. **(MI)**

- Treatment with GnRH 32 d after 1st TAI decreased the proportion of nonpregnant dairy cows inseminated after a detected estrus, whereas treatment did not affect P/AI for cows completing the Resynch protocol. **(WI)**

*Interaction of nutrition and reproduction:*

- A lower input heifer development system provides lower cost alternative to more conventional systems, possibly due to increased ADG post insemination. **(NE)**
- Young beef bulls with elevated subcutaneous backfat thickness (SBCF) had increased sperm morphological abnormalities compared to those with less SCBF. **(GA)**
- There was a linear relationship between SBCF and the probability of young beef bulls failing a breeding soundness examination due to sperm morphology defects. **(GA)**

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

- Decreasing the period from follicular emergence to induced luteolysis enhanced the steroidogenic capacity of the pre-ovulatory follicle, despite a smaller diameter. This had a positive impact on estrus characteristics of lactating dairy cows that could be associated with increased fertility. **(MI)**
- CIDRs increased circulating concentrations of progesterone sufficient to keep animals from exhibiting estrus and was not different from cows in the midluteal stage of their cycle. Local concentrations in uterine tissue; however, were significantly greater when a CIDR was in place compared to uterine tissue collected during the midluteal phase. **(TX)**
- Vaccinating with a vaccine that contained both BVD and IBR viruses resulted in abnormal cycles and changes in cytokine concentrations and leukocyte populations. **(TX)**
- Periconceptual maternal nutrition aimed at moderate weight gains can have multigenerational effects on the gene regulation of fetal muscle tissue. **(ND)**

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

The members of the NC1201 continue to place themselves as scientists who provide unbiased information to the livestock industry based on research data. As an example of this achievement, over the last year, the members of the NC1201 participated in more than 5 workshops, 52 regional or national meetings, and over 40 scientific meetings, reaching several thousand people. The target audience of such efforts continues to be producers, veterinarians, technicians, and students involved in the National and International beef and dairy cattle industries.

**IMPACTS:**

- Multi-sire pooled semen appears to enhance conception rates with conventional and sexed semen **(NE)**
- Deep learning algorithms were used to interpret luteal blood perfusion examinations using color Doppler ultrasonography 20 days after insemination. Deep learning

algorithms were able to successfully predicted pregnancy status, having comparable performance to human trained individuals (GA)

- Decreased chute scores were observed at CIDR out and timed-artificial insemination for acclimated heifers when compared to control heifers (KS)
- 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)
- Pregnancy rate improvements observed with the 7&7 Synch protocol can partially be attributed to improving the pregnancy rates of cows experiencing estrus >24 h before AI (ND).
- Controlling follicular dynamics more effectively and efficiently within fertility programs will increase profits on dairy farms (MI)
- Treatment with GnRH 32 d after 1st TAI decreased the proportion of nonpregnant cows inseminated after a detected estrus, whereas treatment did not affect P/AI for cows completing the Resynch protocol (WI).

### **PEER REVIEW PUBLICATIONS (SELECTED):**

A. T. Pickett, R. F. Cooke, L. M. Gonçalves, S. Burato, M. P. Holton, **N. W. Dias**, S. Pancini, T. Redifer, S. G. Clark, J. F. Currin, J. L. Stewart, **P. L. P. Fontes**, V. R. G. Mercadante. 2023. Supplementing Ca salts of soybean oil via low-moisture molasses-based blocks to improve reproductive performance and overall productivity of beef cows. *Anim. Reprod. Sci.* 252:107227. doi:10.1016/j.anireprosci.2023.107227 **(TX, VA, GA)**

Jaclyn N. Ketchum, Lacey K. Quail, Kaitlin M. Epperson, Chloey P. Guy, Jerica J.J. Rich, **Saulo Menegatti Zoca**, Adalaide C. Kline, Taylor N. Andrews, Julie A. Walker, **Pedro Levy Piza Fontes**, Sandy K. Johnson, Megan P.T. Owen, Douglas Eborn, Kelsey M. Harvey, Adam F. Summers, **George A. Perry**. 2024. Evaluation of two beef cow fixed-time AI protocols that utilize presynchronization. *Theriogenology*. 213:59-65. doi:10.1016/j.theriogenology.2023.09.017. **(TX, TN, GA)**

Ketchum, J. N., L. K. Quail, K. M. Epperson, C. P. Guy, J. J. J. Rich, S. **Menegatti Zoca**, A. C. Kline, T. N. Andrews, J. A. Walker, **P. Fontes**, S. K. Johnson, M. P. T. Owen, D. Eborn, K. M. Harvey, A. F. Summers, **G. A. Perry**. 2024. Evaluation of two beef cow fixed-time AI protocols that utilize presynchronization. *Theriogenology*. 213:59-65. <https://doi.org/10.1016/j.theriogenology.2023.09.017> **(TX, TN, GA)**

L.P. Reynolds, **C.R. Dahlen**, A.K. Ward, M.S. Crouse, P.P. Borowicz, B.J. Davila-Ruiz, C. Kanjanaruch, K.A. Bochantin, **K.J. McLean**, K.L. McCarthy, A.C.B. Menezes, W.J.S. Diniz, R.A. Cushman, J.S. Caton. 2023. Role of the Placenta in Developmental Programming. *Anim. Reprod. Sci.* 257 (2023) 107322. **(ND, TN)**

**P. L. P. Fontes**, L. M. Goncalves, S. Burato, **S. M. Zoca**. Impact of sire over conditioning on bull fertility. 2023 Applied Reproductive Strategies for Beef Cattle. Wyoming. (GA, TN)

Rich, J. J. J., E. J. Northrop-Albrecht, K. M. Epperson, S. **Menegatti Zoca**, S. D. Perkins-Oines, J. A. Walker, **R. N. Funston**, V. R. G. Mercadante, **G. A. Perry**. 2023. Effect of a single supplemental dose of GnRH in two different fixed-time artificial insemination synchronization protocols among beef cows and heifers. Applied Animal Science. 39:443-448. <https://doi.org/10.15232/aas.2023-02429> (TX, NE, TN)

Rocha, C. C., T. Martins, **F. A. C. C. Silva**, M. Sponchiado, K. G. Pohler, and M. Binelli. 2023. Viperin (RSAD2) gene expression in peripheral blood mononuclear cells of pregnant crossbred beef cows is altered by Bos indicus genetics. Theriogenology 209:226-233 (FL, TX)

Seekford, Z. K., D. B. Davis, M. J. Dickson, L. M. Gonçlaves, S. Burato, M. P. Holton, J. G. Gordon, K. G. Pohler, **G. C. Lamb**, T. D. Pringle, R. L. Stewart, M. S. Ferrer, **P. L. P. Fontes**, J. J. Bromfield. 2023. Bulls fed a high gain diet decrease blastocyst formation after in vitro fertilization. Reprod. 166(2):149-159. <https://doi.org/10.1530/REP-23-0006> (TX, GA)

**Silva, F. A. C. C.**, T. Martins, M. Sponchiado, C. C. Rocha, K. G. Pohler, F. Peñagaricano, and M. Binelli. 2023. Hormonal profile prior to luteolysis modulates the uterine luminal transcriptome in the subsequent cycle in beef cross-bred cows. Biology of Reproduction:1-14. doi: 10.1093/biolre/ioad035 (FL, TX, WI)

**Silva, F. A.**, T. Martins, M. Sponchiado, C. C. Rocha, N. Ashrafi, S. F. Graham, K. Pohler, F. Peñagaricano, A. Gonella-Diaza, and M. Binelli. 2023. Pre-estrus progesterone does not affect post-estrus luminal metabolome in cross-bred beef cows. Reproduction 166(2):99-116. doi: <https://doi.org/10.1530/REP-22-0372> (FL, TX, WI)

VanWye GM, Andersen CM, **Smith EG**, Erwin ZL, Spinka CM, Pooch SE, and **Thomas JM**. Evaluation of later timepoints for fixed-time artificial insemination of beef heifers and cows when using sex-sorted semen. Theriogenology 2024;214:334-341. <https://doi.org/10.1016/j.theriogenology.2023.11.005> (MO, MI)

VanWye GM, **Smith EG**, Spinka CM, Smith MF, Lucy MC, and **Thomas JM**. Inducing luteolysis prior to atresia of the first follicular wave by altering the interval to prostaglandin F2 $\alpha$  administration after long-term progestin presynchronization. Theriogenology 2024;214:323-333. <https://doi.org/10.1016/j.theriogenology.2023.11.002> (MO, MI)

Z. K. Seekford, D. B. Davis, M. J. Dickson, L. M. Gonçlaves, S. Burato, M. P. Holton, J. Gordon, K. G. Pohler, **G. C. Lamb**, T. D. Pringle, R. L. Stewart, M. S. Ferrer, J. J. Bromfield, and **P. L. P. Fontes**. 2023. Bulls fed a high-gain diet decrease blastocyst formation after in vitro fertilization. Reproduction, 166:149-159. doi:10.1530/REP-23-0006. (GA, FL, TX)

**OTHER PUBLICATION AND OUTREACH EFFORTS:** The members of the NC1201 published over 80 documents in the last year, either in popular press, extension publications, or peer review abstracts. Although most of those publications are authored within groups, it is the

result of collaborative discussions and aids in advancing toward the overall goal of the project. Other efforts include digital outreach, such as webinars and podcasts.

### **CONFERENCE PROCEEDINGS (SELECTED):**

Christenson, D. J. Maddux, **J. Thomas**, and **R. Funston**. 2023. Artificial insemination of beef heifers with multi-sire sexed semen. 2023. *Nebraska Beef Cattle Report*. Univ. Nebraska, Lincoln. MP 117:19-21. **(NE, MO)**

Christenson, D., **J. Thomas**, D. Kelly, and **R. Funston**. 2023. Extending melengestrol acetate treatment from fourteen to eighteen days in beef heifers. *Nebraska Beef Cattle Report*. Univ. Nebraska, Lincoln. MP 117:16-18. **(NE, MO)**

**P. L. P. Fontes**, L. M. Goncalves, S. Burato, **S. M. Zoca**. Impact of sire over conditioning on bull fertility. 2023 Applied Reproductive Strategies for Beef Cattle. Wyoming. **(GA, TN)**

Wiltbank, M. C., J. P. N. Andrade, **V. Gomez-Leon**, A. Garcia-Guerra, P. L. J. Monteiro, R. R. Domingues, **P. M. Fricke**, R. Sartori. 2024. The dichotomy between pregnancy survival and loss: challenging “post”-conceived notions. *J. Dairy Sci.* 107(Suppl 1). **(WI, OH, KS)**

**Pursley, J. R. and M. C. Wiltbank**. 2023. The evolution of Ovsynch and the high fertility cycle. XXV Curso Novos Enfoques na Producao e Reproducao de Bovinos, March 24. Uberlandia, Brazil. **(MI, WI)**

### **FUNDING**

#### *Collaborative Funding:*

Fontes, P. L. P. and G. A. Perry. USDA – AFRI 2021-2026 \$650,000. Paternal origins of offspring fetal and postnatal development **(GA, TX)**

Perry, G. A. and P. L. P. Fontes. USDA – AFRI 2022-2027 \$650,000. Unraveling the benefits of omega-6 fatty acids to pregnancy establishment and maintenance in beef females **(GA, TX)**

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 **(TN, ND)**

Wiltbank M. C. and V. E. Gomez-Leon. USDA – AFRI 2021-2025 \$649,966. Role of LH/FSH pulses and transcriptomics for a new model of follicle selection in cattle **(KS, WI)**

#### *Other Funding:*

Other reported 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.