

## Multistate Research Activity Accomplishments Report

Project Number: NC-1201

Project Title: Methods to Increase Reproductive Efficiency in Cattle

Period Covered: March 14, 2019 To July 24, 2020

Date of This Report: August 25, 2020

Annual Meeting Dates: July 24, 2020 (meeting was held virtually)

Meeting Participants: Bob Cushman (USMARC), Reinaldo Cooke (TX), Carl Dahlen (ND), Padro Fontes (UG), Paul Fricke (WI), Cliff Lamb (TX), Jamie Larson (UM), Kyle McLean (UT), Vitor Mercadante (VA), George Perry (SD), Richard Pursley (MI), Shelly Rhodes (VA), George Smith (Administrative Advisor), Jeff Stevenson (KS), Adam Summers (NM),

Brief summary of minutes of annual meeting:

Due to the issues with COVID-19 the annual meeting was held on July 24, 2020 virtually. The meeting was called to order over Zoom by George Perry. The meeting began with everyone discussing how their respective university was handling COVID-19 and what impact it was having on research and extension. Members Bob Cushman (USMARC), Reinaldo Cooke (TX), Carl Dahlen (ND), Padro Fontes (UG), Paul Fricke (WI), Cliff Lamb (TX), Jamie Larson (UM), Kyle McLean (UT), Vitor Mercadante (VA), George Perry (SD), Richard Pursley (MI), Shelly Rhodes (VA), George Smith (Administrative Advisor), Jeff Stevenson (KS), and Adam Summers (NM) were in attendance. Pedro Fontes was nominated and elected secretary. The group had a discussion on timing and venue for next year's meeting. We discussed the hopes of changing the venue next year. The group discussed and agreed to have the annual meeting next year in conjunction with American Society of Animal Science and American Society of Dairy Science meetings in July of 2021. The motion passed. George Smith gave an administrative update. Next year's officers at the annual meeting of the NC-1201 multistate research project will be Adam Summers (Chairperson) and Pedro Fontes (Secretary).

### **Accomplishments (research; objectives 1 and 2):**

Short Term Outcomes of Research from NC-1201 participants:

#### Dairy cattle

- Luteolysis in fertility programs of lactating dairy cows can be effectively managed with a double dose of cloprostenol. The cost benefit of this simple labor reducing finding is approximately \$10 per cow per year or \$5,000 per year in a 500-cow dairy herd. Lactating dairy cows' pregnancy losses may be related to an increased time to embryo attachment. (Michigan)
- Utilizing glucose infusion to restore normoglycemia in heat-stressed dairy cattle does not restore milk production. This indicates that the characteristic hypoglycemia of heat-stressed cattle is not a primary limiting factor for milk production. Likewise, it may not be the critical limiting factor for fertility during heat stress. (Virginia)

- Supplementation with a rumen-protected glucose product caused a linear increase in crude protein intake and MUN with increasing dose, but did not impact concentrations of progesterone, milk yield, or dry matter intake. (Kansas)
- Transition diseases negatively impact early postpartum ovulation risk and is associated with measurable changes in periparturient physical activity and postpartum metabolic profiles. (Kansas)
- Delaying timing of AI using sexed semen relative to induction of ovulation after a DO protocol decreased P/AI in primiparous lactating Holstein cows. (Wisconsin)

### Beef cattle

- The use of a controlled internal drug release (CIDR) containing progesterone for 7 days increases vaginal pH overtime and a greater pH at fixed-time artificial insemination increased pregnancy success of beef cows. (Virginia)
- A single examination using color Doppler ultrasonography detects the majority of non-pregnant *Bos taurus* cows at 20 or 22 days after fixed-time artificial insemination (Georgia)
- Nutritional plane does impact appear to impact the morphological abnormalities seen in spermatozoa of mature bulls. (Tennessee)
- Protein supplementation can impact presence and overall profile of a variety of cytokines in uterine fluid during heifer development. (Tennessee)
- Concentration of amino acids in uterine fluid is impacted more by pubertal status than protein supplementation. (Tennessee)
- Recognition of pregnancy mechanisms may be altered in heifers with increased numbers of follicles (USMARC)
- Estradiol plays a role in regulating the biological clock in the uterus. (USMARC)
- Estrus expression near the time of TAI enhanced pregnancy establishment factors in *B. indicus* cows, including conceptus development and mRNA expression of interferon-tau. (USMARC)
- Presynchronization with PGF and a CIDR insert increased estrus expression and PR/AI in replacement beef heifers. (Texas)
- In addition to impacting body composition and concentrations of hormones and metabolites, divergent nutrition in mature beef bulls impacted post-thaw sperm motility and other sperm characteristics that could alter fertility. (North Dakota)
- Gonadotropin releasing hormone within antral follicles may be a key regulator of the follicle's ability to produce estradiol (South Dakota)
- There were greater differences in uterine function than in conceptus developmental competence between highE2 and lowE2 animals on day 16 of pregnancy. (South Dakota)
- Use of a CIDR in this resynchronization protocol increased estrus expression and increased resynchronization pregnancy rates for heifers, but did not improve pregnancies in cows, and did not influence overall pregnancy or embryonic loss. (South Dakota)

**Outputs:** This group combined for 166 publications including 53 journal articles and 7 book chapters. Most of the non-journal articles focused on extending research findings to stakeholders through the U.S. and the world.

**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.
- The FB Miller Internship at the University of Missouri was successful in training students in reproductive management by providing the knowledge, tools, and competency for them to become future leaders in the genetic improvement of beef and dairy herds.
- The University of Missouri dual DVM-MS program provided further training and expertise in the area of beef cattle reproduction to veterinary students that intended to offer specialized reproductive services as part of a food animal practice.

**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.

**Impacts:**

Key grants funded during the reporting period:

<b>Years of funding</b>	<b>Value</b>	<b>Funding Agency</b>	<b>States Included</b>
2020-2021	\$25,000	Angus Foundation	GA, TX
2020-2021	\$18,500	Select Sires Inc.	GA, MO
2020-2022	\$1,000,000	USDA-NIFA	TX
2020-2021	\$96,246	Inguran, LLC	TX
2019-2020	\$129,167	Inguran, LLC	TX
2019-2021	\$45,284	USDA – Foreign Ag Service	TX
2019-2021	\$499,981	USDA-AFRI	WI
2020-2022	\$500,00	USDA-AFRI	MI
2020	\$150,000	Boehringer Ingelheim Animal Health	MI
2019-2021	\$150,000	Michigan Alliance for Animal Agriculture	MI
2020-2023	\$500,00	USDA-AFRI	MO
2019-2020	\$55,000	Elanco	SD
2018-2021	\$150,000	USDA-AFRI	SD

2019-2022	\$500,000	USDA0AFRI	SD
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### **Accomplishments (long term industry impacts and communication of results; Objective 3)**

**Activities:** This group combined for more than 100 presentations of those data at either industry or academia events during the reporting period. The audiences included academicians, veterinarians, farm consultants and of course producers and their management teams.

#### **Milestones:**

- Fertility programs for dairy cows developed by members of this group have led to fertility levels near that of nulliparous heifers. It has taken approximately 40 years from when there was a deviation in fertility between lactating cows and heifers to the point at which they have come together again in some pilot herds.
- Members of this group discovered that pregnancy prior to 130 days in milk increases chances of pregnancy and reduces chances of pregnancy loss in the next lactation in lactating dairy cows. This is referred to now as the high fertility cycle. The cost benefit of this is approximately \$115 per cow per year or \$57,500 per year in a 500-cow dairy herd.

#### **Indicators:**

- Dairy cow milk production per cow continues to increase across the United States. Efforts of NC-1201 participants efforts, for example in the state of Michigan, has led to the greatest average milk production per cow ever recorded in the United States at 26,340 lbs. per year in one state.
- Reproductive efficiencies have a much greater impact on average milk production per cow than any other management area. Fertility programs developed by members increased the percent of cows that became pregnant at the ideal time in lactation so low or no milk production in late gestation was minimized.

#### **Publications:**

##### *Refereed Journal Articles*

1. Middleton, E. L., and J. R. Pursley. 2019. Blood samples before and after embryonic attachment accurately determines non-pregnant lactating dairy cows at 24 d post-AI using the BioPRYN test for PSPB. *J. Dairy Sci.* Aug;102(8):7550-7575.
2. Middleton, E. L., T. Minela, and J. R. Pursley. 2019. The High Fertility Cycle: How timely pregnancies in one lactation lead to less body condition loss, fewer health issues, greater fertility, and reduced pregnancy losses in the next lactation. *J. Dairy Sci.* June;102(6):5577-5587.
3. Pursley, J. R., T. Minela, J. P. Martins, and E. Middleton. 2019. Factors influencing pregnancy loss in lactating dairy cows. *Journal of Animal Science*, Volume 97, Issue Supplement\_2, July 2019, Page 117, <https://doi.org/10.1093/jas/skz122.207>. Published: 29 July 2019.

4. Harl A, Westfall-Rudd D and Rhoads ML. 2019. Increased utilization of tactile activities in reproductive physiology laboratory sections to improve cognitive learning. *NACTA J.* 2019 63(2):341-343.
5. Negron-Perez VM, Fausnacht DW and Rhoads ML. Invited Review: Management strategies capable of improving the reproductive performance of heat-stressed dairy cattle. *J Dairy Sci.* 2019 Dec;102(12):10695-10710. doi: 10.3168/jds.2019-16718.
6. Rhoads ML. Effects of periconceptional heat stress on primiparous and multiparous daughters of Holstein dairy cows. *Theriogenology.* 2020 Mar 11. pii: S0093-691X(20)30181-3. doi: 10.1016/j.theriogenology.2020.03.015.
7. Zhang Z, Zhao LD, Johnson SE, Rhoads ML, Jiang H and Rhoads RP. Oxytocin is involved in steroid hormone-stimulated bovine satellite cell proliferation and differentiation in vitro. *Domest Anim Endocrinol.* 2019 Jan;66:1-13. doi: 10.1016/j.domaniend.2018.07.003.
8. Timlin, C.L., A. Lynn, L.K. Wooldridge, K. Uh, A.D. Ealy, R.R. White, K. Lee, V.R.G. Mercadante. 2020. Using physical parameters of bovine zygotes to predict in vitro development success. *Zygote.* In press (accepted 06/2020).
9. Fontes, P.L.P., R.F. Cooke, N. Oosthuizen, C.L. Timlin, N.W. Dias, J.F. Currin, S. Clark, K.G. Pohler, G.C. Lamb, V.R.G. Mercadante. 2019. Impacts of administering prostaglandin F2 $\alpha$  analogue 24 h prior to progesterone insert removal on expression of estrus in beef females. *Livestock Science* (2019). doi: <https://doi.org/10.1016/j.livsci.2019.06.007>
10. Fontes, P.L.P., N. Oosthuizen, F.M. Ciriaco, C.D. Sanford, L.B. Canal, K.G. Pohler, D.D. Henry, V.R.G. Mercadante, C.L. Timlin, A.D. Ealy, S.E. Johnson, N. DiLorenzo, and G.C. Lamb. 2019. Impact of fetal vs. maternal contributions of *Bos indicus* and *Bos taurus* genetics on embryonic and fetal development. *J. Anim. Sci.* 97:1645-1655.
11. Vailes, M.T., S.R. McCoski, L.K. Wooldridge, S.T. Reese, K.G. Pohler, D.A. Roper, V.R.G. Mercadante, and A.D. Ealy. 2019. Post-transfer outcomes in cultured bovine embryos supplemented with epidermal growth factor, fibroblast growth factor 2, and insulin-like growth factor 1. *Theriogenology.* 124:1-8.
12. Crouse, M.S., K.J. McLean, N.P. Greseth, A.K. Ward, L.P. Reynolds, C.R. Dahlen, B.W. Neville, P.P. Borowicz, and J.S. Caton. 2020. Maternal nutrition and stage of early pregnancy in beef heifers: Impacts on abundance of neutral amino acid transporters in utero-placental tissues. Submitted. *J. Anim. Sci.* 98: Issue 7, July 2020, skaa197, <https://doi.org/10.1093/jas/skaa197>
13. Crouse, M.S., N.P. Greseth, K.J. McLean, M.R. Crosswhite, N. Negrin Pereira, A.K. Ward, L.P. Reynolds, C.R. Dahlen, B.W. Neville, P.P. Borowicz, and J.S. Caton. 2019. Maternal nutrition and stage of early pregnancy in beef heifers: Impacts on hexose and AA concentrations in maternal and fetal fluids. *J. Anim. Sci.* 97:1296-1316. doi: 10.1093/jas/skz013.
14. Caton, J.S., M.S. Crouse, L.P. Reynolds, T.L. Neville, C.R. Dahlen, A.K. Ward, and K.C. Swanson. 2019. Maternal nutrition and programming of offspring energy requirements. *Tran. Anim. Sci.* 3 (3) 976-990. (Invited Review). <https://doi.org/10.1093/tas/txy127>.
15. Crouse, M.S., J.S. Caton, R.A. Cushman, K.J. McLean, C.R. Dahlen, P.P. Borowicz, L.P. Reynolds, and A.K. Ward. 2019. Moderate nutrient restriction alters expression of genes impacting production efficiencies of beef cattle in fetal liver, muscle, and cerebrum by d 50 of gestation. *Trans. Anim. Sci.* 3:855-866. <https://doi.org/10.1093/tas/txz026>.

16. Reynolds, L.P., P.P. Borowicz, J.S. Caton, M.S. Crouse, C.R. Dahlen, and A.K. Ward. 2019. Developmental Programming of Fetal Growth and Development. In: R.N. Funston and J.T. Mulliniks (Eds.), *Developmental Programming in Livestock Production, Veterinary Clinics of North America: Food Animal Practice*, Vol. 35, No. 2, pp 229-247. Elsevier: Philadelphia, PA.
17. Oliveira, M., D. McGee, J. Brett, J. Larson, and A. Stone. 2020. Evaluation of production parameters and health of dairy cows treated with pegbovigrastim in the transition period. *Preventive Veterinary Medicine* 176:1-7 (DOI:10.1016/j.prevetmed.2020.104931).
18. Steichen, M. M., and J. E. Larson. 2019. Effects of supplemental progesterone using a CIDR insert on pregnancy per embryo transfer of dairy heifer recipients of embryos produced in vitro. *Anim. Repro. Sci.* 203:45-51. doi.org/10.1016/j.anireprosci.2019.02.006
19. Oliveira Filho, R. V., G. A. Franco, S. T. Reese, F. G. Dantas, P. L. P. Fontes, R. F. Cooke, J. Rhinehart, K. W. Thompson, K. G. Pohler. 2019. Using pregnancy associated glycoproteins (PAG) for pregnancy detection at day 24 of gestation in beef cattle. *Theriogenology*. 141:128-133. doi: 10.1016/j.theriogenology.2019.09.014.
20. Sauls\_Hiesterman, J. A., K. E. Olagaray, S. E. Sivinski, B. J. Bradford, and J. S. Stevenson. 2020. Relationships of metabolites and hormones in follicular fluid and blood serum in transition dairy cows supplemented with a *Saccharomyces cerevisiae* fermentation product. *Theriogenology*. In preparation.
21. Stevenson, J. S., S. Banuelos, and L. G. D. Mendonça. 2020. Transition dairy cow health is associated with first postpartum ovulation risk, metabolic status, milk production, rumination, and physical activity. *J. Dairy Sci.* 103: In press.
22. Sauls-Hiesterman, J. A., S. Banuelos, B. Atanasov, B. J. Bradford, and J. S. Stevenson. 2020. Physiologic responses to feeding rumen-protected glucose to lactating dairy cows. *Anim. Reprod. Sci.*: in preparation. *Anim. Reprod. Sci.* 216: In press.
23. Sinclair, C. D., D. L. Thompson, Jr., J. S. Stevenson, T. Rozell, A. Jager, and J. Kouba. 2020. Direct contact may affect the efficacy of stallion exposure in hastening the onset of cyclicity in anestrous mares. *Theriogenology* 156:138-143.
24. Sauls-Hiesterman, J. A., B. E. Voelz, and J. S. Stevenson. 2019. A shortened resynchronization treatment for dairy cows. *Theriogenology* 141:105-112.
25. Scanavez, A. L. A., L. G. D. Mendonca, J. S. Stevenson, and A. G. Arruda. 2019. Evaluation of seasonal patterns and herd-level traits associated with insemination risk in large dairy herds in Kansas. *PLoS ONE* 05/2019; 14(5):e0217080.
26. Stevenson, J. S. 2019. Spatial relationships of ovarian follicles and luteal structures in dairy cows subjected to ovulation synchronization: Progesterone, and risks for luteolysis, ovulation, and pregnancy. *J. Dairy Sci.* 102:5686-5698.
27. Abedal-Majed MA, Kurz S, McNeel AK, Freetly HC, Largen V, Magamage M, Sargent K, Wood JR, Cushman RA, Cupp AS. Vascular Endothelial Growth Factor A isoforms modulate follicle development independent of diet through diverse signal transduction pathways. *Biol Reprod* 2020; 102:680-692.
28. Perry GA, Cushman RA, Perry BL, Schiefelbein AK, Northrop EJ, Rich JJJ, Perkins SD. Role of preovulatory concentrations of estradiol on timing of conception and regulation of the uterine environment. *Syst Biol Reprod Med* 2020; 66:12-25.
29. Cushman RA, Soares ÉM, Yake HK, Patterson AL, Rosasco SL, Beard JK, Northrop EJ, Rich JJJ, Miles JR, Chase CC Jr, Gonda MG, Perry GA, McNeel AK, Summers AF.

- Brangus cows have ovarian reserve parameters more like Brahman than Angus cows. *Anim Reprod Sci* 2019; 209:106170.
30. Schubach, K. M., R. F. Cooke, A. P. Brandão, T. F. Schumacher, K. G. Pohler, D. W. Bohnert, and R. S. Marques. 2019. Impacts of post-weaning growth rate of replacement beef heifers on their reproductive development and productivity as primiparous cows. *J. Anim. Sci.* 97:4085-4092.
  31. Cooke, R. F., K. G. Pohler, J. L. M. Vasconcelos, and R. L. A. Cerri. 2019. Estrous expression during a fixed-time artificial insemination protocol enhances development and interferon-tau messenger RNA expression in conceptuses from *Bos indicus* beef cows. *Animal* 13:2569-2575.
  32. Oosthuizen, N., R. F. Cooke, K. M. Schubach, P. L. P. Fontes, A. P. Brandão, R. V. Oliveira Filho, E. A. Colombo, G. A. Franco, S. Reese, K. G. Pohler, and G. C. Lamb. 2020. Effects of estrous expression and intensity of behavioral estrous symptoms on variables associated with fertility in beef cows treated for fixed-time artificial insemination. *Anim. Reprod. Sci.* 214:106308.
  33. Oosthuizen, N., P. L. P. Fontes, K. Porter, and G. C. Lamb. 2020. Presynchronization with Prostaglandin F<sub>2</sub> $\alpha$  and prolonged exposure to exogenous progesterone impacts estrus expression and fertility in beef heifers. *Theriogenology* 146: 88-93. doi: 10.1016/j.theriogenology.2020.02.010
  34. Noronha, I. M., R. F. Cooke, C. F. G. Martins, R. V. Oliveira Filho, K. G. Pohler, and J. L. M. Vasconcelos. 2020. Administering an additional prostaglandin F<sub>2</sub> $\alpha$  injection to *Bos indicus* beef cows during a treatment regimen for fixed-time artificial insemination. *Anim. Reprod. Sci.* doi:10.1016/j.anireprosci.2020.106535.
  35. Lauber, M. R., B. McMullen, J. J. Parrish, and P. M. Fricke. 2020. Hot topic: Short Communication: Effect of timing of induction of ovulation relative to timed artificial insemination using sexed semen on pregnancy outcomes in primiparous Holstein cows. *J. Dairy Sci.* (accepted).
  36. Ricci, A., M. Li, P. M. Fricke, and V. E. Cabrera. 2020. Short Communication: Economic impact among 7 reproductive programs for lactating dairy cows including a sensitivity analysis of the cost of hormonal treatments. *J. Dairy Sci.* 103:5654-5661.
  37. Carvalho, P. D., V. G. Santos, H. P. Fricke, L. L. Hernandez, and P. M. Fricke. 2019. Effect of manipulating progesterone before timed artificial insemination on reproductive and endocrine outcomes in high-producing multiparous Holstein cows. *J. Dairy Sci.* 102:7509-7521.
  38. Taylor JF, TN Rowan, RD Schnabel, JE Decker and DJ Patterson. 2020. Genomic diversity and predicted lethal haplotypes in US beef cattle breeds. *BMC Genomics* (in preparation).
  39. Locke, JWC, JM Thomas, ER Knickmeyer, MR Ellersieck, JV Yelich, SE Poock, MF Smith, and DJ Patterson. Comparison of long-term progestin-based protocols to synchronize estrus prior to natural service or fixed-time artificial insemination in *Bos indicus*-influenced beef heifers. *Anim. Reprod. Sci.* Volume 218, July 2020, 106475.
  40. Knickmeyer, ER, JM Thomas, JWC Locke, RC Bonacker, LA Ciernia, JN Ketchum, MR Ellersieck, SE Poock, MF Smith, and DJ Patterson. 2019. Altering duration of the pre-synchronization period in a long-term progestin-based estrus synchronization protocol for timed artificial insemination of beef heifers. *Theriogenology* 136:66-71.

41. Knickmeyer, ER, JM Thomas, JW Locke, RC Bonacker, MR Ellersieck, SE Poock, MF Smith, and DJ Patterson. 2019. Evaluation of split-time artificial insemination following administration of a long- or short-term progestin-based estrus synchronization protocol in beef heifers. *Theriogenology* 133:179-186.
42. Patterson, DJ, and JM Thomas. 2019. Control of estrus and ovulation in beef heifers and cows. *Clinical Theriogenology*. Volume 11, Number 3:265-284.
43. Epperson, K. M., J. J. J. Rich, S. Menegatti Zoca, S. D. Perkins, E. J. Northrop, R. F. Daly, J. A. Walker, J. R. Rhoades, and G. A. Perry. 2019. Influence of BVDV infection on AI conception and breeding season Pregnancy success in Vaccinated Beef Herds. Submitted to *Bovine Practitioners*
44. Afedi, P. A., L. Jing, G. A. Perry, and D. E. Raynie. 2020. Immunodepletion of multiple High-Abundant proteins from Bovine fluids. Accepted to *J of Bioanalytical Methods and Techniques*.
45. Vasquez-Hidalgo, M. A., G. A. Perry, K. A. Vonnahme. 2020. Hemodynamics of the Umbilical Artery and Conceptus-related measures in singleton and twin pregnancies in ewes. Accepted to *Repro Bio*.
46. Mesman, R. D., Z. E. Cotreras-Correa, H. A. Paz, G. A. Perry, and C. O. Lemley. 2020. Vaginal bacterial community composition and concentrations of estradiol at the time of artificial insemination in Brangus heifers. Accepted to *J Anim Sci*.
47. Owen, M.P.T., E. J. Northrop, J. J. J. Rich, G. A. Perry, R. D. Messman, T. T. N. Dinh, K. J. McCarty, J. Yang, D. Wan, and C. O. Lemley. 2020. Oxylin concentrations in bovine corpora lutea during maternal recognition of pregnancy. *Theriogenology* In Press
48. Carvalho, P. H. V., G. A. Perry, and T. L. Felix. 2020. Effects of steroidal implants on feedlot performance, carcass characteristics, and serum and meat estradiol-17 $\beta$  concentrations of Holstein steers. *Translational Anim Sci*. 4(1):206-213.
49. Perry, G. A., J. A. Walker, J. J. J. Rich, E. J. Northrop, S. D. Perkikns, E. E. Beck, M. D. Sandbulte, and F. B. Mokry. 2020. Influence of Sexcel<sup>TM</sup> (Gender Ablation Technology) Gender-Ablated Semen in Fixed-Time Artificial Insemination of Beef Cows and Heifers. *Theriogenology* 146:140-144.
50. Chase, C., E. A. Kolb, R. E. Buterbaugh, C. L. Rinehart, D. Ensley, G. A. Perry. And K. Abdelsalam. 2020. Protection against Bovine Respiratory Syncytial Virus in Calves Vaccinated with Adjuvanted Modified Live Vaccine Administered in the Face of Maternal Antibody. *Vaccine* 38(2):298-308.
51. Dickson, M. J., S. K. Kvidera, E. A. Horst, C. E. Wiley, E. J. Mayorga, J. Ydstie, G. A. Perry, L. H. Baumgard, and A. F. Keating. Impact of chronic and increasing lipopolysaccharide exposure on production and reproductive parameters in lactating Holstein dairy cows. *J Dairy Sci* Feb 6. pii: S0022-0302(19)30131-6.
52. Northrop, E. J. J. J. J. Rich, J. J. Rhoades, and G. A. Perry. 2019. Comparison of two bovine serum pregnancy tests in detection of artificial insemination pregnancies and embryonic loss in beef cattle. *PLoS One*. 2019; 14(1): e0211179.
53. Tenley, S. C., R. S. Gomes, S. L. Rosasco, E. J. Northrop, J. J. J. Rich, A. K. McNeel, A. F. Summers, J. R. Miles, C. C. Chase Jr, C. A. Lents, G. A. Perry, J. R. Wood, A. S. Cupp, R. A. Cushman. 2019. Maternal Age Influences the Number of Primordial Follicles in the Ovaries of Yearling Angus Heifers. *Anim Reprod Sci*. 200:105-112.



1. Minela, T., and J. R. Pursley. 2020. Increasing dose of cloprostenol sodium reduced pregnancy losses but did not increase pregnancies per AI in lactating dairy cows. Abstract #161. International Embryo Technology Society, New York, NY.
2. Stewart J, Newberne H, Arneson A, Harrod M, Negron-Perez V, Haines H, Jordan J, White R, Ealy A, El-Kadi S, Rhoads R and Rhoads M. Glucose infusion during heat stress restores normoglycemia but does not improve milk production. 2020. American Dairy Science Association Annual Meeting. Virtual Meeting.
3. Timlin, C.L., A. Lynn, L.K. Wooldridge, K. Uh, A.D. Ealy, R.R. White, K. Lee, V.R.G. Mercadante. 2020. Using physical parameters of bovine zygotes to predict in vitro development success. International Embryo Technology Society. Annual Meeting Proceedings.
4. Timlin, C.L., T. Parrish, N.W. Dias, F.V. Santili, S. Pancini, V.R.G. Mercadante. 2020. Uterine gene expression of beef cows in response to supplementation with calcium salts of soybean oil. ASAS-Southern Section. Annual Meeting Proceedings.
5. Pancini, S., J.F. Currin, J.L. Stewart, S. Clark-Deener, T. Redifer, N.W. Dias, C.L. Timlin, A.F.F. Sales, V.R.G. Mercadante. 2020. Effect of injectable trace mineral supplementation on beef cow fertility and overall mineral status. ASAS-Southern Section. Annual Meeting Proceedings.
6. Dias, N.W., A.F.F. Sales, C.L. Timlin, C.R. Friedel, V.R.G. Mercadante. 2020. Engaging youth through bovine reproductive practices. ASAS-Southern Section. Annual Meeting Proceedings.
7. Franco, G., G. Damaso, S. Reese, V. M. Negron-Perez, C.L. Timlin, K. Uh, K. Lee, V. R. G. Mercadante, K. Pohler. 2019. Comparison of developmental capacity of bovine parthenogenetic and biparental IVF embryos and its effects on placental products secretion. Society for the Study of Reproduction. Annual Meeting Proceedings.
8. Mercadante, V. R. G., R. R. White, J. Currin, H. L Bradford, S. Clarke, J. F. Stewart, N. W. Dias, C. Timlin, S. Pancini. 2019. Effects of dam relative calving date on progeny performance, *Journal of Animal Science*, Volume 97, Issue Supplement 3, Pages 27–28.
9. Mercadante, V. R. G., R. R. White, J. Currin, H. L Bradford, S. Clarke, J. F. Stewart, N. W. Dias, C. Timlin, S. Pancini. 2019. Repeatability of estrus detection patch readings and relationship with breeding success. *Journal of Animal Science*, Volume 97, Issue Supplement 3, Pages 30–31.
10. Dias, N. W., A. Sales, C. L. Timlin, S. Pancini, J. Currin, V. R. G. Mercadante. 2019. Vaginitis incidence and effects on fertility of beef females enrolled on estrus synchronization protocols using a controlled internal drug release (CIDR) device. *Journal of Animal Science*, Volume 97, Issue Supplement 3, Page 242.
11. Pancini, S., R. F. Cooke, A. P. Brandão, N. W. Dias, C. Timlin, P. L. P. Fontes, A. Sales, J. Wicks, A. Murray, and V. R. G. Mercadante. 2019. Supplementing a yeast-derived product to feedlot cattle: Impacts on performance, physiological responses, and carcass characteristics. *Journal of Animal Science*, Volume 97, Issue Supplement 3, Page 154.
12. Fontes, P. L. P., N. Oosthuizen, F. M. Ciriaco, C. D. Sanford, L. B. Canal, K. Pohler, D. D. Henry, V. R. G. Mercadante, C. Timlin, A. Ealy, S. Johnson, N. DiLorenzo, G. C. Lamb. 2019. Awardee Talk - Impact of fetal versus maternal contributions of *Bos indicus* and *Bos taurus* genetics on embryonic and fetal development. *Journal of Animal Science*, Volume 97, Issue Supplement 3, Pages 142–143.

13. Dias, N.W., A.F.F. Sales, J.F. Currin, T. Redifer, H.H. Scherer, V.R.G. Mercadante. Virginia Tech Graduate Extension Scholars program: Bovine artificial insemination course for inmates. 2019. *Journal of Animal Science*, Volume 97, Issue Supplement 3, Page 85.
14. Dias, N.W., H.H. Scherer, V.R.G. Mercadante. 2019. Virginia Tech Graduate Extension Scholars program: Report of a Scholar. ASAS-Southern Section. *Journal of Animal Science*, Volume 97, Issue Supplement 1, Page 8.
15. Timlin, C.L., L. Hungerford, T. Redifer, J.F. Currin, V.R.G. Mercadante. 2019. A retrospective analysis of bull:cow ratio effects on pregnancy rates of beef cows previously enrolled in fixed-time artificial insemination protocols. ASAS-Southern Section. *Journal of Animal Science*, Volume 97, Issue Supplement 1, Page 1.
16. Rich, J. J. J., E. J. Northrop, K. M. Epperson, S. M. Zoca, S. D. Perkins, J. A. Walker, C. L. Timlin, N. W. Dias, V. R G Mercadante, G. A. Perry. 2019. Effects of low doses of GnRH at CIDR removal on estrus expression and conception rates in beef heifers. *Journal of Animal Science*, Volume 97, Issue Supplement\_2, July 2019, Page 124.
17. Dahlen, C.R., S.R. Underdahl, M.S. Crouse, K.L. McCarthy, C.J. Kassetas, F. Baumgaertner, J.D. Kirsch, S.T. Dorsam, K.K. Sedivec, A.K. Ward, and J.S. Caton. 2020. Effects of managing mature beef bulls on divergent planes of nutrition on body composition and concentrations of hormones and metabolites. Abstract. 2020 ASAS-CSAS-WSASAS Virtual Annual Meeting.
18. Dahlen, C.R., S.R. Underdahl, M.S. Crouse, K.L. McCarthy, C.J. Kassetas, F. Baumgaertner, J.D. Kirsch, S.T. Dorsam, K.K. Sedivec, A.K. Ward, and J.S. Caton. 2020. Effects of managing mature beef bulls on divergent planes of nutrition on motility and kinematic properties of fresh and frozen-thawed sperm. Abstract. 2020 ASAS-CSAS-WSASAS Virtual Annual Meeting.
19. Dahlen, C.R., C.J. Kassetas, T.W. Geary, A.L. Zezeski, S.R. Underdahl, M.S. Crouse, K.L. McCarthy, F. Baumgaertner, J.D. Kirsch, S.T. Dorsam, K.K. Sedivec, A.K. Ward, and J.S. Caton. 2020. Effects of managing mature beef bulls on divergent planes of nutrition on novel measures of bull fertility. Abstract. 2020 ASAS-CSAS-WSASAS Virtual Annual Meeting.
20. Kassetas, C.J., J.S. Caton, J.D. Kirsch, S.T. Dorsam, K.L. McCarthy, M.S. Crouse, K.K. Sedivec, B.W. Neville, and C.R. Dahlen. 2020. Effects of feeding 60% dried corn distillers grains plus solubles or the equivalent sulfur as calcium sulfate on trace mineral concentrations in serum and seminal plasma. Abstract. 2020 ASAS-CSAS-WSASAS Virtual Annual Meeting.
21. Kassetas, C.J., T.W. Geary, A.L. Zezeski, J.S. Caton, J.D. Kirsch, S.T. Dorsam, K.L. McCarthy, M.S. Crouse, K.K. Sedivec, B.W. Neville, and C.R. Dahlen. 2020. Effects of feeding 60% dried corn distillers grains plus solubles or the equivalent sulfur as calcium sulfate on DNA structure and integrity in bull semen. Abstract. 2020 ASAS-CSAS-WSASAS Virtual Annual Meeting.
22. McCarthy, K. L., J. Nestande, C. J. Kassetas, F. Baumgaertner, J. D. Kirsch, S. T. Dorsam, T. L. Neville, A. K. Ward, P. P. Borowicz, L. P. Reynolds, K. K. Sedivec, J. Chris Forcherio, R. Scott, J. S. Caton, and C.R. Dahlen. 2020. Effects of feeding vitamin and mineral and (or) energy supplements to beef heifers during the first 83 days of gestation on progesterone concentrations, corpus luteum size, and fetal body measurements. Abstract. 2020 ASAS-CSAS-WSASAS Virtual Annual Meeting.

23. Menezes, A.C.B., K.L. McCarthy, C.J. Kassetas, F. Baumgaertner, J.D. Kirsch, S.T. Dorsam, T.L. Neville, A.K. Ward, P.P. Borowicz, L.P. Reynolds, K.K. Sedivec, J.C. Forcherio, R. Scott, J.S. Caton, and C. R. Dahlen. Effects of feeding a vitamin and mineral supplement and (or) an energy supplement on concentrations of amino acids in beef heifer serum and fetal fluids at d 83 of gestation. Abstract. 2020 ASAS-CSAS-WSASAS Virtual Annual Meeting.
24. Baumgaertner, F., S.R. Underdahl, K.L. McCarthy, A.C.B. Menezes, W.J.S. Diniz, A.K. Ward, K.K. Sedivec, S.T. Dorsam, J.D. Kirsch, J.S. Caton, and C.R. Dahlen. 2020. Effects of energy supplementation during early gestation in beef heifers on body weight, concentrations of IGF-1, and calf characteristics. Abstract. 2020 ASAS-CSAS-WSASAS Virtual Annual Meeting.
25. Reynolds, L. P., K.L. McCarthy, M.S. Crouse, C.J. Kassetas, F. Baumgaertner, S. Dorsam, J.D. Kirsch, T.L. Neville, P. Coy, J.S. Caton, P.P. Borowicz, C.R. Dahlen. 2020. Effects of feeding restriction dietary intake on expression of oviductal glycoprotein 1 (OVGP1) in the oviductal ampulla of beef cows. Abstract. 2020 ASAS-CSAS-WSASAS Virtual Annual Meeting.
26. Oosthuizen, N., P.L.P. Fontes, R.V. Oliveira Filho, C.R. Dahlen, D.M. Grieger, J.B. Hall, S. Lake, C.R. Looney, V.R.G. Mercadante, G.A. Perry, J.G. Powell, L.D. Prezotto, G.E. Seidel, R.S. Walker, R.C. Cardoso, K.G. Pohler, and G.C. Lamb. 2020. Presynchronization and delayed fixed-time artificial insemination increases pregnancy rates with sex-sorted semen in replacement beef heifers. Abstract. 2020 ASAS-CSAS-WSASAS Virtual Annual Meeting.
27. Menezes, A. C. B., K.L. McCarthy, C.J. Kassetas, F. Baumgaertner, J.D. Kirsch, S. Dorsam, T.L. Neville, A.K. Ward, P.P. Borowicz, L.P. Reynolds, K.K. Sedivec, J.C. Forcherio, R. Scott, J.S. Caton, and C.R. Dahlen. 2020. Effects of feeding a vitamin and mineral supplement and (or) an energy supplement on the abundance of SLC7A5 transporter in beef heifer placentomes at d 83 of gestation. Late Breaking Abstract. 2020 ASAS-CSAS-WSASAS Virtual Annual Meeting.
28. McCarthy, K.L., S.R. Underdahl, M. Undi, S. Becker, K.K. Sedivec, C. Forcherio, R. Scott, J.S. Caton, and C.R. Dahlen. 2020. Young Scholar Presentation: Energy and Mineral Supplementation Strategies for Beef Cattle Grazing the Northern Great Plains. J. Anim. Sci. (ASAS Midwest Abstract)
29. Kassetas, C. J., Joel S. Caton, James D. Kirsch, Sheri T. Dorsam, Kacie L. McCarthy, Matthew S. Crouse, Kevin K. Sedivec, Bryan W. Neville, and Carl R. Dahlen. 2020. Effect of feeding 60% dried corn distillers grains plus solubles or the equivalent sulfur on performance, hormone concentrations, and glutathione peroxidase activity in yearling Angus bulls. J. Anim. Sci. (ASAS Midwest Abstract)
30. Dahlen, C. R., S R. Underdahl, K. L. McCarthy, M. C. Crouse, J. D. Kirsch, S. T. Dorsam, C. J. Kassetas, T. C. Gilbery, K. K. Sedivec, and J. S. Caton. 2020. Effects of feeding rumen-protected methionine to mature beef bulls. J. Anim. Sci. (ASAS Midwest Abstract)
31. Dahlen, C.R., K.L. McCarthy, S.R. Underdahl, M.R. Crosswhite, and B.W. Neville. 2019. Effects of injectable trace mineral supplements at the initiation of estrus synchronization on pregnancy rates in beef cows. J. Anim. Sci. 97. Suppl 3. 371-372 (Abstr). <https://doi.org/10.1093/jas/skz258.740>

32. Brandt, K. J.\*, T. B. Ault\*, P. Myer, L. Schneider, and K. J. McLean. 2019. The effect of supplemental protein from weaning until first breeding on heifer development and uterine environment characteristics. *J. Anim. Sci.* 97(Supplement 3)140.
33. Brandt, K. J.\*, T. B. Seay\*, P. Myer, L. Schneider, and K. J. McLean. 2019. Supplemental proteins impact on uterine environment characteristics in developing beef heifers from weaning through breeding. UTIA Graduate Research and Poster Symposium, UTBFC Annual Research and Recommendation Meeting, Knoxville, TN.
34. Harrison, T. D.\*, K. J. Brandt\*, R. R. Payton, L. Schneider, P. Myer, J. Rhinehart, L. A. Rispoli, J. L. Edwards, and K. J. McLean. 2019. The effects of protein supplementation on concentrations of angiogenic cytokines and miscellaneous chemokines during heifer development. UTIA Graduate Research and Poster Symposium, UTBFC Annual Research and Recommendation Meeting, Knoxville, TN.
35. Seay, T. B.\*, K. R. McLeod, R. L. Baldwin VI, J. L. Klotz, J. L. Edwards, and K. J. McLean. 2019. Effect of induced fescue toxicosis and stress on intestinal tissue apoptosis, barrier function, and intake in steers. Applied Reproductive Strategies in Beef Cattle Meeting, Knoxville, TN.
36. Seay, T. B.\*, P. Myer, and K. McLean. 2019. Evaluation of induced fescue toxicosis on uterine environment and fetal development during early gestation in heifers. UTIA Graduate Research and Poster Symposium, UTBFC Annual Research and Recommendation Meeting, Knoxville, TN.
37. Chaney, E. M., T. D. Harrison, K. J. Brandt, L. G. Schneider, R. R. Payton, and K. J. McLean. 2020. The effect of growth rate on the uterine environment in beef heifers. *J. Anim. Sci.* (Accepted).
38. Harrison, T. D., L. G. Strickland, R. R. Payton, L. G. Schneider, K. J. Brandt, E. M. Chaney, K. J. McLean. 2020. Differing planes of nutrition affecting the cytokines of bovine seminal plasma in beef cattle. *J. Anim. Sci.* (Accepted).
39. Seay, T. B., K. J. Brandt, R. R. Payton, L. G. Schneider, P. R. Myer, J. D. Rhinehart, L. A. Rispoli, and K. J. McLean. 2020. Pro- and anti-inflammatory cytokines in the uterine environment throughout beef heifer development with supplemental protein. *J. Anim.*
40. Dysart, L. M., R. Messman, C. O. Lemley, and J. E. Larson. 2019. Effects of estradiol benzoate on female reproductive characteristics in beef cows. *J. Anim. Sci.*
41. Crouse, A. A., L. M. Dysart, and J. E. Larson. 2019. Effects of exogenous estradiol on reproductive characteristics of cattle. *MSU Undergraduate research symposium*:34.
42. Oosthuizen, N., P. L. P. Fontes, and G. C. Lamb. 2020. Presynchronization with Prostaglandin F<sub>2α</sub> and prolonged exposure to exogenous progesterone impacts estrus expression and alters fertility in beef heifers. *J. Anim. Sci.* (In press).
43. Oosthuizen, N., G. D. Melo, G. E. Seidel, R. L. Stewart, G. C. Lamb, and P. L. P. Fontes. 2020. Effects of delayed injection of prostaglandin F<sub>2α</sub> and TAI in the 14-d CIDR-PG & TAI protocol in replacement beef heifers. *J. Anim. Sci.* (In press).
44. Oosthuizen, N., P. L. P. Fontes, R. V. Oliveira Filho, C. R. Dahlen, D. M. Grieger, J. B. Hall, S. Lake, C. R. Looney, V. R. G. Mercadante, G. A. Perry, J. G. Powell, L. D. Prezotto, G. E. Seidel, R. S. Walker, R. C. Cardoso, K. G. Pohler, and G. C. Lamb. 2020. Presynchronization and delayed fixed-time artificial insemination increases pregnancy rates with sex-sorted semen in replacement beef heifers. *J. Anim. Sci.* (In press).
45. Fontes, P. L. P., N. Oosthuizen, F. M. Ciriaco, D. D. Henry, C. D. Sanford, L. B. Canal, V. R. G. Mercadante, A. D. Ealy, S. E. Johnson, N. DiLorenzo, and G. C. Lamb. 2019.

- Impact of fetal versus maternal contribution of *Bos indicus* and *Bos taurus* genetics on embryonic and fetal development. J. Anim. Sci.
46. G. C. Lamb, N. Oosthuizen, and P. L. P. Fontes. 2019. Reproductive management of beef females in tropical and sub-tropical environments. J. Anim. Sci. (In press).
  47. Fontes, P. L. P., R. F. Cooke, N. Oosthuizen, C. L. Timlin, N. W. Dias, J. F. Currin, S. Clark, K. G. Pohler, G. C. Lamb, and V. R. G. Mercadante. 2019. Administration of prostaglandin F<sub>2α</sub> 24 h prior to CIDR removal impacts reproductive performance of suckled beef cows assigned to the 7-d CO-Synch + CIDR protocol. J. Anim. Sci. Volume 97, Suppl. 1, 48-49.
  48. Oosthuizen, N., K. Schubach, P. L. P. Fontes, A. Brandão, R. O. Filho, E. Colombo, K. G. Pohler, G. C. Lamb, and R. F. Cooke. 2019. The impact of estrus intensity on variables associated with fertility in *Bos taurus*-influenced beef cows. J. Anim. Sci. 97, Suppl. 3, 362-363.
  49. Oosthuizen, N., P. L. P. Fontes, and G. C. Lamb. 2019. Reproductive management of beef females in tropical and sub-tropical environments. J. Anim. Sci. 97, Suppl. 3, 37.
  50. Sinclair, C. D., J. Stevenson, A. Jager, N. Long, T. Rozell, and J. Kouba. 2019. Stallion exposure fails to alter circulating LH concentrations or hasten ovulation in seasonally anestrous mares. J. Anim. Sci. 97(Suppl. 3):240–241.
  51. Cushman RA, Spuri-Gomes R, Tenley SC, Rosasco SL, Rich JJJ, Northrop EJ, Miles JR, Lindholm-Perry AK, Keel BN, Perry GA, Summers AF, Cupp AS. Influence of age of dam on daughter reproductive performance and follicle number in beef heifers. Midwest Section ASAS, March 2020.
  52. Rosasco SL, Melchior EA, Cox SH, Dunlap RL, Hernandez Gifford JA, Scholljegerdes EJ, Cushman RA, Summers AF. Effect of stair-step nutrition on ovarian development in replacement beef heifers. Western Section ASAS, July 2020.
  53. Fontes, P. L. P., R. F. Cooke, N. Oosthuizen, B. Carpenter, and G. C. Lamb. 2018. Administration of prostaglandin F<sub>2α</sub> 24 h prior to CIDR removal alters distribution of estrus expression in replacement beef heifers assigned to the Select-Synch estrus synchronization protocol. J. Anim. Sci. 96, Suppl. 3, 362.
  54. Fontes, P. L. P., N. Oosthuizen, F. M. Ciriaco, D. D. Henry, C. D. Sanford, L. B. Canal, V. R. G. Mercadante, A. D. Ealy, S. E. Johnson, N. DiLorenzo, and G. C. Lamb. 2018. Impacts of *Bos indicus* vs. *Bos taurus* genetics and nutrient energy restriction during early gestation on offspring performance and feed efficiency. J. Anim. Sci. 96, Suppl. 3, 365–366.
  55. Oosthuizen, N., P. L. P. Fontes, D. A. Thomas, L. B. Canal, C. D. Sanford, N. DiLorenzo, and G. C. Lamb. 2018. Relationships among feed efficiency, performance, and value of bulls in the Florida Bull Test. J. Anim. Sci. 96, Suppl. 3, 200.
  56. Oosthuizen, N., K. Schubach, P. L. P. Fontes, A. Brandão, R. O. Filho, E. Colombo, K. G. Pohler, G. C. Lamb, and R. F. Cooke. 2019. The impact of estrus intensity on variables associated with fertility in *Bos taurus*-influenced beef cows. J. Anim. Sci. 97, Suppl. 3, 362-363.
  57. Oosthuizen, N., P. L. P. Fontes, and G. C. Lamb. 2019. Reproductive management of beef females in tropical and sub-tropical environments. J. Anim. Sci. 97, Suppl. 3, 37.
  58. Oosthuizen, N., P. L. P. Fontes, and G. C. Lamb. 2020. Presynchronization with Prostaglandin F<sub>2α</sub> and prolonged exposure to exogenous progesterone impacts estrus expression and alters fertility in beef heifers. J. Anim. Sci.

59. Oosthuizen, N., G. D. Melo, G. E. Seidel, R. L. Stewart, G. C. Lamb, and P. L. P. Fontes. 2020. Effects of delayed injection of prostaglandin F<sub>2α</sub> and TAI in the 14-d CIDR-PG & TAI protocol in replacement beef heifers. *J. Anim. Sci.*
60. Oosthuizen, N., P. L. P. Fontes, R. V. Oliveira Filho, C. R. Dahlen, D. M. Grieger, J. B.
61. Hall, S. Lake, C. R. Looney, V. R. G. Mercadante, G. A. Perry, J. G. Powell, L. D. Prezotto, G. E. Seidel, R. S. Walker, R. C. Cardoso, K. G. Pohler, and G. C. Lamb. 2020. Presynchronization and delayed fixed-time artificial insemination increases pregnancy rates with sex-sorted semen in replacement beef heifers. *J. Anim. Sci.*
62. Lauber, M. R., B. McMullen, J. J. Parrish, and P. M. Fricke. 2020. Effect of timing of AI using sexed semen relative to induction of ovulation after a Double-Ovsynch protocol on pregnancy outcomes and fetal sex in lactating primiparous Holstein cows. *J. Dairy Sci.* 103(Suppl 1):93-94.
63. Cabrera, E. M., M. R. Lauber, E. M. Peralta, T. R. Bilby, and P. M. Fricke. 2020. Human chorionic gonadotropin (hCG) dose-response 7 days after synchronization of ovulation in lactating Holstein cows I: ovulatory responses and serum progesterone concentrations. *J. Dairy Sci.* 103(Suppl 1):240.
64. Cabrera, E. M., M. R. Lauber, E. M. Peralta, T. R. Bilby, and P. M. Fricke. 2020. Human chorionic gonadotropin (hCG) dose-response 7 days after synchronization of ovulation in lactating Holstein cows II: pregnancy outcomes and accessory corpus luteum regression. *J. Dairy Sci.* 103(Suppl 1):240-241.
65. Mezera, M. A., M. R. Lauber, A. D. Beard, E. M. Cabrera, M. C. Wiltbank, and P. M. Fricke. 2020. Effect of route of administration of dinoprost tromethamine on serum profiles of PGFM and progesterone in lactating Holstein cows. *J. Anim. Sci.*
66. Knickmeyer, ER, JM Thomas, RC Bonacker, JWC Locke, MR Ellersieck, SE Poock, MF Smith, and DJ Patterson. 2019. Evaluating strategies to improve pregnancy rates resulting from artificial insemination in beef heifers. In: *Proceedings, Applied Reproductive Strategies in Beef Cattle*. Knoxville, TN.
67. Knickmeyer, ER, JM Thomas, JWC Locke, RC Bonacker, L Ciernia, JN Ketchum, MR Ellersieck, SE Poock, MF Smith, and DJ Patterson. 2019. Altering length of the pre-synchronization period in a long-term progestin-based estrus synchronization protocol for timed artificial insemination of beef heifers. *American Society of Animal Science Annual Meeting*. Austin, TX. PSXIII-11.
68. Knickmeyer, ER, JM Thomas, JWC Locke, RC Bonacker, MR Ellersieck, SE Poock, MF Smith, and DJ Patterson. 2019. Evaluation of split-time artificial insemination following administration of the 7-d CO-Synch + CIDR estrus synchronization protocol in beef heifers. *American Society of Animal Science Annual Meeting*. Austin, TX. PSXIII-12.
69. Patterson, DJ, DS Brown, MF Smith, WR Lamberson, JF Taylor, TE Spencer, SE Poock, JM Thomas, and JE Decker. 2019. The National Center for Applied Reproduction and Genomics (NCARG) in Beef Cattle: Supporting improvements in reproductive management. *American Society of Animal Science Annual Meeting*. Austin, TX. No. 102.
70. Decker, JE, DJ Patterson, B Arisman, TN Rowan, JM Thomas, DS Brown, WR Lamberson, SE Poock, MF Smith, TE Spencer, and JF Taylor. 2019. The National Center for Applied Reproduction and Genomics (NCARG) evaluates accuracy of genomic prediction in commercial Angus cattle. *American Society of Animal Science Annual Meeting*. Austin, TX. No. 101.

71. Haag, M, JE Decker, DS Brown, MF Smith, WR Lamberson, JF Taylor, TE Spencer, SE Poock, JM Thomas, and DJ Patterson. 2019. The National Center for Applied Reproduction and Genomics (NCARG): Developing high-impact educational programs for beef industry participants. American Society of Animal Science Annual Meeting. Austin, TX. No. 109.
72. Patterson, DJ, DS Brown, MF Smith, WR Lamberson, JF Taylor, TE Spencer, SE Poock, JM Thomas, and JE Decker. 2019. The National Center for Applied Reproduction and Genomics (NCARG) in Beef Cattle. American Society of Animal Science Annual Meeting. Austin, TX. No. 110.
73. Menegatti Zoca, S., J. J. J. Rich, K. M. Epperson, and G. A. Perry. 2019. Evaluation of the Variability among Bulls for CD9 and SERPINA5 on the Bovine Sperm Head. Society for the Study of Reproduction Meeting
74. Perkins, S. D., B.N. Keel, E.J. Northrop, T.G. McDaneld, R.A. Cushman, B.R. Harstine, J.M. DeJarnette, M.D. Utt, and G.A. Perry. 2019. Influence of microRNAs from Semen on Bovine Fertility. Society for the Study of Reproduction Meeting
75. Rich, J. J. J., E. J. Northrop, K. M. Epperson, S. Menegatti Zoca, S. D. Perkins, R. F. Daly, R. A. Cushman, and G. A. Perry. 2019. Differences in relative abundance of GnRH-I and GnRH-II in granulosa cells of bovine antral follicles at specific stages of follicular development. Society for the Study of Reproduction Meeting
76. Northrop, E. J., J. J. J. Rich, R. A. Cushman, J.R. Miles, A.K. Lindholm-Perry, B.N. Keel, R. Yao, X. Ge, and G. A. Perry. 2019. The influence of preovulatory estradiol on trophoctoderm and uterine gene expression around maternal recognition of pregnancy in beef cattle. Society for the Study of Reproduction Meeting
77. Epperson, K. M., J. J. J. Rich, , S. Menegatti Zoca, S. D. Perkins, E. J. Northrop, J. A. Walker, J. R. Rhoades, and G. A. Perry. 2019. Effect of Progesterone Supplementation in a Resynchronization Protocol on Follicular Dynamics and Pregnancy Success. Society for the Study of Reproduction Meeting
78. McLean, M. K., T.W. Geary, A.L. Zezeski, M.F. Smith, T.E. Spencer, K.G. Pohler, S.T. Reese, and G.A. Perry. 2019. Effect of preovulatory estradiol on subsequent luteal progesterone secretion in beef cows. Society for the Study of Reproduction Meeting
79. Ciernia, L. A., M.F. Smith, G.A. Perry, J.J. Rich, E.J. Northrop, S.D. Perkins, J.A. Green, A.L. Zezeski, and T.W. Geary. 2019. Effect of Preovulatory Estradiol and Postovulatory Progesterone on the Establishment of Pregnancy in Beef Cattle. Society for the Study of Reproduction Meeting
80. Perry, G. A., S. D. Perkins, E.J. Northrop, J.J.J. Rich, S. D. Mayes, C. L. Wright, and J. R. Russell. 2019. Effect of trace mineral source on heifer reproductive performance. J. Anim. Sci National Meeting

### *Popular Press Articles*

1. Mercadante, V.R.G., T.B. Wilson, S. Greiner. 2020. May Virginia Beef Herd Advisor. VA Cattlemen Association Newsletter.
2. Mercadante, V.R.G., T.B. Wilson, S. Greiner. 2020. April Virginia Beef Herd Advisor. VA Cattlemen Association Newsletter.

3. Mercadante, V.R.G., T.B. Wilson, S. Greiner. 2020. March Virginia Beef Herd Advisor. VA Cattlemen Association Newsletter.
4. Mercadante, V.R.G., T.B. Wilson, S. Greiner. 2020. February Virginia Beef Herd Advisor. VA Cattlemen Association Newsletter.
5. Stevenson, J. S. 2020. Those darn pregnancy losses. *Hoard's Dairyman* 165:301.
6. Stevenson, J. S. 2020. Genomics: better pregnancy rates with more milk. *Hoard's Dairyman* 165:226.
7. Stevenson, J. S. 2020. Health rules when establishing pregnancies. *Hoard's Dairyman* 165:166.
8. Stevenson, J. S. 2020. Can post-A.I. treatments improve fertility? *Hoard's Dairyman* 165:95.
9. Stevenson, J. S. 2020. Research validated repro programs. *Hoard's Dairyman* 165:13.
10. Stevenson, J. S. 2019. Insemination risk varies throughout the year. *Hoard's Dairyman* 164:672.
11. Stevenson, J. S. 2019. The "whodunit" biology of heat. *Hoard's Dairyman* 164:594.
12. Stevenson, J. S. 2019. We have so much to learn about reproductive failures. *Hoard's Dairyman* 164:532.
13. Stevenson, J. S. 2019. Sexed semen has changed breeding strategies. *Hoard's Dairyman* 164:427.
14. Stevenson, J. S. 2019. Cows without a corpus luteum can still be fertile. *Hoard's Dairyman* 164:359.
15. Stevenson, J. S. 2019. Quicker AI breeding is possible. *Hoard's Dairyman* 164:277. 5
16. Stevenson, J. S. 2019. The right ovary is dominant. *Hoard's Dairyman* 164:232.
17. Mercadante, V.R.G., T.B. Wilson, S. Greiner. 2020. January Virginia Beef Herd Advisor. VA Cattlemen Association Newsletter.
18. Mercadante, V.R.G., T.B. Wilson, S. Greiner. 2019. December Virginia Beef Herd Advisor. VA Cattlemen Association Newsletter.
19. Mercadante, V.R.G. Graduate student provides inmates with technical training for agricultural work. *Virginia Tech News*. February 15th, 2019.
20. Mercadante, V.R.G. Heifer development seminar opens doors to understanding. *The Delmarva Farmer*. November 27th, 2019
21. Mercadante, V.R.G., T.B. Wilson, S. Greiner. 2019. November Virginia Beef Herd Advisor. VA Cattlemen Association Newsletter.
22. Mercadante, V.R.G., T.B. Wilson, S. Greiner. 2019. October Virginia Beef Herd Advisor. VA Cattlemen Association Newsletter.
23. Mercadante, V.R.G., T.B. Wilson, S. Greiner. 2019. September Virginia Beef Herd Advisor. VA Cattlemen Association Newsletter.
24. Mercadante, V.R.G., N.W. Dias, C.L. Timlin, S. Pancini, A.F.F. Sales. 2019. Characteristics of Successful Reproductive Management Programs. *Proceedings of the Applied Reproductive Strategies in Beef Cattle*.
25. Mercadante, V.R.G., T.B. Wilson, S. Greiner. 2019. August Virginia Beef Herd Advisor. VA Cattlemen Association Newsletter.



1. Pursley, J. R. and J. Cibelli. 2020. Reproductive Techniques in Cattle. Chapter 1 of Reproductive Technologies in Animals. Elsevier. Editor: Giorgio A. Presicce DVM PhD
2. Pursley, J. R. 2020. Fertility programs for 1st and subsequent AI. Chapter for Hoard's Dairyman magazine's Fertility of Dairy Cattle book. Editor: Dr. Jeff Stevenson.
3. Mercadante, V.R.G., G.C. Lamb, N. Oosthuizen, and P. L. P. Fontes. 2020. Selection and management of the embryo transfer recipient herd for embryo transfer. In: Richard M. Hopper, editor, Bovine reproduction. Willey Blacwell, Oxford, UK. (In press).
4. Fontes, P. L. P., N. Oosthuizen, G. C. Lamb. 2019. Reproductive management of beef cattle. In: Animal Agriculture: Sustainability, Challenges and Innovations. Elsevier Inc. Philadelphia, PA.
5. Cushman RA. Preview: Changing views on the role of the uterus in post-partum reproductive function in beef cows. J Anim Sci 2019; 97:4021-4022.
6. Cushman RA, Perry GA. Developmental programming of fertility in livestock. Vet Clin North Am Food Anim Pract 2019; 35:321-330.
7. Fricke, P. M. 2020. Chapter 15: Methods for pregnancy diagnosis. In: Dairy Cattle Fertility, W. D. Hoard and Sons Company, Fort Atkinson, WI, pp. 87-93.

*Extension fact sheets*

Fricke, P. M. and J. R. Pursley. 2019. Body condition score changes affect pregnancy rates. Dairy Herd Management.

Authorization: