

Multistate Research Activity Accomplishments Report

Project Number: NC-1201

Project Title: Methods to Increase Reproductive Efficiency in Cattle

Period Covered: March 15, 2018 to March 14, 2019

Date of This Report: April 15, 2019

Annual Meeting Dates: March 13 – 14, 2019

Meeting Participants: Bob Cushman (USMARC), Paul Fricke (WI), Rick Funston (NE), Dave Patterson (MO), George Perry (SD), Richard Pursley (MI), George Smith (Administrative Advisor), Adam Summers (NM), Adele Turzillo (NIFA)

Brief summary of minutes of annual meeting:

The meeting was called to order by Richard Pursley. Jack Britt and Milo Wiltbank, former members of this project, were introduced. Dr. Britt was a founding member and spent time talking about how the project was formed and how it developed during the first few years. Members David Patterson, Richard Pursley, George Perry, Robert Cushman, Adam Summers, Paul Fricke, Rick Funston, and George Smith (administrative advisor) were in attendance. Jordan Thomas from the University of Missouri and three graduate students (two from Michigan State University and one from the University of Missouri) were present. Adam Summers was elected secretary. The group had a discussion on timing and venue for next year's meeting. We discussed the possibility of changing the venue since we had met in conjunction with the Midwest ASAS/ADSA meetings for two years. The group felt the Midwest Meetings did not have a sufficient turnout of scientists from a cattle reproduction standpoint and felt there were better opportunities elsewhere. The group discussed the possibility of having the meeting in conjunction with another meeting. Dave Patterson moved to have the meeting in conjunction with the American Society of Animal Science meeting in July of 2020. Robert Cushman seconded the motion. The motion passed. Each participant discussed data from their station report. Adele Turzillo joined us via internet and gave an update on the current status of USDA AFRI funding opportunities and the upcoming budget. George Smith gave an administrative update and offered some suggestions on modifications and requirements for the meeting reports. Dr. Wiltbank gave an update on their current work on follicle deviation and multiple ovulations. The meeting concluded with discussions of collaborative extension projects (ARSBC and DCRC) and the potential for collaborative research projects with sexed semen in both beef and dairy heifers. Next year's officers at the annual meeting of the NC-1201 multistate research project that will be held in Madison, Wisconsin on July 23 and 24, 2020, will be George Perry (Chairperson) and Adam Summers (Secretary).

Accomplishments (research; objectives 1 and 2):

Short Term Outcomes of Research from NC-1201 participants:

Dairy cattle

- Continued development of fertility programs for dairy cows increased pregnancies per AI and on-farm profit through decreased involuntary culling, increased herd level milk production, and increased calves born annually.
- Controlling calving interval with fertility programs reduced the percentage of cows with unhealthy body condition at time of parturition. Thus, fewer cows have metabolic and uterine problems following calving.
- Fertility programs decreased double ovulation rate, pregnancy loss, and subsequent twinning in lactating dairy cows.
- Decreasing pregnancy loss reduces variation in herd calving interval.
- Decreased twinning resulted in increased milk production per cow and decreased involuntary culling and death.

Beef cattle

- Moderate maternal nutrient restriction during the first 50 d of gestation in beef heifers alters transcript abundance of genes impacting production efficiencies in fetal liver, muscle, and cerebrum.
- Treatment of nulliparous dairy heifers with 2,000 IU hCG on d 7 of the estrous cycle increased P4 concentrations but did not affect P/AI or P/ET 32 d after estrus or ovulation but decreased pregnancy loss only for heifers receiving IVF embryos.
- The ability to induce ovulation is critical for fixed-time AI, but animals that do not exhibit estrus prior to fixed time AI had decreased AI conception rates, decreased breeding season pregnancy success, and conceived later in the breeding season.
- BVDV exposure in well vaccinated herds still had a negative effect on both first service AI conception rate and overall breeding season pregnancy success.

Outputs: This group combined for 141 publications including 49 journal articles. 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 and presentations in this report.

Impacts:

Key grants funded during the reporting period:

Wiltbank, M. C. and P. M. Fricke. 06-01-2019 - 05-31 2021. Pivotal periods of pregnancy loss and maintenance after embryo transfer. USDA AFRI Foundational program. \$499,981.

Perry et al., USDA AFRI 2018 \$150,000 Role of GnRH-I/-II in regulation of bovine follicular steroidogenesis. Iowa Beef Industry council

Perry et al., 2018 \$17,000 Ability of fixed-time resynchronization in beef cattle to decrease costs and increase production efficiency.

Perry et al., USDA AFRI. 2019 \$500,000. Characterization of estrogen responsive genes in the endometrium that contribute to pregnancy success in beef cattle.

Pursley, J. R. 2018. Enhancing maternal recognition of pregnancy in lactating dairy cows to enhance profit on dairy farms. Michigan Alliance for Animal Agriculture. February 1, 2019 to January, 31, 2021; \$150,000.

Pursley, J. R. 2018. Use of color doppler ultrasound for reproductive research. AgBioResearch, MSU. \$50,000.

Accomplishments (long term industry impacts and communication of results; Objective 3)

Activities: This group combined for more than 140 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

Barletta, R. V., P. D. Carvalho, V. G. Santos, L. F. Mello, C. E. Consentini, A. S. Netto, and **P. M. Fricke**. 2018. Effect of dose and timing of prostaglandin F2 α treatments during a Resynch protocol on luteal regression and fertility in lactating Holstein cows. *J. Dairy Sci.* 101:1730-1736.

Beard, J.K., J.A. Musgrave, **R.N. Funston**, and J.T. Mulliniks. 2018. The effect of cow udder score on subsequent calf performance in the Nebraska Sandhills. *Trans. Anim. Sci.* doi.org/10.1093/tas/txy025

Bedford, A., L. Beckett, K.N. Hardin, N.W. Dias, T. Davis, **V.R.G. Mercadante**, A.D. Ealy, and R.R. White. 2018. Propionate Affects Insulin Signaling and Progesterone Profiles in Dairy Heifers. *Scientific Reports.* 10.1038/ s41598-018-35977-1.

Block, J.J., A.D. Blair, **R.N. Funston**, K.R. Underwood, M.G. Gonda, A.A. Harty, R.R. Salverson, and K. C. Olson. 2018. Influence of maternal protein restriction in primiparous heifers during mid-and/or late gestation on dam and suckling calf performance through weaning. *J. Anim. Sci.*

Borchardt, S., A. Pohl, P. D. Carvalho, **P. M. Fricke**, and W. Heuwieser. 2018. Short communication: Effect of adding a second prostaglandin F2 α injection during the Ovsynch protocol on luteal regression and fertility in lactating dairy cows: A metaanalysis. *J. Dairy Sci.* 101:8566–8571.

Brandão, A.P., R.F. Cooke, K.M. Schubach, R.S. Marques, D.W. Bohnert, R.S. Carvalho, N.W. Dias, C.L. Timlin, S. Clark-Deener, J.F. Currin, D.B. Jump, K.G. Pohler, R.L.A. Cerri, and **V.R.G. Mercadante**. 2018. Supplementing Ca salts of soybean oil after artificial insemination increases pregnancy success in *Bos taurus* beef cows. *J. Anim. Sci.* sky156:10.1093

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Cantrell, B., H. Lachance, B. Murdoch, **R. Funston**, R. Weaver, and S. McKay, 2018. First report of global DNA methylation in the limbic system of cattle with extreme measures of docility. *BMC Genomics.*

Carvalho, P. D., V. G. Santos, J. O. Giordano, M. C. Wiltbank, and **P. M. Fricke**. 2018. Development of fertility programs to achieve high 21-day pregnancy rates in high producing dairy cows. *Theriogenology* 114:165-172.

Caton, J.S., M.S. Crouse, L.P. Reynolds, T.L. Neville, **C.R. Dahlen**, A.K. Ward, and K.C. Swanson. 2018. Maternal nutrition and programming of offspring energy requirement. *Translational Animal Science*. Accepted (TAS-2018-0235) <https://doi.org/10.1093/tas/txy127>

Conley, A.J., E.L. Legacki, C. Corbin, S. Stanley, **C.R. Dahlen**, and L.P. Reynolds. 2018. Serum and tissue pregnanes and pregnenes after dexamethasone treatment of cows in late gestation. *Reproduction*; Accepted REP-18-0558

Cordoba, M. C., P. L. Ruegg, R. D. Shaver, K. A. Weigel, P. D. Carvalho, V. E. Cabrera, and **P. M. Fricke**. 2018. Repro Money: A farmer-directed, team-based extension program to improve reproductive performance of dairy herds in Wisconsin. *J. Ext.* 56(2):2RIB4.

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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. 2018. Moderate nutrient restriction of beef heifers alters expression of genes associated with tissue metabolism, accretion, and function in fetal liver, muscle, and cerebrum by d 50 of gestation. *Trans. Anim. Sci*; Accepted.

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. 2019. 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.

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Harty, A. J., Kincheloe, **R. Funston**, R. Salverson, M. Webb, K. Underwood, J. Legako, K. Olson. 2018. Influence of maternal protein restriction in primiparous heifers during mid- and/or late-gestation on meat quality and fatty acid profile of progeny. *Meat. Sci*.

Locke, JWC, JM Thomas, ER Knickmeyer, MR Ellersieck, JV Yelich, SE Poock, MF Smith, and **DJ Patterson**. 2019. 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. *Theriogenology*. In review.

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