**ANNUAL REPORT OF COOPERATIVE REGIONAL RESEARCH PROJECT NE-2227**

**University of XXXXXXXX**

**Department of XXXXXXXX**

**2022 Annual Report**

**Project:** NE-2227, Contribution of Ovarian Function, Uterine Receptivity, and Embryo Quality to Pregnancy Success in Ruminants

## Participants (FTE)

PI – XXXXXXXX (0.X) University of XXXXXXXX; Graduate students at University of XXXXXXXX: XXXXXX; Undergraduate students at the University of XXXXXX: XXXXXXXXX

## Target Audience

*Target Audiences: (e.g.,* Scientists working in similar areas of reproductive physiology and management. Local and regional stakeholders (veterinarians, producers, and relevant industry companies) working in both beef and dairy cattle. Undergraduate and graduate students in animal science and veterinary medicine.)

*Efforts:* (e.g., Manuscripts in peer-reviewed scientific journals, abstracts and posters at scientific conferences, presentations at scientific conferences, industry, and commodity group meetings. Undergraduate and graduate formal classroom and laboratory instruction. Direct interaction with producers, veterinarians, and other relevant stakeholders locally, nationally, and internationally.)

## Products:

*Peer-reviewed Manuscripts (2022)*

1. Menichetti B.T., **Garcia-Guerra A**, Lakritz J., Weiss, W. P. Velez J. S., Bothe H., Merchan D., Schuenemann G. M. 2021. Effect of timing of prepartum vaccination relative to pen change with an acidogenic diet on lying time and metabolic profile in Holstein dairy cows. Journal of Dairy Science, 104 (10): 11059-11071.

*Abstracts (2022)*

1. B. J. Duran, F. L. V. Pinaffi, J. C. L. Motta, C. Hayden, A. E. Crist, C. Rykaczewski, S. Wellert, E. Rojas-Canadas, M. L. Mussard, **A. García-Guerra**. 2021. “Corpus luteum regression after induced pregnancy loss in cattle is preceded by a reduction in uterine artery vascular perfusion”. Abstract P136. Proceedings of the 54th Annual Meeting of the Society for the Study of Reproduction 2021, December 13-18, St Louis, MO.

*Conference Proceedings (2022)*

None

*Thesis and Dissertations (2022)*

None

## Accomplishments

Examples below. Please include Objective under which research fits. These are the latest objectives:

**Objective 1: Identify Mechanisms that Regulate Ovarian Function and Oocyte Quality during the Estrous Cycle**

**Objective 2: Determine Factors Associated with Fertilization, Embryo Development, and Conceptus-Endometrial Interactions that Dictate Pregnancy Success**

Example below:

*A. Induced pregnancy loss by conceptus demise after classical maternal recognition of pregnancy and fate of the corpus luteum*

* Pregnancy Establishment in Ruminants. Induction of pregnancy loss on day 35 of gestation in cattle results in luteolysis by gestation day ~45. Results from previous research indicate that uterine blood flow increases during the second month of gestation. Furthermore, it has been hypothesized that the increase in utero-ovarian blood flow during the second month of gestation causes reduced utero-ovarian transport of uterine secreted PGF2α and thus preventing luteolysis. Therefore, the aim of this study was to test the hypothesis that luteolysis after pregnancy loss is temporally associated with a decrease in ipsilateral uterine artery vascular perfusion. Results obtained from this study indicate a tendency for an effect of time on uterine artery vascular perfusion index in cows undergoing pregnancy loss, characterized by a 24% reduction in vascular perfusion beginning 4 days before luteolysis. These results provide support for the hypothesis of a physiological mechanism, involving increased uterine blood flow, responsible for maintenance of the CL during the second month of pregnancy in cattle.

**Objective 3: Develop and Evaluate Novel Reproductive Management Strategies and Technologies to Improve Reproductive Performance of Ruminants**

*B. Optimization of ovulation synchronization protocols to maximize fertility and reproductive efficiency.*

* The 5-day CO-Synch is an extensively used TAI protocol; however, it requires multiple administrations of prostaglandin F2α (PGF). We conducted a study to evaluate the effect of increasing progesterone (P4) device insertion from 5 to 6 days during a TAI protocol on ovarian dynamics and fertility in beef cows. Cows in the 6-day group had a larger maximum preovulatory follicle diameter and a greater CL volume seven days after ovulation than cows in the 5-day group. Furthermore, cows assigned to the 6-day group had greater estrus expression and pregnancy rate than cows in the 5-day group. Similarly, we performed a study to evaluate the effect of length of P4 treatment (5 vs 6 days) on ovarian dynamics, behavioral estrus, and fertility to embryo transfer (ET) in Holstein heifers. Neither preovulatory follicle size nor corpora lutea volume were different between treatments. Furthermore, utilization rate and pregnancies per ET (P/ET) at D32 were not affected by treatment. However, P/ET at D60 tended to be greater for the 6-day group and pregnancy loss tended to be less for the 6-day group compared to the 5-day group. Thus, increasing the length of P4 treatment during a prolonged proestrus CO-Synch by one day improved fertility to ET by reducing pregnancy loss. Presynchronization treatments administered before initiation of a CO-Synch type regimen are designed to improve ovulatory response and synchronization of follicular development in beef cows. The objective of this study was to determine the effect of various presynchronization strategies before initiation of a 6-day CO-Synch, on estrous expression and fertility to timed artificial insemination (TAI) in suckled beef cows. Preliminary results of this study indicate that pregnancies per AI (P/AI) on day 35 after TAI were greater for cows presynchronized with a progesterone device and prostaglandin compared to cows presynchronized with prostaglandin alone or cows that did not undergo presynchronization.

**Opportunities for training and professional development:**

Examples below:

* Undergraduate students worked with PI and graduate students to develop and complete formal research agreements for Undergraduate Summer Research experience and Honors thesis projects.
* Postdoctoral fellows, graduate and undergraduate students received training in the design, implementation, and analysis of reproductive biology research.
* Postdoctoral fellows, graduate and undergraduate students gave formal and informal presentations about their research and contributed as teaching assistants in undergraduate courses.
* Postdoctoral fellows led research teams and they developed independent research ideas.
* Graduate and undergraduate students attended scientific meetings in 2021 (Society for Study of Reproduction, American Society of Animal Science and International Embryo Transfer Society).

**How results have been disseminated to target audience:**

Examples below:

* Manuscripts were published in peer-reviewed journals
* Abstracts and oral presentations at national and international scientific meeting such as Society for the Study of Reproduction (SSR), American Society of Animal Science (ASAS), International Embryo Technology Society (IETS).
* Presentations were delivered by PI to stakeholder groups (producers and veterinarians) at stakeholder-organized conferences.

**Plans for Next Reporting Period:**

Examples below:

**Objective 1:**

* Studies are underway to evaluate the utilization of AMH to customize superstimulation treatments for the purpose of in vivo and in vitro embryo production in cattle and sheep.

**Objective 2:**

* Studies to evaluate the effect of inhibition of PGF2α secretion on corpus luteum life span after induced pregnancy loss during the second month of gestation are being pursued.

**Objective 3:**

* Studies to evaluate the use of simplified pre-synchronization prior to initiation of the 5-day CO-Synch in beef cattle to maximize ovulation to the initial GnRH are underway.
* Completion of study to evaluate the association between anogenital distance, AMH, the age at onset of puberty and heifer fertility are currently underway.

**Major Changes:** Not applicable

**Support:**

Examples below:

* USDA NIFA/AFRI grant 2021-67015-33838
* Hatch Regional/Multistate Funds, The Ohio State University
* OARDC SEEDS Early career investigator – The Ohio State University

**Impact Statement:**

Example below:

Pregnancy loss during the second month of gestation vary between 5% to 50% depending on the type of breeding strategy utilized among other factors. Pregnancy loss can result in significant economic losses and the economic impacts of pregnancy losses increase as stage of gestation advances due to the failure to produce the product of economic value. Insight gained from our research provides important information to advance the understanding of the mechanisms that govern the maintenance of pregnancy, ultimately allowing for the development of strategies to reduce pregnancy loss and, thus, increase reproductive efficiency.

The success of reproductive technologies in ruminants such as fixed time AI and ET rely on the ability to adequately control the estrous cycle. The research from the Ohio State NE-1727 has focused in the development and testing of strategies to improve synchronization, earlier identification of non-pregnant animals and identification of phenotypes associated with superior fertility after both AI and ET.