Multistate Research Regional Project NC-1201
Annual Meeting Minutes
September 9-10, 2015
Columbia, MO – Animal Sciences Center
Period of Report: October 2014 through September 2015

Present at Annual Meeting
Abel, Jillian – University of Missouri
Carvalho, Paulo – University of Wisconsin
Cooke, Reinaldo – Oregon State University
Cushman, Robert – US-MARC
Fricke, Paul – University of Wisconsin
Garverick, Allen – University of Missouri
Hamernik, Deb – University of Nebraska (Administrative Adviser)
Hill, Scott – Kansas State University
Lamb, Cliff – University of Florida
Larson, Jamie – Mississippi State University
Murphy, Cliff – University of Missouri
Muth-Spurlock, Ashleigh – Mississippi State University
Patterson, David – University of Missouri
Rhoads, Michelle – Virginia Tech
Soares, Emerson – US- MARC
Steckler, Teresa, University of Illinois
Stevenson, Jeffrey – Kansas State University
Thomas, Jordan – University of Missouri
Turzillo, Adelle – USDA-NIFA (by telephone)

Absent at Annual Meeting
Dahlen, Carl – North Dakota State University
Funston, Rick – University of Nebraska
Perry, George – South Dakota State University

Meeting called to order at 7:50 a.m. on September 9th by Dr. Teresa Steckler, Chair

Introductions of attendees

Welcome by Dr. Tom McFadden, Chair, Division of Animal Sciences

Announcements
2015 JAM Physiology and Endocrinology program. Two symposia are being planned: (1) Epigenetics of Growth organized by Kim Vonnahme, NDSU and (2) History and Contributions of the Dairy Cattle Reproduction Council (DCRC) and Applied Reproductive Strategies in Beef Cattle (ARSBC) organized by Cliff Lamb

Station reports
Florida by Dr. Cliff Lamb
US-MARC by Dr. Robert Cushman and Emerson Soares
Wisconsin by Paulo Carvahlo and Dr. Paul Fricke
Mississippi by Ashleigh Muth-Spurlock and Dr. Jamie Larson
Missouri by Jordan Thomas and Dr. David Patterson

Adjourned for catered lunch at 12:25 p.m.

Meeting resumed at 1:00 p.m.

Reports by NIFA (Adelle Turzillo) and Administrative Adviser (Deb Hamernik)

Station Reports resumed
Kansas by Dr. Jeffrey Stevenson
Illinois by Dr. Teresa Steckler
Virginia by Dr. Michelle Rhoads

Adjourned to attend overview presentations by selected faculty from the University of Missouri (Drs. Randy Prather, Michael Smith, Tom Spencer, Jeremy Taylor, and Jared Decker)

Meeting adjourned for the day at 5:20 p.m.

Meeting called to order at 8:00 a.m. on September 10th by Dr. Teresa Steckler, Chair

Station Reports
Virginia by Dr. Michelle Rhoads (continued from the previous day)
Oregon by Dr. Reinaldo Cooke

Business Meeting

Reinaldo Cooke will serve as Secretary for the 2016 annual meeting
Jeffrey Stevenson will serve as Chair for the 2016 annual meeting

Two alternative locations and dates were discussed for the 2016 annual meeting:

1. Week of August 22, 2016 either preceding or following the ARSBC meeting in Des Moines, IA (Host: George Perry)
2. September 7-8 in Bloomington, IL at the Farm Bureau complex (Host: Teresa Steckler)

Dr. Patterson will follow-up on the dates for the ARSBC meeting and inform Dr. Stevenson.
Dr. Stevenson will communicate with the committee and set the date and location by vote.

Responsible parties for writing the new project:
Dr. Cushman will take lead for the Epigenetics-Fetal Programing section
Dr. Fricke will take lead for the dairy section
Drs. Lamb, Patterson, and Steckler will take lead for the beef section
Each station representative was tasked to ponder various ideas and provide a paragraph summary of potential station contributions to the new project.

Rewrite Schedule per Dr. Hamernik:

September 15, 2016	Intent to renew submitted to NIMS
	Statement of Issues (Justification and Rationale)
October 15, 2016	Objectives
November 15, 2016	Appendix E filed for all station representatives
December 15, 2016	Project write-up is due

Meeting adjourned at 11:55 a.m.

Accomplishments

Objective 1. To determine mechanisms that regulate reproductive processes impacting production efficiency in cattle.

Role of molecular pathways in regulating reproductive function (MN, SD, USDA-MARC)
Impact of maternal environment on progeny (FL, MN, MS, ND, NE, ND, MN, USDA-MARC, FL)
To examine the use of new technologies to assist with enhancing reproductive performance (KY, WI)

North Dakota

Nutrient transporters in bovine utero-placental tissues on days 16 to 50 of gestation were studied. The hypothesis was that transporters for glucose and amino acids in utero-placental tissues would be differentially expressed across days of early pregnancy. To test this hypothesis, crossbred Angus heifers (n = 46), were synchronized, bred via AI and then ovariohysterectomized on d 16, 22, 28, 34, 40, or 50 of gestation (n = 5 to 9/d), or were not bred and ovariohysterectomized on d 16 of the synchronized estrous cycle (n = 7) to serve as nonpregnant (NP) controls. These results support our hypothesis that there is an effect of day on the expression of glucose and amino acid transporter mRNAs in utero-placental tissues of heifers during early pregnancy.

South Dakota

Estradiol has been reported to play a critical role in pregnancy establishment and embryonic survival. Our objective was to focus on the role of preovulatory estradiol in embryo survival from fertilization to maternal recognition of pregnancy. Estrus was synchronized in beef cows (n = 29) with the CO-Synch protocol and inseminated (d 0). In summary, there were no differences between cows that did or did not express estrus in ISG expression, or in protein or glucose concentration of uterine flushes. Therefore, the increased embryo survival to d 30 of gestation among cows that express estrus is not associated with embryo survival until maternal recognition.

Among cattle the LH surge that causes ovulation occurs shortly after the onset of a spontaneous estrus. In addition an injection of 100 μg of GnRH can induce an LH surge capable of inducing ovulation. We hypothesized that different preovulatory estradiol profiles would result in different ovulatory LH surges, and that an injection of GnRH (100 μg) would induce a secondary LH surge among cows that exhibited standing estrus prior to the GnRH injection. In order to establish the importance of estradiol on initiating an LH surge, ovariectomized multiparous cows (n=26) received estradiol cypionate (ECP), estradiol benzoate (EB) or no treatment (CON) to mimic a preovulatory period. There was an effect of treatment, time, and a treatment by time interaction ($P < 0.01$) on circulating concentrations of LH, with ECP treated cows having increased concentrations of LH at hour -16, -12, -8, and -4 compared to EB and CON. However, EB had greater concentrations of LH than ECP at 30, 60, 90, 120, and 150 min after GnRH and CON having greater concentrations of LH at 30 and 60 min after GnRH compared to ECP. In summary, exogenous estradiol influenced timing and peak concentrations of an LH surge.

US-MARC-Nebraska
Presentation concerning the marker assisted population–markers for growth and carcass traits, including the MSTN (myostatin allele). Presentation of information concerning their stair-step nutrition approach to study puberty and ovarian reserves (increase in primordial follicles, but no changes in primary or secondary follicles). During refeeding period, an increase in gene expression occurred suggesting a genomically directed change in ovarian function by feeding. Studies concerning the effects of body condition score and oocyte quality are underway in beef heifers.

Aspiration of bovine follicles 12–36 hours after induced corpus luteum lysis serendipitously identified two populations of cows, one with High androstenedione (A4; > 40 ng/ml; mean = 102) and another with Low A4 (<20 ng/ml; mean = 9) in follicular fluid. We hypothesized that the steroid excess in follicular fluid of dominant follicles in High A4 cows would result in reduced fertility through altered follicle development and oocyte maternal RNA abundance. These data suggest that the dominant follicle environment of High A4 cows including reduced estrogen conversion and androgen excess contributes to infertility in part through altered follicular and oocyte development.

Mississippi
Research is underway to examine factors associated with each dominant follicle of the estrous cycle in the cow and how these factors influence oocyte fertility. Dominant follicles ipsilateral to the CL grow slower than those contralateral to the CL. Studies examining ovarian function in cows fed endophyte-infected seed (fescue toxicosis) and control MaxQ nontoxic fescue seed. Blood perfusion in the ovary measured by doppler is not affected by fescue treatments.

Kansas
An experiment was conducted with the objective to determine the effects of estradiol, progesterone, presence of a corpus luteum (CL), and (or) size of a dominant follicle on the characteristics and patterns of GnRH-induced LH release and subsequent ovulation during a timed artificial insemination (TAI) program. In 70 lactating dairy cows, a total of 163 blood collection periods resulting in a GnRH-induced LH release was analyzed. Measures of LH included: time to LH peak concentration during the 6-h blood collection period, the two largest concentrations of LH, mean, and variance of the 6 LH concentrations, baseline LH mean and variance, and area under each LH curve. Individual and combination effects of CL presence and a dominant follicle less than or >13.5 mm, in addition to individual and combination effects of progesterone: low (<0.45 ng/mL; n = 83), medium (0.53 to 2.41 ng/mL; n =25), and high (2.66 to 10.7 ng/mL; n =55), and estradiol: low (<4.0 pg/mL; n = 89) and high (>4.0 pg/mL; n = 74) were independent variables in models to determine their influence on characteristics of LH and ovulation. Measures of GnRH-induced LH concentration were inhibited at greater concentrations of progesterone and in the presence of a CL. In contrast, GnRH-induced LH concentrations were increased when estradiol was >4.0 pg/mL, but relatively unaffected by the size of dominant follicle. Furthermore, resulting incidences of ovulation were decreased at greater progesterone concentrations and presence of a CL, and increased at greater estradiol concentrations and presence of a follicle >13.5 mm. Peak GnRH-induced LH concentration was greater in cows with

progesterone <0.45 ng/mL and ovulation incidence was increased from 70.4 to 85.1%. In cows with or without a CL, the presence of a follicle >13.5 mm did not increase mean LH concentration or incidence of ovulation. We conclude that presence of a CL and elevated progesterone concentration at the time of GnRH treatment of cows in TAI programs is inhibitory to subsequent LH responses and ovulation, but in the face of larger concentrations of estradiol and increased LH concentrations, more cows ovulated, and likely influences subsequent TAI pregnancy outcomes.

Virginia

Heat stress at the time of conception affects the subsequent milk production of primiparous Holstein cows; however, it is unknown whether these effects are maintained across multiple lactations. Therefore, the objective of the current study was to examine the relationship between periconceptional heat stress and measurements of milk production and composition in cows retained within a herd for multiple lactations. Milk production was significantly affected by periconceptional heat stress. When a significant difference or tendency for a difference was detected between the HSC and TNC cows, the TNC produced more milk in all but one comparison. The advantage in milk production for the TNC cows over the HSC cows ranged from 82 ± 42 to 399 ± 61 kg per lactation. Alterations in fat and protein percentage were variable and most often detected in first lactations (first > second or third). Overall, the most striking result of this study is the consistency of the relationship between HSC and milk production. The nature of this relationship suggests that heat stress at or around the time of conception impairs cow milk yield throughout her lifetime.

Pre-pubertal exposure of the developing ovaries and reproductive tract (RT) to estrogen or xenoestrogens can have acute and long-term consequences that compromise the reproductive performance of cattle. This research examined effects of the selective estrogen receptor modulator tamoxifen (TAM) on gene and protein expression in pre-pubertal ovaries and RT with particular focus on signaling pathways that affect morphology. Results indicate that reproductive development in prepubertal Holstein heifer calves is TAM-sensitive, and that bovine RT and ovarian development are supported, in part, by ER-dependent mechanisms during the period studied here. Potential long-term consequences of such developmental disruption remain to be defined.

Early weaning is a management strategy that has long-term benefits for the growth and development of cattle. Most research investigating the effects of early weaning has focused on terminal growth and carcass characteristics rather than traits that are important for replacement breeding heifers. In an effort to better understand the consequences of early weaning for heifers retained in the breeding herd, the following experiment was designed to investigate the impact on reproductive performance and metabolic function. Taken together, these results demonstrate that a lesser insulin response was necessary to properly clear the glucose in the EW heifers, and are indicative of greater insulin sensitivity in the EW heifers.

Nebraska

Effect of post-weaning heifer development on pregnancy rates and subsequent feed efficiency as a pregnant first calf heifer. To determine the impact of heifer development system on pregnancy rates and feed efficiency as a pregnant first calf heifer a 3 yr study was conducted. In Yr 1, weaned heifers either grazed corn residue (CR) or were fed in a drylot (DLHI). In Yr 2 and 3 heifers either grazed CR, upland range (RANGE), or were fed diets differing in energy, high (DLHI) or low (DLLO), in a drylot setting. Percent of mature BW prior to the breeding season was similar among treatments except DLHI which was significantly greater (P = 0.04) at 66.6% compared to 60.0, 61.0, and 61.7% for RANGE, CR, and DLLO treatments, respectively. Pregnancy rates to AI were similar (P = 0.62) among treatments (58.6, 66.3, 59.9, 52.6 ± 9.7%; RANGE, CR, DLHI, DLLO). A subset of AI-pregnant heifers from each development treatment were placed in a Calan gate system; they were allowed a 20 d acclimation and training period before beginning the 90 d ad libitum hay treatment period on approximately gestational d 170. Offerings were recorded daily and orts collected weekly. Initial BW was not different (P = 0.62) among treatments (458, 468, 473, 464 ± 9 kg; RANGE, CR, DLHI, DLLO). Body weight at the end of the treatment period was also not different ([P = 0.55] 485, 497, 503, 491 ± 17 kg; RANGE, CR, DLHI, DLLO). Intake did not differ among treatments, either as DMI ([P = 0.59] 9.2, 9.4, 9.5, 9.4 ± 0.7 kg; RANGE, CR, DLHI, DLLO) or as a percentage of BW ([P = 0.98] 1.96, 1.95, 1.95, 1.96 ± 0.15%; RANGE, CR, DLHI, DLLO). There was no difference (P = 0.61) in ADG (0.28, 0.33, 0.32, 0.28 ± 0.17; RANGE, CR, DLHI, DLLO) or residual feed intake (P = 0.41) (-0.095, -0.096, 0.144, 0.113 ± 0.156; RANGE, CR, DLHI, DLLO) among treatments. Although there was no difference (P = 0.41) in the 3-mo-development cost among treatments ($166.06, 141.66, 160.63, 171.80 ± 12.52; RANGE, CR, DLHI, DLLO), there was a $30.14 numerical difference between the most expensive treatment, DLHI, and the least costly treatment, CR. Post-weaning heifer development system did not impact heifer pregnancy rate or feed conversion as pregnant first calf heifers.

Effect of MGA vs CIDR estrus synchronization on estrus response and pregnancy rates in 311 d old beef heifers. A study compared the effect of melengestrol acetate (MGA)-PG and 14-day controlled internal drug release (CIDR)-PG estrus synchronization protocols on estrus response and pregnancy rates of 311 d old Angus-based, crossbred heifers (n = 153). Fall-born heifers, at 10 mo of age, were assigned randomly to 1 of 2 estrus synchronization protocols in the spring (2 replications/treatment). Heifers in the MGA protocol received MGA for 14 d fed through the diet beginning on d 0 of the synchronization treatment period. Heifers in the CIDR treatment received the same diet as MGA heifers and were implanted with a CIDR (Eazi-breed CIDR) on d 2 of the treatment period and removed on d 16. Following estrus synchronization, heifers from both treatments were combined and received a single PG (Lutalyse) injection on d 32. All data was analyzed with the GLIMMIX procedure of SAS (SAS Inst. Inc., Cary, NC). Heifers with activated heat detection aids (Estrotect) were AI 12 h following observation. Group BW was measured at weaning (198 kg) and prior to breeding (273 kg). Pre-breeding BW was 50.1% of predicted mature BW. Heifer age at breeding was not different (P = 0.12) between MGA and CIDR treatment groups. Percentage of heifers demonstrating signs of estrus was similar (P = 0.42) between synchronization treatment groups (CIDR vs MGA, 71.5 vs 77.4 ± 1.0%). Heifers not expressing estrus were not given an opportunity to become pregnant and removed from

the herd. Pregnancy rates to AI of heifers expressing estrus (n = 115) were similar (*P* = 0.27) between CIDR and MGA synchronization treatment (46.3 vs 36.1 ± 6.8%). Bulls were placed with heifers at a 1:25 ratio 10 d following AI. Final pregnancy rate was also similar (*P* = 0.96) between CIDR and MGA treatment groups (51.0 vs 51.5 ± 7.4%). Heifer BW at pregnancy diagnosis was not different (*P* = 0.45) between CIDR and MGA treatment groups (325 vs 321 ± 3.4 kg). The numerical 10% decrease in AI pregnancy rate in MGA compared with CIDR synchronization is not significant but is of interest. Approximately half of these 311 d old heifers exposed to AI and bulls became pregnant.

Economic aspects of rebreeding non-pregnant cows. A study was conducted to evaluate the economic aspects of retaining ownership and rebreeding open spring-calving cows to be sold as pregnant fall-calving cows. Composite Red Angus × Simmental females diagnosed as non-pregnant after regular spring breeding season were utilized over a 2 yr period (Yr 1, n = 61; Yr 2, n = 72). Hay and supplement were fed from November to February. Cows diagnosed as non-pregnant after a second breeding season were sold in March. Pregnant cows grazed Sandhills meadow pastures until April, when they were sold. Cows were synchronized with a 7-d controlled internal drug release (CIDR)-PG protocol prior to a 60 d natural service breeding season beginning in November, utilizing a 1:25 bull to cow ratio. Pregnancy diagnosis was determined by ultrasound 30 d after bull removal. A partial budget analysis was performed for Yr 1 to compare the economics of selling non-pregnant cows immediately after pregnancy diagnosis or retaining ownership and rebreeding them to sell as pregnant cows in more favorable market prices. Total cost was calculated by adding the purchase price (cull cow value at first pregnancy diagnosis), feeding costs, meadow grazing and management cost, breeding cost, and 6% annual interest rate on the purchase price. The net cost of 1 pregnant cow was calculated as the difference between total cost and cull value, divided by the number of pregnant cows. The overall rebreeding pregnancy rate was 90.2% for Yr 1 and 81.9% for Yr 2, the percentage of the pregnant cows that conceived in the first 21 d of the breeding season was 89.1% for Yr 1 and 79.7% for Yr 2. The total cost/female was $1,186.38. Subtracting the cull value of the open cows sold in March, the net cost of one pregnant cow was $1,185.08. The pregnant cows were sold for $1,638.00, resulting in a $452.92 net gain/pregnant cow. While conventional wisdom has held open cows should be sold after pregnancy detection, we conclude rebreeding a non-pregnant cow to be sold at higher market prices may be an economic alternative.

Objective 2. To increase the efficiency and predictability of sustainable reproductive management programs for cattle.

Pre- and post-insemination strategies to optimize reproductive efficiency (FL, KS, KY, MN, MO, MS, ND, NE, SD, USDA-MARC, WI)
Reproductive management programs to facilitate artificial insemination in cattle (FL, KS, KY, MN, MO, MS, ND, NE, SD, USDA-MARC, WI)

North Dakota

Strategies of synchronizing estrus for natural service breeding in suckled beef cows was studied (n = 1,520) in commercial operations in Uruguay and managed in grazing pastures. Cows were stratified by body condition score (mean of 3.94), then randomly assigned to

one of four treatments in a 2×2 Latin square design with factors of PGF (yes or no) and CIDR (yes or no) to receive: (1) no treatment prior to initiation of the breeding season (**Control**, n = 389); (2) 25 mg prostaglandin $F_{2\alpha}$ (PGF) i.m. on day of bull turnout (d 0, **PGF**, n = 383); (3) a controlled internal drug releasing insert (CIDR) 7 days prior to bull turnout (d -7) with removal on d 0 (**CIDR**, n = 375); or (4) a CIDR on d -7 followed on d 0 with CIDR removal and 25 mg PGF (**CIDR-PG**, n = 373). Mature bulls that passed a breeding soundness examination were placed in pastures with cows a rate of 25 cows per bull for the duration of the breeding season. Season ending pregnancy status was determined via palpation per rectum or transrectal ultrasonography. No interaction was present ($P = 0.41$) among PGF and CIDR factors for final pregnancy rate. Final pregnancy rates were greater ($P < 0.01$), however, for cows administered PGF (76.3%) compared with those not receiving PGF (69.4%). Administration of a CIDR had no impact ($P = 0.21$) on final pregnancy rates (71.3% and 74.6% for cows receiving a CIDR and cows not receiving a CIDR, respectively). At the time of calving (September-December 2015) the date will be recorded and used to evaluate calving distribution for each treatment. In addition, weight of each resultant calf will be recorded at the time of weaning.

A Bull Test project was initiated at the request of veterinarians participating in the NDSU PregCard project. The goal of the project was to summarize incidence and reasons for failure of reproductive soundness examinations in yearling and mature bulls. Results: (1) BullTest cards were an effective way to collect data; (2) more yearling bulls failed tests because of semen morphology issues compared with mature bulls; (3) more mature bulls failed tests because of penile defects compared with yearling bulls; (4) failure rate was greater for yearling and mature bulls that were retested compared with bulls tested for the first time; (5) no statistical differences were observed in failure rates between tests that included a full BSE and tests that just evaluated semen; (6) no statistical differences were observed between herd tests and tests for bull sales; and (7) more data are needed to confirm results and to determine whether data tendencies are truly significant.

South Dakota

Cryopreservation allows for long-term storage of semen. However, cryopreservation and thawing imposes stress on spermatozoa, and prematurely initiates the process of capacitation; possibly decreasing sperm lifespan. Liquid semen is not exposed to these stressors, leading to a potential longer lifespan in the female reproductive tract and thus increasing the window for successful insemination. The objective of this study was to compare fertility of liquid and frozen semen when varying the interval from CIDR removal to insemination using the 7-day CO-Synch + CIDR protocol. In summary, there was no difference in pregnancy success between liquid and frozen semen. However, cows that exhibited estrus and inseminated at 60 h after CIDR removal had greater pregnancy success compared to cows that did not exhibit estrus.

Virginia

This experiment examined how follicular fluid affects the in vitro maturation of cumulus oocyte complexes. The magnitude of cumulus cell expansion during the maturation phase affects the ability of bovine oocytes to undergo fertilization and develop to the blastocyst stage in vitro. The objective of this study was to determine how inclusion of follicular fluid

in maturation media would affect the trajectory and final rate of cumulus cell expansion. Preliminary studies indicate that when COC are subjected to in vitro fertilization (n=37-160 per treatment per replicate, 10 replicates), inclusion of follicle fluid at a rate of 75% does not increase cleavage rates nor improve blastocyst rates. Thus, even though maturation of COC in 75% follicle fluid resulted in the greatest amount of cumulus cell expansion during in vitro maturation it did not improve the apparent developmental potential of oocytes following fertilization.

US-MARC Nebraska

The use of genetic markers to aid in selection decisions to improve carcass and growth characteristics is of great interest to the beef industry. However, it is important to examine potential antagonistic interactions with fertility in cows before widespread application of marker-assisted selection. The objective of the current experiment was to examine the influence of 2 commercially available markers currently in use for improving carcass traits, the myostatin (*MSTN*) F94L and μ-calpain (*CAPN1*) 316 and 4751 polymorphisms, on heifer development and reproductive performance. From these results, we concluded that the *MSTN* F94L and *CAPN1* polymorphisms can be used to improve carcass traits without compromising fertility in beef heifers. The influence of these markers on cow performance and herd life remains to be determined. While the delay in puberty associated with the *MSTN* F94L polymorphism did not negatively impact reproductive performance in heifers, caution should be used when combining this marker with other markers for growth or carcass traits until the potential interactions are more clearly understood

Florida

Dr. Lamb reviewed the progress made at the North Florida Research and Extension Center in Marianna in reducing the breeding season of their station cow herd by introducing AI in 2006. Duration of the breeding season was reduced in a stair-step fashion from 120 days with all natural service to 72 days. A stringent culling strategy was followed (culling all cows not conceiving in breeding season; retaining only replacement heifers that conceived during the first 25 days of the breeding season). Results included reducing the mean calving day from 79.2 to 38.7 days and increasing the value of weaned calves from $87 in 2008 to $169 in 2013 (increased weaning weights resulting from more calves born earlier in successive breeding seasons). We conclude that exposing beef females to TAI and reducing the BS length for six years altered calving distribution, increased breeding season pregnancy rates, and increased calf value.

A total of 190 multiparous suckled beef cows composed of Angus, Brangus, and Braford were enrolled in the experiment. All cows were subjected to the 7-d CO-Synch + CIDR estrus synchronization protocol. In brief, cows received a 100-μg injection of GnRH (2 mL Factrel; Zoetis Animal Health) at CIDR (1.38 g P4; Zoetis Animal Health) insertion [d -10] with a 25-mg injection of PGF (5 mL Lutalyse; Zoetis Animal Health) at CIDR removal [d -3], followed by an injection of 100-μg GnRH and TAI [d 0] at 66 h after CIDR removal. Cows were blocked by breed and stratified by DPP and BCS, and randomly assigned to receive one of the following treatments: 1) two injections of placebo (1 mL of 0.9% saline), one at TAI and a second injection 14 d after TAI (CTRL, n = 53); 2) two injections of 325 mg bST (Posilac, Elanco Animal Health, Greenville, IN, USA), one at TAI and a second injection 14 d

after TAI (2bST, n = 40); 3) one injection of 325 mg bST at TAI and a placebo injection 14 d after TAI (TAIbST, n = 48); and 4) a placebo injection at TAI and one injection of 325 mg bST 14 d later (d14bST n = 49). We conclude that administration of 325 mg bST during the time of TAI to suckled beef cows enhanced concentrations of IGF-1, but failed to improve pregnancy rates, fetal size, PSPB concentrations, and had no effect on calf birth weight.

Wisconsin
Presentation of reproductive program used at the UW Dairy to push their herd 21-day pregnancy rates to34%. All cows are inseminated at first service using Double Ovsynch. Once inseminated, a pre-GnRH injection is administered 25 days later and pregnancy diagnosis at 32 days. Open cows with a corpus luteum received $PGF_{2\alpha}$ (PG) at open check and a second dose 34 hours later. At 56 hours after the first PG injection GnRH is administered and occurs 16 hours later. Cows with no CL receive GnRH and a CIDR, PG 7 days later, GnRH in 56 hours and AI 16 hours after GnRH. Milk production (305-day) is in excess of 30,000 lbs.

Studies are underway examining the incorporation of a second PG injection in the Ovsynch program to improve the risk of luteolysis in both 5 and 7day programs. Results are suggestive that improvements in pregnancy risk may come with increased luteolysis. Discussion of efforts to increase risk of ovulation after the first GnRH injection. Increased ovulation occurs in cows with low progesterone concentrations leading to increased timed AI pregnancy risk.

Manipulating the reproductive cycle to achieve optimal progesterone during an Ovsynch protocol dramatically increases in fertility in lactating dairy cows.

Manipulating progesterone at the first GnRH treatment of an Ovsynch protocol dramatically increased ovulatory response to GnRH but had a minimal effect on fertility. Addition of a second $PGF_{2\alpha}$ treatment during an Ovsynch protocol dramatically increases fertility to timed AI, whereas reducing the duration of the protocol from 7 to 5 d does not.

Cows that lost BCS before calving lost more back fat, had fewer P/AI, and had more health events during the first 120 d of lactation.

Manipulating cows into a low progesterone environment during growth of the preovulatory follicle before TAI did not negatively affect fertility, pregnancy loss, or pregnancy-associated glycoprotein after TAI in Irish Holstein-Friesian dairy cows.

Missouri
The Missouri Show-Me Heifer program was reviewed. Since 1997, the value of replacement heifers has increased from $826 to $2944 in 2014. The program has penetrated nearly 100% of the 114 counties in Missouri and 18 other states. More than 90% of the heifers enrolled in the program are inseminated artificially. The results clearly show that heifers with reproductive tract scores (RTS) of 1 should be culled. Heifers with RTS of 3 or more have conception risks ranging from 46 to 52%. Presentation of the Missouri research involving split time AI for heifers and cows that are not in estrus at the recommended time

AI breeding time. Results validate that GnRH is not needed for either heifers or suckled cows that are inseminated at the recommended timed AI time. Studies also are underway in Montana and Missouri examining the comparison of the long 14-day CIDR vs. 7-day CO-synch + CIDR program in 2-year-old cows. In summary, continued growth in the Show-Me-Select Heifer Program highlights the importance of economic incentives to drive technology utilization and improve heifer development practices statewide.
The experiment was designed to evaluate timing of GnRH administration in beef heifers based on estrous status with split-time AI. Estrus was synchronized for 816 heifers across four locations using the 14-d CIDR-PG protocol (CIDR insert [1.38 gm progesterone] on d 0 with removal on d 14; 25 mg PGF2α (PG) 16 d after CIDR removal on d 30; and 100 μg GnRH depending on treatment). Estrous detection aids (Estrotect) were applied at PG on d 30, with estrus recorded at 66 and 90 h after PG on d 33 and 34, respectively. These data suggest however that among heifers for which AI is delayed based on failure to exhibit estrus by 66 h after PG, timing of GnRH administration (66 vs 90 h after PG) may be more flexible.

The experiment was designed to evaluate timing of GnRH administration in beef cows based on estrous status with split-time AI. Estrus was synchronized for 622 cows across six locations using the 7-d CO-Synch + CIDR protocol (100 mg GnRH + CIDR insert [1.38 gm progesterone] on d 0; 25 mg PGF2α (PG) at CIDR removal on d 7; and 100 μg GnRH depending on treatment). Estrous detection aids (Estrotect) were applied at CIDR removal and PG on d 7, with estrus recorded at 66 and 90 h after PG on d 10 and 11, respectively. These data suggest that delayed administration of GnRH to 90 h coincident with AI among cows failing to exhibit estrus by 66 h after PG results in a greater overall estrous response.

Kansas
Our objective was to determine the benefit of including GnRH and PGF2a (PG) as part of a presynchronization option before enrolling cows in a timed artificial insemination program. Holstein cows in one herd were assigned weekly at calving from January 2012 through August 2014 to a completely randomized design consisting of two presynchronization treatments (see figure on p. 4). Cows in the Presynch-11 (n = 290) control were administered two PGF2a injections (Presynch PG-1 and Presynch PG-2) 14 d apart starting at 39 ± 4 d postpartum (study Days 0 and 14). Cows receiving the experimental presynchronization treatment (Gsynch-11, n = 287) were treated with GnRH (Pre-GnRH) on study Day 7 and PG (Pre-PG) on study Day 14. On study Day 25, all cows were enrolled in the Ovsynch-56 timed AI program: GnRH-1 on study Day 25, PG on study Day 32, GnRH-2 on study Day 34, 56 h after PG, and timed artificial insemination (AI) on study Day 35, 16 h after GnRH-2. Pregnancy per AI at 32 and 60 d after AI did not differ between treatments, but were suppressed during summer months in both treatments to <70% of the P/AI of non-summer months. Because more than 90% of the cows were ovular as treatments were applied, the GnRH treatment of Gsynch-11 could not be assessed for its benefit in anovular cows. The Gsynch-11 presynchronization treatment performed comparably with the standard Presynch-11 program and may provide a viable presynchronization option for use before first AI in dairy herds.

Illinois
The experiment was conducted to determine if delaying timed AI, second GnRH injection, or both will increase pregnancy rates in nonestrous suckled beef cows exposed to the 7-d CO-synch + CIDR [GnRH (100 μg) on d -7, PGF2α (25 mg) and CIDR removal on d 0, and a second injection of GnRH 60 h after PGF2α (d 2)] timed AI program. On day 0, all cows received an ESTROTECT™ heat detector patch. Patches score was assessed 60 h after CIDR removal and cows with activated patches assigned to the Estrus control (CON; n=80) group. The remaining cows were randomly assigned into three equal-sized groups balanced for parity, days postpartum, and BCS: Early GnRH and early AI (E-E; n=21), Early GnRH but delayed AI (E-D; n=24), or Delayed GnRH and delayed AI (D-D; n=24). Pregnancy diagnosis was performed via transrectal ultrasonagraphy 35 d after fixed-time AI. Pregnancy rates in the CON, E-E, E-D, and D-D averaged 64, 52, 42, and 50%.

Impacts

- Proper ovarian steroid production is crucial for fertility in cows; however, the influence of specific steroids and the mechanisms of action remain unclear. Research performed by ARS researchers at Clay Center, NE, in collaboration with the University of Nebraska at Lincoln and the Federal University of Lavras in Lavras, Brazil indicated that improper ovarian function led to altered steroid production that was associated with altered gene abundance in the egg. This altered gene abundance in the egg can lead to decreased fertility. Attempts to shift the profile of steroid hormones produced did not improve fertility, but did provide evidence that estrogen may be the steroid hormone most likely to improve fertility in beef cows. This lack of an improvement in fertility indicates that improper steroid production may be a function of poor egg quality and not a contributor to poor egg quality, thereby explaining why shifting the steroid profile does not improve the fertility.
- Caution must be taken when using genetic markers to increase production efficiency to insure that selection for production does not cause a decline in fertility in the cow herd. A change in the sequence of the myostatin gene that is associated with greater rib eye area and decreased fat depth in steers was determined to be associated with an increased age at puberty in heifers by ARS researchers at Clay Center, NE. This gene variant did not change the percent of heifers that became pregnant and did not delay the date of calving. Results indicate that selection for this genetic marker alone may not greatly impair reproductive function in the cow herd; however, the interaction of this gene with other genetic markers for production efficiency and the influence of this gene on reproductive longevity remain to be evaluated.
- Results from current and ongoing research have been used to make recommendations to stakeholders and their consultants regarding implementation of systematic synchronization and resynchronization systems for lactating dairy cows as well as timing and methods for pregnancy diagnosis. Data generated in these projects has been published in scientific journals and included in numerous extension proceedings.
- Selecting only cows that have exhibited estrus before timed artificial insemination can improve pregnancy success.

- Split-time artificial insemination (STAI) involves a single insemination performed at one of two time points and allows beef heifers to be managed based on estrous status following the administration of an estrus synchronization protocol.
- When considering STAI in beef heifers after synchronization of estrus with the 14-day CIDR-PG protocol…
    - It is not necessary to administer GnRH to heifers that express estrus prior to 66 hours after PG
    - GnRH may be administered concurrent with AI 24 hours later for heifers that failed to express estrus prior to 66 hours after PG
- It is not necessary to administer GnRH to heifers that express estrus prior to 66 hours after PG
- GnRH may be administered concurrent with AI 24 hours later for heifers that failed to express estrus prior to 66 hours after PG
- The centralized data base developed in support of the Show-Me-Select Replacement Heifer Program facilitates tracking of reproductive data on replacement beef heifers generated from the program.
- Data generated from the program has been used successfully to compete for USDA-NIFA funded integrated project awards.
- The Show-Me-Select Replacement Heifer Program draws on the fundamentals upon which Extension and the Land Grant System were founded: the use and application of what we know to create knowledge.
- The Show-Me Select Replacement Heifer Program facilitates transfer of science-based knowledge to beef producers in Missouri enabling participants to make practical production and management decisions based on economics.
- One limitation to successful ovulation synchronization programs is the ability of GnRH to induce ovulation. Our recent study indicates that in the presence of a corpus luteum and elevated progesterone concentrations, LH is released in response to GnRH in a dose-response manner and thus limits occurrence of ovulation. Greater estradiol concentrations, however, can facilitate greater GnRH-induced LH release and increased incidence of ovulation.
- Alternative presynchronization options that include GnRH can enhance pregnancy risk when applied to dairy cows before enrolling them in a timed AI program such as Ovsynch. Previous combinations of GnRH and $PGF_{2\alpha}$ used in presynch programs have improved pregnancy risk in dairy cows beyond using standard presynch $PGF_{2\alpha}$ programs. Applying GnRH 7 days before $PGF_{2\alpha}$ and then enrolling cows 11 days later in Ovsynch, failed to improve pregnancy risk compared with two doses of $PGF_{2\alpha}$ administered 14 days apart and enrolling cows in Ovsynch 11 days later. Both presynch programs, however, produced annual pregnancy risk exceeding 35% at 32 days after AI.
- Based on the case study at the University of Florida, after six years of exposure to applied reproductive technologies calves were valued at $169 per calf more than prior to incorporating reproductive management technologies. Therefore, in FL alone, if every cow herd were to incorporate reproductive management tools such as estrus synchronization, AI, and reducing the length of the breeding season the overall impact would exceed $150 million per year.

- In previous reports the AI Cowculator was introduced. Based on economic research, the AI Cowculator is a smartphone application for Android and iPhone/iPad users that may be downloaded free of charge and is a decision aid tool to assist producers to determine whether they should consider TAI rather than purchasing herd sires for their cow herds. This application has been downloaded by 3,429 people in 42 states and six countries. In addition, the excel version of the economic model has been downloaded 242 times by industry professionals. The Facebook page developed as a support Supplement to the AI Cowculator has received 430 'likes' and reaches between 50 and 900 readers for every post.
- We demonstrated that there is an effect of day on the expression of glucose and amino acid transporter mRNAs in utero-placental tissues of heifers during early pregnancy.
- Using prostaglandin $F_{2\alpha}$ at the initiation of a natural service breeding system improved final pregnancy rates in cattle with low body condition managed on expansive pasture
- A system of monitoring and reporting results of bull breeding soundness examinations was developed and implemented successfully.
- Our novel ovariohysterectomy model allowed us to characterize expression of major glucose and amino acid transporters in uterine and conceptus tissues from d 16 to 50 of gestation.
- We continue to monitor real-time pregnancy rate and bull breeding soundness examination data in the Upper Great Plains. Our system of monitoring and reporting enabled out team and participating veterinarians to provide individual consultation to over 2,000 beef operations with data reported from over 300,000 beef females and over 12,000 breeding bulls.
- -Low input heifer development systems have resulted in a significant savings per pregnant heifer over conventional heifer development systems.
- -Synchronization systems decrease date of conception during the breeding season.

Publications

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