

Project/ Activity Title: NCERA57 – Swine Reproductive Physiology (Multistate Research Coordinating Committee and Information Exchange Group)

Date of Annual Report: 08/10/2018

Annual Meeting Dates: 05/23/18

Period the Report Covers: 10/01/2017 - 09/01/2018

Participants

Members: Clapper, Jeffery (Jeffery.clapper@sdsu.edu) – South Dakota State University; (Feugang, Jean (jn181@ads.msstate.edu) – Mississippi State; Ross, Jason (jwross@iastate.edu) – Iowa State; Stewart, Kara (krstewart@purdue.edu) – Purdue University; Safranski, Tim (SafranskiT@missouri.edu) – University of MO; Geisert, Rodney (geisertr@missouri.edu)– University of MO; White, Brett (bwhite2@unl.edu) – University of NE; Davis, Duane(davis@k-state.edu) – Kansas State; Rempel, Lea (Lea.Rempel@ars.usda.gov) – USDA, ARS, USMARC; Miles, Jeremy (Jeremy.Mile@ars.usda.gov) – USDA, ARS, USMARC.

Non-Member Representative: Mote, Benny (benny.mote@unl.edu)– University of NE, Knox, Robert (rknox@illinois.edu) – University of IL

Visitors: Steve Terlouw (Steve.terlouw@unitedanh.com) – United Animal Health

Summary of Minutes:

May 23rd, 2018:

On Wednesday, May 23rd, in Brookings, SD, the meeting was called to order by institutional host, Dr. Jeffrey Clapper.

Dr. Mark Mirando was brought in via teleconference to provide an update from the USDA-NIFA. NIFA director stepped down and is replaced (May 6th) by Dr. Thomas Shanower. He will be in this position for approx 1-2 years. NIFA annual report is available. National Program Leader has been hired and is Dr. Michelle Colby. Mark provided and reviewed the budget for NIFA. Budget shows 2017 appropriations, the President's budget and then congress approved budget. HATCH monies did not change much. Smith Lever and 1890 Institution programs also so no additional growth. Competitive programs - AFRI justifications for use of money appropriations (google NIFA explanatory notes). Three AFRI RFA's will be coming out in 2018. Highlighted the REEU program which is undergraduates in extension money. Expect posting of Animal Health and Production RFAs in May. New program - Sustainable Ag Systems - covers all types of agriculture and food systems, including animal agriculture. Letter of intent is June 27th. Likely to make 8 awards in this category this year. Animal Repro had a success rate of 28% for \$500k awards. Dual Purpose program with NIH in its final year with final deadline due Sept. 27th.

Station Reports: Each institution provided a brief presentation of current research with group discussions.

1. Rob Knox: Feeding Melatonin during proestrus and early gestation in gilts and P1 sows. Means to address seasonal infertility with melatonin during summer months June-Oct. Orally dosed at 3mg/d for 21 d starting in follicular phase in both the gilts and P1 sows. Inside and outside temperatures were recorded during the study and showed great amounts of variation, sometimes even hotter in the barn than outside temps. Lighting intensity recorded as well with great variation (some areas of barn were full curtain-sided). Gilt fertility - No impacts of melatonin. Interestrus interval longer in mid summer and decreased as fall approached. More gilts had estrus within 23 da in early fall compared to summers. Moving gilts in 1st or 3rd week of cycle shortened or lengthened their cycle. Conception and farrowing was not impacted - NS results. In P1 sows, effects of melatonin were to reduce estrus expression, which was contrary to what was expected. Season impacted return rates and fertility in P1 sows. Second study: gilts receive melatonin and how that impacts their response to PG600 and pregnancy establishment. Three lighting schedules were used for the gilts with additional supplemental heating. Pregnancy rate had a tendency to increase in melatonin treatments with limited number of animals. Overall, Rob is unsure what to say about melatonin.
2. Brett White: GnRh II expressed ubiquitously with its own receptor, highest levels in the testes. Hypothesis that GnRh II stimulates LH-independent testosterone production from leydig cells. Created a GnRh II knockdown pig model with 70% knockdown of GnRH II receptor levels. KD animals have reduced testosterone production without changes in LH concentrations. Controls have 2 pulses of T4 in a time period vs 1 in KD animals. 135-18 GNRHI antagonist and GNRHII agonist at the same time. Ex vivo testicular tissue assays show KD animals produce less testosterone. KD animals had reductions in a large portion of repro steroids. Secondary effects - tendency for reduced prostate and significant reduction in penile weight with limited number of animals at this point. Reduced sperm production (tendency), reduced motility, progressive motility and rapid cells. How does GNRHII KD work in steroidogenesis - no changes in LHR or STAR abundance or aromatase, CYP enzymes were increased in KD (body trying to produce more T4???), reduced leydig cell number, larger leydig cells.
3. Jeremy Miles: Embryo elongation regulation from molecular factors. Focuses on tubular phase. Hypothesis that alterations in molecular factors lead to delay elongation or failure of elongation. Litter homogeneity and embryo variation - 73% homogeneity in tubular likely because they are a short lived phase, therefore, set 80% as definition of uniform pregnancies. Metabolomics and RNA-seq data - from various stages of embryos - identified metabolites different between embryo stage groups where several are identified as amino acids where creatinine and serine goes up as embryos progress, uric acid and tryptophan decrease. LC identified more significantly different metabolites than MC.
4. Kara Stewart: Utilizing low dose semen. A survey of sow farms across the US conducted in 2017 showed that producers are adopting PCAI but not lowering the number of sperm cells in the insemination dose at the same rate as adoption of the PCAI technology. A study on a commercial farm in Colorado looked at lowering the dose of semen from 1.2 billion to 0.075 billion using PCAI and deep uterine AI. The study found that conception rates were not different with the lowered doses of semen, but the total and viable embryos were reduced in the lowered doses, regardless

of location of semen deposition. The study also revealed an increase in the rate of underdeveloped embryos as the doses of semen were lowered.

5. Tim Safranski: Cooling mechanisms for boars. Determined what boars are actually exposed to using loggers in boar studs. Housed boars in the Brody chambers and evaluated evaporative (fans on face and testis and drippers on face and testis in latin square design) vs conductive cooling (portion of the floor was cooled under front half of boar) on rectal, ear, testis temp and RR. Boar temp differential (testis implant vs implanted in omentum in belly reader). Abatement strategies were effective at maintaining body temperatures. Testis HS temps were higher for HS boars over abatement boars by about 1 degree. Epididymal sperm - Increased total sperm abnormalities in HS with no abatement. No effect on core body temp - therefore rectal temps in a boar stud will not show stress.
6. Jason Ross: Strategies for improving reproductive performance in gilts - tertiary follicle activity at 95d have larger vulvas and tend to achieve puberty earlier. Body weight is poorly corr with vulva width at 15 weeks of age. Scoring systems can be used to classify vulva sizes on a 3-point, 5-point or farm crew, subjective score. Scores were corr to ability to achieve first parity. After 2 parities, comparing smalls to M and L, caused reductions in TB. The gilts in the lowest category irrespective of the scoring system were the lowest producing. Maternal arginine supplementation on swine production efficiency - positive effects were weaning weight and pre-weaning ADG. Sow prolapse study - off farm data collection, historical data extracted from each participating farm, site visits. Data being collected about herd, facility, management, animals, records, sample banking. Perineal scoring - sows in category 3 are higher risk for prolapse. Maybe could be used as a scoring system for culling. On average, farms that are best and worst stay there over time.
7. Steve Terlouw: United Animal Health update on 2017 OvuGel trial. OvuGel original protocol was to administer OvuGel at 96h post weaning and breed at 120h. High producing sows have sows in heat on day 3 (typically the sows that have very high farrowing rates in the farms). Protocol began to morph into a heat detection program to identify the early and late sows. Sows that do not stand in heat have lower farrowing rates, but 35% still farrow, with reduced TB (much lower n in this treatment). CR and FR were high for sows in heat on day 5. The study had a feed outage in sows where sows went for 36h without feed on one week. Study also had rotovirus infection that skewed some data. Switched farm to estrus detection program where begin detection day 3. give proestrus and in heat sows ovugel on day 3. Same protocol for day 4. On day 5 everyone else gets bred conventionally with no ovugel (LH surge appears to have already started). Recommending the new protocol. OvuGel also appears to reduce gestation length by 1d predicted to be from breeding closer to the time of ovulation.

The business meeting reconvened following the station reports. Minutes from the previous meeting were approved by Jeff Clapper, Second by Jeremy Miles, and approved by all members. Members thanked Jeff Clapper for organizing the hosting the 2018 producer symposium on Tuesday, May 22, 2018 in Brookings South Dakota. It was acknowledged that Ryan Samuel and Lea Rempel were instrumental in planning and organizing the symposium. There were 76 attendees at the symposium.

Members decided that we need to encourage other institutions to participate therefore recruitment efforts for the NCERA57 group were discussed. Rob Knox and Benny Mote were invited to officially join

the group. Several potential recruits were mentioned and current members volunteered to initiate an invitation to the NCERA57. The following current members volunteered to contact possible recruits. Jason Ross will contact new hire at Penn State; Tim Safranski will contact Shelly Rhoads and Mark Estienne; Lea Rempel will contact Katie Summers; Brett White will contact Clay Isen; Rod Geisert will contact Dan Mathew. Duane Davis said that Kansas State is not replacing him for the time being.

A secretary for 2018 was elected and we are glad to say that Brett White, Nebraska, was nominated by Jeremy Miles, seconded by Tim Safranski, and unanimously voted into this position. Kara Stewart was promoted from current secretary into the position of NCERA57 Chair for 2019. Congratulations to the elected officials for 2019 NCERA57.

Lea Rempel mentioned that the NCERA57 program was likely up for renewal in October, 2018 and that we should be working on the document. The committee will ask John Parrish to lead the efforts to rewrite the renewal. Rod Geisert volunteered to assist in the first draft. The committee will then plan a Zoom (or similar) online meeting to discuss details in finalizing the renewal.

It was decided that the 2019 meeting would be held at Starckville, Mississippi at Mississippi State lead by Jean Fenguang on May 20-21st, 2019. Jeremy Miles motioned for approval, second from Jason Ross, and the committee unanimously voted to approve. It was also suggested that the 2020 meeting and mini-symposium take place at Purdue University with Kara Stewart.

The committee would like to send Duane Davis a card thanking him for his years of service to this committee. Brett White will get the card and send the letter on behalf of the NCERA57 group.

No other business was needed to discuss therefore the meeting was officially adjourned.

Accomplishments:

Reported peer –reviewed publications from cooperating institutions within the NCERA-57 group yielded 80 manuscripts, abstracts, proceeding and book chapters associated with swine reproduction, physiology or genetics.

Impacts:

Committee members performed research this past year that has provided insights into key aspects of swine production and reproduction, in particular. Areas of investigation encompassed applied approaches to improve reproductive efficiency as well as more basic approaches to gain a fundamental understanding of mechanisms of biological mechanisms involved in swine reproduction. Areas of research included; identification of genes involved in signal transduction pathways of porcine oocytes at fertilization, heat stress mitigation in boars, estrus synchroniazation and ovulation induction in sows and gilts, genomic and metabolomic factors affecting wean-to-estrus interval, gene editing technologies, sow supplementation in gestation and lactation, nanoseparation of sperm cells effects on live offspring, and many more.

Publications (citations in bold are from more than one station):

Boar Performance (IL, IN, MS, USMARC, MO, NC)

Knox RV, Miller DJ. 2017. Comparative mammalian male reproduction: Male ART in Animal Species. Encyclopedia of Reproduction.

Miller DJ. 2018. The epic journey of sperm through the female reproductive tract. *Animal*. doi.org/10.1017/S1751731118000526

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Stewart, K.R., Bradley, C.L., Wilcock, P., Domingues, F., Kleve-Feld, M., Hundley, J. and F.A. Cabezon. 2018. Superdosing phytase fed to mature boars improves semen concentration and reproductive efficiency. *Prof. Animal. Sci.* 34(1):95-102.

Durfey CL, Swistek SE, Liao SF, Crenshaw MA, Clemente HJ, Ryan PL, Willard ST, Feugang JM. Assessment of magnetic nanoparticle conjugates for boar semen quality enhancement. *Journal of NanoBiotechnology*, 2018 (In review)

Lewis MB, Durfey CL, Hartung SK, Steadman CS, Park SB, Clemente HJ, Willard ST, Ryan PL, Feugang JM. Investigating the Cryotolerance of Boar Spermatozoa Subjected to Prior Selection. *Reproduction, Fertility and Development* 30, no. 1: 244-244. 2018

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Sow and Gilt Performance (IL, IN, USMARC, MO, NC)

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Knox RV, Miller DJ. 2017. Comparative mammalian male reproduction: Male ART in Animal Species. *Encyclopedia of Reproduction*.

Knox RV, Webel SK, Swanson M, Johnston ME, Kraeling RR. 2017. Effects of estrus synchronization using Matrix® followed by treatment with the GnRH agonist triptorelin to control ovulation in mature gilts. *Anim Reprod Sci.* 185:66-74.

Ulguim RR, Bortolozzo FP, Wentz I, Johnston M, Webel SK, Arend L, Knox RV. 2018. Ovulation and fertility responses for sows receiving once daily boar exposure after weaning and OvuGel® followed by a single fixed time post cervical artificial insemination. *Theriogenology*. 105: 27-33.

Casey, T., Harlow, K., Ferreira, C.R., Sobreira, T.J.P., Schinckel, A.P. and K.R. Stewart. 2018. The potential of identifying replacement gilts by screening for lipid biomarkers in reproductive tract swabs taken at weaning. *Journal of Applied Animal Research*, 46(1):667-676.

Calderon-Diaz, J.A., Vallet, J.L., Boyd, R.D., Lents, C.A., Prince, T.J., DeDecker, A.E., Phillips, C.E., Foxcroft, G., Stalder, K.J. 2017. Effect of feeding three lysine to energy diets on growth, body composition and age at puberty in replacement gilts. *Animal Reproduction Science.* 184:1-10. <https://doi.org/10.1016/j.anireprosci.2017.06.007>.

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Growth, Development, Physiology (IL, MS, USMARC, MO)

Fu YR, Knox R, Li L, Ren S. 2018. Differential genes expression Eph-ephrin A1 and LEPR-LEP with high or low number of embryos in pigs during implantation. *Reprod. Dom. Anim.*

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Basic Science and Technology (IL, IN, MS, USMARC, MO, NC)

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