Project/Activity Number: NCERA-214
Project/Activity Title: Increased Efficiency of Sheep Production
Period Covered: October 1, 2014 – September 30, 2019
Date of This Report: August 21, 2019
Annual Meeting Date(s): June 2-4, 2019

Participants:
Official station representatives in attendance:

Last name	First name	Email	Institution
Burke	Joan	joan.burke@ars.usda.gov	USDA ARS, Booneville, AR
Crane	Alison	arcrane@ksu.edu	Kansas State University
Ehrhardt	Richard	ehrhard5@msu.edu	Michigan State University
Hoffman	Travis	travis.w.hoffman@ndsu.edu	North Dakota State University
Miller	Jim	jmille1@lsu.edu	Louisiana State University
Minton	Ernest	eminton@k-state.edu	Kansas State University
Murphy	Tom	tom.murphy@ars.usda.gov	USDA ARS, Clay Center, NE
Stewart	Whit	whit.stewart@uwyo.edu	University of Wyoming
Whitney	Travis	trwhitney@ag.tamu.edu	Texas A&M AgriLife
Wildeus	Stephan	swildeus@vsu.edu	Virginia State University

Other scientists in attendance:

Last name	First name	Institution
Blackburn	Harvey	USDA ARS, Fort Collins, CO
Purdy	Phil	USDA ARS, Fort Collins, CO

Graduate students in attendance:

Last name	First name	Institution
Kochendoerfer	Niko	Cornell University
Moody	Jordan	Michigan State University

Industry affiliates in attendance:

Last name	First name	Institution
Burgett	Rusty	National Sheep Improvement Program
Hendrickson	Amy	American Sheep Industry Association
Maneotis Isaacs	Karissa	American Lamb Board
Shultz	Susan	American Sheep Industry Association

Brief summary of minutes of annual meeting:
Monday June 3, 2019
The meeting was called to order by Travis Whitney at 8:45 a.m. at the National Laboratory for Genetic Resources Preservation, Fort Collins, CO.

8:50 a.m.
Ernie Minton (administrator advisor) was present on Monday morning and discussion began on the future of the group.

Ernie Minton: Reminded us that the current group (NCERA-214) will expire September 30, 2019. He doesn't think there is any other option for us than having to skip a year. This is because the process to submit a new project begins in the fall, goes under review, and is approved in March to start October 1. Thus, even if we were to get the paperwork in fall of 2019, we could not meet in summer of 2020. He is also the coordinator for a animal behavior group that has transitioned to NC and sees a lot of similarities between ours and theirs. Since members from both groups (e.g., animal behavior scientists and sheep scientists) are generally the only scientist of their "type" at their respective institutions, they benefit a lot from the nationwide network.

Travis Whitney: Pointed out that Katherine Petersson (who could not be in attendance) has done a fair amount of work to get the NC transition going.

Joan Burke: The transition ran into a road block because we hadn't identified which member would be committed to which objective(s), so much of this specific paperwork and discussion didn't get off the ground.

Jim Miller: Stressed the importance of organizing specific objectives because a parasitology group he was formerly involved with was denied continuation for not doing so.

Richard Ehrhardt: Recalled that, as a group, we didn't see any downside to the NC transition but we struggled to define objectives that were inclusive yet broad enough.

Ernie Minton: Stated that his preference is to switch to an NC group. He stressed that extension specialists, that may not have formal research appointments at their institution, are still involved and important to NC groups. Additionally, multi-state instruction can serve as a research component. He also suggested including goats in the future NC group may be an avenue to acquiring additional collaborators.

9:20 a.m.
Group introductions followed by a short break

9:35 a.m.
Began station reports

<u>Objective 1</u>
Jordan Moody (M.S. student, Michigan State University) presented "The effect of late lactation and pre breeding nutrition on reproductive outcomes in an accelerated lambing system".

Joan Burke (USDA ARS) presented "Factors that limit out of season breeding success in ewes".

Tom Murphy (USDA ARS) presented "Evaluation of Romanov ewes mated to wool and hair sire breeds: F_1 ewe performance in a fall lambing system"

Stephan Wildeus (Virginia State University) presented "Sperm motion characteristics of ram semen liquid-stored in a milk egg yolk extender at four temperatures", "Rate of egg yolk inclusion

in a milk extender on sperm kinematics of ram semen during chilled liquid storage", and "Libido, semen quality and reproductive tract characteristics in intact and altered (short scrotum and castrated) post-pubertal male dairy sheep lambs".

11:30 a.m.

Objective 2
Stephan Wildeus (Virginia State University) presented "Effect of breed, sex, birth type and lambing season on growth rate of forage-reared lambs" and "Performance of landrace hair sheep lambs in a forage-based, semi-continuous production system".

12:00 – 1:00 p.m.
Lunch

1:00 p.m.

Susan Shultz (American Sheep Industry Association): updated the group on the Let's Grow program. The program is currently done funding projects but are continuing to look for future sources. On behalf of ASI, she expressed her appreciation for the collaborative research we've accomplished across institutions and stressed the importance of continuing as a group.

Amy Hendrickson (American Sheep Industry Association): also expressed appreciation to the group on behalf of ASI. Discussed the secure sheep and wool supply plan that will ensure security of supply of sheep products in the event of a major disease outbreak. She also discussed the importance of being aware of biased, misinterpreted science used by anti-sheep advocates.

1:15 p.m.
Description of facilities and recent research conducted at the National Laboratory for Genetic Resources Preservation.

Harvey Blackburn (USDA ARS): Coordinating committees have been developed for each species and are comprised of university and ARS scientists as well as industry personnel to gain insight into future direction. Described gene bank and storing information system for preservation of small ruminant germplasm The U.S. sheep industry has a great diversity of breeds that is not common in other countries. Semen, embryos, and tissue samples have been collected from sheep and goats. Genotyping submitted specimens enables researchers to examine genetic changes over time. Genomic data is secured and available for other researchers to access it. He stressed the importance of interactions among scientists in this group and would like to expand their small ruminant germplasm storage.

Phil Purdy (USDA ARS): Described non-surgical techniques in ovine artificial insemination. If such techniques are to be utilized by the industry, the need to be simple, inexspensive, and user-friendly. They've observed differences in ewe fertility under AI due to ewe age, technique, and breed but have been successful.

Toured facilities

3:45 p.m.

Rusty Burgett (National Sheep Improvement Program): Updated the group on recent efforts within NSIP. They continue to see growth both in new enrollment and number of animals in the database. They would like to revamp the research and development side of the group, but struggle to find consistent funding. New trait development is a major area of interest going forward.

4:00 p.m.

Resumed station reports (Objective 2)

Travis Hoffman (North Dakota State University) presented "Carcass and sensory characteristic differences between ram and wether lambs of light, medium, and heavy slaughter weights".

Travis Whitney (Texas A&M AgriLife) presented "Replacing cottonseed meal and sorghum grain with corn dried distillers grains with solubles in lamb feedlot diets: growth performance, rumen fluid parameters, and blood serum chemistry".

Objective 3
Jordan Moody (M.S. student, Michigan State University) presented "Effect of late lactation nutrition on milk production and composition in prolific sheep on an accelerated lambing system".

Niko Kochendoerfer (Ph.D. candidate, Cornell University) presented "Achieving sustainable year-round sheep milk production – progress report"

Objective 4
Niko Kochendoerfer (Ph.D. candidate, Cornell University) presented work from their group in securing funding and designing contract grazing for solar farms in New York.

Tuesday June 4, 2019
9:15 a.m.
Resumed station reports at the Laramie Research and Extension Center (Laramie, WY; Objective 4).

Jim Miller (Louisiana State University) presented "Evaluation of the effect of Bedoukian compound X administered twice on gastrointestinal nematode and coccidia infection in sheep".

Richard Ehrhardt (Michigan State University) presented "Shearing during late pregnancy increases size at birth but does not alter placental endocrine responses in sheep".

Objective 5

Richard Ehrhardt (Michigan State University) described the lamb profit tool that was developed at MSU. This program is free and available for download on the MSU website. He has presented it to area producers and has seen a lot of interest in adopting it.

Alison Crane (Kansas State University) described her sheep and goat extension and research program.

10:30 a.m.

Karissa Maneotis Isaacs (American Lamb Board): Discussed potential research collaborations and funding opportunities through ALB. Competition from Australia and New Zealand imports is continuing to grow. There is an effort to make research results more accessible to producers. The Lamb Summit will be take place August 27-28 in Fort Collins.

Break for tours and lunch

1:00 p.m.
Business meeting called to order.

Travis Whitney: Resumed discussion on plans for informal 2020 meeting. The group agreed that it is important to meet in 2020 even though it won't be an official NCERA or NC group.

Rusty Burgett: Offered Spencer Iowa to be a potential group meeting for 2020 to be in conjunction with the NSIP Center of the Nation sheep sale to take place the last Saturday of July. The sale includes an educational event the Friday before and NSIP could cover some or all of travel costs if group members presented. Another option is the NSIP Eastern Sale in Wooster, Ohio but this is more difficult to travel to and generally smaller, offering less interactions with producers.

Jim Miller: Offered a meeting in Maine as well.

1:20 p.m.
Began drafting 2019 resolutions.

Travis Whitney: Motioned to pass resolutions. Approved by Jim Miller. Seconded by Richard Ehrhardt.

1:30 p.m.

The group began discussion on future collaborations and amending/creating objectives. Potential participants for each proposed objective were identified and will be finalized via email at a later date. Additional universities/institutions to include and possible goat researchers/extension personnel to recruit to future NC group were discussed.

Travis Whitney: Motioned to approve final list of participants by objective via email at a later date. Approved by Jim Miller. Seconded by Travis Hoffman.

2:00 p.m.

Whit Stewart: Discussed moving Sheep and Goat Research journal forward. He would envision the journal publishing 1 or 2 review articles per year, but also becoming an avenue for quality research that may have been done on a smaller scale (on-farm trials, surveys, etc.).

2:15 p.m.

Host of 2020 Meeting:
Travis Whitney voted to have informal meeting in Spencer Iowa July 23-25, 2020. Approved by Jim Miller. Seconded by Travis Hoffman.

Travis Whitney: Gave update on his final approval of juniper as a feed ingredient in livestock rations.

2:20 p.m.

Travis Whitney: Motioned to adjourn meeting. Approved by Jim Miller. Seconded by Richard Ehrhardt.

Accomplishments:
Michigan State University
Outreach accomplishments involved the presentation of programs with proceedings/manuals on birth management, grazing management, parasite management and health management for small ruminant production under a wide scale of farm size and operator experience. Applied research efforts included development of a calculator tool to assess the profitability of lamb production. In addition, a series of experiments were continued to examine the impact of nutrition on reproductive outcome according to season in highly productive sheep. These studies also allowed the study of changes in plane of nutrition and other management practices on fetal growth and development as well as potential impacts on postnatal growth, metabolism and reproductive function. Courses were offered as a clinical clerkship to DVM students on small ruminant production medicine and to undergraduate students on sheep production.

South Dakota State University
Emily Petzel successfully completed the MS degree requirements in the Animal Science department in the discipline of ruminant nutrition – co-advisors Drs. Derek Brake and Jeff Held, SDSU. Petzel's thesis title "What is the Value of Corn Residue to Grazing Cattle?". Two peer reviewed journal articles have resulted from this work, 1 published in JAS and another in the final stage of reviewer revisions. Petzel is currently pursuing a PhD at the University of Missouri-Columbia under the mentorship of Dr. Brake. Upon completion of her PhD program I expect Emily will contribute to an academic community in the area of sheep nutrition research. My career goals include training young scholars with a sheep interest to provide a pool of faculty candidates with exceptional skills and talent to fill vacancies within federal agencies and land-grant institutions.

Funding has been granted by the ASI "Let's Grow" committee to support the "Northern Plains Lamb Value Discovery Program" led by Dr. Travis Hoffman, NDSU and MN Sheep Extension Specialist and co-investigators SDSU Extension sheep staff, Dr. Jeff Held and Mr. David Ollila. SDSU sheep extension faculty, Dr. Jeff Held and Mr. Dave Ollila co-hosted the educational programming for the 81th Annual South Dakota Sheep Growers Annual Convention held September 28 and 29, 2018 in Brookings, SD. The 2-d educational program included facilities tours, workshops, lamb and wool promotion and featured presentations by industry experts, university personnel plus ASI and ALB representatives. There were three primary convention segments with attendance ranging from 150 to 200 people. A key target audience to attend this convention was new and beginner producers.

Texas A&M AgriLife Research

Got two species of ground juniper approved as commercial livestock feed ingredients. Enhanced our knowledge that DDGS can completely replace high-priced cottonseed meal and up to 66% of the grain sorghum in lamb feedlot diets, while concurrently improving growth performance, health, carcass characteristics, and cooked meat sensory characteristics. Impact Scenario: 650,000 head of market sheep and goats in Texas. Considering that DDGS are generally priced approximately $80/ton less than cottonseed meal, potential savings to the Texas Sheep and Goat industry is **$3,800,000/year**. Other accomplishments: Multiple websites and social media sites have been constructed, Two graduate and two undergraduate students were trained during these projects.

University of Rhode Island

This research and outreach programs continue to investigate sustainable alternatives to commercial dewormers and educate small ruminant producers in best management practices for parasite control through the use of online resources and training program, in-person workshops, and project-supported fecal egg count analysis to assist with genetic selection for parasite resistance.

USDA, ARS, Dale Bumpers Small Farms Research Center

The importance of genetics in gastrointestinal parasite control. Perhaps the most important means of parasite control is parasite resistance within an animal. Genetic resistance to parasitic nematode infection (measured by low fecal egg counts relative to flock/herd mates) varies among individuals within a breed and is known to be moderately heritable; however, sometimes selection for one trait leads to poorer performance in other important traits. As lead for a multi-institutional, multi-disciplinary team funded by NIFA's Organic Agriculture Research and Extension Initiative, ARS scientists from Booneville, AR, Louisiana State University, Virginia Tech, and the Oak Ridge Institute for Science and Education reported that selection for parasite resistance leads to reduced need to deworm without negating selection for growth traits, and with slight antagonisms with reproduction traits in Katahdin sheep. Evidence of impact includes a "Section Editor Favorite Paper" in Journal of Animal Science in 2017, an invited presentation to the Texas Sheep and Goat Expo 2017 and 2018, and having ARS sheep genetics sought after throughout the U.S. and Canada. This information is important to sheep producers, scientists, veterinarians, and extension specialists aiming to improve genetic parameters and parasite resistance in sheep.

USDA, ARS, U.S. Meat Animal Research Center

Experiments investigating the performance of maternal sheep breeds in extensive production systems are in their final year of replication. The utility of the EZ Care composite has been demonstrated and adopted by several producers in the region. Additional experiments investigating breed and other genetic effects on maternal characteristics and lamb production are in planning stages. Many other researchers at USMARC utilize the sheep populations to investigate genetic and environmental effects on disease susceptibility and lamb quality. In April 2019, USMARC hosted sheep producers and researchers from around the country in an effort to develop focus groups to guide the future direction of our sheep flocks.

Utah State University
Utah State University explored the impact of mineral supplements on diet selection by sheep exposed to diets that varied in the concentration of Ca, P, and Mg. This study gives support to the idea that sheep can self-select mineral supplements such that they can rectify physiological states of mineral deficiency. This means that animals presented with an array of mineral supplements with different concentrations of P, Ca and Mg will be able to sustain their mineral nutrition based on their individual needs.

Virginia State University
Data collection continued on a project evaluating semi-continuous production lamb in a forage-based system using accelerated mating in sub-flocks. Lambs are produced in 4 mo intervals under pasture lambing, are placed under rotationally using summer and winter annuals and cool perennial gasses, and are marketed at targets weights of 35 top 40 kg. Growth rates are determined under varying forage environments and different levels of agro-byproduct supplementation.

Impacts:
Michigan State University
Our extension programs over the past year (May 2018 to May 2019) reached an audience of 925 small ruminant producers in the state of Michigan as well as nearby locations. A total of 6 specific extension educational programs were delivered. Producers surveyed reported high satisfaction with these programs and were able to articulate many new management practices they learned in these programs that they will apply to their farms. We were able to make advances in the understanding of the nutritional management of highly productive sheep and at the same time, learn more about the basic biology of fetal growth and development with projects conducted in 2018/2019. We published 2 papers in peer reviewed journals and created 11 extension education articles or videos. We have continued to expand our team of educators and researchers in our sheep program in 2018/2019.

South Dakota State University
Recent studies by investigators at South Dakota State University has shown that common pre-marketing management practices in the North Central region effects the shrink loss in feeder and finished lambs. Results from these studies indicate that both feeder and finished lambs with an overnight stand experience more shrink loss than lambs held in either a familiar environment or a transition pen prior to shipment. Based on the shrink loss results of this work, the pre-marketing practice of overnight stand (shift from starch based diet to poor quality forage *ad libitum* and access to water) would require at least $5.00 per cwt more to return the same gross dollars as

lambs compared to other common pre-marketing practices. Additionally a producer survey conducted by South Dakota State University investigators revealed that less than 20% of the respondents had knowledge of the degree of shrink loss in their lambs that occurs during marketing.

Texas A&M AgriLife Research

The Texas A&M AgriLife Research Livestock Nutrition Program, along with numerous collaborating Universities, government organizations (e.g., TX and US Forest Service, TX Soil and Water Conservation Boards, NRCS), various industries (e.g., ranching, forestry equipment, commercial brush harvesters and wood processors), developed the TX A&M AgriLife Wood to Feed Program. This program focuses on the use of ground woody products as a livestock feed ingredient and the effects of plant secondary compounds (mainly terpenes and condensed tannins) on animal growth, health, and end products (wool, meat fatty acids, sensory characteristics); rumen physiology, microbiology, and efficiency; synergies with various feed ingredients and nutrients; reducing internal parasite viability and fecal egg shedding; and milk characteristics of sheep and goats on rangelands.

After working with Dr. Whitney for four years, the U.S. Food and Drug Administration recently presented the "Ground Juniper" definition to the Association of American Feed Control Officials (AAFCO) Ingredient Definitions Committee, which voted unanimously to approve as a new tentative definition. To Dr. Whitney's knowledge, no other faculty member in the entire world has ever received AAFCO approval for a new livestock roughage ingredient definition. Dr. Whitney's efforts will have an enormous impact across multiple levels (e.g., natural resource management [air, water, soil, and forage]; feed manufacturing, ranching, and feedlot industries; land development industry; wildlife management; and rural communities).

Ground woody products have unique characteristics not shared by any other livestock feed ingredient:

- They are the PERFECT "all-natural" and "organic" ingredient because they do not require any inputs by man to grow; e.g., land cultivation, planting, irrigated water, fertilizer, pesticides, herbicides, or defoliants.
- When harvested, can concurrently: enhance ecosystems, natural resources, and land value; increase soil health, forage production, and available water; and reduce allergens and the risk of wildfires.
- Studies have reported that groundwater and streamflow can increase after juniper trees are removed; however, establishing accurate economic and social values is currently impossible due to the accuracy of the models used. What is known (in many conditions), is that more water can reach the soil when juniper trees are removed, thus enhancing soil health and forage production and diversity.
- Available year-around, thus not subjected to seasonal feed ingredient pricing characteristics or availability.
- Ground wood fiber products will change the paradigm of the feed and feeding industries because long-term contracts can be implemented for an all-natural, organic feed ingredient that will be available year-around.
- Wood fiber products will reduce the price ceiling level of all other roughage ingredients with similar feeding and nutritional characteristics.

University of Rhode Island

Program evaluations and follow up surveys are administered to all program participants on a continual basis. This tracking confirms that the majority of program participants indicate plans to adopt or improve at least one new parasite control practice at the onset of receiving education, and then do go on to adopt or improve at least one parasite control practice in subsequent years of follow-up. The practices with the highest adoption include: FAMACHA© scoring, fecal egg count analysis, selective deworming, and genetic selection for parasite resistance. The program evaluations also confirm that program participants are gaining new knowledge.

As a result of thirteen National Sheep Improvement Program workshops conducted during 2017 and 2018 throughout the Northeast and Virginia, at least 9 producers enrolled in the NSIP program as a result of project workshops and outreach, and at least 30 producers indicated plans to enroll. At least 12 producers are utilizing or plan to utilize NSIP breeding stock.

The University of Rhode Island uses Google Analytics to track website usage. During Year 3 of the USDA SARE Grant, LNE-342 (9/1/2017 to 8/31/2018), a total of 9,667 new users visited the website with 8,215 (85%) being from the U.S. followed by 442 from Canada. By region, 3,564 new users were from target Northeast states and neighboring states and regions in Canada. Of the new users from the U.S., 45% of website traffic in YR3 was attributed to direct typing of the website address, with 31% being from social channels such as Facebook, followed by 3% from other website referrals (primarily the ACSRPC website). The remaining 21% is attributed to search engines. A similar trend was observed in YR1 and YR2 in which the primary website traffic channels came from both social and direct sources and when added to referrals (79% total for YR3), is indicative of success with targeted outreach methods.

The videos produced and posted online in October 2014 have the following approximate YouTube views as of May 20, 2019: *Why and How To Do FAMACHA© Scoring:* 22,695 views and *Why and How To Do Sheep and Goat Fecal Egg Counts:* 19,302 views. The video, *Why and How To Practice Integrated Parasite Control For Sheep and Goats,* posted online in February 2016, has received approximately 6,316 views as of May 20, 2019.

USDA, ARS, Dale Bumpers Small Farms Research Center

The impact of the research that occurred at DBSFRC resulted in farmer-friendly publications and YouTube videos available through the National Center for Appropriate Technology and the website of the American Consortium for Small Ruminant Parasite Control. Collaboration with farmers using the National Sheep Improvement Program contributed to improved accuracies of Estimated Breeding Values for parasite resistance and connectedness among farms as well as increased value of breeding stock and use by commercial farms. This latter work was associated with a NIFA, OREI grant, "Understanding Parasite Resistance in Organic Livestock and Using a Systems Approach for Control."

USDA, ARS, U.S. Meat Animal Research Center

Two scientists at USMARC have primary sheep responsibilities. Brad Freking transitioned into his current role in October 2016 after focusing primarily on swine genetics since 1997. Tom Murphy started at USMARC in November 2018 after 2 years on faculty at Montana State University. Among other responsibilities, the two are wrapping up experiments initiated by Kreg

Leymaster while planning future research projects. Currently, USMARC has Romanov, Katahdin, Dorset, Polypay, and EZ Care (½ Romanov, ¼ White Dorper, ¼ Katahdin) ewe flocks. Strong collaboration among university and ARS researchers and input from regional and national sheep producer groups will guide future investigations in these flocks. Historic data from the Katahdin and Polypay flocks at USMARC is in the process of being uploaded to the National Sheep Improvement Program database. Enrolling in NSIP will initiate genetic connectedness with commercial producers. Furthermore, USMARC's ability to phenotype individuals for difficult or labor intensive traits will aid in future trait development for NSIP. Research results have and will continue to be disseminated to the general public and scientific community at extension events, regional and national conferences, and peer-reviewed articles.

Utah State University

A better understanding of the self-selection of minerals by sheep will allow for the development of innovative managing strategies (i.e., providing a choice of minerals with different concentrations) aimed at enhancing the nutrition and welfare of animals grazing in rangelands based on their dynamic and unique needs.

Virginia State University

Research was completed that further defined the storage environment of liquid stored ram semen for vaginal AI. Sperm motion analysis indicated that the addition of egg yolk at 15% to a simple skim milk extender was optimal in maintain progressive motility. Similarly, storage at 5 and 10˚C maintained the sperm progressive motility equally well over extended storage of several days when compared to higher storage temperatures.

Publications:

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Glasscock, J. L., T. R. Whitney, J. R. Roper, A. R. Holmes, S. G. Marrs, W. C. Stewart*, and E. J. Scholljegerdes. 2018. Substituting ground woody plants for cottonseed hulls in goat feedlot diets: growth performance and blood serum chemistry. J. Anim. Sci. 96:2851−2860. doi: 10.1093/jas/sky159

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