UNIVERSITY OF WYOMING
AGRICULTURAL EXPERIMENT STATION

Laramie Research & Extension Center

2023 ANNUAL REPORT

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Laramie Research & Extension Center

2023 ANNUAL REPORT

The Laramie Research and Extension Center (LREC) is comprised of ~9,000 acres of rangeland and ~450 acres of irrigated hay meadows, the Hansen Livestock and Teaching Arena, and our greenhouse facilities. The total land base includes pastures and meadows immediately west of Laramie, WY, and on the way to Wheatland, WY, at the McGuire Ranch. LREC is led by a director (Dr. Scott Lake, Animal Science) and associate director (Dr. Derek Scasta, Ecosystem Science and Management) and houses UW Extension sheep and range specialists. LREC also includes 6 unit managers and accountant Amy Newman, in addition to a team of hourly technicians and student workers.

In terms of agricultural production, LREC produces hay, beef cattle, sheep, and swine. Hay production is concentrated west of Laramie, WY, and relies upon flood irrigation with water from the Pioneer Canal-Lake Hattie irrigation district. Beef cattle include commercial and purebred cattle and feed yard facilities with a ~225 head capacity. Sheep production is focused on Rambouillet sheep selected for moderate frame, bone, and muscle. Ewes are selected for growth, maternal instinct, and twinning rates, all with an eye on high-quality wool production. Swine production relies on artificial insemination with the best boars available to produce high-quality and functional show pigs that sell through the 307 Elite Sale and produce pigs for meat classes, the livestock judging team, the meat lab, and various research projects. The grazing livestock production relies on native rangeland and improved pastures that are important for wildlife and botanical diversity.

LREC also includes a 20,000-square-foot greenhouse facility that hosts specialized teaching and research. The facility includes 6 greenhouses in 18 sections with a total of 11,000 square feet of greenhouse space in addition to 3 acres of small plot space outside. This space is critical for research and teaching in all disciplines studying plants.

Importantly, LREC also includes the Hansen Livestock and Teaching Arena, which hosts many events such as youth livestock clinics, high school and collegiate rodeos, livestock sales, and more. The arena is often used for animal science labs, university clubs and rodeo, and 4-H horse projects. Our arena manager is also the teamster caring for Pistol and Pete—our Haflinger team, which attended 16 different events around the state in 2022–2023. Pistol and Pete are also used for feeding hay through the winter.

We hope this report gives you insights into the important and diverse production, extension, teaching, and research activities at LREC in 2023.

UNIT MANAGER REPORTS

Sheep Unit Manager Report – Kalli Koepke

Inventory

- 350 head mature Rambouillet ewes
- 115 head ewe lamb replacements
- 7 head mature sires
- 4 head teasers
- 70 head feedlot lambs
- 11 head ram lambs

2023 Summary

We maintained ~450 head of Rambouillet ewes this year, 115 head of those as replacement ewe lambs. We lambed 270 head of ewes in 2023; 25 head of those lambed in the fall of 2023. We will lamb out 350 head in the 2024 season. We maintained 7 head of breeding sires and 4 teaser rams. Seventy head of the 2023 lamb crop were retained for meat lab and teaching activities. Fourteen head of the lambs that were kept were donated to the Lamb-a-Year program.
We also retained 11 head of ram lambs to participate in the 2023–2024 Wyoming Wool Growers Ram Sire Test. We finished the lambing season with 180% lambing rate, 15% death loss, and 156% weaning rate. The remainder of the lamb crop not retained was sent to Centennial Livestock Auction for market.

In August 2023, we introduced 4 donkeys as guardian animals. Within a month all donkeys were bonded to their flocks. Since the introduction of the donkeys, the unit has not had a loss from predators.

We have also embarked on a new inventory system in 2023, the Shearwell system. We have transferred over all our inventory records to this device and have proceeded to use the system for lambing, weaning, general weights, maternal records, and paternal records. Lamb-a-Year and the annual Ram Test have both participated in the system for weighing and record keeping. We have been very successful with record keeping since the introduction of this system.

The Sheep Unit helps with many important extension, research, and teaching activities that are crucial to UW and the state, including the Wyoming Wool Growers Ram performance test and sale, Lamb-a-Year program, Albany County 4-H Sheep program, University of Wyoming Extension Sheep Task Force, 7220 National Wool Invitational, state 4-H and FFA wool judging contests, and several animal science classes.

Beef Unit Manager Report – Ben Hollinger

Inventory

- 147 bred mature cows (8 purebred Herefords, 15 Red Angus, 124 commercial crossbreds)
- 62 crossbred bred heifers
- 68 yearling heifers
- 3 black Angus bulls
- 3 Hereford bulls
- 2 Red Angus bulls

2023 Summary

We artificially inseminate almost the entire herd and rely on bulls to breed any cows that did not get bred. The 2023 calf crop weaned an average of 560.8 lbs. The Beef Unit is moving toward building a herd of 2 small subsets of purebred Herefords and Red Angus and a larger set of commercial crossbred red baldies. We are interested in Herefords and Red Angus and their performance at high altitude and respective levels of susceptibility to brisket or high-altitude disease. The goal is to produce quality crossbred cattle that will thrive at high altitudes.

There are 42 weaned steer calves on a feed study. All weaned steers that do not go on study are sold at Torrington Livestock Market. They are typically backgrounded for 30–45 days on cut hay meadows at LREC until they are sold or put on study. Calving begins in late February for heifers and about 2 weeks later in mid-March for mature cattle. After artificial insemination (typically around June 1) mature cattle head to our summer pasture 40 minutes northeast of Laramie where they are on a grazing study and have cleanup bulls turned out until late July or early August.

Cattle are typically brought home to LREC from summer pastures in October or November and are grazed on hay meadows or river bottoms. Feeding hay usually begins around Christmas.

The Beef Unit helps with the advanced beef production class by providing opportunities for students to assist with vaccinating and calving, and provides cattle for BCS labs, among other activities. We also assist with the bull test class by having students assist with feeding and doctoring of bulls, fitting and picturing bulls, and building catalogs, fliers, and putting together the sale day.

Swine Unit Manger Report – Patrick Parker

Inventory

- 15 breeding sows
- 5 replacement gilts
- 3 boars
- 148 pigs born in 2023

2023 Summary

The swine unit has 15 Hampshire cross sows that farrow 2 times per year. All sows are artificially inseminated with purchased semen. Three boars are maintained in the herd to use as teasers. Most of the production from these sows goes to support teaching and the UW Meat Lab. The UW judging teams, as well as judging teams from the surrounding states, utilize our swine herd for practice and contests.

There are very few swine herds that are open to the public, so we have a great opportunity to teach generations about the swine industry. We also provide feeder pigs for the 307 Elite Sale; this is usually an online sale that supports 4-H and FFA kids with their fair projects. The unit provides hands-on teaching for multiple college and grade school classes.

The swine unit has provided the facility needs and production requirements for a wide range of research projects, from human biomedical projects to feeding and supplementation projects. All feeder or fat pigs not used for teaching or research needs are marketed through the Centennial Livestock Auction.

The Swine Unit helps with many important extension, research, and teaching activities that are crucial to UW and the region, including Wyoming State Fair, the National Western Stock Show in Denver, Albany County 4-H Swine Program, Showcase Showdown Livestock Judging Contest, 4th Grade Rendezvous, Albany County Cattlewomen's Ag Expo, and several animal science classes.

Arena and Equine Manager Report – Elias Hutchinson

Inventory

- 2 Haflinger draft geldings
- 2 quarter horse saddle horses
- 1 American Shetland gelding pony
- 4 BLM guardian burros

2023 Summary

In 2022–2023, there were 47 different individual events hosted at the Hansen Livestock and Teaching Arena. These included events such as horse clinics, livestock judging and fitting clinics, agility dog competitions, ag expo, youth rodeos, high school regional rodeo, Laramie River Rendezvous (UW College Rodeo), Tribute to Steamboat Ranch Bronc Riding, Ranch Rodeos, archery shoots, bull sale, UW Extension seminars, etc.

The arena and Mary Mead classroom are utilized almost continuously throughout the school year as well as the summer with a daily schedule of events going from 6 a.m.–10 p.m., 7 days a week. Specific UW groups that consistently utilize the space are College of Ag classes, livestock judging, wool judging, rodeo, ranch horse, equestrian team, and Albany County 4-H. Hansen is a gathering place not only for the university but for the public as well. With the versatility of the space and access to the classroom, many groups make use of Hansen.

The UW remuda of saddle horses, draft team, mascot, and burros are a very busy bunch. All the equines except the burros are used to help teach numerous animal science labs and classes during the school year. In addition, they also facilitate learning opportunities for aspiring equestrians on club teams such as The Ranch Horse Versatility Team, Equestrian Team, and The Pistol and Pete Teamsters, a new draft horse club. Cowboy Joe, the Shetland pony, appears at countless UW sports and alumni functions throughout the year.

The Pistol and Pete draft team are arguably the busiest mascots at UW. In 2022–2023, the team appeared at more than 16 different events on campus and around the state. These events include Laramie Jubilee Days, Sheridan WYO Days, UW's Presidents Christmas Party, campus events, Wyoming State Fair, Cheyenne Frontier Days, etc. The team is also used to feed the sheep during the winter at LREC. They feed about 1 ton a day, 5 days a week from December 1 to April 1—rain or shine, and even in 30-below-zero weather. Unlike a tractor, they will always start in the cold.

Early this fall we started a new project of introducing BLM burros as guarding animals in hopes to curb the prevailing predatory pressures on our sheep flock. It has been a learning experience finding the most efficient integration and management practices for the burros and sheep. Since their introduction, we have had massive success and have seen no predatory death loss in groups paired with a burro.

The Arena and Equine Unit helps with many important extension, research, and teaching activities that are crucial to UW and the region, including ANSC horsemanship clinics, Albany County Fair Horse Competition, 4-H mock horse shows, 4-H Sheep and Goat Clinic, UW Livestock Judging Clinic, 4-H Showcase Showdown, Bull Test Field Day, and the ag expo, in addition to several animal science classes.

Hay and Irrigation Unit Manager Report – Landon Hoffer

Inventory

- 450 hay meadow acres
- Annual total hay production: 900–1,100 tons (2–2.5 tons per acre)
- 2023 Production: 1,100 tons

2023 Summary

January, February, and March are spent spreading manure from the feedlot pens onto the hay meadows around the farm. Hay meadows are dragged and liquid fertilizer is spread in March and April. Early April is our small window to burn any ditches that need it and fix irrigation structures. Irrigation water normally arrives the last week of April and so we are busy 6–8 hours per day irrigating in May and June. The majority of meadows are flood irrigated using tarp dams and ditches. Thirty-five acres are under a wheel line irrigation system. Irrigation water is turned off by July 1. Haying takes place in July and August. In September, our fields are sprayed for weeds. September and October have been times where we get caught up on any large-scale outdoor projects before winter. November and December are when the bulk of our large winter shop/welding projects take place.

Greenhouse Unit Manager Report – Ryan Pendleton

The LREC Greenhouse consists of a 20,000-square-foot headhouse facility that contains 10 research laboratories, classroom, office, specialized processing, and supply areas. There are 6 greenhouse ranges housing 18 greenhouse sections, amounting to 11,000 square feet of greenhouse space attached to the facility. The facility is surrounded by 3 acres of micro plot field space. There are also 3 hoop houses available for research.

The staff here at the greenhouse are responsible for daily watering of the plants, fertilizing plants when needed, and pest and weed control. The staff also cleans used pots, provides growing media for researchers, and performs general upkeep and cleaning of the facility. Plants are watered once to twice per day, and temperatures of the greenhouses are recorded twice a day. Weekly pest inspections are done by the staff, and the plants are routinely sprayed for pests when needed. Outside plots are tilled and sprayed with herbicides to prepare them for research. The staff also maintains the overhead irrigation system outside. Cover crops are planted in research plots when not in use to help with weed suppression, and to improve soil health. Used growing media is disposed of outside in a soil disposal pile.

Researchers are responsible for planting of their research, as well as data collection, and any harvesting and processing. The facility has a processing room with a Wiley grinding mill and 4 drying ovens that are utilized by researchers.

The Greenhouse Unit is important to many different researchers in varying departments, including plant science, botany, molecular biology, and ecosystem science and management. Nine classes are taught at the greenhouse facility annually, ranging from plant propagation to weed science and plant pathology.

EXTENSION ACTIVITIES

UNIVERSITY OF WYOMING | Extension

LREC hosts many events each year that include youth and adult education and training. In 2023, banner events included the Albany County 4-H Sheep Program, Wyoming Wool Growers Ram Test, Wyoming High Altitude Bull Education Program and Sale, Wyoming Extension Sheep Task Force, 4-H and FFA Wool Judging at the 7220 National Wool Invitational and State Contest, Collegiate Wool Judging at the 7220 National Contest and Cowboy Classic National Invitational, Extension Plant Walk at the McGuire Ranch, America's Grasslands Conference Tour at the LREC rangelands and prairies, the Wyoming – SRM Annual Meeting, and a tour for the Wyoming Legislative Agriculture, State and Public Lands & Water Resources Committee. Here, we will highlight a few of these extension activities in greater detail.

UW Extension Plant Walk at the McGuire Ranch – June 19, 2023

This was a collaborative effort between UW Extension, Laramie Rivers Conservation District, Rocky Mountain Herbarium, US Forest Service, and UW Biodiversity Institute. A total of ~45 participants attended, with 38 completing program evaluations. Participants received a presentation on the history of the ranch, current grazing and rangeland research at the ranch, and then broke into groups to look at plants.

America's Grasslands Conference Tour of LREC's Rangelands and Prairies – August 8, 2023

The National Wildlife Federation (NWF) has been hosting a biennial conference since 2011 with host locations including South Dakota, Kansas, Colorado, Texas, and North Dakota. During the pandemic, they were considering hosting the next conference in Wyoming. It was important to NWF to have a university co-host and the UW College of Agriculture, Life Sciences and Natural Resources served in this capacity. A total of 26 people from across the United States and Canada participated and received presentations on plant and animal diversity, grazing management, carbon sampling, and sheep and beef cattle research at LREC.

High Altitude Bull Test and Sale – April 1, 2023

The goal of the High Altitude Bull Test and Sale is to evaluate potential sires on their ability to serve producers at high altitudes; increase applied production agriculture experience available for students; and engage producers in research and education related to brisket disease and bull development. In the first year of the test, 9 producers consigned a total of 41 bulls. Bulls were managed at LREC from January through March 2023. Animals were weighed biweekly to monitor performance throughout the test. Bulls evaluation was based on ultrasound measurement to evaluate carcass characteristics, reproductive tests, and pulmonary arterial pressure (PAP) testing to assess the risk of pulmonary hypertension. The data collected on bulls in the test provided consigners and producers with valuable information to utilize when making management and sire selection decisions.

The High Altitude Bull Test culminated in an educational field day and private treaty sale on April 1, 2023, with approximately 50 people. The field day was aimed at providing producers with new educational opportunities to learn about brisket disease and bull development. The field day featured presentations from Landon Eldridge, UW Livestock Judging coach, on bull selection and evaluation; Chase Markel, UW graduate student, on PAP testing; and Dr. Mark Enns, professor at Colorado State University, on understanding and utilizing the PAP EPD. The field day featured a poster session highlighting current beef research being conducted at the University of Wyoming. Twenty bulls consigned to the test were available for private treaty sale during the field day.

In its second year, the bull test has been expanded to include a 45-day screening period and a longer feed efficiency test that utilizes the GrowSafe system at LREC to measure feed intake and calculate feed efficiency. The program has also transitioned to a live sale that will be held at the field day on March 26, 2024.

Ram Test Program – April 1, 2023

The University of Wyoming's ram testing program has established itself as a cornerstone for sheep ranchers nationwide, offering a comprehensive platform to evaluate and select premier sheep genetics. This unique program, celebrating its 63rd year, stands as 1 of only 2 remaining tests in the nation that assesses dual-purpose wool and meat sheep genetics.

Throughout its operation, rams are consigned by producers from various parts of the country and managed at LREC over a span of 160 days. During this period, key metrics such as growth performance, feed conversion efficiency, and wool quality traits are meticulously gathered on each ram. These metrics are then integrated into a selection index, enabling the identification of genetically superior rams. The program utilizes 2 indices, namely the Rambouillet Index and the Wyoming Certified Index, to highlight the top-performing 30% of rams, ensuring that only the best genetics are recognized and promoted.

In its 2022–2023 iteration, the ram test program evaluated 120 rams from 25 ranches across 6 states. The following year, the 2023–2024 program saw participation from 90 rams representing 21 ranches from 3 states and Canada, illustrating the program's widespread appeal and its role in advancing sheep genetics across North America.

The conclusion of the testing period is marked by an educational field day and silent auction, an event that garners significant interest from industry stakeholders. This culmination not only provides an opportunity for attendees to engage with cutting-edge sheep genetics but also serves as an integral part of the ANSC 4230 Advanced Sheep Production course. Students in this course gain invaluable hands-on experience in managing rams and applying principles of genetic selection, further enriching their academic and practical understanding of sheep production.

The University of Wyoming's ram testing program continues to be a pivotal resource for the sheep industry, driving innovation and excellence in sheep genetics through its comprehensive testing and educational initiatives.

TEACHING

ANSC 1010 Introduction to Animal Science: Introduction to the field of animal science, including meat and dairy products, nutrition, reproduction, breeding and genetics, livestock selection, and diseases and health of domestic livestock species, with application to the management of beef cattle, sheep and wool, dairy cattle, swine, and horses. This course routinely uses LREC animal facilities for teaching. Taught by a team of faculty, Department of Animal Science.

ANSC 3535 Introduction to Wool Evaluation: This course teaches students how to objectively evaluate raw wool characteristics and quality-determining factors across various wool grades and breed types. Particular emphasis will be given to how quality-determining factors influence replacement selection and the end product produced. Competitive wool judging format will be used to enhance organizational skills, wool judging terminology, and oral articulation skills. LREC provides the opportunity for students to look at a range of fleeces. Taught by Whit Stewart, Department of Animal Science.

ANSC 3540 Collegiate Wool Judging: Students representing the university in regional and national wool intercollegiate contests are selected from this course and have the opportunity to judge at the 7220 National Wool Invitational (which includes 6 universities representing ~70 students and is hosted at LREC), the National Western Stock Show in Denver, the Black Hills Stock Show, Houston Livestock Show, and San Antonio Livestock Show, among others. Taught by Whit Stewart, Department of Animal Science.

ANSC 4120 Principles of Mammalian Reproduction: In fall 2023, 38 students enrolled. Students enrolled in ANSC 4120 participated in 4 laboratories held at the LREC Multipurpose Building and Wool Classroom. Laboratories provided students exposure to performing breeding soundness exams as well as techniques for semen collection, artificial insemination, and estrus synchronization. Taught by Jeremy Block, Department of Animal Science.

ANSC 4130 Management of Reproduction: In spring 2023, 10 students enrolled. Students enrolled in ANSC 4130 participated in 11 laboratories held at the LREC Multipurpose Building and Wool Classroom. Laboratories provided students with the opportunity to gain hands-on experience with rectal palpation, breeding soundness exams, semen handling and processing, artificial insemination, reproductive ultrasonography, pregnancy diagnosis, and fetal sexing. Laboratories also include demonstrations of techniques used for non-surgical embryo recovery and ovum pickup/in vitro fertilization. Taught by Jeremy Block, Department of Animal Science.

ANSC 4220 Advanced Beef Production and Management: 14 students enrolled in 2023. The advanced beef production and management course is focused on enhancing student knowledge and skills related to the management and production of beef cattle, integrating concepts of animal breeding, nutrition, reproduction, and health. Students completed numerous labs at the Laramie Research and Extension Center, including those focused on bull selection, body condition scoring, artificial insemination, heifer selection, pregnancy detection, ultrasounding, calving, and pulmonary arterial pressure (PAP) testing. Students were able to gain hands-on experience working with cattle throughout the semester, allowing them to build their animal handling and management skills. Taught by Shelby Rosasco, Department of Animal Science.

ANSC 4230 Advanced Sheep Production (Lecture and Lab Sections): This course integrates animal breeding, nutrition and reproductive physiology in sheep production management schemes. Students get the opportunity to work through field study scenarios and work with managers at the LREC Sheep Unit. Taught by Whit Stewart, Department of Animal Science.

ANSC 4500 Bull Test Enterprise: In spring 2023, 8 students enrolled; in fall 2023, 14 students enrolled. The bull test enterprise course is designed to provide experiential learning centered around the UW High Altitude Bull Test and Sale. The course is focused on enhancing student knowledge and skills related to bull growth and development, nutrition, reproduction, and health, as well as providing students with practical experience in the management, performance testing, and marketing of cattle. Students are directly involved in the management of bulls on test, collection of data, development of marketing materials, and organization of the bull sale and extension field day. Students spend extended periods of time managing the bulls on test at the Laramie Research and Extension Center, including daily health checks, doctoring bulls, weighing bulls, assisting with pulmonary arterial pressure (PAP) testing, clipping and picturing bulls, assisting with carcass ultrasound data collection, and helping with breeding soundness exams. Students in the course also help generate marketing materials for bulls participating in the high-altitude bull test and sale, and learn the basics related to the development of effective marketing materials. Taught by Shelby Rosasco, Department of Animal Science.

ANSC 4500 Lamb-a-Year (Introduction to the Lamb Industry): This course represents a cornerstone initiative for value discovery among commercial Wyoming sheep producers, while simultaneously serving as a vital capacity-building pillar for the UW Sheep Program. This innovative program invites donations of lambs from across the region, which are then finished at LREC. Here, we undertake comprehensive assessments of feed conversion efficiency and carcass data, providing insights that are seldom accessible to producers who typically market feeder lambs rather than finished

products. It offers a practical framework for undergraduate research projects focused on lamb management, thereby enriching the sheep production curriculum through a practical, hands-on approach. This creates a dynamic synergy between extension services, teaching, and research, fostering a comprehensive learning environment for students. During the 2022–2023 academic year, the program received donations of 153 lambs from 30 different ranches, showcasing the widespread support and engagement within the community. Taught by Whit Stewart, Department of Animal Science.

ANSC 5550 Lamb Feeding Strategies: This course for graduate students is an investigation in animal nutrition course that allows students to get hands-on opportunities to understand feeding lambs for optimal development, growth, and performance at the LREC Sheep Unit. Taught by Whit Stewart, Department of Animal Science.

BOTN 4640 Flora of the Rocky Mountains: This field course visited the McGuire Ranch in June over several days to do a plant species inventory. Students worked with faculty to collect plants and then did identification and recording for the herbarium back on campus. Taught by David Tank, Department of Botany.

FDSC 2040 Principles of Meat Animal Evaluation: LREC provides facilities for teaching efforts within the animal and veterinary sciences degree program. The FDSC 2040: Principles of Meat Animal Evaluation course is one of the courses within this undergraduate program. The course is designed to help students understand the connection between live animals and the carcasses they produce. Students evaluate market-ready cattle, hogs, and lambs to estimate carcass traits such as amount of fat and muscle, meat quality, and yield of saleable, consumable product. The LREC facilities, specifically the confinement barn and multipurpose facilities, serve as the venue for these labs. After each live animal lab (taught every other week during the semester), the UW Meat Laboratory harvests livestock and students measure carcass traits to

determine the accuracy of their live animal evaluation estimations. The LREC staff are integral to the facilitation to this course as they ensure facilities and livestock are available for labs. The LREC budget procures any livestock needed that are not raised on the farm. Student enrollment for this course ranges from 35–50 and is generally made up of first- and second-year students. The course is taught during the spring semester. Taught by McKensie K. Phillips and Landon E. Eldridge, Department of Animal Science.

FDSC 3060 Principles of Meat Science and Muscle Biology: This course teaches the principles of muscle, adipose, and connective tissue growth, structure, and metabolism; conversion of muscle into meat; fresh meat properties and quality; chemical properties of meat; meat microbiology, preservation, and storage; meat by-products; and HACCP. This course routinely uses LREC animal facilities for live animal evaluation all the way through slaughter at the meat lab. Taught by Cody Gifford, Department of Animal Science.

PLNT 1000 Agroecology (both fall and spring semesters): This course utilizes LREC greenhouses for planting and maintenance of a living collection of diverse crops for students to learn from. This collection is used for plant identification and anatomy lessons. We also tour LREC with Ryan Pendleton so students can learn about greenhouse production and agricultural research. Students in 2023 numbered ~50 in the fall (taught by Urszula Norton, Department of Plant Science) and ~30 in the spring (taught by Randa Jabbour, Department of Plant Science).

PLNT 2026 Horticultural Science Laboratory: Was taught during the fall semester. This class had an enrollment of 13 students. This is the 1-hour lab class that accompanies PLNT 2025. This class is required for all horticulture minors and agriculture education majors. In this class, we apply hands-on learning to concepts taught in PLNT 2025 Horticulture Science. Our experiments include the study of plant anatomy, floral anatomy, fertilizer, potting media, floral design, seed propagation, asexual propagation through cuttings, organic versus conventional food products, light level impact on plant growth, transpiration rates of plants, and vase life of cut flowers. The students take data on each study and write lab reports on their findings. Taught by Elizabeth Moore, Department of Plant Science.

In this lab, each student created a round floral arrangement and delivered their arrangement to someone on campus who has helped them in some way.

PLNT 3300 Plant Propagation: Was taught during the spring semester and had an enrollment of 12 students. This was a very hands-on class where students conducted 10 experiments over the course of the semester, collected data, and wrote detailed lab reports on each experiment. In addition to the experiments, students took quizzes on lecture material. The experiments students conducted were (1) seed viability testing, (2) seed propagation comparing various stratification methods and chemical scarification, (3) asexual propagation of evergreen species, (4) asexual propagation of deciduous species, (5) asexual propagation of herbaceous species, (6) tomato grafting, (7) budding technique, (8) asexual propagation through specialized reproductive structures, (9) asexual propagation through layering techniques, and (10) micropropagation. Taught by Elizabeth Moore, Department of Plant Science.

PLNT 4970 Applied Plant Protection: This course was taught at LREC for the first time this year. It was critical for students to have easy access to field sites, lab and greenhouse space, and equipment such as the elutriator, threshers, and so forth. Taught by Randa Jabbour, Bill Stump, and Clint Beiermann, all Department of Plant Science, in fall 2023.

REWM 2400 Range Ecosystems and Plants: This course is designed to teach students about the ecology of rangeland ecosystems and to recognize common plants found throughout the western United States. Students toured the McGuire Ranch to learn about sagebrush plant communities, with 31 students in the laboratory attending the field trip. Taught by Brian Sebade, Department of Ecosystem Science and Management.

REWM 4330 Rangeland Ecosystem Assessment & Monitoring: This course focuses on measuring attributes of rangeland systems, including cover, biomass, and density, as well as characteristics of rangelands including livestock utilization. Field measurements are in turn used by students in computer labs to analyze and interpret findings. Effort: Beginning in fall 2013, REWM 4330 classes have collected utilization and production data at the LREC–McGuire Ranch. We use 1 x 1 meter grazing exclosures (see photo) to estimate utilization based on the difference in weights of herbage inside versus outside exclosures. Production is estimated solely inside exclosures. We also estimate utilization around the exclosures with the modified Robel technique. We estimate these values in native sagebrush, seeded sagebrush, and within the Plumbago Creek holding pasture. Results: In 2023, we collected data on October 23, after cattle grazing had ended on October 15. Production (lbs/acre of dry matter) was 346 lbs/acre in sagebrush in a rocky ridge in the north-central part of McGuire Ranch, 358 lbs/acre in native sagebrush, 994 lbs/acre in seeded sagebrush, and 1,884 lbs/acre in the riparian zone along Plumbago Creek. Our estimates of utilization with the paired plot method ranged from 17.0% in native sagebrush to 43.0% in seeded sagebrush, 45.7% in native sagebrush along the rocky ridge, and 53.2% in the Plumbago Creek riparian area. Taught by Jeffrey Beck, Department of Ecosystem Science and Management.

ANIMAL SCIENCE RESEARCH

Effects of Choline Supplementation on Reproductive Performance of Ewe Lambs in the Breeding and Non-breeding Seasons

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PROBLEM: Despite the importance of fertility, current estimates of average number of lambs born per ewe are only slightly better compared to the 1970s.

EFFORT: A study was conducted to determine whether supplementation of choline during the early post-mating period could improve reproductive outcomes in ewe lambs. Rambouillet ewe lambs in the non-breeding (June; n=78) and breeding (October; n=52) seasons were randomly assigned to either control (no supplementation) or choline-supplemented treatment groups. Ewe lambs were submitted to an estrus synchronization protocol and then subsequently placed with rams for a 6-day mating period. At the end of the synchronization protocol, ewe lambs in the choline treatment group were fed 5 g of rumen-protected choline loaded in gelatin-coated capsules per ewe for 12 days. Control animals were fed empty gelatin capsules each day for the 12-day treatment period. Pregnancy status was determined at 70 ± 3 days after initiation of the mating period.

RESULTS: Preliminary data for pregnancy rate are summarized below in Table 1. The project is still ongoing and will evaluate effects of choline supplementation on number of lambs born as well as their growth performance and carcass quality.

Table 1. Effects of choline supplementation during the early post-mating period on pregnancy rates obtained during the non-breeding and breeding seasons.

Season	Treatment	Pregnant (%)
Non-Breeding	Control	14/37 = 37.8%
	Choline	18/41 = 44.0%
Breeding	Control	17/24 = 70.8%
	Choline	15/28 = 53.6%

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Effects of Intrauterine Administration of CXCL12 on Pregnancy Rates Following Embryo Transfer in Mature Rambouillet Ewes

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PROBLEM: Understanding factors that positively regulate pregnancy establishment and survival can improve reproductive outcomes and profitability in livestock production systems. The chemokine, C-X-C motif chemokine ligand 12 (CXCL12), is involved in placental development.

EFFORT: A preliminary study was conducted to test whether intrauterine administration of recombinant CXCL12 at the time of embryo transfer could improve pregnancy establishment. Embryos were produced via superovulation and surgical embryo recovery from mature Rambouillet ewes. Recovered embryos of appropriate stage and quality were frozen using controlled-rate freezing. Mature Rambouillet ewes were also used as recipients. Estrus was synchronized in recipient ewes using a standard long progestin protocol and expression of estrous was confirmed based on the presence of markings from vasectomized teaser rams. Recipient ewes that were confirmed to express estrous were randomly assigned to 1 of 3 treatment groups: control (embryo-holding medium only) or embryo-holding medium supplemented with either 100 or 500 ng/ml recombinant CXCL12. At day 6–8 after estrus, laparoscopic embryo transfer was performed on all ewes with at least 1 corpus luteum (CL). Two embryos were thawed and then transferred into the uterine horn ipsilateral to the ovary with a CL of each recipient female. Pregnancy status was determined at day 70 ± 3 days of gestation.

RESULTS: Preliminary results for pregnancy rate are summarized in Table 1 below. The study is ongoing and will evaluate the effects of CXCL12 on the number of lambs born as well as their post-natal growth performance.

Table 1. Effects of intrauterine administration of CXCL12 at the time of embryo transfer on pregnancy rates in mature Rambouillet recipients

CXCL12 (ng/ml)	Pregnant (%)
Control (0 ng/ml)	5/9 = 55.6%
100 ng/ml	5/9 = 55.6%
500 ng/ml	6/8 = 75.0%

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Effects of Intrauterine Administration of Interleukin-1 beta (IL1B) during the Periovulatory Period on Conceptus Survival at Day 15 of Gestation

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PROBLEM: Pregnancy in cattle is defined by a significant amount of embryonic mortality during the first 3 weeks of gestation. Therapeutic approaches to improve early embryo survival and pregnancy establishment could have a significant impact on reproductive efficiency.

EFFORT: A preliminary experiment was conducted to test whether intrauterine administration of IL1B during the periovulatory period in beef cattle could improve conceptus survival at day 15. Non-lactating, mature beef cows at the Laramie Research and Extension Center were used for the study. Cows were synchronized using a standard ovulation synchronization protocol. At the time of induced ovulation (day 0), cows were randomly assigned to 1 of 6 doses of recombinant IL1B (0, 0.1, 1, 10, 100 and 1,000 ng/ml). Doses of IL1B were administered intrauterine in a volume of 5 ml into each uterine horn using a sterile infusion pipet. At day 7, cows with a corpus luteum present received 2 embryos produced by in vitro fertilization; 1 embryo was transferred into each uterine horn. At day 15, non-surgical recovery procedures were performed to recover conceptuses. Recovered uterine fluid was assayed to quantify levels of interferon-τ.

RESULTS: Results from the study are summarized in Table 1 below. Further research with a greater number of animals is needed to confirm the results of this preliminary study.

Table 1. Effect of intrauterine administration of recombinant interleukin-1 beta (IL1B) during the periovulatory period on conceptus survival and recovery rates at Day 15.

Dose of IL1B (ng/ uterine horn)	Cows (n)	Embryos transferred (n)	Survival Rate (%)[a,b]	Conceptus recovery rate (%)[a]
0	8	16	11/16 = 69%	6/16 = 38%
0.5	5	9	8/9 = 89%	5/9 = 56%
5	6	12	10/12 = 83%	5/12 = 42%
50	6	12	5/12 = 42%	4/12 = 33%
500	7	14	12/14 = 86%	5/14 = 36%
5,000	2	4	4 /4 = 100%	3/4 = 75%

[a]Data are presented as actual proportions

[b]Survival rate was calculated as the proportion of uterine flushes with a concentration of interferon tau > 200 ng/ml

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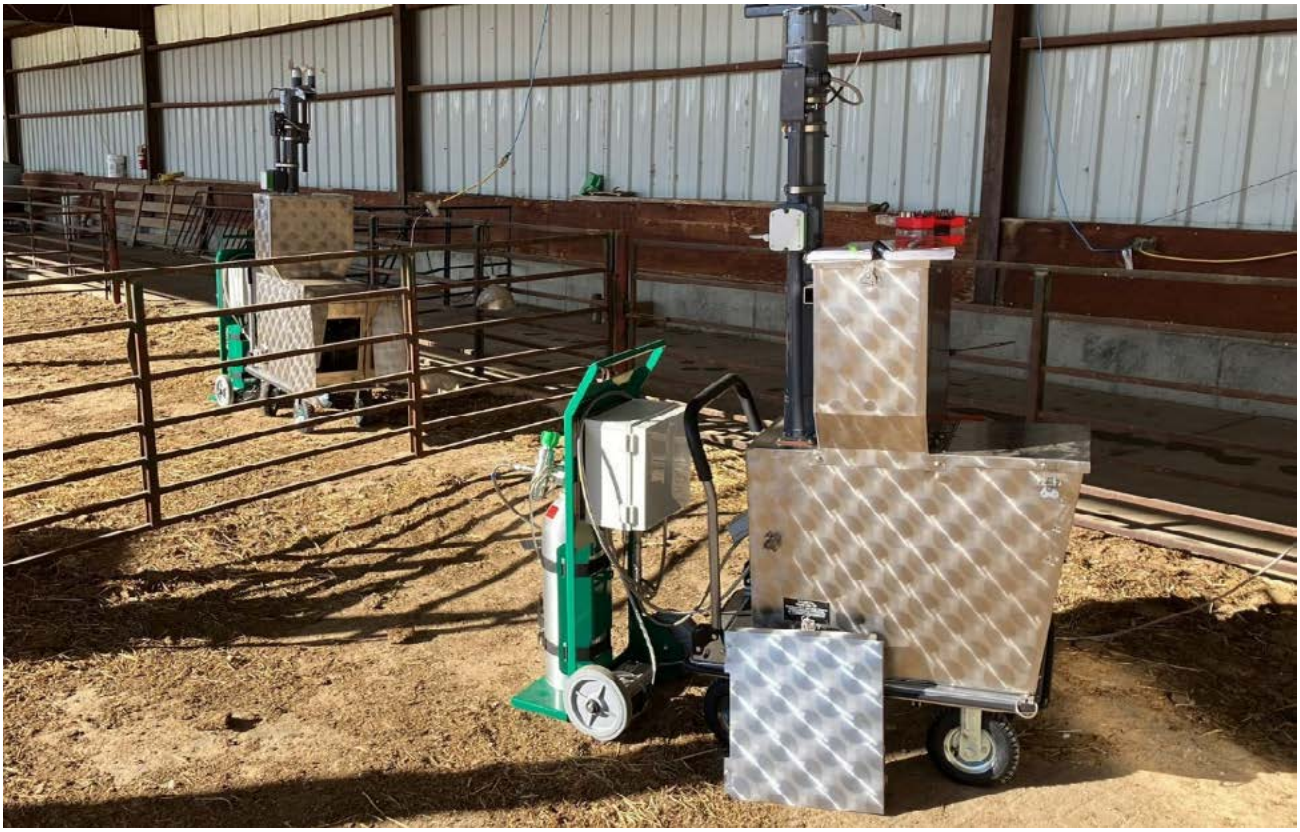

Installation of Sheep GreenFeed Units at the Sheep Research Unit

AUTHOR(S): Paulo M. T. Lima,[1] Whit Stewart,[1] John Derek Scasta[2]

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PROBLEM: Increasing scrutiny towards livestock production is perceived all over the world, especially due to its potential impacts on climate change, heavily attributed to greenhouse gases (GHG) emissions from ruminants. The most prominent of these GHG would be the enteric methane (CH4) coming mostly from carbohydrate digestion and released via eructation as a co-product of feed metabolism. The state of Wyoming stands out as one of the most important sheep-producing states in the country; therefore, an accurate characterization of CH4 emissions from these animals representing the production conditions of the state is a crucial tool to promote the sustainability of the activity. Having precise science-based information should also provide support to local producers.

EFFORT: To efficiently measure CH4 emissions from sheep, 2 GreenFeed units (C-Lock Inc. - Rapid City, SD, USA) were purchased and installed at LREC on December 13–14, 2023.

RESULTS: These units are automated head chamber systems used to measure methane emissions from sheep. As a stand-alone system, it provides methane data very quickly in animals housed in collective or individual stalls, generating valuable data concerning emissions resulting from already established or innovative feeding strategies with the potential to be adopted in Wyoming sheep production systems. These units place our group in a strategic position in our region, equipped to produce novel and important knowledge on this topic.

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Effect of Ewe Parity, Age, and Breed on Serum Calcium and Other Metabolites during the Periparturient Period

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PROBLEM: Historic USDA census data suggests that docking percentages, or lambing percentage, which is measured by the number of lambs born per ewe, in Wyoming has increased more than 30% in the last 50 years. While increasing the number of lambs born and eventually sold increases overall profitability for sheep operations, there has been an increase in metabolic disorders, like hypocalcemia (milk fever; low calcium) and hypoglycemia (pregnancy toxemia; low energy/glucose), due to this increase in prolificacy. The NRC defines calcium requirements by a multifactorial equation that is influenced by number of lambs gestated and body weight. The increase in lambs gestated induces the "pull-effect" or the increase in demand in minerals and energy during gestation due to fetal formation. Our understanding of micromineral requirements in contemporary and highly prolific sheep populations is unknown.

EFFORT: In collaboration with USDA Agricultural Research Service USMARC, we are evaluating serum mineral and energy metabolite status in ewes during the periparturient period. This study is being conducted on the Rambouillet, Polypay, Katahdin, CIV Composite, and Romonov breeds of sheep.

RESULTS: Preliminary research suggests that in Rambouillets, there are multiple significant differences between age of the ewe and number of lambs born when evaluating serum mineral profiles. Ongoing analysis in other breeds and their energy metabolites is currently underway. We hope that this research helps nutritionists, veterinarians, and producers in understanding the risk factors and reducing the prevalence of metabolic disorders around parturition in contemporary sheep populations.

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Sheep Foraging Behavior and Diet Selection in a Northern Mixed-grass Prairie with a High Abundance of Larkspur: Effects of Breed, Timing, and Grazing Duration

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PROBLEM: Sheep grazing has been tested as a larkspur management method to prevent cattle poisoning; however, issues with reductions in forage biomass for subsequent cattle grazing have been reported.

EFFORT: Our objectives were to quantify the effects of sheep breed, timing, and duration of grazing on selectivity of grasses, forbs, and larkspur, with the goal of reducing impacts on available forage for cattle. From mid-May through early July, 185 sheep were grazed near Cheyenne in 4 sequential 7.4-acre paddocks in a dense area of plains larkspur (*Delphinium geyeri*). Sheep bites were observed to quantify the effects of breed, timing, and duration within paddocks on mean percentages of grasses, forbs, and larkspur. The results of our study indicated that not only were there breed differences, but also timing and duration played significant roles in diet selection by sheep. Paddocks 1 and 2 were grazed from mid-May through the middle part of June while 3 and 4 were grazed from the latter half of June into July.

RESULTS: Major differences between the average percentage of forbs and grasses were found between the early and later grazed paddocks (Table 1). Additionally, we saw significant increases in the amount of grass bites and a decrease in forb bites by day 9 within a given paddock. Dorper ewes selected for a greater percentage of forbs compared to Rambouillet and Hampshire ewes. Expectations of a co-grazed system with both species should be tempered to seasonal and phenology considerations to maximize grazing productivity yet reserve range resources for future use.

Table 1. Paddock and day within paddock comparison of observed mean bite proportions for forbs, grasses, and larkspur.

	Paddock					*P* - value		
Item[1]	1[3]	2	3	4	SEM	Paddock	Day	P × D[2]
Grass, %						< 0.0001	< 0.0001	0.08
d 1-3	92.07^{ab}	87.82^{bcd}	73.5^{e}	70.75^{e}	4.2			
d 5-7	87.43^{abcd}	95.01^{ab}	80.38^{cde}	79.21^{de}	4.48			
d 9-11	-	99.35^{ab}	96.17^{ab}	94.08^{ab}	2.23			
d 12-14	-	99.39^{a}	99.1^{ab}	95.3^{ab}	3.67			
Forb, %						< 0.0001	< 0.0001	0.22
d 1-3	7.34^{abc}	12.16^{cde}	23.1^{e}	26.49^{e}	3.73			
d 5-7	8.44^{abc}	4.99^{ab}	19.61^{cde}	20.7^{de}	4.48			
d 9-11	-	0.65^{ab}	3.83^{ab}	5.92^{abc}	2.23			
d 12-14	-	0.61^{a}	0.9^{ab}	4.7^{abc}	3.67			
Larkspur, %						0.06	<0.0001	0.0004
d 1-3	0.58^{ab}	0.02^{ab}	3.4c	2.76^{bc}	1.35			
d 5-7	4.11^{abc}	0^{a}	0.01^{ab}	0.09^{ab}	2.4			
d 9-11	-	0^{a}	0^{a}	0^{a}	-			
d 12-14	-	0^{a}	0^{a}	0^{a}	-			

[1]Means sharing a superscript within plant functional groups (i.e., grass, forb, larkspur) are not statistically different ($P > 0.05$).; [2]P × D = paddock by day within paddock interaction.; [3]Paddock 1 was only grazed for 9 d due to low forage availability early in the grazing season. Bite counts were only done until d 7 in paddock 1.

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Antimicrobial Susceptibility of Ewe Mastitis-Associated Bacteria

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PROBLEM: Antimicrobial compounds are commonly used to treat livestock diseases, including mastitis, both prophylactically and therapeutically. Concerns about overutilization of antimicrobial compounds and antibiotic resistance have arisen, and consumer surveys show the average consumer is wary of antibiotic use in livestock and believe their usage affects human health. The objectives of this study were to identify levels and types of antimicrobial resistance in ewe milk-derived *Staphylococcus* spp. and *Streptococcus* spp. and to evaluate any differences in antimicrobial resistance in weaning treatment.

EFFORT: Rambouillet ewes from the Laramie Research and Extension Center sheep flock were used. Ewes were assigned to 1 of 3 groups: intramuscular injection of penicillin at weaning, restricted feed access 48 h prior to and 72 h post-weaning, and a combination of the treatments. Ewe milk samples were collected during early lactation, at weaning, and post-weaning. Milk samples were cultured and bacterial colonies were sub-cultured for isolation and identification. *Staphylococcus aureus*, coagulase-negative staphylococci (CoNS), and *Streptococcus* spp. were subjected to in vitro antimicrobial susceptibility testing.

RESULTS: Coagulase-negative staphylococci were a common mastitis pathogen (59% of milk samples), and *S. aureus* and *Streptococcus* spp. were less common. The *S. aureus* isolates were susceptible to ceftiofur, erythromycin, and penicillin, though isolates were resistant against tetracycline (55%) and sulfadimethoxine (65%). Coagulase-negative staphylococci isolates were susceptible to ceftiofur, penicillin, and tetracycline, though some exhibited resistance against erythromycin (40%) and sulphadimethoxine (44%). *Streptococcus* spp. isolates were susceptible to ceftiofur, erythromycin, penicillin, and tetracycline, albeit 33% were resistant against sulfadimethoxine. *S. aureus* isolates from ewes treated with penicillin were resistant and all isolates from feed-restricted ewes were susceptible. These findings may contribute to establishing antimicrobial alternatives, including management techniques that may reduce the incidence of mastitis.

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Characterizing Feedlot Performance and Carcass Characteristics of High-Altitude Disease Risk in Finishing Cattle

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PROBLEM: Tremendous economic loss is attributed to high-altitude disease mortality of calves in the Mountain West and Great Plains. Recent data show a higher incidence of heart failure related mortality in finishing beef cattle at low elevations. Pulmonary arterial pressure (PAP) testing has long been used as an indication of risk for cattle at high elevations, yet there is a need for indicators of risk in the finishing phase. The objective of this project is to evaluate performance and carcass characteristics in cattle divergent in risk for high altitude disease.

EFFORT: Forty-one long yearling heifers (21 ovariectomized; 20 intact) and 43 9-month-old steers (20 implanted with SYNOVEX PLUS; 23 no implant), were PAP tested and stratified into 2 risk groups (low ≤ 42 mmHg; moderate/high > 42 mmHg). Cattle were fed a high-energy ration until finishing and were weighed and ultra-sounded for 12th rib fat thickness every 2 weeks. Feed intake data was collected using the Vytelle SENSE™ system. Final weights were collected prior to transport to a commercial abattoir for harvest where carcass quality metrics and muscle tissues were collected.

RESULTS: Higher-risk heifers had greater feed intake and body weight gain compared to low-risk heifers. Intact heifers had greater body weight gain but lower intramuscular fat when compared to their ovariectomized contemporaries. Implant type had no effect on PAP, but had a positive impact on growth metrics. Muscle samples from implanted steers were less tender, juicy, and more metallic compared to non-implanted steers. Samples from low-risk steers were more umami than high-risk steers. Live growth performance and carcass quality of cattle differed by risk, but the mechanisms are unclear.

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Influences of Pregnancy Status, Stage of Gestation, and Parity on the Reproductive Tract Microbiome and the Developing Rumen Microbiome in Cattle

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PROBLEM: Improvements on reproductive efficiency in beef cattle is one of the key factors of herd profitability and a vital component of production. Studies show the influence specific microbial profiles of the reproductive tract have on reproductive health and susceptibility to disease. The objective of this study was to determine if there are shifts in the maternal reproductive tract microbiome based on parity, pregnancy status, or stage of gestation.

EFFORT: Angus-cross females from the Laramie Research and Extension Center herd were exposed to a cleanup bull following AI. At pregnancy checking, 10 bred cows, 10 bred heifers, 10 open cows, and 4 open heifers were selected for the study. At ~180 days post breeding, vaginal and uterine swabs were collected. Bred females were also sampled at 3 different stages of gestation. Microbial DNA was isolated from all samples to characterize the microbiome.

RESULTS: Data indicates greater evenness in the abundance of various taxa in bred females, whereas open females tend to have more volatility. The reproductive tract composition shifts throughout gestation, indicating that this environment is adjusting and adapting, which may be a critical feature to maintain a healthy pregnancy. Parity does not appear to impact the reproductive tract microbiome on a community level; however, unique taxa (Ureaplasma) appear to be differentially abundant between heifers and cows. These data may serve to identify females with lower potential for reproductive success and develop targeted strategies to alter the microbiome to improve conception and maintenance of pregnancy.

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Influence of Antral Follicle Classification on the Maternal Reproductive Tract Microbiome in Beef Heifers

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PROBLEM: Antral follicle count (AFC) has been identified as a reliable indicator of fertility in cattle. Additionally, the reproductive tract microbiome has been demonstrated to differ in beef females with varying fertility outcomes. Recent research suggests uterine metabolites and hormones differ by AFC in cattle; therefore, we sought to investigate the relationship between AFC and the reproductive tract microflora. The objective of the current study was to characterize the reproductive tract microbiomes over time in heifers divergent in antral follicle classification.

EFFORT: Heifers with high AFC (n = 10/yr; AFC = 38.4) and low AFC (n = 10/yr; AFC = 12.8) were evaluated over a 2-year period. Reproductive tract swabs were collected pre-breeding, pre-parturition, postpartum, and prior to re-breeding. Only pre-breeding samples from year 2 were analyzed. Microbial DNA was isolated and purified for 16S sequencing, then analysis of microbial diversity and composition were conducted in QIIME2.

RESULTS: No differences in microbial analysis were observed by AFC status across year 1 ($P \geq 0.41$) or at pre-breeding across both years ($P \geq 0.41$). Differences in uterine and vaginal samples were observed in both alpha, beta, and taxonomic composition across time ($P \leq 0.02$). Microbial richness, evenness, and phylogenetic diversity were greatest postpartum and lower prior to parturition and breeding. Differential abundance in *Prevotella*, *Streptococcus*, and Ureaplasma were observed over time. While these findings fail to establish a relationship between AFC and reproductive tract microbial characteristics, differences by reproductive tract niche and time point illustrate a clear association of the microbiome with reproduction.

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The Influence of Stair-Step Nutritional Management on Ovarian Development and Reproductive Parameters in Developing Beef Heifers

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PROBLEM: Management decisions during the first year of life play a key role in establishing heifer fertility and longevity. Recent research suggests utilization of a stair-step nutritional strategy may influence the size of the ovarian reserve in heifers. The objective of the current study was to investigate development of heifers managed on a stair-step (SS) or constant gain (CG) nutritional strategy in both drylot and native range environments on ovarian development.

EFFORT: Forty spring-born Angus crossbred heifers (671 ± 72 lb) were selected for a 2 × 2 factorial design and assigned to 1 of 4 treatments: SS-drylot, CG-drylot, SS-native range, and CG-native range. Stair-step heifers were targeted to gain 0.55 lb/d the first 45 days and 1.65 lb/d the final 45 days. Constant gain heifers were targeted to gain 1.1 lb/d throughout the 90-day feeding period. Heifers were ovariectomized at the conclusion of the feeding period.

RESULTS: Progesterone concentrations revealed puberty attainment in 23 heifers at initiation of treatments, with the majority of heifers in all treatments reaching puberty by day 45 ($P = 0.98$). Ovarian weight, surface follicle count, and dominant follicle diameter were similar ($P \geq 0.30$). No differences were observed ($P \geq 0.53$) for the number of primordial, primary, or secondary follicles/section across treatments. Utilization of a stair-step nutritional program in either a grazing or drylot system did not influence the ovarian reserve. Results suggest the ovarian reserve may be most sensitive to the effects of a stair-step dietary treatment during the peripubertal period.

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RANGELAND, PASTURE, AND NATURAL RESOURCES RESEARCH

Targeted Disturbance for Improved Nitrogen Mineralization and Forage Production in Meadows

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PROBLEM: Irrigated hay meadow soils of the Laramie Basin are unique. Due to long-term flood irrigation in cold environments, meadow soils have developed an organic "thatch" horizon at the surface that stores up to 1,500 lb nitrogen (N) per acre. If only a small portion of this N were made available to plants each growing season, producers could eliminate the need to apply fertilizer on their meadows while maintaining acceptable yield.

EFFORT: To stimulate N release for plant growth, we applied targeted grazing and light tillage to the flood-irrigated meadow south of the Hansen Arena at LREC. Targeted grazing was applied in October 2021 and 2022 using 1,200-lb dry cows for 24 hours at rates of 375 head/acre and 100 head/acre. Tillage was performed in October 2021 using a rototiller to 2-inch depth.

RESULTS: Results showed that, although the heavy grazing and tillage treatments successfully stimulated N release from the soil, disturbance to the plant community led to poor yields. In summer 2022, no treatment outperformed the untreated control. In summer 2023, both grazing treatments yielded less than the untreated control. However, in 2023 the rototilled treatment had recovered and yielded the best, although not significantly different than the untreated control. Results indicate leaving flood-irrigated meadows undisturbed leads to the highest and most consistent yield.

Table 1: Hay yield (ton/acre) for 4 treatments to stimulate N release and hay growth in flood-irrigated meadows in 2022 and 2023. Yields followed by different letters were significantly different at p = 0.05.

Treatment	2022 Hay yield		2023 Hay yield	
	(ton/acre)		(ton/acre)	
Control	2.09	A	1.71	AB
100 head/acre graze	1.83	A	1.37	AB
375 head/acre graze	1.34	AB	1.00	B
Rototill	0.64	B	1.85	A

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Proportional Abundance of the Songbird Community across Grazed Pastures at the LREC McGuire Ranch

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PROBLEM: Migrating songbirds in arid and grassland regions are declining at a steep rate due to a variety of habitat disturbances within critical breeding habitats. During the breeding season, sagebrush-obligate songbirds may choose nest locations on functioning ranches dominated by shrub species for nesting coverage and foraging opportunities. Historic high-intensity, continuous cattle grazing on sagebrush steppe ecosystems has caused declines in the songbird population by altering vegetation structure and creating less favorable conditions for nest success. Quantifying the avian community response to an adaptive multi-paddock rotational grazing (AMP) and infrastructure is relatively unknown.

EFFORT: We quantified the songbird community response to multi-paddock and prescriptive cattle grazing treatments on a sagebrush steppe ranch in Wyoming. We conducted avian point counts at 5 fixed locations within each grazing treatment pasture, detecting songbird presence by visual and auditory cues. Point counts were conducted twice throughout the breeding season, taken in conjunction with the multi-paddock herd movements.

RESULTS: Our results indicated that of the 689 observed occurrences for all species, 3 focal species dominate the songbird community on McGuire Ranch. Horned lark (*Eremophila alpestris*) proportional abundance was significantly higher (61%, n = 418) than that of other species. Vesper sparrow (*Pooecetes gramineus* (15%, n = 101)) and Brewer's Sparrow (*Spizella breweri* (9%, n = 64)) had the second and third highest proportional abundance. Thick-billed longspur (*Rhynchophanes mccownii*) and other songbird species detected during point counts were relatively low, with proportional abundances ranging from 1–6%. Further analysis will be conducted to determine the songbird community response to the timing of sampling, trends in varying environmental conditions, and distance from infrastructure on the ranch.

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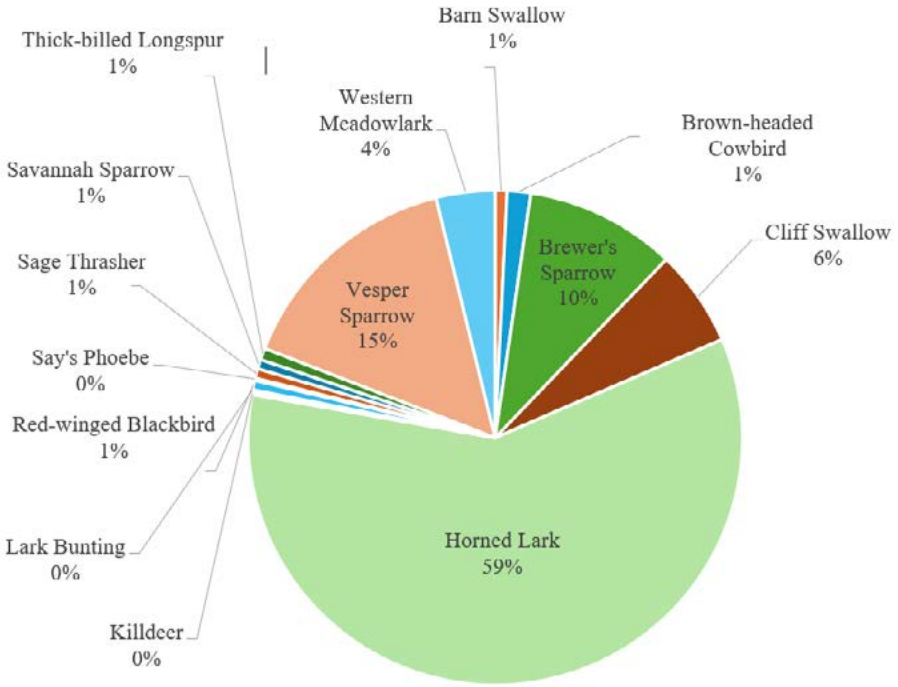

Foraging Behavior of Cattle within an Adaptive Multi-paddock Rotational (AMP) Grazing System in Sagebrush Steppe at the LREC McGuire Ranch

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PROBLEM: Observing the foraging behavior of cattle in varying grazing systems is pertinent information for understanding how cattle optimize their environment. By gathering this information, specialists can understand the utilization rates and energy expenditures of cattle for each grazing system to improve livestock production.

EFFORT: We analyzed the foraging behavior of beef cattle on a sagebrush steppe ranch for the summer of 2023. This study utilized an adaptive multi-paddock rotational grazing system and a prescriptive grazing system with varying cattle densities per pasture. The adaptive grazing treatment had 100 cow-calf pairs in a single pasture for a set time and was rotated every 1–3 weeks [mean 0.5 (± 0.309 standard deviation) cow-calf pairs per acre]. The prescriptive grazing treatment had 10–31 cow-calf pairs in 5 pastures [mean 0.09 (± 0.002 standard deviation) cow-calf pairs per acre] that stayed for 12–13 weeks. We used the bite count method to estimate the average foraging behavior of the cows in both treatments. We used linear mixed models with each grazing treatment set as the main fixed effect, the pastures as a random effect, and foraging behavior metrics as response variables.

RESULTS: Our analysis determined that cattle in an AMP grazing system on average have a longer foraging bout duration and take more bites per minute than cattle in a prescriptive treatment ($p = 0.010$ and $p = 0.005$, respectively). However, there were no significant differences in the total distance moved between grazing bouts and the total bites taken per step ($p = 0.669$ and $p = 0.138$, respectively). Further analysis to quantify energy expenditure for each grazing treatment will be explored further.

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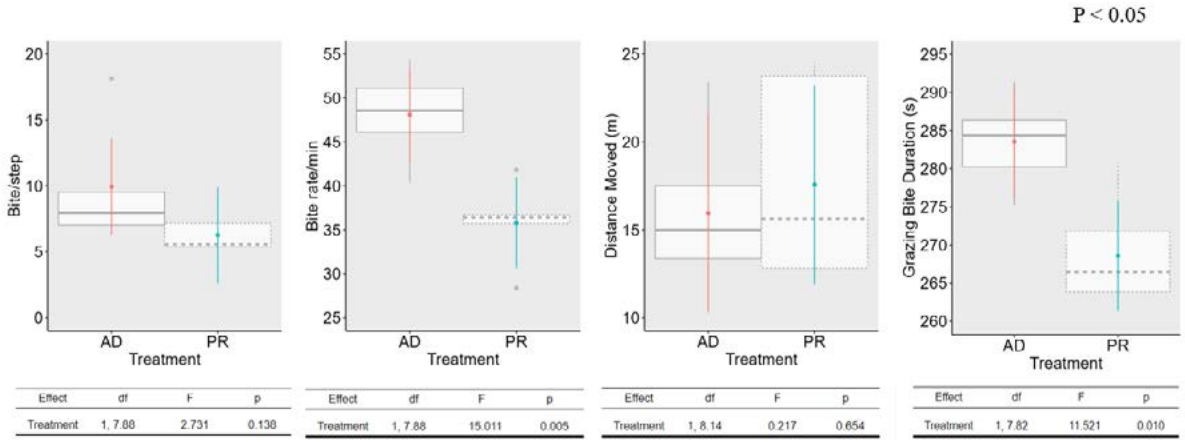

AD- Adaptive herd (red)
PR- Prescriptive herd (blue)

Quantifying Daily Activity of Beef Cows at the LREC McGuire Ranch Using an Activity-logging "Smart" Ear Tag

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PROBLEM: Precision agriculture technology has revolutionized row crop and dairy agriculture, but innovation and adoption have lagged for pasture-based livestock systems on rangelands. Moreover, the extensive nature of livestock grazing on rangelands, and the subsequent integration of precision technology, is constrained by many factors, including weather, topography, individual animal characteristics, and cellular signal access. Understanding temporal patterns of activity in the context of such constraining factors could enhance the modification of features of enterprises to enhance productivity, particularly in the quantification of individual animal behaviors on rangelands.

EFFORT: We deployed HerdDogg, Inc.© smart ear tags using a Y-Tex® Ultra Tagger Plus applicator on mature beef cows (black and black baldies with calves; Bos taurus) on June 2021 ,25, when it was convenient as cows were already being constrained in a hydraulic squeeze chute for artificial insemination. Data for cow D123 was downloaded on September 18, 2021, using the HerdDogg, Inc.© smartphone app during grazing at the McGuire Ranch. Animal care and use followed the *Guide for the Care and Use of Agricultural Animals in Research and Teaching* (Federation of Animal Science Societies, 1999).

RESULTS: The daily activity of cow D123 displays 3 distinct periods of activity: (1) pre-dawn, (2) mid-morning, and (3) late-afternoon/ evening (Figure 1). The most distinct period of resting and ruminating occurs after noon when temperatures are the warmest (Figure 1). Integrating cattle activity data with genetic traits, production outcomes, and environmental stressors may optimize livestock enterprises. Furthermore, near real-time assessment of daily activity patterns in extensive environments may operationalize early detection of problems that exacerbate foraging patterns of cattle.

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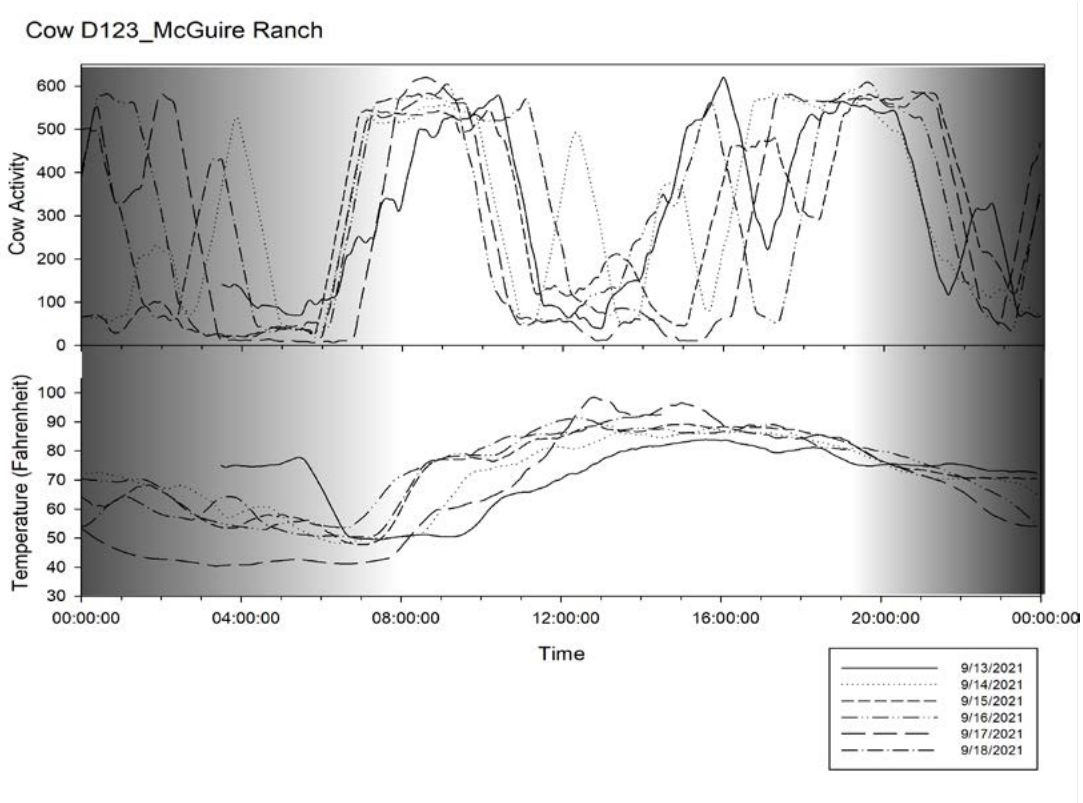

Infrastructure Development for Grazing Research at the LREC McGuire Ranch

AUTHOR(S): Timm Gergeni,[1] Derek Scasta,[1] Ben Hollinger[2]

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PROBLEM: Ranch-scale grazing research to answer complex animal and environment questions requires sufficient pasture infrastructure with persistent needs at LREC ranch facilities.

EFFORT: The Metrics, Management, and Monitoring project (or 3M) is a multi-region research initiative with the primary goal of understanding how farmers and ranchers' management practices impact soil health, carbon sequestration, and overall ecosystem health on pasture and rangeland between 3 different ecoregions located in Wyoming and Colorado (Western), Michigan (Midwestern), and Oklahoma and Texas (Southern). The 3M Western Region Research hub is located 30 miles northeast of Laramie, Wyoming, at the University of Wyoming's 5,500-acre McGuire Ranch dominated by Wyoming big sagebrush (*Artemisia tridentata*) and cool season grasses. Approximate historical cattle herd consists of ~200 cow-calf pairs grazing for 90–120 days annually beginning June 1 within 2 pastures.

RESULTS: Funding secured through the 3M grant has resulted in infrastructure enhancement and development at the University of Wyoming's McGuire Ranch. Developments include the following: installation of 12 miles of internal 4-strand Wyoming Wildlife friendly fence, resulting in 10 pastures ranging in size from 96–367 acres, including gates and hardware and removal of ~2 miles of existing fence; installation of 1 mile of 2-inch high-density welded poly pipe trenched to 6 feet, including well and stock tank plumb-in and curb stops (3) for winterization; installation of two 15-foot-diameter and one 30-foot-diameter bottomless stock tanks, including all concrete work; drilling of 370-foot water well, including plumb-in, stock tank floats, pressure tank, pump controls, and electrical; and installation of cellular stock tank water-monitoring sensors by Ranch Check. Infrastructure development at McGuire Ranch has not only resulted in enhanced grazing management, but in greater research opportunities across multiple disciplines with minimal internal cost to the University of Wyoming.

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The University of Wyoming's McGuire Ranch: A Comprehensive Study of its History, Current Uses, and Ecological Significance

AUTHOR(S): Nicki Nimlos,[1] Timm Gergini,[1] John D. Scasta[1]

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PROBLEM: Much like a captivating novel, the McGuire Ranch holds an ambiguous past with diverse ownership and use, inviting us to unravel the mysteries that remain in its narrative today.

EFFORT: Through interviews with the McGuire family, extension members, and researchers, coupled with exploring historical archives, we sought to formally document the detailed history and current uses of the McGuire Ranch and provide a robust description of the ecological landscape

RESULTS: Before the University of Wyoming's Laramie Research and Extension Center (LREC) acquired the McGuire Ranch on January 3, 1992, it had been under the ownership of various oil, mining, and railroad companies for many years. It was not until 1943 that all sections of the present McGuire Ranch came under the ownership of a single entity. In 1973, the ranch was purchased by Patrick Leroy McGuire, known as Pat, along with his 3 brothers. They ran operations with more than 200 head of cattle, horses, and sheep while residing in Wheatland, Wyoming. In 1975, Pat drilled a well on the ranch to grow malting barley for the breweries in Colorado, despite being advised by geologists that the odds of finding water were 1 in a million. Astonishingly, he found substantial groundwater and was able to pump 7,000 gallons per minute and irrigate over 1,200 acres of alfalfa and malting barley. For 2 years, Pat irrigated his crops, but was unable to achieve prosperous yields. Ultimately, on September 27, 1984, he was forced to foreclose on the ranch due to delinquency on 2 State Farm loans, a predicament shared by many farmers across America during the 1980s farm debt crisis. During his 11-year ownership, Pat encountered numerous unexplained mutilations of cattle and encounters with extraterrestrials on the ranch. These experiences led him to be interviewed by UW's psychologist, Dr. Leo Sprinkle, and featured on the ABC television show "That's Incredible". The Farmers Home Association assumed ownership of the ranch in 1985. After failing to sell it, they donated the ranch to LREC. Along with the ranch, LREC acquired the water rights, water wells, and all of Pat's cropping equipment. LREC put cattle on the ranch in the spring of 1993 and has since utilized it for summer-fall grazing, research, and teaching.

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GREENHOUSE RESEARCH

Impacts of Weeds on Nutritive Quality of First Cutting Alfalfa in Wyoming

AUTHOR(S): Clint Beiermann

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PROBLEM: Many alfalfa fields in Wyoming have weeds present in the forage harvested from the first cutting. The impacts of weeds on yield and quality are well studied in many row crops. However, there is little research that attempts to quantify the impacts of weeds on yield and quality of established alfalfa.

EFFORT: My research attempts to quantify the effects of weeds present on nutritive quality of alfalfa hay. First cutting alfalfa was sampled from fields in 4 different counties in Wyoming: Platte, Goshen, Natrona, and Sheridan. Fields were sampled prior to first cutting for plant biomass of alfalfa and any weed species present. Nutrient analysis was performed on blended proportions of plant biomass, including the following specific ratios: 100% alfalfa, 0% weed; 75% alfalfa, 25% weed; 50% alfalfa, 50% weed; 25% alfalfa, 75% weed; and 0% alfalfa, 100% weed. The LREC Greenhouse lab space serves as a home base for my program to store equipment and organize for days in the field. Forage biomass samples for this project and others need to be dried, weighed, and processed throughout the growing season and the lab space at the LREC Greenhouse serves as a place to get these activities done.

RESULTS: Three weed species were found in the fields that were sampled: downy brome, dandelion, and tansymustard. All 3 species reduced crude protein content as they increased in % of the forage biomass composition. Downy brome caused the most severe reduction in protein content, compared to dandelion and tansymustard. This data can be useful in predicting potential reduction in nutrient quality of alfalfa, based on the proportion of weed biomass present in the alfalfa field.

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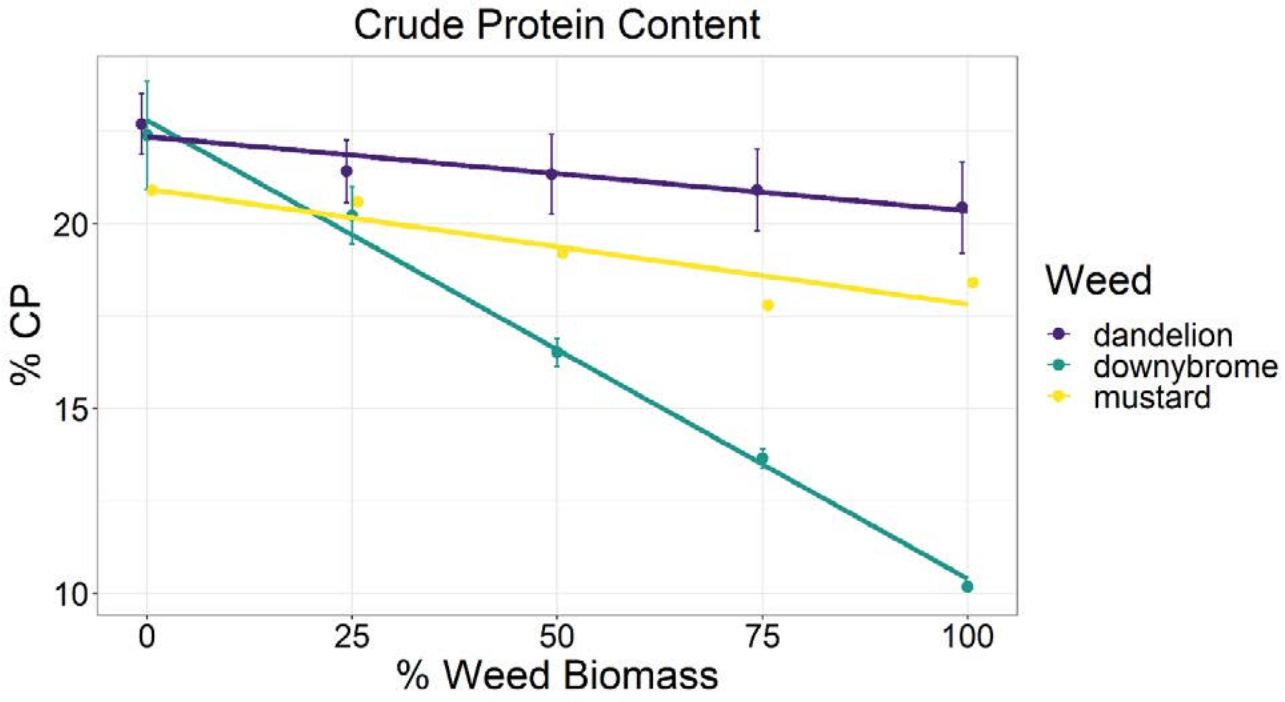

Impacts of Biostimulants on Plant Growth and Rhizobacterial Communities in Purple Mizuna (*Brassica juncea*)

AUTHOR(S): MT Brock,[1] C Weinig[1]

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PROBLEM: Innovations in Controlled Environment Agriculture (CEA) provide a possible avenue to meet domestic food demand while minimizing detrimental environmental impacts associated with conventional agriculture. Advances in and widespread adoption of CEA are limited by a lack of foundational and use-inspired research in CEA. Of particular note, little is known about the distribution or function of microbes in CEA settings, despite the pervasive effects of microbes on plant performance and the potential to manage CEA microbiomes to improve plant yield.

EFFORT: We raised *Brassica juncea* (purple mizuna) in control pots and pots inoculated with commercially available biostimulants. We measured plant size (leaf length) and harvested microbial communities from the root-soil boundary layer for characterization of microbial taxonomy and diversity via 16S rRNA profiling.

RESULTS: Biostimulants increased plant size by up to 44% (left panel below) and significantly altered the rhizosphere microbial community composition (right panel below). We are exploring which microbial taxa associate with enhancements in plant yield and will be examining how the timing of exposure to rhizobacterial communities (priority effects) impacts plant health and yield in CEA.

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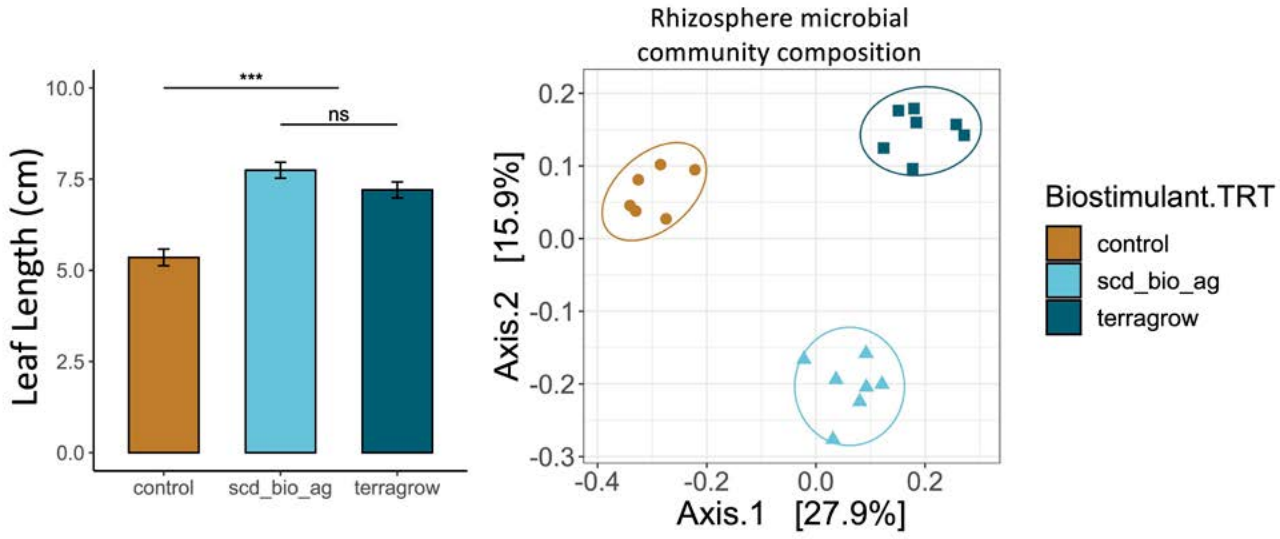

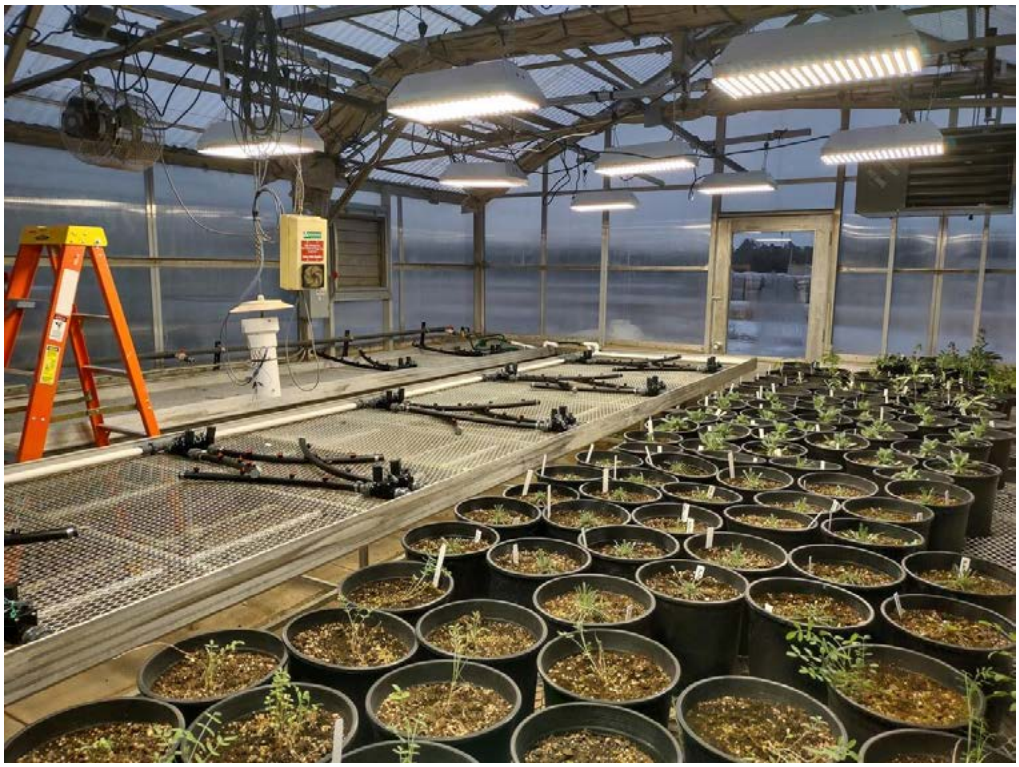

Determine the Impacts of Reduced Substrate Volumetric Water Content on the Growth and Physiology of Native Ornamental Plants in Wyoming

AUTHOR(S): Ji-Jhong Chen[1]

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PROBLEM: The impacts of reduced soil water availability on native ornamental plants have not been studied yet, and their drought-tolerant mechanisms have not been investigated.

EFFORT: Eleven LED lights were installed to extend the photoperiod to 12 hours per day in winter. Plant materials, including *Asclepias speciosa* (showy milkweed), *Penstemon eriantherus* (fuzzytongue penstemon), and *Penstemon grandifloras* (beardtongue), purchased from a local nursery, are established in the greenhouse and will be tested for their drought tolerance and suitability for water-wise landscaping. In addition, a sensor-based automated irrigation system is established at the greenhouse.

RESULTS: This project is currently being conducted, and a substrate-specific calibration equation has been obtained. A sensor-based automated irrigation system is established at the greenhouse. This system contains 24 solenoid valves and will control substrate volumetric water contents at setpoints to study drought responses of different plants. Quantum sensors and thermistors are installed in the greenhouse to continuously monitor and record environmental data. Plant materials, including *Asclepias speciosa* (showy milkweed), *Penstemon eriantherus* (fuzzytongue penstemon), and *Penstemon grandifloras* (beardtongue), purchased from a local nursery, are established in the greenhouse.

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Endophytic Fungi and Biocontrol of Canada Thistle

AUTHOR(S): Timothy Collier[1]

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PROBLEM: Canada thistle is one of most problematic weeds on rangelands throughout the western U.S. Biological control using imported, non-native insects is one approach for managing Canada thistle although impacts of insect damage are variable and may be weak.

EFFORT: My lab is beginning to examine how fungal endophytes—fungi that live inside plant leaves and other parts—influence the outcome of biological control of Canada thistle. Across plant species, fungal endophytes are known to reduce herbivory, promote growth, alter photosynthesis, and inhibit disease. I have Canada thistle plants growing in the greenhouse in anticipation of plating material on fungal media dishes to look for and identify endophytes as a first step in the project. I am currently trying to recruit a graduate student to work on this.

RESULTS: Nothing to report at this time.

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Developing Local Production Capabilities for Native Bumble Bees

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PROBLEM: Little is known about the key factors determining success of native pollinators in Wyoming. Pollination services provided by wild native bees are not only critical for agriculture but also maintain plant populations critical for game and non-game animals in the state.

EFFORT: Wyoming's native bumble bees are critical in wild and managed ecosystems, but they aren't actively managed in the state for agriculture in open fields or greenhouses. The LREC Greenhouse space, combined with irrigated and dry plots are providing ideal spaces to learn how to rear these native bees as well as perform experiments to determine what types of forage best attract workers and support colonies and queens. In 2023, we seeded a mix of primarily native forage in an open irrigated plot and grew pollinator friendly plants in the greenhouse space. We also began experiments comparing various methods for initiating colonies from wild-caught queens.

RESULTS: Mixed wildflower plantings at LREC attracted a diverse suite of native pollinators. Ongoing work aims to identify which of these plants were used most heavily by different pollinator types. Plants grown in the greenhouse were planted at local sites around town (including in partnership with the Laramie Downtown Business group). We successfully started several *Bombus huntii* colonies from wild-caught queens and will expand these efforts in 2024.

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Restoring Native Plants for Forest and Rangeland Resilience

AUTHOR(S): Kristina M. Hufford[1]

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PROBLEM: Native seed availability has limited reclamation and restoration since the 1970s and is now considered a global challenge in land management. Surprisingly little is known about revegetation requirements for many native plant species. In addition, commercial seeds of native plant species are often scarce, resulting in a focus on relatively few species available through cultivation.

EFFORT: We identified seed sources, germination, and establishment requirements of several native species in Wyoming, including native legumes. Two legumes were assessed for toxicity levels and growth requirements. Seed collections were made throughout Wyoming and in nearby states. Seeds required scarification to ensure germination.

RESULTS: Plants were highly susceptible to greenhouse pests and low nutrient levels, presenting a challenge for cultivation in controlled growth environments. Toxicity levels varied from population to population and initial results indicate that each species will require further investigation to determine the relative contributions of the genotype (population origin) and environment to toxin levels. Of the 2 legumes studied, *Oxytropis lambertii* and *Lupinus argenteus* both have characteristics that recommend them for use in horticulture and rangeland reclamation.

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Phytochrome-Mediated Response of Strawberry to Far-Red Light Reflected from Different Plant Canopies and Far-Red LED

AUTHOR(S): Fraidoon Karimi[1]

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PROBLEM: In a dense planting environment, the plant canopy is enriched by far-red light (Fr) reflected by surrounding plants. Low R:Fr is ultimately changing plant morphology, physiology, and biochemistry. There is lack of report in kin recognition studies in strawberries, which is important for maximum crop production. According to reports thus far, a lower R:Fr ratio boosts fruit output in some strawberries. But there is a lack of report on the effects of far-red light on different growth stages of strawberry, as well as an understanding of the irreversibility of its effects in plant organs.

EFFORT: Two experiments were conducted from May through November 2023 in LREC Greenhouse 46B to understand the response of strawberries to reflected far-red lights from different surrounding species canopies and to determine the effect of far-red lights in different growth stages of strawberry.

RESULTS: Although strawberries do not discriminate between kin and non-kin in reflecting far-red light, they showed cooperative behavior with interspecies. Plants oriented their leaves to empty space in presence of their kin, but overlapped on non-kin. This may be useful in maximizing strawberry production under dense planting such as in a controlled environment or when intercropping with other crop species. This may also be useful in reducing weed management costs in strips of strawberry in open field cultivation, if belowground competition is minimized. The effect of far-red light on June-bearing strawberries was reversible and Fr light effects seem to be organ specific. Far-red light, in combination with natural PAR, can widen the plant canopy, which helps in better aeration, quantum harvest, and ease of crop harvest and management without affecting other vegetative traits.

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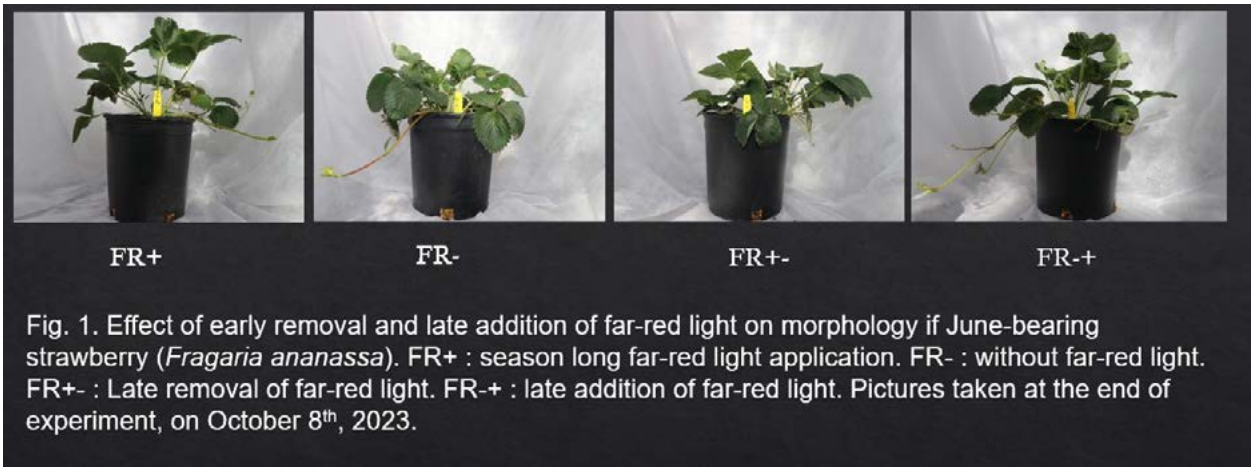

Fig. 1. Effect of early removal and late addition of far-red light on morphology if June-bearing strawberry (*Fragaria ananassa*). FR+ : season long far-red light application. FR- : without far-red light. FR+- : Late removal of far-red light. FR-+ : late addition of far-red light. Pictures taken at the end of experiment, on October 8th, 2023.

Using LREC to Support the Development of Epigenomic Tools from *Euphorbia esula* L. (Leafy Spurge)

AUTHOR(S): Camellia Moses Okpodu[1]

AFFILIATION: [1]Department of Botany, University of Wyoming

PROBLEM: Leafy spurge infestation has an estimated direct annual impact of $40.5 million in Montana, North Dakota, South Dakota, and Wyoming. Biological controls take several years to make an impact and should be considered one of many methods of control. For effective, long-term control of leafy spurge, establishing competitive vegetation with perennial grasses and selective herbicides is the recommended management tool for containing and preventing the spread of existing infestations and for eradication of new infestations. We are using biochemical and epigenomic techniques to better understand the life cycle of leafy spurge and the survival approaches that make it a complex plant to contain through biological controls.

EFFORT: Last year, I applied for the Mary and Trent MacDonald Data Science Faculty Fellowship. This funding allowed for me to work on the isolation of DNA from leafy spurge. We grow leafy spurge in the greenhouse and spent last semester isolating DNA. Because of the terpenoids and other secondary metabolites, it has made getting clean DNA from the plant a challenge. In November 2023, we were able to finally isolate DNA from spurge and we sent it to be sequenced by Novogene. In working on this project, I discovered there is no DNA reference library for spurge. If we can get good quality DNA, this data could serve as a reference library for others. We will attend the PAG-31 meeting in San Diego and start a collaboration with Horvath, David - REE-ARS in North Dakota.

RESULTS: We were able to isolate genomic DNA (Figure 1). We sent the control DNA to be sequenced in November. We received the first report from Novogene (Table I). Unfortunately, the QC for the sample is not of the quality needed. We will try a clean-up step after we purify the DNA and see if that will improve our OC run.

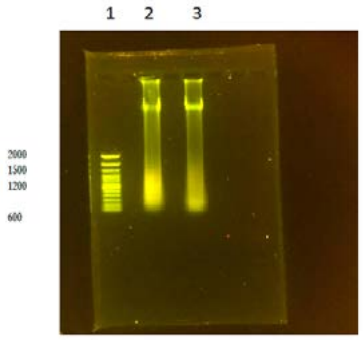

Figure 1. Genomic DNA isolated from leafy spurge on a 0.8% 1X TAE gel. Lane 1, Invitrogen 100 pb DNA ladder; Lanes 2 and 3 genomic DNA isolated from non-treated plants.

Table 1. Quality Control Run of Control Genomic DNA from Leafy Spurge by Novogene 12-

QC	Concentration	Comments
Failed	72.40 (ng/μL)	Slightly degraded, slightly impure, Severe RNA contamination/extra fragments, severely [colored]

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Greenhouse Weather Station

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PROBLEM: Weather refers to short-term changes in the atmosphere (for example, daily and annual variations in air temperature), while climate describes what the weather at a specific location is like over long time periods.

EFFORT: Our research group has been collecting weather data around Wyoming since 2020. These weather data serve 2 purposes: they provide stakeholders with real-time weather conditions at their location and, going forward, they provide an archive of past and current climate conditions that may be used to determine impacts of potential future climate changes. We installed a weather station at the LERC Greenhouse facility during the summer of 2021. This station is a test bed for instrumentation that is deployed across the state, while also providing real-time weather data at the greenhouse.

RESULTS: The LREC Greenhouse weather station collects a comprehensive set of measurements, including air temperature, wind speed and direction, precipitation, relative humidity, air pressure, solar radiation, snow depth, and soil moisture and temperature. Data are collected at 5-minute intervals and downloaded every 10 minutes. In addition to the listed weather sensors, 2 cameras record digital images of the station site at 15-minute intervals (Figure 1). After being QA/QD'd these data and images are archived at the University of Wyoming Water Resources Data System. Recent weather data and images are also available on the station web page (http://www.wrds.uwyo.edu/Mesonet/Greenhouse.html), which is updated hourly. For more information or to access archived data, contact the authors.

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Disturbance and Resources across Global Grasslands (DRAGNet) Seed Bank Experiment

AUTHOR(S): Lauren Shoemaker,[1] Melissa H DeSiervo,[1] Courtenay Ray[1]

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PROBLEM: Humans are driving changes in plant community diversity, abundance, and biomass through physical and chemical disturbances, such as tilling and increased fertilization. The DRAGNet experiment seeks to understand the impacts of these disturbances individually and in tandem across multiple grassland plant communities. One factor that could affect grassland recovery from disturbance is the availability and persistence of seeds in the soil (i.e., the seed bank). To quantify the size and diversity of the seed bank from one grassland community in eastern Wyoming, we are monitoring seed germination over time in field-collected soil in the LREC Greenhouse.

EFFORT: We collected soils from experimental plots at the UW Sustainable Agriculture Research and Extension Center (SAREC) near Lingle, WY, in March 2022 and transferred the soils to trays at the LREC Greenhouse. The soils are kept moist and are monitored weekly for seedlings. As possible, all seedlings are quantified and identified to species.

RESULTS: Thus far, approximately 900 seedlings have germinated from the seed bank. Once the seed bank experiment is complete, seedling germination data will be paired to field measurements of grassland response to disturbance and nutrient addition at SAREC. This data will be combined with similar experiments in grasslands around the world to better understand grassland responses to multiple anthropogenic drivers. Our local data is serving as preliminary data for an in-preparation collaborative NSF grant proposal between the University of Wyoming and Michigan State University.

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Impacts of Coal Char and Biochar on Plant Growth, Nitrogen Retention, and Soil Properties on Sandy Loam and Sandy Clay Loam Agricultural Soils

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PROBLEM: N fertilizer leaching, especially nitrate (NO3-N), is a severe problem in coarse texture and sandy soils. Excessive use of N fertilizers can increase concentrations of NO3 in groundwater and streams, causing health problems for humans and animals. High concentrations of NO3-N have been detected in groundwater in many agricultural regions with coarse-textured soils and in many of these areas the problem is increasing.

EFFORT: A greenhouse pot study used coal char (CC) and biochar (BC) as a soil amendment to evaluate plant growth, N retention, and soil properties. A field study outside the greenhouse was also set up to evaluate long-term plant growth and soil health by using coal char as a soil amendment. Leachate water was collected to analyze the NO3-N and NH4+, plant biomass was measured, and soil properties were analyzed after the harvest.

RESULTS: Results of this greenhouse study suggest that CC and BC applied with fertilizer in the range of application rate 2–6% (w/w) on sandy loam (SL) and sandy clay loam (SCL) soils can significantly increase plant growth compared to non-char fertilized control treatment. All treatments contained the same amount of nitrogen in the soil. Moreover, char materials as a soil amendment seemed more effective in SL soil than in SCL soil. Soil organic matter was significantly increased in CC and BC treatments. NO3-N retention was effective in CC treatments compared to other treatments. As expected, the leaching of NH4-N from both soils tested was less than NO3-N.

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Common Lambsquarters Germination in Response to Nitrate and Far-Red Light

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PROBLEM: Temperature and light are one of the reliable environmental cues that weeds use to determine the time and place of emergence. This time clock and canopy gap detection ability ensures that weeds emerge on cultivated fields during planting time and when canopy gap is detected. Knowledge of this mechanism has helped farmers avoid certain types of weeds by using cover crops or planting dates. However, cover crops and planting dates may not be effective if there is temperature and light variability within or between species. In addition to light, nitrate is used by weeds to optimize their information about canopy gap or as a backup in determining canopy gap in the absence of light. With nitrate as a major requirement in cultivated crops, it is not clear whether its application promotes or suppresses the emergence of common lambsquarters and, if so, at what concentration?

EFFORT: All accessions of common lambsquarters—at USDA repository—and different populations of kochia from Colorado, Nebraska, Montana, Powell, and Lingle were obtained and grown at the greenhouse for seed increase. This was followed by common lambsquarters germination in response to nitrate and light.

RESULTS: The results suggest variation in light sensitivity among the accessions, implying that cover crops may not effectively suppress common lambsquarters accessions that are light insensitive. The results also suggest that increasing concentration of nitrate increases germination of some biotypes of common lambsquarters in very low intensity and low intensity red light and reduces germination in plant canopy light.

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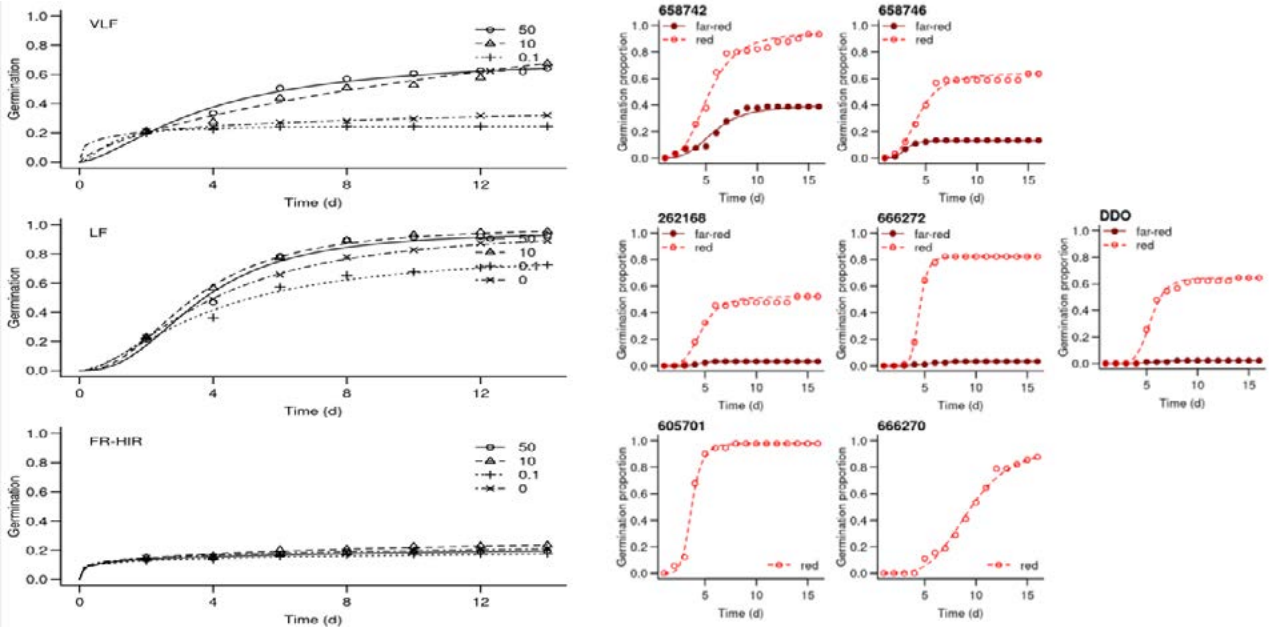

Molecular Basis of the Role of Chloroplast-Nucleus Communication in Plant Immunity

AUTHOR(S): Seungmee Jung,[1] Jesse Kaleku,[1] Jongchan Woo,[1] Eunsook Park[1]

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PROBLEM: The endomembrane system has been linked to pathogen and mutualist-induced cell death and is important for the proper activation and recycling of PRRs. Presumably because of this, a number of pathogen effectors appear to target host membrane trafficking pathways. The cytoskeleton is likewise a common target for pathogen effectors because of its important role in resistance, including responses to mechanical stresses such as attempted fungal penetration and the movement of organelles to their appropriate subcellular locations during the defense response. The 2 most important organelles for the defense response are the nucleus and the chloroplast, both of which are also common effector targets. Chloroplasts are important sources of defense signals, including ROS and salicylic acid (SA), while the nucleus is important in transcriptional reprogramming. Stromules, narrow stroma-filled tubes that extend from plastids, often attached to other subcellular compartments, including the nucleus, are induced by HR and other forms of PCD. Several inducers of HR from viruses and bacteria were shown to induce stromule formation and clustering of chloroplasts around the nucleus in *N. benthamiana*. This perinuclear chloroplast clustering may be facilitated by stromules themselves and appears to involve microtubules and the cytoskeleton. Stromules are believed to facilitate the translocating of signaling molecules from the chloroplast to the nucleus and may stabilize chloroplast sub-cellular positioning.

EFFORT: Using advanced microscopy and biochemical approaches, we monitor the dynamics of organelles and rapid changes of the cellular status upon pathogen infection in plant cells.

RESULTS: None to report at this time.

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Laramie Research & Extension Center

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