






Executive Summary

The Corona Range and Livestock Research Center (CRLRC) is a working ranch, field research laboratory that encompasses 27,886 acres of native rangeland in the immediate center of the State. Sited on the Research Center is the Southwest Center for Rangeland Sustainability (SWCRS), which includes an indoor and an outdoor classroom, a commercial kitchen, and limited overnight accommodations. The CRLRC has historically been minimally staffed to provide for daily animal care needs with reliance on campus-based faculty and graduate students to provide additional labor as needed to complete the task at hand.

The CRLRC has faced two major challenges this past year. 1) Regional drought currently challenges the development of immediate research projects due to drought mitigation practices that include downsizing herd inventory, as well as, exclusion or limitations of specific areas of the ranch for grazing to provide for pasture management during limited precipitation levels. 2) Statewide Covid-19 spread mitigation has suppressed implementation of new research activities on the research center, however previously initiated essential research is still being conducted under Covid Safe Practice protocols. While critical research is allowed a process for implementation, it does not lend itself to CRLRC during the pandemic as future Covid mitigation efforts could impact studies with Principal Investigators and labor efforts wholly from campus 200 miles away.

The CRLRC started the fiscal year with 745 beef cattle, 567 sheep, and 95 goats, however highly variable, lower than average precipitation has caused the CRLRC to plan on the reduction of livestock inventory to approximately 164 beef cattle, 130 sheep, and 53 goats by just after the first of the year 2021. Limited numbers of livestock will be relocated to dry lot feeding for research or short-term research or management with the hope of bringing back to the ranch; however, most of the livestock will likely be sold and never return to the ranch. Selling livestock during drought results in suppressed livestock value which then results in increased costs due to high prices for replacement livestock due to higher market demands during regional livestock inventory building. Much of future livestock inventory increases will be the result of retaining replacement animals from within crops usually sold for operating income, therefore operation expenses will be increased and revenue will be decreased.



Drought mitigation is a continual struggle, planning is always at the forefront of any annual plan, and CRLRC has maintained financial means to mitigate the investment in future herd buildup through herd replacements purchase and/or reverse economies of building herd from ranch-raised replacements.

All research that was initially lined up for 2020 before the Covid-19 mitigation efforts were subsequently approved for continuation under Covid Safe Practices and the experimental protocol was completed for the year for each. However, any studies that were not scheduled before that point and time have been postponed indefinitely, until such time that it seems practical to initiate without complications with data collection efforts.

The SWCRS, a concept brought to fruition by our advisory committee, is the outreach and educational arm of the CRLRC. Statewide Covid-19 mitigation efforts stopped any face-to-face meetings of groups of clientele that made our outreach mission safe, effective, and economical and forced us to cancel our annual flagship program, the United States Beef Academy. Currently, SWCRS associated faculty and staff are brainstorming and planning for new and exciting outreach and educational programming so that we can hit the ground running as soon as deemed socially responsible to congregate our clientele for the dissemination of the information and knowledge they desire and deserve.

A photograph of a person wearing a maroon polo shirt and a grey cap with a logo, looking towards a dark-colored horse in a field. The person's hand is visible near the horse's head. The background shows a wooden fence and green trees under bright sunlight.

Meeting The Needs Of New Mexico

The Agricultural Experiment Station (AES) system is the research arm of New Mexico State University's (NMSU) College of Agricultural, Consumer, and Environmental Sciences (ACES), consisting of scientists on the main campus and at agricultural science centers (ASCs) throughout New Mexico. The 12 ASCs support fundamental and applied research under New Mexico's varied environmental conditions to meet the agricultural and natural resource management needs of communities in every part of the state. ASCs consist of two types: 1) facilities without resident faculty, which serve as research support field laboratories for campus-based faculty, and 2) off-campus facilities with faculty stationed at the centers that also serve, in part, as research support field laboratories for campus-based faculty.

The Corona Range and Livestock Research Center does not have resident faculty and serves as a research support field laboratory for campus-based faculty. Much of the research conducted at the center has worldwide implications that inherently address state and local needs, such as, investigating basic cellular function in heifer reproductive timeline to increase longevity in the herd and source of supplemental protein effect on progeny and breeding interval.

A photograph of a man wearing a black cowboy hat, glasses, and a red and white checkered shirt. He has a goatee and is wearing a red lanyard with "NMSU Cooper" and "Days" visible. He is also wearing a white name tag. The background shows other people wearing hats, suggesting a conference or meeting.

Natural Resource Management

- Evaluating regrowth of juniper saplings targeted by grazing goats as a control mechanism
- Effects of goats as a control mechanism as it relates to water dynamics concerning sapling size/density
- Using hydrogels to enhance restoration of rangelands in a monsoon driven dryland system

Recently completed natural resource projects in analysis and final publication include:

- The role of frugivores (fruit eaters) in dispersal and germination of juniper seeds in Central New Mexico
- Evaluation of different herbicides to control Cholla cactus on rangelands

Range Livestock Production

- Evaluating the efficacy of killed vs. modified live vaccines on calf performance and serum titer levels
- Using growth implants on beef heifer calves and the effect on sale weight and reproductive ability
- Developing strategies to increase the longevity of breeding heifers by increasing ovarian egg potential

Agricultural Experiment Station

What Is the Agricultural Experiment Station?


NMSU's Agricultural Experiment Station is the principal research unit of the College of Agricultural, Consumer and Environmental Sciences. All research faculty in the college have appointments in the Agricultural Experiment Station.

Mission

The Agricultural Experiment Station is not a physical site, but rather a system of scientists who work on facilities on the main campus in Las Cruces and at 12 agricultural science and research centers located throughout the state. The Agricultural Experiment Station system also interacts with other university research units and various state and federal agencies to provide opportunities for research that will benefit the citizens of New Mexico.

The Agricultural Experiment Station supports research designed to:

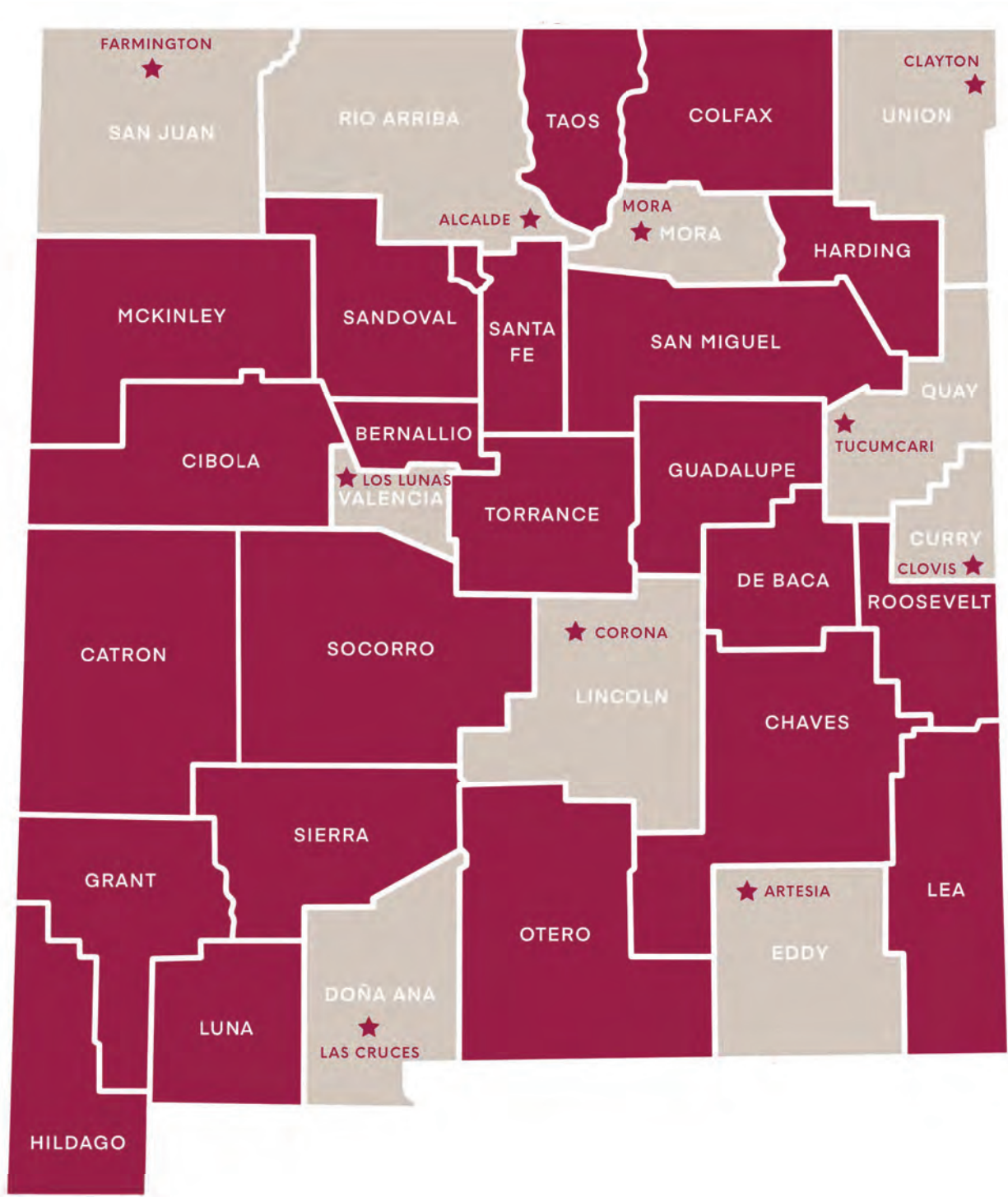
- Enhance agricultural profitability.
- Stimulate economic development using natural resources.
- Improve the quality, safety and reliability of food and fiber products.
- Sustain and protect the environment with ecologically sound practices.
- Manage and protect natural resources.
- Improve the quality of life for the people of New Mexico.



AES Research Focus Includes, but is not limited to:

Agricultural water use efficiency, endangered/ sensitive species management, cattle genetics to improve grazing, improve forage quality, range management improved crop selection, soil-borne disease prevention, food safety and nutrition, product development and value-added agricultural products, medicinal plant uses, and water quality and treatment.

NMSU Agricultural Experiment Station



★ Station Locations

Corona Research Center

Fiscal Year: 2020
Fiscal Period: 30-Jun-20

Department	Acct Type	Account Index Desc	Revenue YTD	Expense Budget	Expense YTD	Budget Balance Available YTD	Fund Balance Dr/(Cr)
Corona Research Center	SALES & SERVICE	CORONA STATION - REVOLVING	\$306,898.76	\$118,000.00	\$247,862.22	(\$129,862.22)	(\$179,241.13)
Corona Research Center	SALES & SERVICE	WIND ENERGY LEASE	\$47,250.00	\$0.00	\$12,970.00	(\$12,970.00)	(\$74,780.00)
Corona Research Center	SALES & SERVICE	ANRS LIVESTOCK JUDGING TEAM	\$0.00	\$2,000.00	\$0.00	\$2,000.00	(\$1,000.00)
		Total Sales and Service Funds	\$354,148.76	\$120,000.00	\$260,832.22	(\$140,832.22)	(\$255,021.13)
							* See note
Corona Research Center	STATE APPROPRIATIONS	CORONA CENTER RANCH OPERATING		\$96,981.44	\$96,981.36	\$0.08	
Corona Research Center	STATE APPROPRIATIONS	CORONA ADMIN		\$9,555.00	\$9,627.02	(\$72.02)	
		Total State Appropriated Funds		\$106,536.44	\$106,608.38	(\$71.94)	

Note: " () " In the Fund Balance column indicates a positive number. These figures are based on an overall NMSU budget balance and may not reflect the exact budget at varying times of the year for the Corona Research Center.

AES RESEARCH

NMSU's Agricultural Experiment Station research publications provide information to help improve production techniques and efficiencies for farmers, ranchers, dairies, and other agricultural producers.



Forestry



Agronomy



Dairy



Weather and Climate



Horticulture



Task Force Reports



Livestock and Range



Water



Economics

UNITED STATES BEEF ACADEMY- SUMMARY 2019

Investigators: John Wenzel, Bruce Carpenter, Craig Gifford, Shad Cox, Ryan Ashley, Paul Gutierrez, Shanna Ivey, Clint Loest, Eric Scholljegerdes, Adam Summers, Marcy Ward, Jack Thomas, Chris Allison, Dean Fish, J. P. Pollreis, Gary Sides, Mose Moseley, Kevin Millner, and Leann Saunders

The United States Beef Academy (USBA) is an educational event for young men and women who are motivated to learn about the beef industry. It is a five-day, intensive educational opportunity and focuses on current methods and technology used in beef production. Each day of the Academy focuses on a different scientific area of beef production. This event is under the direction of New Mexico State University Department of Extension Animal Sciences and Natural Resources, Texas Agri-Life Extension, and Colorado State University. The US Beef Academy was formed to provide a unique, intense educational experience for the students that attend. The faculty of the Academy consists of the specialists in the Department of Extension Animal Sciences and Natural Resources and Texas AgriLife Extension, professors from the Department of Animal and Range Sciences from both NMSU and CSU along with speakers from allied industries.

Day one focuses on the consumer of beef and their desire to purchase a safe and wholesome product. We have several speakers on food safety, proper cooking methods, how genetics and production methods can influence the quality of the product, and conduct a taste panel for the students to witness for themselves these differences can make on the final product.

Day two focuses on animal health and welfare, with topics such as cattle Stewardship and Stockmanship, preventative health care, immune function, and how immune function can be enhanced with proper husbandry practices and vaccination procedures and includes becoming BQA certified.

Day three focuses on nutrition. Topics include feeds and feeding, anatomy and physiology of the ruminant animal, the role nutrition plays in production, and how to maximize nutrition in an arid environment.

Day four focuses on beef cattle reproduction. Topics include anatomy and physiology of the reproductive tracts of the cow and bull, the estrous cycle, production practices that can influence reproductive function, current technologies that are employed in industry, and cutting edge technology such as genomic information and how to use it.

Day five continues with live cattle palpation and ultrasound, then the rest of the day focuses on marketing and the global picture of US beef. Topics include marketing options, cattle futures, value-added marketing programs, and the role US beef plays in the global demand for beef.

The U.S. Beef Academy is housed at the Corona Range and Livestock Research Center in Corona, NM. The student body of the Academy consists of college upperclassmen, graduate students, and veterinary students. To date, the academy has had 68 students from 16 states and Mexico. The Academy has strong national corporate support including our title sponsor, Zoetis Animal Health, major sponsor Zinpro Performance Minerals, and day sponsors including the NM Beef Council, Purina Mills, Zoetis, American Breeder Services, and IMI Global. The opportunity for students to interact with others from outside their home area greatly enhances their educational experience and hopefully provides an opportunity for them to form lasting friendships with students that have a different background, experience, and viewpoint of the beef production industry. The faculty of the US Beef Academy hopes that the future leaders of the beef industry will have received at least a portion of their knowledge in Corona, NM.

JUNIPER SAPLING REGROWTH FOLLOWING TARGETED GRAZING TREATMENTS IN RELATION TO TERPENOID CONCENTRATION

Investigators: Yasser M. Almalki, Andrés F. Cibils, Richard E. Estell, Dave Stricklan, Santiago A. Utsumi, and Alexander G. Fernald

Chemically defended woody plants are expected to grow at slower rates compared to less-well defended counterparts. The objective of our study was to determine whether regrowth of browsed one seed juniper saplings (*Juniperus monosperma*) was related to initial terpenoid concentrations. Targeted grazing with small ruminants was applied on sixteen 10 x 30 m sapling-infested rangeland plots at NMSU's Corona Range and Livestock Research Center in the summer of 2006 (n = 8) and spring of 2007 (n=8). Immediately after grazing, the foliage of approximately 10 saplings in each plot was harvested and subsequently analyzed in the lab using gas chromatography/mass spectrometry. In 2017, we returned to the plots to measure sapling survival and regrowth. We hypothesized that sapling regrowth rate would be inversely related to terpenoid concentration measured in 2006/07. We used linear regression to explore this hypothesis using PROC REG in SAS 9.4. Plot averages were used in two separate regression analyses (summer and spring). Crown height of saplings increased 20.1 ± 1.4 cm and 19.9 ± 2.2 cm, and terpenoid concentration was 0.30 ± 0.01 mg/gDM and 0.26 ± 0.01 mg/gDM in spring and summer plots, respectively. Terpenoid concentration explained 52% of the variation in sapling regrowth in spring plots ($\beta = -88.2$; $P=0.04$) and 81% of the variation in sapling regrowth in summer plots ($\beta = -227.6$; $P<0.01$). As predicted, we found an inverse relationship between initial terpenoid concentration and one-seed juniper sapling regrowth 10y after applying targeted grazing treatments with small ruminants. Since sheep and goats preferentially browse saplings with low terpenoid levels, our results suggest that heavily browsed saplings that survive are likely to exhibit the highest regrowth rates after treatment.

ONE-SEED JUNIPER SAPLING CONTROL: EFFECTS OF SIMULATED BROWSING ON SOIL-PLANT WATER DYNAMICS IN RELATION TO SAPLING SIZE AND DENSITY

Investigators: Yasser M. Almalki, Alexander G. Fernald, Andrés F. Cibils

This study seeks to understand how simulated targeted grazing impacts soil moisture redistribution between saplings and understory grass and whether this creates windows of opportunity for juniper seedling recruitment. The objective of our study is to determine whether: 1) sapling defoliation frees up detectable amounts of soil moisture for understory growth and new seedling establishment, 2) the effects of defoliation are contingent on sapling size and stand density, and 3) sapling survival and understory response depend on the frequency of defoliation. We hypothesized that soil volumetric water content will increase over the short term (weeks) with simulated targeted grazing of one seed juniper saplings compared to control plots; increase in soil volumetric water content and understory growth resulting from defoliation treatments will be greater in sparse stands with larger saplings; sapling control (kill) and understory response will be as follows: herbicide > 2 defoliations > single defoliation > control (no defoliation).

METHOD(S)

Twelve sapling-infested rangeland plots at NMSU's Corona Range and Livestock Research Center were established in the summer of 2019 for the experiment. Each plot has four sub-plots with short or large and sparse or dense sapling stands. An electric fence was set up to prevent cattle from entering experiment plots during the study timeline. Beginning in fall 2019, soil volumetric water content was measured using four CS655 sensors on each plot; buried in the superficial soil layer at 0.15-0.25 m under sapling drip lines (figure 2).

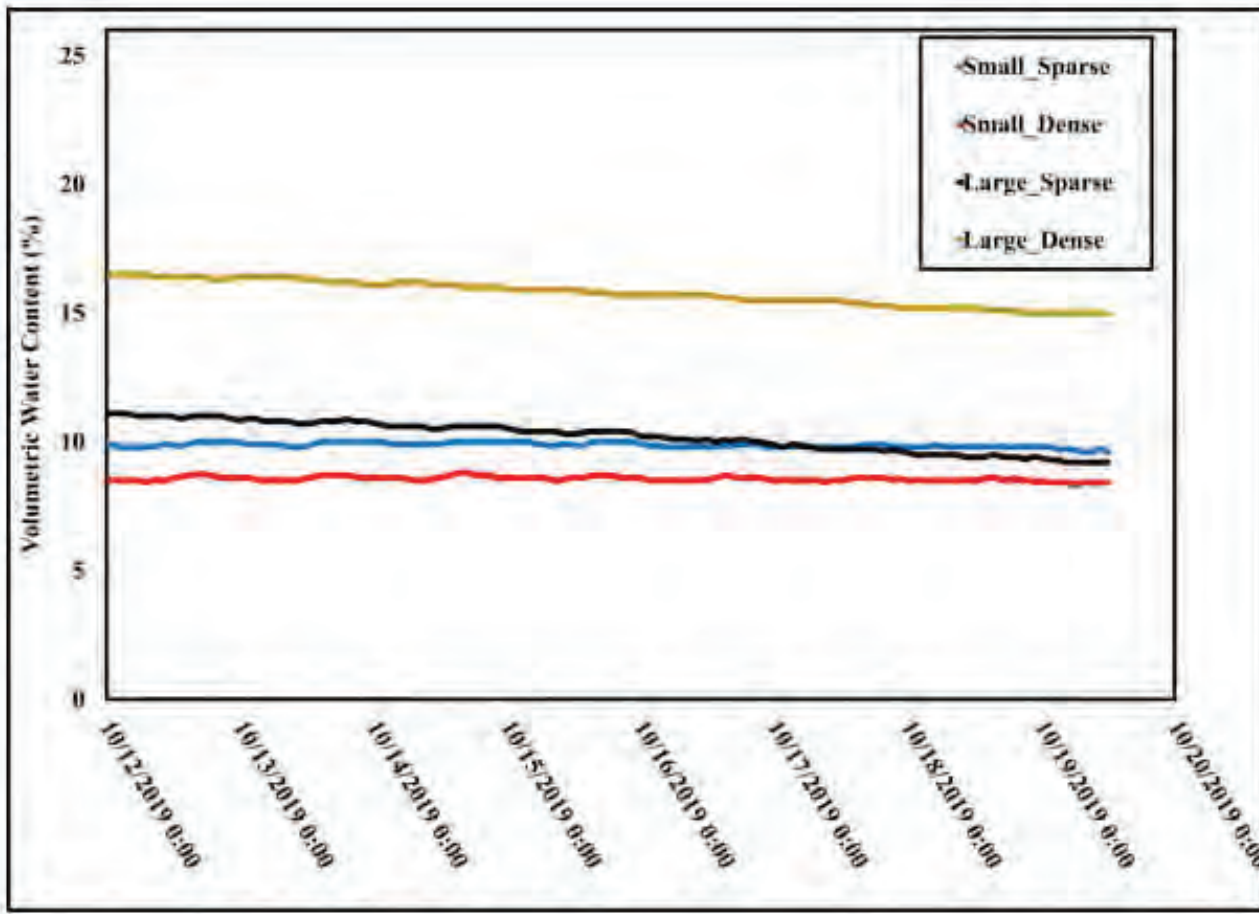
PROGRESS

Four defoliation treatments with three replicates: a) single clipping in year 1; b) single clipping in years 1 and 2; c) herbicide application in year 1 (completely removed); and d) untreated (control) will be randomly applied on the plots in the spring and summer of 2020 (figure 1). Additionally, a weather station will be installed in the pasture to collect the hydrological data needed to understand the eco-hydrological processes involved in this study.

Figure 1. Plot layout and design of the experiment

		Treatment			
		Herbicide in year 1	Single clipping in year 1	Single clipping in years 1 and 2	Control
Size	Small Sapling	Small Sapling	Small Sapling	Small Sapling	Small Sapling
	Large Sapling	Large Sapling	Large Sapling	Large Sapling	Large Sapling
Patches	Sparse Sapling	Sparse Sapling	Sparse Sapling	Sparse Sapling	Sparse Sapling
	Dense Sapling	Dense Sapling	Dense Sapling	Dense Sapling	Dense Sapling

Figure 2. An example of the percentage of volumetric water content (VWC) in plot number 2 during a week on October 2019 for the four situations of the saplings.



IMPACT STATEMENT

Our research goal is to understand the eco-hydrological processes involved in vegetation changes that occur as a result of applying targeted grazing prescriptions to suppress one seed juniper sapling growth and encroachment. By the end of the study, we anticipate understanding how simulated targeted grazing impacts soil moisture redistribution between saplings and understory grass and whether this creates windows of opportunity for juniper seedling recruitment. Our findings will help refine currently targeted grazing prescriptions for one seed juniper saplings.

CONFERENCE ABSTRACTS SUBMITTED

Almalki, Y.M., A.G. Fernald, and A.F. Cibils. 2020. One seed juniper sapling control: Effects of simulated browsing on soil-plant water dynamics concerning sapling size and density. Society for Range Management, February 16-20, 2020, Denver, CO.

Almalki, Y.M., A.F. Cibils, R.E. Estell, D. Stricklan, S.A. Utsumi, and A.G. Fernald. 2019. Juniper sapling regrowth following targeted grazing treatments concerning terpenoid concentration. Society for Range Management, February 10-14, 2020, Minneapolis, MN.

USING HYDROGELS TO ENHANCE WATER HOLDING CAPACITY AND ULTIMATELY RESTORATION SUCCESS IN A MONSOON DRIVEN DRYLAND SYSTEM

Investigators: A. M. Faist, S. M. Meadors, and E. A. Lehnoff

POTENTIAL IMPACT(S)

Through drought and lack of available water across the US southwest, active rangelands are experiencing land degradation and a reduction in desirable grass species used in native range forage. With water limitations only projected to increase further exacerbating the problem, we must identify novel and creative ways to enhance native grass cover on rangelands to aid in livestock production and bolster local economies. One area that holds promise is the use of superabsorbent polymers or called hydrogels. Through being integrated directly with the top layer of soil, these hydrogels are a small crystalline substance that can soak up nearly 1,000 times their weight in water. Through this mechanism, hydrogels can capture available water when it is plentiful and then slowly release it to the thirsty plants between the often-prolonged periods when no rain occurs. While commonly used in agriculture the inclusion of including hydrogels in rangelands that commonly experience monsoon type pulses of rains. With the potential for increased water availability over greater durations, germination and establishment potential is also increased. Through greater grass cover, higher stocking rates and livestock production levels are also improved.

Fig 1) Fencing and plots after watering treatments applied (photo credit: S. Meadors).



METHOD(S)

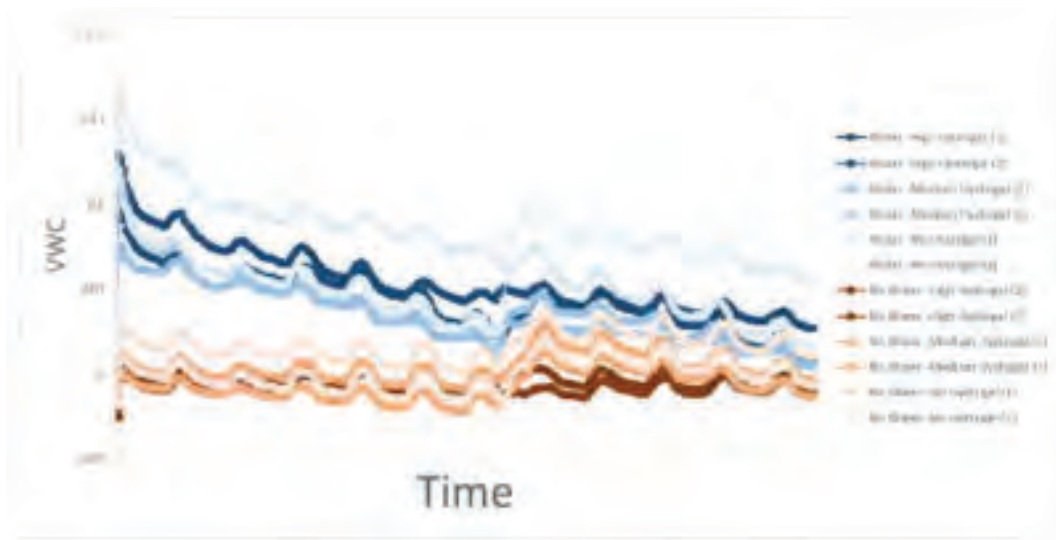
Fencing and Experimental Setup: To remove the effects of herbivory and predation the site was placed in an existing excavated grazing enclosure. Then, within this livestock enclosure, additional rodent fencing was put in place surrounding the study site. Here, a ~3 ft high ¼ inch hardware cloth was placed around the perimeter with an 8-inch trenching to reduce encroachment underneath the fencing and galvanized flashing placed at the top to reduce the ability to climb over the fence. Within this rodent fencing the experimental design of 1m² plots was implemented (Fig 1). The experimental levels were arranged in a fully factorial design of hydrogel (high, medium, none) placed in the top 4 cm of the soil surface through raking, watering level (ambient, high) applied evenly over the 1m² plot, and seed treatment (seeds or transplants added). The three species added for observation were *Elymus elymoides* (squirrel tail), *Machaeranthera tanacetifolia* (Tansyleaf tansyaster), and *Atriplex canescens* (fourwing saltbush). Seeds were planted at approximately ½ to 1cm depth to provide seed-soil contact. Seedlings were grown in controlled greenhouse conditions for approximately 4 months and transplanted in designated treatments..

Monitoring: Treatments and seeding/seedlings were applied at the beginning of the monsoon season in the spring of 2019. Peak monsoon season was chosen to provide moisture in pulses to the hydrogels and allow for observations on vegetation germination (seeds), growth (seeds, seedlings, and background vegetation). Monitoring for germination and vegetation cover change was conducted every two weeks after the field implementation to identify how the inclusion of hydrogel levels coupled with different water levels enhances germination. In addition to monitoring vegetation changes, soil moisture was monitored under the different treatments using 5 cm Campbell scientific soil moisture sensors.

RESULTS

Vegetation monitoring, both of the target seeded and planted species, and background vegetation cover is ongoing and results will be disseminated after treatments have been implemented one year to address both initial germination levels but also establishment outcomes. Soil moisture sensors are also being monitored continuously to identify how the hydrogels coupled with and without water addition added to soil moisture levels over time. A snapshot of soil moisture from September 13 through September 27 shows that, outside of diurnal cycles, as expected the addition of water increased soil moisture levels, however, the inclusion of hydrogels did not have an obvious extension or retaining higher soil moisture levels after watering occurred (Fig 2). Further efforts to analyze all data are in effect to interpret treatment effects on vegetation and how this may aid in management actions.

Fig 2) Snapshot of soil moisture levels overtime under the different treatments of water added or no water added (i.e., ambient conditions) coupled with the three levels of hydrogel addition (High, medium, none). Dates include September 13th through September 27th and were measured hourly.



THE ROLE OF FRUGIVORES IN THE DISPERSAL AND GERMINATION OF ONE-SEED JUNIPER (*JUNIPERUS MONOSPERMA*) SEEDS IN CENTRAL NEW MEXICO

Investigators: Dave Stricklan

The objectives of the research within this dissertation were to evaluate the influence of frugivores on the dispersal pattern and germination of one-seed juniper (*Juniperus monosperma* [Englem.] Sarg.) seeds in central New Mexico. Findings show mesocarnivores and then lagomorphs delivered the most total seeds to the landscape in all habitat classifications (cone trees, non-cone trees, transition zone, and grassland) except directly under the canopy of cone trees, where perching birds deposited the most seeds. Lagomorph pellets containing seeds were present in the highest percentage of plots in all habitats except around cone trees where seeds deposited in bird pellets were present in every plot. Lagomorphs are likely the most effective dispersal vectors of one seed juniper seed. Most seeds deposited by mesocarnivores were in large clumps contained in scats. The deposition of seeds by birds was primarily under perch sites associated with cone trees. Porcupines and mesocarnivores (and in some other one seed juniper woodlands, black bears) make long-range forays into grasslands and may be responsible for depositing seeds that result in "outpost" juniper in the grassland. Mean germination percentages of bare seeds (imbibed), seeds encased within frugivore delivery matrices, but not seeds subsequently freed from a frugivore delivery matrix differed significantly by frugivore group and from seeds left within the fleshy pericarp of cones ($P < 0.5$). The highest bare seed germination value for a frugivore group was 70.8% (mesocarnivore) and the lowest was 33.3% (bird). Seeds in cones had a germination value of 9.7%. The highest value for frugivore matrix encased seeds was 40.1% (bird) and the lowest was 5.8% (porcupine). The highest germination value for seeds in the matrix-free trials, which used seeds screened from the frugivore matrix after the matrix germination trials, was 18.6% (lagomorph) and the lowest was 2.1% (porcupine). Seeds still encased within cones after the same period germinated at 6.7%. Both habitat classification and frugivore group were significant ($P < .05$) factors in determining differences in seed numbers at study plots.

PH.D. DISSERTATION

Stricklan, D. The role of frugivores in the dispersal and germination of one-seed juniper (*Juniperus monosperma*) seeds in central New Mexico. 2019.

IMPACT STATEMENTS

Our research is the first to study seed dispersal mechanisms and germination success that enable one-seed juniper to aggressively invade grassland habitats in central New Mexico. By understanding what drives seed dispersal, our research will help land managers implement intervention programs designed to slow down the rate of juniper reinvasion thus reducing the frequency of application of costly control treatments.

GERMINATION OF ONE-SEED JUNIPER SEEDS DISTRIBUTED BY DIFFERENT FRUGIVORE GROUPS

Investigators: D. Stricklan, P. Saud, A. F. Cibils, R. L. Steiner, D. S. Cram, K. Young, A. M. Faist

One seed juniper (*Juniperus monosperma* [Englem.] Sarg.) encroachment into grassland habitats is facilitated by a diverse group of frugivores. To test seed germination after gut passage, we collected pellets or scats containing mature seeds from four frugivore groups: passerine (perching) birds, lagomorphs (hares and rabbits), mesocarnivores (coyotes and foxes), and porcupines. For comparison of germination success, we also evaluated seeds from intact, non-digested one-seed juniper cones. We conducted germination trials under three different scenarios: 1) imbibed bare seeds (a measure of potential germination); 2) seeds still encased within a frugivore deposited pellet or scat matrix or still in a non-digested cone, and 3) matrix-free seeds that had gone through the matrix germination trials and then were freed from the matrix (a simulation of seeds that become dislodged from scats or pellets). In the bare seed trials, germination was highest ($70.8 \pm 7.4\%$) for seeds digested by mesocarnivores and was $63.9 \pm 5.7\%$ for porcupines which was higher ($p < 0.05$) than germination of seeds from bird pellets ($33.3 \pm 7.7\%$). Germination of seeds from all frugivores, including lagomorphs ($51.4 \pm 7.2\%$) was higher ($P < 0.05$) than for seeds encased in cones ($9.7 \pm 3.2\%$). The germination percentage of seeds still encased in frugivore pellets or scats was highest for birds (40.1 ± 4.2) and was significantly lower ($P < 0.05$) for other frugivores. Seeds freed from all frugivore deposition matrices showed the second pulse of germination activity, especially seeds from lagomorph pellets. Germination success differences can influence the nature of one-seed juniper woodland infill and encroachment into bordering grasslands, which can lead to loss of soil health, lower grass biomass production, and a diminishment of habitat quality for grassland dependent wildlife species.

Peer-reviewed article accepted in November 2019

Rangeland Ecology and Management. In Press.

IMPACT STATEMENTS

Our research is the first to study seed germination success of dispersal of one-seed juniper seeds that are distributed by frugivores. We have other research that shows the pattern of one-seed juniper dispersal seeds by frugivores. This companion study helps elucidate the germination success of seeds depending on the frugivore dispersing them. Our research will help land managers implement intervention programs designed to slow down the rate of juniper reinvasion thus reducing the frequency of application of costly control treatments.

EVALUATION OF DIFFERENT HERBICIDES TO CONTROL CHOLLA CACTUS ON RANGELANDS

Investigators: Kert Young

SUMMARY

In several parts of NM, cholla becomes invasive, establishes in dense thickets that make livestock management very difficult, and reduces livestock access to rangeland and pastureland forage. Many livestock producers spend money and time to reduce invasive cholla. Cholla management research is in direct response to New Mexicans asking for NMSU Extension Service guidance on the most effective methods of invasive cholla control.

Cholla research on the NMSU AES Corona Ranch from 2017 to present compares how well different herbicide active ingredients and application rates control invasive cholla plants. The cholla research is ongoing and more years of data collection are required before any data analysis can be conducted or results determined.



Herbicides are applied to cholla with a hand-held, CO₂-powered, single-nozzle sprayer during the growing season. Cholla herbicide applications are monitored for 3+ years to quantify percent control. Herbicide effectiveness is measured annually by comparing the number of live to the number of dead cholla in each study area including untreated areas. The pesticide industry supports this cholla research and is interested in the eventual results of these projects conducted by an impartial scientist. The eventual results will help the herbicide industry understand how well their herbicides control cholla, what is the least amount of herbicide to apply to achieve satisfactory control, and which herbicides are most effective. This research helps the NMSU Brush and Weeds Management Program provide accurate guidance to New Mexicans on the most effective herbicides to control invasive plants in NM. The people, businesses, and environment of NM are the beneficiaries of this research on the NMSU Corona Ranch.



EVALUATION OF SERUM NEUTRALIZATION TITERS AND CALF PERFORMANCE WHEN COWS GRAZING NATIVE RANGELAND ARE VACCINATED FOR BOVINE VIRAL DIARRHEA VIRUS AND INFECTIOUS BOVINE RHINOTRACHEITIS USING EITHER A MODIFIED LIVE OR KILLED VACCINE

Investigators: E. A. Melchior, S. L. Rosasco, S. L. Lodge-Ivey, R. L. Dunlap, S. H. Cox, P. H. Walz, E. J. Scholljegerdes, and J. C. Wenzel

POTENTIAL IMPACTS

Bovine viral diarrhea virus (BVDV) is responsible for losses of \$1.5-2.5 billion in the beef and dairy industries. These financial losses include pregnancy losses as well as poor performance of persistently infected animals that will also shed the virus and spread BVDV throughout the herd. Researchers have identified that regular vaccinations of the cowherd contribute greatly to reducing instances of BVDV. However, of the vaccination choices provided, there are inconsistencies in the frequency of use and protection, which end up costing producers more if their animals are not as well protected against the pathogen. The objective of this study is to determine how the consistent use of either a modified-live viral vaccine (MLV) or killed viral vaccine (KV) on the dam will impact the growth and immune response of the calf when challenged against BVDV. Results of this project will provide further insight into the interplay of immune function, colostrum antibodies, rumen metabolome, and growth performance long-term from dam vaccination status. Finally, through the proposed research we will provide producers with information to make informed decisions regarding herd health programs.

MATERIALS AND METHODS

Cattle Management: In 2014, all heifers received an MLV vaccination at 60 days of age (branding) and were then randomly assigned to receive either an MLV (Bovishield 5 Gold FP/ VL5, Zoetis Inc., Parsippany-Troy Hills, NJ) or KV vaccine (Cattlemaster 4 FP/ VL5, Zoetis Inc.) at weaning and all subsequent vaccinations. In 2015, Fifty-nine crossbred (Angus x Hereford) heifers at the Corona Range and Livestock Research Center in Corona, NM were randomly assigned to receive either a Modified Live vaccine or Killed vaccine for the duration of their life starting at approximately 60 days of age (branding).

Progeny Performance: Approximately 45 days after weaning, calves were transported from the Corona Range and Livestock Research Center to the New Mexico State University Campus Livestock for a 60-d growth performance trial. Progeny is currently on trial and at the end of the 60-d growth, the period will be subjected to an immune challenge using a strain of BVDV to determine immune performance based on the dam's vaccination type.

SAMPLE ANALYSES

For heifers born in both 2014 and 2015, blood samples were collected beginning at the branding timepoint to determine titer response against infectious bovine rhinotracheitis and bovine viral diarrhea virus. Titers were collected at weaning through their first breeding season, and biannually at pregnancy check and branding.

A subset of 20 2015-born animals and their progeny will be utilized to examine dam treatment effect on calf performance. Cows and their calves will have additional collections of rumen content and blood samples at calving, d7, d35, d63, and d205.

Following a 45d post-weaning interval, calves will be transported and adapted to the Calan Broadbent Gate feeding system for individual feed efficiency analysis of average daily gain. Additionally, rumen and blood samples will be collected every 14d to examine rumen microbial environments with feed efficiency and blood metabolites.

After the feed efficiency study, calves will be immune challenged with BVDV, where rectal temperatures and clinical observations will be taken daily, with blood samples collected every other day for 21 days to determine virus isolation and neutralization in the sera, as well as virus isolation from nasal swabs. Rectal temperatures as well as core body temperature using a data logger system implanted in the animal. Calves are expected to clear the infection within 28 days post-inoculation.

STATISTICAL ANALYSES

Data were analyzed utilizing the MIXED procedures of SAS 9.4 (SAS Inst. Inc., Cary, NC). Individual heifer/cow and the subsequent calf were considered the experimental unit. The model included vaccine treatment as the main effect. Titer data, volatile fatty acids, and ruminal pH were measured using repeated measures. A P-value \leq of 0.05 was considered significant.

UPDATES

In the current study, weaning weights did not differ ($P > 0.05$) in progeny from cows receiving an MLV vaccine at branding and then divided into receiving a KV or MLV vaccine for life (2014-born; Table 1) or in weaning weights of progeny born to cows having received only an MLV vaccine or KV vaccine since branding (2015-born; Table 2, $P > 0.05$). Similarly, titers against infectious bovine rhinotracheitis and bovine viral diarrhea virus of 2014 and 2015 born animals were not significantly different over time ($P > 0.05$). This indicates that the use of a combination vaccination program may provide sufficient acquired immunity over time, regardless of vaccination type utilized (KV or MLV, or combination; Figures 1, 2, 3a, 3b).

2015 Progeny ruminal pH and volatile fatty acid concentrations were not different ($P > 0.05$) across days postpartum or treatment type. Age impacted ruminal pH, with ruminal pH increasing with age ($P < 0.0001$, Table 4). This result was expected as developing calves have a more acidic pH from consumption of milk earlier in life and proliferation of lactose-utilizing bacteria in their rumen which stabilizes as they mature. Cow body condition score did not differ between treatments ($P > 0.05$) and ranged from a 3 – 5 at calving. Similarly, calf birth weights ranged from 25 – 42 kgs and were not significantly different between the dam vaccination group ($P > 0.05$, Table 4).

Currently, all vaccine treatment regimens will continue to examine longevity and changes in titers over the lifetime of the animal. Progeny born in 2019 and 2020 will continue to be monitored for immunocompetence, ruminal function, puberty, and growth performance as they progress to maturity. The second year of this study is currently being conducted with calving expected February 2020. Finalized data will be compiled and disseminated through regional meetings and peer-reviewed publications.

Table 1. Weaning weights of calves born to cows having received an MLV vaccine at branding, and then divided into receiving a KV or MLV vaccine for life (2014-born) are not different.

Year	Treatment ^{1,2}		P-value ³
	K	M	
2016	217.6 ± 7.2	217.5 ± 7.0	0.99
2017	241.2 ± 12.4	248.3 ± 8.7	0.65
2018	238.6 ± 6.1	236.7 ± 6.1	0.94
2019	239.3 ± 5.4	251.5 ± 5.7	0.12

¹K: Killed viral vaccine; M: a modified-live viral vaccine.

²Weaning weights presented as LSMMeans ± SEM.

³Statistical significance is considered at a P < 0.05.

Table 2. Weaning weights of calves born to cows having received only an MLV vaccine or KV vaccine since branding (2015-born) are not different.

Year	Treatment ^{1,2}		P-value ³
	K	M	
2017	234.8 ± 4.8	230.3 ±	0.49
2018	207.8 ± 6.8	205.2 ± 6.5	0.78
2019	243.9 ± 8.2	239.1 ± 7.3	0.66

¹K: Killed viral vaccine; M: modified-live viral vaccine

²Weaning weights presented as LSMMeans ± SEM.

³Statistical significance is considered at a P < 0.05.

Table 3. Ruminal pH and major volatile fatty acid proportions of 2015-born cattle from their fourth calving cycle from birth through weaning time point.

Item	Day										SEM	P-value ²	Day	Trt	Day × Trt
	0		7		35		63		205						
	Treatment ¹														
	K	M	K	M	K	M	K	M	K	M					
Ruminal pH	6.97	7.0	6.8	7.06	7.06	7.3	7.37	7.19	7.33	6.91	0.31	0.64	0.94	0.65	
Acetate ³	69.1	72.9	73.5	73.4	61.4	72.5	72.4	65.5	79.7	79.3	2.1	<0.0001	0.42	0.036	
Propionate ³	17.7	15.8	15.8	16.3	18.1	15.4	15.6	14.9	12.5	12.1	1.1	<0.0001	0.22	0.55	
Butyrate ³	9.5	8.7	8.8	8.3	10.1	9.4	9.1	9.6	6.3	6.5	0.5	<0.0001	0.56	0.63	
A: P ⁴	4.29	4.68	4.16	4.13	4.14	4.77	4.73	4.47	6.4	6.2	0.25	<0.0001	0.40	0.08	

¹ K: Killed viral vaccine; M: modified-live viral vaccine; Data presented as LSMMeans. Data with superscript are significantly different.

²Significance noted as P < 0.05.

³Molar proportion of total volatile fatty acids (mol/100mol)

⁴Acetate: Propionate ratio.

Table 4. Ruminal pH and major volatile fatty acid proportions of progeny from 2015-born from 7-days of age through weaning time point.

Item	Day								SEM	P-value ²		
	7		35		63		205					
	Treatment ¹											
	K	M	K	M	K	M	K	M		Day	Trt	Day × Trt
Ruminal pH	6.37 ^c	6.60 ^c	6.85 ^b	6.78 ^b	6.97 ^b	6.74 ^b	7.68 ^a	7.85 ^a	0.14	<0.0001	0.22	0.2
Acetate ³	0.75	0.75	0.73	0.72	0.68	0.68	0.74	0.75	0.02	0.18	0.92	0.98
Propionate ³	0.18	0.19	0.15	0.16	0.15	0.16	0.18	0.12	0.02	0.35	0.61	0.28
Butyrate ³	0.04	0.04	0.07	0.08	0.07	0.12	0.06	0.05	0.005	0.0069	0.32	0.48
A: P ⁴	4.02	4.89	4.74	4.39	4.70	4.42	5.6	5.7	0.29	<0.0001	0.77	0.11

¹ Dam Treatment: K: Killed viral vaccination; M: modified-live viral vaccination; Data presented as LSMMeans. Data with superscript are significantly different.

² Significance noted as $P < 0.05$

³ Molar proportion of total volatile fatty acids (mol/100mol)

⁴ Acetate: Propionate ratio

Table 3c. Cow body condition score (BCS) at calving from 2015-born animals and calf birth weights are not affected by vaccination type.

Item	Treatment ¹		SEM	P-value ²
	K	M		
Cow BCS at birth	4.3	4.4	0.05	0.18
Calf Birth weight (kg)	31.9	32.6	0.80	0.47

¹ Dam Treatment: K: Killed viral vaccine; M: Modified-live viral vaccine; Data presented as LSMMeans.

² Significance noted as $P < 0.05$

Figure 1. No differences in serum-neutralization titers against infectious bovine rhinotracheitis of cows having received an MLV vaccine at branding, and then divided into receiving a KV or MLV vaccine for life (2014-born).

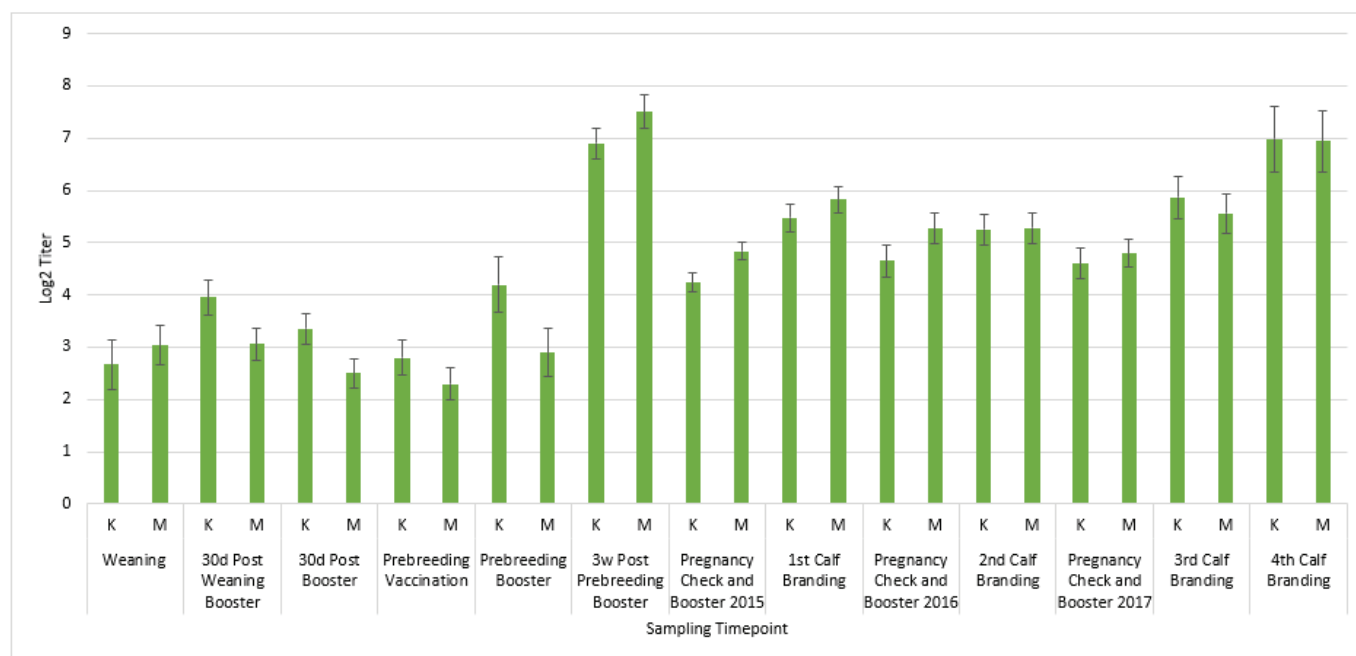


Figure 2. No differences in serum-neutralization titers against infectious bovine rhinotracheitis of cows having received only an MLV or KV vaccine since branding (2015-born).

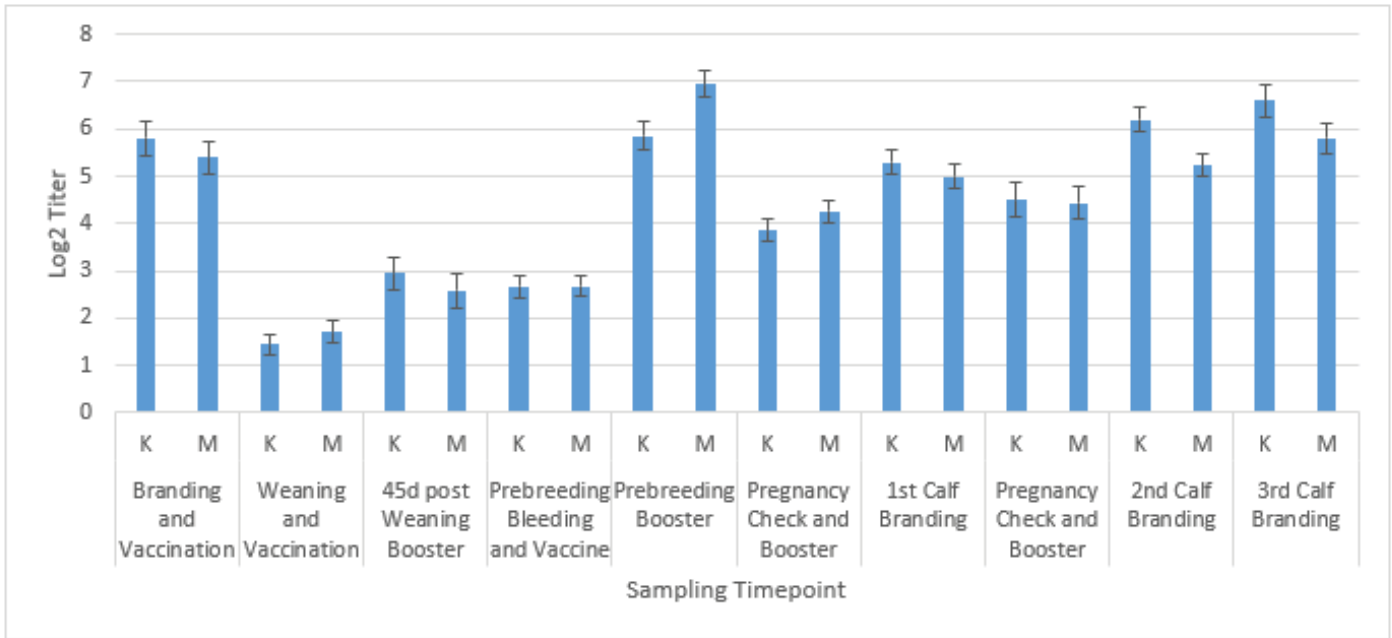


Figure 3a. No differences in May 2016 titers against BVDV Types 1a and 2a of cows having received an MLV vaccine at branding, and then divided into receiving a KV or MLV vaccine for life (2014-born).

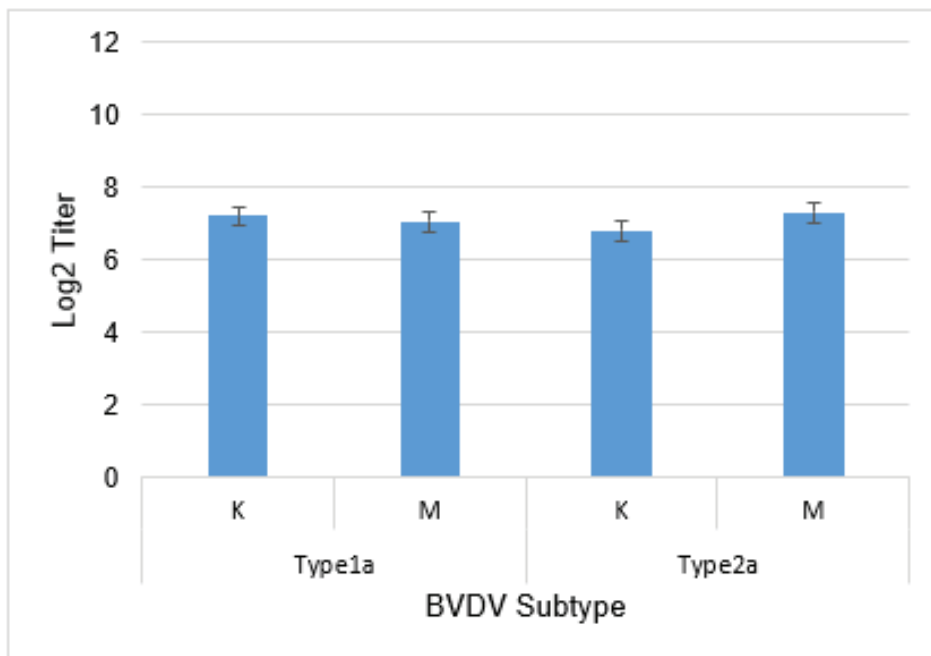
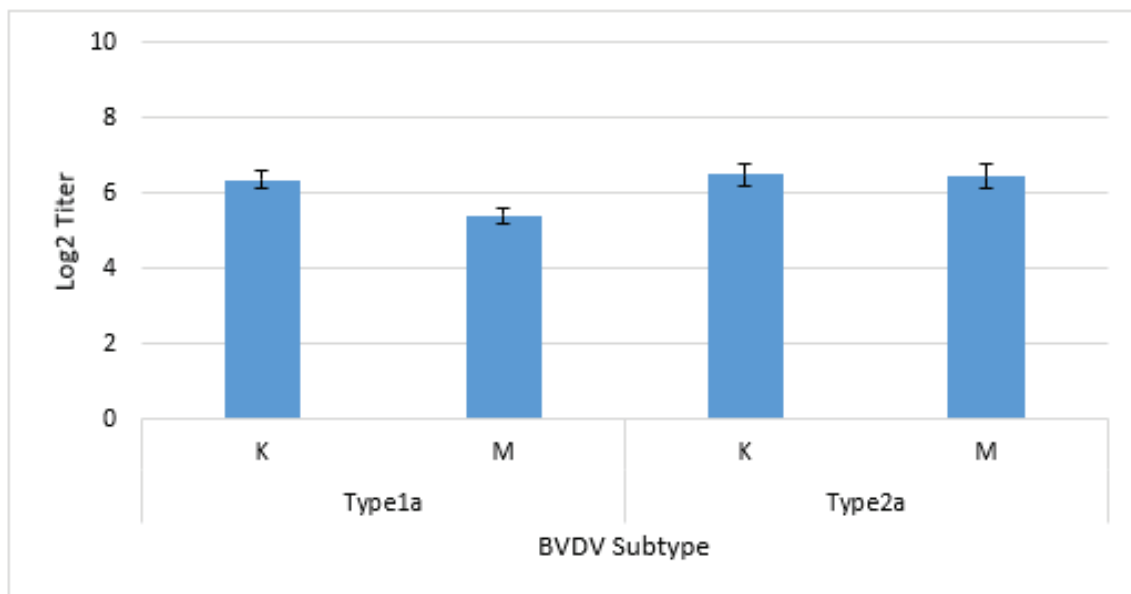


Figure 3b. No differences in May 2017 titers against BVDV Types 1a and 2a of cows having received an MLV vaccine at branding, and then divided into receiving a KV or MLV vaccine for life (2014-born).



EFFECTS OF GROWTH-PROMOTING IMPLANTS ADMINISTERED DURING THE SUCKLING PHASE OR AT WEANING ON GROWTH AND REPRODUCTION IN REPLACEMENT BEEF HEIFERS GRAZING NATIVE RANGE

Investigators: S.L. Rosasco, C. J. Kassetas, S. H. Cox, R. L. Dunlap, J. A. Hernandez Gifford, E. J. Scholljegerdes, and A. F. Summers

Angus-Hereford crossbred heifers (n = 170) were utilized over 2 years to determine the effects of a growth-promoting implant administered at 2 distinct periods of development either 3 or 8 mo of age on growth, reproduction, and ovarian development. Heifer calves were allotted to three treatments: 1) non-implanted controls (CON; n = 57), 2) implanted at approximately 3 mo. of age with Synovex C (BIMP; n = 61), or 3) implanted at approximately 8 mo of age with Synovex C (WIMP; n = 52). In year 2, heifers were subjected to ovarian ultrasonography to measure antral follicle counts and reproductive tract scores. Additionally, a subset of heifers (n = 16) were unilaterally ovariectomized to evaluate ovarian development. Heifers implanted at 3 mo of age were heavier at weaning compared to CON and WIMP heifers (235 vs 223 vs 217 ± 4.4 kg; P = 0.01). Furthermore, BIMP heifers had an increased (P = 0.02) yearling body weight compared to WIMP heifers. This trend continued with BIMP heifers having greater body weight at breeding (P = 0.06) compared to WIMP heifers. The average daily gain was similar (P > 0.09) among treatments from weaning to yearling and yearling to breeding; however, WIMP heifers had increased overall average daily gain compared to BIMP heifers. Antral follicle count and reproductive tract scores were not influenced by treatment (P > 0.44). Estrus response and first service conception rates did not differ (P = 0.28) regardless of treatment. Furthermore, implant status and timing of administration did not affect (P = 0.86) overall pregnancy rates. The size of the ovary, surface follicle counts, and diameter of the dominant follicle were all similar (P > 0.09) regardless of the timing of Synovex C implant administration. Follicular fluid concentrations of estradiol, progesterone, and estradiol: progesterone, did not differ (P ≥ 0.52) among treatments. Utilizing growth-promoting implants did not influence postweaning reproductive development or compromise pregnancy rates in beef heifers. Based on these results, administration of growth-promoting Synovex C implant at 3 mo of age may allow for increased body weight at weaning, without hindering pregnancy rates.

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APPLYING DEVELOPMENT STRATEGIES TO INCREASE THE OVARIAN RESERVE IN REPLACEMENT BEEF HEIFERS GRAZING NATIVE RANGE

Investigators: S. L. Rosasco, E. A. Melchior, S. H. Cox, R. L. Dunlap, J. A. Hernandez Gifford, E. J. Scholljegerdes, R. A. Cushman and A. F. Summers

Based on recent research, it may be possible to influence the number of primordial follicles in the ovaries during the first year of life. The over-arching hypothesis was that development protocols early in life will influence the ovarian reserve in replacement beef heifers. Spring-born Angus crossbred heifers (n=40) were utilized to determine the effect of a stair-step development system on growth and reproduction. Heifers (11 mo) were assigned to one of four treatments: 1) constant gain a dry lot (CG-d), 2) stair-step dry lot (SS-d), 3) constant gain pasture (CG-p), and 4) stair-step pasture (SS-p). Constant gain heifers were targeted to gain 0.5 kg/d ADG, while stair-stepping heifers were targeted to gain 0.25 kg/d for the first 45 d and 0.75 kg/d ADG for the last 45 d. All heifers were ovariectomized after d 90. Growth parameters were not impacted by the development strategy. Primordial follicles/section was increased (P = 0.04) in SS-p and SS-d heifers compared to CG-d heifers, with CG-p being similar to all other treatments. Decreasing intake during the peri-pubertal period slows activation of primordial follicles and increases the size of the ovarian reserve at breeding. Differences in diets between dry lot and native range also alter mechanisms controlling primordial follicle activation. Additional data are being analyzed to investigate the influence of treatment on heifer age at puberty and follicle quality.

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