2021 Report

Corona Range and Livestock Research Center
and
The Southwest Center for Rangeland Sustainability

CORONA

NM STATE

NNUAL REPORT —— 2021

The NMSU Agricultural Experiment Station supports research that is addressing real-world problems. Research is at the core of NMSU's mission to improve upon the lives of people globally.

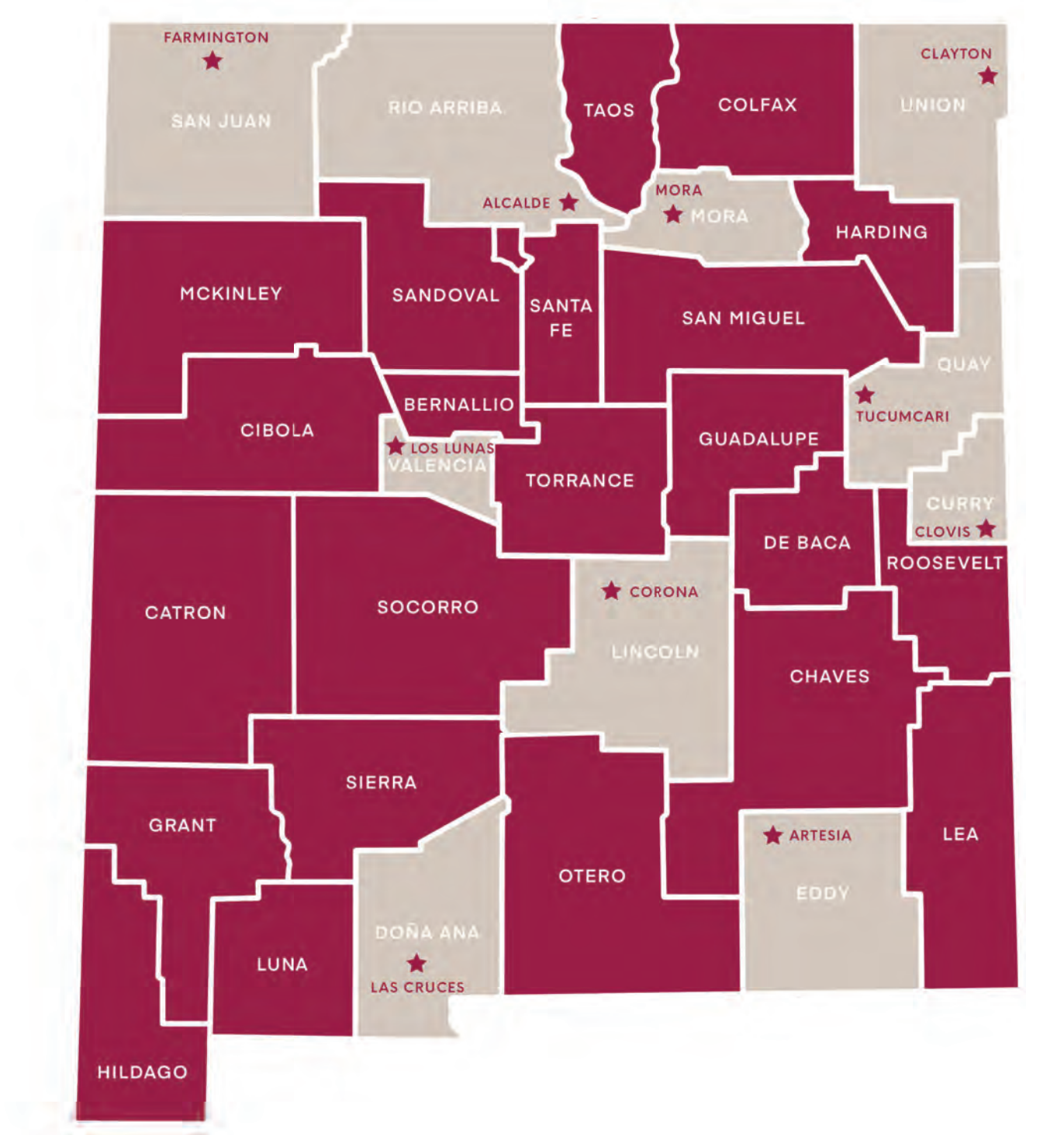
https://coronasc.nmsu.edu/

MISSION

The mission of the CRLRC is to enhance the understanding of woody brush invasion, hydrology, livestock production, wildlife management and discover innovative solutions to improve economic development in rangeland-bound communities.

CRLRC is a collaborative effort between animal, range, and wildlife scientists, economists, land and wildlife agency personnel, and ranchers.

NMSU Agricultural Experiment Station



Notice to Users of This Report

This report has been prepared to aid Science Center staff in analyzing the results of the various research projects from the past year and to record data for future reference. These are not formal Agricultural Experiment Station Report research results. The reader is cautioned against drawing conclusions or making recommendations as a result of the data in this report. In many instances, data represents only one of several years' results that will ultimately constitute the final formal report. Although staff members have made every effort to check the accuracy of the data presented, this report was not prepared as a formal release. None of the data is authorized for release or publication without the written prior approval of the New Mexico Agricultural Experiment Station.

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Contents

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 which inherently address state and local needs, such as evaluating the efficacy of differing vaccination sources and regimens.

Projects Addressing Specific Regional and State Production Practices

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 with sapling size/density
- Using hydrogels to enhance the restoration of rangelands in a monsoon driven dryland system could be an implication in restoration activities with renewable energy development

Range Livestock Production

- Evaluating the efficacy of killed vs. modified live vaccines on calf performance and serum titer levels
- Developing strategies to increase the longevity of breeding heifers by increasing ovarian egg potential
- Developing tools for effective, financially sound drought decisions

Executive Summary

The Corona Range and Livestock Research Center (CRLRC) is a working ranch, a 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. Historically, the CRLRC has 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 tasks at hand.

The CRLRC has faced extreme drought this past year with only two major precipitation events during the summer. Fortunately, these two events were able to somewhat heal the land. In response to the drought, livestock inventory was heavily reduced by 75 percent. This in itself brings additional challenges to the CRLRC in reducing overall gross income for self-funding operations, however, drought is a cyclical factor in Southwest range livestock operations and CRLRC maintains one and one-half to two years operations capital in reserve to deal with this cyclical pattern of income and expenditures. This too will pass as we gear towards tightening up expenditures until livestock inventory builds back up to service itself without relying on these planned capital reserves. During this period of re-growth, it does dampen research capabilities somewhat with less livestock and prolonged investigative periods due to lower numbers to achieve statistical confidence. Not all is lost, as changes in operations and the ability to respond more effectively drive scientific thought to develop new ideas in much-needed research direction and potential. CRLRC and our scientists have joined or developed interdisciplinary teams of investigators looking to enhance research opportunities and operations by bringing digital agriculture to the ranch. This emerging technology to assist in data collection to help mitigate future drought issues through either more precise monitoring, assessment, or response to these data, as well as, provide measurements of livestock efficiency to help develop a more environmentally productive female, as well as, aid in culling decisions for future stocking reductions. Further, teams looking to develop research, monitoring, and assessment of carbon management or healthy soil management on rangeland livestock operations to assist our producers in gaining the knowledge they need to address future legislative issues or to assist in monetizing the benefit that producers provide the globe is also being searched for funding sources.

In the meantime, Pattern Energy completed construction on the Corona area wind farms and the portion of the farm on CRLRC went live at the end of the year. This relationship provides NMSU and CRLRC a significant income stream that the Board of Regents has dedicated the majority to come back to Corona, and for the first two years, all income generated will be used to complete the SWCRS facilities as they were planned over fifteen years ago. This commitment by NMSU and ACES will provide our ability to develop new and exciting outreach and educational opportunities to our clientele at a much higher level.

Additionally, the SWCRS is perched to restart in-person programming in 2022, such as our popular Rancher's Roundtable series and additional Beyond the Roundtable events. Plans late last year were to start in February, however, with the latest surge of Covid variants, we have decided to wait until May when we can utilize the outdoor classroom to mitigate any virus spread.

The CRLRC and SWCRS are excited about our future as the world changes around us. New challenges and opportunities continue to arise and we will be situated to respond with research and outreach to serve the State of New Mexico.

2021 Financial Summary

Corona Research Center

Fiscal Year: **2021**

Fiscal Period: **30-Jun-21**

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	$433,555.42	$70,000.00	$175,000.70	($105,000.70)	($437,795.85)
Corona Research Center	SALES & SERVICE	WIND ENERGY LEASE	$73,410.11	$0.00	$0.00	$0.00	($161,311.20)
Corona Research Center	SALES & SERVICE	ANRS LIVESTOCK JUDGING TEAM	$0.00	$500.00	$0.00	$500.00	($1,000.00)
		Total Sales and Service Funds	**$506,965.53**	**$70,500.00**	**$175,000.70**	**($104,500.70)**	**($600,107.05)**
							* See note
Corona Research Center	STATE APPROPRIATIONS	CORONA CENTER RANCH OPERATING		$111,118.36	$112,734.80	($1,616.44)	
Corona Research Center	STATE APPROPRIATIONS	CORONA ADMIN		$9,555.00	$9,555.24	($0.24)	
		Total State Appropriated Funds		**$120,673.36**	**$122,290.04**	**($1,616.68)**	

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.

2021
RESEARCH PROJECTS

UNITED STATES BEEF ACADEMY - SUMMARY 2021

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. Pollreisz, 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 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 US beef's role 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 84 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.

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

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

POTENTIAL IMPACT(S)

This study sought to understand how simulated targeted grazing could improve rainfall effectiveness by influencing soil moisture redistribution between saplings and understory grass. The objective of our study was to determine whether: 1) sapling defoliation frees up detectable amounts of soil moisture for understory growth; 2) the effects of defoliation are contingent on sapling size and stand density. We expect that our findings will help refine currently targeted grazing prescriptions for one seed juniper saplings.

METHODS

Four defoliation treatments: a) single clipping in year 1 (GO); b) single clipping in years 1 and 2 (GT); c) herbicide application in year 1 (completely removed, H); and d) untreated (control, C) were applied on twelve sapling-infested rangeland plots at NMSU's Corona Range and Livestock Research Center in the summer of 2020. Soil volumetric water content (SVWC) was measured using CS655 probes buried in the superficial soil layer at two depths (0-10 and 20-25 cm) under sapling drip lines. The simulated browse treatment was applied in October-2020 as year 1 and May-2021 as year 2 by manually punching and pulling off 60% of the saplings cover. Data were analyzed as a split-plot design with repeated measures using SAS 9.4 Proc Mixed software for the SVWC as the response variable. The fixed effects in the model were treatment, plant situation, and time with their interaction.

RESULTS

SVWC at 0-10 cm soil depth was affected by time over the year and its interaction with defoliation treatment ($P < 0.0001$); however, the defoliation treatment did not affect SVWC, nor did the plant situation (Fig. 1). At 20-25 cm depth, SVWC was affected by the levels of defoliation and by the plant situations ($P = 0.047$ and 0.003, respectively); furthermore, SVWC was also affected by the time and the interaction of treatment and time ($P < 0.0001$) (Fig. 2). Regardless of the plant situation, the mean of SVWC in both soil depths was higher in the H treatment plot (10% and 11%, respectively) during the study period, compared to other treatments. Herbicide treatment and sapling size appear to have a greater impact on the amount of soil moisture at 20-25 cm soil depth. Our results suggest that the levels of defoliation and the sapling's situations would promote increasing soil moisture for the understory.

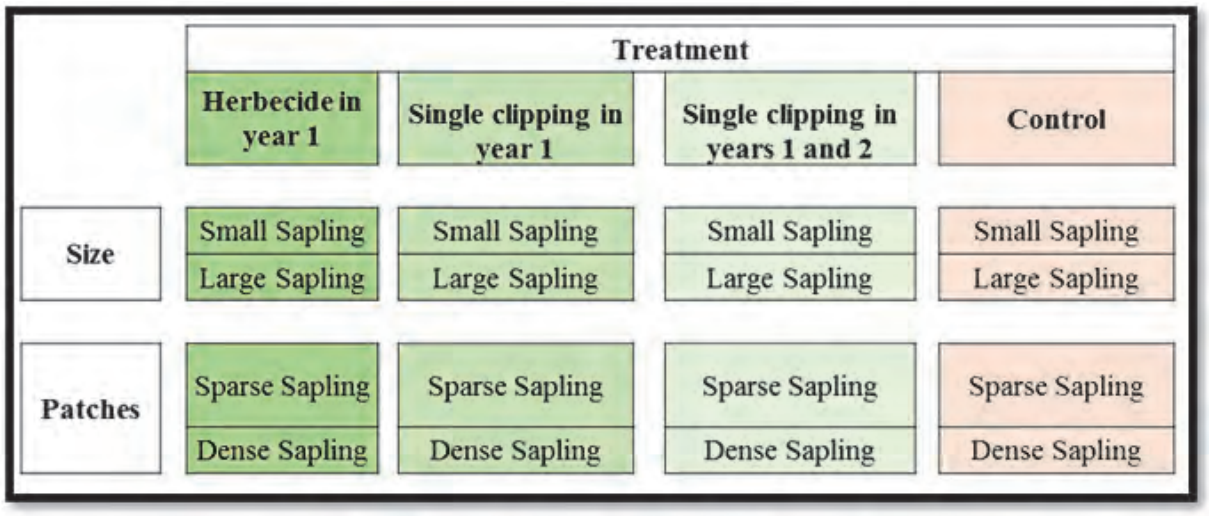

FIGURE 1: Plot layout and design of the experiment.

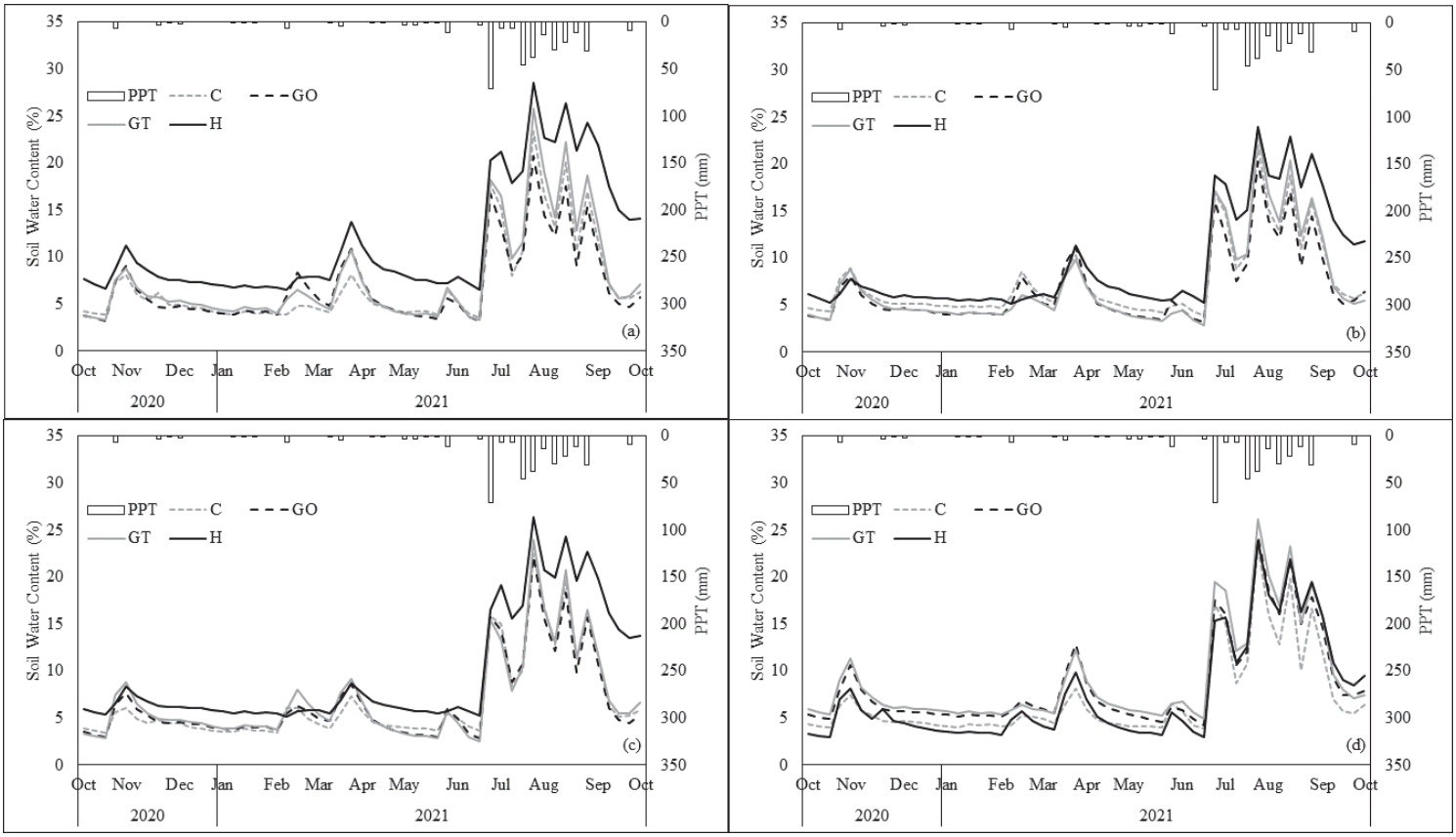

FIGURE 2: Mean soil moisture content at 0-10 cm soil depth of sparse stands with small saplings (a), dense stands with small saplings (b), sparse stands with large saplings (c), and dense stands with large saplings (d) from October 2020 to October 2021. C indicates control treatment; GO, grazing once treatment; GT, grazing twice treatment; H, herbicide treatment. PPT indicates precipitation.

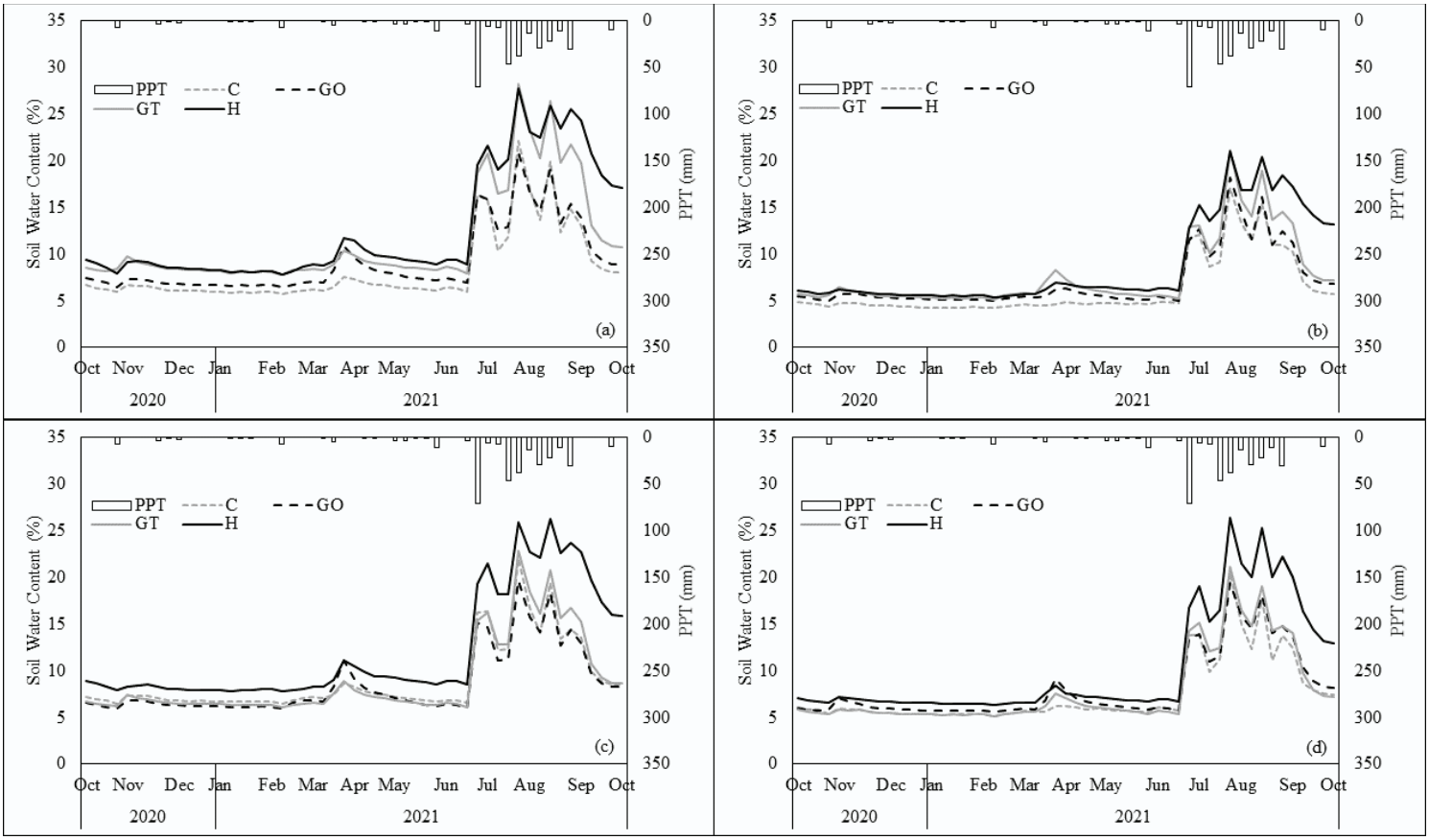

FIGURE 3: Mean soil moisture content at 20-25 cm soil depth of sparse stands with small saplings (a), dense stands with small saplings (b), sparse stands with large saplings (c), and dense stands with large saplings (d) from October 2020 to October 2021. C indicates control treatment; GO, grazing once treatment; GT, grazing twice treatment; H, herbicide treatment. PPT indicates precipitation.

EFFECTS OF SIMULATED BROWSING ON WATER POTENTIAL OF ONE SEED JUNIPER SAPLING TO SAPLING AND DENSITY

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

POTENTIAL IMPACT(S)

Shrub encroachment into rangelands has some impacts on livestock production. This study sought to understand how simulated targeted grazing impacts the water use of one seed juniper sapling. The objective of our study was to compare the xylem water potential of one seed juniper sapling to simulated browse treatment under different sapling sizes and densities during the growing season. We expect that our findings can be useful for currently targeted grazing prescriptions for one seed juniper saplings.

METHODS

Three defoliation treatments: a) single clipping in year 1 (GO); b) single clipping in years 1 and 2 (GT); and c) untreated (control, C) were applied on nine sapling-infested rangeland plots at NMSU's Corona Range and Livestock Research Center in the summer of 2020. Then, two plots in each treatment were randomly selected for xylem water potential measurements using a Scholander pressure chamber (Model 1000). The measurements were taken every two weeks during predawn and midday from May 2021 to October 2021. Data were analyzed as a split-plot design with repeated measures using SAS 9.4 Proc Mixed software for the xylem water potential as the response variable. The fixed effects in the model were treatment, plant situation, and time with their interaction.

RESULTS

Xylem water potential at predawn time was affected by time over the season ($P < 0.0001$); however, the defoliation treatment and plant situation did not affect xylem water potential (Fig. 1). At midday time, xylem water potential was affected by the levels of defoliation and by the time and their interaction ($P = 0.039$, < 0.0001, and < 0.0001, respectively). Furthermore, xylem water potential at midday in the GT was significantly less than GO (P 0.0561) and C (P 0.0469). In general, the mean of xylem water potential decreased (less negative) with defoliation at both times. Our results suggest that the frequency of defoliation would promote increasing water availability in the soil.

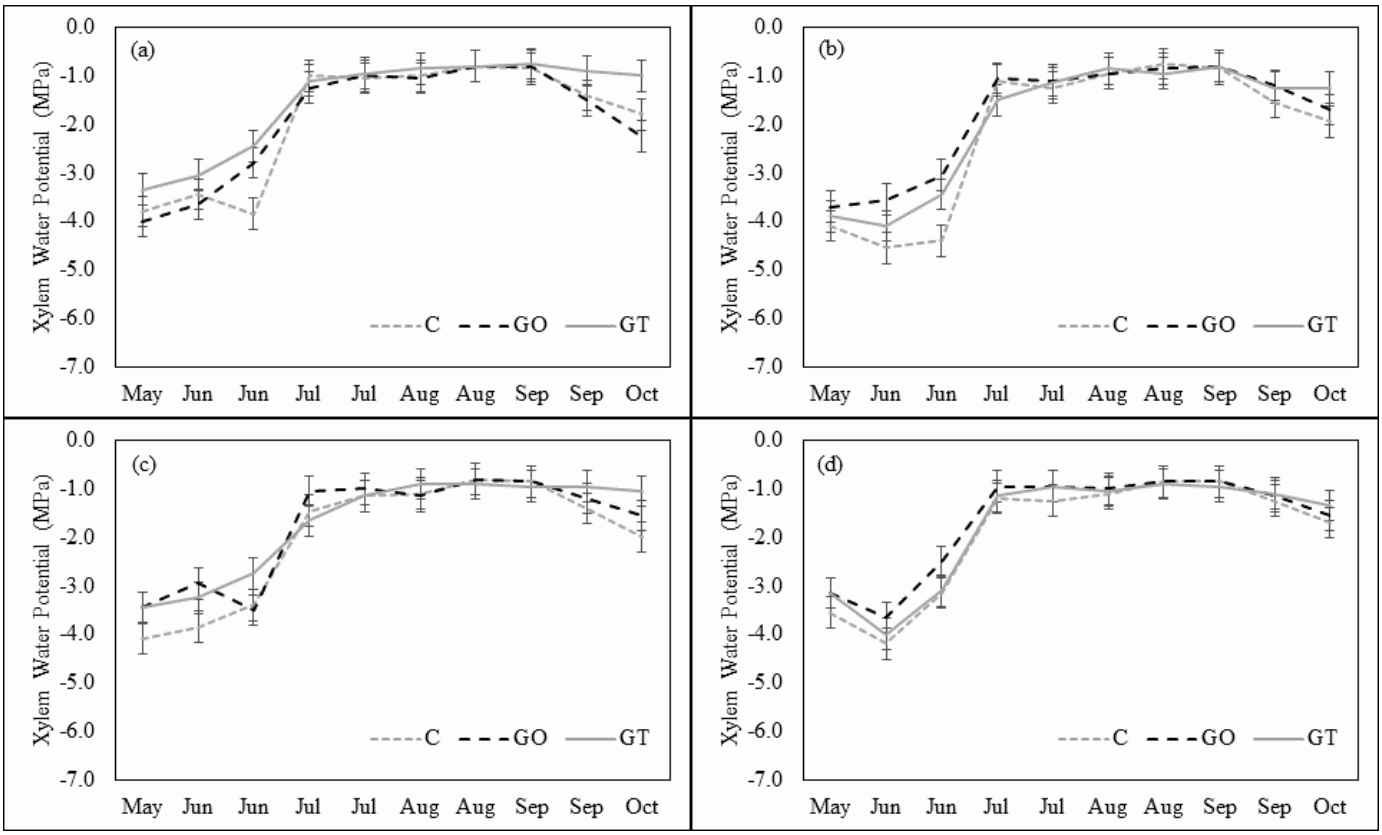

FIGURE 1: Mean predawn water potential of small sparse saplings (a), small dense saplings (b), large sparse saplings (c), and large dense saplings (d) from May 2021 to October 2021. C indicates control treatment; GO, grazing once treatment; GT, grazing twice treatment. Error bars represent the standard error of the mean.

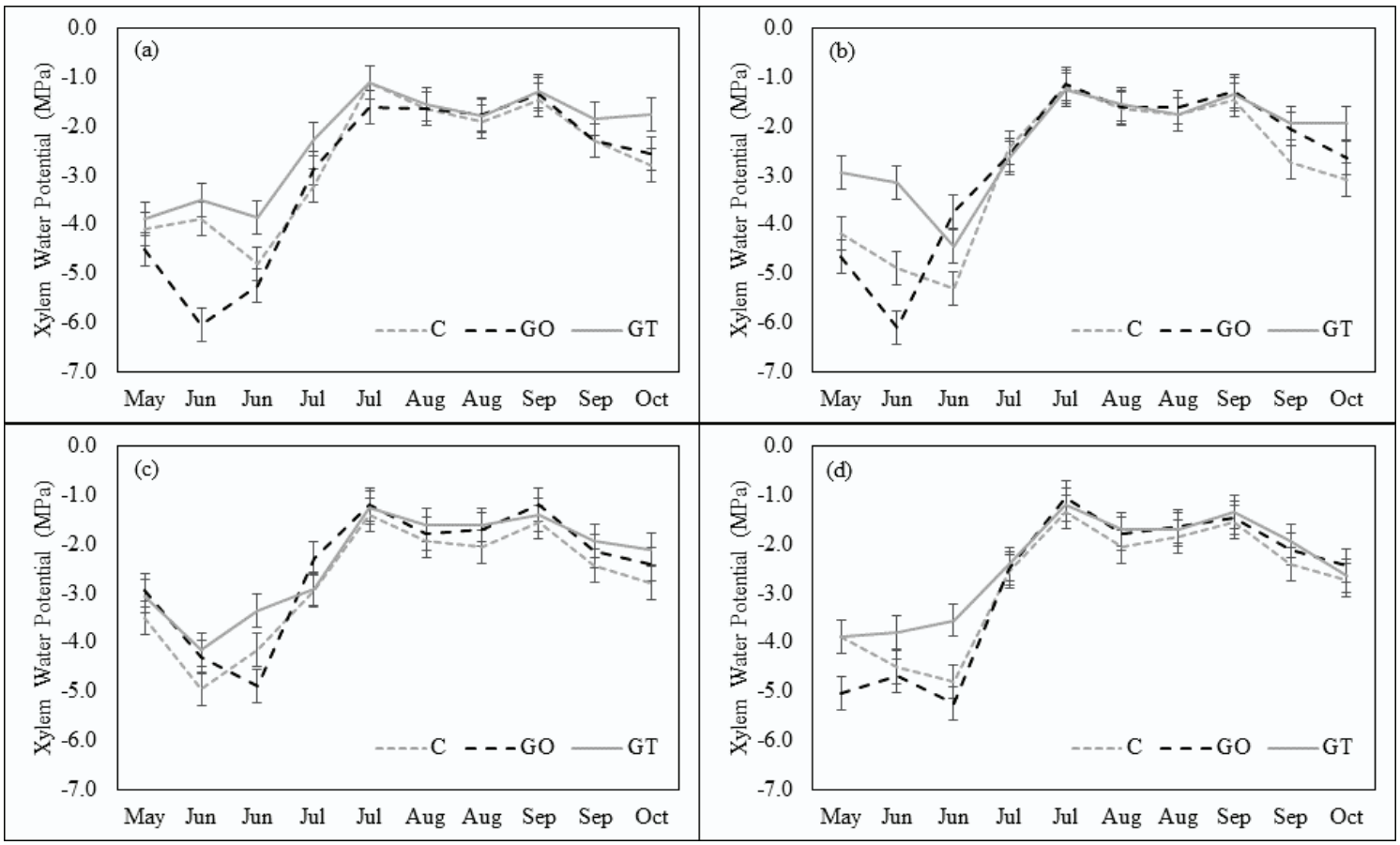

FIGURE 2: Mean midday water potential of small sparse saplings (a), small dense saplings (b), large sparse saplings (c), and large dense saplings (d) from May 2021 to October 2021. C indicates control treatment; GO, grazing once treatment; GT, grazing twice treatment. Error bars represent the standard error of the mean.

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. Lehnhoff

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 alternatively 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 are also increased. Through greater grass cover, higher stocking rates and livestock production levels are also improved.

METHODS

Fencing and experimental setup: To remove the effects of herbivory and predation the site was placed in an existing excavated grazing exclosure. Then, within this livestock exclosure, 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.

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

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 hydrogel levels and different water levels enhance 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 and 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.

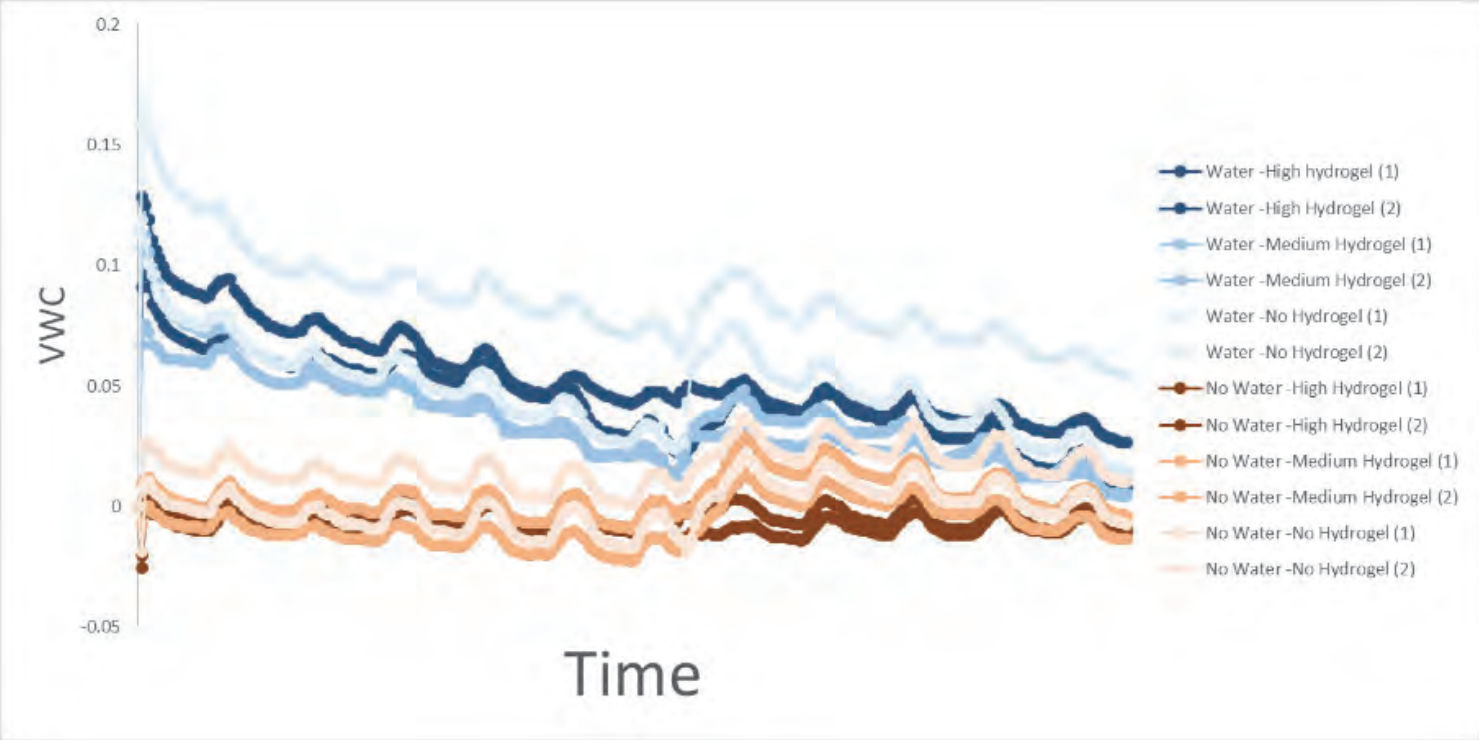

FIGURE 2: Snapshot of soil moisture levels over time under the different treatments of Water added, or no water added (i.e., ambient conditions) coupled with the three levels of hydrogel addition (High, medium, none). Dates include September 13th through September 27th and were measured hourly.

RUMINAL DYNAMICS AND GROWTH PERFORMANCE IN COMMERCIAL WESTERN WHITEFACE WETHERS CONSUMING DIFFERING SOURCES OF WATER WITH HIGH AND LOW SULFUR CONTENT

Investigators: E. A. Melchior-Tiffany, M. K. Chavez*, C. W. Anderson*, K. F. Boswell*, S. H. Cox‡, S. L. Lodge-Ivey*, and A. F. Summers**

*Department of Animal and Range Sciences, New Mexico State University, Las Cruces, NM 88011;
‡Corona Range and Livestock Research Center, Corona, NM, 88318

Thirty-five commercial western whiteface wethers (40 kg) were used to evaluate the effects of various sources of water with high and low sulfur content on growth performance, feed and water intake, and ruminal dynamics. Sheep were individually fed a pelleted complete diet for 56 days. Sheep were stratified by weight and assigned randomly to one of four water treatments: consumption of city water for 56 days (CON), consumption of well water for 56 days (WELL), consumption of city water for 28 days followed by consumption of well water for 28 days (CW), and finally city water for 28 days, followed by consumption of well water for 14 days followed by consumption of city water for 14 days (CWC). High-sulfur well water (1600mg SO42-/L) or city water (120 mg SO42-/L) were provided ad libitum depending on the treatment. Weights and rumen fluid were collected every 14 days for analyses of average daily gain, ruminal volatile fatty acids, pH, ammonia, and ruminal bacterial populations across treatment groups. Total dry matter intake was unaffected by water source ($P = 0.95$) and sampling period ($P \geq 0.49$). Average daily feed intake ranged from 1.65-173 kg × day -1. Water intake measured as liters consumed per day did not vary across treatments ($P = 0.87$), nor as total water consumed by sampling period ($P \geq 0.43$). The average daily gain was unaltered by water treatment ($P = 0.56$). Ruminal pH and ruminal ammonia concentrations were unaffected by treatment ($P > 0.42$). Ruminal ammonia concentrations were at their lowest at week 1 of the study (2.8 ± 0.41 mM) and were highest at week 9 of the study (8.0 ± 0.41 mM, $P < 0.001$). Volatile fatty acids were affected by week ($P \leq 0.04$). These shifts in microbial populations account for differences in the production of volatile fatty acids and ruminal ammonia each week, regardless of treatment. The weak effect of sampling was likely due to changes in the stability of the ruminal environment. These results indicate that growth performance and rumen function are not affected by a sulfur concentration of 1600mg SO42-/L in wethers.

EFFECT OF UNDEGRADABLE PROTEIN SUPPLEMENTATION LEVEL DURING THE PREBREEDING PERIOD ON PERFORMANCE AND OVARIAN CHARACTERISTICS IN YEARLING HEIFERS

Investigators: M.K. Chavez†, E. A. Melchior†, C. W. Anderson†, S. H. Cox‡, R. L. Dunlap‡, J. A. Hernandez Gifford†, E. J. Scholljegerdes†, R. A. Cushman and A. F. Summers†*

†Department of Animal and Range Sciences New Mexico State University, Las Cruces, NM 88003,
‡Corona Range and Livestock Research Center, Corona, NM 88318,
*USDA, ARS, U.S. Meat Animal Research Center, P. O. Box 166, Clay Center, NE 68933

Increased supply of undegradable protein to yearling heifers before the first breeding season has been associated with improved reproductive outcomes. An experiment was conducted to evaluate the effects of differing levels of undegradable protein supplementation in British crossbred heifers (11 to 12 mo) on growth, reproductive parameters, and ovarian physiology. Thirty Angus x Hereford heifers were stratified by BW and randomly assigned to one of two dietary protein supplements. Treatments were fed at a rate equal to 1.14 kg/d as heifers grazed dormant range and were formulated to provide 1) 36% CP containing 36% RUP (36RUP) or 2) 36% CP containing 50% RUP (50RUP). The treatment period initiated in February and terminated in May corresponding to the beginning of the breeding season, and lasted a total of 90 d. At the termination of supplementation, bilateral ovariectomies were performed on heifers and ovarian samples were collected. Bodyweight was not different among treatments at any point in the study (P = 0.42). However, 50RUP heifers had greater (P = 0.05; 0.84 and 0.72 kg/d) overall average daily gains. Reproductive parameters, such as tract score (P = 0.44) and antral follicle count (P = 0.68) were not different between treatments. The proportion of heifers that had attained puberty was similar between treatments (P = 0.22) at the initiation of the study and 45 (P = 0.18). All heifers were considered pubertal by the end of the study. Treatment had no effect on ovarian morphometry (P = 0.49) or histology (P = 0.4). Ovarian steroid hormone concentrations measured in follicular fluid were not different between treatments (P = 0.13). Supplement intake increased throughout the study and was greater for heifers fed the 50RUP supplement (P < 0.01). Despite the increased intake, serum urea nitrogen was lower for 50RUP heifers (P = 0.05) and follicular urea nitrogen tended to be lower for 50RUP heifers (P = 0.06). These results indicate that increased RUP does not exert effects on ovarian morphometry or steroid hormone production. Further research is warranted to investigate the potential effects of increased supply of RUP on other aspects of the reproductive system.

DIVERGENT COW BODY CONDITION SCORES AT WEANING IMPACTS ON GROWTH AND METABOLISM DURING THE SUBSEQUENT CALVING SEASON

Investigators: M. Crimminst, S. Cox‡, A. Selmant, C. Andersont, and E. Schlljegerdest

†Department of Animal and Range Sciences New Mexico State University, Las Cruces, NM 88003,
‡Corona Range and Livestock Research Center, Corona, NM 88318,

F**unding:** $35,000
Funding sources: Agricultural Experiment Station, Hatch funds
Funding duration: 2/2022 to 7/2022

NM PROBLEM ADDRESSED BY RESEARCH

Cows that can effectively harvest forage and convert to a saleable calf are a key indicator of profitability.Times of limited precipitation that reduce quantity and quality of range forage can negatively impact cow productivity.However, some cows appear to thrive in these times and can maintain good conditions and wean a healthy calf. What is not known is the inherent differences in a cow, of similar genetics and environment, that is better able to maintain acceptable production levels during these times when compared to a contemporary that loses condition. Identifying cows that have divergent body condition scores when managed on the same pasture and assessing their metabolic differences, may provide insight, into what makes for an efficient cow. This experiment was conducted in the spring of 2021 with two groups of cows that varied in body condition score (4.2 vs 5.8 on a 9 point scale) at weaning during the 2020 drought. Overall, cows that were in lower condition, did gain weight when placed in a dry lot and fed a high-quality diet, but were never able to “catch up” to cows that naturally maintained a higher body condition.Likewise, no differences in feed efficiency (lb of gain: lb of feed) or milk production were observed. Based on the metrics used in this study, researchers were unable to identify the reason some cows maintain lower body condition scores than others. Nevertheless, cows that maintained lower body condition gave birth to lighter calves than the cows in greater condition, yet calves, at weaning were not statistically different but were numerically lower in weight. Looking at the history of this group of cows, the low condition group consistently weaned lighter calves. Therefore, when producers are making culling decisions, these cows may be less productive based on lower saleable calf weight and should be considered for culling if cows must be sold.

INTRODUCTION

During the 2020 growing season, the New Mexico State University Corona Range and Livestock Research Center (CRLRC) experienced drought much like many of the other ranches in New Mexico. During the weaning period, body condition scores were collected and a group of cows that were confirmed pregnant and weaned a calf appeared to have distinctly different body condition scores (BCS).Therefore, researchers sought to investigate why there were differences in cows that grazed the same pasture together with similar genetics and ages diverged in body condition. The hypothesis was that cows in greater body condition scores were more feed efficient and/or produced less milk than lower conditioned cows. The objectives were to monitor individual intake before calving and collect blood and milk samples up to 60 days postpartum.

MATERIALS AND METHODS

All procedures were conducted by an approved NMSU Institutional Animal and Care Committee protocol.
On December 17, 2020, BCS were assessed on the CRLRC cows in which a group of 24 were selected for the study based on having a low (<5; 12 cows) or high (>5; 12 cows) BCS. Each BCS group averaged 7.3 years of age.The actual average BCS for the low and high BCS groups were 4.4 and 5.8, respectively. Cows were transported to campus in Las Cruces one month before calving and were adapted to the Broadbent Calan gate individual feeding system. Cows were fed a diet that was formulated to meet or slightly exceed the NASEM (2016) requirements for maintenance (2.6% of Bodyweight). Because the objective of this experiment was to determine any metabolic or feed efficiency differences between the two body condition score groups. By limiting intake, any differences due to variation in intake were eliminated.

Cows were weighed and bled every 14 days. Blood was collected via coccygeal venipuncture into a serum collection tube.Calves were weighed and bled and colostrum was collected within 12 hours of calving. Twenty-four-hour milk production was determined using a mechanical milker on day 60, postpartum.

Blood samples were analyzed for glucose, non-esterified fatty acids (NEFA), beta-hydroxybutyrate (ketone). Colostrum was analyzed for IgG concentrations.

Data were analyzed as a completely randomized design using the PROC GLM procedure of SAS (SAS Inst. Inc., Cary, NC) with body condition score as the fixed effect for body weight, milk production, and BCS change. Whereas time course data were analyzed using the PROC MIXED procedure with time and treatment x time interactions serving as the fixed effects. Treatment differences were considered significant at a P-value of 0.05 and a tendency at 0.12.

RESULTS

Initial cow body weight (start of the trial March 2021) was greater for HS than LS (P = 0.05) with BCS not differing (P = 0.18; Table 1). It is important to note that after weaning when treatments were assigned (December 2020), BCS differed (P < 0.001). Final cow body weight was greater for HS than LS (P = 0.03) with BCS tending (P = 0.09) to be greater for HS. Dry matter intake tended to be lower for LS than HS cows (P = 0.06). Average daily gain and feed efficiency averaged across the 60-d feeding trial were not different (P ≥ 0.18). Colostrum Immunoglobulin concentration did not differ (P = 0.23). Sixty-day 24-h milk production did not differ (P = 0.38).

No treatment × day interactions (P ≥ 0.68) were observed for any of the blood parameters measured (glucose, non-esterified fatty acids, and beta-hydroxybutyrate). Overall blood glucose tended (P = 0.12) to be lower for LS than HS. Ketone approached a tendency for LS to be greater (P = 0.13) than HS, whereas non-esterified fatty acids were not different (P = 0.97).

Calf birthweight tended to be lower for LS (P = 0.06; Table 2) when compared to HS. Nonetheless, calf ADG from birth to 60 d of age and 60-d body weight was not different (P ≥ 0.12). Weaning weights were not different (P = 0.52) but differed numerically by 19 lbs.

DISCUSSION

This is a unique experiment where cows were not fed to achieve divergent BCS, rather they naturally achieved different BCS in the same environment (same pasture) and all were diagnosed as pregnant (Fall 2021). This is not uncommon in any cow/calf system and often producers explain a lower BCS to greater milk production and therefore larger calves at weaning.However, in 2021, calves born to LS cows were 48 lbs lighter than HS calves at weaning. Cows from the HS treatment had greater BCS and weaned larger calves, therefore, suggesting that they may be inherently more efficient, particularly since they were all maintained on the same drought-stricken pasture throughout lactation in 2020.

During the current experiment (spring 2021), both groups, LS and HS, gained weight and had a similar trajectory of weight gain throughout the trial (Figure 1). It was hypothesized that because the HS group maintained a higher BCS and weaned a heavier calf in the previous weaning season, they would have converted feed more effectively. Yet feed intake and ADG was similar with a consistent magnitude of difference between BCS groups throughout the feeding trial (Figure 2).

Blood metabolites were collected to potentially identify metabolic differences. Blood glucose reflects intake and fermentation, whereas an increase in non-esterified fatty acids indicates the animal is mobilizing fat stores for energy. Beta-hydroxybutyrate is a ketone, that becomes elevated when glucose supply is limiting and the animal becomes overly reliant on fat mobilization for energy.Blood glucose was greater for HS, with a slight increase in NEFA and ketones for LS, which is typical when blood glucose is reduced. One may attribute this to the lower DMI for LS, however, cows were fed as a percentage of their body weight (or g of DMI / kg of BW) and were similar for both treatments.Russel and Wright (1983) reported that NEFA and the ketone, beta-hydroxybutyrate, were better indicators of energy status than glucose alone. Because all cows were consistently gaining weight, all would be considered in a positive plane of nutrition and would have expected the blood metabolites to be the same. Vizcarra et al. (1988) reported a decrease in NEFA as BCS increased. Therefore, differences in blood metabolites may be attributed to the slight difference in BCS.

Overall, the results of this experiment do not provide specific reasons as to why LS maintained a lower BCS than HS cows. Looking back at the history of these cows (7 years of information), the LS cows have consistently maintained lower BCS and weaned lighter calves than the HS, irrespective of the precipitation received. Future directions with this work would be to provide this set of cows free-choice access to feed to see if voluntary feed intake varies along with investigations into the rumen microbiome and genetics.

LITERATURE CITED

NASEM. 2016. Nutrient requirements of beef cattle. 8th rev. ed. Washington, DC: National Academies Press.

Russel, A. J. F, and I. A. Wright. 1983. The use of blood metabolites in the determination of energy status in beef cows. Anim. Sci. 37:335-343.

Vizcarra, J. A., R. P. Wettemann, J. C. Spitzer, and D. G. Morrison. 1998. Body condition at parturition and postpartum weight gain influence luteal activity and concentrations of glucose, insulin, and nonesterified fatty acids in the plasma of primiparous beef cows. J. Anim. Sci. 76:927-936.

Table 1. Effects of divergent body condition scores at weaning on subsequent cow intake, growth, and blood metabolites during the subsequent calving season.

	Treatment[1]			
Item	LS	HS	SE	*P*-value
BW				
Initial	1147	1285	49	0.05
Final	1193	1351	49	0.03
BCS				
Initial	5.1	5.5	0.2	0.18
Final	6.0	6.4	0.1	0.09
DMI[2], lb/d	31.0	33.8	1.0	0.06
ADG[3], lb/d	1.04	1.10	0.17	0.80
G:F[4], lb ADG / lb DMI	0.04	0.03	0.01	0.81
24-h Milk yield	24.2	21.3	2.4	0.38
Glucose, mg/dL	60.9	64.2	1.6	0.12
NEFA, µmol/L[5]	248.0	246.6	30.1	0.97
Beta-hydroxybutyrate, mM	1.74	1.55	0.09	0.13

[1]LS: Low score (BCS 4.4 at weaning); HS: High score at weaning (BCS 5.8).
[2]DMI: Dry matter intake.
[3]ADG: Average daily gain.
[4]G:F: Gain to feed.
[5]NEFA: Non-esterified fatty acids.

Table 2. Calf growth performance born to cows with divergent body condition scores.

	Treatment[1]			
Item	LS	HS	SE	*P*-value
Bodyweight, lb				
Birth	66.2	74.9	3.2	0.06
d-60	213.7	230.1	7.5	0.12
0 to 60 d ADG, lb/d	2.45	2.58	0.09	0.30
Weaning weight	531.5	550.5	20.7	0.52

[1]LS: Low score (BCS 4.4 at weaning); HS: High score at weaning (BCS 5.8).

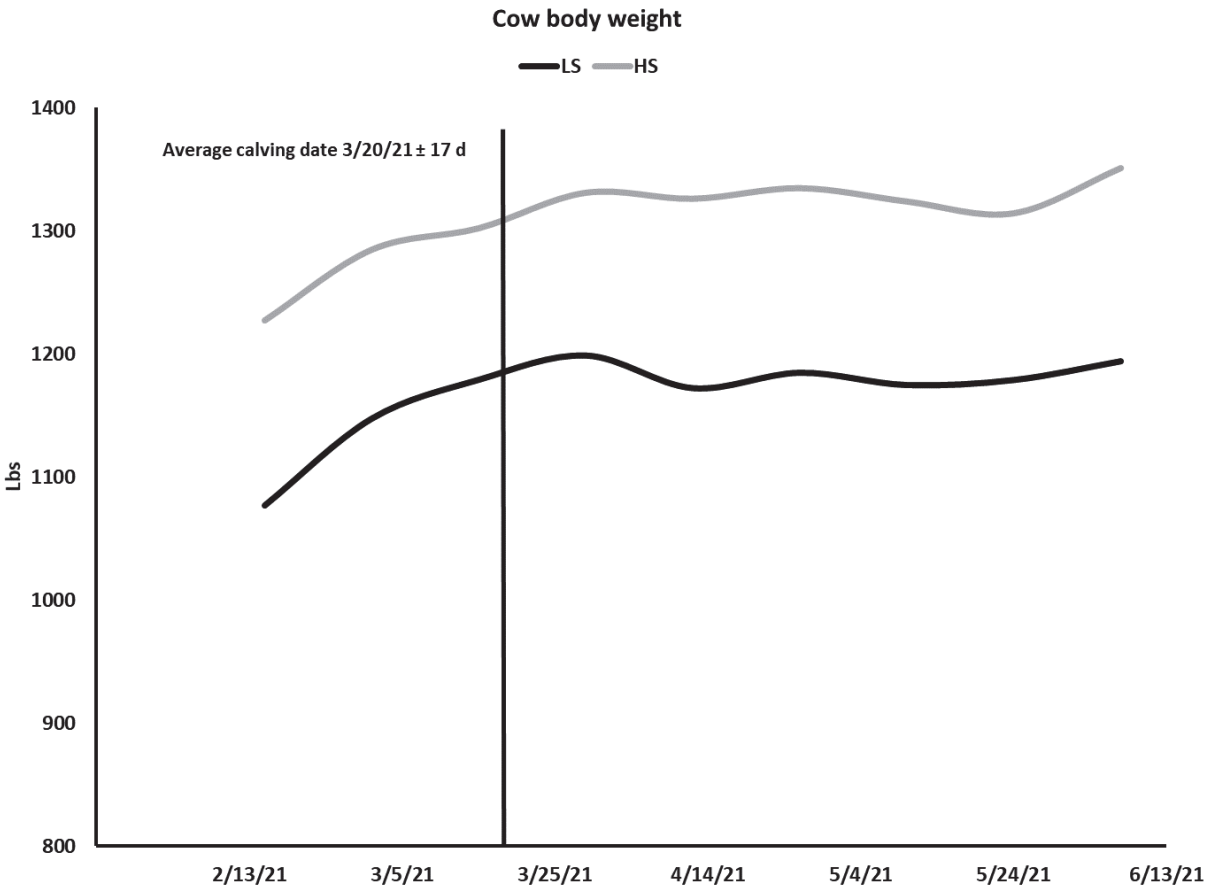

Figure 1. Cow body weight changes over time

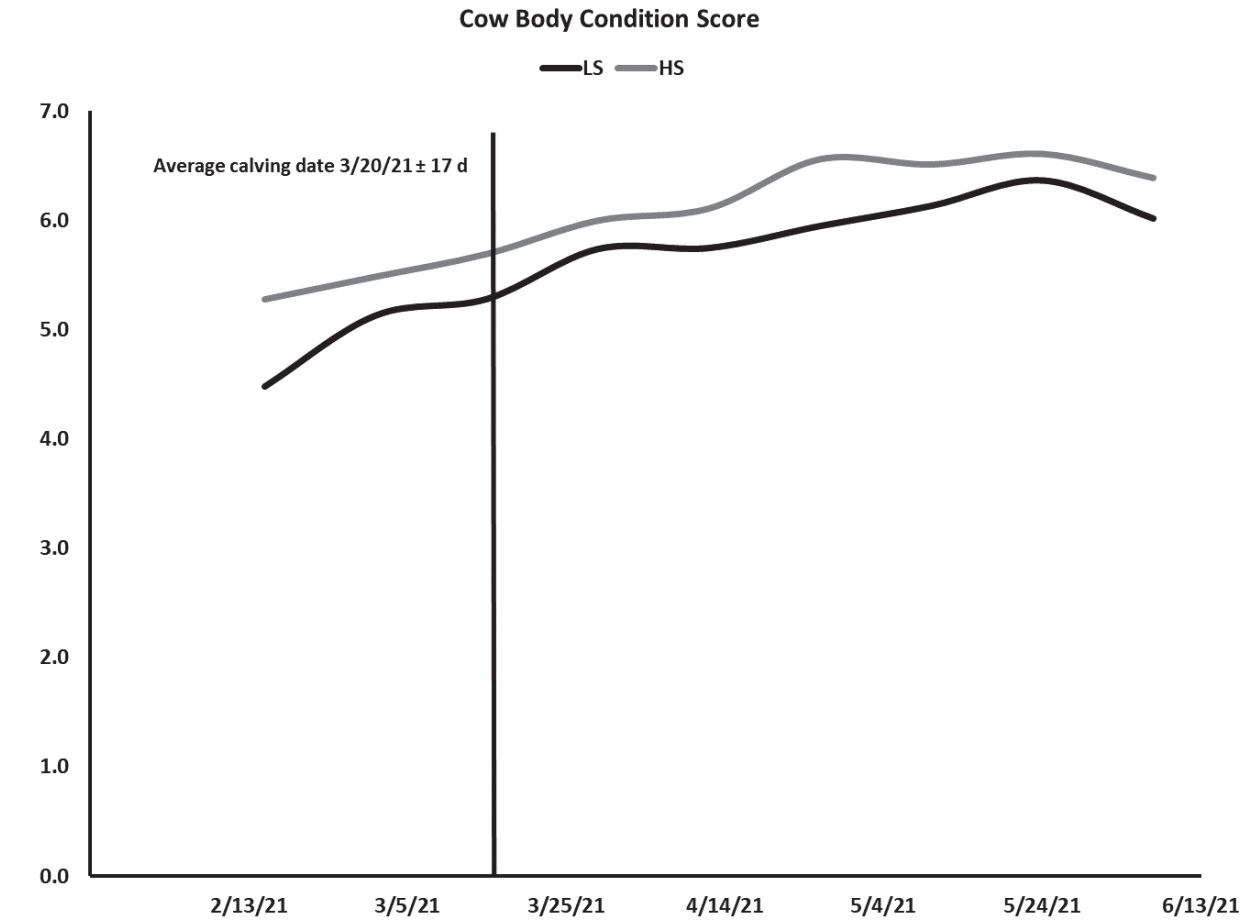

Figure 2. Cow BCS changes over time.

EVALUATION OF CALF GROWTH PERFORMANCE PREWEANING AND POSTWEANING WHEN COWS ARE VACCINATED USING A LIFETIME REGIMEN OF A MODIFIED LIVE VIRAL OR KILLED VIRAL VACCINE AGAINST BOVINE VIRAL DIARRHEA VIRUS

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NM PROBLEM ADDRESSED BY RESEARCH

Identifying vaccination protocols in cow-calf operations is critical for disease prevention and production efficiency. Understanding the impact of vaccination type on colostrum quality, and progeny growth and performance when vaccinating pregnant animals is important to understand potential implications postweaning.

MATERIALS AND METHODS

Preweaning

Animals, Diets, and Treatments

In 2015, 58 commercial Angus x Hereford heifers were randomly assigned to receive a lifetime regimen of either a modified-live viral (Bovi-Shield Gold FP L5, Zoetis, Animal Health, Florham Park, NJ) or killed viral vaccination (Cattlemaster Gold FP 5, Zoetis Animal Health, Florham Park, NJ) against bovine viral diarrhea virus (BVDV). Beginning at their third parity, cow-calf pairs were sampled throughout the preweaning period.

Nineteen 2019 spring-born commercial Angus x Hereford cow-calf pairs, fourteen 2020 spring-born commercial Angus x Hereford cow-calf pairs, and sixteen 2021 spring-born commercial Angus x Hereford cow-calf pairs were utilized over a three-year study to examine the effects of dam vaccination treatment on calf development during the preweaning phase. Pairs were kept on rangeland throughout the preweaning phase, supplemented with 20% CP supplement (Rancher Pro 20% Cube, Hi-Pro Feed, Friona, TX), and provided with loose salt mineral ad libitum. The loose-salt mineral was composed of 10% Ca, 7% P, 2% Mg, 0.5% K, 2500 ppm Cu, 5000 PPM Zn, 2500 ppm Mn, 75 ppm I, 15 ppm Se, and 246 KIU/kg vitamin A (Hi-Pro Feed, Friona, TX).

Vegetation was composed of a major overstory of moderate woodlands consisting of Pinyon pine (Pinus edulis) and various juniper species (Juniperus spp:). Predominant grasses in these pastures included blue grama (Bouteloua gracilis), side oats grama (Bouteloua curtipendula), hairy grama (Bouteloua hirsute), sand dropseed (Sporobolus cryptandrus), common wolf tail (Lycurus phleoides), three awns (Aristida spp.), and black grama (Bouteloua eriopoda) with minor components of other grasses and annual forbs (Knox, 1998; Forbes and Allred, 2001). Forage clipping samples were collected every four weeks utilizing a 0.25-m2 quadrat with four quadrats collected in 6 locations throughout the pasture. Forage clipping was collected to ensure forage availability did not limit cow productivity and characterize the nutritional content of the forage.

Sample Collection

Samples of colostrum, milk, rumen content, and blood were collected from the dam on day 1, day 7, day 35, day 63, and day 205 postpartum. Cow colostrum was measured for Quantitative IgG analysis. Cow body condition at calving and weaning was determined. Samples of blood and rumen content were collected from calves on days 7, 35, 63, and 205 of age. Calf birth weight and weaning weight was measured. Rumen content samples were collected via oral lavage (Lodge-Ivey et al., 2009). Approximately 20mL of rumen content was collected, ruminal pH was determined via pH meter (ThermoFisher), and samples were subsequently snap-frozen via liquid N and subsequently stored at -80°C until further analyses. Additionally, blood samples were collected via coccygeal venipuncture into serum separator vacuum tubes (Corvac, Kendall Healthcare, St. Louis, MO). Approximately 20mL of blood was collected, and samples were centrifuged at 1200 x g for 20 minutes at 4°C. Serum was removed and stored at -20°C until assays were conducted.

Ruminal Analyses

Ruminal ammonia was evaluated using the phenol-hypochlorite procedure adapted to a microtiter plate (Broderick and Knag-Meznarich, 1980). Intra- and inter-assay coefficients of variation were 3.5% and 6.4%, respectively. Rumen samples were analyzed for volatile fatty acid concentrations of acetate, propionate, butyrate, isobutyrate, valerate, and isovalerate by gas chromatography (Agilent Systems 7980) as described by May and Galyean (1996).

Serum Analyses

Serum samples were analyzed to quantify serum urea nitrogen (SUN), glucose, and non-esterified fatty acid (NEFA) concentrations. Samples were analyzed using a 96-cell EPOCH 2 microplate reader (BioTek Instruments, Winooski, VT) with commercially available kits for NEFA (Wako Chemicals USA, Inc., Richmond, VA; sensitivity of 0.01 mmol × L−1), glucose (Thermo Electron Corp., Waltham, MA; sensitivity of 0.3 mg × dL−1) and SUN (Thermo Electron Corp.; sensitivity of 2.0 mg × dL−1).

Statistical Analyses

Data were analyzed using the MIXED and GLIMMIX procedures of SAS 9.4 (SAS Inst. Inc., Cary, NC). Dam and calf ruminal pH, VFA concentrations, and ammonia throughout the preweaning period were analyzed as repeated measures, where a year, day, treatment, and subsequent interactions were examined. As sampling occurred over 3 years, the effect of year was initially included in the model. Where year and subsequent interactions were insignificant, they were removed from the model.

Postweaning

Animals, Diets, and Treatments

Nineteen 2019 spring-born Angus x Hereford calves (steers and heifers) and fourteen 2020 spring-born Angus x Hereford calves (steers and heifers) were utilized after a 45-d post-weaning interval. Calves were born to dams receiving a lifetime regimen of modified-live viral (n=18; Bovi-Shield Gold FP L5, Zoetis, Animal Health, Florham Park, NJ) or killed viral vaccination (n= 14; Cattlemaster Gold FP 5, Zoetis Animal Health, Florham Park, NJ) against bovine viral diarrhea virus (BVDV). Calves were weaned in October, at which time calf body weight was recorded and all calves received a modified-live viral vaccination (Bovi-Shield Gold 5, Zoetis Animal Health, Florham Park, NJ), against infectious bovine rhinotracheitis (IBR), BVD type I, and type II, parainfluenza 3 (PI3), and bovine respiratory syncytial virus (BRSV). Calves also received vaccination against Mannheimia haemolytica (One Shot, Zoetis Animal Health) and were dewormed (Dectomax, Zoetis Animal Health). Following weaning, all calves were managed together and grazed a common pasture for 45-d until transportation from the Corona Range and Livestock Research Center (Corona, NM) to the Campus Livestock Research Center (Las Cruces, NM).

In both 2019 and 2020, calves were provided a 21-d diet acclimation period while being trained to use the Calan Broadbent gate feeding system. Calves were provided ad libitum access to the diet (Table 1) for 56-d to determine feed efficiency, orts were recorded daily.

Sample Collection

Animals were weighed every two weeks to determine growth performance. Rumen content samples were collected via oral lavage (Lodge-Ivey et al., 2009) every two weeks beginning at the initiation of the 60-d feed efficiency trial. Approximately 50mL of rumen content was collected, ruminal pH was determined via pH meter (Thermo Fischer), and samples were subsequently frozen at -80°C until further analyses were conducted. Additionally, blood samples were collected via coccygeal venipuncture into serum separator vacuum tubes (Corvac, Kendall Healthcare, St. Louis, MO). Approximately 20mL of blood was collected, and samples were centrifuged (1200 x g for 20 minutes at 4°C). Serum was removed and stored at -20°C until assays were conducted.

Ruminal Analyses

Ruminal ammonia was evaluated using the phenol-hypochlorite procedure adapted to a microtiter plate (Broderick and Knag-Meznarich, 1980). Intra- and inter-assay coefficients of variation were 3.5% and 6.4%, respectively. Rumen samples were analyzed for volatile fatty acid concentrations of acetate, propionate, butyrate, isobutyrate, valerate, and isovalerate by gas chromatography (Agilent Systems 7980) as described by May and Galyean (1996).

Serum Analyses

Serum samples were analyzed to quantify serum urea nitrogen (SUN), and glucose concentrations. Samples were analyzed using a 96-cell BIOTEK microplate reader with commercially available kits for glucose (Thermo Electron Corp., Waltham, MA; sensitivity of 0.3 mg × dL−1), and SUN (Thermo Electron Corp.; sensitivity of 2.0 mg × dL−1).

Statistical Analyses

Data were analyzed as a completely random design using the MIXED procedure of SAS 9.4 (SAS Institute Inc., Cary, NC). Ruminal fermentation measures of pH, VFA concentrations, and ruminal ammonia throughout the feed efficiency trial were analyzed as repeated measures, where a year, week, treatment, and their interactions were examined. Similarly, serum metabolites of glucose, NEFA, and SUN were analyzed as repeated measures. If interactions were non-significant, they were removed from the model. Physiological data of average daily gain, average daily dry matter intake, and feed efficiency, measured as gain: feed, were analyzed using the MIXED procedure to evaluate the effect of vaccination treatment on growth. The least-square means were compared using Fisher's LSD. Effects were considered significant at a P-value of < 0.05 with tendencies declared at P-values between 0.05 and 0.10.

RESULTS

Preweaning

Calving and weaning body condition scores (BCS) are presented in Table 1. Calf birth and weaning weights and weaning weight percentage are presented in Table 1. Body condition score at calving was similar between treatments and years ($P \geq 0.22$) but weaning body condition score was significantly impacted by year of study ($P < 0.05$). Cow weaning weights were significantly higher for MLV cows ($P = 0.02$). Calf birth weight was similar between treatment groups and year of study ($P \geq 0.53$). Calf weaning weights were similarly affected by the year of study ($P < 0.0001$). This was likely due to the early weaning of calves at approximately 4.5 months of age in year 3 of the study, although calves in year 2 were roughly 25kg lighter than calves in year 1 of the study. As a result of early weaning, cow weaning weight percentage was significantly less in year 3 than in previous years ($P < 0.0001$). However, in drought-stricken environments where available forage is scarce, early weaning is an effective management tool for producers.

Quantitative IgG concentrations were analyzed in colostrum throughout the study. Data are presented in Figure 1. Immune protection in calves is highly dependent upon receiving timely, high-quality colostrum. Immunoglobulin G is the most prevalent antibody present in colostrum in cattle and is transferred to the calf through consumption, rather than through in-uteroplacental transfer. Cows receiving KV vaccinations have ~60% more IgG than cows receiving an MLV vaccination ($P = 0.02$, Figure 1).

Serum metabolites, ruminal ammonia, and pH, separated by cow or calf, are presented in Table 2. Serum urea nitrogen, glucose, and ruminal ammonia differed across the day and year of study ($P \leq 0.05$) for cows. This was unsurprising as nutrient demands change throughout the preweaning phase for lactating cattle. Cow NEFA concentrations were highest on day 1 and day 7, indicating that the energy demands of calving may have induced lipolysis for increased circulating NEFA. Similarly, calf NEFA concentrations differed by day and year × day interaction across all parameters ($P \leq 0.05$), peaking at day 7 of age. Cattle may rapidly utilize brown fat early in life to maintain homeostasis in cold weather environments, and previous studies have indicated NEFA concentrations increase in response to cold exposure. Calf ruminal ammonia peaked at day 7, indicating rapid utilization of residual milk passing through the esophageal groove and early ruminal function.

Postweaning Feed Efficiency

Growth performance and feed efficiency are reported in Table 3. Feed efficiency, measured as gain: feed, was unaffected by treatment. Calves from Year 2 had significantly higher final body weight ($P = 0.01$), average daily gain ($P < 0.0001$), average dry matter intake ($P < 0.0001$), and feed efficiency ($P = 0.0016$), likely due to diet differences between Year 1 and Year 2 (Table 3). Growth performance was unaffected by treatment.

Ruminal pH was significantly affected by the year and week of the trial and was unaffected by treatment (Table 4). However, as ruminal pH remained at or above 7.0 for both years 1 and 2, the differences may not have biological relevance in fermentation. Ruminal pH changes can likely be attributed to ongoing shifts in microbial populations to the diet, resulting in statistical, but not biological relevance each week. Ruminal ammonia was similarly affected by year and week of collection, but not by treatment (Table 4). Ruminal ammonia concentrations were significantly reduced from year 1 of the trial to year 2, which may be attributed to dietary changes. Ruminal microorganisms require a nitrogen source for growth, and Satter and Slyter (1974) determined that a minimum ammonia concentration of 2.9mM is needed for rumen microbial protein synthesis. In the present study, ruminal ammonia concentrations were below this threshold for all but one week. This suggests that there may have been insufficient rumen microbial protein synthesis based on the diet. Ruminal volatile fatty acids (VFA) were analyzed for acetate, propionate, butyrate, isobutyrate, valerate, isovalerate, acetate: propionate, and total VFA (Table 4). Acetate is the primary energy source for ruminant animals consuming forage-based diets and represents the largest fermentation product. Acetate proportions were higher in year 2 compared to year 1 (P =0.018) and varied over a week of sampling (P = 0.0001) likely resulting from dietary differences as well. A tendency for a year × week interaction was observed (P = 0.06). Propionate serves as a glucogenic precursor and is secondary in the proportion of fermentation products. As diets increase in starch concentration, propionate proportions increase relative to forage-based diets. In the present study, propionate was significantly affected by year × week interaction (P = 0. 0011). Butyrate was affected by year (P < 0.0001) and week (P = 0.008), and a tendency for the treatment effect (P = 0.06), however, this may be not biologically relevant. Isobutyrate proportions were significantly affected in a year × week interaction (P = 0.02) and significantly reduced in year 2 of the trial. Total VFA was higher in year 2 (P = 0.0001) and were affected by week (P < 0.0001). For a forage-based diet, acetate: propionate ratios were expected to fall within 3-4, which was observed in the present study. A significant year × week interaction was observed (P = 0.009), with A:P ranging from 3.2 – 4.1.

CONCLUSIONS

Based on the experiments conducted, the vaccination type of the dam does not impact calf growth or ruminal dynamics in the preweaning phase or post-weaning. This provides additional information to producers when making management decisions, that long-term implementation of a killed viral or modified-live viral vaccination program on cows will not impact progeny performance.

Table 1. LS Means of cow body conditions score, birth, and weaning weights of calves over three calving seasons.

	Year							*P*-value		
	1		2		3#					
Item	KV	MLV	KV	MLV	KV	MLV	SEM	Year	Trt	Year × Trt
BCS, Calving[1]	4.3	4.4	4.5	4.4	4.2	4.7	0.19	0.73	0.18	0.22
BCS, Weaning[1]	5.1	5.3	4.5	4.8	4.0	4.3	0.2	<.05	0.14	0.98
Cow Weaning Weight[2]	465.5	477.7	457.8	505.9	480.9	514.5	18.0	0.28	0.02	0.55
Calf Birth Weight[2]	31.7	32.3	33.1	35.0	32.6	31.5	2.4	0.77	0.53	0.78
Calf Weaning Weight[2#]	231.8	241.4	218.2	218.3	158.1	169.7	11.7	<0.001	0.43	0.86
Weaning %[3]	49.9	50.8	47.4	43.7	32.9	33.0	2.6	<0.001	0.64	0.60

[1]Body condition evaluated from 1-9.

[2]kg

[#]Calves early-weaned (avg age 120d) in year 3.

[3]Weaning weight percentage of cows, determined by calf weaning weight as a percentage of cow weaning weight.

Table 2. LS Means of serum metabolites and ruminal characteristics of cows and their calves during the preweaning period over three calving seasons.

	Day, postpartum																			
	1			7			35			63			205							
	Year																*P*-value			
Item	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	SEM	Year	Trt	Day	Year × Day
Cow																				
n	19	14	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUN[1]	4.5	9.9	5.9	13.8	4.9	5.1	9.3	4.9	7.5	9.7	8.5	4.9	13.2	11.5	3.3	2.9	<0.01	0.78	<0.01	<0.01
Glucose[2]	54.5	124.7	84.9	62.0	66.4	77.4	53.9	49.0	64.1	62.3	61.6	57.7	56.0	62.3	56.6	4.3	<0.01	0.09	<0.01	<0.01
NEFA[1]	0.37	0.56	0.53	0.45	0.63	0.42	0.38	0.26	0.46	0.34	0.18	0.37	0.39	0.19	0.16	0.05	0.78	0.86	<0.01	<0.01
pH	6.9	7.1	7.3	6.9	7.3	7.2	7.1	7.4	7.5	7.2	7.2	6.6	7.4	7.0	6.8	0.2	0.74	0.64	0.08	0.002
Ammonia[1]	4.4	4.5	2.9	4.1	4.0	2.6	4.3	7.2	1.8	3.3	4.5	2.5	2.4	2.3	5.9	0.5	<0.01	0.98	0.06	<0.01
Calf																				
n	19	14	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUN[1]	5.6	7.2	2.3	6.8	7.0	3.4	2.5	5.9	3.8	3.5	3.7	4.2	6.7	4.2	8.4	0.9	0.01	0.61	<0.01	<0.01
Glucose[2]	59.7	111.8	79.5	57.9	104.6	118.5	75.2	99.9	112.6	73.4	84.3	90.6	69.4	75.9	103.4	9.3	<0.01	0.66	0.07	<0.01
NEFA[1]	0.65	0.31	0.35	0.63	1.1	0.18	0.19	0.2	0.17	0.23	0.49	0.18	0.42	0.52	0.11	0.1	<0.01	0.26	<0.01	<0.01
pH	-	-	-	6.5	6.7	6.6	6.8	6.5	7.1	6.8	6.8	6.7	7.7	7.5	6.9	0.1	0.37	0.71	<0.01	<0.01
Ammonia[1]	-	-	-	9.2	6.7	8.8	5.8	6.7	3.7	3.8	5.3	3.3	2.8	3.6	4.2	0.6	0.56	0.87	<0.01	<0.01

[1]mmol

[2] mg × dL^{-1}

Table 3. LS Means of feed efficiency, average daily gain, and growth over a 56-d feed efficiency trial, conducted over two years.

	Treatment							
	K		M			*P*-value		
	Year							
Item	1	2	1	2	SEM	Year	Treatment	Year × Treatment
Initial BW[1]	244.5	239.3	254.9	247.2	13.4	0.61	0.47	0.92
Final BW[1]	300.2	339.2	309.5	344.5	15.9	0.01	0.62	0.89
ADG[1]	0.99	1.78	0.97	1.73	0.08	< 0.001	0.66	0.85
ADMI[1]	6.7	9.1	6.5	9.8	0.36	< 0.001	0.52	0.21
G:F[2]	0.14	0.2	0.14	0.18	0.01	0.002	0.42	0.41

[1]kg

[2]Feed efficiency measured as kg gain: kg feed consumed.

Table 4. LS Means of ruminal pH, volatile fatty acids, and ammonia concentration differences by week and year of 56-d feed efficiency trial, conducted over two years.

	Week													
	1		3		5		7		9			*P*- value		
	Year													Year ×
Item	1	2	1	2	1	2	1	2	1	2	SEM	Year	Week	Week
Ruminal pH	7.64	7.08	7.61	7.00	7.33	7.15	7.12	7.23	7.27	7.82	0.1	0.015	0.0006	< 0.0001
Ruminal ammonia[1]	1.91	0.49	2.34	1.26	1.88	1.51	2.41	0.91	2.96	1.56	0.2	< 0.0001	< 0.0001	0.0009
Acetate[2]	61.2	64.8	63.1	66.4	59.0	64.4	61.5	60.4	63.6	68.7	1.5	0.018	0.0001	0.06
Propionate[2]	16.4	18.1	15.4	16.6	17.2	20.2	16.1	23.1	15.6	18.1	0.9	0.0027	<0.0001	0.001
Butyrate[2]	7.8	10.6	7.6	11.4	8.2	9.9	8.7	10.5	7.3	8.2	0.6	< 0.0001	0.0088	0.08
Isobutyrate[2]	11.6	2.4	10.9	2.3	12.2	2.0	11.4	1.7	11.2	1.8	0.2	< 0.0001	0.06	0.02
Valerate[2]	0.45	0.62	0.45	0.69	0.56	0.74	0.58	1.3	0.4	0.6	0.08	< 0.0001	< 0.0001	0.0009
Isovalerate[2]	2.4	3.2	2.4	2.3	2.8	2.6	1.4	2.8	1.5	2.2	0.3	0.014	0.0057	0.05
Total VFA[1]	40.0	64.1	40.2	58.8	46.7	83.0	66.8	82.5	49.1	60.1	6.6	0.0001	< 0.0001	0.23
A:P	3.7	3.6	4.1	4.0	3.6	3.4	4.0	3.2	4.1	4.0	0.17	0.25	< 0.0001	0.009

[1] mmol × L^{-1}

[2] mol / 100mol

Table 5. LS Means of serum urea nitrogen and glucose concentrations during 56-d feed efficiency trial, conducted over two years.

	Week													
	1		3		5		7		9					
	Year											*P*- value		
Item	1	2	1	2	1	2	1	2	1	2	SEM	Year	Week	Year × Week
SUN[1]	5.8	8.7	3.2	5.7	3.5	7.9	6.1	1.7	5.4	1.7	1.0	0.59	0.001	< 0.0001
Glucose[2]	70.3	73.3	75.9	68.4	44.6	53.1	36.0	73.3	50.9	68.6	5.8	0.002	< 0.0001	0.0009

[1] mmol × L^{-1}

[2] mg × dL^{-1}

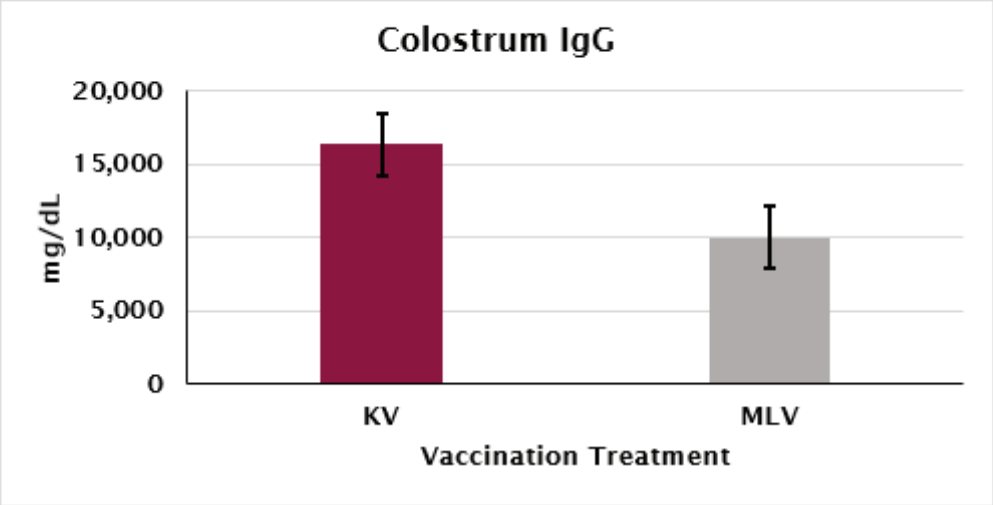

Figure 1. LS Means of quantitative IgG in colostrum from cows receiving a KV or MLV vaccination ($P = 0.02$).

EVALUATION OF ANTIBODY TITERS AND HERD LONGEVITY WHEN COWS ARE VACCINATED USING A LIFETIME REGIMEN OF A MODIFIED LIVE VIRAL OR KILLED VIRAL VACCINE AGAINST BOVINE VIRAL DIARRHEA VIRUS AND INFECTIOUS BOVINE RHINOTRACHEITIS

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NM PROBLEM ADDRESSED BY RESEARCH

Researchers have identified that regular vaccinations of the cowherd contribute greatly to reducing instances of bovine viral diarrhea virus (BVDV) at the later production phases. 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. Specifically, the use of a killed viral compared to a modified live viral vaccination, or a combination of these has been examined in this study to evaluate the long-term effects of vaccination type on reproductive performance, and herd and antibody longevity. This research will provide additional information about the long-term effects of vaccination beginning at 3 months of age throughout the lifetime of the cow. Finally, through the proposed research we will provide increased evidence for choosing vaccination strategies that maximize health, productivity, and efficiency of animals for cow-calf producers.

MATERIALS AND METHODS

All experimental procedures were approved by New Mexico State University Institutional Animal Care and Use Committee.

Animals and Treatments

66 Angus × Hereford cross heifers born in spring of 2014 and 58 Angus × Hereford cross heifers born in spring of 2015 grazed native range as described by Forbes and Allred (2001) at the New Mexico State University Corona Range and Livestock Research Center (CRLRC). All heifers born in 2014 received a modified live viral (Bovi-Shield Gold FP L5, Zoetis, Inc) vaccination at 60d of age against bovine viral diarrhea virus and were randomly assigned to receive either a lifetime regimen of a modified-live viral or a killed viral (Cattlemaster Gold FP 5, Zoetis, Inc.) vaccination in the fall of each year at calf weaning time. Heifers born in 2015 were randomly assigned to receive either a modified live viral (Bovi-Shield Gold FP L5, Zoetis, Inc) or a killed viral (Cattlemaster Gold FP 5, Zoetis, Inc.) vaccination at 60d of age against bovine viral diarrhea virus. All heifers were revaccinated at ~205 d of age, beginning their yearly lifetime vaccination protocol with either vaccination treatment in the fall of each year at calf weaning time.

Blood samples were collected via coccygeal venipuncture, centrifuged at 1,200 × g for 20 min at 4 °C, and serum was collected and frozen at -20°C. Serum was evaluated for antibody titers against infectious bovine rhinotracheitis and bovine viral diarrhea virus throughout the lifetime of each group of cattle, beginning at weaning for 2014-born animals, and at branding for 2015-born animals. Blood samples were subsequently collected twice yearly to evaluate serum neutralization titer longevity over the lifetime of the animal in the herd (Figure 1 and 2).

Statistical Analyses

Titer data were analyzed using the MIXED procedure of SAS 9.4 (SAS Inst. Cary, NC) as a completely randomized design, where vaccine treatment was considered the fixed effect, and the individual heifer was the experimental unit. The model included a year of birth (2014 or 2015), date of sampling, and treatment. Titer data were initially transformed to log2 for analysis and back-transformed into their titer value after completion of analysis. Titer data were analyzed using repeated measures using an autoregressive covariance structure. Means were calculated using LS Means and reported using Tukey's Adjustment factor. Survival analysis for herd longevity was performed using the LIFE TEST procedure of SAS to examine the influence of vaccine treatment on lifetime productivity. Effects were considered significant at $P \leq 0.05$, and trending at $0.05 < P \leq 0.10$.

Update

Cows have similar weaning weights through their fifth calf (Table 1, Table 2), indicating vaccination type does not influence cow weaning weight nor weaning weight percentage. In the current study, no differences ($P > 0.05$) were determined in weaning weights of 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).

Cow longevity is a critical component of beef production, with cows typically remaining in the herd 5-6 years. Input costs over time indicate that cows remaining in the herd that produced five or more calves are more likely to achieve increased profitability for the producer. Thus, the longevity of both 2014-born cows (Figure 3) and 2015-born cows (Figure 4) was assessed through calves born in 2021. Herd retention rate is not influenced by vaccination treatment ($P \geq 0.86$).

Cattle from this study will remain on their vaccination regimen to examine longevity and changes in titers over the lifetime of the animal. A subsequent study is being conducted to evaluate cell-mediated immune responses from these animals, now in their productive lifetime.

Table 1. Weaning weights (kg) of 2014-born cows and their calves having received an MLV vaccine at branding, and then dived into receiving a KV or MLV vaccine for life. Weaning weights presented as LSMeans ± SEM.

	Treatment[1]		
Year	KV	MLV	*P*-value
Cow			
2016	415.5 ± 9.7	444.4 ± 8.5	0.02
2017	474.5 ± 14.1	502.2 ± 12.5	0.14
2018	451.6 ± 11.9	481.9 ± 11.0	0.07
2019	478.7 ± 15.2	513.2 ± 14.7	0.11
2020	480.6 ± 14.3	490.8 ± 13.8	0.61
2021	487.8 ± 19.9	474.05 ± 18.8	0.30
Calf			
2016	218.1 ± 7.2	218.0 ± 6.7	0.99
2017	241.7 ± 12.4	248.8 ± 8.7	0.65
2018	239.1 ± 6.4	237.5 ± 5.8	0.85
2019	252.1 ± 5.7	239.7 ± 5.3	0.12
2020	201.3 ± 6.8	207.2 ± 7.6	0.57
2021	210.7 ± 11.4	221.6 ± 12.1	0.52

[1]MLV: modified-live viral vaccination; KV: Killed viral vaccination

Table 2. Weaning weights (kg) of cows and their calves having received only an MLV vaccine or KV vaccine since branding (2015-born).

	Treatment[1]		
Year	KV	MLV	*P*-value
Cow			
2017	460.9 ± 18.3	412.2 ± 17.2	0.06
2018	444.4 ± 9.9	441.2 ± 9.3	0.81
2019	478.7 ± 15.2	513.2 ± 14.7	0.11
2020	480.6 ± 14.3	490.8 ± 13.8	0.61
2021	487.8 ± 19.9	474.05 ± 18.8	0.30
Calf			
2017	235.3 ± 4.8	230.3 ± 4.4	0.49
2018	208.2 ± 6.8	205.6 ± 6.5	0.78
2019	244.4 ± 8.3	239.6 ± 7.3	0.66
2020	211.9 ± 8.4	210.1 ± 7.6	0.86
2021	199.4 ± 10.2	177.8 ± 10.9	0.16

[1]MLV: modified-live viral vaccination; KV: Killed viral vaccination

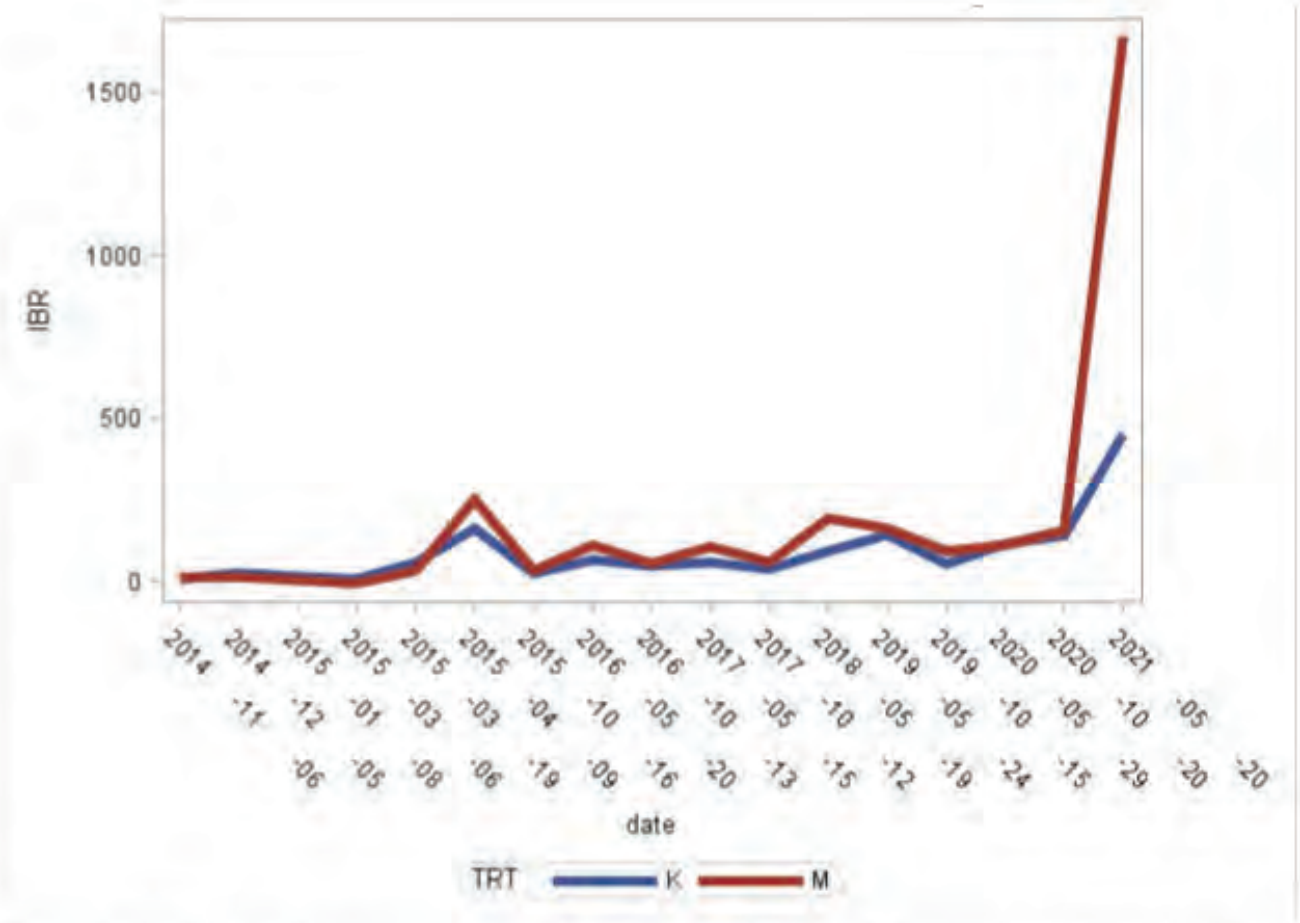

Figure 1. IBR Titer for 2014-born cattle. Titers differed significantly by treatment (P =0.0047) and by date (P <0.0001) and are significantly higher for the MLV group.

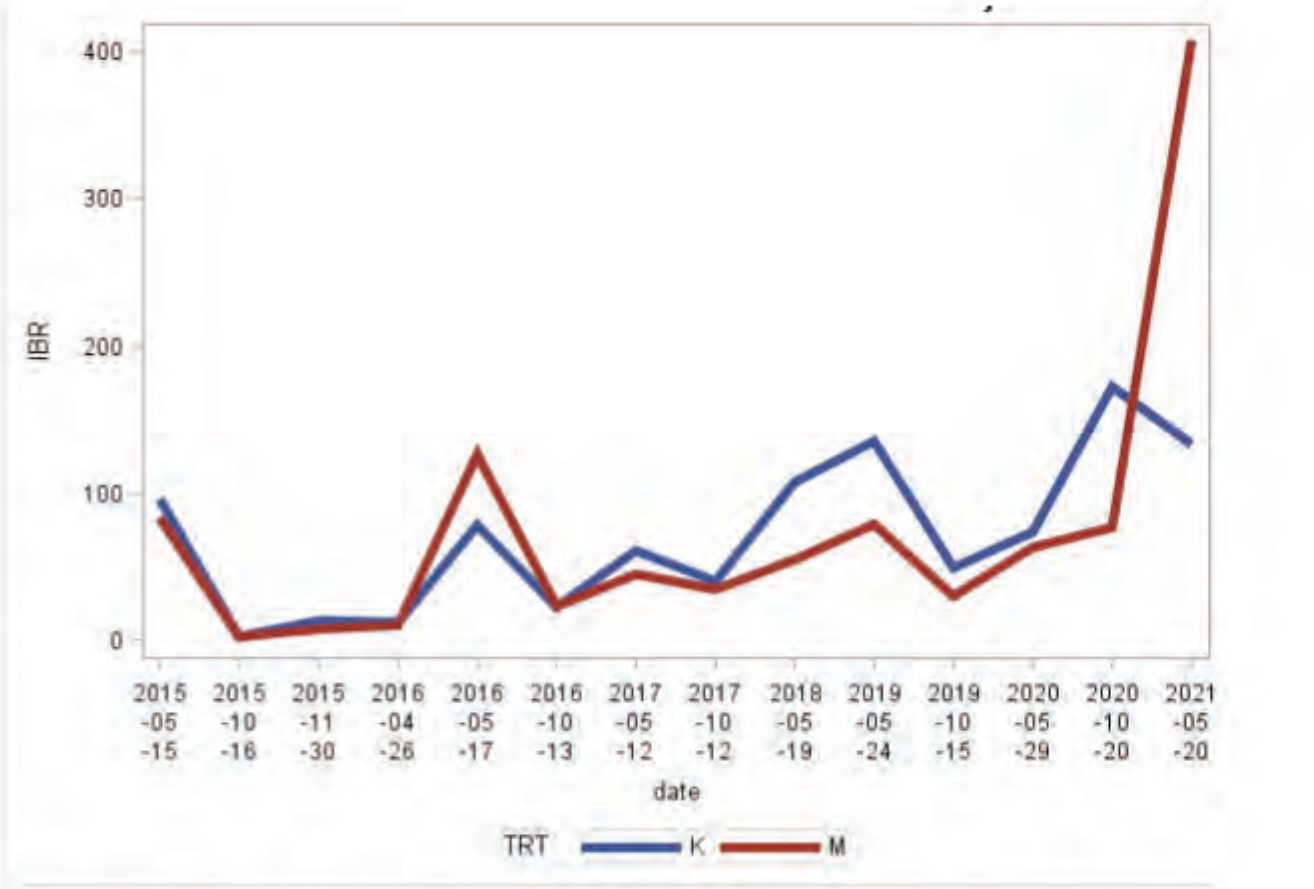

Figure 2. IBR titers for 2015-born cows. Titers are significantly different by date (P <0.0001), but not by treatment (P = 0.85).

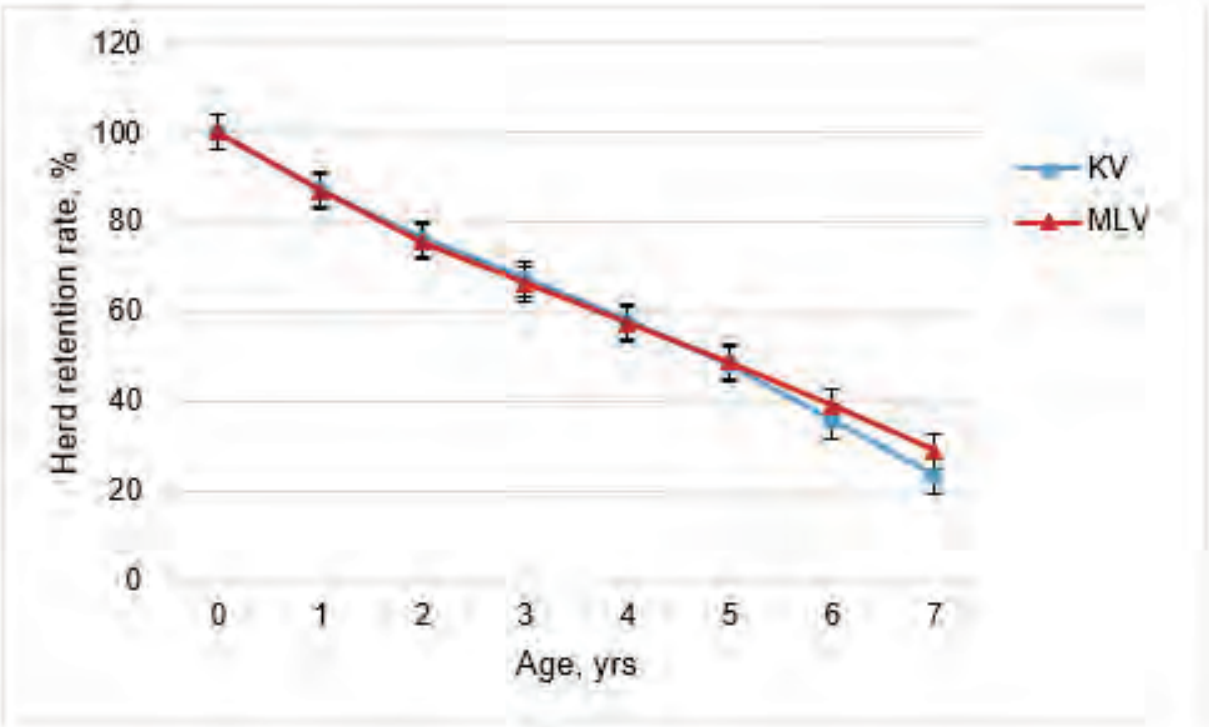

Figure 3. The herd retention rate of 2014-born cows through October 2021 Treatment does not affect herd longevity (P =0.96) when using a combination of KV and MLV or MLV only vaccination programs.

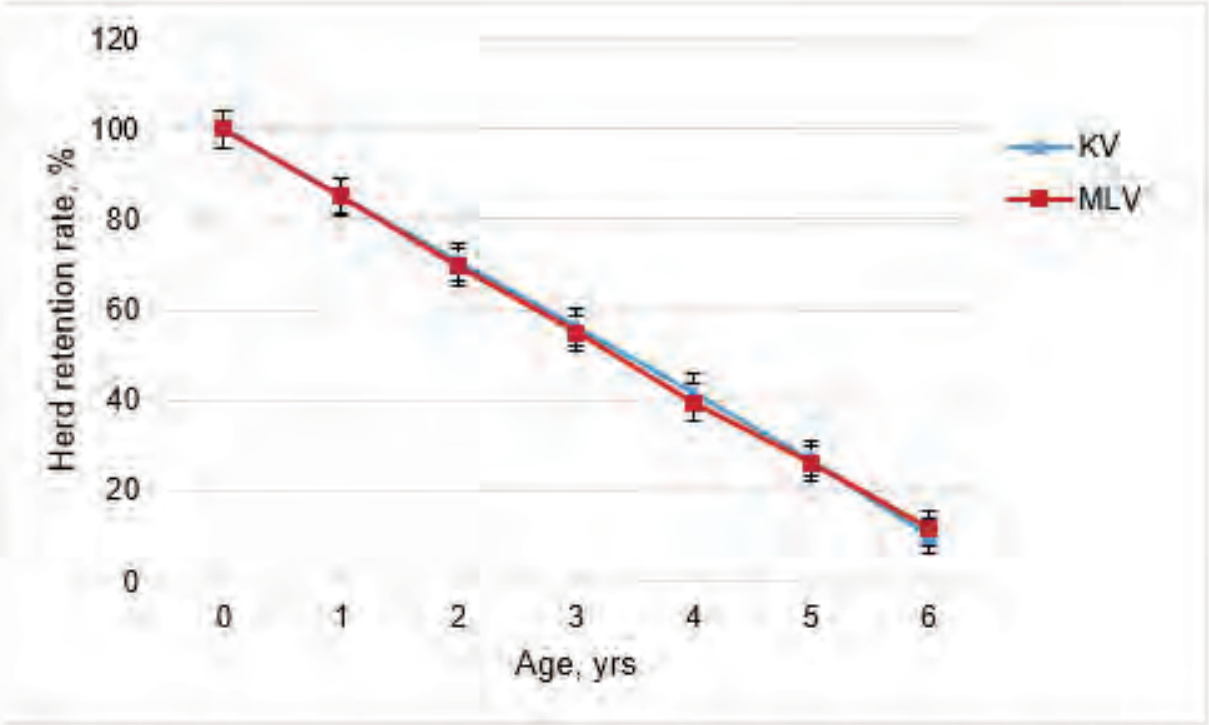

Figure 4. The herd retention rate of 2015-born cows through October 2021. Use of a lifetime regimen of KV or MLV vaccination does not affect herd longevity ($P = 0.86$)

EVALUATION OF IMMUNE PERFORMANCE OF CALVES BORN TO COWS VACCINATED WITH A LIFETIME REGIMEN OF A MODIFIED-LIVE OR KILLED VIRAL VACCINE WHEN CHALLENGED WITH A BOVINE VIRAL DIARRHEA VIRUS

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#Zoetis Inc.

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NM PROBLEM ADDRESSED BY RESEARCH

Bovine viral diarrhea virus (BVDV) is responsible for losses of $1.5-2.5 billion in the beef and dairy industries. Financial losses are the result of pregnancy loss, poor growth performance, and the production of persistently infected animals that continue to shed the virus throughout their lifetime. The objective of this study was to examine the impact of cow vaccination protocols on calf immunity, where cows received only a killed viral (KV) or modified-live viral (MLV) vaccination against BVDV during their lifetime in the herd. Results of this project provide further insight into vaccination strategies that can be implemented by producers that provide the best protection of calves against BVDV.

MATERIALS AND METHODS

All procedures were approved by the Institutional Care and Use Committee and Institutional Biosafety Committee at New Mexico State University.

Animals and Treatment

Sixteen calves were born to dams that had received a lifetime regimen of only a modified live viral (Bovishield Gold 5 FP5, Zoetis Inc., Kalamazoo, MI, n=9) or a killed viral vaccine (Cattlemaster Gold 5 FP5, Zoetis Inc., Kalamazoo, MI, n=7) against bovine viral diarrhea virus in spring of 2021. Calves were branded at roughly 90d of age and vaccinated with a 7-way clostridial vaccination (UltraBac 7, Zoetis Animal Health) but were unvaccinated against viral pathogens. Calves were early weaned one week before the challenge (mean age 120 days) and housed in a dry lot before and during the challenge. Calves were intranasally inoculated with 4mL of bovine viral diarrhea virus noncytopathic type 2a strain 1373 (2mL/nare, 1.2 x 106 virus/mL, propagated by Auburn University, Auburn, AL) using an atomizer (Teleflex Medical MAD300 Lma Mad Nasal Intranasal Atomizer, Teleflex Medical Inc.).

Calves were monitored twice daily for 28 days for clinical signs of BVDV infection. Clinical scoring including rectal temperatures, nasal and ocular discharge, diarrhea, abnormal respiration, and depression or inappetence were collected every twelve hours starting at day 1 post-inoculation, on a 0-to-3-point scale (absent, mild, moderate, severe) based on previous literature (Ellis et al., 2001; Strong et al., 2015).

Treatment and Death

Calves that sustained a 40.5°C fever or higher for 3 consecutive days were treated with anti-inflammatory medication (flunixin) intravenously (Prevail, VetOne, Meridian, ID) and tulathromycin antibiotics (Draxxin, Zoetis Inc., Kalamazoo, MI) subcutaneously to treat any secondary bacterial infection. Based on the predetermined criteria of pyrexia response, 3 calves received this treatment. On day 11 post-challenge one calf succumbed to viral infection. On day 12 post-challenge one calf succumbed to viral infection. Necropsy evaluation was performed on both carcasses to validate viral presence in the spleen, lung, small intestine, mesenteric and bronchial lymph nodes, and the thymus gland. Postmortem analysis indicated both calves died from lymphoid depletion as a result of BVDV infection.

Sampling

Blood samples were collected at 0700 h, beginning on d-2, pre-challenge on d 0, 3, 6, 8, 10, 14, and 28 post-challenge. Blood samples were collected for analysis of complete blood counts and viral isolation through the buffy coat in EDTA tubes (BD Vacutainer PPT tube, Franklin Lakes, NJ) on days 0, 3, 6,8, 10, 14, and 28 post-inoculation (Kansas State Veterinary Laboratory, Manhattan, KS). Blood samples (~20 mL) were collected into serum separator tubes on day -2, 0, 3, 6, 8, 10, 14, 21, and 28 post-inoculation via jugular venipuncture (Corvac, Sherwood Medical., St. Louis, MO) for analysis of haptoglobin, glucose, non-esterified fatty acids (NEFA), and serum urea nitrogen (SUN). Serum haptoglobin was analyzed via ELISA at the Kansas State Veterinary Laboratory (Manhattan, KS). Serum metabolites of glucose, SUN, and NEFA were analyzed using a 96-cell EPOCH 2 microplate reader (BioTek Instruments, Winooski, VT) with commercially available kits for NEFA (Wake Chemicals USA, Inc., Richmond VA; sensitivity of 0.01 mmol × L−1), glucose (Thermo Electron Corp., Waltham, MA; sensitivity of 0.3 mg × dL−1) and SUN (Thermo Electron Corp.; sensitivity of 2.0 mg × dL−1).

Diet

Calves were provided access to alfalfa hay (Table 1) and loose salt mineral ad libitum. The loose-salt mineral was composed of 10% Ca, 7% P, 2% Mg, 0.5% K, 2500 ppm Cu, 5000 PPM Zn, 2500 ppm Mn, 75 ppm I, 15 ppm Se, and 246 K IU/kg vitamin A (Hi-Pro Feed, Friona, TX). Calves were supplemented with 1.53 kg per head per day of a commercial 20% crude protein (CP) supplement (23.4% CP and 74.86% total digestible nutrients (TDN), dry mass (DM) basis; AC Nutrition, Roswell, NM).

Statistical Analyses

Phenotypic data were analyzed using SAS 9.4 (SAS Institute, Cary, NC). Overall clinical scoring was analyzed using Kruskal-Wallis rank-sum test. Viral isolation from the buffy coat was analyzed as a binomial using the GLIMMIX procedure of SAS with a logit link. Serum nutritional metabolites of NEFA, glucose and SUN were analyzed with the MIXED procedure of SAS using cow treatment as a fixed effect and repeated measures of day to analyze metabolite changes over the challenge period.

RESULTS

Clinical scores (Table 2) were composed of measurements of rectal temperatures, nasal and ocular discharge, diarrhea, abnormal respiration, and depression or inappetence. Scores ranged from 0-11 and were significantly different by day ($P < 0.0001$), but not by treatment ($P \geq 0.08$). Day 9 post-infection had the highest clinical scores, which was unsurprising given the virulence of this strain of BVDV. A tendency for an increase in clinical scores for depression, inappetence, mucosal discharge, elevated respiration, and temperatures was observed for calves born to MLV cows ($P = 0.08$). Serum haptoglobin (Hp) and overall rectal temperatures (RT) were not different by treatment, but a day effect was observed ($P < 0.0001$). Rectal temperatures peaked at day 8, and serum Hp peaked on day 10 post-challenge. Serum Hp concentration and RT had a tendency for a slight positive correlation ($P = 0.06$; correlation coefficient = 0.16). Haptoglobin (Table 4), a measurement of inflammation, was not different by treatment ($P = 0.93$) but a day effect was observed, peaking at day-10 post-inoculation ($P = 0.0015$) before returning to pre-challenge concentrations.

Complete blood counts were taken on d 0, 3, 6, 8. 10, 14, and 28 of post-challenge (Table 3). Leukocytes, a measurement of general white blood cells, were significantly different by treatment ($P = 0.03$) and day of challenge ($P < 0.0001$). Neutrophils were unaffected by treatment ($P = 0.44$) but were significantly altered by the day of challenge ($P = 0.0039$). Lymphocytes were significantly different by treatment ($P = 0.01$) and by day of challenge ($P < 0.0001$). Monocytes were unaffected by treatment ($P = 0.25$) but were significantly reduced over the day of challenge ($P < 0.0001$). Eosinophil percentage of total white blood cells was unaffected by treatment ($P = 0.11$) but was altered by day post-challenge ($P <0.0001$), with a tendency for a treatment × day interaction ($P = 0.06$). Basophil percentage was unaffected by treatment ($P = 0.82$) or day ($P = 0.58$). Hematocrit was unaffected by treatment ($P = 0.31$) but was significantly reduced by day post-challenge ($P < 0.0001$). Platelets were unaffected by treatment ($P =0.15$) or day ($P = 0.72$). Fibrinogen was unaffected by treatment ($P = 0.37$) but was significantly increased by day post-challenge ($P < 0.0001$) before returning to baseline levels.

The average daily gain was similar between treatments (P = 0.69), however as calves were not individually fed during this experiment, evaluations of feed efficiency or dry matter intake were unable to be assessed. Serum urea nitrogen, glucose, and non-esterified fatty acids (NEFA) were analyzed as an observation of nutrient status (Table 4). A tendency for a treatment × day interaction for serum urea nitrogen (P = 0.07) was observed, as well as a significant treatment × day effect for NEFA concentrations (P = 0.01), which were significantly higher for KV calves at days 14 and 21 post-viral inoculations. This may suggest more energy reserves were being mobilized to meet energy demand by these animals than that of the MLV calves during the same time points. While remaining within normal limits, glucose decreased until d 14, before returning to near baseline levels by day 28. Serum glucose was unaffected by treatment (P = 0.8) but was reduced significantly during peak viral infection before returning to near baseline levels at day 28 post-inoculation (P < 0.0001). The pattern of decline of glucose from d-2 through d 14 could be related to changes in metabolic energy demand due to viral insult. The reduction in both SUN and glucose and the increase of NEFA concentrations at the onset of viral infection and recovery period indicate the nutritional status of the animal was shifted, likely to compensate for immune cell production.

CONCLUSION

In conclusion, vaccination of cows with a modified live viral or killed viral vaccination provides moderate protection for calves when challenged with BVDV. Calves that were born to KV cows and received their colostrum had increased leukocyte and lymphocyte concentrations compared to MLV calves. Lymphocytes play a large role in the cell-mediated immune system, and an increase in these cells indicates an infection and heightened antibody response. Calves born to MLV cows tended to have higher clinical scores. This study provides further information about the role of maternal vaccination on calf performance postweaning when challenged with a virus. Further investigations into specific nutritional and immunological pathways should be examined.

Table 1. Nutrient analysis (dry matter basis) of alfalfa hay fed *ad libitum* throughout the immune challenge.

Item	% DM
Dry matter	88.98
CP	18.46
NDF	62.34
TDN	57.17
Ca	1.28
P	0.24
K	2.66
Mg	0.24
Zn, ppm	25.70

Table 2. Clinical scores and rectal temperatures of calves challenged with BVDV.

	Day post-challenge															*P*-value		
Item	2	4	6	8	10	12	14	16	18	20	22	24	26	28	SEM	Day	Trt	Day x Trt
Clinical Score[1], AM	0	1.7	2.2	4.1	3.7	3.0	1.5	1.2	0.9	0.7	0.5	0.57	0.8	1	0.3	<0.01	0.75	0.97
Clinical Score[1], PM	0	2.5	3.3	3.7	4.5	4.3	4.0	3.6	3.5	2.8	2.9	2.3	2.7	2	0.3	<0.01	0.08	0.89
Rectal Temperature[2], AM	38.3	38.9	38.9	39.8	39.5	39.2	38.5	38.3	38.4	38.2	38.2	38.2	38.5	38.2	0.1	<0.01	0.68	0.78
Rectal Temperature[2], PM	39.3	39.9	40.0	40.5	40.9	39.8	39.9	39.9	39.8	3.5	39.6	39.3	39.3	39.4	0.1	<0.01	0.65	0.94

[1]Clinical score includes observation of nasal and mucosal discharge, coughing, depression, inappetence, and lethargy.

[2]°C

Table 3. Complete blood counts of calves during the immune challenge by treatment and day.

	Day post-challenge																	
	0		3		6		8		10		14		28					
	Treatment														SEM	*P*-value		
Item	KV	MLV	KV	MLV	KV	MLV	KV	MLV	KV	MLV	KV	MLV	KV	MLV		Day	Trt	Day x Trt
Leukocyte[1]	14.7	13.2	12.9	11.6	9.4	7.8	9.7	9.7	9.8	8.3	11.8	9.9	10.7	9.9	0.9	<0.01	0.03	0.98
Erythrocyte[2]	10.7	10.7	8.9	10.1	9.8	9.9	9.2	8.5	9.2	9.6	8.8	9.0	8.9	8.8	0.5	0.005	0.54	0.74
Hemoglobin	14.7	14.5	13.9	13.6	13.3	13.3	12.4	12.9	12.4	12.8	11.8	12.0	12.0	11.9	0.2	<0.01	0.54	0.67
Lymphocyte[1]	7.8	6.7	6.8	6.2	4.8	4.1	5.3	4.6	6.6	5.5	7.1	5.7	4.8	4.4	0.6	<0.01	0.01	0.98
Monocyte[1]	1.1	0.9	0.5	0.3	0.4	0.2	0.1	0.4	0.4	0.4	0.8	0.3	0.9	0.9	0.1	<0.01	0.25	0.35
Hematocrit, %	38.7	39.2	36.5	36.0	34.5	35.0	32.0	33.4	32.0	33.4	30.4	31.2	32.4	31.0	0.6	<0.01	0.31	0.37
Platelet[1]	599.0	753.7	558.1	723.1	565.6	594.0	541.5	653.4	656.0	611.1	749.0	625.7	630.6	802.6	84.1	0.72	0.15	0.38
Fibrinogen[4]	428.5	366.6	442.8	433.3	457.1	377.7	457.1	455.5	585.7	511.1	342.8	342.8	285.7	371.4	44.4	<0.01	0.57	0.49
Neutrophil[1]	5.5	5.3	5.4	3.6	4.1	3.3	4.2	4.8	2.6	2.2	3.6	3.9	4.1	4.4	0.6	0.003	0.44	0.73
Basophil[1]	0.0	0.05	0.01	0.01	0.02	0	0	0.02	0.04	0.01	0	0	0.02	0.02	0.01	0.82	0.58	0.14

[1]$K \times \mu L^{-1}$

[2]$M \times \mu L^{-1}$

[3]$mg \times dL^{-1}$

Table 4. Serum blood metabolites throughout the immune challenge.

	Day post-challenge										*P*-value		
Item	-2	0	3	6	8	10	14	21	28	SEM	Day	Trt	Day x Trt
SUN[1]	8.3	21.5	5.9	9.0	4.8	13.0	17.3	8.8	9.3	1.7	<0.01	0.9	0.07
Glucose[2]	84.7	83.9	78.5	81.3	65.6	69.6	63.0	68.4	80.5	4.0	<0.01	0.8	0.8
NEFA[1]	0.46	0.38	0.37	0.41	0.35	0.45	0.43	0.21	0.09	0.05	<0.01	0.72	0.01
Haptoglobin[2]	20.6	17.9	15.3	18.2	26.1	80.5	34.2	13.7	16.1	8.1	<0.01	0.93	0.93

[1]mmol × L^{-1}

[2]mg × dL^{-1}

Outreach Activities

- Western Spirit Groundbreaking Presentation (invited speaker), online, Jan 13
- Spring Sheep Webinar: Flock Health and Predation, online Feb 18
- Native American Producer Success Project, Lambing Preparation Webinar, online, Mar 10
- Oklahoma Corporation and Black & White Sheep and Goat Shows and Sales, Apr 23-25
- Artesia Junior Livestock Jackpots Shows, ringman, May 29
- New Mexico Cattlegrower's and Woolgrower's Mid-year Meetings, Jun 6-8
- NMSU AXED Sheep and Goat Clinic, instructor, Jun 11-13
- Southern NM Livestock School, goat instructor, Jun 25-27
- Ag NM/Texas Farm Credit Station Tour, Jul 12
- United States Beef Academy, Jul 18-24
- NMSU Chancellor's Tour and Introduction to Pattern Energy, Jul 28
- Lincoln County Fair, manager, Aug 2-7
- National Cattlemen's Beef Association Annual Convention, Tradeshow Booth, Nashville, Aug 9-13
- Clayton Livestock Research Center Field Day, Aug 16
- Los Lunas Ag Science Center Field Day, Aug 18
- Leyendecker Plant Science Center Field Day, Aug 25
- Region 9 Educational Cooperative Wind Farm Tour, Aug 27
- BLM/NMSU Research Meeting and Tour, Sep 1
- John T. Harrington Forestry Research Center Field Day, Sep 10
- New Mexico Livestock Expo, Sep 12-18
- Fabian Garcia Plant Science Center Field Day, Sep 22
- Southern NM State Fair, Sep 28-30
- Eastern NM State Fair, Oct 3-9
- New Mexico Wool Show Superintendent and Coordinator, Oct 3-9
- Mesalands Community College Wind Farm Tour, Oct 15
- Corona Range and Livestock Research Center Field Day, Nov 2
- NM Farm and Livestock Wool Advisory Group, Nov 9
- Pattern Energy, LLC Investment Group Tour, and Lunch, Nov 17
- Central NM Electric Cooperative Facility Tour, Nov 23
- Reprologix Tour and Meeting, Ft. Scott, Kansas, Nov 30-Dec 2
- Pattern Energy Community BBQ, Dec 8
- Joint Stockman's Convention, Online, Dec 14-17
- Leyendecker Farm Manager Selection Committee, Chair
- Rumen Microbiologist Selection Committee, Member
- New Mexico Wool Growers, Director's and Vice President

CRLRC Staff and Supplemental Labor Faculty, Staff and Students

Faculty and Staff

Shad H. Cox- Director and Program Operations

MS- Animal Science (Reproductive Physiology and Toxicology
BS- Agriculture (Animal Science)

Richard Dunlap- Farm/ Ranch Manager

BS- Agriculture (Range Science and Animal Science)

Campus-based Supplemental Labor Scientists

Eric Scholljegerdes- PhD

Ruminant Nutrition

Adam Summers- PhD

Reproductive Physiology

Graduate Students

Emily Melchior- PhD Student

Ruminant Nutrition

Kathryn Smith- PhD Student

Ruminant Microbiology

Colin Anderson- MS Student

Ruminant Nutrition

Taylor Andrews- MS Student

Reproductive Physiology

Maria Chaves- MS Student

Ruminant Nutrition

Micayla Crimmins- MS Student

Range Science

Itzel Duran- MS Student

Ruminant Nutrition

Kylie Forrest- MS Student

Reproductive Physiology

Alexis Selman- MS Student

Ruminant Nutrition

Undergraduate Students

Cierrah Kassetas

Animal Science

Shelby Techaney

Animal Science

Lexi Lehmke

Animal Science

Cooperators/Collaborators

Scientists and Educators

Brad Butterfield, Ph.D. Northern Arizona University
Bruce Carpenter, Ph.D., Texas A&M University
Bob Cushman, Ph. D. USDA ARS Meat Animal Research Center
Dean Fish, Ph.D., Santa Fe Ranch Foundation, Nogales, AZ
Elise Gornish, Ph.D. University of Arizona
Kevin Millner, DVM, Zoetis
Mose Moseley, Ph.D., Positively Mose LLC
Seth Munson, Ph.D. US Geological Survey
J. P. Pollreisz, DVM, Zoetis
Leann Saunders, IMI Global
Gary Sides, Ph.D., Zoetis
Santiago Utsumi, Ph.D., Michigan State University
Paul Walz, Ph.D., Auburn University

Academic and Corporate Institutions

Ajinomoto N.A.
Auburn University
Baylor Medical School
Hatch Funded NC-1201 Multi-State Research Group
Hatch Funded W-3012 Multi-State Research Group
Hi-Pro Feeds
Merck Animal Health
Michigan State University
NMSU, Agricultural Economics and Agricultural Business (AEAB)
NMSU, Animal and Range Sciences (ANRS)
NMSU, Clayton Livestock Research Center (CLRC)
NMSU, Entomology, Plant Pathology and Weed Science (EPPW)
NMSU, Extension Animal Science and Natural Resources (EASNR)
NMSU, Klipsch School of Electrical and Computer Engineering (KSECE)
NMSU, Tucumcari Agriculture Science Center (TASC)
NMSU, Water Resources Research Institute (WRRI)
North Dakota State University
Texas A&M University, San Angelo
USDA-ARS, Jornada Experimental Range (JER)
USDA-ARS, Meat Animal Research Center (MARC)
USDA-ARS, National Animal Disease Center (NADC)
University of Wyoming
Western Sustainable Agriculture Research and Education Grant (W-SARE)
Zoetis

Outreach Partnerships

BABS Global
AC Nutrition
ADM Alliance Nutrition
Beef Reproduction Task Force
Colorado State University
Corteva AgriSciences (formerly Dow AgroSciences)
Hi-Pro Feeds
IMI Global
New Mexico Beef Council
NMSU, Extension Animal Sciences and Natural Resources (EASNR)
Paul's Veterinary Supply
Purina Mills
Texas A&M Agrilife Extension
United States Beef Academy
Zinpro Performance Minerals
Zoetis

2021 Report

Corona Range and Livestock Research Center
and
The Southwest Center for Rangeland Sustainability

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