**REPORT**

**Multistate Project NC1181:** **Optimizing land use for beef cattle production**

**Period Covered: 9/30/21-10/1/22**

**Date: 10/6/22**

**Annual Meeting Date and Location: 8/11 and 8/12/22 meeting held virtually with Karla Wilke hosting.**

**Participants: Mitch Stephenson, Karla Wilke, Jerry Volesky, Andrea Basche, Mary Drewnoski, Jay Parsons, Bruno Pedreira, Keith Harmoney, Jaymelynn Farney, Walter Fick, Paul Beck, John Guretzky**

**Brief Summary of Annual Meeting:** Participants all joined via zoom connection. Participants shared research results obtained thus far in the project. Additional discussion was conducted on sharing information through webinars and other electronic media and in person meetings. Participants also discussed conducting a series of joint meetings across state lines as was done with the last project, after more results are finalized.

**Objectives**

* Enhance productivity and efficient use of pasture, rangeland, and other forage resources
* Create and evaluate opportunities to incorporate forage production within cropping systems
* Develop management strategies for cows/calf systems that use limited or no perennial pasture
* Assess economic performance, resiliency, and adaptability of the systems and management practices explored
* Improve stakeholder understanding of the systems and management practices evaluated

**Accomplishments**

*Short-term outcomes:*

* Objective 1: Enhance productivity and efficient use of pasture, rangeland, and other forage resources

The second year (2021) of a multi-location (North Platte, NE, Sidney, NE, Lincoln, NE, and Hays, KS) experiment was conducted to evaluate the effects of seeding rate and nitrogen fertilizer rate on oat forage yield and quality. This was done for both a spring and late summer planting date. Data analysis for the complete two-year study will be completed after the final data collection of the late summer planting which takes place in late October, 2021. Across locations and for the spring planting, both seeding rate and nitrogen fertilizer rate main effects were significant. Forage yields at the 50, 75, and 100 lb/acre seeding rates were not different from each other and greater than the 25 lb/acre rate. Forage yield increased linearly in response to nitrogen fertilizer. \*\* Multi-state research project \*\*

A study was conducted to introduce warm-season annual grass species into perennial cool-season grass pastures to increase dry matter production during the mid-summer time period that perennial cool-season grasses would be most dormant. An increase in production during this time period could result in an overall increase in total land area production. Three warm-season annual grasses (sorghum-sudangrass, crabgrass, and teff) were no-till drilled at three seeding rates into perennial cool-season western wheatgrass pasture. Western wheatgrass yields prior to seeding warm-season annual grasses were not significantly different due to treatment and averaged 2230 lb/acre in 2020 and 1595 lb/acre in 2021, and were not different among treatments. The lack of rainfall in June 2021 likely reduced dry matter yield production potential of western wheatgrass. Following wheatgrass harvest in June, soil was dry in both years, and precipitation adequate for germination of annual warm-season grasses was lacking. In 2020, emergence was fair, but continued dry conditions resulted in poor final establishment except for sorghum-sudangrass plots. At 90 days after seeding, sorghum-sudan plots averaged 6600 lb/acre additional forage. Productive crabgrass and teff plants were rare and resulted in no additional harvested forage. In 2021, sorghum-sudangrass yields were much lower than in 2020 but were still greater than for crabgrass or teff. In spring of 2021, plots with sorghum-sudangrass in 2020 had western wheatgrass yields that averaged 400 lb/acre less than the control plot and the averages of the failed teff and crabgrass seedings. In 2022 following warm-season grass seeding, western wheatgrass yields were not different between treatments. Combined over 2 years, plots with interseeded sorghum-sudangrass had significantly greater total forage output.

From 2020-2022, we also conducted an experiment at the University of Nebraska-Lincoln Eastern Nebraska Research and Extension Center (ENREC) near Mead, NE to evaluate whether herbicide application can be used to enhance establishment of sorghum sudangrass (Sorghum bicolor x S. bicolor var. sudanense cv. Super Sugar) interseeded into smooth bromegrass (Bromus inermis Leyss.) pastures without having negative impacts on perennial plant persistence. The experiment had a split-plot design with twelve, 0.6-ha pastures including three replications each of N-fertilized smooth bromegrass (FERT) and unfertilized, legume-mixed smooth bromegrass (LEG) whole plots and interseeded and unseeded subplots. Each pasture, which supported two steers (Bos taurus) from spring through summer, contained six, 0.10-ha, rotationally stocked paddocks. In each year, one paddock served as the subplot for herbicide application, interseeding, and vegetation data collection, while the other five paddocks supported the steers when not occupying the subplot. Sorghum sudangrass was seeded the last week of May each year at 42 kg ha-1 using a Great Plains seed drill.

A study interseeding warm season annuals into cool-season perennials was conducted to compare replacement heifer growth and development as compared to a warm season annual (crabgrass) and a warm-season perennial (bermudagrass). Heifers on the interseeded fescue treatment had the greatest total gains and gain per acre for the grazing period, during the 1st year and during the second year there were no gain differences observed between forage species. A third year of replication is occurring through November of 2022.

In 2021-2022 research was conducted to evaluate how distribution within a continuously grazed pasture contributed to variability in plant community composition based on how frequently cattle utilized a given area. Several forbs and lower growing species, including western ragweed, kentucky bluegress, scribners rosettgrass, and others, were more frequently observed on areas receiving heavier grazing pressure. We also finalized research evaluating regional differences in plant communities across the Nebraska Sandhills. This research explored variability among different grazing management at different regions of the state. This research concluded that regional differences were more important that grazing management in determining the species present on Sands Ecological Sites in the Nebraska Sandhills. It also highlighted ranches that some ranches were more efficient in their grazing without negative effects to the plant community. Lastly, virtual fence technology is currently being employed to evaluate adaptive management based on observed use on pastures.

In the southern portion of the Flint Hills in Kansas, 4-years of work has been conducted evaluating March versus April burn for the pasture and addition of essential oils in mineral. Over the 4 years there was no overall effect of burn date on cattle gains, however, that was variable based on precipitation effects. Cattle consuming the essential oil mineral had a 0.10 pound/day improvement in average daily gain over the 4 years. Overall, fly numbers were not impacted by burn date nor addition of essential oils. However, early season grazing there were more years when steers on the April burn had less flies than March burn, but this advantage disappeared within 4 weeks of being on grass.

A multistate collaborative research project with the University of Arkansas was conducted at the OSU Eastern Research Station and University of Arkansas Livestock and Forestry Research Station was completed. The research objectives were to evaluate the effects of supplementation programs on performance of growing stocker calves on bermudagrass based pastures over 2 years at the ERS and 3 years at LFRS. Supplementation during the late summer was more efficient than supplementing throughout the entire summer. Byproduct based supplements hand-fed at 2.5 pounds per day required 4 to 5 pounds of supplement per pound of added gain. Self-fed molasses-based supplements did not consistently improve performance and required over 10 pounds of supplement per pound of added gain. \*\* multi-state project \*\*

Similarly, a study in Nebraska (3-year project) found that supplementing yearling cattle with DDG, particularly in the last part of the summer, maybe an economical method for summer cattle management. Results indicated supplemented cattle outgained non-supplemented cattle with no difference in performance between the supplemented groups. This suggests supplementing only the last half of the grazing season could result in improved gains while reducing supplementation costs. When evaluating distillers cost and yearling value over a ten year period, return to management above control was $14.96 and $32.21/yearling for full summer supplementation and half summer supplementation, respectively.

Research at the USDA ARS Southern Plains Range Research Station and the OSU Klemme Range Research Station was conducted to determine if stocking rates can be increased by replacing a fraction of the daily forage intake with supplementation while avoiding negative impacts on animal performance and native range condition. Feeding dried distillers grains cubes to growing steers on native range in the late summer increased gains by 0.8 to 1.1 pounds per day requiring only 2.3 to 2.7 pounds of supplement per pound of added gain. By increasing stocking rates and improving performance, High Supplement increased gain per acre by 110 to 150% over Negative Controls requiring 3.8 pounds of feed per pound of added gain per acre.

* Objective 2: Create and evaluate opportunities to incorporate forage production within cropping systems

Seventeen different plant species and blends were utilized as a summer forage and/or cover crop to be followed with wheat. Due to severe drought conditions during growing period, one grazing harvest was collected and a biomass measurement for cover crop will be harvested in October immediately prior to planting wheat, in which wheat yield will be evaluated based on summer forage/cover crop and usage of the forage.

A multistate collaborative research project with the University of Arkansas and Oklahoma State University was conducted at the University of Arkansas Livestock and Forestry Research Station. Our objectives were to determine the effect of wheat (*Triticum aestivum*) establishment method (conventional tillage [CT] vs no-till [NT]) and seeding rate on forage and animal production over 3 yr. Increasing seeding rate resulted in increased forage mass and forage allowance per kg steer BW in no-till production but not in CT fields. No-till also resulted in reduced forage production during the fall and winter grazing season but tended to increase residual forage mass at the end of the spring grazeout period. Even with the reduced fall forage production, steer gains during the fall and winter were not affected by tillage system and were improved by no-till in the spring.

The nutrient content of small cereal silage from operations in Nebraska was measured at harvest and post fermentation. At packing, 40% of the samples were above the target dry matter of 30-35%. Samples that were too wet at packing had a significant increase in the loss of energy (total digestible nutrient) content of the silage during fermentation. The majority (60%) of producers did not measure dry matter of the crop when chopping. It appears that moisture management is a challenge for producers and increased effort to ensure the target dry matter content is achieved before packing could improve the quality of small grain silage produced.

In 2020, we began an experiment to evaluate forage mass and yields in a grazed, double cover crop system consisting of fall-seeded triticale and late-spring seeded pearl millet. The principal objective was to evaluate effects of seeding legumes versus applying nitrogen fertilizer or not fertilizing as management strategies for grazed, double cover crops. In 2021, the first year of the experiment, we observed significant effects of management strategy on vegetation components in spring and summer and in total across the year. In spring, the fertilized strategy yielded 23% and 10% more grass than the legume-seeded and unfertilized strategies, respectively. In the legume-seeded strategy, red clover emerged, but it produced little dry matter. In summer, the fertilized strategy yielded 268% and 27% more grass than the legume-seeded and unfertilized strategies. However, soybean yield compensated for 58% of the reduced grass yield in the legume-seeded compared to the fertilized strategy. The legume-seeded strategy also yielded 46% and 23% less weeds compared to the fertilized and unfertilized strategies. Totaled across the year, the fertilized strategy maintained a 65% and 16% grass yield advantage compared to the legume-seeded and unfertilized strategies. This research will continue through 2023.

The control of established Old World Bluestem (OWB) and any potential injury to native vegetation following two years of herbicide application may result in more exposed soil surface area. A benign cover crop (pearl millet) to cover soil and provide erosion control may be beneficial on herbicide treated areas. Ideally, any herbicide used to aid in cover crop establishment would also have activity to help further control of OWB. Producers could benefit from a proven system to control OWB that also helps to prevent possible consequences of control, such as soil erosion and the loss forage dry matter. This experiment was formulated to test the development of a possible system to control OWB, to prevent new seedling establishment, and to minimize subsequent erosion potential through use of seven different treatments. Treatments consisted of different herbicides and timing and addition of warm-season annual forage. Glyphosate treatments were much more effective at controlling OWB than other treatments, with control levels similar to previous research near 80%. Imazapyr treatments were much less effective at controlling OWB than in previous studies, and imazapyr applied in two consecutive years attained near 70% control. Imazapyr in the second season was more successful at suppressing OWB than in year one, but still failed to control as well as glyphosate in year two. The use of mesotrione at labeled rates failed to control OWB for cover crop growth. The use of millet as a cover crop was not successful. OWB frequency after two years of herbicide treatment still ranged from 54-100% in herbicide treated plots, and competition of OWB, even at the lowest levels of OWB frequency, did not allow millet to establish and compete with the OWB.

* Objective 3: Develop management strategies for cows/calf systems that use limited or no perennial pasture

Previously our research has shown that limit feeding a mix of nutrient dense by-products such as distillers grains with low digestibility roughages such as wheat straw or corn residue is an effective and economical way to feed cows in confinement. However, it appears that this practice does appear to limit their calf’s rate of gain. Current research has indicated providing a separate higher quality ration for the calves can improve rate and cost of gains resulting in more profit potential over early weaning at 4 months or age or when weaning 7 months of age, but providing the calves with the same diet as the cows in the same bunk at the same time. Providing a growing period (90 days) after weaning at 7 months of age can result in some compensatory gain for calves not supplemented on the cow, however, neither the early weaned or non-supplemented calves weighed as much or had better returns than the supplemented calves.

When cow and calf performance of two August-calving cow systems that combined corn residue grazing with 1) perennial forage grazing and hay or 2) summer drylot feeding and fall cover crop grazing were compared there were no differences in pregnancy rates between systems and no consistent difference in calf performance. Overall, the drylot/cropland system appears to have potential as alternative to a perennial forage-based system for producers with limited or no perennial grass.

* Objective 4: Assess economic performance, resiliency, and adaptability of the systems and management practices explored

Stduent, Jedidiah Hewlett, (2020-2022 August) completed Masters Degree with project titled, Analyzing Flexibility as a Risk Management Strategy in Agricultural Systems. Department of Agricultural Economics. University of Nebraska-Lincoln.

* Objective 5: Improve stakeholder understanding of the systems and management practices evaluated

Results from studies associated with Objectives 1, 2, 3, and 4 have been presented at multiple on-line and in-person producer workshops.

Co-instruction on a new course being offered at UNL with 50 enrolled students (resident and online sections) titled “Cover crops in Agroecosystems.” The course is the first of its kind in the U.S. to focus specifically on cover crop management. The course is being taught in collaboration with eight other instructors at six institutions.

Data has been shared in experiment station reports, in podcast, in popular press articles and on Ag Today (radio program from Kansas State).

Risk management and profitability of various crop-livestock production systems were a focus with details include incorporation of risk management tools like federal insurance programs into the assessment of system economic resilience. These outreach materials were circulated to email lists with over 2,000 subscribers and most were accompanied by a podcast recording.

Activities

* Objective 1: Enhance productivity and efficient use of pasture, rangeland, and other forage resources

12 research projects conducted, 5 manuscripts in process, 9 abstracts, 8 publications including 1 multi-state publications, 15 extension reports

* + 1. Multi-state collaborative projects
			1. Oat seeding rates
			2. Interseeding of annuals into perennial forage systems
			3. Timing and type of supplement for cattle on bermudagrass pastures.
		2. Practice to enhance productivity of pasture and/or rangeland
			1. Completed 3rd year of interseeding warm season annual into cool-season perennial and grazing with replacement heifers. Manuscript preparation has begun
			2. Use of virtual fences and grazing management (continuous versus other grazing plants)
			3. Completed 4th year of evaluating pasture burn date and addition of essential oils in mineral for cattle gains, pasture composition changes, and fly control. Manuscript preparation has begun
			4. Fertility management in bermudagrass, fescue, and crabgrass trials
			5. Methods to control broomsedge in native pastures and fescue
		3. Feeding cattle for improvements in gains and/or pasture utilization
			1. Supplemented steers with a DDG cube with or without changes in stocking rate
			2. Completed 3rd year of evaluating form of supplementation (hand-fed, free-choice block, or free-choice liquid supplement) on steers grazing stockpiled bromegrass. Measured cattle gains and forage quality and production. Manuscript preparation has begun.
			3. Completed 3rd year of evaluating variety of fescue forage with or without the addition of legumes and type of implant on stocker steer gains. Measured cattle gains and forage quality and production. Manuscript preparation has begun.
			4. Completed 3rd year of supplementing DDG for yearling cattle on summer grass in Nebraska. Measured cattle gains and forage quality and production. Manuscript preparation has begun.
* Objective 2: Create and evaluate opportunities to incorporate forage production within cropping systems
* 4 research projects, 5 abstracts, 6 publications, 1 extension report
* Two undergraduate students were trained in forage sample collection and analysis.
1. Seventeen annual plant species and blends were evaluated for use as a forage and/or summer cover crop.
2. Lead a program to better understand current production practices when making small grain cereal silage and the resulting issues. Collaborated with extension educators to collect small grain silage samples both at harvest and post-fermentation and information on production practices from 17 producers.
3. The third year of a three year project to investigate the grazing potential of cereal rye, triticale and winter wheat for early spring use in the NCR, including the timing of the start of grazing and nutritive value of forage as measured by cattle gain was completed.
4. The third year of a study to compare cereal rye, triticale and winter wheat for spring silage production was completed. To better understand how each species may fit into a crop rotation the relative timing of maturation of each species coupled with the yield and nutritive value at various stages was evaluated.
* Objective 3: Develop management strategies for cows/calf systems that use limited or no perennial pasture
* 2 abstracts, 1 publication, 1 extension report
* The 3rd year of a study to evaluate the nutritional management of the young calf when cow/calf pairs are managed in drylot was completed.
* Objective 4: Assess economic performance, resiliency, and adaptability of the systems and management practices explored
	+ - * + Graduate student completed Masters Degree, Jedidiah Hewlett.
				+ 3 abstracts
				+ 9 extension reports
* Objective 5: Improve stakeholder understanding of the systems and management practices evaluated
* Research results were translated for use by producers and disseminated through electronic newsletters, podcasts, media interviews (print and visual), extension publications, and distributed through social media.
* Presentations were given (in person events) reaching over 4,000 producers and consultants.
* Webinar recordings from this year had over 7,000 views.
* Book chapters were developed for Beef Cattle Nutrition based on information generated from projects
* Cover crop biomass calculator developed as online tool for producers
* Member of team is co-instructor on course offered at UNL in collaboration with 6 other institutions and 8 other instructors. Course specifically focuses on cover crops in agrosystems.

**Impacts**

From Oct 1, 2021 to Sept 30, 2022, progress was made to develop and continue proposed research projects evaluating rangeland and pasture management strategies, opportunities for forage production on croplands, and cow-calf management strategies with limited pasture.

Additionally, as many of these projects were completed, they were published in peer-reviewed articles. Getting research results out to a producer audience is equally important. This NC-1181 group of researchers was able to develop webinars resulting in over 9,000 views. Information was also shared through electronic newsletters and podcasts with over 50,000 subscribers and additional downloads from search engines. With a large number of projects finishing the 3rd year of data collection, through the 2023 reporting period several multi-state producer meetings will be conducted to cover the topics researched.

Some direct management practices that may be useful for producers to implement in practices could be utilizing some of the supplementation strategies that were measured. Specifically, waiting and supplementing cattle on grass during the later portion of grazing season results in a greater return to management as compared to non-supplemented or supplementing over the entire period. Another supplementation strategy that can increase profit is to supplement in the winter to achieve higher rates of gain and implanting when grazing corn residue and retaining calves on grass into September.

Pasture management is still a critical component of maintaining productivity of the pastures and the livestock species. Grazing distribution and monitoring of locations within pastures is important for plant diversity. Using some new technologies to help with grazing distributions may help with implementation. Old world bluestem is a heavy competitor with other vegetation. Establishing a cover crop to suppress OWB is unlikely, as remnant OWB becomes competitive before a summer cover crop is able to establish.

Establishing sorghum sudangrass in cool-season western wheatgrass improved forage production with a net increase of nearly 3 ton forage/acre greater than the cool-season grass alone. With timely precipitation occurring, vast improvements in production with limited pasture land resources is possible. This is also seen from a livestock production standpoint where sufficient production of sorghum-sudan forage improves cattle performance during the dormant season on cool-season perennial pastures, but with low tonnage then cattle do not perform differently.

With the widespread drought through the Great Plains, the impacts of the confined cow research will likely be easier to document after the drought abates and the producers who were able to feed in confinement and maintain calves through normal weaning (7 months) have a better idea what the calves bring at the sale versus selling early. Additionally, while cow-calf pairs are in confinement, producers can increase return by providing a separate diet to the nursing calves.

**Outputs**

***Abstracts/Posters/Professional Presentations (Bold = authors from multiple states)***

1. **Beck, P. A., W. K. Coblentz, J. A. Jennings, and M. R. Beck. 2022. INVITED: Using annual forage crops to extend grazing: What are the benefits to production and livestock enterprise economics? 2022 ASAS National Meeting ABSTR.**
2. Grigsby, Z., S. A. Gunter, I. Palacios, M. Schneider, and P. A. Beck. 2022. Effects of supplementing an extruded 100% ddgs cube to steers on native range in Northwestern Oklahoma. 2022 ASAS National Meeting ABSTR.
3. Adams, J. M., L. O. Tedeschi, and P. A. Beck. 2022 Effect of supplementing extruded dried distillers’ grains cubes to stocker cattle grazing introduced pastures on subsequent feedlot performance and carcass characteristics. 2022 ASAS National Meeting ABSTR
4. Grigsby, Z., P. Beck, C. Worthington, M. New, T. Fanning, and D. Turner. Using a 100% distiller’s dried grains cube on stocker calves grazing native range in western Oklahoma and feedyard performance and carcass characteristics. Plains Nutrition Council Annual Conference Proceedings. (Abstr).
5. Adams, J. M., L. O. Tedeschi, and P. A. Beck. 2022 Effect of supplementing extruded dried distillers’ grains cubes to stocker cattle grazing introduced pastures on subsequent feedlot performance and carcass characteristics. Plains Nutrition Council Annual Conference Proceedings. (Abstr).
6. Grigsby, Z. N., and P. A. Beck. 2022. Using a 100% extruded DDGS cube on steers grazing native range. J. Anim. Sci. 100 (Suppl. ): (Abstr.).
7. J. Adams, J. Robe, Z. Grigsby, A. Rathert, N. Uzee, M. Major, D. Lalman, and P. A. Beck. 2021. Effect of dried distillers’ grains cube supplementation rate on voluntary intake and digestibility of bermudagrass hay fed to growing heifers. J. Anim. Sci. 99 (Suppl. 3):182-183. (Abstr.). <https://doi.org/10.1093/jas/skab235.331>
8. Gadberry, S., D. Lalman, F. J. White, S. Linneen, and P. A. Beck. 2021. Meta-analysis of the effects of monensin on growth and bloat of growing beef calves on pasture. J. Anim. Sci. 99 (Suppl. 3):468-469 (Abstr.). <https://doi.org/10.1093/jas/skab235.831>
9. Sartin, A., K. Calus, M. Grabau, A. Kuhn, D. Redfearn and M. Drewnoski\*. 2022. Effect of species and maturity on yield, digestibility and protein content of winter hardy small cereal gain silage. American Forage and Grassland Council.
10. Johnson, A., J. Rees, N. Beckman, B. Schick, G. Lesoing, E. Laborie, K. Clark, C. Bieler, D. Redfearn and M. Drewnoski\*. 2022. Impacts of small grain cereal silage management on fermentation and nutritive value - a survey of Nebraska producers. American Forage and Grassland Council.
11. Speer, H. and M.E. Drewnoski\*. 2021. Survey of nutritionists’ perceptions of vitamin A requirements and supplementation in beef cow-calf systems. Western ASAS.
12. Carlson, Z.E., L. McPhillips, G.E. Erickson, M.E. Drewnoski and J.C. MacDonald\*. 2021. Production Responses of an Alternative Beef Cow-calf System. Journal of Animal Science 99(Supplement\_1):116. DOI: 10.1093/jas/skab054.192.
13. Millikan, T. M., M. B. Stephenson, A. Orozco-Lopez, K. A. Mollet, S. Das, J. D. Volesky. 2022. Regional differences in rangeland plant communities in the Nebraska Sandhills. 75th Annual Meetings of the Society for Range Management. Albuquerque, NM.
14. Orozco-Lopez, A. T. Millikan. K. Mollet, M. B. Stephenson. 2022. Cattle diet selection on upland Sandhills rangeland during the growing season. 75th Annual Meetings of the Society for Range Management. Albuquerque, NM
15. Boerman, S.L., J. A. Musgrave, K. J. Hanford. J. R. Brennan, M. B. Stephenson, J. T. Mulliniks. 2022. Impact of increasing level of milk production on cow and calf performance in the Nebraska Sandhills. 2022 Wester American Society of Animal Science Annual Meetings. Park City, Utah.
16. Afi, Maroua and Jay Parsons. “Integrated Crop-Livestock vs. Specialized Farming Systems in Nebraska: A Comparative Analysis of Technical Efficiency.” Accepted Presentation. 2022 Western Agricultural Economics Association Annual Meeting. Santa Fe, NM. June 27, 2022.
17. Parsons, J. and J. Siebert. “Improving Decision Making Skills in Agriculture.” Concurrent Session Presentation. 2022 National Farm Business Management Conference. Fort Collins, CO. June 15, 2022.
18. Hewlett, Jedidiah and J. Parsons. “Analyzing Flexibility as a Risk Management Tool in Agricultural Systems.” Concurrent Session Presentation. 2022 National Farm Business Management Conference. Fort Collins, CO. June 14, 2022.
19. Parsons, J. and J. Siebert. “Improving Proactive Decision Making in Agriculture.” Accepted presentation at the 2021 INFORMS Annual Meeting. Anaheim, CA. October 25, 2021.

***Journal Articles (Bold = authors from multiple states)***

1. **Guretzky, J.A., K.R. Harmoney, J.L. Moyer J.D. Volesky, M.B. Stephenson. 2021. Interseeding annual warm-season grasses into pastures: Forage nutritive value and yields. Agronomy Journal. 113:2544-2556; https://doi.org/10.1002/agj2.20653.**
2. Guretzky, J.A., H. Hillhouse, and D.D. Redfearn. 2022. Nitrogen fertilizer rate and timing effects on smooth bromegrass interseeded with sorghum-sudangrass. Crop, Forage & Turfgrass Management. 8(1); https://doi.org/10.1002/cft2.20156.
3. Guretzky, J.A., and D.D. Redfearn. 2021. Seeding rate effects on forage mass and vegetation dynamics of cool-season grass sod interseeded with sorghum-sudangrass. Agronomy. 11(12), 2449; https://doi.org/10.3390/agronomy11122449.
4. Adams, J. M. R. Farris, S. Clawson, E. Ward, and P. A. Beck. 2022. Economic feasibility of extruded dried distillers’ grains cube as a supplement for steers grazing introduced mixed grass pastures. Appl. Anim. Sci. 38:(accepted in press)
5. Beck, P. A., and R. R. Reuter. 2022. Invited Review: Nutritional management of calves grazing wheat and small grain pasture. Bovine Pract. (accepted; in press)
6. Adams, J. M., J. Robe, Z. Grigsby, A. Rathert, M. Major, D. Lalman, A. Foote, L. O. Tedischi, and P. A. Beck. 2022. Effects of supplementation rate of an extruded dried distillers’ grains cube fed to growing heifers on voluntary intake and digestibility of bermudagrass hay. J. Anim. Sci. 100:1-11 skac097 <https://doi.org/10.1093/jas/skac097>
7. Gadberry, S., D. Lalman, F. J. White, S. Linneen, and P. A. Beck. 2022. Meta-analysis of the effects of monensin on growth and bloat of growing beef calves on pasture. Transl. Anim. Sci. 6: txac031 <https://doi.org/10.1093/tas/txac031>
8. Beck, P. A., M. R. Beck, J. M. Adams, D. Hubbell, III, T. Hess, A. P. Foote, and E. B. Kegley. 2022. Effect of tillage method and seeding rate of wheat pasture on forage production and calf performance. Appl. Anim. Sci. 38:211-221. <https://doi.org/10.15232/aas.2021-02262>
9. Beck, P. A., A. P. Foote, W. L. Galyen, T. W. Hess, D. S. Hubbell, M. S. Gadberry, E. B. Kegley, and M. D. Cravey. 2021. Effects of bambermycin or monensin offered in self-fed mineral supplements on performance of steer calves grazing small grain pasture. Appl. Anim. Sci. 37:670-680.
10. Krupek, F.S., Mizero, S., Redfearn, D., and Basche, A. 2022. Assessing how cover crops close the soil health gap at on-farm experiments. Agricultural and Environmental Letters. <https://doi.org/10.1002/ael2.20088>
11. Krupek, F.S., Redfearn, D., Eskridge, K.M. and Basche, A., 2022. Ecological intensification with soil health practices demonstrates positive impacts on multiple soil properties: A large-scale farmer-led experiment. Geoderma. 409, 115594. <https://doi.org/10.1016/j.geoderma.2021.115594>
12. Carlson, Z. E., L. J. McPhillips, G. E. Erickson, M. E. Drewnoski, and J. C. MacDonald. 2022. Production cow-calf responses from perennial forage-based and integrated beef-cropping system. Translational Animal Science. https://doi.org/10.1093/tas/txac090
13. Linder, H. F., M.E. Drewnoski and J.C. MacDonald. 2022. Interaction of urea with frequency and amount of distillers grains supplementation for growing steers on a high forage diet. Translational Animal Science. https://doi.org/10.1093/tas/txac076
14. Reynolds, M. B. and M.E. Drewnoski. 2022. Is it time to re-think our one-size fits all approach to nitrate toxicity thresholds in forages? Translational Animal Science. https://doi.org/10.1093/tas/txac023.
15. Anderson, L., H. Blanco-Canqui1, M. E. Drewnoski, J. MacDonald, K. Calus, M. Brinton, B. H. Hansen, K. M. Ulmer, Z. Carlson and F. H. Hilscher. 2021.Cover crop grazing impacts on soil properties and crop yields under irrigated no-till corn-soybean management. Soil Science Society of America Journal. 1-16.

***Extension Research Reports/Publications***

1. **Harmoney, K.R., and J.A. Guretzky. 2022. Interseeding sorghum-sudangrass into perennial cool-season western wheatgrass pasture. Kansas Agricultural Experiment Station Research Reports: Vol. 8: Iss. 2. https://doi.org/10.4148/2378-5977.8276.**
2. Beck, P., D. Lalman, and R. Reuter (Eds.). 2022. Oklahoma State University 2021 Annual Summary Research at the Department of Animal and Food Sciences. P-1064 <https://extension.okstate.edu/fact-sheets/2022-annual-summary.html>
3. Beck, P. 2021. Managing Annual Forages for Livestock Production. In Proc. SW Missouri Spring Forage Virtual Conference. (online) February 23-24, 2021.
4. Adams, J. M., R. Farris, S. Clawson, E. Ward, P. Beck, and D. Turner. 2022. Effects of dried distiller’s grains cube supplementation for steers grazing introduced pastures on animal performance and forage production. Animal and Food Sciences 2021 Annual Summary P-1064 pp 8-9
5. Adams, J. M., R. Farris, S. Clawson, E. Ward, P. Beck, and D. Turner. 2022. Profitability of supplementing dried distiller’s grains cubes to improve animal performance and replace N fertilizer for steers grazing introduced pastures. Animal and Food Sciences 2021 Annual Summary P-1064 pp 10-11
6. Grigsby, Z., P. Beck, M. New, C. Worthington, and D. Turner. 2022. Using a 100% dried distillers grains cube as a supplement for steers grazing mixed grass prairie in western Oklahoma. Animal and Food Sciences 2021 Annual Summary P-1064 pp 18-19
7. Grigsby, Z., P. Beck, S. Gunter, and D. Turner. 2022. Dried distillers grains cube for steers grazing mixed grass prairie in Northwest Oklahoma. Animal and Food Sciences 2021 Annual Summary P-1064 pp 16-17
8. Farney, J. K. and T. Bottorff. 2022. Effect of Corn Type and Form of Supplement on Grazing Steers. Kansas Agricultural Experiment Station Research Reports: Vol. 8: Iss. 3. <https://doi.org/10.4148/2378-5977.8288>
9. Farney, J. K. and M. Frahm. 2022. Stocker Steer Gains and Fly Numbers as Impacted by Burn Date and Type of Mineral on Tallgrass Native Range – Year 3. Kansas Agricultural Experiment Station Research Reports: Vol. 8: Iss. 3. <https://doi.org/10.4148/2378-5977.8289>
10. Farney, J. K. 2022. ﻿Evaluation of Grazing Options During Summer for Growing Heifers – Year 2. Kansas Agricultural Experiment Station Research Reports: Vol. 8: Iss. 3. <https://doi.org/10.4148/2378-5977.8290>
11. Farney, J. K., M. Frahm, S. Strnad, and T Bottorff. 2022. Evaluation of Implants, Clover, and Fescue Variety on Stocker Steers – Year 2. Kansas Agricultural Experiment Station Research Reports: Vol. 8: Iss. 3. <https://doi.org/10.4148/2378-5977.8291>
12. Pedreira, B. C., D. Helwig, M. Haywood, J. K. Farney, and G. Sassenrath. 2022. Bermudagrass Under Different Fertility and Harvest Management Practices. Kansas Agricultural Experiment Station Research Reports: Vol. 8: Iss. 3. <https://doi.org/10.4148/2378-5977.8280>
13. Pedreira, B. C., D. Helwig, M. Haywood,. J. K. Farney, and G. Sassenrath. 2022. Impact of Fertility and Mowing on Crabgrass Quantity and Quality for Hay Production in Southeast Kansas. Kansas Agricultural Experiment Station Research Reports: Vol. 8: Iss. 3. <https://doi.org/10.4148/2378-5977.8281>
14. Pedreira, B. C., D. Helwig, M. Haywood,. J. K. Farney, and G. Sassenrath. 2022. Fertilization Management to Improve Stockpiled Tall Fescue in the Fall. Kansas Agricultural Experiment Station Research Reports: Vol. 8: Iss. 3. <https://doi.org/10.4148/2378-5977.8282>
15. Speer, H. F., H. C. Freetly, M. E. Drewnoski. 2023. Comparison of Semi-confined and Pasture-based August Calving Beef Cow Systems. MP 117: 5-8.
16. K. C. Adair, K. M. Butterfield, Z. E. Carlson, B. C. Troyer, J. Xiong, M. M. Norman, G. E. Erickson, M. E. Drewnoski, B. L. Nuttelman and J. C. MacDonlad. 2023. Timing of Implant Use in the Backgrounding System. Nebraska Beef Report. MP 117: 22-25.
17. Wheeler, K. E., D. Dustin, J. Parsons, M. E. Drewnoski, and K. Wilke. 2023. Effects of Strategic Supplementation on Return to Management and Performance of Yearling Cattle. Nebraska Beef Report. MP 117: 26-28.
18. Sartin, A. M., K. J. Calus, M. T. Grabau, A. K. Kuhn, M. E. Drewnoski and D. D. Redfearn, 2023. Effect of Species and Maturity on Small Grain Silage Yield and Quality. Nebraska Beef Report. MP 117: 34-36.
19. Parsons, J. “Five Key Principles of a Good Risk Management Culture.” CAP Series 22-0801, Center for Agricultural Profitability, University of Nebraska-Lincoln, August 2, 2022.
20. Parsons, J. 2022. “Use of Livestock Risk Protection Insurance for Cattle Continues to Grow.” University of Nebraska-Lincoln, Cornhusker Economics, July 20, 2022.
21. Parsons, J. “Risk Preference Calculator: A Tool to Help Decision-Makers Succeed.” CAP Series 22-0204, Center for Agricultural Profitability, University of Nebraska-Lincoln, Feb. 18, 2022.
22. Parsons, J. “Pasture, Rangeland, Forage Insurance Applications Due December 1 for 2022 Coverage.” CAP Series 21-1106, Center for Agricultural Profitability, University of Nebraska-Lincoln, Nov. 15, 2021.
23. Niemeyer, S. and J. Parsons. 2021. “Tax Implications If Liquidating a Beef Herd.” UNL BeefWatch, November 1, 2021. University of Nebraska-Lincoln. Lincoln, NE. URL: https://beef.unl.edu/beefwatch/2021/tax-implications-if-liquidating-beef-herd.
24. Parsons, J., Hewlett, J. and Tranel, J. 2021. “Risk Strategies for Managing Drought.” RightRisk News, Vol. 9, Issue 10. RightRisk Education Team. Laramie, WY.
25. Parsons, J. 2021. “Manage pasture production risk with PRF insurance.” Nebraska Farmer, 163(9):44-45 (October).
26. Redfearn, D. and J. Parsons. 2021. “Economic Considerations for Converting Cropland to Perennial Grazing Lands.” CAP Series 21-0909, Center for Agricultural Profitability, University of Nebraska-Lincoln, Sept. 28, 2021.

 ***Extension publications (peer-reviewed)***

1. Basche, A., K. Koehler-Cole, H. Yu, J. Sun, N. R. Gotoor. 2022. Cover crop biomass calculator available for Nebraska. CropWatch. July.
2. Ferreira, T., S. Ramiriz, E. Robinson, and A. Basche. 2022. Cover crop species decomposition and nitrogen release during the corn growing season. CropWatch. May.
3. Oys, E., K. Koehler-Cole, A. Basche, C. Proctor, and F. S. Krupek. 2022. Expanding the integrated weed management toolbox: winter cover crop impacts on weed dynamics in Eastern and Central Nebraska. CropWatch. April.
4. Krupek, F. S., D. Redfern, and A. Basche. 2022. On-farm research indicates importance of cover crops for soil health in Nebraska. CropWatch. January.
5. Wilke, K. and M. Drewnoski. What are my Options when I am Out of Grass? Beefwatch electronic newsletter. [May 22](https://beef.unl.edu/beefwatch/2022/what-are-my-options-when-i-am-out-grass)
6. Wilke, K. When Drought Stressed Pastures Look Dormant in July. Beefwatch electronic newsletter. [July 22](https://beef.unl.edu/beefwatch/2022/when-drought-stressed-pastures-look-dormant-july)
7. Wilke, K. Managing Early Weaned Calves. BeefWatch electronic newsletter. [August 22](https://beef.unl.edu/beefwatch/2022/managing-early-weaned-calves)
8. Wilke, K. Winter Supplementation of Beef Calves- When Supplement Doesn’t Pay Beef Watch electronic newsletter. [December 21](https://beef.unl.edu/beefwatch/2021/winter-supplementation-beef-calves-%E2%80%93-when-supplementation-doesn%E2%80%99t-pay)
9. Schick, B., M. E. Drewnoski, J. Rees. 2022. Drought-stressed corn: A feed Opportunity. BeefWatch. July.
10. Biehler, C., B. Beckman, and M. Drewnoski. 2022. Weighing Risk and Reward of Annual Forages. BeefWatch Newsletter. July.
11. Influence of topography on grazing distribution in the Sandhills, GSL Researcher Newsletter, April 1, 2022
12. Xiong and Stephenson. Technical Note: Where are my cattle at? – Part II: Virtual Fencing. UNL BeefWatch, July 1, 2022.
13. Dozler, K., Y. Xiong, M. Stephenson. Virtual fencing: A new frontier for grazing management. Gudmundsen Sandhills Lab Fall 2022 Researcher Newsletter.

***Workshops***

1. Drought monitoring workshop (75 participants)
2. Risk management and profitability 3.5 hour workshops including management of forage production, cattle marketing and land expenses in various systems throughout the state of Nebraska.
	1. Jansen, J., J. Parsons, E. Dennis, and R. Benjamin. Managing Cattle for Profit Workshop. Valentine, NE. Aug. 31, 2022. Attendance: 7.
	2. Jansen, J., J. Parsons, and E. Dennis. Managing Cattle for Profit Workshop. West Point, NE. Mar. 16, 2022. Attendance: 13.
	3. Saner, R., J. Parsons, and E. Dennis. Risk Management Workshop for Cattle Producers. Arthur, NE. Nov. 17, 2021. Attendance: 9.

***Multi-State Outreach Presentations***

1. Wilke, K. Drought Mitigation Tools for the Cowherd. Presented in Dodge City, KS at Cattle U (60 people)
2. Wilke, K. Managing Cows in Confinement. Presented in Alma, NE (50 people)
3. Wilke, K. Managing Cows in Confinement. Presented in Wayne, NE (20 people)
4. Wilke, K. Adding Yearlings to the Cow-calf Operation for Income Diversification or Drought Mitigation. Presented at the Range Beef Cow Symposium in Rapid City, SD (600 people)
5. Farney, J. Practicalities of cover crops for cattle. Presented in Enid, OK (35 people)
6. Wheeler, K, M. Drewnoski and K. Wilke. Strategic supplementation of yearlings. Imperial, NE.
7. Drewnoski, M. Using small cereals for forage, David City, NE.
8. Drewnoski, M. Using small cereals for forage, Mead, NE.
9. Drewnoski, M. Cow/calf systems with limited perennial grass. Dubuque, IA.
10. Drewnoski, M. Using late summer planted cover crops for forage. Wichita, KS.
11. Drewnoski, M. Using small cereals for forage. Grand Island, NE. (70 people)
12. Drewnoski, M. Mineral and vitamin considerations for cows in confinement. Alma, NE
13. Drewnoski, M. Cover crops, grazing and soil health. Yankton, SD.

***Webinars/Videos and URL for online access***

1. Wilke, K., R. Saner, J. Parsons. Early Weaning Calves: Nutrition, Risk Management, and Marketing. <https://cap.unl.edu/livestock/early-weaning-calves-nutrition-risk-management-and-marketing-aug-18-2022-webinar>
2. Parsons and Drewnoski. 2022. Tips for making annual forages work for you. Center for Ag. Profitability. Drewnoski, M.E. 2021. What feed yards should know about cover crops. UNL Feedlot Roundtable.
3. Drewnoski, M. E. 2021. Can you have your cake and eat it too?. Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA). Cover Crop Webinar Series.
4. Johnson, L., A. Schmidt, and J. Parsons. “Valuing Manure as a Seller or a Buyer.” One-hour webinar presentation for the Center for Agricultural Profitability, University of Nebraska-Lincoln. January 13, 2022. Attendance: 48. https://cap.unl.edu/management/valuing-manure-seller-or-buyer-jan-13-2021-webinar.
5. Bowman, M. and J. Parsons. “Cover Crops, Soil Health and Financial Incentives.” One-hour webinar presentation for the Center for Agricultural Profitability, University of Nebraska-Lincoln. October 7, 2021. Attendance: 53. https://cap.unl.edu/crops/cover-crops-soil-health-and-financial-incentives-oct-8-2021-webinar.

**Funding (include grants and contracts)**

* + - 1. USDA Natural Resources Conservation Service. “Cover Crop Initiative: A collaborative project to advance knowledge and utilization of cover crops for conservation measures in Nebraska.” $1,049,500. Lead PI Andrea Barsche, Co-PI Daren Redfearn. 2021-2025.
			2. USDA National Institute of Food and Agriculture. "Developing and deploying a perennial grain crop enterprise to improve environmental quality and rural prosperity.” $10,000,000. Project Director: Jake Jungers. 2020-2025.
			3. NC SARE Research and Education Grant. Evaluating virtual fences for cattle in regards to water resources, forage management, invasive weed control, and wildlife systems,” $250,000. Lead PI Jaymelynn Farney, Co-PIs Bruno Pedreira and Drew Ricketts. 2022-2025.
			4. Dennis, E., Jansen, J., and Parsons, J. Risk Management Education for Nebraska Livestock and Forage Producers Affected by Drought and Underserved by Crop Insurance. North Central Extension Risk Management Education Center – 2022 ERME Underserved Producers. Project period: 4/1/22 to 9/30/23. $100,000. Submitted: 11/18/21. Awarded: 2/11/22.
			5. Allen, C., Jenkins, J., Parsons, J., Schacht, W., Stephenson, M., Uden, D., and Volesky, J. Assessing tradeoffs of rangeland management approaches using collaborative adaptive management. NCR-SARE. Project Period: 11/1/21-10/31/24. $247,011.