ALTERNATIVE BURNING STRATEGIES

EFFECTS ON CATTLE PERFORMANCE, GRASSLAND, AND THE ENVIRONMENT

Burning of tallgrass prairie is an effective and widely used tool for control of invasive species. It can improve forage quality and subsequent cattle gains and alter grazing distribution. Yearly spring burning is common practice within the tallgrass native system, but research shows that burn-timing alternatives may have a more significant impact on undesirable plant species. Along with the many desirable impacts of burning native range, there are negatives, most notably, smoke management. Smoke that drifts into cities presents a health hazard for those affected by allergies or other health problems. It creates a problem for manufacturing companies if air quality falls below acceptable EPA levels.

Summer weather patterns raise another burning-related issue. A pasture that receives little or no moisture during the summer after being burned completely in the spring produces a limited amount of forage. The lack of forage compromises cattle performance and increases soil runoff with wind or heavy rains. In this way, burning also affects greenhouse gas emissions, which vary with changes in soil cover and weather patterns throughout the year.

An alternative to complete burning is patch-burning, a practice by which portions of a pasture are burned in a yearly rotation. One of the most common patch-burning regimens, burning one-third of the pasture each year in a rotation (Figure 1), has been shown to provide ecological benefits such as soil ecosystem and wildlife habitat improvement and an increase in plant biodiversity. Researchers theorize that patch burning mimics historical patterns of burning and grazing. It compares to a time when fires were ignited by lightning, and bison and other species preferentially grazed the burned areas.

GRASSLAND IMPACTS

Investigations of burning alternatives include a three-year project to evaluate patch burning and continual burning in which pastures in the patch-burn system were found to have more tallgrass, forb, and litter cover. A seven-year study in Kansas showed minimal differences in plant populations in patch-burned as compared to continuously burned (burned entirely every year) pastures with cattle grazing. The only exception was an increase in annual grasses in patch-burned pastures after seven years, with changes in plant composition based on time since the fire. Researchers observed a decrease in big bluestem one year postburn with stabilization after that. Little bluestem and Indian grass tended to decrease, and *sericea lespedeza* decreased the year of the burn, and then returned to pre-burn levels.

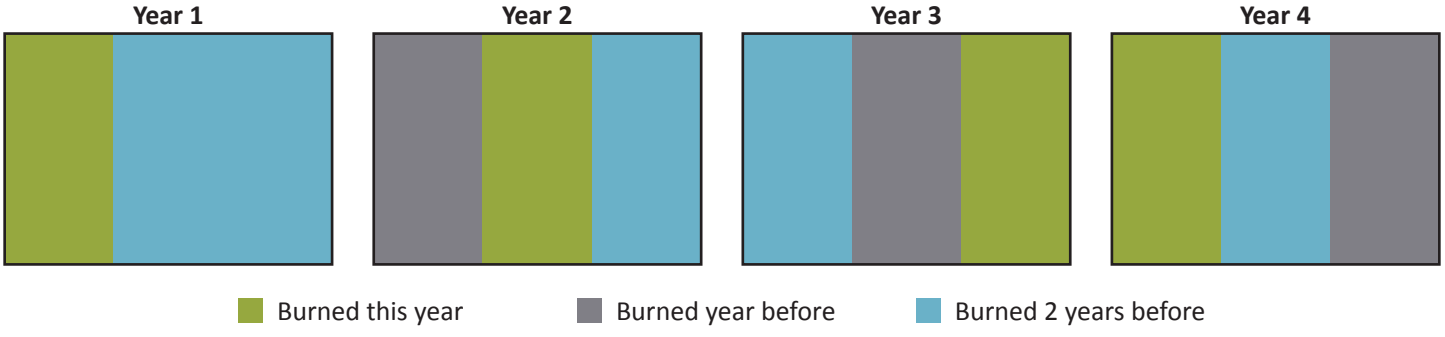

Figure 1. Illustration of a four-year burning regimen showing the rotation for burning one-third of the pasture each year.

CATTLE PERFORMANCE

Overall, no negative effects on cattle gains have been reported for animals grazed on patch-burn versus continuously burned pastures (Table 1), but patch-burn may offer a gain advantage in drought years. For example, a Kansas study found that in years when less than 60 percent of normal precipitation was received during the grazing season, calves on patch-burned pastures gained 0.24 lb per day more than calves on continuously spring-burned pastures during a 90-day double-stock grazing period.

An Oklahoma study compared stocker cattle performance during 183-day grazing periods between a similar patch-burn system and a traditional burning system in which an entire pasture is burned once every three years. Although average livestock production did not differ among treatments, conservation-based management reduced the variability over the years.

A study in Tennessee found higher gains for cattle grazed on patch-burned versus continuously burned pastures during a dry summer. Burned patches of pasture were higher in protein and energy value than areas not influenced by fire. Even though the nutritional value of a pasture burned in its entirety was of higher quality than the patch-burned pasture, in years when weather was less than desirable, the patch-burned pasture provided more forage for cattle than the pasture burned completely.

Compared to unburned pastures, patch-burned pastures have been shown to improve cattle performance. In general, steers in this study did not perform as well as those in other studies, but average daily gains in the patch-burned system were significantly greater than gains in the unburned system. In the five years from 2011-2015, cattle in the patch-burned system gained about 0.22 lb per day and 3.7 lb per grazeable-acre more than cattle in the unburned system over a period of approximately 90 days (Table 1). The patch-burning system increased animal productivity by 28 percent compared to unburned pastures.

In an Oklahoma study on mixed-grass prairie, stocker cattle gains during the first four years were the same as gains recorded for unburned pastures. Over the next seven years, patch-burn grazing calves gained approximately 48 lbs more than calves grazed on unburned pastures. Additionally, the patch-burned pasture showed improvement in forage quality and a 28 percent increase animal productivity compared to animals grazed on unburned pastures.

Table 1: Performance measures of different methods to manage pasture with fire.

Author	Measure	Unburned	Yearly burn	Patch-burn	Animal type	Years	Pasture type
Farney et al.[a]	ADG, lb/d	---	2.36	2.43	Steers	2006-2012	Tallgrass native range
Moffet and Reuter[b]	ADG, lb/d	0.78	---	1.00	Steers	2011-2015	Cross timbers rangelands
Moffet and Reuter[b]	Gain, lb/ac[e]	12.8	---	16.5	Steers	2011-2015	Cross timbers rangelands
Limb et al.[c]	ADG, lb/d	1.42	---	1.70	Stocker cattle	2003-2009	Mixed prairie
Limb et al.[c]	ADG, lb/d	1.59	---	1.65	Stocker cattle	1999-2002	Mixed prairie
Winter et al.[d]	BCS	5.5		5.4	Cow	2009-2011	Native range
Winter et al.[d]	Weight, lb	1400		1470	Cow	2009-2011	Native range in Nebraska
Winter et al.[d]	Weight, lb	400		450	Calf at weaning	2009-2011	Native range in Nebraska

[a] Farney et al. 2017. Professional Animal Scientist. Seven-year study. No difference in ADG overall, but in years of severe drought, patch-burning resulted in improved calf gains.

[b] Moffet and Reuter, 2017. Great Plains Grazing Field Research Symposium. This five-year study was conducted on 3,500 acres of Cross Timbers rangeland in south-central Oklahoma where vegetation is a mix of open grassland, grassland and scattered trees, and woodland. Patch burning was compared with not burning, and steers grazed for about 90 days each year at an average stocking rate of 27 AUD per grazeable acre.

[c] Limb et al. 2011. Rangeland and Ecology. This 11-year study found no difference in cattle gains in the first four years but a significant difference in the following seven years. The numbers in the table were generated from figures in the publication and are close approximations, not the actual reported average daily gain.

[d] Winter et al. 2014. Rangelands. Control pastures were burned in 2009 and not burned before grazing in 2010 or 2011. Pastures are native range in Nebraska. The numbers appearing in the table are from figures included in the publication, not the exact numbers reported.

[e] Grazeable acres: approximately two-thirds of the total area of these pastures was grazeable, and the remainder was woodland.

Cow-calf pairs on patch-burned pastures had similar cow body condition and body weight for cows and calves versus pastures that were burned entirely or not burned. Cows managed on patch-burned pastures in Oklahoma were given body condition scores similar to those on traditional pasture management. Additionally, the cows on the patch-burned pastures needed 120 lbs less feed per head during winter supplementation time than traditionally grazed cows.

GREENHOUSE GAS EMISSIONS

In the agriculture sector, cattle grazing systems are one of the primary sources of greenhouse gas emissions, particularly nitrous oxide (N_2O) and methane (CH_4). The main factors that control the flow of volatile gas emissions (greenhouse gas fluxes) from a beef-cattle grazing system on a grassland are weather conditions, burning regimes, grazing, and soil microorganisms.

To investigate how grazing systems affect managed grasslands, K-State researchers conducted a study in a tallgrass prairie in Kansas designed to evaluate the effect of annual burning and patch burning on a three-year basis in three watersheds under an animal density of one cow-calf pair per grazed 7.9 acres. Results showed that patch burning on a three-year basis can offset 90 percent of CH_4 emissions from the beef cattle cow-calf pair after one year of burning and 63 percent after two years of burning (Figure 2). By comparison, with annual burning, the soil can capture and store (sequester) 67 percent of CH_4 emissions from the cow-calf pair. Results provide quantifiable evidence of the role of managed (grazed and burned) temperate grassland soils as a strategy for the removal (sink) of CH_4 and N_2O. These findings demonstrate the importance of this alternative burning method for supporting the food supply, economy, and ecosystem.

SUMMARY

- Patch burning helps diversify range ecosystems.
- Patch burning does not negatively affect cattle performance and may increase cattle gains compared to pastures that are not burned.
- In drought years, patch burning can be used as a management strategy to improve cattle gains.
- Burning of pastures, including patch burning, provides a method to offset carbon emissions from a cow-calf operation.

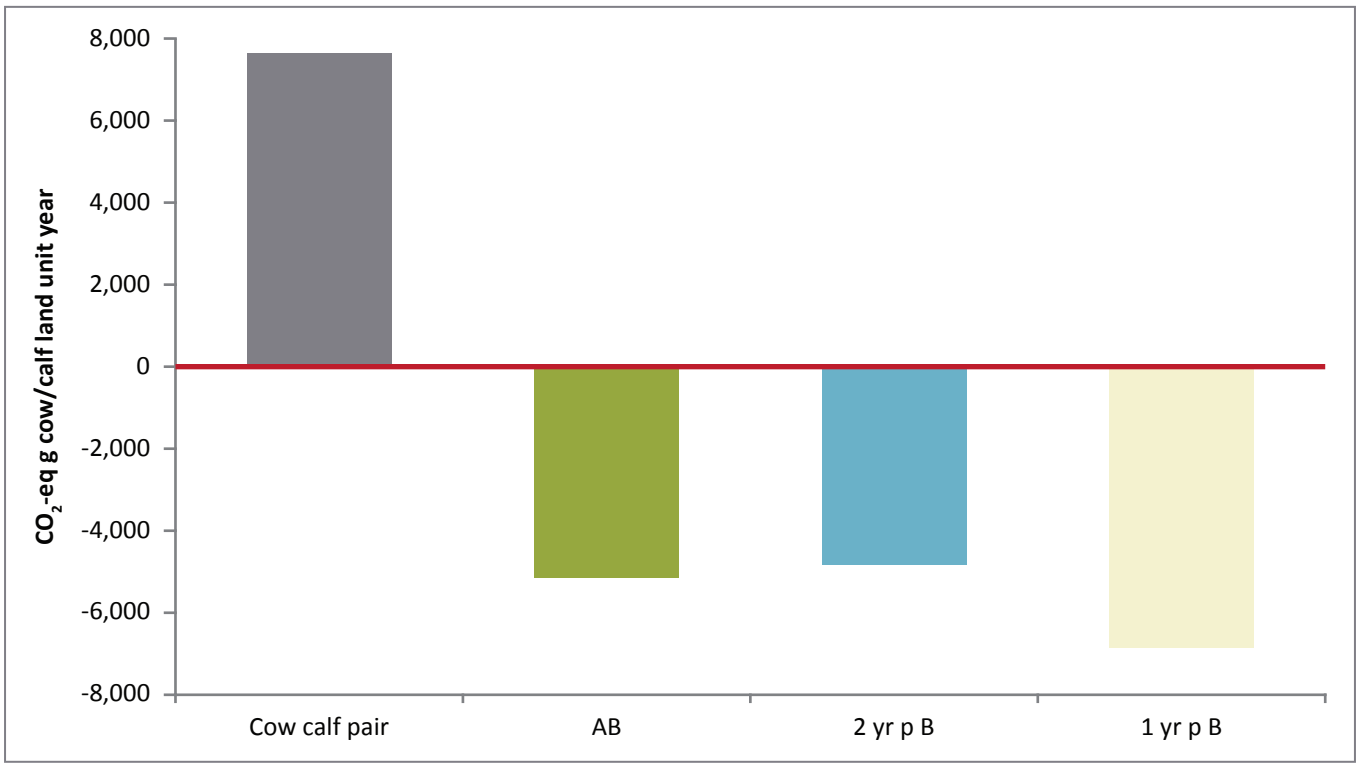

Figure 2. Managed grassland soil capacity to capture CH_4 and N_2O emissions from three watersheds under annual burning (AB) and patch burning on a 3-year basis: 2-years post-burning (2 yr p B) and 1-year post-burning (1 yr p B). The cow-calf pair bar indicates emission from the animal during the grazing season. Sources: Rivera-Zayas et al., 2016; Todd et al., 2016.

REFERENCES

Farney et al. 2017. Patch-burning on tall-grass native range does not negatively impact stocker performance or negatively impact pasture composition. Prof. Anim. Sci. 33:549-554.

Fuhlendorf, S. D. et al., 2006. Should heterogeneity be the basis for conservation? Grassland bird response to fire and grazing. Ecol. App. 16:1706-1716.

Limb et al. 2011. Pyric-herbivory and cattle performance in grassland ecosystems. Rangeland Ecol. Manage. 64:659-663.

McGranahan, D. A., et al. 2014. Patch burning improves forage quality and creates grass-bank in old-field pasture: Results of a demonstration trial. Southeastern Nat. 13:200-207.

Moffet, C.A. and R.R. Reuter. 2016. Stocker cattle performance is greater when grazing patch-burned rather than unburned cross timbers rangeland. Great Plains Grazing Field Research Symposium. Stillwater, Oklahoma, 90-95.

Rivera-Zayas, J., M. Arango, N. Notenbaert and C.W. Rice. 2016. Greenhouse gas emissions from beef-cattle grazing systems on temperate grasslands. Great Plains Grazing Field Research Symposium. Oklahoma State University, Stillwater, OK June 14, 2016, 79-83.

Todd, R.W., C. Moffet, J. Neel, K.E. Turner, J.L. Steiner and N.A. Cole. 2016. Pasture-Scale methane emissions of grazing cattle. Great Plains Grazing Field Research Symposium. Stillwater, Oklahoma, 46-53.

Winter et al. 2014. Patch-burn grazing effects on cattle performance: research conducted in a working landscape. Rangelands. 36:2-7.

AUTHORS

Jaymelynn Farney, *Beef Systems Specialist, Kansas State University*
Charles Rice, *Soil Microbiologist, Kansas State University*
Johanie Rivera-Zayas, *Soil Microbiologist, Kansas State University*
Corey Moffet, *Rangeland Management Specialist, USDA–Agricultural Research Service, Woodward, Oklahoma*

REVIEWERS

Ryan Reuter, *Range Beef Cattle Nutritionist, Oklahoma State University*
Walt Fick, *Range Management Specialist, Kansas State University*

THIS MATERIAL IS BASED UPON WORK SUPPORTED BY:

U.S. Department of Agriculture, Project Nos. 2013-69002-23146 through the National Institute for Food and Agriculture's Agriculture and Food Research Initiative, Regional Approaches for Adaptation to and Mitigation of Climate Variability and Change. Great Plains Grazing is a group of research scientists, Extension specialists, and consumer experts from Kansas State University, Oklahoma State University, University of Oklahoma, Tarleton State University, Samuel Roberts Noble Foundation, and the USDA's Agricultural Research Service working together to improve and promote regional beef production while mitigating its environmental footprint.

K-STATE Research and Extension

Publications from Kansas State University are available at ***www.bookstore.ksre.ksu.edu***

Kansas State University Agricultural Experiment Station and Cooperative Extension Service
K-State Research and Extension is an equal opportunity provider and employer. Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, as amended. Kansas State University, County Extension Councils, Extension Districts, and United States Department of Agriculture Cooperating, J. Ernest Minton, Interim Director.

MF3251 February 2019