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Cattle performance does not differ between patch and broadcast burning

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Abstract

Over the past few decades, patch burning has become a recommended practice in the Southern Plains of the USA rather than burning an entire pasture at one time. Patch burn plans follow a burn sequence where several patches with different times-since-last-burn occur within the pastures, whereas for the broadcast burn plans entire pastures are burned at one time every several years so that each year the time-since-last burned is uniform across the pastures. The objective of our study was to determine whether animal performance, per hectare or per head, differed between the two treatments. In our long-term experiment, in three replicate blocks, the blocks were divided into two pastures that were randomly assigned the patch-burn treatment, where ¼ of the pasture was burned in a 4-yr rotation, or the broadcast burn treatment, where the entire pasture was burned every 4 years. The pastures were grazed each year with weaned growing cattle (BW = 242±16 kg) to harvest a targeted 25% of the expected annual forage production over an approximately 180 d period (45% of the use was in the dormant, DS, and 55% of the use was in the growing season, GS). Cattle received a range cube protein supplement during the dormant season. The annual gains per hectare were 60.0 kg/ha for both the broadcast and patch burn treatments. The effect of grazing season on gain per hectare and average daily gain was significant with GS gain of 49.4 kg/ha and DS gain of 10.6 kg/ha. Average daily gains were more than three times greater in the GS (0.78 kg/d) than in the DS (0.21 kg/d). These data show that whatever benefits exist for patch burning over broadcast burning, animal performance cannot be counted among them, nor can animal performance be used to justify one over the other.

Introduction

Fire is an important part of the disturbance regime in the Great Plains of North America that helped to maintain the grassland and to suppress woody plant encroachment (Anderson et al. 1970; Limb et al. 2011; Wright and Bailey 1982). Patch burning has been proposed as conservation-based management that gets fire back on the landscape (Limb et al. 2011). One feature of patch burning is that the most recently burned patch is more highly selected than other patches with longer times-since-last-burn and utilization rates are greater in the newest burn patch than others (Scasta et al. 2015). When the pasture is moderately stocked, but the most recently burned patch can only supply a fraction of the grazing animals forage demand, then utilization of the recently burned patch is uniformly heavy and use is light in other areas. In years when production is limited, the use can increase in otherwise lightly used patches and these patches serve as a forage buffer. In subsequent years, standing dead material accumulates within the pasture and forage quality declines. If patch burning is stopped for a period of

years, grazing may need to be adjusted to allow the most recently burned patch to recover from heavy use within the growing season as occurs when a new patch is burned. The continual rotation of burned patches within a pasture increases the uniformity of use on the cycle time scale, but increases heterogeneity on the annual time scale. In broadcast burn pastures that are moderately stocked, the forage is all high quality, but grazing use is only moderate and soon plants that don't get grazed early in the grazing period will become less desirable and animals may begin repeat grazing some plants and avoiding other plants or even grazing sites. The uniformity of grazing use in these broadcast burn pastures, on time scales from grazing season to fire return interval, is less than for the recently burned patches. The annual provisioning of high-quality forage that occurs in the patch burn pastures each year could contribute to better animal performance. The objective of this study was to determine whether animal performance, in terms of average daily gain or gain per hectare, differs between patch and broadcast burn treatments.

Methods

The site of this long-term burning and grazing study was the Southern Plains Range Research Station in Woodward, Oklahoma, USA. The site is located near the boundary between the Cfa Koppen-Geiger climatic zone (temperate, without a dry season, and hot summers) and Bsk zone (arid, steppe, and cold; Peel et al., 2007). The experiment was set up as a randomized complete block design with 3 blocks of two pastures. The pastures ranged in size from 6.1 to 16.1 ha. Within each block, pastures were randomly assigned to one of the two burn treatments, broadcast burning or patch burning. The broadcast burn treatment involved burning the entire pasture every 4th year and the patch burn treatment involved dividing the pasture into 4 patches and burning 1 patch each year in a 4-yr rotation. For both treatments, the prescribed burns were conducted in late winter or early spring. The pastures were grazed with growing steers for a period of 83 to 97 d in the growing season (mid April to mid July) and another 83 to 91 d in the dormant season (late November to late February). Cattle were received 45 to 35 d prior to the beginning each grazing period and weighed. The cattle were stratified by receiving weight and each strata was proportionately represented in each experimental unit. The target initial weight for the growing season steers was 227 kg and for the dormant season steers it was 249 kg. Stocking rates were adjusted based on the expected annual forage production and pasture size to achieve a target forage harvest for the year of 25% with 55% of the target harvested in the growing season and the remaining 45% harvested in the dormant season. Cattle received a protein supplement during the dormant season grazing 3 days each week to meet their protein requirement.

Forage production each year was estimated by clipping quadrats in the fall from inside exclosures that had been established the winter before. In each patch of the patch-burn pastures and quarter of the broadcast-burn pastures, 8 exclosures (~ 1m in diameter) were established and the standing dead material was removed by cutting with a string trimmer to approximately 3-cm stubble height unless the patch or pasture was burned. In the fall when the plants were mostly senesced a quadrat (0.5 m^2 square) was centred in the exclosure, clipped to a 3-cm stubble height, the standing crop was placed in labelled paper bags, and taken to the laboratory to be dried in an oven and weighed.

Results

The effect of grazing season on average daily gain (ADG) interacted with forage year ($p < 0.001$). The advantage in ADG cattle had during the growing season ranged between 0.379 kg/d more (2018) and 0.831 kg/d more (2023). Averaging across forage years, the ADG for steers was more than three times greater during the growing season (0.78 kg/d, SE = 0.020 kg/d) than during the dormant season (0.21 kg/d, SE = 0.020 kg/d, $p < 0.001$). Burn treatment had no significant effect on ADG ($p = 0.5325$) irrespective of the grazing season, forage year, or both ($p = 0.7679$, 0.6222, or 0.5684, respectively, Fig. 1).

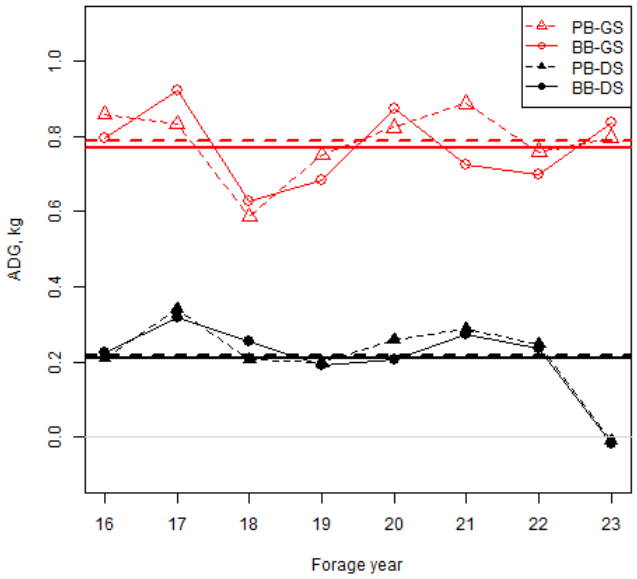

Fig. 1. Average daily gain of steers in each forage year, grazing season, and burn treatment.

Converting individual animal performance to performance per unit area for each grazing season and treatment, the significant grazing season effect on ADG translated to a significant grazing season effect on gain ($p < 0.001$) with an average growing season gain of 49.4 kg/ha (SE = 1.69 kg/ha) and dormant season gains of 10.6 kg/ha (SE = 1.69 kg/ha), irrespective of burn treatment (the p value for the season by treatment interaction was 0.8511). There was also no significant main effect of burn treatment on gain ($p = 0.9872$). Combining the two grazing season gains in each forage year and treating forage year as a fixed effect, the effect of forage year on annual gains was significant ($p < 0.001$, Fig. 2), but annual gains were not different between burn treatments ($p = 0.9853$) and burn treatment didn't interact with the effect of forage year ($p = 0.8646$). Annual gains in forage years 2017 and 2020 were each greater than in forage years 2018 and 2023 and no other forage year differences were significant. Treating forage year as a random effect, annual gains were not significantly different between the broadcast and patch burn treatments ($p = 0.9802$) and both averaged 60.0 kg/ha (SE = 2.74 kg/ha).

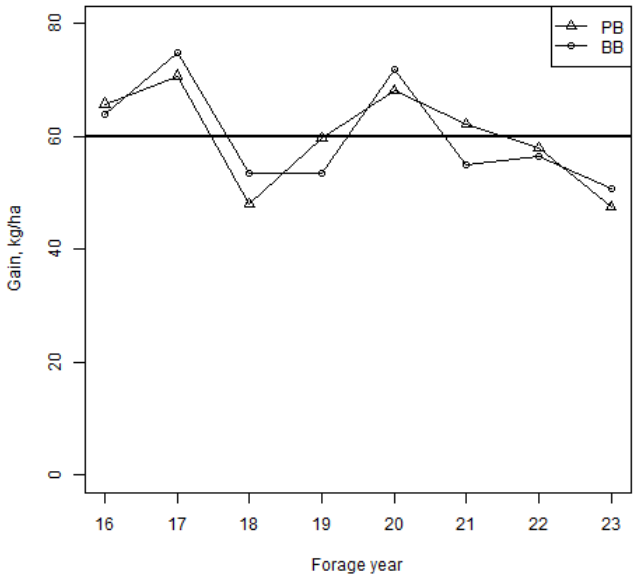

Fig. 2. Animal body weight gain (kg per hectare) for steers grazing each forage year in patch burn and broadcast burn treatments.

Conclusions

These data show that whatever benefits exist for patch burning over broadcast burning, animal performance cannot be counted among them, nor can animal performance be used to justify one over the other. Animal performance in this study varied by forage year and the season when grazing occurred, but the burn treatment was never significant and it never interacted with the other effects.

Acknowledgements

The use of animals in this experiment was reviewed by the Oklahoma and Central Plains Agricultural Research Center's Animal Care and Use Committee at Woodward and approved (AUP-002, AUP-016, and AUP-025).

References

Anderson KL, Smith EF, Owensby CE (1970) Burning bluestem range. J. Range Mang. 23, 81-92.

Limb RF, Fuhlendorf SD, Engle DM, Weir JR, Elmore RD, Bidwell TG, 2011. Pyric–Herbivory and Cattle Performance in Grassland Ecosystems. Range. Eco. & Mgmt. 64, 659–663.

Peel MC, Finlayson BL, McMahon TA (2007) World map of the Köppen-Geiger climate classification updated. Hydrol. Earth Syst. Sci. 11, 1633–1644.

Scasta JD, Thacker ET, Hovick TJ, Engle DM, Allred BW, Fuhlendorf SD, Weir JR (2015) Patch-burn grazing (PBG) as a livestock management alternative for fire-prone ecosystems of North America. Renewable Agri. Food Sys. 31, 550-567.

Wright HA, Bailey AW (1982) 'Fire Ecology: United States and southern Canada', (John Wiley and Sons: New York)