The Professional Animal Scientist 33:549–554
https://doi.org/10.15232/pas.2016-01574

Patch burning on tall-grass native prairie does not negatively affect stocker performance or pasture composition

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ABSTRACT

The purpose of this study was to determine stocker BW gain on patch-burned native tall-grass prairie while also determining plant species influenced by fire. The study was conducted in a split-block experimental design where treatments consisted of a yearly spring burn on the pastures (CON) or patch burning of one-third pasture per year (PB). Stocker steers grazed the pastures using a three-quarter-season (~114 d) grazing period from about mid-April to mid-August from 2006 to 2012. Steer ADG, final weight, and total BW gain were not different by treatment ($P > 0.35$). However, when comparing treatment effects with precipitation classification (high, average, low), cattle on PB had a greater ADG ($P = 0.02$; 0.10 kg/d), final weight ($P = 0.07$; 12 kg), and total BW gain ($P = 0.02$; 11.8 kg) in low precipitation years (2011 and 2012). Overall, patch burning provides similar BW gains as yearly burning on native tall-grass prairie, while providing a BW gain advantage in low precipitation years. The switchgrass (*Panicum virgatum*) population declined ($P < 0.05$) on CON treatment, whereas the population of other perennial grasses increased. The amount of annual grasses, including hairy crabgrass (*Digitaria sanguinalis*) and yellow foxtail (*Setaria pumila*), increased ($P < 0.05$) under PB. Botanical composition shifts were similar on patch-burn pastures and full-burn pastures, with the exception of increasing annual grasses with patch burning.

Key words: native range, burning, botanical composition, cattle performance

INTRODUCTION

Burning tall-grass prairie is an effective and widely used management tool to improve weight gains and manipulate grazing distribution of cattle on native range. Traditional single-fire and intensive grazing systems are commonly accepted management practices for cattle producers across the nation, especially in the Flint Hills (Fuhlendorf and Engle, 2001; Hamilton, 2007). Numerous benefits have been associated with patch-burn grazing; however, the system has been promoted primarily as a method to increase biodiversity, heterogeneity, and wildlife habitat (Fuhlendorf et al., 2006; Bidwell et al., 2009; NPS, 2009). Patch burning has been theorized to mimic the historical patterns of the effects of lightning and the subsequent grazing patterns of American bison, resulting in a management unit with a shifting mosaic of grazing distribution (Weir et al., 2007). Because cattle production is a large component of the tall-grass prairie environment, it is important to quantify cattle performance with patch burning.

The objectives of this study were to (1) determine stocker BW gains on patch-burned native tall-grass prairie and (2) determine plant composition as influenced by fire and grazing.

MATERIALS AND METHODS

Animals used in this study were cared for in accordance with the standards described in the *Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching* (FASS, 1999).

This study was conducted at the Bressner Research pastures near Yates Center, Kansas. This research unit is owned by the Kansas State University Foundation and managed by an advisory council made up of area extension agents, state extension specialists, and producers. The unit is 253 ha and located along the eastern edge of the Kansas Flint Hills region at 37°51′54.18″N, 95°48′16.15″W. The vegetation at the site is classified as tall-grass prairie in which the dominant grasses include big bluestem (*Andropogon gerardii* Vitman), little bluestem [*Schizachyrium scoparium* (Michx.) Nash], Indiangrass [*Sorghastrum nutans* (L.) Nash], and switchgrass [*Panicum virgatum* L.] (NRCS, 2008). After fire through grazing (mid-April to Mid-August), precipitation for the area was 42.67, 88.95, 76.00, 63.27, 64.62, 14.12, and 22.00 cm in 2006, 2007, 2008, 2009, 2010, 2011, and 2012, respectively. Long-term average annual precipitation for Woodson County is 106.98 cm, and annual growing-season (April through September) precipitation is 68.58 cm (Kansas State University; Mesonet, 2016). Prior to initiation of this study, in 2005 all pastures were burned in April and grazed with

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stocker steers for a 90-d double-stocked grazing season. This followed a 4-yr study where all pastures were burned in April and double stocked with steers grazing for 90 d in the summer, and half the pastures were grazed in the fall for 44 to 67 d.

Treatments and Sampling

The Bressner unit was divided into 8 individual pastures (approximately 32 ha each), with 4 pastures on the north side and 4 pastures on the south side. Using a split-block experimental design, 2 treatments were implemented and replicated 4 times over 7 yr (2006–2012). The 2 treatments consisted of control (**CON**) pastures, which were burned and grazed every year, and patch-burn (**PB**) pastures, which were patch burned and grazed on a one-third (11 ha) per year basis. For the PB pastures each patch in the patch treatment was burned once in every 3-yr cycle. Therefore, in each PB pasture, cattle had access to graze one-third of the pasture that was burned within the year, one-third burned the previous year, and one-third that had not been burned for 2 yr (design analogous to Fuhlendorf et al., 2006). The pastures on the north side were assigned to the PB treatment, and the south side pastures were CON. This burn design was implemented because of the ability to control and contain fire based on the ranch layout to protect the PB pastures in the event of an out-of-control neighboring wildfire on the south side (the north, west, and east sides of ranch are surrounded by roads). To determine nuisance effects of pasture location, ADG on steers was assessed by pasture for years when all pastures were burned (2005 and 2016), and no difference in ADG was detected based on pasture ($P = 0.15$). Dates of burning for all pastures for this experiment were April 13, 2006; April 9, 2007; April 9, 2008; April 14, 2009; April 12, 2010; April 12, 2011; and April 2, 2012.

Stocker steers (n = 1,495 over 7 yr; >90% black hided) were purchased from auctions, vaccinated for respiratory pathogens, implanted, and wormed using commercially available products at each producer's operation before placement in pastures. Steers were weighed individually using electronic scales (Tru-Test Inc., Mineral Wells, TX) at the start and end of the grazing period. Steers were randomly assigned to a treatment using a predetermined randomized pasture assignment based on order through the chute. Based on this method, average initial weight within years were the same for treatments ($P = 0.98$, Table 1).

Cattle on both treatments were stocked from mid-April through mid-August and had free access to the entire area of each pasture along with free-choice mineral. This grazing season is classified as a three-quarter grazing season (~114 d) based on the season-long average grazing of 154 d for Flint Hills (primarily big bluestem) grass (Smith and Owensby, 1978). Cattle on the PB pastures (n = 773 over the 7 yr, average initial weight = 255.57 ± 1.71 kg) were stocked at 0.94 steer/ha, and cattle on the CON pastures (n = 722 over the 7 yr, average initial weight = 255.12 ± 1.74 kg) were stocked at 0.96 steer/ha. These stocking rates were for a total of 114 d of grazing in 2007 to 2010 and 2012; 113 d of grazing in 2006; and 118 d of grazing in 2011 and calculated to provide 2 animal unit months grazing pressure. Stocking rates remained the same every year to minimize confounding effects on botanical composition due to differences in stocking rates. In 2011 two pastures from each treatment were removed from analysis because pasture treatment integrity was compromised due to cattle commingling between treatment pastures. There were still 2 pastures of each treatment included in analysis for 2011.

In late August through September of each year, one 100-point transect was established in each of the one-third portions of the PB pastures and two were established in each of the CON pastures. Each one-third of the PB pastures represents a subplot within the pasture. Transects for the CON pastures were located on clay upland range sites. A total of 20 transects were established, 12 in PB pastures and 8 in CON. Distance between points within a transect was approximately 4 m. A modified step-point method (Owensby, 1973) was used to determine botanical composition. To summarize, when walking along transects, a point was lowered to the ground at specific locations, and hits were recorded. Hits could be on plants at the soil surface, bare ground, or litter. If a plant was not hit, the plant nearest the point was recorded by species. If the hit or closest plant was a grass, then the nearest nongrass species was recorded. Therefore, at each point there was potential for 2 plants to be recorded. To calculate total basal cover the number of plants that were hit by the point was divided by the number of points taken. To calculate percent composition for grasses, hits on a grass plus times a grass was recorded as the nearest plant was divided by total points taken. At each point, if the hit was not a forb or woody plant, then the nearest forb or woody plant was recorded to provide a better representation of nongrass species present. Percent composition of a nongrass species was calculated by adding hits plus times recorded as the closest plant plus times recorded as the nearest nongrass divided by 100 points and then multiplied by the total basal cover.

Table 1. Initial BW, final BW, total BW gain, and ADG by treatment[1] comparisons

Item	CON	PB	SEM	*P*-value
Initial BW, kg	255.0	255.0	2.0	0.98
Final BW, kg	378.4	381.6	6.4	0.51
Total BW gain, kg	123.1	126.4	3.2	0.35
ADG, kg/d	1.07	1.10	0.05	0.35

[1]CON = control pastures burned yearly; PB = patch-burned pastures, where one-third of the pasture was burned yearly on a rotation.