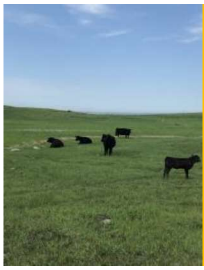

Aboveground Cumulative Production on Rangelands using a Patch-burn Grazing System

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Summary

Aboveground cumulative production accounts for any additional plant growth that occurs from regrowth following a grazing event plus growth consumed by the animal during the grazing event. Rotational grazing intervals of two, four and six weeks are evaluated in a patch-burn grazing system to understand the impact on aboveground cumulative production.

Introduction

Patch-burn grazing is the application of prescribed fire to focus livestock grazing on a portion of a grazing unit, with the objective of increasing the diversity and structure of vegetation in a way that benefits wildlife and maintains livestock production. Burning only a portion of the acreage annually, in a rotational manner, can create a mosaic of heterogeneity for grassland-dependent wildlife that also maintains production and economic benefits for livestock producers.

The movement of livestock between two or more subunits of rangeland such that alternating periods of grazing and no grazing occur within a single growing season is defined as rotational grazing (Heitschmidt and Taylor, 1991). The origin of rotational grazing dates back to the turn of the 20th century, when an institutional and scientific response to severe rangeland degradation occurred.

Rotational grazing became established as the norm, and various direct and indirect benefits resulted when coupled with the ability of managers to observe and adapt (Briske et al., 2011). Prior to the 20th century, much of the Great Plains evolved with disturbances such as fire and grazing. While rotational grazing has continued to be modified and widely adapted, burning largely has been suppressed.

Research quantifying the impacts of using fire to benefit herbivores dates back to the 1960s. Scientists applied fire treatments to understand how fire influenced grazing behavior, animal growth and the plant community. Improvement to forage palatability and nutritive value, the abundance of herbaceous plants and weight gains of cattle were documented (Duvall and Witaker, 1964; Hilmon and Hughes, 1965; Angell et al., 1986).

Despite a reduction in plant biomass when compared with unburned patches, post-fire forage growth was attractive to grazers because the plant material was higher in protein content and lower in fiber (Fuhlendorf et al., 2017; Sensenig et al., 2010). Current research has documented that fire and grazing could increase the productivity of important native forage species such as little bluestem (*Schizachrium scoparium*) and western wheatgrass (*Pascopyrum smithii*) (Limb et al., 2011; Vermeire et al., 2004).

Since the time of its institution, the merits of rotational grazing have been highly debated by researchers and livestock producers. The term born during a period of widespread range degradation was applied to many management concepts such as rest-rotation, deferred rotation and season-long grazing (Society for Range Management, 1998).

The persistence of the rotational grazing debate is due in part to terminological confusion. A review of literature would suggest that contrasting interpretations exist regarding the efficacy of rotational grazing (Briske et al., 2011). However, rotational grazing continues to be valued by producers (Budd and Thorpe, 2009).

Many popular news outlets, trade magazines and conservation agencies promote the application of rotational grazing for production, conservation and ecological benefits (Goodloe, 1969; Norton, 1998;

Teague et al., 2004, 2008). A closer look at experimental evidence suggests that regional and local conditions have much to do with results achieved. Factors such as stocking rates, seasonal distribution of rainfall, soil type, topography and time between deferment periods may influence the outcome greatly (Sampson, 1951; Vermeire et al., 2008).

The detrimental or beneficial effects of grazing systems are largely determined by how, where and when grazing is used. Livestock play a major role in regulating forage production through the defoliation of plants (Huntly, 1991).

Defoliation can promote shoot growth; however, overgrazing can reduce plant production significantly (Hyder, 1972; Rogler, 1951). In this study, rotational grazing intervals are evaluated in a patch-burn grazing system to understand the impact on cumulative forage production.

Procedures

A randomized block design was initiated in 2019 with three grazing treatments each replicated four times to monitor aboveground cumulative production in a patch-burn grazing system at the Central Grasslands Research Extension Center. Rotational grazing intervals of two, four and six weeks (with an equivalent rest period) were assigned to treatments.

Caged grazing exclosures, measuring 2.43 by 4.87 meters, were located in an 8- or 16-hectare patch burn that had been completed in the spring prior to grazing turnout. A control was established to represent non-grazed, season-long forage production.

Soil type and vegetation communities were similar among replicates, as defined by the Natural Resources Conservation Service's ecological site descriptions and equivalent land use histories. The sites frequently consisted of Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*), western wheatgrass (*Pascopyrum smithii*), blue grama (*Bouteloua gracilis*), goldenrod (*Solidago spp.*), Flodman's thistle (*Cirsium flodmanii*) and more.

Cow-calf pairs grazed freely in the pasture from May 22 to Oct. 23, 2019, at a moderate stocking rate designed to achieve 30% forage utilization. The degree of disappearance within the patch-burn area at the grazing exclosures was 72% for graminoids and 11% for forbs.

Aboveground Cumulative Production
Forage production was collected following each grazing interval from areas that were predetermined and marked with global positioning system (GPS) technology. All standing biomass was clipped to the soil surface from three 0.25 m^2 frames per treatment in the grazing exclosure and its paired plot (grazed). Clippings were separated by grass and forbs and oven-dried at 50 C for 48 hours, and samples were weighed.

Upon collection of samples, the grazing exclosure was removed and installed at the paired (grazed) plot, which then was allowed to recover from grazing (two, four or six weeks). The data collected at the end of each grazing interval represented forage production from in and out of the grazing exclosure. The control was sampled every four weeks throughout the growing season.

Results and Discussion

Year One
The livestock at the Central Grasslands Research Extension Center expressed a preference for burned patches versus unburned patches, despite the burned patches having a lower amount of available forage at the beginning of the growing season. A study conducted at the station during 2017-2018 indicated that livestock are attracted to burned patches because of increased forage quality (Lakey and McGranahan, 2018). The degree of disappearance within the patch-burn area at the grazing exclosures was 72% for graminoids and 11% for forbs in 2019.

Aboveground cumulative production at the two- and four-week grazing intervals were statistically different ($P = 0.0474$) from the non-grazed control, but not different ($P > 0.05$) from the six-week grazing interval during the 2019 growing season (Figure 1). It appears that time, which is represented by different grazing intervals, might be a driver for cumulative production of aboveground plant growth.

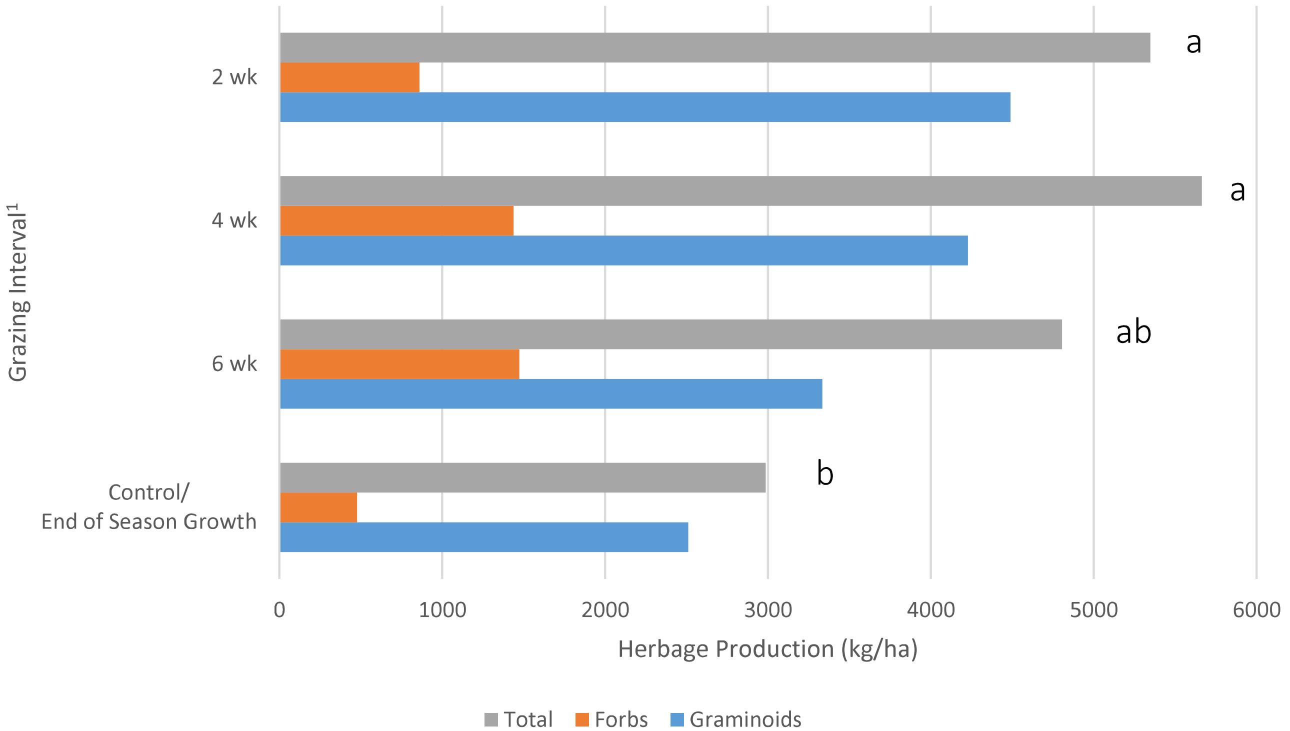

Figure 1. Aboveground cumulative production in a patch-burn grazing system at the Central Grasslands Research Extension Center during 2019. [1]Total production with the same letters are not different (P > 0.05).

Disturbance-driven heterogeneity is important to maintain rangelands in the northern Great Plains that evolved with disturbances such as fire and grazing (Bowman et al., 2009; Kay, 1998). The response of herbage production to these disturbances may be decreased growth, equal growth or increased growth. We hope this study will help us understand how cumulative forage growth is affected by different levels of grazing intervals in a patch-burn grazing system.

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