Early Intensive Grazing, Patch Burning and Season-long Grazing

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Early season intensive grazing and patch burning are being tested as a means of reducing Kentucky bluegrass (Poa pratensis L.), an invasive grass species in the northern Great Plains. After three years, results indicate that early intensive grazing can reduce Kentucky bluegrass foliar cover and frequency. Removing cattle before the native grasses and forbs have received much grazing pressure should allow these species to increase in the community. A burn treatment was added in October 2014.

Studies have shown that burning can reduce Kentucky bluegrass for a year, but in the second year, it usually has returned to pre-burn levels. However, burning followed by grazing may help keep the Kentucky bluegrass in a reduced state and maintain the native plant community composition and productivity. This will be tested in the coming years.

Summary

Kentucky bluegrass (*Poa pratensis* L.) is a perennial cool-season grass that begins growth in the spring earlier than the native species. Its forage quality is high in the spring but decreases through the season, resulting in reduced overall forage quality during the summer (Patton *et al.* 2001). Heavy grazing pressure while Kentucky bluegrass is growing actively may favor native species.

In this study, each of nine pastures was assigned to one of three treatments: early intensive grazing, season-long grazing and patch burning with season-long grazing. All pastures are stocked with yearling cattle at a moderate stocking rate prior to Kentucky bluegrass reaching the two-leaf stage.

The early intensive treatment is grazed for about 1.2 months with a stock density of about 0.96 AU/acre, equivalent to a stocking rate of 1.1 AUM/acre. The season-long and patch burning treatments are grazed for about four months with a stock density of about 0.29 animal units per acre (AU/acre), also equivalent to a moderate stocking rate of 1.1 animal unit months per acre (AUM/acre).

We began applying the early intensive and season-long grazing treatments in 2011. Total forage production did not differ between pastures; however, early intensive grazing has reduced foliar cover and frequency of Kentucky bluegrass.

The first patch burn took place in the fall of 2014, and those pastures were grazed the same as the season-long pastures in 2015. On the patch burn treatment, one-fourth of each pasture is burned in the fall, with a new portion burned each year on a four-year rotation. Unfortunately, the weather did not cooperate and the pastures were not burned in the fall of 2015.

Introduction

Kentucky bluegrass was introduced by early colonists along the East Coast and spread across America by settlers and natural dissemination (Carrier and Bort 1916). Kentucky bluegrass can be a problem throughout the tallgrass and mixed-grass prairies (Sather 1996).

A perennial cool-season grass, Kentucky bluegrass begins growth in the spring earlier than the native species and gains competitive advantage by using soil water and shading the later-emerging species. The forage quality of Kentucky bluegrass is high in the spring when green and actively growing, but it decreases as the summer progresses, although it can green up again in the fall if adequate moisture is available (Patton *et al*. 2001, North Dakota Department Lands 2011). The dominance of Kentucky bluegrass in the plant community results in reduced forage quality of the pasture in the summer.

The timing of grazing can have a great impact on plant species composition by reducing those species that are growing actively during the grazing period and releasing from competition those plants that are growing actively when grazing pressure is absent (Stephenson 2010).

Preliminary studies examining the impact of prescribed burns on Kentucky bluegrass give some indication that it may be an effective management technique. Fall burns in South Dakota mixed-grass prairie decreased Kentucky bluegrass the year following treatment from 33 to 13 percent (Bahm *et al*. 2011). However, two years after burning, the canopy cover was not different among treatments. Similarly, annual burns in Kansas tallgrass prairie reduced Kentucky bluegrass cover from 30 to 7 percent during a four-year period (Abrams 1988).

Burning during the spring, summer and fall seasons effectively reduced Kentucky bluegrass in North Dakota mixed-grass prairie, but the cover was not different than the unburned control two years post-fire (Sedivec *et al.* 2014). Native plant species in the study were not harmed by fire, consistent with a previous study on native grass (Limb *et al.* 2011a). Short-term suppression of Kentucky bluegrass is consistent among burn trials, but its return to pre-treatment abundance two years after fire also is consistent. To maintain the benefits of burning, additional disturbance is needed the year following fire.

Plant community composition and vegetation structure variability through space and time need to be included in management decisions (Willis and Birks 2006). The interaction of fire and grazing increases rangeland vegetation structure and composition diversity in tall grass prairie (Fuhlendorf *et al.* 2006, Churchwell *et al.* 2008, Coppedge *et al.* 2008, Engle *et al.* 2008, Fuhlendorf *et al.* 2010).

The different patch types create a structurally and compositionally heterogeneous landscape (Fuhlendorf and Engle 2001, 2004). Patch burning management suppressed the invasion of an exotic forage species in southern tallgrass prairie (Cummings *et al.* 2007). Further, burning vegetation increases the forage quality, and patch burn grazing can increase livestock weight gains (Limb *et al.* 2011b).

Grazing or fire alone does not yield the desired effects on suppressing or controlling Kentucky bluegrass. In this study, we combine these two disturbances to reduce Kentucky bluegrass abundance and maintain native plant community composition and productivity.

Specifically in this study, we hope to determine if: 1) early heavy grazing followed by summer rest can shift the balance to favor the native species, 2) patch burn management will promote native plant species and Kentucky bluegrass will be less abundant and productive than in season-long grazing pastures, and 3) livestock weight gain will be greater in patch burn pastures compared with season-long grazing pastures.

Procedures

This study is being conducted at the Central Grasslands Research Extension Center in Stutsman County northwest of Streeter, N.D. The pastures have been used for a variety of grazing experiments in the past, but in years prior to this study, these pastures received only light grazing in the summer months. In 2009 and 2010, these pastures were stocked lightly in mid-May. Half of the animals were removed in late June or late July, and the rest remained until late September to mid-October.

Kentucky bluegrass had become dominant, with foliar cover averaging about 30 percent and frequency of occurrence (in 25- by 25-centimeter [cm] frames) averaging 90 percent in 2011 on our monitored sites.

In 2011, six pastures of about 40 acres each were assigned to one of two treatments: early intensive grazing and season-long grazing. Livestock were not rotated among pastures, and each pasture received the same treatment each year. On the early intensive treatment, 41 to 50 head of yearling cattle were stocked in each pasture after Kentucky bluegrass greened up (as early as mid-April) and were removed when 30 percent of the native species received some grazing (Table 1). Beginning with 2014, the cattle were removed after 1.2 months.

On the season-long treatment, 15 to 19 head of yearling cattle were placed on each pasture in mid-May and removed between the end of August and mid-September, with the objective of grazing at a moderate stocking rate.

Table 1. Stocking history of the early intensive and season-long treatments for 2011 to 2015 and patch burn treatment in 2015 at Central Grasslands Research Extension Center, Streeter, N.D.

Treatment	Year	Average head/pasture	Average starting weight (lbs.)	Date on	Date off	Days grazed	Stocking rate (AUM/ acre)
Early intensive	2011	41.7	750	May 2	June 6	35	0.98
	2012	46.0	748	April 13	May 24	41	1.26
	2013	50.0	773	May 6	June 7	32	1.10
	2014	43.6	785	April 30	June 6	37	1.19
	2015	44.7	750	April 23	June 2	40	1.27
Season-long	2011	15.0	780	May 13	Sept. 15	125	1.30
	2012	18.3	865	May 9	Sept. 21	135	1.85
	2013	15.7	694	May 23	Aug. 28	97	0.96
	2014	13.3	786	April 30	Sept. 2	125	1.23
	2015	13.0	750	April 23	Aug. 27	126	1.20
Patch burn	2015	13.7	751	April 23	Aug. 27	126	1.22

Year	Precipitation	Early Intensive				Season-long		Patch Burn		All Sites
		When cattle removed		End of season		End of season		End of season		
		Above-ground biomass	Utilization	Above-ground biomass	Utilization	Above-ground biomass	Utilization	Above-ground biomass	Utilization	Average production
	(in.)	(lbs/acre)	(%)	(lbs/acre)	(%)	(lbs/acre)	(%)	(lbs/acre)	(%)	(lbs/acre)
2011	25.01	2,721	59	7,847	20[b1]	6,348	47[a]	N/A	N/A	7,098
2012	18.21	2,850	49	8,387	31[b]	6,545	63[a]	N/A	N/A	7,466
2013	16.97	1,690	42	6,314	33[b]	5,556	45[a]	N/A	N/A	5,935
2014	23.90	1,816	29	5,395	15[b]	5,786	52[a]	5,281	36[ab]	5,487
2015	19.12	1,515	41	6,548	13[b]	6,033	49[a]	5,975	46[a]	6,185
5-year avg.	20.64	2,119	44	6,898	22	6,054	51	5,628[2]	41[2]	6,434

Table 2. Total crop year precipitation (Oct. 1 to Sept. 30), above-ground biomass production and forage utilization on the early intensive, season-long and patch burn treatments from 2011 to 2015.

[1] Means in the same row followed by the same letter are not significantly different at *P*=0.05.
[2] Two-year average.

Beginning in 2014, the cattle were placed on the season-long treatment at the same time they were stocked on the early intensive treatment. The actual stocking rates have been between 0.96 and 1.85AUMs/acre. The overall objective is to achieve a similar grazing pressure on the early intensive pastures as on the season-long pastures but in a shorter period of time (Table 1).

In 2014, three pastures of about 40 acres were assigned to the patch burn treatment. These pastures were stocked briefly in 2014 to reduce fuel loads, and then one-fourth of each pasture was burned on Oct. 29, 2014. We plan to burn one-fourth of each pasture in the fall each year after a heavy frost so that after four years, all of each of the patch burn pastures will have been burned. However we were not able to burn in 2015. Starting in 2015, the patch burn pastures are stocked the same as the season-long pastures each year.

Changes in the plant community are monitored by sampling the foliar cover of all plant species, litter, and bare ground in twenty 50- by 50-cm frames at each of four locations in each pasture. Forage production and utilization are determined using the cage comparison method, clipping at the peak of forage production in late July and when the cattle are removed from the season-long and patch burn treatments, with the remaining forage on the early intensive treatment also being sampled when the cattle are removed. All samples are oven-dried and weighed to determine dry matter weight.

These sampling procedures are different than those done on the early intensive and season-long pastures from 2009 to 2013 (Patton *et al.* 2014), so the results cannot be compared.

Results

Total Production and Utilization

Forage production was not significantly different *(P*>0.05) between the early intensive and the season-long grazing treatments in 2011, 2012, 2013, 2014 or 2015, and production on the patch burn treatment was not different from the other treatments in 2014 or 2015 (Table 2). At the time the cattle were taken off the early intensive treatment, they had utilized 29 to 59 percent of the forage produced so far in the season, but only 13 to 33 percent of the forage produced during the entire growing season.

At the time the cattle were taken off the season-long treatment, they had utilized 45 to 63 percent of the forage produced during the growing season. End-of-season utilization on the patch burn pastures averaged 36 percent in 2014 and 46 percent in 2015 (Table 2). Total forage utilization was significantly different between the early intensive and season-long treatments each year. Utilization on the patch burn treatment prior to burning in 2014 was not different from either of the other treatments, but in 2015, utilization was greater on the patch burn than on the early intensive treatment ($P \leq 0.05$).

Foliar Cover and Frequency of Occurrence

Plant foliar cover and frequency of occurrence in 50- by 50-cm frames were sampled between June 4 and June 9 in 2015. Figure 1 shows the relative foliar cover on the early intensive, patch burn and season-long treatments in 2015. For the most part, differences among treatments reflect differences that existed prior to 2014. We will be watching for changes in

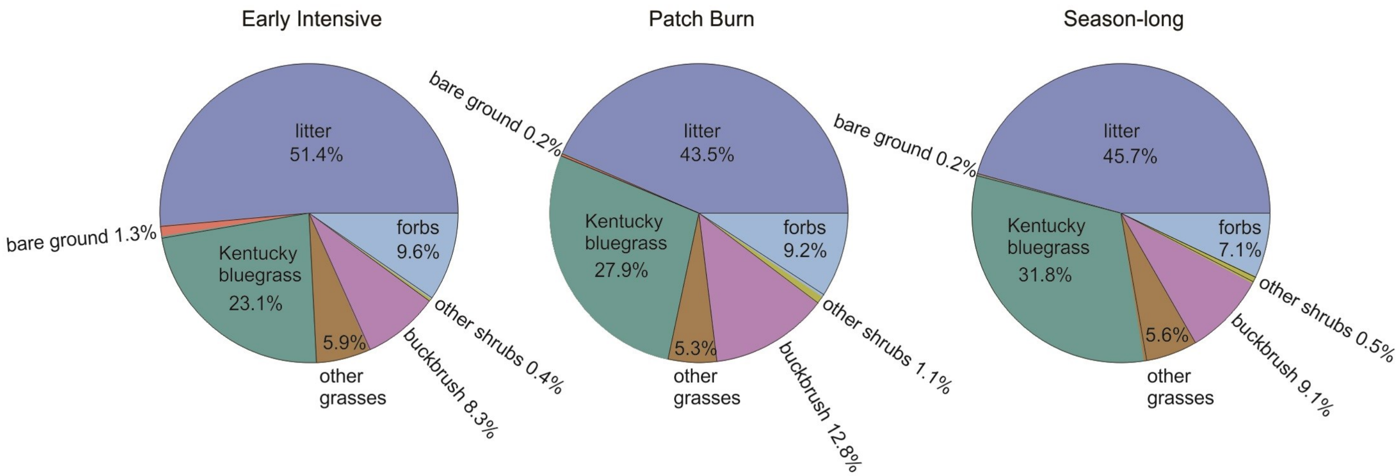

Figure 1. Relative cover on the early intensive, patch burn and season-long treatments in 2015.

these classes of cover as well as the other individual plant species on the sites as the study continues.

Kentucky bluegrass cover is less and litter cover is greater on the early intensive treatment than on the season-long treatment. This is supported by previous work comparing these treatments (Patton *et al*. 2014), but as many of the differences in cover may have been present before the treatments were established, we will look for changes in species cover through time when comparing the treatments.

Some changes in species composition have been detected between 2014 and 2015. Overall, eight species have increased in foliar cover, frequency of occurrence in 50- by 50-cm frames or both between 2014 and 2015 ($P \leq 0.05$). Those species were: western yarrow (*Achillea millefolium* L.), slender wheatgrass (*Elymus caninus* [L.] L.), cudweed sagewort (*Artemisia ludoviciana* Nutt.), wooly sedge (*Carex pellita* Muhl. ex Willd.), clustered field sedge (*Carex praegracilis* W. Boott.), prairie chickweed (*Cerastium arvense* L.), Flodman's thistle (*Cirsium flodmanii* [Rydb.] Arthur) and prickly lettuce (*Lactuca serriola* L.). Litter cover and frequency also increased between 2014 and 2015.

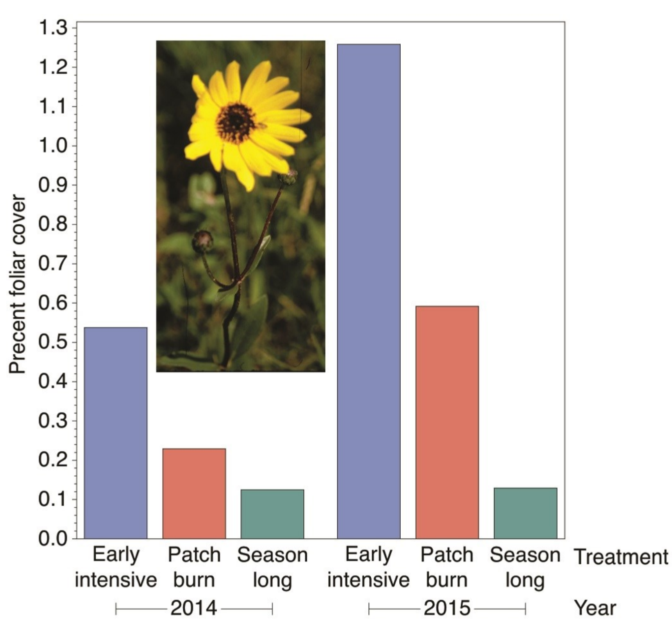

Figure 2. Percent foliar cover of stiff sunflower (*Helianthus pauciflorus* Nutt. ssp. *pauciflorus*) on the early intensive, patch burn and season-long treatments in 2014 and 2015.

Only a few changes can be attributed to the grazing treatments. Stiff sunflower (*Helianthus pauciflorus* Nutt. ssp. *pauciflorus*) increased on all treatments, but it increased the most on the early intensive treatment and is now significantly greater on the early intensive treatment than on the season-long treatment ($P \leq 0.05$; Figure 2). Prickly lettuce was not found in the 2014 sampling, but was found on the early intensive and patch burn treatments in 2015 and was significantly more abundant ($P \leq 0.05$) on the early intensive than on the other two treatments (Figure 3). Prairie cordgrass (*Spartina pectinata* Bosc ex Link) was not found on any treatment in 2014 and was only found on the early intensive treatment in 2015.

No changes in species composition were detected within the patch burned pastures that could be attributed to burning.

Cattle Performance

Cattle gained the most weight on the season-long treatment and they lost weight on the early intensive treatment, with a significant difference between the season-long/patch burn and the early intensive treatments. There was no significant difference in body condition scores among treatments for the period from April 23 to June 2, during which cattle were on the early intensive treatment (Table 3). There was no significant difference in gains between the season-long and patch burn treatments for the period from June 2 to Aug. 27 or the grazing season as a whole.

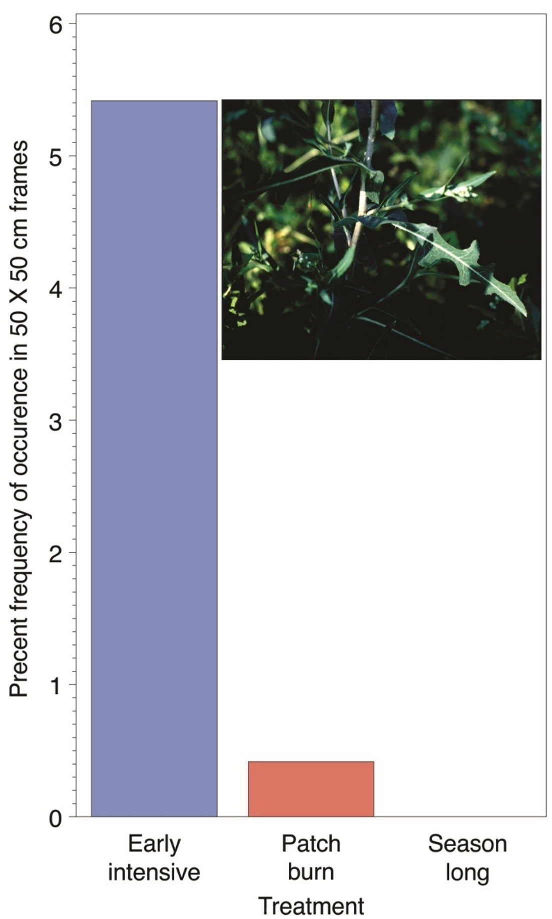

Figure 3. Frequency of occurrence of prickly lettuce (*Lactuca serriola* L.) on the early intensive, patch burn and season-long treatments in 2015.

Discussion

Kentucky bluegrass begins growth early, and early grazing appears to reduce its abundance in the community and favor other grasses and forbs. Fire removes senescent vegetation and promotes early green-up. This should have concentrated grazing on the burned part of the patch burn pastures in 2015 early in the season and potentially reduced Kentucky bluegrass. However, five to 10 years of grazing treatments will be required to change the plant species composition fundamentally.

The early intensive and season-long treatments have been in place since 2011 and still only minor changes in plant species were detected from the 2014 and 2015 vegetation sampling. The first burn took place in the fall of 2014 and the grazing treatment started in 2015, so the vegetation on the patch burn treatment may not have had time to respond by the early June sampling date.

This was the first year that we monitored cattle performance. It was also the year with the least early spring forage production (see Table 2). The fact that the cattle did not do as well as on those treatments is not surprising because the stocking density on the early intensive is about three times higher than on the season-long and patch burn treatments. The cattle on the early intensive treatment likely would not do as poorly in years with normal spring forage production.

While early intensive grazing may be an effective long-term management strategy to reduce Kentucky bluegrass, animal performance should be considered, especially in the case of pre-breeding females with higher nutritional needs. Supplementation may be needed. Grazing animal age and stage should be matched accordingly on a yearly basis when utilizing early intensive grazing as a treatment because Kentucky bluegrass production can vary widely

Table 3. Livestock gains on the season-long, patch burn and early intensive grazing treatments in 2015.

Cattle went on all three treatments on April 23, and were removed from the early intensive treatment on June 2 and from the patch burn and season-long treatments on August 27.

	Treatments			
	Early Intensive	**Patch Burn**	**Season-long**	**LSD (0.05)**
Average head/pasture	44.7	13.7	13.0	
Average April 23 weight (lbs)	750	751	750	
Average June 2 weight (lbs)	711[c]	753[b]	764[a][1]	9.75
April to June average daily gain (lbs/day)	-0.98[b]	0.06[a]	0.35[a]	0.30
April to June gain/acre (lbs/acre)	-46.67[b]	0.87[a]	4.72[a]	4.29
Body condition score (June 2)	4.91	4.92	5.01	NS[2]
Average August 27 weight (lbs)	--	927.83	917.24	NS
June to August average daily gain (lbs/day)	--	2.03	1.78	NS
June to August gain per acre (lbs/acre)	--	61.54	52.73	NS
April to August average daily gain (lbs/day)	--	1.41	1.32	NS
April to August gain per acre (lbs/acre)	--	62.42	57.46	NS

[1] Means in the same row followed by the same letter are not significantly different at P=0.05.

[2] Means are not significantly different.

in the northern Great Plains, depending on soil and spring moisture conditions.

In this first year, cattle did not show higher gains on the patch burn treatment than on the season-long treatment, but we will need to wait until we are further into the burn cycle before we conclude that patch burning has no effect on cattle gains.

At this early stage in the project, Kentucky bluegrass still makes up a large part of the plant community, and if early grazing ceased, Kentucky bluegrass would recover quickly. We will continue to monitor the impact of these treatments during the next several years.

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