Mechanical Treatment and Burning for High Quality Range Forage

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Summary

Annual yields of western wheatgrass and total vegetation were increased on a clayey range site following mechanical treatment. More important to the range manager, year to year variability in forage production was reduced, since soil moisture is stabilized.

Yields of Japanese brome, an annual grass, increased from the second through the fourth growing seasons after treatment. Three consecutive years of abundant fall precipitation beginning in 1980 probably triggered seed germination of this invader plant.

Prescribed burning of the mechanical range treatments drastically reduced production of Japanese brome and increased forage quality. Both quantity and quality of western wheatgrass increased after burning. Prescribed burning did not negatively impact yields of total vegetation. Reducing the yield of an undesirable species such as Japanese brome causes an increase in percentage composition, if not the yield, of desirables such as western wheatgrass. Therefore, range condition percentage and carrying capacity should be higher. Further prescribed burning research in South Dakota would appear to be important since the cost of this practice is relatively low compared with most, if not all, other range improvement practices.

(Key Words: Range Improvement, Prescribed Burning, Forage Yields.)

Introduction

Mechanical treatments on rangelands have a proven record of increasing both forage quantity and quality. The type of treatment is dependent on landowner preference and equipment available. Dozens of furrowers have been built by landowners in the past few years. Many landowners recognize that a two-fold or greater increase in forage quantity following mechanical treatment is less costly than purchasing additional grazing land.

Both density and forage yields of western wheatgrass increased following mechanical treatment of claypan soils (Gartner and White, 1984). The cause is probably improved soil moisture, since precipitation was retained where it fell. Mechanical treatments sometimes cause a population explosion of annual grasses, especially Japanese brome. With favorable soil moisture, annuals quickly become established where native vegtation is disturbed and where soil nitrogen levels may be temporarily increased.

If the annual grass population becomes abundant, desirable perennial grasses are adversely affected by the competition for moisture and nutrients. Previous research in western South Dakota has shown that both yield and density of Japanese brome can be reduced by prescribed burning in winter, spring or fall (Gartner et al., 1978). At the same time, yield and density of western wheatgrass can be expected to increase, especially when burning is done in late winter or early spring. Prescribed burning as a range management or range improvement tool has been suppressed in South Dakota, probably because of landowner experience with detrimental effects caused by some wildfires. However, research and experience have shown that there can be many positive benefits from prescribed burning of range ecosystems.

The purpose of the study reported herein was to test the hypotheses that (1) a severe invasion of mechanically treated rangeland by Japanese brome could be effectively reduced by burning, (2) burning would not adversely affect total forage yields and may increase western wheatgrass yields, and (3) burning might improve forage quality. Information reported herein should be considered as a progress report, since all data have not been tested statistically.

Experimental Procedure

Three mechanical treatments and an untreated control were randomly assigned to each of the three replications across a south-facing clayey range site in central Meade County. Pitting, furrowing and a rip + furrow treatment were applied on the contour in the fall of 1978. Each treatment comprised an area of 32 x 125 feet (about .1 acre). In 1979, about 2 acres, encompassing all treatments, and ample adjacent untreated range, were fenced to permit forage sampling while cattle were utilizing the pasture.

Vegetation sampling began in 1980, the second growing season after mechanical treatments were applied. Five randomly located 1 x 4.8-foot plots were clipped to ground level about mid-July each summer. Vegetation was field-sorted into the following components: western wheatgrass, other perennial grasses, annual grasses and forbs. Sacked samples were oven-dried at 70° C for 48 hours, then weighed to the nearest .1 gram. In 1984 and 1985, the western wheatgrass component was analyzed for crude protein. Other vegetation attributes estimated included western wheatgrass and Japanese brome densities.

All treatments in the original experimental design were burned on May 11, 1984. The purpose of the burning was to reduce an excessive accumulation of dead annual grasses as well as to reduce future Japanese brome populations by destroying the seed source. An area of untreated range, equal in size to the original 1978 treatments and adjacent to each replication, was staked and in 1984 became a fifth treatment for sampling purposes, i.e., no mechanical treatment and not burned. Each added area of range was thought to be ecologically similar to those assigned a treatment in 1978.

Results and Discussion

Total vegetation yields in the second growing season (1980) following mechanical treatment were not widely different (table 1). Greater western wheatgrass yields on mechanically treated plots compared to the controls suggested a positive response to the treatments. In the 1982 and 1983 growing seasons, the percentage of western wheatgrass stabilized or began to decline in all but the rip + furrow treatment. Total vegetation yields on the two furrowing treatments were considerably greater than on the untreated control in 1982. Western wheatgrass comprised a large portion of those differences between treatments. Mechanical treatments, except pitting, appeared to effectively increase forage yields and improve range condition.

Japanese brome became a sizable component of the vegetation on mechanically treated plots in 1982 and 1983 (table 1). That species also increased greatly on plots having no mechanical treatment. Substantial increases in the Japanese brome population appear related to a combination of environmental factors, especially fall precipitation. While total annual precipitation in northwestern South Dakota was above average in 1978, there was a deficit in the fall (table 2). Fall precipitation was also below average in 1979. Thus, Japanese brome comprised only a small percentage of the total vegetation in 1980 irrespective of treatment (table 1). Above-average fall precipitation from 1980 through 1983 resulted in a favorable environment for germination and growth of this winter annual grass.

In mid-summer 1984, Japanese brome comprised a large portion (38%) of the total vegetation on those plots with neither mechanical treatment nor burned (table 1). However, that species comprised only 7% of plots with no mechanical treatment but which were burned the previous May. While composition of Japanese brome was reduced on plots with both mechanical treatment and burning, actual weight increased or was unchanged on the two furrowing treatments. Vegetation green-up was more advanced on the mechanical treatments on the date burned. Hence, burning was less complete and less effective than on plots with no mechanical treatment. The incomplete burn on mechanical treatments was less effective for causing mortality to Japanese brome plants and seed. Burning probably would have been more effective if done about a month earlier.

There appeared to be no carry-over effect from burning into the second growing season after the burn (1985). In general, both weight and composition of Japanese brome decreased from 1984 to 1985 regardless of treatment. That reduction can be attributed to average fall precipitation in 1984 followed by an extremely dry winter and spring in 1985.

Burning significantly reduced density of Japanese brome in 1984, but there was no carry-over effect in 1985 (table 3). Western wheatgrass density decreased somewhat after burning, contrary to earlier studies (Gartner et al., 1978). That negative response was very likely caused by burning when western wheatgrass was actively growing.

Burning significantly increased the crude protein content of western wheatgrass in the first growing season post-burn with or without prior mechanical treatment (table 4). No other research has been found that reported vegetation responses to a combination of mechanical treatment and burning. However, a Montana landowner has burned furrowed range with favorable results (Frank Sparks, Pelvna, MT, personal communication). Drought in 1985, which caused reduced plant growth, may have led to increased nitrate uptake by plants, resulting in higher crude protein in 1985 than in 1984.

Literature Cited

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TABLE 1. EFFECT OF MECHANICAL TREATMENT AND BURNING ON YIELDS (LB/A) OF WESTERN WHEATGRASS, JAPANESE BROME AND TOTAL VEGETATION ON A CLAYEY RANGE SITE, W. K. RANCH, MEADE COUNTY, SD, 1980-85. PERCENTAGE COMPOSITION OF GRASSES IS SHOWN IN PARENTHESES

Burning Treatment:		Burn (May 11, 1984)				Not burned
Mechanical Treatment:		Furrow	Rip/Furrow	Pit	None	None
	W. whtgrass. :	186 (29)	274 (41)	205 (27)	133 (17)	
1980	Jap. brome :	16 (3)	7 (1)	5 (<1)	1 (<1)	
	Total veg. :	629	664	768	775	
	W. whtgrass. :	455 (33)	605 (48)	390 (34)	184 (21)	
1981	Jap. brome :	216 (16)	207 (16)	144 (13)	113 (13)	
	Total veg. :	1386	1272	1152	874	
	W. whtgrass. :	1304 (35)	1708 (40)	837 (37)	466 (24)	
1982	Jap. brome :	1522 (40)	1813 (43)	614 (27)	629 (32)	
	Total veg. :	3761	4247	2280	1978	
	W. whtgrass. :	314 (29)	578 (53)	480 (25)	423 (24)	
1983	Jap. brome :	338 (31)	260 (24)	663 (35)	648 (36)	
	Total veg. :	1091	1084	1893	1799	
	W. whtgrass. :	880 (41)	1192 (64)	640 (50)	466 (46)	263 (22)
1984	Jap. brome :	510 (24)	260 (14)	181 (14)	76 (7)	452 (38)
	Total veg. :	2125	1859	1290	1020	1175
	W. whtgrass. :	594 (66)	639 (77)	265 (46)	216 (44)	117 (58)
1985	Jap. brome :	44 (5)	11 (1)	60 (11)	27 (4)	14 (7)
	Total veg. :	898	831	569	493	202

TABLE 2. AVERAGE ANNUAL AND FALL (AUGUST THROUGH OCTOBER) PRECIPITATION (INCHES) AND DEPARTURES FROM THE AVERAGE FOR NORTHWEST[1] SOUTH DAKOTA, 1978-1985

	1978	1979	1980	1981	1982	1983	1984	1985
Annual	17.56	12.53	11.66	14.48	24.76	14.71	16.89	13.68
Dep.	2.14	-2.89	-3.76	-.94	9.34	-.57	1.61	-1.60
Fall	2.52	2.48	5.17	4.87	7.80	4.71	3.65	3.57
Dep.	-1.03	-1.07	1.62	1.32	4.25	1.14	.08	.00

[1] A geographic area designated by the National Climatic Data Center, Asheville, NC, that includes all or part of seven counties.

TABLE 3. MEAN DENSITIES (STEMS/SQ. FT) OF JAPANESE BROME AND WESTERN WHEATGRASS ON BURNED AND UNBURNED RANGELAND, W. K. RANCH, MEADE COUNTY, SD

	Not burned		Burned	
	1984	1985	1984	1985
Japanese brome*	81.0a	2.2	12.2a	1.3
Western wheatgrass	19.5	9.6	13.4	13.1

*Means in the same row followed by the same letter are significantly different (P<.05).

TABLE 4. MEAN CRUDE PROTEIN (%) OF WESTERN WHEATGRASS CLIPPED AT GROUND LEVEL IN JULY 1984 AND 1985 ON AREAS MECHANICALLY TREATED AND UNTREATED IN 1978 AND BURNED MAY 11, 1984

Burning Treatment:	None	Burn			
Mechanical treatment[1]:	None	C	F	P	RF
1984[2]	8.19	8.56	10.25	8.94	9.56
1985[2]	12.94	10.50	10.81	10.37	9.81

[1] Treatments: None and C = no mechanical treatment; F = contour furrowing; P = pitting; RF = ripping + furrowing.

[2] Orthoganal comparisons of means were significantly different (P=.01) for none vs C, F, P, RF; C vs F, P, RF and F vs P, RF for both years. P vs RF was not significantly different either year.