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Western Wheatgrass Recovery From Drought

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WESTERN WHEATGRASS RECOVERY FROM DROUGHT

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Summary

Native grasses are predictably taller in wet years than in dry years and their density also increases with favorable precipitation. These responses of western wheatgrass are more dramatic on mechanically treated rangeland when precipitation is adequate. Measurements taken in July 1991 confirmed that western wheatgrass was slightly taller and density at least two times greater on mechanically treated claypan soils compared with untreated soils 13 and 18 years following treatment. Increases of this magnitude constitute a potentially greater carrying capacity which livestock producers should be prepared to utilize. This report briefly summarizes the effects of mechanical treatment on height and density of western wheatgrass 13 and 18 years following treatment and in a wet year following several dry years.

(Key Words: Western Wheatgrass, Mechanical Renovation, Drought Recovery.)

Introduction

Various kinds of mechanical treatments have been imposed on rangelands in western South Dakota over the past 4 or 5 decades. Deep ripping, shallow chiseling, and furrowing (commonly on the contour) have been applied on thousands of acres of Clayey, Claypan, and other range sites. The success of these practices for increasing range productivity are due to the widespread occurrence of clayey textured soils, the affinity of western wheatgrass for clayey soils, and the capability of this grass to reproduce by rhizomes which are, apparently, stimulated by soil disturbances. Furthermore, mechanical treatments improve the soil capacity for water retention, thereby increasing soil moisture for plant growth.

Mechanical treatments tend to make the surface of rangelands even rougher for vehicular travel. With a little planning, trails can be left throughout a pasture for checking livestock, fences, water, etc., without diminishing treatment effectiveness. Some landowners view furrowed range as beneficial because it limits recreational vehicle travel. Surface roughness is the key for capturing and retaining snowfall in winter as well as holding summer precipitation where it falls. Water is South Dakota's most valuable asset for insuring maximum productivity on any piece of land. Thus, it is imperative that landowners strive to reap maximum benefits when precipitation is adequate and assure good grass growth when soil moisture becomes scarce. Mechanical range renovation can provide these benefits.

The objective of this study was to determine if western wheatgrass height and density on claypan soils would still be enhanced 13 and 18 years following mechanical treatment. A secondary objective was to ascertain if western wheatgrass recovery from drought was more favorable on mechanically treated soils than on untreated soils.

Methods

Having at least two prior mechanical treatment studies still available for monitoring, the decision was made in early 1991 to relocate the study areas and sample western wheatgrass height and density on

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treated and untreated claypans. Unexpectedly, the persistent drought of the past several years in western South Dakota appeared to be broken as above-average precipitation fell over much of the area early in the growing season. Thus, it was possible to obtain information on both the longevity of mechanical treatments and the recovery of western wheatgrass following drought as related to mechanical treatment.

Study 1: Deep Ripping, 1973-1977

In late May, 1973, deep ripping was applied on three different Claypan range sites on the Antelope Range Field Station, Harding County, and on another Claypan site in Meade County (A. Kammerer Ranch). The vegetation on each of these sites differed, not because of utilization differences but due to soil variability.

A construction ripper with 24-inch shanks on 4-foot centers was pulled with an International TD-20 crawler tractor. Ripper shanks penetrated the soil to a depth of 20 to 24 inches. Application cost was estimated to be $10 per acre. Forage production was measured in 1974 and 1975 in Harding County and from 1974 through 1977 in Meade County.

Study 2: Comparison of Mechanical Treatments, 1978-1988

Another study was initiated in the fall of 1978 in southwestern Meade County (Harrington Ranch) on a Thin Claypan range site. It was designed to compare long-term forage and soil moisture responses in three mechanical treatments and in an untreated control, each replicated four times. Treatments tested were **ripping** (with the construction ripper); **furrowing** (furrows 24 in. wide, 3 to 6 in. deep, on 5-ft. centers); and **rip + furrow** (deep ripper with attachments to open 12 to 16 in. wide furrows, 8 to 12 in. deep, on 4-ft. centers). Vegetation and soil moisture data were collected each year through 1988.

Given these circumstances, western wheatgrass heights and densities were sampled in July 1991 on mechanically treated and untreated range to determine if these attributes were still enhanced 13 and 18 years posttreatment. At each of the deep ripping study sites, two plant heights (maximum leaf height) and the total number of western wheatgrass stems were recorded in each of 50 square-foot quadrats along paced transects in both the ripped and adjacent untreated range. The same measures were similarly recorded in the mechanical treatment comparison study in southwestern Meade County on the Harrington Ranch. At that site, 200 plant heights were recorded and density was counted in 100 square-foot plots along paced transects within each treatment.

Results and Discussion

Most of western South Dakota was affected by drought during the years 1978 through 1990. Weather records from the Rapid City Regional Airport during this 13-year period indicated that annual precipitation was above average in only four years, and in two of those four years it was less than 0.25-inch above the long-time average. The pattern of growing season precipitation was similar. Abundant precipitation in May, June, and July of 1991 resulted in extremely good growth of native cool-season grasses. Some persons stated that the drought was broken. However, soil moisture over most of the area was severely depleted over the past 13 years and one good precipitation year will probably not replenish moisture in the entire soil profile.

Study 1: Deep Ripping, 1973-1977

Annual forage production data collected during the course of this study indicated that this form of mechanical treatment resulted in about a twofold increase in total forage yields, most of which was western wheatgrass. These results were published in the Antelope Range Field Day Report, 1977; the Department of Animal Science Cow-Calf Day Report, 1978; and the Journal of Range Management, Vol. 34, 1981.

Western wheatgrass height and density sampled in July 1991 indicated that plant vigor was greater on ripped than on untreated claypan soils even after several years of drought (Table 1). Plant heights averaged across all four sites were only about 3% greater on ripped than on untreated areas, suggesting that the 1973 ripping treatment had little effect on 1991 plant height. The average density increase on treated compared with untreated soils in both Harding and

TABLE 1. MEAN WESTERN WHEATGRASS HEIGHTS (INCHES) AND DENSITIES (STEMS/FT^2) IN JULY 1991 AT FOUR CLAYPAN SITES RIPPED IN 1973

		Height		Density	
County	Site	Untreated	Ripped	Untreated	Ripped
Harding	Silver Sage	9.1	8.4	17.0	33.3
Harding	Corral	8.0	8.4	6.4	47.7
Harding	Big Sage	9.1	9.8	5.2	15.0
Meade	Kammerer	9.9	10.7	10.7	29.9

Meade Counties was 277%, meaning that there were approximately three times as many stems per square foot on ripped claypans. The data indicate that, 18 years after ripping and following several years of drought, western wheatgrass density was still enhanced by mechanical treatment. The data also indicate that, when sufficient soil moisture is available for good plant growth on claypans, western wheatgrass density is a better measure of response to mechanical treatment than is plant height. This suggests that since plant height and density are related to total forage yields, the greater productivity of ripped claypans will provide returns in the form of more forage for at least 18 years after treatment. Observations over the past 30 years of several ripped soils across western South Dakota support this conclusion.

Study 2: Comparison of Mechanical Treatments, 1978-1988

Annual forage yields and soil moisture levels among the four treatments on the Harrington Ranch were previously reported in the Department of Animal and Range Sciences Field Day Report, Antelope, 1983; in the Cow-Calf Day Report, 1984; and in the USDA and USDI Vegetative Rehabilitation and Equipment Workshop 38th Annual Report, 1984. This study provided additional evidence that mechanical treatments can improve soil moisture available for plant growth, leading to greatly increased forage production. Western wheatgrass height and density recorded for the years 1980 through 1988, together with departures from annual and growing season precipitation, exemplified the close relationships between plant height, density and precipitation and were reported in South Dakota Farm and Home Research, Vol. 40, No. 1, 1989.

Sampling of western wheatgrass heights in 1991 at the Harrington Ranch study area supported the data shown above for Study 1, which indicated that western wheatgrass height was not different on the ripped and untreated soils (Table 2). However, western wheatgrass was considerably taller in 1991 on both furrowing treatments than on either the untreated or ripped soils. This suggests that either soil moisture was not as depleted in the furrowed soils or that furrowed soils absorbed more precipitation (and melted snow) when it was available before and during the 1991 growing season. While there was virtually no difference in 1991 between average height of western wheatgrass on ripped and untreated soils, average height was greater on ripped claypans from 1980 through 1986 (Table 2).

Density was about 38% greater on the ripping treatment and 136 to 163% greater on the furrowing treatments than on the untreated soils. Although plant heights were not different, the greater density would account for a greater yield difference on the treatments. Furrows retain more precipitation than ripping, and water leaches sodium and other salts deeper into the profile, perhaps allowing western wheatgrass roots to survive at greater depths. This action may be a form of "drought-proofing," since plant densities and, frequently, plant heights were greater on mechanically treated soils when precipitation was limited.

Storing precipitation where it falls and allowing it to percolate into the soil profile tends to moderate the normally wide fluctuations in annual forage yields and supports a longer green-forage season in summer. Evaporation losses, especially from claypan soil surfaces, are also reduced on mechanically treated rangelands. All these benefits can improve livestock

TABLE 2. MEAN WESTERN WHEATGRASS HEIGHTS (INCHES) AND DENSITIES (STEMS/FT^2) ON MECHANICALLY TREATED AND UNTREATED CLAYPAN SOILS IN SOUTHWESTERN MEADE COUNTY (HARRINGTON RANCH) RELATIVE TO ANNUAL AND GROWING SEASON PRECIPITATION DEPARTURES, 1978-1991[a]

	Precipitation departures from normal (in.)		Height				Density			
Year	Annual	Growing season	U	R	R+F	SF	U	R	R+F	SF
1978	-1.55	-0.36	---	---	---	---	---	---	---	---
1979	-3.13	-1.78	---	---	---	---	---	---	---	---
1980	+0.06	-1.26	5.3	6.8	7.7	7.2	---	---	---	---
1981	-2.99	-1.97	9.1	9.8	11.5	11.7	24.2	24.9	18.7	14.3
1982	+8.85	+6.05	10.2	11.8	15.6	16.3	13.8	17.2	19.8	10.4
1983	-0.78	-1.59	7.7	8.3	10.8	10.9	37.2	40.3	37.5	33.5
1984	-1.04	+0.26	9.5	10.3	14.3	14.7	19.8	29.5	50.2	37.2
1985	-2.63	-4.84	4.7	5.0	6.5	6.7	6.6	6.9	17.1	14.5
1986	+5.17	+3.66	8.4	9.1	11.7	12.6	18.3	22.6	36.4	32.7
1987	-3.85	-3.78	7.9	7.8	10.3	10.9	9.6	13.1	20.1	15.3
1988	-5.35	-4.58	6.7	6.5	8.9	9.5	---	---	---	---
1989	-2.70	-2.93	---	---	---	---	---	---	---	---
1990	+0.18	+0.87	---	---	---	---	---	---	---	---
1991	NA	NA	11.5	11.3	13.7	13.2	19.0	20.9	35.6	35.7

[a] U = untreated; R = rip; R+F = rip and furrow; SF = Sparks furrow.
--- = height and density not sampled; NA = not available.

production, wildlife habitat, and soil and water conservation on South Dakota rangelands.

Highly variable precipitation across South Dakota rangelands is the primary factor affecting range forage production and economic returns of a ranch. Many landowners perceive that the economic benefits from fencing and water developments are greater than from mechanical treatments. Yet, mechanical treatments appear to be the most consistent range improvement for assuring a stable quantity of native vegetation. Since soil moisture fluctuates with precipitation, any form of "surface roughness" that retains precipitation where it falls will assure stable forage growth even during dry cycles.