

Herbage Yields from a Clayey Range Site 10 and 11 Years after Severe Renovation

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Abstract

A clayey range site 56 km south of Gillette, Wyoming, was renovated in October, 1967, using a moldboard plow, disc plow, rotovator, blade, and atrazine applied in strips on April 30, 1968. Because of drought in 1977, there were no measurable differences in total herbage yield among all treatments 10-years after the renovation. However, the following year, 1978, above-average precipitation increased herbage yields, and differences among treatments were significant. Western wheatgrass (*Agropyron smithii*) yield, which accounted for over half the total production in 1977 and '78, was highest on the moldboard plow, the disc plow, and rotovator treatments, in that order.

Mechanical and chemical range treatments has increased herbage production and improved species composition (Rauzi 1974, 1975). Contour furrowing, pitting, and ripping have been the most widely used mechanical treatments on northern plains rangelands. At the University of Wyoming's Archer Substation in southeastern Wyoming, pitted pastures supported a 25% heavier stocking rate than moderately grazed pastures over a 24-year period (1942-1965) (Rauzi 1968). Contour furrowing a panspot range site in southeastern Montana increased average yearly herbage production by 527 kg/ha over an 8-year period (Wight et al. 1978). Branson et al. (1966) reported that rangelands having medium textured to medium fine textured soils are the most suitable for mechanical renovation. Wight and Siddoway (1972) stated that the effectiveness of a surface modification treatment depends on the site and vegetation characteristics. This paper reports the effects on vegetation responses 10 and 11 years after mechanical and chemical treatments were applied on a clayey range site. During the 10th and 11th year after treatment, growing conditions were below and above average, respectively, as determined by precipitation and available soil water.

Site Description and Methods

A clayey range site on a north facing 5% slope was made available by the Durham Ranches, Inc. 56 km south of Gillette, Wyoming, in a 25- to 30-cm precipitation zone. Soils were Renohill and Ulm clay loam, members of a fine montmorillonitic mesic family of Ustollic Haplargids. Agronomically the two soils are similar, although the Renohill is shallower than the Ulm soil.

Blue grama (*Bouteloua gracilis*) was the dominant species. Other vegetation in varying amounts included western wheatgrass (*Agropyron smithii*), Sandberg bluegrass (*Poa secunda*), junegrass (*Koeleria cristata*), dryland sedges (*Carex* sp.), big sagebrush (*Artemisia tridentata*), plains pricklypear (*Opuntia polyacantha*), and some annual grasses and annual and perennial forbs.

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The clayey range site was renovated in the fall of 1967. The five renovation treatments were with (1) a rotovator, (2) a disc plow, (3) a moldboard plow, (4) road patrol (blade), and (5) atrazine at 17 kg/ha applied in strips 36 cm wide with 30 cm of nonsprayed area between strips in the spring of 1968. Results of the 5-year study (1968-1972) have been reported (Rauzi 1975).

Precipitation records are not available at the site. Precipitation for May and June 1977, at the Lawver weather station, which is about 32 km to the southwest, was 30 mm less than the 1968-1972 average: 24 and 62 mm, respectively. During May 1978, 177 mm of rain was recorded at the Lawver station—120 mm more than the 5-year average. June precipitation records were not available, but other stations in the county reported that precipitation for June 1978 was below the longtime average. The July and August precipitation was above average and mean average respectively.

In late April 1977, three 0.37m² subplots were randomly established on each main plot and the previous year's vegetation was removed. The current year's herbage growth within the subplots was hand clipped to ground level in September. Subplots were not established on the main plots in the spring of 1978, but the current year's herbage growth within a randomly placed subplot (0.37²) on each main plot was hand clipped to ground level. Air-dry herbage yields were determined for western wheatgrass, blue grama, dryland sedges, forbs, and total herbage.

Vegetative composition for each treatment was determined by weight. Herbage yields were analyzed by analyses of variance and Duncan's multiple range test for significance was applied at the 5% probability level.

Results and Discussion

Herbage Yields

The severe drought, during 1977 limited plant growth on all treatments. During 1978, the cool-season species grew well and remained green into late September because of above-average rainfall in May and rains in July and August. In 1977, total herbage yields from the check were 30% less than the 1968-72 average, whereas in 1978, there was nearly twice the 1968-72 average (Table 1). In 1977, there were no significant differences in the yield of dryland sedges, forbs and total herbage yields. Only western wheatgrass and blue grama were significantly affected by treatments in 1977. In 1978, there were significant differences among treatments in yield components except the forbs. During 1977 and 1978, the moldboard plow treatment produced more western wheatgrass than any other treatment, followed by the disc plow and rotovator treatments in descending order. The greatest increase of western wheatgrass between 1977 and 1978 was obtained from the check, blade and the strip-sprayed atrazine treatments. Western wheatgrass yields from the moldboard plow and atrazine treatments in 1977 increased 56% and 327%, respectively, over the 1968-72 average and decreased on all other treatments.

Yields of blue grama were significantly greater from the

Table 1. Yield (kg/ha air-dry) western wheatgrass, blue grama, dryland sedges, and forbs 1968-72, 1977, and 1978, from mechanically and chemically treated clayey range site at the Durham Ranches Inc., Gillette, Wyoming.

Species and year	Check	Moldboard plow	Disc plow	Rotovator	Blade	Atrazine	Year mean
Western wheatgrass							
1968-72	113 ^{bc}	198 ^b	354 ^a	398 ^a	153 ^b	15 ^c	
1977	51 ^c	308 ^c	171 ^b	130 ^b	51 ^c	64 ^{bc}	129 ^b
1978	375 ^{bc}	746 ^a	651 ^{ab}	652 ^{bc}	383 ^{bc}	327 ^c	522 ^a
Blue grama							
1968-72	237 ^b	34 ^d	84 ^{cd}	195 ^{bc}	208 ^b	871 ^a	
1977	197 ^b	19 ^d	33 ^{cd}	133 ^{bc}	63 ^{cd}	307 ^a	125 ^a
1978	212 ^b	31 ^d	70 ^d	168 ^{bc}	103 ^c	303 ^a	148 ^a
Dryland sedges							
1968-72	19 ^a	2 ^c	9 ^{bc}	11 ^{bc}	30 ^a	1 ^c	
1977	52 ^a	50 ^a	37 ^a	57 ^a	76 ^a	17 ^a	48 ^a
1978	41 ^{bc}	12 ^c	74 ^a	34 ^{bc}	90 ^a	37 ^{bc}	48 ^a
Forbs							
1968-72	32 ^b	724 ^a	209 ^b	67 ^b	50 ^b	39 ^b	
1977	11 ^a	16 ^a	37 ^a	38 ^a	31 ^a	—	22 ^a
1978	142 ^a	259 ^a	160 ^a	106 ^a	196 ^a	72 ^a	154 ^a
Total herbage ²							
1968-72	454 ^d	988 ^a	681 ^{cd}	704 ^{bc}	466 ^d	952 ^{ab}	
1977	319 ^a	393 ^a	294 ^a	358 ^a	226 ^a	390 ^a	329 ^c
1978	844 ^{bc}	1185 ^a	1109 ^a	1038 ^a	810 ^c	950 ^{bc}	989 ^a

¹Treatment means within years followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

²Includes all herbage listed above plus junegrass, sandberg and others.

strip-sprayed atrazine treatment than from the check in both 1977 and 1978, and yields from the check, in turn, were higher than those from any other treatment. However,

yields of blue grama for 1977 and 1978 were less than for the 1968-72 average for all treatments. The greatest decrease in blue grama yield in 1977 and 1978, as compared with the 1968-72 average, was from the strip-sprayed atrazine treatment. Apparently, the blue grama did not respond to the July and August rains in 1978.

There were no significant differences among treatments in the yield of the dryland sedges in 1977. In 1978, yields of dryland sedges from the blade and disc plow treatments were significantly higher than those from all other treatments. Compared with the 1968-72 average, yield of dryland sedges increased over all treatments in 1977 and 1978; the increase was greater on all renovation treatments other than the check.

Forbs were of minor importance on all treatments in 1977, but in 1978 they made up 10 and 24% of the total herbage on the rotovator and blade treatments, respectively. Except on the moldboard plow and disc plow treated plots, more forbs were present in 1978 than during the 1968-72 period.

Numerous junegrass and Sandberg bluegrass plants were scattered throughout all plots in 1978, but were not present in 1977. Annual grasses were absent in 1977, and they were of minor importance in 1978, except on the strip-sprayed plots, where they accounted for 12% of the total herbage. Cheatgrass (*Bromus tectorum*), Japanese brome (*Bromus japonicus*), and sixweeks fescue (*Vulpia octoflora*) were the annual grasses found on the experimental area in 1978.

Composition

Vegetative composition was influenced by the treatment and weather. Between 1968-72 and 1977, the percentage of western wheatgrass decreased in the check, rotovator, and blade treatments and increased on the moldboard plow, disc plow, and strip-sprayed atrazine treatments (Fig. 1). In

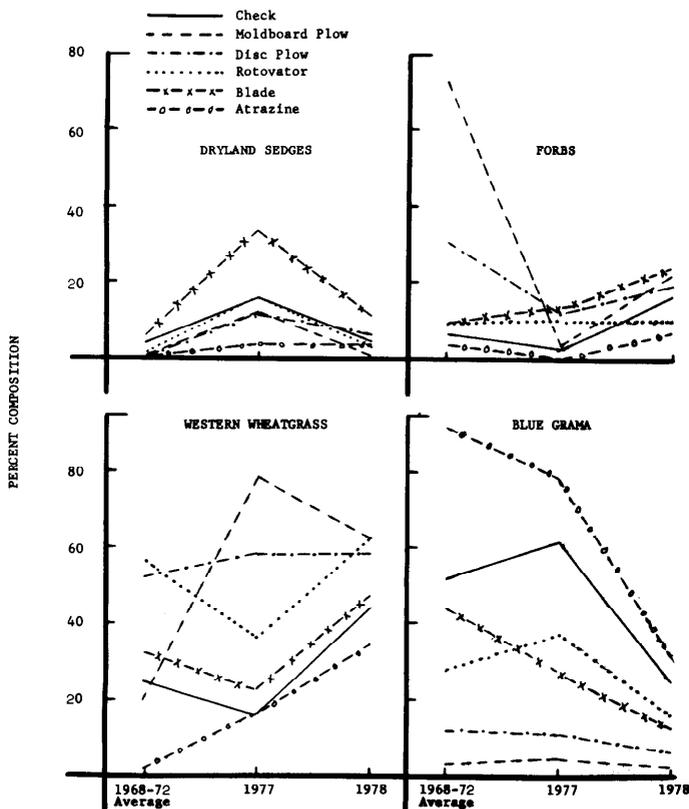


Fig. 1. Percentage composition by weight from clayey range site mechanically and chemically treated at the Durham Ranches Inc., Gillette, Wyoming.

1978, western wheatgrass increased on all treatments except the one where moldboard plow was used, where it decreased substantially because of the increase in forbs. The percentage of blue grama increased in 1977 over the 1968-72 average for the check, rotovator, and moldboard plow treatments, but decreased on all treatments in 1978. The decrease was greatest on the check and strip-sprayed atrazine treatments. Dryland sedges increased in the composition in 1977 over the 1968-72 average, but decreased on all treatments in 1978. The greatest decrease was on the blade treatment. Except for the disc plow and moldboard plow treatments, forbs were of only minor importance in the 1968-72 average. Forbs decreased in 1977 on all treatments as compared with 1968-72 average because of the drought, and they increased in 1978 when rainfall was above average. The dominant forbs present in 1978 were tumbled mustard (*Sisymbrium altissimum*), plains plantain (*Plantago purshii*), and plains bahia (*Bahia oppositifolia*), and scarlet globemallow (*Sphaeralcea coccinea*).

The drought year of 1977 and above-average precipitation in 1978 were two extremes. Below-average precipitation years are, perhaps, more common than average years in the northern plains. The moldboard plow treatment was not recommended as a practice at the end of the five-year study period (1968-72). However, more western wheatgrass was

present on the moldboard plow treatment than any other treatment in both 1977 and 1978. The strip-sprayed atrazine treatment produced more blue grama than any other treatment regardless of year.

Thus, during the period of treatment evaluation, it is important to consider the growing conditions. The drought in 1977 masked the effectiveness of the treatments, because plant growth was limited. In 1978, however, 11 years after treatment, the native range treated with moldboard plow, disc plow, and rotovator produced significantly more total herbage than the check.

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