Seeding Crested Wheatgrass on Drought Depleted Range[1]

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The effects of severe drought in reducing production, carrying capacity, and in changing the composition of native range vegetation are widely known. Likewise the problems inherent in post-drought restocking of drought depleted range have been recognized. Native range recovers slowly from drought, and little is known of methods of accelerating this rate of recovery, or the rate of increase in forage production which could be obtained by reseeding adapted grasses immediately after drought.

Between 1931 and 1937 eastern Montana suffered from the effects of severe drought. Droughts in 1931, 1934, and 1936 were the most severe during the 62 years of record, and precipitation of 1933 and 1935 was also below normal. As a result of this extended dry period, the native ranges were reduced to less than 20 percent, and in some cases to less than 10 percent, of their pre-drought density.

Beginning in the late spring of 1937, moisture conditions became more favorable, and recovery of the range began. Sandberg bluegrass (*Poa secunda*), needle-and-thread (*Stipa comata*), and buffalo

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[1] *Study conducted by the former Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Montana.*

grass (*Buchloe dactyloides*) increased most rapidly. Western wheatgrass (*Agropyron smithii*) and blue grama (*Bouteloua gracilis*) recovered more slowly.

In 1938 a study was undertaken on the U. S. Range Livestock Experiment Station near Miles City, Montana, to determine whether crested wheatgrass could be seeded successfully directly into drought-depleted native range, thereby hastening recovery of the range.

During the past thirty-years considerable work has been done in the Northern Great Plains region with Standard crested wheatgrass (*A. desertorum*). Investigations have been made on methods of establishment, nutritive qualities, and the general forage value and adaptability of this species as compared to others for reseeding (Westover *et al.*, 1932; Reitz *et al.*, 1936; Whitman *et al.*, 1941; Williams and Post, 1941; Williams *et al.*, 1942; McCall *et al.*, 1943; Williams and Post, 1945; Woolfolk, 1951; Short and Woolfolk, 1952; and others). It is now recognized that crested wheatgrass is well adapted to the region, and that it compares favorably with native range species in many respects.

Crested wheatgrass is normally used as early spring forage. It is usually grazed at a heavy rate during this time to obtain maximum use while the plant is still green and succulent, as it tends to become coarse and unpalatable at maturity (Williams, 1941; Short and Woolfolk, 1952). Occasionally a significant amount of fall regrowth may be obtained (Woolfolk, 1951).

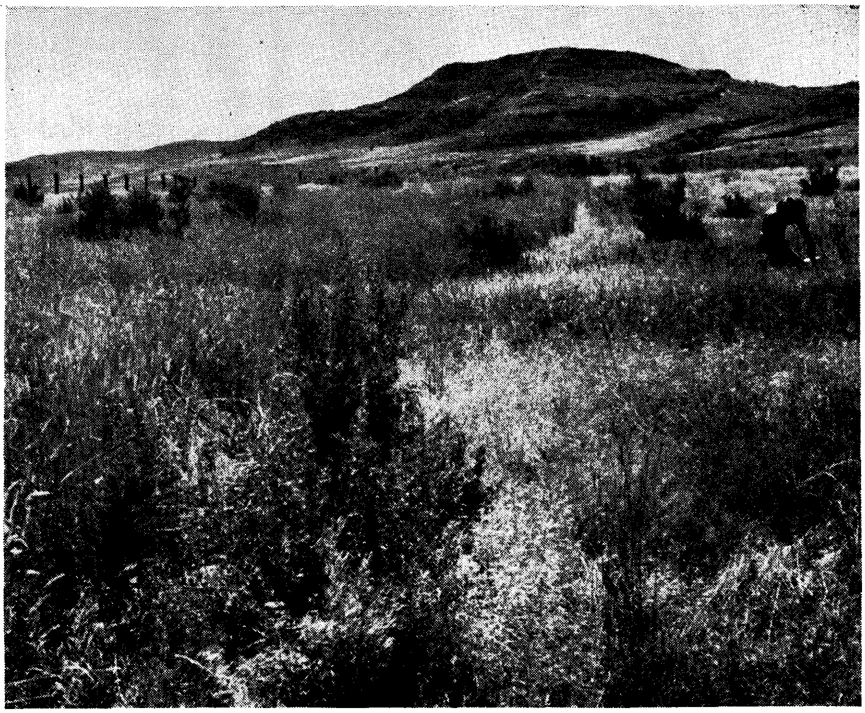

FIGURE 1. Camelback study area, U. S. Range Livestock Experiment Station, near Miles City, Montana, in 1950, showing strip seeded to crested wheatgrass in fall of 1938 (*left*) and part of control strip (*right*). The annual grasses still comprise a considerable portion of the vegetation on the control strip after 12 years of protection from grazing. Photo U. S. Forest Service.

Experimental Procedure

The site selected for the study was located near the east boundary of the station in an area that had been severely abused for many years by transient and market herds of livestock. This period of over-use began before World War I and ended in 1932, when the area was fenced and the transient herds excluded.

The study was set up in a split plot design with four blocks or replicates on a gently sloping, blue grama subtype on Havre very fine sandy loam soil. In each block were two main plots, each 40 x 217.8 feet, or 0.2 acre. Each main plot was divided longitudinally down the center into sub-plots. One of the sub-plots in each of the main plots was left in untreated native range to serve as a control. The two remaining sub-plots (one in each main plot) were seeded to crested wheatgrass, one in the spring and the other in the fall. Main plots were randomized within blocks as were sub-plots within main plots.

Crested wheatgrass was drilled into the native sod without seedbed preparation at the rate of 4 pounds per acre. Spring plantings were made on April 23, 1938, and fall seedings on October 25, 1938. The spring planted sub-plots were seeded again on April 18, 1939, because of almost complete failure of the 1938 spring plantings. At the time, this failure was attributed in large measure to competition from the dense growth of annual grasses and forbs.

A one-meter square chart quadrat was laid out in each sub-plot in 1938, prior to seeding, to study changes in plant density and composition as measured by basal area. The quadrats were carefully matched between the two sub-plots in each plot as to species composition and vegetation density. A series of eight 0.1 mil-acre clipping areas for yield determinations were also laid out in each sub-plot, spaced mechanically on two lines running parallel to the long axis of the sub-plots.

The study area was fenced in 1938 and protected from grazing throughout the course of the study.

Weather

Weather during the period of study was generally favorable, following the succession of dry years during the mid-thirties. Both annual and growing season precipitation (April 1-September 30) were 10-15 percent below the long time average of 13.00 and 9.29 inches, respectively, in 1938 and 1939. In 1940 these totals were above average. During the years 1941 through 1948, they averaged slightly above normal. In 1949 the growing season precipitation dropped to about 40 percent of average (about the same level as during the drought years of 1931, 1934 and 1936), while total annual precipitation was about 60 percent of normal. During 1950 both growing season and annual precipitation totals were approximately normal.

Experimental Results

Examination of plots in midsummer of 1939 disclosed that all spring seedings of crested wheatgrass were barely successful, averaging 0.34 plants per square foot. The fall seeding was rated as highly successful with an average of 1.03 plants per square foot. A highly successful stand of crested wheatgrass was considered to be 0.7 or more plants per square foot; a succesful stand, 0.4 to 0.6; and a barely successful stand, 0.1 to 0.3 plants per square foot.

By 1940 the number of plants had declined markedly on all plots. At that time the fall seeding of crested wheatgrass was rated as barely successful—0.13 plants per square foot—and the spring seedings as complete failures with no plants present. It was concluded at the time that competition from native vegetation was primarily responsible for the poor success of the crested wheatgrass plantings.

Vegetation Density

A statistical analysis of the initial total density and blue grama density, as determined from the chart quadrats, disclosed no significant differences between the controls and seeding treatments or between seeding treatments at the beginning of the study.

When inspection of the reseeded plots in 1940 indicated that the reseeding was a failure on some of the plots and barely successful on others, it was decided to chart some of the quadrats to ascertain changes that had occurred in density of the native vegetation between 1938 and 1940. For this purpose, charting was limited to the quadrats in the four control sub-plots of the fall seeding. These were charted in October, 1940.

Average density of the perennial grasses and prickly-pear *(Opuntia polycantha)* increased from 401 (.04 percent) to 1,901 (.19 percent) square centimeters per quadrat or 373 percent in the two-year period (Table 1). Most of this increase was due to blue grama which increased 847 percent. Sandberg bluegrass increased 11 percent.

This increase in native vegetation took place while the number of plants of crested wheatgrass was declining rapidly. It may be inferred that the competition afforded by the native vegetation was a primary cause of this decline.

Vegetation Production

The eight 0.1 mil-acre sample clipping plots in each sub-plot were first laid out and the native species clipped in late June of 1938 to determine the amount of forage produced at the beginning of the study. No significant differences in total production, perennial grass, or annual grass and forb production were found at the outset of the study between treatments or between treatments and controls.

Since a successful stand of crested wheatgrass was established only on the fall seeded plots, yield samples were taken of this treatment in 1940 to determine the increase in native forage and also the increase due to reseeding. As the stand of crested wheatgrass did not appear to be sufficiently dense to noticeably affect forage production by native species, the control sub-plots of this treatment were not sampled. These same fall-seeded crested wheatgrass sub-plots and the corresponding control sub-plots were sampled in 1950.

Average forage production in pounds per acre on fall-seeded crested wheatgrass sub-plots in 1938, 1940 and 1950, and control sub-plots in 1938 and 1950, is summarized in Table 2. The most notable changes between 1938 and 1940 on the fall seeded plots were

Table 1. Average density of perennial vegetation on native range as determined on chart quadrats (one-meter square) in 1938 and 1940.

	Density per Quadrat in Square Centimeters	
Species	1938	1940
Western wheatgrass	0	T
Needleleaf sedge (*Carex eleocharis*)	0	T
Blue grama	173	1641
Sandberg bluegrass	228	254
Sand dropseed (*Sporobolus cryptandrus*)	0	6
Prickly pear	0	T
Needle-and-thread	T	0
Total	401	1901

Table 2. Average forage production in pounds per acre, air-dry, on two treatments, in 1938, 1940 and 1950.

	Pounds Per Acre				
	Fall seeded plots			Control	
Species	1938	1940	1950	1938	1950
Crested wheatgrass	0	28	1393	—	—
Blue grama	12	257	—	7	—
Other perennial grasses	73	60	132*	117	—
All perennial grasses	85	345	1525	124	187
Annual grasses	630	165	—	593	—
Forbs	112	290	—	125	—
Annual grasses and forbs	742	455	50	718	398
Total	827	800	1575	842	585

*Includes blue grama.

the four-fold increase in perennial grass production, and the 39 percent decrease in production of annual grasses and forbs. The perennial grass increase was due mostly to the 20-fold increase in blue grama, which comprised 17 percent of perennial grass production in 1938 and 74 percent in 1940, but also partly to the presence of crested wheatgrass which was seeded after the 1938 sampling. This increase was partially offset by the decrease in production of other perennial grasses.

The decrease of slightly over one-third in total production of annual grasses and forbs was due, no doubt, to increased competition from the perennial grasses. Within this group the annual grasses declined 75 percent over the two-year period, while the forbs increased 150 percent.

The net result over the two-year period was a non-significant 3 percent decline in total forage production.

Between 1940 and 1950 the changes in production by plant groups on the fall seeded plots were considerable. Crested wheatgrass increased 50-fold during the period, while blue grama and other perennial grasses together decreased 60 percent. The total change for all perennial grasses was a 340 percent increase. During this period production of annual grasses and forbs decreased 89 percent.

These changes resulted in doubling of total forage production over the 10-year period, due primarily to the enormous increase in crested wheatgrass.

On the crested wheatgrass plots, over the entire 12-year period, production of perennial grasses increased 18-fold, annual grass and forb production declined 94 percent, and total forage production almost doubled. During this period, on the native range, perennial grass production increased 50 percent, annual grasses and forbs declined 40 percent, and total production declined about 30 percent.

It is evident that the fall seeding of crested wheatgrass, which was rated as successful in 1939, but only barely successful in 1940, was a complete success by 1950, ten years later (see Figure 1).

Summary

It has been commonly observed that native range in the Northern Great Plains region recovers slowly from the effects of extreme drought. In 1938 a study was initiated at the U. S. Range Livestock Experiment Station near Miles City, Montana, to follow the course of recovery in native range, and to determine if recovery could be speeded up by seeding crested wheatgrass.

Crested wheatgrass was seeded on native range in a replicated, split plot design in 1938 and 1939. Spring and fall seedings were compared with each other and with non-seeded native range. Changes in vegetation density and production were followed from 1938 to 1950, a period of recovery from the drought of the 1930's.

From this study the following conclusions were drawn:

1. Fall seeding of crested wheatgrass was superior to spring seeding in obtaining successful stands, where competing vegetation was not removed.
2. Crested wheatgrass in the first few years after seeding was hindered by competition from native range vegetation with a basal area density of 4 per cent or more.
3. Native perennial grass species, particularly blue grama, tended to increase in density and production more rapidly at the end of a drought period than did crested wheatgrass planted at the end of a drought.
4. The observed increase in crested wheatgrass and perennial grass production was at the expense of annual grasses.
5. After twelve years of recovery from drought under protection from grazing, range, which had been seeded to crested wheatgrass at the end of the drought, produced 700 per cent more perennial grass forage and two to two and one-half times as much total production as did native range under the same conditions.

LITERATURE CITED

McCall, Ralph, *et al.* 1943. The apparent digestibility and nutritive value of several native and introduced grasses. Mont. Agr. Exp. Sta. Bull. 418. 30 pp.

Reitz, L. P., *et al.* 1936. Crested wheatgrass in Montana; comparison with slender wheatgrass and brome grass. Mont. Agr. Exp. Sta. Bull. 323. 53 pp.

Short, L. R. and E. J. Woolfolk. 1952. Reseeding to increase the yield of Montana range lands. U. S. Dept. Agr. Farm. Bull. 1924. 26 pp.

Westover, H. L. *et al.* 1932. Crested wheatgrass as compared with bromegrass, slender wheatgrass, and other hay and pasture crops for the Northern Great Plains. U. S. Dept. Agr. Tech. Bull. 307. 35 pp.

Whitman, W. C., *et al.* 1941. Grass. N. Dak. Agr. Exp. Sta. Bull. 300. 112 pp.

Williams, R. M. and A. H. Post. 1941. Dry-land pasture experiments at the Judith Basin Branch Station. Mont. Agr. Exp. Sta. Bull. 388. 25 pp.

———, and ———. 1945. Dry-land pasture experiments. Mont. Agri. Exp. Sta. Bull. 431. 31 pp.

———, *et al.* 1942. Wintering steers on crested wheatgrass. Mont. Agr. Exp. Sta. Bull. 407. 18 pp.

Woolfolk, E. J. 1951. Crested wheatgrass grazing values. No. Rocky Mt. Forest and Range Exp. Sta. Res. Note 91. 10 pp. Mimeo.