Effects of Grazing and Protection on a Twenty-Year-Old Seeding

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Millions of acres have been and are being seeded to grass in the western United States in attempts to restore depleted range and crop lands. Some areas are grazed soon after successful establishment while others are protected for periods of time varying with requirements of government programs. Some areas have been seeded to native grasses while on others, introduced species are used. Many questions arise about proper seeding mixtures and management in relation to establishment of permanent high-producing grasslands. Long term studies are necessary to find answers for these questions.

This paper reports a survey of an area seeded to three different grass mixtures in 1941. Part of each seeded area has been protected and a part grazed. Therefore, an opportunity was provided to measure the stability, over a long period of time, of seeded grassland under grazing and protection.

Methods of Study

Three different grass mixtures were seeded on an upland field previously cultivated for nearly 40 years. The soil is uniform and typical of the clay upland range site in western Kansas (Table 1). Under natural conditions the bulk of the climax native vegetation would be blue grama *(Bouteloua gracilis)*, western wheatgrass *(Agropyron smithii)* and buffalo grass *(Buchloe dactyloides)* (Albertson, 1937). Small amounts of sideoats grama *(Bouteloua curtipendula)* and big and little bluestem *(Andropogon gerardi* and *A. scoparius)* are found in the more favorable mesic locations on the site.

Part of the field was seeded to a bluestem mixture which consisted of four pounds of big and little bluestem, three pounds of sideoats grama, two pounds of blue grama and two pounds of switch grass *(Panicum virgatum)* per acre. Another portion of the field was seeded to blue grama at the rate of 10 pounds per acre. A third portion was seeded to a mixture of two pounds of sideoats grama, two pounds of blue grama and eight pounds of western wheatgrass. The three mixtures will be referred to as the bluestem mixture, blue grama, and wheatgrass-grama mixture in the order mentioned above. Different methods of seedbed preparation were used but for the purposes of the study reported here, the important fact is that a good stand was obtained at the end of two years by all methods.

Three years after seeding, the area was fenced in with a native pasture for use by livestock. The seeded field has been moderately grazed for the past 17 years. Two exclosures, 135 feet long and 40 feet wide, were constructed to protect small portions from grazing. One exclosure was constructed across the ecotone of the blue grama and bluestem mixture (Exclosure I) and the other on the border between blue grama and the wheatgrass-grama seeding (Exclosure II) (Figure 1).

Table 1. Soil profile description of clay uplands site used for seeding three grass mixtures.

Horizon	Depth	Texture	Structure	Reaction
A_1	0-13″	silty clay loam	weak, granular, massive	none
B_1	13-18″	silty clay	blocky, platy	none
B_2	18-25″	silty clay	blocky, massive	slight
B_3Ca	25-30″	silty clay	blocky, massive	strong
C_1	30″ +	silty clay	massive	none

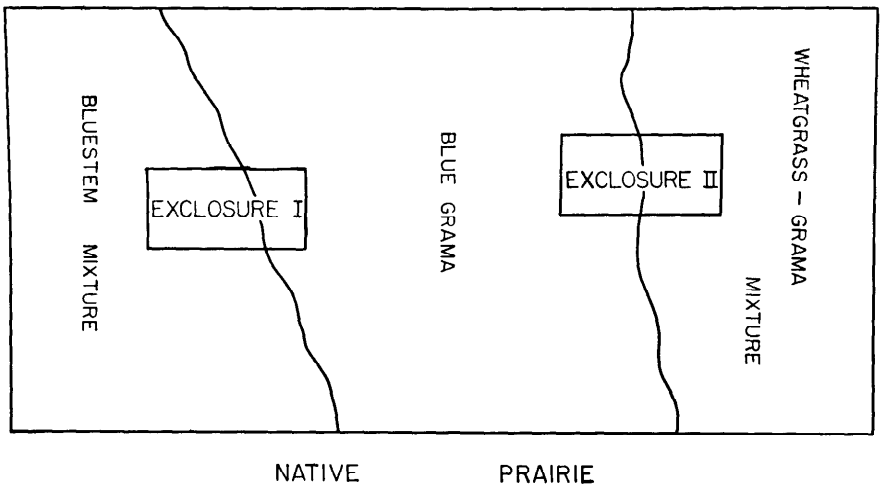

FIGURE 1. Reseeded area showing locations of plantings of different mixtures and exclosures that protected small areas from grazing.

Measurements were made in 1961, 20 years after planting, of the composition and yield of the vegetation inside and outside exclosures. With exclosures located on ecotones of the seeded areas, an excellent opportunity was provided for comparing vegetative composition, yield and the extent of the spread of various species under both protected and grazed conditions. Measurements were taken in all three seeded areas under both treatments.

Percentage composition and cover was measured by use of randomly placed point frames as described by Levy and Madden (1933). A total of 3,000 points were used in each treatment of each area. Yields were determined by clipping five meter quadrats at the end of the growing season in each treatment of each area. Portable cages were used to protect clip quadrats from grazing.

Results

The bluestem mixture was successfully established on the heavy upland soil even though the bluestems are not often abundant in native vegetation on such sites. Big and little bluestem accounted for 90 percent of the total vegetation in the area seeded to the bluestem mixture and protected from grazing for 20 years (Table 2). With exclusion of livestock the area was occupied and dominated by big and little bluestem. Switch grass and tall dropseed *(Sporobolus asper)* were the only other common grasses found on the portion seeded to the bluestem mixture.

Under protection at the other end of the exclosure, the area seeded to blue grama was successfully invaded by many other grasses (Table 2). Blue grama composed only 30 percent of the vegetation while the bluestems and switch grass furnished over 57 percent (Table 2). Small amounts of sideoats grama had also invaded from the other part of the exclosure located in the bluestem mix seeding. Western wheatgrass had invaded from a considerable distance outside the exclosure. In other words, long-time protection from grazing permitted the taller mesic grasses to invade a blue grama grass seeding even though the nature of the soil was presumably more suitable to blue grama. Apparently, even the drouth, 1952-1956, did not favor the short grass sufficiently to reassert dominance under protection.

Western wheatgrass formed over half the vegetation in the area seeded with wheatgrass-grama (Table 3). Blue grama and sideoats grama each formed about 20 percent of the vegetation. At the end of the exclosure situated in the area seeded to blue grama, the major portion of the vegetation was blue grama (Table 3). Western wheatgrass was the most successful invader forming 17.8 percent of the vegetation while sideoats grama accounted for only four percent.

Table 2. Composition of vegetation from two seeded areas after 20 years of protection inside an exclosure compared to composition on moderately grazed areas outside the exclosure (Exclosure I).

Species	Bluestem mix		Blue grama	
	Protected	Grazed	Protected	Grazed
	(Percent)			
Big bluestem	47.64	0.35	9.63	.....
Little bluestem	42.45	12.50	19.79	.....
Blue grama	.....	24.31	30.01	86.38
Sideoats grama	0.94	9.03	1.07	.....
Western wheatgrass	.....	1.39	4.81	0.51
Switch grass	6.13	5.90	27.80	.....
Tall dropseed	1.42	11.11	.....	.....
Buffalo grass	.....	6.25	.....	0.51
Subsere grasses	.....	15.97	.....	2.32
Other grasses	0.47	6.94	1.06	4.88
Forbs	0.94	6.26	4.80	5.40

Effects of Grazing

Areas outside the exclosures had been subjected to moderate grazing for 17 years. Observations indicated that animals concentrated more in the area seeded to bluestems and, therefore, grazing was heavier in that area.

A wide variety of grasses was found in the grazed area planted to the bluestem mixture (Table

Table 3. Composition of vegetation from two seeded areas after 20 years of protection inside an exclosure compared to composition on moderately grazed areas outside the exclosure (Exclosure II).

Species	Wheatgrass-Grama mix		Blue grama	
	Protected	Grazed	Protected	Grazed
	(Percent)			
Blue grama	20.31	43.66	70.11	92.60
Sideoats grama	20.31	35.92	4.02	0.26
Western wheatgrass	53.13	11.97	17.81	.....
Buffalo grass	.....	3.17	.....	0.77
Subsere grasses	.....	0.70	.....	2.05
Other grasses	4.91	2.82	3.06	1.79
Forbs	2.34	1.05	5.16	5.16

2). The five grasses used in the original planting constituted only 52 percent of the vegetation. Blue grama alone comprised over 24 percent of the vegetation cover under grazing but was not present in the protected area. Tall dropseed with over 11 percent could have been in the original mixture in small quantities or may have invaded from the nearby native prairie. Buffalo grass and western wheatgrass probably invaded from the nearby native prairie. Grasses typical of a late stage in secondary succession, referred to as subsere grasses, furnished nearly 16 per cent of the cover. These included such grasses as sand dropseed *(Sporobolus cryptandrus)*, red threeawn *(Aristida longiseta)*, windmill grass *(Chloris verticillata)* and similar species. Little bluestem was common but had been greatly reduced by grazing. Big bluestem did not survive the moderate grazing pressure on the site.

Blue grama formed more than 86 percent of the vegetation on the grazed area outside exclosure one in the blue grama seeding. Even though the bluestems and switch grass were successful invaders of the blue grama seeding under protection, none of these species were found in the grazed area. Apparently, the habitat was borderline for support of the taller grasses. With the added moderate grazing factor, the tall grasses disappeared. Only 2.3 percent were subsere grasses.

Vegetation on the wheatgrass-grama mix seeding was quite stable under moderate grazing (Table 3). After 17 years of use, over 91 percent of the total vegetation was still furnished by the three species originally planted. Western wheatgrass was considerably reduced but both blue grama and sideoats grama were more abundant than in the protected area. Small islands of buffalo grass were widely scattered throughout and subsere grasses were rare.

On the grazed area planted to blue grama near exclosure two, over 92 percent of the vegetation was furnished by this one species. No significant invasion was made by any other species.

Forage Production

Seasonal production of forage in the area seeded to the bluestem mixture was greatly different between grazed and protected locations. Protected areas produced more than twice as much forage as grazed areas (Table 4). Besides the reduction in the higher producing bluestems due to grazing, the general vigor of all the grazed plants appeared to be decreased. Since grazing management is based on forage production potential of an ungrazed site it might be assumed that moderate grazing of the bluestem mixture is not the proper degree of use. Lighter grazing may have maintained the abundance and vigor of the bluestems. However, it has been observed that even very light grazing on the clay upland site in native prairie causes the disappearance of the bluestems. The type of management necessary to maintain the bluestems on the clay upland site may not be economically feasible.

Production from the protected area of wheatgrass-grama mixture was 3,439 pounds per acre as compared to 2,988 pounds on the grazed area. Even less difference in production existed between the protected and grazed locations in the blue grama seeding (Table 4).

Forage yields under moderate grazing of three types of seeding were quite similar indicating that, under grazing, the production for the site was similar irrespective of the seeded species. However, there was a large difference in yields of three protected areas.

Records of forage production on the grazed seeded area and on an adjacent native pasture have been kept from 1945 to 1961 (Table 5). Clippings made on the seeded area were averaged from quadrats on all three types of seeding. Very little difference was found in the average production of the native and seeded

Table 4. Production in 1961 of grass in three seeded areas grazed moderately for 17 years and adjacent comparable areas protected for 20 years.

	Bluestem mix	Blue grama	Wheatgrass-Grama
	(Pounds)		
Protected	5,525	2,210	3,439
Grazed	2,171	2,120	2,998

Table 5. Average forage yields from 1945 to 1961 on seeded area compared to native grassland on the same site.

	Native	Seeded
Average	2,190	2,028
Highest Year	4,271	2,028
Lowest Year	897	679
1961	2,823	2,845

grasslands (2,190 and 2,028 pounds per acre respectively). The native prairie was dominated by buffalo grass and blue grama and had been grazed moderately for many years while the seeded area contained many species all subjected to the same grazing intensity. Production in 1961 was almost identical on both locations.

Discussion and Summary

Study of a seeded area after twenty years of protection and 17 years of moderate grazing revealed many characteristics of an upland area in west-central Kansas.

Three different grass mixtures were seeded on a clay upland site characterized by a heavy silty clay loam to silty clay soil. The grass mixtures used were bluestem mixture containing big and little bluestem, sideoats grama, and switchgrass; blue grama only; and western wheatgrass-grama mixture with western wheatgrass, blue grama, and sideoats grama.

Big bluestem and little bluestem can be maintained on the clay upland site under protection. After 20 years of protection, the two bluestems formed 90 percent of the total plant population where the bluestem mixture had been seeded. However, only small amounts of the bluestems occur in an adjacent similar native prairie. In fact, the two bluestems and switch grass successfully invaded a stand of blue grama (one of the dominants of the clay upland) when protected from grazing.

Moderate grazing greatly reduced the abundance of the bluestems. Blue grama was the most abundant grass in the grazed area seeded to bluestem mixture, but many of the taller grasses were still present in larger amounts than on native prairie. No significant invasion of blue grama by the taller grasses occurred under moderate grazing. Large numbers of subsere grasses were found in the grazed bluestem mixture area indicating a lack of stability.

All three grasses in the wheatgrass-grama mixture seeding were were still dominant after 20 years of protection. Moderate grazing reduced the relative amount of western wheatgrass and allowed blue grama and sideoats grama to increase but all three were sufficiently abundant to be considered dominants. Invasion of the blue grama seeding by the two taller grasses occurred to a limited extent and only when protected from grazing.

Areas seeded to pure blue grama were relatively stable after 20 years when subjected to moderate grazing. Only about two percent of the vegetation was furnished by subsere grasses and nearly 90 percent by blue grama.

Production from the bluestem mixture when protected was over two and one-half tons in 1961 but 17 years of moderate grazing had reduced it to slightly over one ton for the same year. Production on the blue grama seeding was nearly equal on grazed and ungrazed areas but moderate use did reduce the yield on the wheatgrass-grama mixture.

It is interesting to note that variation in production of the three mixtures was not as great under moderate use as it was when the areas were protected from grazing. Yields from moderately grazed bluestem mixture and blue grama were nearly equal while the wheatgrass-grama area produced nearly one-third more forage.

Average yields of native and seeded grasslands for the past 17 years were about equal indicating that the site potential under grazing is about the same regardless of species.

Although bluestems will grow on this site, they do not produce any more than blue grama with moderate use. Results of this study of a 20-year old seeding trial would indicate that use of dominant, native grasses in a seeding mixture is most satisfactory. Results of this study indicate that the clay upland site is capable of maintaining tall grasses with complete protection but not with moderate use.

Previous history of cultivation may influence the type of grasses the soil will support. Adjoining native grasslands on the same soil type protected for 30 years and close to a seed source of the bluestems did not support big and little bluestem.

LITERATURE CITED

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