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Introduction

Grazing by domestic livestock and wildiife is still the largest agricultural use of land in America. Over one billion acres are devoted to use by grazing animals. In South Dakota, over 50 percent of our state is in grassland, constituting one of our most abundant and important resources.

A survey conducted in 1962 by the USDA has indicated that grazing land in the United States is producing about half its potential. Where South Dakota ranks in relation to the national average is not known, but the factors that have contributed to decreased range productivity in other parts of the Nation have had their effect on South Dakota ranges as well. It has been estimated that in the Northern Great Plains about 10 percent of the ranges are in excellent condition, 20 percent in good, 40 percent in fair, and 30 percent in poor range condition. It is the 70 percent fair and poor condition ranges that are the least productive and offer the greatest opportunity for increased range productivity. This is not to say that good and excellent condition ranges cannot be made more productive, but that they are producing closer to their potential than ranges in lower condition classes.

Increased range production through range improvement practices offers one of the greatest potentials for increased production of animal products from our ranges.

There are numerous practices and ways to improve the productiveness of rangeland including grazing systems, deferment, fertilization, mechanical treatments and others. Two methods that have shown promise from research at the Newell Field Station are summarized in this paper.

The Use of Clover to Increase Forage Production on Native Ranges

Mixed stands of legumes and grasses are known to produce more forage than when grasses are grown alone. Legumes provide an additional source of nitrogen, and essential plant nutrient, for use by the grass plants. This beneficial relationship of grass-legume mixtures has been used most extensively for hay production, irrigated pastures, and introduced early-spring pastures. The same principle can be applied to native ranges. It is generally agreed that native legumes were much more abundant in native grasslands than they are today. Grazing pressure has generally reduced their abundance.

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Seeding native legumes into rangeland has met with very limited success due to the scarcity of seed and difficulty of establishment. Presently, seeding of clovers and pasture-type alfalfas may offer a more promising approach to increasing range productivity with legumes.

Prior to 1962, several years of below normal precipitation and continued heavy use depleted many of the ranges on heavier clay soils in western South Dakota. In many cases an almost denuded condition existed with very little evidence of perennial grass cover. Several methods of range renovation were tried in the spring of 1962, on a deteriorated Dense Clay Range Site. Of these methods, the seeding of clover into existing western wheatgrass range appears to be the most promising. Madrid sweetclover was seeded at a rate of 2.5 pounds of pure live seed per acre. Since the initial seeding, the clover stand has maintained itself by natural reseeding.

Range recovery was very rapid when precipitation increased in 1962 and successive years, and when deferment from grazing permitted the perennial grasses (western wheatgrass and green needlegrass) to recover. Seeding of clover stimulated the recovery and production beyond what could be expected under deferment alone.

Table I compares the forage production from a Dense Clay Range Site that was seeded to clover with range which was not. The average total production over five years was increased nearly 2.5 times by the clover. Range which was seeded to clover produced an average of 1804 pounds per acre compared to 740 pounds per acre on range without clover. This resulted in an average increase of 1064 pounds of forage per acre, per year.

The increased total forage production was due only in part to the clover forage. The beneficial effect of the nitrogen supplied by the clover and used by the grass plants increased the average production of grass 549 pounds per acre (Table II). Range which was seeded to clover produced a three-year average of 1379 pounds per acre of perennial grass compared to 830 pounds per acre when clover was absent.

Table I. Forage production (perennial grass and clover) from western wheatgrass range seeded to sweetclover compared to untreated native range, 1963-1967. Pounds of oven-dry forage per acre.

	With clover	Without clover	:	Increase (lb./A.)
1963	3032	511	:	2521
1964	949	698	:	251
1965	1833	1063	:	770
1966	950	444	:	506
1967	2257	983	:	1274
Ave.	1804	740	:	1064

Table II. Effect of clover on the production of perennial grass, 1965-1967. Pounds of oven-dry forage per acre.

	With clover	Without clover	:	Increase (lb./A.)
1965	1425	1063	:	361
1966	625	444	:	181
1967	2088	983	:	1105
Ave.	1379	830	:	549

Competition from clover has not been detrimental to the stand of native grasses. The density of western wheatgrass and green needlegrass is just as great or greater when growing with clover as when growing alone.

Plants which are grown on soils containing high levels of soil nitrogen produce forages that are higher in protein than plants which are grown on nitrogen deficient soils. Thus soils of high fertility not only produce more forage, but also improve the forage quality. Western wheatgrass growing in association with sweetclover maintained a higher crude protein content, than when growing without clover (Fig. 1). When averaged over 16 collection dates from May to December, the grass protein content was increased by approximately 2 percent when growing with clover. Sweetclover was consistently higher in protein than the grasses even into early winter after most of the leaves had fallen. The mixed stand of grass and clover would provide adequate levels of protein for a grazing animal over a longer period of time not only because of a higher percent protein of the clover, but also because of the higher protein level of the associated grasses.

Areas which appear to be the best adapted to seeding clover into existing vegetation are those classified as Dense Clay Range Sites. The vegetation is primarily western wheatgrass with some green needlegrass and associated forbs. These sites do not deteriorate into short grass sods when overgrazed but are occupied by annual weeds,and a reduced stand of perennial grasses as range condition declines. The soils are fine textured and develop a friable surface one to two inches thick in the spring due to freezing and thawing breaking up the structure during the winter. This friable soils surface provides a good media for clover seed germination.

Ripping to Improve Spotty Western Wheatgrass Range

Ranges with a general aspect of grass vegetation intermixed with nearly barren areas are common in western South Dakota. These barren areas support very few productive range plants but are occupied primarily by dwarfed, low growing weeds. Such range is often called panspot, scabland, slick spot or hardpan range. Differences in physical and chemical soil characteristics

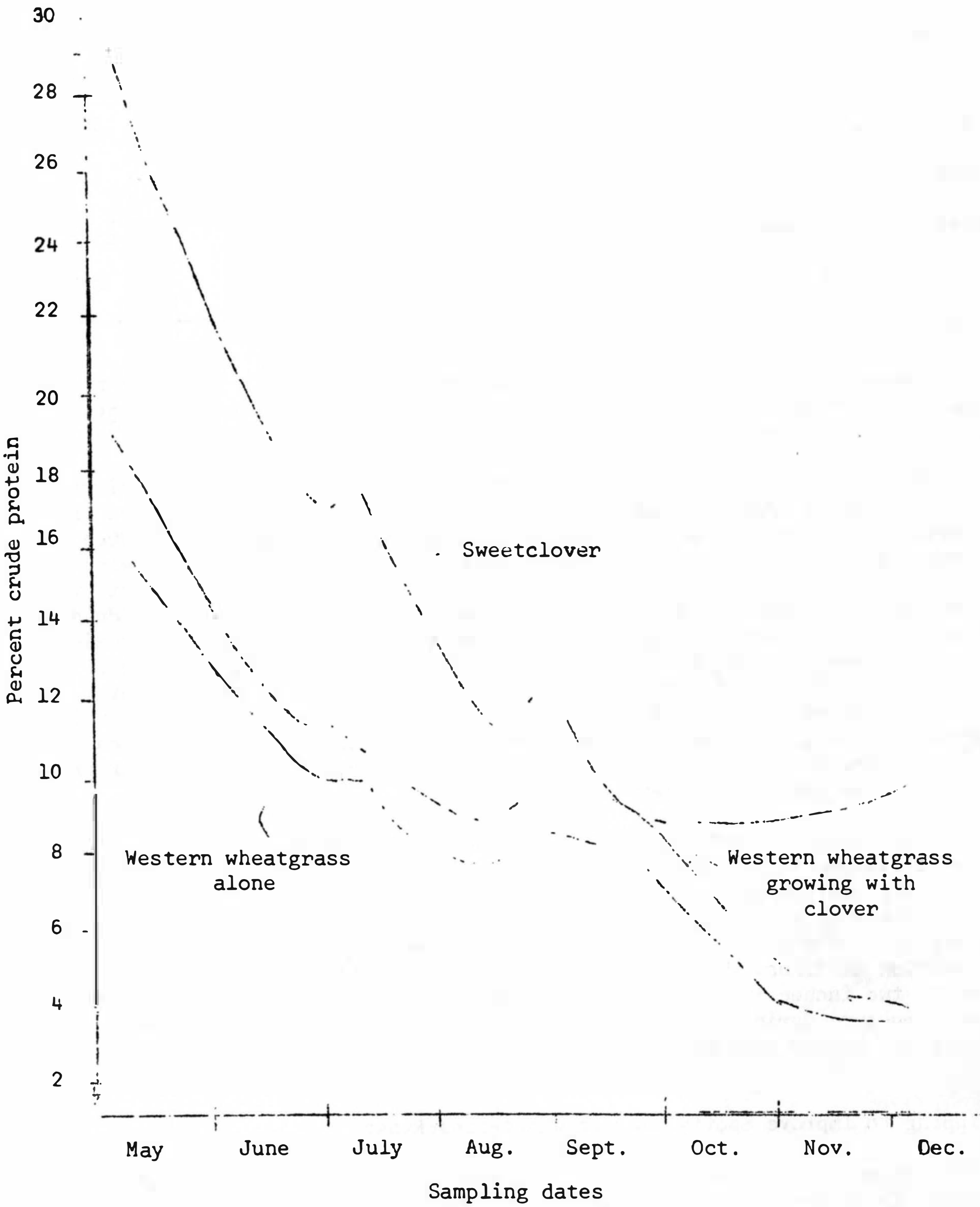

Fig. 1. Comparison of crude protein content in sweetclover, western wheatgrass growing with sweetclover, and western wheatgrass growing alone from May to December, 1966.

between the vegetated and barren areas accounts for the spotty appearance. The barren areas have soils which are compacted and sealed at the surface, and therefore nearly impermeable to water. Conditions are very adverse for plant establishment and survival. In many cases selective grazing has helped to perpetuate this spotty condition. New tender shoots and plants which attempt to colonize these areas are constantly grazed, making establishement difficult.

Production of range forage could be increased if corrective measures were taken to revegetate these barren areas, which in many instances account for over 50 percent of an area. Western wheatgrass with its ability to establish in new areas by means of rhizomes or underground stems, is especially well adapted to re-vegetating these areas when soil conditions are improved.

In September of 1963 an area of typical spotty western wheatgrass range was ripped using an 8-inch shoe on a Noble frame. The area was ripped to a depth of 12-14 inches, spaced approximately 6 feet apart. A portion of the area was fenced to exclude livestock grazing. Favorable growing conditions have prevailed since the initiation of the study, which is in contrast to the droughty conditions that prevailed from 1969-1961 prior to the initiation of the treatments.

Table III summarizes the response of western wheatgrass to ripping and deferment from grazing from 1965 to 1967. Results are presented only for western wheatgrass since it is the most abundant and important forage plant on the study area. Ripping has increased the density, weight, height and percent of western wheatgrass plants producing seedstalks over the non-treated area. By 1967 the ripped area which was protected from grazing had a density of 424 plants per square meter compared to 206 for the non-ripped area. The increased density is one of the most important improvements brought about by ripping, indicating that new plants are establishing in the previously barren areas. An improvement in vigor is also evident in that the height of plants and percent of plants producing seedstalks is greated where ripped. The combination of more vigorous plants and greater density has increased the weight of forage from 266 on the non-ripped area to 740 pounds per acre on the ripped area. Ripping and protection from grazing has essentially increased the productiveness of this range type by 2.8 times.

Deferment from grazing is essential for any renovation treatment such as ripping to be effective. Comparing the response of western wheatgrass to ripping treatments when protected from grazing with its response when not protected indicates that a much greater response can be expected when deferment follows treatment (Table III). Deferment is recommended at least during the first growing season and if possible grazed only during the dormant season the following year.

Table III. Effect of ripping and protection from grazing on spotty western wheatgrass type range. All measurements are for western wheatgrass.

	Not grazed Inside exclosure		Grazed Outside exclosures	
	Ripped	non-ripped	Ripped	non-ripped
Density Plants per sq. meter 1/				
1965	294	108	40	21
1966	437	136	121	15
1967	424	206	183	40
Weight (lb./A.) 2/				
1965	560	108	54	18
1966	421	64	*	*
1967	740	266	*	*
Height of plants (in.)				
1965	11.5	8.1	8.2	6.3
1966	7.3	6.0	*	*
1967	10.6	9.0	*	*
Percent of plants producing seedstalks				
1965	18.9	0.0	25.6	2.4
1966	3.7	0.0	*	*
1967	3.1	0.0	*	*

1/ One square meter = 39.4" x 39.4".

2/ Used for relative comparison of treatments and not necessarily a production or yield value.

* Data not collected because of grazing.