Eight-year Comparisons of Continuous and Rotational Grazing on the Southern Plains Experimental Range

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THIS paper presents experimental results of one form of rotation grazing on the semi-arid native rangeland of the southern Great Plains. The studies were conducted by the Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, in cooperation with the Oklahoma Agricultural Experiment Station, Bureau of Animal Industry, and other agencies. During the growing season, the animals were rotated at regular or irregular intervals on two or three divisions of a dryland, native range. This rotation plan will be referred to as "divisional rotation." To prove its advantages over continuous grazing it must show superiority at the same stocking rate; otherwise results could be confused with a study of rate of stocking.

Recent Literature

Few well-rounded reports have been published in recent years on the subject of rotation grazing, and those available tend more to confuse than to clarify its practical application. Only an occasional paper reports results of experimental work on "divisional rotation." Many of the studies lack replication and proper controls, and some confound rotation grazing with other factors, such as rate of stocking, breed or species of stock, mowing practices, or fertilization. However, the concensus of literature on "divisional rotation" in humid regions shows that rotation grazing has some slight advantages over continuous use where grazing pressure is heavy and pasture production is high and comparatively uniform—Hodgson (1939), Moore (1946), Woodward (1938). But most investigators do not recommend rotation grazing because of the cost of fencing water development, or other factors—Hein (1937), Biswell (1947).

Area, Livestock, and Experimental Procedure

The Area. The experimental range is located in the northwest portion of Oklahoma near the 100th meridian. Annual precipitation is 23 inches, with 16 inches or 70 percent falling in the six summer months. During the period of this study—1941 to 1949—the annual precipitation averaged 26 inches, which is 12 percent above the 77-year average. The normal growing season extends from April 1 to November 1. The topography is gentle, and the soil is a sandy loam.

The vegetation consisted primarily of sand sagebrush, with an understory of blue grass and sand dropseed, and the pastures were selected for uniformity of stand, soil, and topography. The brush had an average foliage density of 75 percent while all grasses had an average basal density of 10 percent. About 15 tall and mid grasses constituted 20 percent of the grass density. Sand lovegrass, sand bluestem, little bluestem, and switchgrass were the most important tall grasses.

Average air-dry forage yield was about

1,300 pounds per acre of which 43 percent was blue grama, 25 percent tall grasses, 15 percent sand dropseed, 10 percent miscellaneous grasses, and 7 percent forbs. At the beginning of the study the density of vegetation was low as a result of the drought of the 1930's, but it increased over 100 percent from 1940 to 1949.

The Livestock. Good grade yearling Hereford steers were used. They were selected as weaner calves weighing 425 pounds, and remained under full control for an entire year. During this time they gained, on the average, 75 pounds per head in winter, and 300 pounds in summer. They were allotted to the pastures by an improved mechanical system which resulted in each animal in any one lot being matched by an animal of essentially the same weight, grade, and winter gain in every other lot.

Experimental Procedure. Comparisons were made on duplicate pastures where continuous and divisional rotation grazing at moderate and heavy stocking rates were carried out. Each heavily grazed pasture contained 50 acres and was cropped at an average of 4.3 acres per steer. The moderately grazed pastures were 75 acres, cropped at 6.3 acres per head. The rotational pastures were divided into three equal parts.

Pastures were grazed in summer during a period of 172 days, the average season started on April 15 and ended on October 4. The animals had free access to salt and water at all times, and were not given supplemental feed during the summer.

In 1942 the steers were rotated between divisions at two-month intervals, but both vegetation and cattle suffered greatly from the concurrent heavy cropping. Thereafter, the animals were rotated at monthly intervals—except in 1947 when the rotation interval was 15 days—to prevent too heavy grazing on the divisions during the latter part of each period.

Results were measured by effects on cattle gains, and changes in density and production of the vegetation. Three statistically accurate line transect studies of vegetational density were made of the experimental pastures. Forage production and utilization studies were made by both clipping and estimating forage inside and outside of movable exclosures.

Results

Steer Gains. Results of the 1942 rotation at two-month intervals were not included in the final summary of gains. It reduced steer gains 65 pounds per head at the heavy rate of use, and 30 pounds at the moderate rate. Gains during the second month were less than half of those recorded for the continuously grazed pasture (Fig. 1).

In 1947, at 15-day intervals rotation, the steers grazed at a moderate rate on the continuous pastures gained 16 pounds more per head than those rotated; on the heavily grazed rate they gained 12 pounds less than those rotated. Neither of these differences was statistically significant.

The results of the seven year study show no statistically significant difference between continuous and rotational grazed steers at either heavy or moderate rate. But continuous grazing at moderate rate did produce 10 pounds average annual advantage in gain per head. Steer gains under rotation were less than under the continuous system in spring and summer cropping, but slightly greater in fall (Fig. 2).

Vegetation. The data show no significant difference between the two systems of grazing. However, there was a statistically significant increase in density of blue grama due to rotation at the heavy rate (Fig. 3).

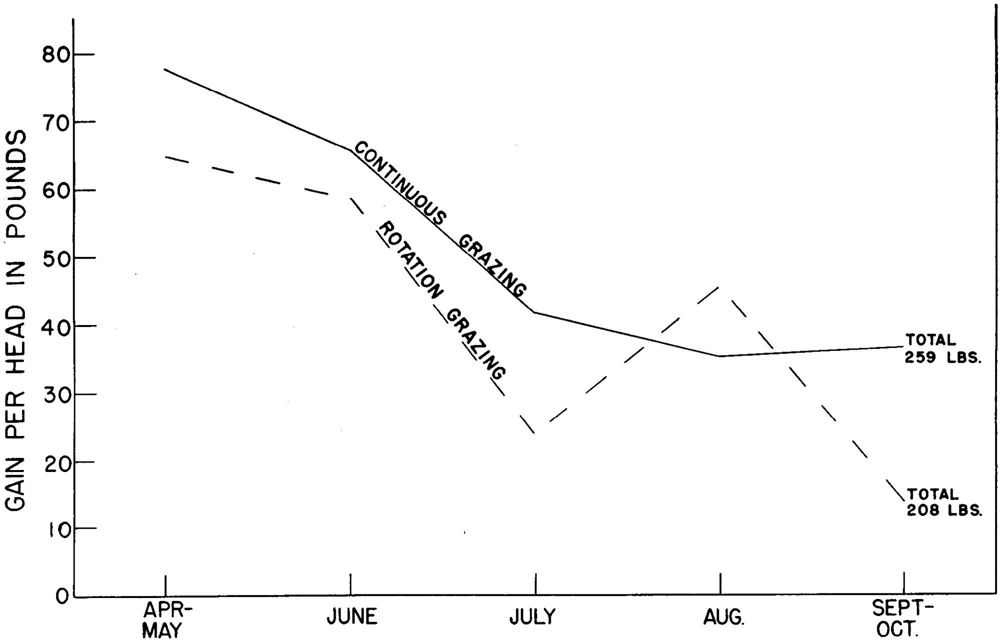

FIGURE 1. Average gain per head of yearling steers on four pastures continuously summer grazed in 1942 as compared with four 3-division rotation pastures, each division of which was grazed for a 2-month period in 1942, April-May, June-July, and Aug.-Sept.

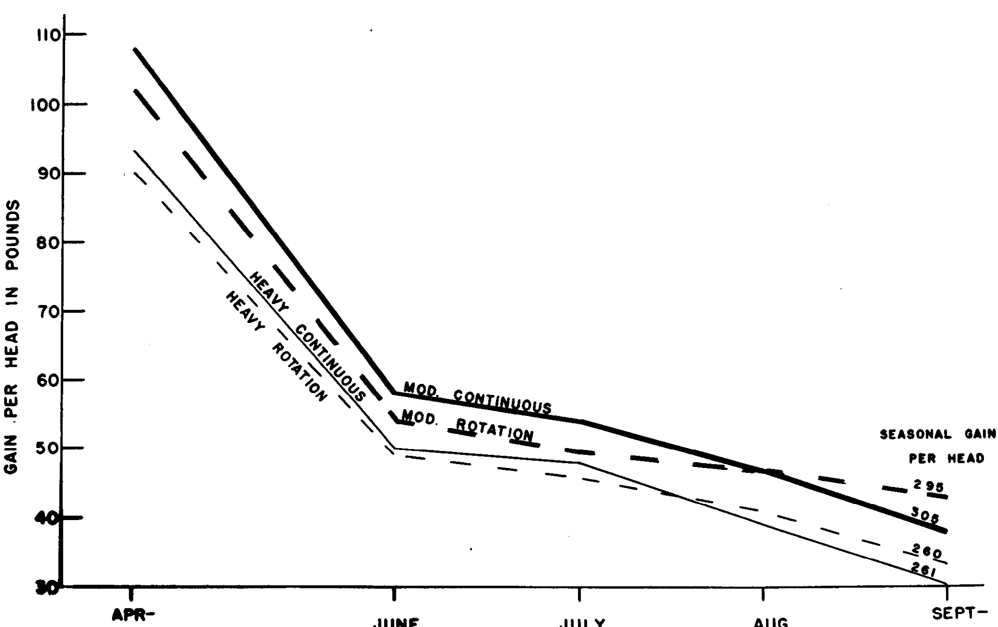

FIGURE 2. Average summer gains of yearling steers from duplicate pastures under four systems of management during 7 summers, 1943 through 1949.

Despite lack of statistical significance between comparisons of all species or classes of vegetation, except blue grama under heavy stocking, the density studies showed a slight advantage of rotation grazing. The tall grasses, such as sand bluestem, little bluestem, sand lovegrass, and switchgrass increased more under rotation at both grazing rates, while sand dropseed decreased slightly in density. The perennial forbs, most of which are fairly palatable to steers, decreased 50 and 67 percent, respectively, under moderate and heavy continuous use, and increased 20 and 33 percent under rotation at both grazing rates. All perennial grasses increased from 86 to 116 percent during the 8-year period regardless of the grazing management system employed.

The only consistent exception to the slight advantage of rotation grazing occurred in the class of miscellaneous mid grasses. Among these, side-oats, grama, Texas bluegrass, sand paspalum, fall witchgrass, and hairy grama increased most under continuous grazing. According to some authorities, sand paspalum, fall witchgrass, and hairy grama are "increasers" under heavy use. If this be true, then rotation grazing benefits the miscellaneous mid grasses more than continuous grazing.

Two other divisional rotations were studied at Woodward, both being tested in two divisional pastures. In the one study the steers were rotated back and forth at monthly intervals during the six months summer season. In the other study the steers were kept on one-half of the pasture for an entire year before being rotated to the other half for a corresponding period. Both tests showed that continuous grazing had a slight though insignificant advantage in gain per head, and a slight advantage in improvement of vegetation.

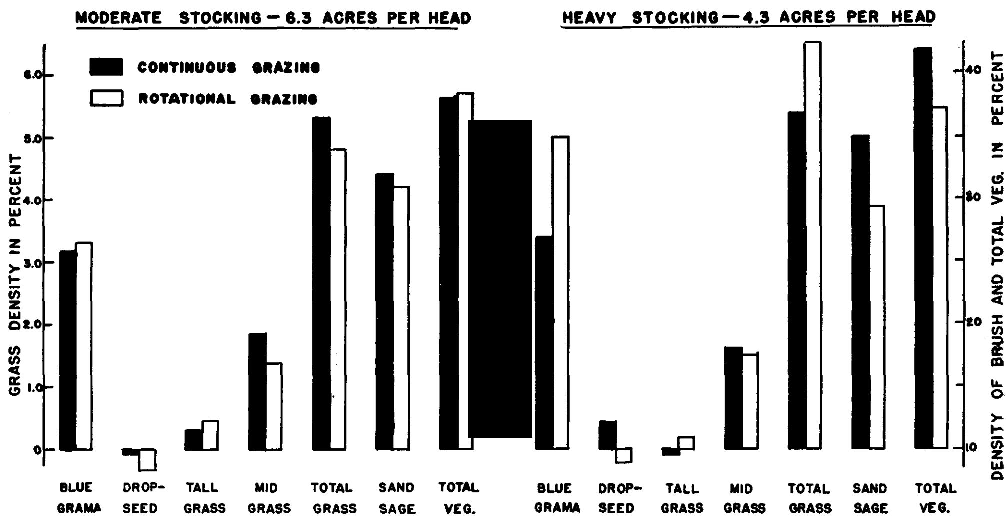

FIGURE 3. Change in percentage density of grass and other vegetation on the experimental pastures from 1940 to 1949, as determined by the line transect method.

DISCUSSION

What are some of the probable causes of failure of "divisional rotation"? Apparently the detrimental effects of heavy stocking on two-thirds of the pasture balances the beneficial effects of deferment on one-third. Cattle gains are less during spring and summer because the animals are denied access to each plant species when it is most palatable and nutritious. Also the cattle make less gain while becoming accustomed to the new pasture. They usually spend some time trailing around the fence lines. Two-thirds of the rotation pasture was being more heavily grazed than the continuously cropped pasture, hence only one-third of the area would receive full benefit of seeding.

What is the probable answer to the paradox that rotation, though providing a rest period, does not significantly improve the grass stand? Evidence indicates the need of a reduction in stocking rate rather than in the rotation of the same number of stock to effect improvement through deferment.

Summary

Continuous and rotational grazing at moderate and at heavy stocking rates were compared on the Southern Plains Experimental Range since 1942. The studies were conducted in duplicate on eight native range pastures. Four of these were divided into three equal parts and grazed on a rotational basis in direct comparison with four undivided pastures. Other pastures were grazed on a two-divisional rotation system. The tests were designed to determine the advantage, if any, of dividing a dryland, native range pasture into two or three equal parts and rotating the grazing animals at regular intervals throughout the growing season.

Yearling Hereford steers of uniform brand, breed, age, size, and quality were grazed at the same stocking rates under the two systems. During the first summer —1942—the animals on rotation pastures were moved between sections at two-month intervals. Both vegetation and cattle were severely punished by this procedure. Since 1942, the animals were rotated at monthly intervals each summer except one when they were moved semi-monthly.

Results of the several tests at the end of eight years show no significant differences between continuous and rotational grazing in cattle gains, but continuous moderate grazing did produce an annual advantage in gain per head of 10 pounds, or 2.5 pounds per acre.

On the other hand, the density and vigor of grasses in the rotational pastures showed slightly more improvement, particularly under heavy stocking, though there were few statistically significant differences. The density of blue grama, sand bluestem, little bluestem, switchgrass, and sand lovegrass increased, while sand dropseed decreased, and more so under rotational than under continuous grazing.

The grass and other vegetation in the rotational pastures did not improve sufficiently during the eight years of grazing to justify the needed cross-fencing and water development, and to manage the cattle on a rotational basis. But the steers on the continuously grazed pastures made slightly greater gains per head and per acre. The detrimental effect of heavy stocking apparently overshadowed the beneficial effect of deferment. The cattle on continuously grazed range have access to all the grasses when they are most nutritious.

Since there are no important significant differences between the two systems in steer gains or in improvement of vegetation, divisional rotation grazing cannot be recommended over continuous grazing as an improved management practice on the sandsage vegetation of the southern Great Plains.

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PRODUCTIVE TYPES OF LIVESTOCK

The most productive types of livestock have been developed in regions where ample feed is produced and where temperate climatic conditions prevail. These regions are also those in which the economic status of the people is best and where considerable emphasis has been placed on research and extension or advisory activities designed to assist livestock producers in their efforts to improve their animals. In less productive regions, the limitations laid down by nature have prevented development, by the livestock producer, of animals highly specialized for meat, milk, wool, or work production. Generally poorer economic conditions have also hindered the development of highly competent research and extension services to assist the livestock owner.

Ralph W. Phillips
in Breeding Livestock adapted to Unfavorable Environments.
FAO Agri. Studies No. 1, 1949.