Mechanical Treatments on Wyoming Range Land

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DURING the past 10 years, the Wyoming Agricultural Experiment Station, the Research Division of the Soil Conservation Service, and the Bureau of Plant Industry, Soils, and Agricultural Engineering of the U. S. Department of Agriculture have cooperated on studies of mechanical treatments for range improvement. This has been done principally at the Archer Field Station in southeastern Wyoming near Cheyenne. During the past four years these experimental studies have been extended to field trials over the state through the cooperation of numerous private landowners and Soil Conservation Service technicians and R. L. Lang of the Wyoming Experiment Station.

Several treatments resulting in the mechanical renovation of the cover and retention of water have materially and consistently increased the volume of perennial grass on shortgrass range over the last 10 years.

These studies of mechanical treatments have included furrows of various sizes ranging from four-inch grooves up to 10-inch plow furrows spaced at various intervals. The spacing intervals included furrows ranging from two feet up to 50 feet apart. It was found that spacings greater than about five feet failed to bring about any significant effect on the volume or composition of the cover. The vegetation adjacent to the furrows, for a distance of one to two feet responds to the additional moisture held in the furrow; however, at intervals of 10, 20 and 30 feet or more apart, this zone near the furrows represented a relatively small portion of the total area. A detailed report was made on this work by Barnes and Nelson (1945). Spacings of small furrows two feet apart have proved the most effective and profitable type of furrowing treatment.

Another type of treatment included in these studies was pitting. This was done with a one-way disc plow (Fig. 1A) developed by A. L. Nelson, Superintendent of the Archer Station, for summer fallow work. This machine gouges out small basins leaving the range with a waffle-like appearance as shown in Figure 1B. These basins or pits, as used in these studies, are spaced about 16 inches apart. The actual capacity of an acre of these pits is roughly 1,000 cubic feet, or a little less than 0.28 acre-inches of water. In its effect on vegetation, this treatment has been equal to small grooves at two-foot intervals. From the standpoint of ease and economy of applying the treatments, the pitting has been superior to all other treatments tested. Consequently, most of our studies the past several years have concentrated on the pitting treatment.

More than 50 plots varying from five to 15 acres each have been established on a variety of soils and vegetative types over the state. The majority of these tests were on shortgrass range which included sites varying from sandy soil to clay loam and vegetation varying from all grass cover to mixtures of sagebrush and shortgrass. Follow-up studies and observations have been made on test plots on sagebrush-wheatgrass type of vegetation, desert-shrub type and on bottomland supporting a pure wheatgrass cover. The results are not conclusive for all soil and vegetative types as yet. However, they show clearly

that pitting on short-grass range is a dependable improvement practice. On the other range types, the studies have run only two or three years and effects of pitting have not been as consistently favorable or as pronounced as on the shortgrass range. Further studies will be made on all of these plots, particularly on types other than shortgrass.

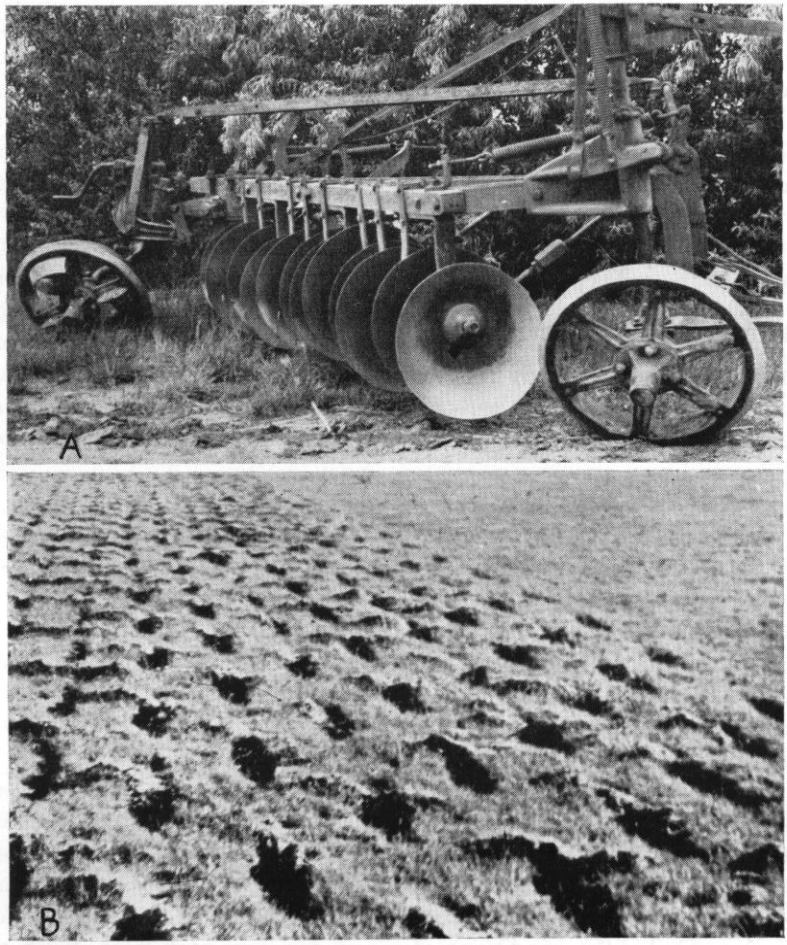

FIGURE 1. A. One-way disc plow with eccentric discs. For use on the range, Nos. 2, 4, 6 etc. discs are removed. Only every other disc remains and these are mounted two inches off center on gang bolt. B. Treated range showing pattern of pits.

The shortgrass range type showing consistent benefits from the pitting treatment consists of approximately 75 to 85 percent blue grama (*Bouteloua gracilis*) and buffalograss (*Buchloe dactyloides*) with the remainder of the cover made up of cool-season grass species and a few annual and perennial forbs. The cool-season species include principally western wheatgrass (*Agropyron smithii*), needleandthread (*Stipa comata*), sandberg bluegrass (*Poa secunda*), dryland sedges (*Carex filifolia* and *Carex stenophylla*), and junegrass (*Koleria cristata*). Across eastern Wyoming the proportion of buffalograss to blue grama in this cover ranges from traces in the northern part to as much as

30 to 40 percent in the southern part. However, over a large portion of the plains of eastern Wyoming around 75 percent of the cover consists of these shortgrass species.

On the shortgrass type, pitting has been applied on a variety of soils ranging from sandy to clay loams. So far there has been little difference in vegetative response to pitting on these different soils. It appears that the composition of the vegetation has been more important to the success of pitting than has the soil type.

Pitting with Eccentric Discs

The pitting treatment initially reduces the vegetative cover by about 30 percent. The vegetative response to this pitting has been marked by an almost immediate increase in western wheatgrass. This is probably due to the tillage and renovation effect plus reduced competition. The western wheatgrass responds more rapidly than other species and pitted range usually has two to three times more western wheatgrass plants than does adjoining non-pitted range. However, there still is a predominance of the shortgrass species.

In 1939 Whitfield and Fly, in the Southern Great Plains, reported an increase in range production and a striking change in composition of the cover following contour furrowing. Under the conditions of the northern part of the Plains, the increase in western wheatgrass and other cool-season species also adds to the grazing capacity of the range through increased conservation of moisture and the resulting greater forage production of all species, more feed early in the spring and a better variety of feed. The average number of western wheatgrass plants per square meter present in the eighth year after pitting was 175 as compared with 84 plants for non-treated range.

Shortgrass range pitted 10 years ago still supports approximately twice as many western wheatgrass plants per unit area as does adjoining non-pitted range. Grooving at two-foot intervals gave similar results on this shortgrass range during the same period. After about the seventh year this treated range has shown a gradual increase in cover of blue grama and buffalograss which has been accompanied by a slight decline in grazing capacity. However, one group of treated pastures in the tenth year were still supporting over 20 percent more grazing with a lower forage utilization than non-treated range.

Shortgrass range with the approximate composition described has shown the greatest response to pitting. In a few locations where the cover is almost exclusively shortgrass with no cool-season species present, the pitting effect has not been so pronounced, although some increase in volume of shortgrass species results from the pitting. In other words, if there is no western wheatgrass or other cool-season species present, the pitting has had little influence on the composition of the shortgrass cover and the benefits of the treatment are somewhat reduced.

The actual value of pitting or similar mechanical treatments at the Archer Station has amounted to an average of approximately 32 percent more sheep carried per acre with 10 pounds more lamb gain per acre each year. Even with this difference in stocking and gains there has been an average of about 50 percent more perennial grass left each year at the end of the grazing season on the pitted pastures. The lamb gains per head as shown in Table 1 have been about equal on the pitted and non-pitted range. Thus the differences in gain per acre are in direct ratio to the stocking rate differences. The advantage as shown in Table 1 means that for eight years the pitted pastures produced a little over 10 pounds more lamb per acre or a total of 80 pounds.

To understand why the pitted pastures carried more sheep and still had significantly more grass left each year, a few points should be noted. The system followed in these studies was to utilize the shortgrass species to the same degree on the pitted and check pastures each year. That is, when grazing had taken the shortgrasses down to an average leaf height of about one inch, grazing was discontinued for the year. By making minor adjustments in the number of animals on the pastures during the season, this degree of use was reached on all pastures at about the same time in the fall. The fact that the pitted pastures support more western wheatgrass and that the sheep tend to concentrate on shortgrasses in the late summer and fall, means that the midgrasses will be underutilized to some extent on the pitted pastures when use of shortgrass is stopped at the one-inch height. This situation suggests the possibility of using cattle or in combination with sheep in order to make more use of this midgrass. However, the carryover on the pitted pastures is not entirely lost in that an excellent litter has been accumulated on the pitted pastures that will serve in soil and moisture conservation.

Costs of pitting are relatively low. The fact that it can be done most any time, wet or dry, means that it can be worked into slack periods and, in many cases, this would mean lower cost of pitting. The implement requires little power, any small tractor will easily handle it on sod land. On practically any shortgrass range the implement can be pulled at speeds up to seven or eight m.p.h. Theoretically, this would mean that with a 10-foot disc, seven or eight acres can be pitted per hour.

TABLE 1

Grazing and utilization record from shortgrass range pitted in 1942 compared with non-pitted range
(Averages of Duplicate Pastures for Each Treatment)

	TREATMENT	1942	1943	1944	1945	1946	1947	1948	1949	8-YR AV.
Sheep Days, per acre	Pitted	71	86	92	86	66	95	68	64	79
	Check	71	69	59	61	46	70	49	56	60
Lamb gain, lbs. per acre	Pitted	32.0	56.4	47.3	43.6	30.0	39.9	33.3	34.3	39.6
	Check	27.9	42.9	28.2	32.1	20.8	29.2	25.2	29.9	29.5
Lamb gain, lbs. per head	Pitted	37.4	62.3	38.5	58.1	50.4	57.3	43.6	49.1	49.6
	Check	34.6	56.9	36.0	54.9	52.0	54.7	47.3	49.0	48.2
Lbs. per acre Perennial Grass Left at end of Grazing season	Pitted	425	446	429	437	269	—	299	640	421
	Check	442	293	219	237	166	—	251	315	274

Formal comparative studies have not been conducted as to the best time of year to pit. However, in establishing numerous field trials over the state some observations have been made. All indications are that the very early spring before plant growth starts is the best time, although fall and winter pitting has been satisfactory. Pitting in the summer has been done occasionally with the least satisfactory results.

Pitting and Seeding

Anderson and Swanson (1949) reported successful seedings on range land in Arizona with the eccentric one-way disc and a culti-packer attached. Under their conditions pitting conserved enough moisture and reduced existing competition sufficiently to allow establishment of several species of lovegrass (*Eragrostis sp.*).

During the last five years studies have been made of the possibilities of seeding adapted grasses into various range types in Wyoming in conjunction with pitting. The objective was to improve the variety of species on a site and in some cases, ultimately to increase the ground cover. Plots for this study were established over the eastern half of Wyoming at more than 30 locations.

FIGURE 2. Implement used for pitting-seeding studies, showing adaptation of seed box and teeth welded on disc for seeding operation.

Several grass species were included in these tests although crested wheatgrass was most commonly used. In a few instances alfalfa and sweet clover were tried. The implement used is shown in Figure 2. The seeding was done simultaneously with the pitting. The teeth were welded on the discs to make a crease in the pits for the seed to fall into and thus be on firm soil with some loose soil falling back and covering the seed. The pitting cuts out about one-third of the existing competition and provides an opportunity for collecting additional moisture around the seed.

These tests were put on typical shortgrass range, on sagebrush-wheatgrass range and on bottom land with a cover predominantly wheatgrasses. In general, these sites were in the 10 to 14-inch rainfall belt.

This reseeding attempt has been almost completely unsuccessful on shortgrass range. The seed would usually germinate, emerge and grow until hot weather arrived, then the competition for moisture from the native, established species eliminated the seedlings. This was the usual experience each year at all locations on the shortgrass and bottom land type. On the sagebrush-wheatgrass type there has been some establishment. On this type, with a sparse cover of perennial grass before the pitting-seeding operation, fair establishment has been obtained. This method of seeding will bear further study on this latter type or similar types with very sparse perennial grass cover. However, from the results of this study, it appears that generally to seed into shortgrass range successfully, it will be necessary to work up a good seedbed to eliminate the competition of native perennials.

SUMMARY

Results from studies at the Archer Field Station in Wyoming show that both small-type closely spaced furrows and pitting significantly increase the forage production on shortgrass range. Larger furrows spaced at intervals of five to ten feet or more do not significantly increase the total production of the range.

On shortgrass range, benefits resulting from pitting with an eccentric disc plow and from closely spaced furrows can be attributed to at least three things: (1) the tillage has a renovation effect on the vegetation; (2) the pits and furrows retain runoff water; and (3) a beneficial change in composition of the cover, that is, less shortgrass and more midgrass, which tends to conserve moisture through greater accumulation of litter and greater snow-holding ability and through the use of moisture earlier in the spring.

Pitting or similar treatment appears beneficial to typical shortgrass range and is most effective if the stand contains some of the taller grasses. Sagebrush-wheatgrass and other vegetative types as yet have not shown marked and consistent benefits from pitting but will bear further observation.

No significant difference in the effect of mechanical treatments on shortgrass range has been noted as related to soil type. Trials have been made on soils ranging from sandy to clay loams.

The value of mechanical treatments on the Archer Station has amounted to about a one-third increase in grazing capacity with a corresponding increase in animal gains.

LITERATURE CITED

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REVEGETATING SAND HILLS IN KANSAS

The sand hills south of the Arkansas River in Finney County, Kansas are an overgrazed, eroded area that was once fine rangeland. The drought of the Thirties practically eliminated the native grasses, and sagebrush, soapweed and poor annual grasses took over the land.

Revegetation results have been good from a treatment promoted by Gerald Van Vleet, Soil Conservation Service conservationist. The brush is first "one-wayed" with 26-inch disks, drawn by a tractor. The one-way disks are set to cut an average of about 2 inches, just enough to "skin" the sage down and still leave plenty of cover. The tractor travels between 3½ and 4 miles per hour over most of the terrain, and the disks cut a 25-foot swath. This also serves to level off hummocks and other irregularities in the ground. The trash is left on top for protection against wind erosion.

Desirable grasses, such as sand love-grass, Indiangrass, switchgrass and sand bluestem, are then seeded by using a grass drill. In extremely rough areas the seeding is done by airplane. Good results have been obtained from seeding in early fall or winter, thus taking advantage of the freezing and thawing in early spring.

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