Longevity of Ripped Furrows in Southern Arizona Desert Grassland

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VARIOUS mechanical treatments have been applied to rangeland to conserve moisture, prevent erosion, and increase forage production. These treatments have included construction of rock and brush percolators, terracing, pitting with an eccentric disc, and contour furrowing with a lister or other shallow-draft plow.

Ripping with a subsoiling chisel is one variation of contour furrowing that has been extensively used. Two (occasionally one or three) subsoiling chisels are spaced five feet apart on a wheeled implement carrier drawn by a heavy crawler-type tractor. This treatment produces a furrow as deep, and a ridge as high, as an average lister furrow. The subsoiling chisel has the additional advantage of loosening the soil to a depth of 18 to 24 inches which provides a deep reservoir for water collected by the furrows.

Because of the heavy draft of the ripper and the resultant large power requirement the treatment is expensive. Commercially ripped furrows in southern Arizona cost from $6 to $15 per acre, where the entire area is treated. In spite of this expense, results on some ranges have been so satisfactory that the method is being used widely.

A major factor in determining the economic feasibility of such a treatment is the longevity of the furrows, i.e., the length of time the furrows are effective in producing more forage than the surrounding, non-ripped range. Several studies (Whitfield and Fly, 1939; Dickson, *et al.*, 1940; Barnes and Nelson, 1945; Caird and McCorkle, 1946), have indicated the value of furrows for expediting recovery of rangeland. Caird and McCorkle place the longevity of listed furrows at seven years. No study on the longevity of ripped furrows has been reported.

The writers had opportunity to observe the condition of ripped furrows on a southern Arizona ranch ten years after treatment. Since the furrows still appeared to be effective, a study of grass yield was made to determine the effects of these furrows after such a prolonged period.

Site Conditions

The study area is at an elevation of 4,950 feet on the Babocomari Ranch, four miles southeast of Elgin, Santa Cruz County, Arizona. The area is representative of some of the highest-potential desert grassland range in Arizona.

Average annual precipitation is about 16 inches, received mostly in July and August. The June mean maximum temperature is 90°F., and the December mean minimum 25°F. Snowfall averages about six inches annually.

The soil, a sandy clay loam, is deep valley fill which contains an abundance of fist-sized boulders. The topography is rolling, or with flat table-lands dissected by deep, steep-sided drainages.

The vegetation is grassland (Fig. 1), with a mixture of blue and hairy gramas (*Bouteloua gracilis*, *B. hirsuta*) predominating. Wolftail (*Lycurus phleoides*), pov-

erty three-awn (*Aristida divaricata*), and a mixture of less important gramas (*Bouteloua* spp.) make up most of the grasses are dominant. A few young mesquites (*Prosopis juliflora* var. *velutina*), and an occasional prickly pear

FIGURE 1. Ripped furrows, ungrazed since before the 1949 growing season. (Above) Two-year-old furrows with mostly poverty three-awn grass. (Below) Ten-year-old furrows with side-oats grama and cane beardgrass.

remaining vegetation. Where water accumulates, sideoats grama (*Bouteloua curtipendula*,) cane beardgrass (*Andropogon barbinodis*), and other mid and tall (*Opuntia* spp.) indicate a potential invasion of shrubs on the study area.

The Babocomari Ranch was originally established as San Ignacio del Babacomari

(*sic*), a land grant to Ignacio and Eulalia Elias, December 25, 1832. It has been grazed almost continually since that time. Mr. Frank C. Brophy has owned the ranch since 1934, at which time it was in a severely depleted condition. In 1939 the Soil Conservation Service entered into a cooperative agreement with Mr. Brophy, established a management plan for the ranch, and applied a number of mechanical range treatments. Several areas of contour-furrows were included in these treatments. Mr. Brophy has contour-furrowed some portions of the range almost every year since the 1940 ripping. The furrows were in pairs spaced five feet apart at approximately 30-foot horizontal intervals. In the fall of 1950 the authors obtained grass yields from one of the originally treated areas.

Methods

The effect of the contour-furrows on forage production was determined by comparing the air-dry yield of grass on and between the pairs of furrows. Sample plots 9.6 square feet in size (4.8′ × 2.0′) were mechanically located throughout the study area. The metal frame was placed either on the furrow or far enough away to be free from the furrow influence. Ripping influenced the area actually furrowed, and for about two feet on either side. Thus, two chisels at five-foot spacing would influence a maximum area of about nine feet. This is in accord with the findings of Caird and McCorkle (1946), Barnes and Nelson (1945), and Whitfield, *et al.* (1939), who concluded that solid listing resulted in heavier forage yields than wider spacings.

The total weight of all the grass within the plot was estimated. This weight was then broken down into estimated percentages by species. The grasses were clipped at a one-inch stubble height, the individual species weighed, and the estimated percentages corrected. The procedure of estimating and weighing was continued until the estimates were consistently within ten percent of the actual percentage weights. After this, the percent composition by weight of the plots was estimated and the species combined in clipping. The samples were retained throughout the study for dry-weight determinations. Fifty plots were clipped on the furrows and fifty between the furrows.

TABLE 1

Forage production on 10-year-old ripped furrows and on adjacent untreated range

SPECIES	POUNDS PER ACRE		PERCENTAGE OF TOTAL WEIGHT	
	On	Off	On	Off
Cane beardgrass	138	9	9.8	1.6
Poverty three-awn	198	80	14.1	14.2
Blue and hairy gramas*	526	319	37.5	56.7
Wolftail	285	78	20.3	13.9
Sideoats grama	154	1	10.9	0.2
Spruce-top grama	30	41	2.0	7.2
Black grama	25	8	1.8	1.5
Other perennials†	28	17	2.0	3.1
Total perennials	1384	554	98.5	98.4
Annual grasses	21	9	1.5	1.4
Total grasses	1405	563	100.0	100.0

* Blue and hairy gramas were combined to facilitate estimates in the field.

† Slender grama, small grama, curly mesquitegrass, vine mesquitegrass, plains bristlegrass, Arizona cottongrass and fluffgrass.

Results

Ten years after ripping, the furrows and ridges were still very evident, although smoothed by erosion and deposition. Forage production on the ten-year-old furrows was 1405 pounds per acre as opposed to 563 pounds between the furrows (Table 1). Most of this increase was due to an increase in cane beardgrass, sideoats grama and wolftail

The percentages of poverty three-awn and annuals remained constant.

From close observation of areas ripped ten and two years before, and from more casual observation of other areas treated at intermediate and later dates, certain successional trends may be recognized. On deteriorated ranges that still have a good remnant of perennial grasses, the first year of ripping is marked by a large increase in annual grasses, as well as by an increase in volume production of perennial grasses adjacent to the furrows. There is also some seedling establishment by perennial grasses.

Poverty three-awn becomes established in the rips more quickly than other native grasses and the years immediately following treatment are marked by an abundance of this grass. As time passes, the three-awn is largely replaced by blue and hairy gramas, wolftail, and sideoats grama. Cane beardgrass assumes dominance on more favorable sites.

Discussion

That these ripped furrows are still operative after more than 10 years is indicated by the high forage production of the furrows in comparison with the non-ripped land. This high forage production and the present condition of the furrows lead the authors to believe that these furrows will probably remain active for about five years more.

Should these furrows remain effective for fifteen years, their longevity would be more than double that reported for listed furrows by Caird and McCorkle (1946). On this basis, the initial outlay for construction of ripped furrows may be double that of listed furrows, if the advantages of forage production are similar for the two treatments. Herbage production in this study was increased 2.5 times under ripping. Dickson, Langley, and Fisher (1940) report grass production increases of 2.1 to 4.1 times as a result of listing at Spur, Texas. Considering the difference in climatic and edaphic conditions between Spur, Texas, and Elgin, Arizona, it appears that the two treatments may be equally effective.

The increased herbage production which follows ripping is only one aspect of the effect of this treatment on range vegetation. The effects of furrowing on the palatability and nutrient qualities of the feed should be more thoroughly investigated. Observations indicate that palatability of the original grasses on ripped areas is reduced because of the coarseness of the grass. Caird and McCorkle (1946) made similar observations on contour-furrowed grassland. They also noted, as did the authors, that grass in the furrows began growth earlier and remained green longer than grass on untreated range. Differences in species composition resulting from ripping would further alter the animals' diet.

The possibilities of this treatment as a soil preparation for range reseeding have never been satisfactorily investigated. Numerous seedings of native and introduced grasses along the furrows made by the ripper have been successful on the Babocomari Ranch. The additional water storage permitted by the deep soil disturbance frequently permits the grasses to produce seed during the year of establishment.

Summary

This study was conducted to determine the longevity of contour furrows made with a subsoiling chisel. Grass production was measured on an area in southern Arizona grassland contour-furrowed in 1940. Ten years after the 1940 treatment the ripped area produced

2.5 times more grass than the non-ripped area. On the basis of this study and present conditions of the furrowed areas, the longevity of contour-furrows appears to be about 15 years.

ACKNOWLEDGEMENT

The authors extend their appreciation to Frank C. Brophy, rancher, for his cooperation in this study, and to Dan Freeman, SCS District Conservationist and supervisor of the original furrow installation, for reviewing the manuscript.

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IF YOU WANT TO WRITE

Do the headwork before the handwork.—*Anonymous.*

A drop of ink may make a million think.—*Byron.*

If you would create something, you must be something.—*Goethe.*

By the work we know the workman.—*LaFontaine.*

Think much, speak little, and write less.—Italian Proverb.

A man may write himself out of reputation when nobody else can do it.—*Thomas Paine,* The Rights of Man.

The pen is the tongue of the mind.—*Cervantes,* Don Quixote.