Influence of Rootplowing and Seeding on Composition and Forage Production of Native Grasses[1, 2]

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Highlight

Effects of rootplowing, with or without seeding, on forage production and composition of native grasses were determined on a deep upland range site. Percent composition of stoloniferous species, particularly buffalograss, was reduced initially and after 6 growing seasons by the rootplowing treatments. Frequency counts indicated a reduction of Texas wintergrass on rootplowed plots (seeded and nonseeded) compared to an undisturbed, native check area. This reduction the first growing season was attributed to the competitive effect of sorghum almum introduced in the seeding mixture. Unsuccessful establishment of other seeded grasses (sideoats grama and switchgrass) appeared to be related to poor seedbed preparation, competition from sorghum almum plants, and below normal rainfall immediately after seeding. Rootplowing decreased grass production. After 6 growing seasons, significantly less forage per acre was produced on rootplowed-seeded plots than on nonrootplowed plots. Differences in forage production were related to plant composition and density.

Resumen[4]

La Influencia del Arado Desenraizador Sobre la Produccion y Composicion de los Zacates Nativos

El estudio fué empezado en el año de 1964 en el rancho experimental de Texas en el Municipio de Throckmorton; el diseño incluyó testigo; y se pasó arado para desenraizar sin la siembra y se pasó arado para desenraizar con la siembra. Después de 6 años los dos tratamientos disminuyeron la producción de forraje y composición de zacates deseables.

El zacate sorghum almum (*Sorghum almum*) apareció en la siembra. El arado desenraizador controló el mezquite (*Prosopis glandulosa* var. *glandulosa*).

Rootplowing for control of dense stands of mixed brush, particularly mesquite (*Prosopis glandulosa* var. *glandulosa*), has been highly effective on many areas of Texas rangeland. However, in sections of the state where rainfall is a limiting factor, this practice frequently destroys a high percentage of the desirable perennial grass species and results in invasion of annual grasses and undesirable weeds (Fisher et al., 1959; Jaynes et al., 1968).

This reduction of existing native grasses as a result of rootplowing is apparently associated with soil disturbance and its effect on microclimate. According to Hughes (1966), average maximum soil temperatures were higher and average minimum soil temperatures were lower at the 6-inch depth on rootplowed plots. Minimum soil temperatures were almost 20 F lower than equivalent measurements on nontreated plots. Air movement and evaporation were also greater on the treated area.

Results of Hughes' study showed that rootplowing on a heavy clay soil reduced herbage production of buffalograss and tobosa (*Hilaria mutica*) compared to a nontreated area. Total production was greatest on the rootplowed plot, but forbs and annual grasses were the major components of the vegetative composition.

Powell and Box (1967) concluded that brush control with a minimum of soil disturbance was the most reliable method of improving successional stage and increasing forage production. Results from their investigation revealed that soil disturbance retarded plant succession and caused large fluctuations in yearly forage production.

Since soil disturbance created by rootplowing appears detrimental to certain species of native forages, presumably this disadvantage could be overcome by reseeding in conjunction with root-

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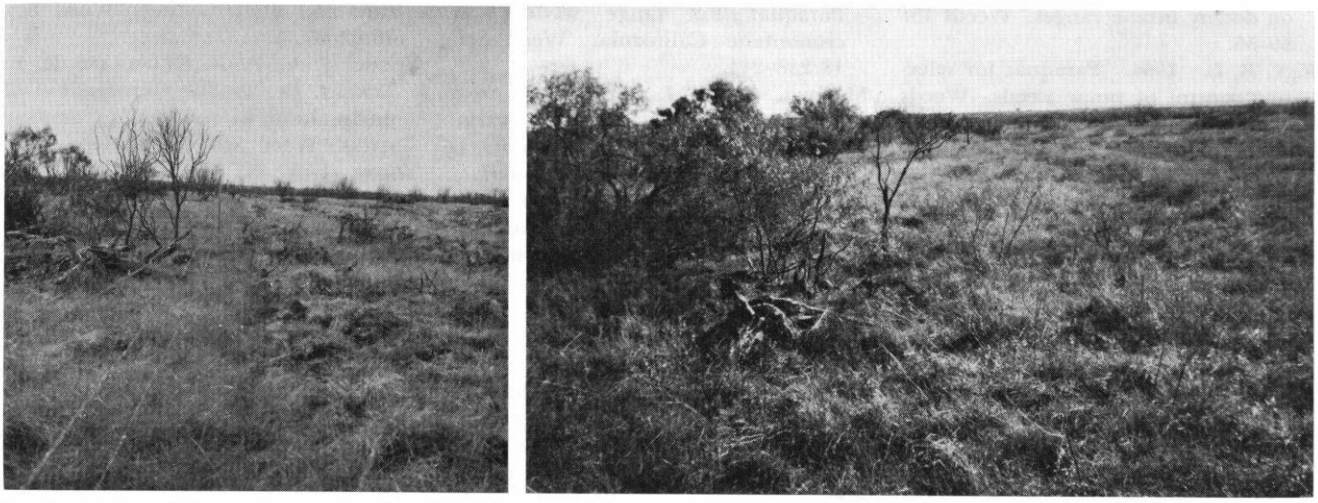

FIG. 1. A view of the study area showing the native check plot adjacent to rootplowed and seeded plots in June, 1964 (left) and in September, 1969, six growing seasons after treatment (right).

plowing. However, results from investigations of this nature are highly erratic. Fisher et al. (1959) reported that good stands of native and introduced grass species were obtained on moderately productive, tobosa–buffalograss type grassland following rootplowing and disking. On the contrary, Jaynes et al. (1968) found that seeding native grasses at the time of rootplowing failed to provide satisfactory stands at several locations. Unsuccessful establishment was attributed to rapid depletion of soil moisture from the loose, open soil created by the rootplow and from severe weed competition.

The objectives of this study were to determine the initial and long term effects of rootplowing, with and without seeding, on forage production and composition of established stands of native grasses.

Study Area and Procedure

The study was conducted on the Texas Experimental Ranch located in Throckmorton County. Although the average annual precipitation (24.83 inches) in this area of the Texas Rolling Plains is somewhat greater than in the western portion, it is considered quite variable (Texas Almanac, 1968). Most of the rainfall occurs during the growing season with May and September the peak months. Annual precipitation was below normal only one year during this study. In 1967, total precipitation was 21.92 inches.

The area used for treatment was a deep upland range site supporting primarily Texas wintergrass and buffalograss with an overstory of moderately dense mesquite (Fig. 1). Since this area had been chained in 1948, most of the mesquite trees were in their secondary growth stage and were of uniform height and canopy cover.

Soil in the experimental plot was classed as Crawford clay with a slope of less than 1%.[5] Characteristically, this soil is a reddish brown, noncalcareous, blocky, heavy clay underlain by limestone at a depth of 20 to 40 inches. This soil is considered highly productive with a high water storage capacity.

In March of 1964, eight adjacent 200 × 25 ft plots were established in a 374 acre reserve pasture on the Experimental Ranch. A preliminary, vegetation survey was made of the area to determine the percent composition and pounds of available forage of existing native grasses. Percent composition and frequency counts were determined by the inclined-point contact method described by Levy and Madden (1933) and available forage was determined by yield from 1.92 ft^2 quadrats. The clipped forage was air-dried, weighed to the nearest tenth of a gram, and converted to pounds per acre by multiplying by 50.

Following the vegetative survey, all 8 plots were plowed to a depth of 12 to 14 inches by a rootplow mounted behind a D-8 Caterpillar tractor. Moisture conditions were considered adequate at the time of plowing.

Four plots were broadcast seeded with an equal mixture of sorghum almum, sideoats grama, and "Caddo" switchgrass to make a total seeding rate of 7 lb./acre and 4 plots were unseeded.

The recommended management procedure following a brush control and seeding treatment of this nature is to defer grazing from the treated area for one or more years during the growing season. In some instances, this results in additional cost to the landowner or operator because of the required reduction in animal units.

Sorghum almum was included in the seeding mixture as a "filler grass" to determine if such a plant could be seeded in conjunction with rootplowing without adversely affecting native stands or the establishment of other seeded species. Sorghum almum has been described as a weak perennial that produces a large volume of forage the first year or two after seeding and then regresses in established stands (Trew, undated). We anticipated that this species might furnish useable forage the first growing season, and provide immediate income to help offset the cost of the treatment.

Immediately after rootplowing and seeding, a fence was constructed to exclude livestock only during 1964. A non-

[5] Soil information obtained from a tentative Soil and Range Classification Guide of Throckmorton County prepared by the U.S.D.A. Soil Conservation Service.

Table 1. Vegetative composition (%) of a grassland community before treatment and after the first and sixth growing seasons following rootplowing with and without seeding.

Species	March, 1964 (Before root plowing)	September, 1964			September, 1969		
		Native Check	Rootplowed		Native Check	Rootplowed	
			Seeded	Nonseeded		Seeded	Nonseeded
Native species							
Texas wintergrass (*Stipa leucotricha*)	67	69	44	69	43	47	41
Buffalograss (*Buchloe dactyloides*)	16	28	8	8	37	14	29
Sideoats grama (*Bouteloua curtipendula*)	0	0	T[1]	0	6	0	7
Miscellaneous grasses	12	0	11	17	8	8	8
Annual grasses	0	2	2	4	3	13	9
Weeds	5	1	6	2	3	3	3
Seeded species							
Sorghum almum (*Sorghum almum*)	–	–	29	–	–	8	2[2]
Sideoats grama (*Bouteloua curtipendula*)	–	–	0	–	–	4	1[2]
Switchgrass (*Panicum virgatum*)	–	–	0	–	–	3	0

[1]Trace.
[2]A small percentage of the seeded species occurred in the nonseeded area due to natural invasion over the six-year period.

rootplowed (native check) plot, established adjacent to the rootplowed area, was not protected from grazing animals.

Stocking rates for the pasture containing the study area were heavy in 1964, 1966, and 1967 at approximately 10 acres per animal unit. Years of lightest utilization were in 1965 and 1969 with 41 and 47 acres per animal unit, respectively. Some deferment was provided during each year except 1964. A 76-day deferment period in 1969 occurred immediately before the final vegetative survey.

Both treated and nontreated areas were evaluated in September of 1964 and 1969 by determining vegetative composition and pounds of available forage by the same techniques previously described. Native and introduced species of sideoats grama were differentiated by their growth forms. The native sideoats grama on the study area was rhizomatous, whereas the seeded species was characteristically the bunch type.

Results and Discussion

A general view of the study area, 6 growing seasons following rootplowing with and without seeding, is shown in Figure 1. Control of mesquite was highly effective, but vegetative surveys revealed initial and long term negetive effects from rootplowing and seeding on composition and reproduction of native grass species.

Vegetative Composition

The initial effect of rootplowing on composition of native grasses is shown in Table 1. The vegetative composition sample of the experimental area revealed that the sod forming or stoloniferous species were less abundant in September of 1964 following rootplowing than they were in March before treatment. Buffalograss was reduced from 16 to 8% on the rootplowed (seeded and nonseeded) areas. Of the miscellaneous grasses, vine mesquite (*Panicum obtusum*) and common curly mesquite (*Hilaria belangeri*) were reduced from 6 and 4% of the original composition, respectively, to 0%.

Texas wintergrass apparently was not affected by rootplowing alone, but rootplowing in conjunction with seeding resulted in a decline of this species. Texas wintergrass is a cool season perennial that normally initiates new growth in September, if moisture conditions are adequate, and matures seed in May. Although conclusive data were not available, it appears that sorghum almum used in the seeding mixture was responsible for the reduction of Texas wintergrass. Sorghum almum contributed 29% to the total vegetative composition in September of 1964; therefore, a sufficient number of plants were present to reduce soil moisture. This may have increased the death loss of Texas wintergrass after rootplowing and limited germination and establishment of new seedlings before the September survey.

There was an increase of less desirable species during the first growing season. Wright threeawn (*Aristida wrightii*) and tall dropseed (*Sporobolus asper*) increased on both rootplowed areas, but sand dropseed (*Sporobolus cryptandrus*) only increased on the nonseeded plots. Annual grasses and weeds were not as abundant the first year after treatment as reported by Fisher et al. (1959) and Jaynes et al. (1968). We assumed that germination of these species was restricted by below normal rainfall during the first 4 months of the 1964 growing season. Also, vegetation was not sampled until September, and the short-lived annual species had already completed their life cycle and disappeared.

Sorghum almum was the only seeded grass in the vegetative composition at the end of the first growing season. The failure to establish sideoats grama and switchgrass was attributed to poor seedbed preparation, competition from the sorghum almum plants, and below normal rainfall during a 4-month period immediately after seeding.

Comparison of vegetative composition on the native check and rootplowed (seeded and nonseeded) plots in September, 1969, revealed long term effects of rootplowing and seeding. The percent composition of Texas wintergrass was approximately the same on all three areas but the percent frequency of Texas wintergrass was 17.7% on the native check compared to 10.4% and 10.7% on the rootplowed, seeded and nonseeded plots, respectively. A reduction in composition of this species on the native check in 1969 compared to 1964 was related to an increase in composition of buffalograss and sideoats grama. However, buffalograss was still greatly reduced on the rootplowed-seeded plots, comprising only 14% of the composition compared to 29 and 37% on the rootplowed-nonseeded and native check areas, respectively. Sideoats grama increased from 0% on the native check and rootplowed-nonseeded plots in 1964 to 6 and 7%, respectively in 1969 but remained at the 0% level on the rootplowed-seeded area. Annual grasses were more abundant on the rootplowed plots, but no differences in percent composition of weeds were observed among treatments.

The three introduced species were present after six growing seasons following rootplowing and seeding. As expected, sorghum almum decreased from 29% in 1964 to 8% in 1969. Sideoats grama and switchgrass accounted for 7% of the total vegetation. Since these two species were not present on the area in 1964, obviously germination and establishment occurred after the first growing season. This would indicate that either moisture conditions were not favorable for germination the year of seeding, or that the seed were partially dormant and required an overwintering period to become viable.

Forage Production

The effect of rootplowing, alone and in combination with seeding, on forage production of native grasses is shown in Figure 2. Although a test of significance was not made for the 1964 data, considerable reduction did occur in pounds of forage produced on the rootplowed (seeded and nonseeded) plots compared to the native check. Air-dry forage from the native check plot averaged 1620 lb./acre compared to 1173 and 823 lb./acre for the rootplowed, seeded and nonseeded areas, respectively. These differences probably would have been greater had the untreated area been excluded from grazing during the first year of the study as were the treated plots. This assumption is supported by comparing the pounds of available forage on the experimental area (3122 lb./acre) before rootplowing in March of 1964 to the native check area (1620 lb./acre) in September.

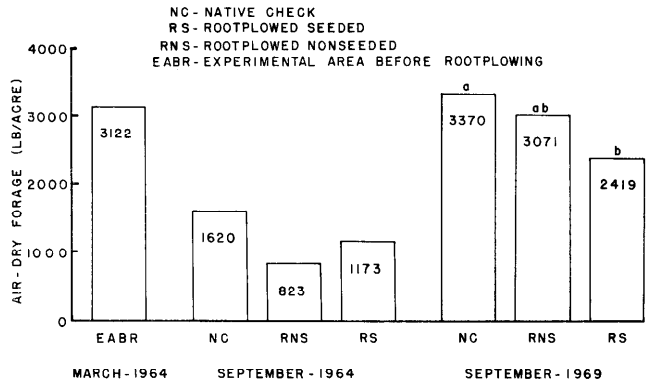

FIG. 2. Initial and long-term effects of rootplowing, with and without seeding, on forage production of native grasses. Values for the 1969 data with different letter superscripts (a,b) are significantly different at $P < .05$.

The difference in production between seeded and nonseeded plots in 1964 was due to the presence of sorghum almum on the seeded area. This species produced 331 pounds of air-dry forage per acre during the first growing season. From observation, this species appeared to produce a larger volume of forage during the second growing season, but plots were not sampled in 1965, therefore, substantiating data were not available.

Production on the rootplowed-seeded plots in 1969 averaged 2419 lb./acre which was significantly ($P < .05$) lower than the 3370 lb./acre produced on the native check. Production on the rootplowed-nonseeded plots was intermediate with an average of 3071 lb./acre. Less forage was produced on the seeded area because sorghum almum had regressed to only 8% of the composition. Possibly this species retarded production of the other grasses by competing for soil moisture and nutrients during the previous years of the study.

Total forage production of each area was related to the percent ground cover as determined by basal density of native grasses. Basal, point-contact readings in 1969 indicated a 41% ground cover on the native check plot compared to 24% on the root plowed (seeded and nonseeded) areas. Greater plant populations of Texas wintergrass, buffalograss, and other stoloniferous species on the native check were responsible for this difference. Although seeded species accounted for 15% of the composition on rootplowed-seeded plots, basal cover was 21% compared to 25% for the rootplowed-nonseeded treatment. Apparently, the seeded species replaced some of the native plants; primarily buffalograss.

Additional studies are needed to determine the feasibility of using sorghum almum or other high producing forage plants in seeding mixtures to help offset the initial cost of rootplowing as a brush control practice. Since rootplowing tends to destroy a certain percentage of native grasses and most rangelands, heavily infested with brush are in poor condition, reestablishment of desirable range plants is a necessity. Therefore, better methods of seedbed preparation and seeding practices in conjunction with rootplowing should be investigated.

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