Mechanical Control of Pricklypear and other Woody Species on the Rio Grande Plains[1]

J. D. DODD

Associate Professor, Department of Range Science, Texas A&M University, College Station, Texas.

Highlight

Rootplowing and rootplowing combined with rootraking increased the density of pricklypear stands but decreased the density of other undesirable woody species. Chaining resulted in extremely dense stands of pricklypear. Dragging caused a great reduction in the density of the pricklypear but had only limited effects on other woody species. Dragging, followed by rootplowing appeared to decrease the density of all undesirable woody species. This dual operation resulted in the establishment of a relatively brush-free grassland, which with management and periodic maintenance, can produce a large quantity of desirable herbaceous forage on a sustained basis.

Control Mecanico de Nopal en los Planos del Rio Bravo

Resumen[2]

El estudio se llevó a cabo en los planos del Río Bravo al sur de Texas. Se observó que tanto el desenraice con arado solo como el desenraice con arado combinado con rastreo aumentaron la densidad del nopal y disminuyeron la densidad de malezas arbustivas. El uso de cadenas resultó en nopaleras muy densas pero solo retardó el crecimiento de otras malezas arbustivas. En cada uno de estos métodos hubo una tendencia a cambiar de un tipo de vegetación dominante con arbustos a otro tipo con nopaleras densas.

Una serie de rastreos (con barandillas) causó una reducción significativa en la densidad del nopal, pero el único efecto sobre las malezas arbustivas fue una reducción de crecimiento. Sin embargo, este método seguido de un desenraice con arado dio lugar a una disminución de la densidad de todas las malezas arbustivas incluyendo el nopal. Este método combinado dio lugar al establecimiento de un pastizal de zacates con pocas especies malas el cual con un manejo adecuado y un control periódico de mantenimiento de las especies indeseables que van a reinvadir puede producir una gran cantidad de forraje deseable proveniente de herbáceas sobre una base de mantenimiento.

Much of the Rio Grande Plains of Texas was originally prairie (Johnston, 1963). It now supports such a growth of brush that only limited quantities of herbaceous forage are produced. Possibly the prominence of brush has been promoted by the reduction in stature and density of herbaceous species with continuous heavy use by both domestic livestock and wildlife.

Although some believe that the brush invasion has been recent, reports on the early vegetation of the Rio Grande Plains indicate that brush species, limited in size and density, have always been present (Johnston, 1963; Inglis, 1964; Lehmann, 1965). Johnston (1963) reports that increases in stature and density of the brush species has taken place during and since settlement. Some writers have attributed these increases to the cessation of fire (Humphrey, 1958; Lehmann, 1965).

Reports about brush invasion and wildlife and domestic livestock use of the vegetation include those of Box (1964), USDA (1964a), Box and Powell (1965), Powell and Box (1966).

Reports on the value of herbicides for the control of pricklypear (*Opuntia* spp.) on the Rio Grande Plains are available (Dameron and Smith, 1939; Darrow, 1950; Hamilton, 1950; Hoffman and Dodd, 1967; and others). In general, these reports indicate little success with broadcast applications. However, individual plant treatment will usually control pricklypear. Little information, however, is available on the chemical control of other woody species and the value of mechanical control measures for woody species, particularly pricklypear (Allison and Rechenthin, 1956; Powell and Box, 1967).

The present research was undertaken to determine the effects of various mechanical control measures on undesirable woody species on the Rio Grande Plains. Rootplowing has been a popular method of brush control in this area for 20 years or longer; other methods such as dragging have been developed more recently.

Methods

During 1964 and 1965, prairie areas on the Rio Grande Plains that had been subjected to the rootplow, rootplow and rootrake, chain, drag, and drag and rootplow were selected for study. Rootplowing is accomplished with a cutting blade mounted on the rear of a crawler tractor. Plowing depth is adjusted to the type of brush present, and is usually deep enough to cut the plants off below the root collar. Recently, a follow-up operation utilizing a front-end or drag rake has become common. This dual treatment is more costly than rootplowing alone. Chaining, one of the early mechanical control techniques used on the Rio Grande Plains, consists of an anchor chain looped between two crawler tractors. This technique probably is not used as commonly now as in the past. Equipment for dragging or railing brush on the Rio Grande Plains varies considerably. In some instances, weighted railroad rails fastened in series are used with a crawler tractor while lighter and smaller drags constructed of rails or large size

[1] This research was possible only with the cooperation of many ranchers on the Rio Grande Plains as well as by the cooperation of the Work Unit Conservationists in Jim Hogg, Zapata, Webb, Starr, and McMullen counties and the County Agricultural Agents in McMullen and Starr counties in locating areas. Appreciation is extended to David Terral for assistance in collecting field data.

[2] Por Dr. Donald L. Huss, Organizacion de las Naciones Unidas para la Agricultura y la Alimentacion (FAO), Dep. de Zootecnia, ITESM, Monterrey, N.L., Mexico.

gas pipe cut in half are used with a wheel tractor. A large-linked chain may be looped behind the light-weight drags for additional bruising.

Criteria for selection of the areas were: (1) an adjacent untreated check area of comparable management, (2) an area where the treatment was not less than 1 nor more than 4 years old, (3) an area representative of either a rolling hardland or sandy-loam range site, and (4) an area of adequate size to measure the results of brush control.

In each site selected, circular plots with a radius of 8 ft were established in both treated and check areas. Plot centers were located on a compass line 100 ft on either side of the boundary between the treated and check areas. Individual members of each pair were 200 ft apart. Each site thus was sampled with an arbitrary number of paired plots. The number of pricklypear plants rooted in each plot was counted.

Five size classes of pricklypear plants were established based on the number of cladophylls: Class 1: 0–5, 2: 6–25, 3: 26–50, 4: 51–100, and 5: over 100 cladophylls. From companion studies (unpublished) it was apparent that classes 1, 2, and 3 were reasonably representative of plants 1, 2, and 3 years old. Various size classes, depending upon the mechanical treatment, were present on the treated areas. This same variation in size was evident to a limited extent in the untreated stands due to the continual abscission of cladophylls and branches from the larger and older plants. Each cladophyll, stem, rhizome, or trunk is capable of vegetative regeneration.

Woody plants, other than pricklypear, were recorded on a frequency and presence basis. Presence is the percentages of study sites of occurrence, while frequency is the percentage of sample plots of occurrence within each site.

Nomenclature used follows Gould (1962).

Results and Discussion

The U.S. Soil Conservation Service (USDA, 1964a) reports that approximately 93% or over 15.75 million acres of the Rio Grande Plains of Texas are infested with undesirable woody species (Fig. 1). Of this total, approximately 12.5 million acres are considered to have a brush canopy cover greater than 20%. This is a sizable increase even though approved mechanical and chemical control measures have been used for many years. The continued increase in undesirable woody species has been accompanied by a corresponding decrease in the density and production of desirable grass species.

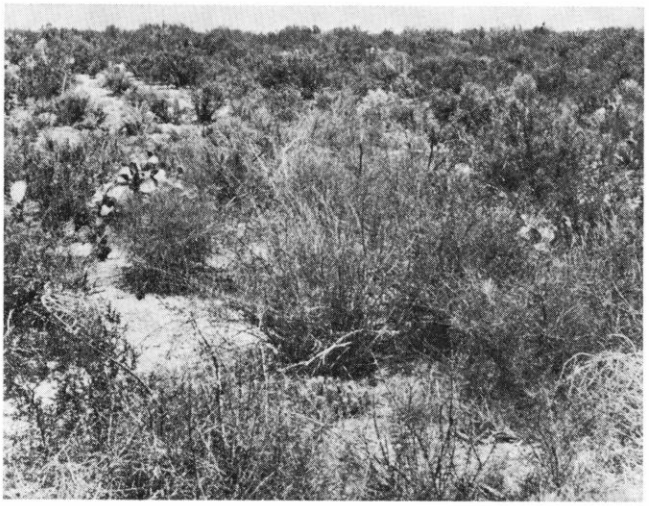

FIG. 1. Typical multispecies brush stand on the Rio Grande Plains. Note the limited number of pricklypear plants.

The results of this investigation show the effects of rootplowing, rootplowing-rootraking, dragging, dragging-rootplowing, and chaining on the vegetation of the Rio Grande Plains. The reaction of 27 woody species, including pricklypear, are expressed as changes in stand density and frequency of occurrence.

Rootplowing had little or no effect on reducing the density and occurrence of pricklypear. However, it was effective in reducing the stands of other woody species (Tables 1, 2, 3). Similar results have been reported by Powell and Box (1967).

Rootplowing broke up the pricklypear plants and scattered the cladophylls and other plant parts (Fig. 2). It did not reduce pricklypear density on any of the areas sampled, but increases from 100 to 300% were common. A maximum increase of over 22 times that prior to treatment occurred on one site. Rootplowed areas were the only ones with plants in classes 4 and 5 (Table 2).

On 40% of the rootplowed areas, pricklypear frequency was in excess of 80% (Table 1). More than

Table 1. Mean, minimum, and maximum density and frequency of pricklypear plants for each of five methods of mechanical control. Untreated denotes data collected from undisturbed vegetation; treated denotes data collected following mechanical treatment.

Treatment	No. Sites	Density (No./acre)						Frequency (%)					
		Treated			Untreated			Treated			Untreated		
		Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
Rootplowed	15	2188	303	5092	823	180	2275	73	20	100	69	40	80
Rootplowed & Rootraked	5	2514	217	6111	1235	217	2254	76	30	100	70	30	100
Dragged	8	889	143	2319	1972	1170	3506	66	17	100	91	70	100
Dragged & Rootplowed	2	65	39	87	2969	2622	3163	20	20	20	100	100	100
Chained	2	4940	3446	6414	2492	1517	3446	95	90	100	90	90	90

FIG. 2. Rootplowed area approximately 1 year old. Establishment and growth of many small pricklypear plants is evident.

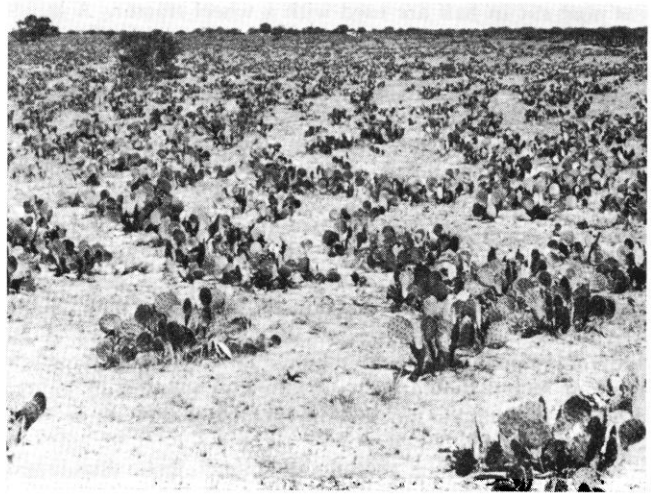

FIG. 3. Uniform stand of pricklypear plants 3 years after area was rootplowed and rootraked.

one-half of the rootplowed areas had frequencies higher than the checks. The higher densities and frequencies for treated sites indicate a more dense and widely dispersed stand than prior to rootplowing.

Rootplowing was effective in maintaining or reducing the presence and frequency of nearly all woody species (Table 3). The data indicate that the presence of three plants, pricklypear (*Opuntia* spp.), leatherstem (*Jatropha spathulata*) and tasajillo (*O. leptocaulis*) remained unchanged. The frequency of the first 2 increased. A sizable decrease in presence and frequency was recorded for mesquite (*Prosopis glandulosa*), condalia (*Condalia* spp.), granjeno (*Celtis pallida*), and other woody species.

Many ranchers have combined rootraking with a rootplowing operation and believe that the added rootraking is effective in clearing the land for seedbed improvement (USDA, 1964b). Fig. 3 shows a pricklypear stand 3 years after rootplowing and rootraking. In 80% of the treated areas an increase in pricklypear density similar to those reported for rootplowing occurred (Table 1). However, a reduction in density was measured on one area. A large number of small, class 1, plants occurred on the rootplowed and rootraked areas (Table 2). The frequency values for the rootplowing-rootraking method were similar to those reported for rootplowing.

Rootplowing followed by rootraking either reduced or did not change the presence and frequency of the species investigated (Table 3). Mesquite decreased considerably, while condalia and desert yaupon (*Schaefferia cuneifolia*) were absent in the treated areas.

Data in Tables 1 and 2 show an increase in pricklypear density with this dual treatment. However, the control of other woody species is better than with rootplowing. This slight improvement in brush control and seedbed condition may justify the additional cost, but pricklypear is still a problem in grassland restoration.

Dragging or railing was developed on the Rio Grande Plains primarily for control of species of *Opuntia* on areas of small brush and tree vegetation (USDA, 1964b). The reduction in woody cover following two draggings with weighted railroad rails is shown in Fig. 4. Dragging reduced pricklypear density, but small plants persisted if

Table 2. Mean number of pricklypear plants per acre in each size class. Size class is based on number of cladophylls per plant. (Class 1: 0–5; Class 2: 6–25; Class 3: 26–50; Class 4: 51–100; Class 5: over 100). Untreated denotes data collected from undisturbed vegetation; treated denotes data collected following mechanical treatment.

Treatment	Treated					Untreated				
	Class					Class				
	1	2	3	4	5	1	2	3	4	5
Rootplowed	1149	888	108	43	9	368	260	108	65	43
Rootplowed and Rootraked	1777	693	43	0	0	585	433	108	65	43
Dragged	737	130	22	0	0	780	715	368	217	152
Dragged and Rootplowed	65	0	0	0	0	953	1149	412	217	217
Chained	3597	1062	281	0	0	1019	1105	303	87	0

FIG. 4. Area on left has been dragged twice with weighted railroad rails; area on right is untreated. Note the difference in density and size of the woody plants.

follow-up maintenance practices were not utilized (Tables 1, 2). In 7 of the 8 areas sampled the density was reduced. The maximum reduction recorded was 94%. However, an increase of about 100% occurred on one of the areas. This increase was apparently due to the application of a single dragging treatment.

The mean frequency of pricklypear occurrence in the dragged plots was considerably less on the treated than the adjacent untreated areas (Table 1). Thus, based on frequency and density, the treated areas had a scattered pricklypear stand of low density while the check areas had dense and relatively uniform stands.

The data in Table 3 indicate that dragging had little effect on the presence of most woody species. Tasajillo, desert yaupon, pin cushion (*Neomammillaria hemisphaerica*), cenizo (*Leucophyllum frutescens*), coyotillo and Texas persimmon were reduced while allthorn increased in presence. The frequency data indicate a sizable reduction in the distribution of pricklypear with dragging while little change for the other species was recorded. Damage to the other brush species was usually retardation of top growth for a limited time. A considerable amount of basal sprouting usually occurred.

A relatively new mechanical brush-control technique used is to rootplow following a series of draggings. Tables 1 and 2 show that dragging reduces the pricklypear stand, while data in Table 3 show that rootplowing is effective for other woody species. By combining these two mechanical methods, a more effective control of the brush on the Rio Grande Plains may be possible.

Two areas were treated by dragging with a light weight drag at spaced time intervals followed by rootplowing. The density reduction was high in all size classes (Tables 1, 2). Based on frequency, the original uniformly distributed pricklypear stand of moderate density was reduced to a stand of scattered plants.

When the dragged areas were rootplowed most woody species were reduced in frequency from 100% to near zero (Table 3). The presence data

Table 3. Mean presence and frequency by mechanical control treatments for the major woody species encountered. Presence denotes percentage of sites of occurrence; frequency is percentage of sample quadrats of occurrence.

	TREATMENT															
	Rootplowed				Rootplowed and Raked				Dragged				Dragged & Rootplowed			
	Presence (%)		Frequency (%)		Presence (%)		Frequency (%)		Presence (%)		Frequency (%)		Presence (%)		Frequency (%)	
SPECIES [1]	T	U	T	U	T	U	T	U	T	U	T	U	T	U	T	U
Opuntia spp.	100.0	100.0	72.7	68.8	100.0	100.0	64.0	82.0	100.0	100.0	47.4	100.0	100.0	100.0	19.1	100.0
Prosopis glandulosa	33.3	86.7	8.9	33.5	20.0	100.0	2.0	39.7	66.7	100.0	30.8	40.9	100.0	100.0	14.1	34.7
Condalia spp.	33.3	80.0	3.8	38.3	0.0	80.0	0.0	23.7	66.7	66.7	17.8	47.7	50.0	100.0	5.0	53.3
Celtis pallida	13.3	66.7	2.0	29.4	33.3	66.7	6.0	22.7	100.0	100.0	36.6	35.4	100.0	100.0	27.8	46.5
Acacia amentacea	60.0	73.3	7.3	37.7	60.0	60.0	14.0	45.7	66.7	66.7	41.4	48.0	50.0	100.0	36.4	72.1
Porlieria angustifolia	13.3	92.3	0.6	44.5	0.0	80.0	0.0	52.3	100.0	100.0	33.2	60.5	50.0	100.0	4.6	54.1
Opuntia leptocaulis	80.0	80.0	29.3	37.2	20.0	80.0	4.0	47.0	33.3	100.0	6.0	34.6	0.0	100.0	0.0	28.5
Aloysia lycoides	13.3	60.0	6.4	14.5	40.0	60.0	14.0	26.0	33.3	33.3	16.7	13.3	0.0	0.0	0.0	0.0
Acacia berlandieri	20.0	33.3	1.9	20.0	0.0	20.0	0.0	2.0	33.3	33.3	10.0	22.0	0.0	0.0	0.0	0.0
Acacia tortuosa	6.7	33.3	0.8	6.6	0.0	20.0	0.0	1.7	33.3	66.7	10.0	30.0	0.0	50.0	0.0	3.0
Koeberlinia spinosa	6.7	40.0	1.3	6.5	20.0	40.0	2.0	6.0	66.7	33.3	6.3	5.9	0.0	100.0	0.0	18.8
Schaefferia cuneifolia	13.3	40.0	2.7	12.0	0.0	40.0	0.0	18.0	0.0	33.3	0.0	6.7	0.0	50.0	0.0	20.0
Jatropha spathulata	66.7	66.7	25.9	19.0	40.0	40.0	8.0	14.0	33.3	33.3	6.1	3.9	50.0	50.0	9.1	5.9
Echinocereus enneacanthus	46.7	80.0	9.7	14.7	20.0	80.0	2.0	23.3	33.3	33.3	3.0	25.5	0.0	100.0	0.0	58.2
Neomammillaria hemisphaerica	6.7	6.7	0.6	1.7	0.0	20.0	0.0	5.0	0.0	33.3	0.0	15.7	0.0	100.0	0.0	23.5
Leucophyllum frutescens	20.0	46.7	3.9	7.1	0.0	20.0	0.0	2.0	0.0	33.0	0.0	2.0	0.0	50.0	0.0	3.0
Karwinskia humboldtiana	0.0	60.0	0.0	11.7	20.0	60.0	4.0	7.7	0.0	33.3	0.0	2.0	0.0	50.0	0.0	3.0
Acacia farnesiana	0.0	13.3	0.0	3.0	20.0	40.0	2.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[1] Other species encountered, but of rare occurrence were Larrea divaricata, Atriplex spp., Forestiera pubescens, Yucca torreyi, Salvia spp., Pithecellobium flexicaule, Zanthoxylum fagara, Diospyros texana, and Echinocactus spp.

do not indicate a change for some species such as pricklypear, mesquite, and granjeno.

In the present investigation, 2 chained areas were sampled. Pricklypear plant density increased, particularly in class 1 plants, on both areas (Tables 1, 2). The frequency increase was slight and of little value as an indication of plant distribution. The density and frequency values show that both the control and treated areas supported uniform dense stands of pricklypear.

Chaining appears to result in the scattering of pricklypear and the establishment of many new plants (Table 1). However, as pointed out in Part II of the Soil Conservation Service report (USDA, 1964b) chaining has some value in the control of single-stemmed trees such as mesquite. Smaller brush species, such as blackbrush and condalia, bend and little damage results from chaining. If the tops are broken, profuse sprouting usually occurs.

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