

Figure 1. Creosotebush community near Bowie, Arizona.

Figure 2. Sand-dune mesquite community near Bowie.

The San Simon Valley in southeastern Arizona is classed as a frail watershed, subject to excessive soil movement and arroyo formation. Historically, this region was productive of grass, browse, cattle, and game. This productivity has greatly decreased with respect to range and watershed usefulness. A combination of factors of mis-management, over-grazing, and drought has removed the original protective grass cover, replaced by various shrubs affording but little protection from erosive thunderstorms.

This is a semi-arid region receiving an average annual precipitation of about 9.5 inches. Shrubs are very effective competitors of grass in the utilization of this limited moisture supply. The delicate balance of competition between grass and shrubs in semiarid regions can be easily disturbed through improper range management and climatic conditions. Once disturbed the ecological balance in favor of shrubs can be maintained by comparatively light grazing pressures by rodents, rabbits, and herbivores. Shrubs now dominate these rangelands to the almost complete exclusion of range forage grasses.

The principal dominant vegetation is sand-dune mesquite (*Prosopis juliflora* var. *glandulosa*), creosotebush (*Larrea tridentata*), and tarbush (*Flourensia cernua*). Sub-dominants are yucca (*Yucca elator*), snakeweed (*Gutierrezia* sp.), Ephedra (*Ephedra trifurca*), fourwing saltbush (*Atriplex canescens*), and cactus. Along the gullies and swales occur catclaw, (*Acacia greggii*) and white-thorn (*A. constricta*). The boundaries between

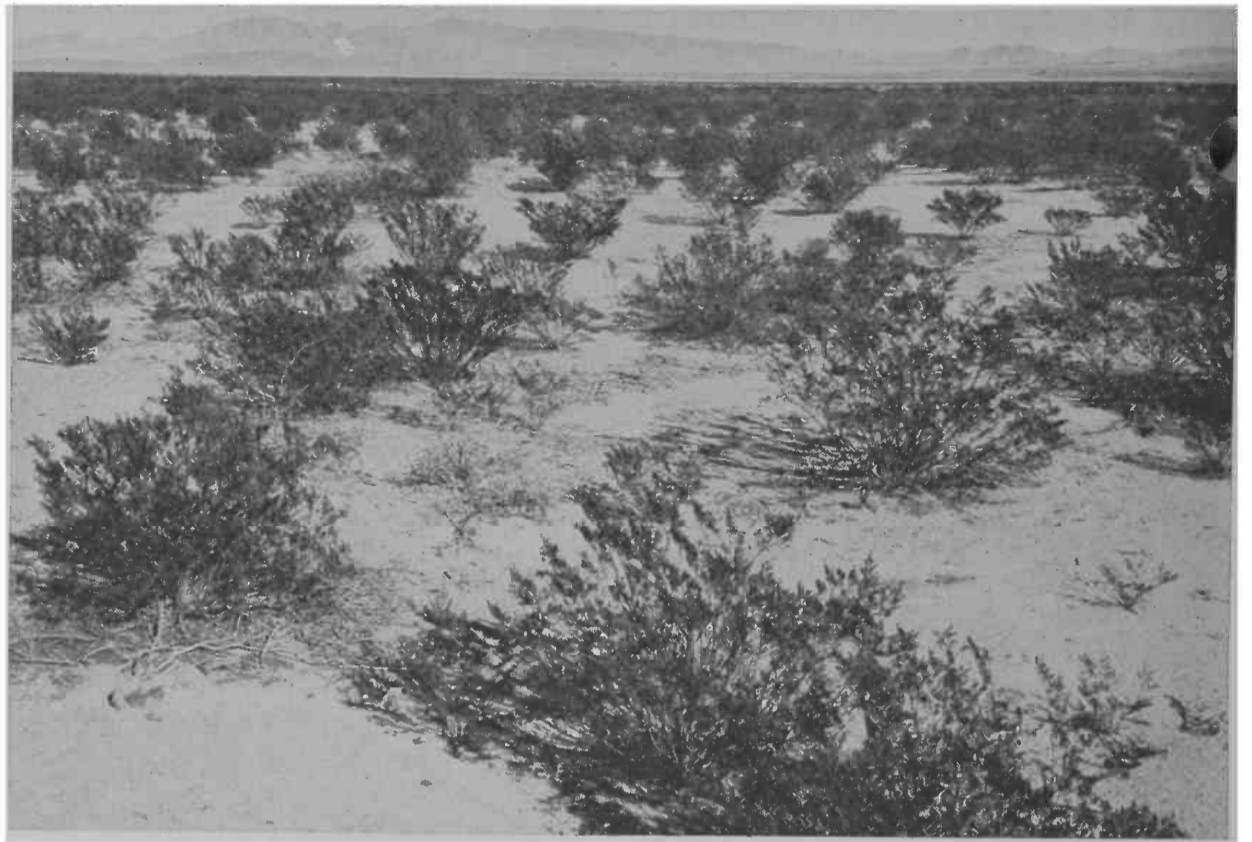
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The San Simon Watershed: Shrub Control

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dominant vegetation types is often quite abrupt. The very limited cover of perennial grass species is composed mainly of sideoats grama (*Bouteloua curtipendula*), black grama (*B. eriopoda*), bush muhly (*Muhlenbergia porteri*), spike dropseed (*Sporobolus*

contractus), mesa dropseed (*S. flexuosus*), sacaton (*S. airoides*), tobosa (*Hilaria mutica*), arizona cottontop (*Trichachne californica*), plains bristlegrass (*Setaria macrostachya*), and cane beardgrass (*Andropogon barbinodis*).

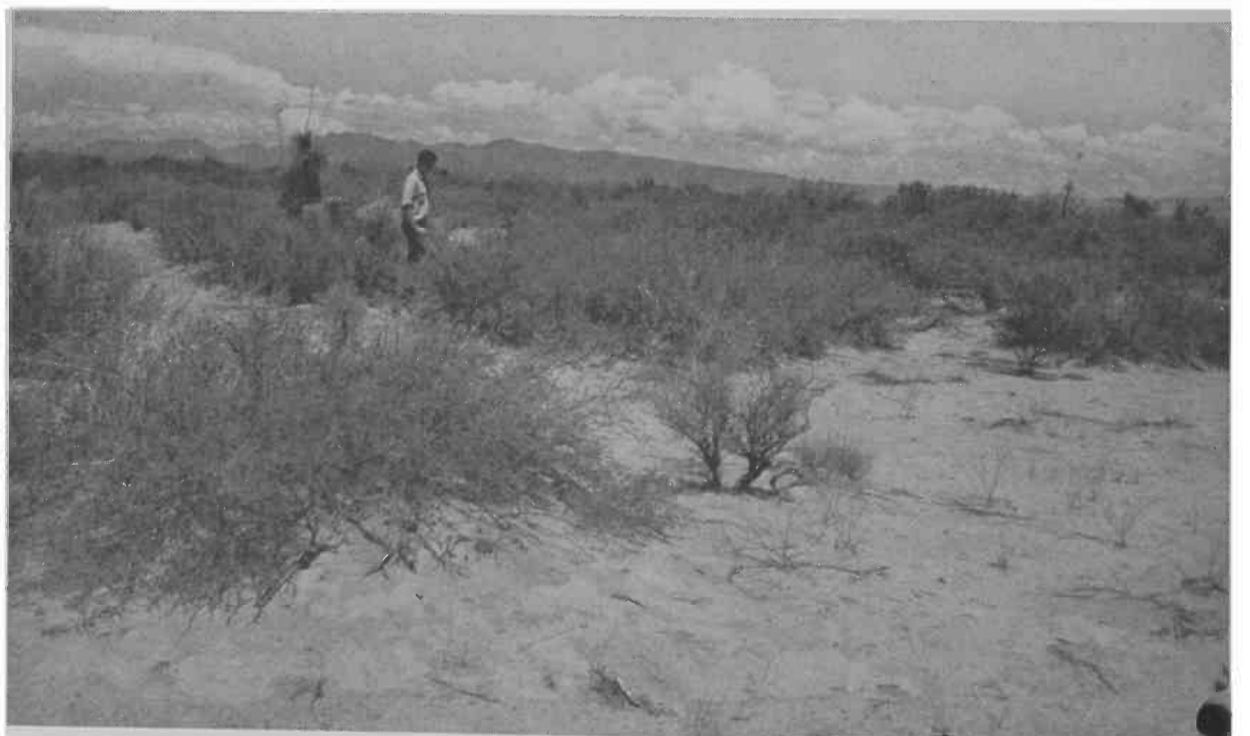




Figure 3. Exposure of sand-dune mesquite by an eroding wash. Note profuse branching at ground level and extensive root system.

Vegetative improvement of the San Simon Watersheds for protection against erosion and increased forage production requires first the removal of shrubs and second the planting of adapted range grasses. It has been universally demonstrated in the seeding of semiarid rangelands that shrub removal is necessary because shrubs

utilize the limited moisture supply necessary for germination and seedling establishment of the seeded species. However, preliminary revegetation trials in the San Simon area by various agencies have met with failure. Research was needed to understand the specific limiting conditions of this area.

Under contract research with the Bureau of Land Management, the Department of Watershed Management, University of Arizona undertook a project in 1962 to study the problems of revegetation of the San Simon. The first phase of that project, brush control, is reported here.

Studies were initiated in 1963 on the valley floor northeast of Bowie and on the bajadas south of San Simon, Arizona. Study sites were selected from typical rangelands, freely traversed by cattle as they moved between water tanks and grazing areas. The sites were subsequently fenced and excluded from grazing. The Bowie Site has two distinct plant communities; one is creosotebush (Fig. 1) and the other is sand-dune mesquite (Fig. 2). Sand-dune mesquite appears to grow as a small colony of profusely-branched plants. This appearance is deceptive because often only one plant is present having branched profusely at the ground level (Fig. 3). Both mesquite and creosotebush may have

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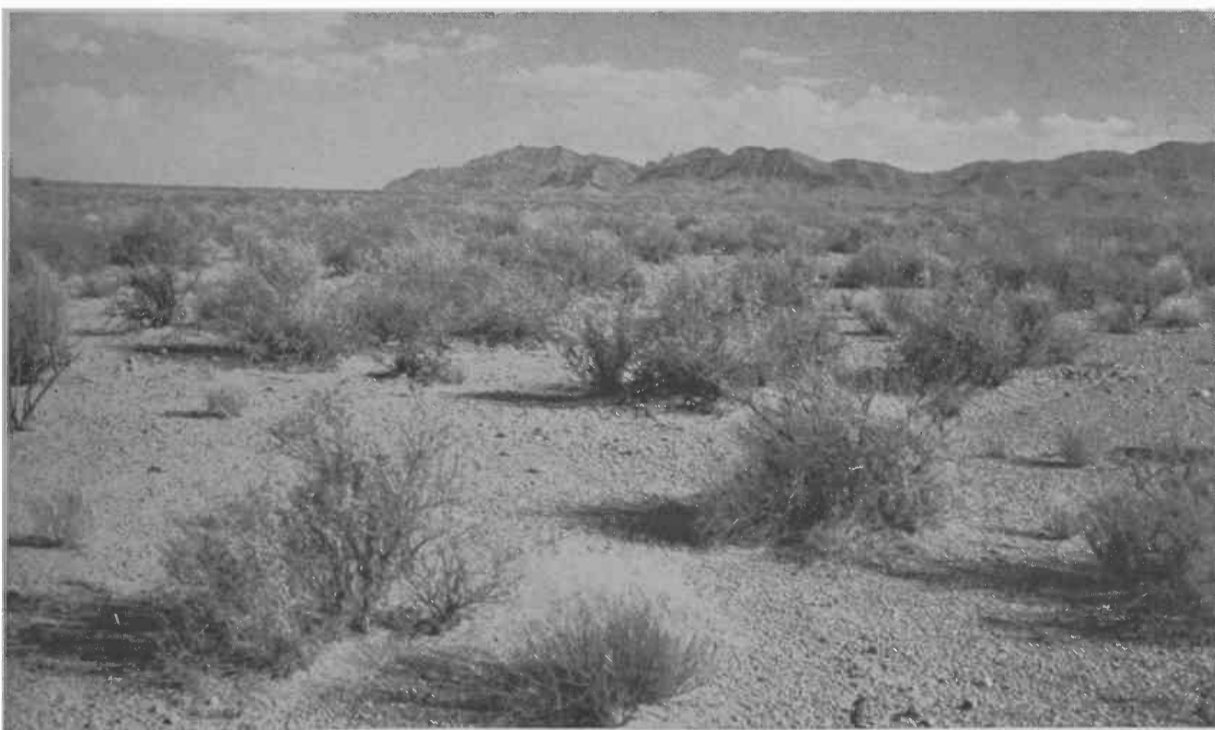


Figure 4. Mixed-shrub community of creosotebush, tarbush, sand-dune mesquite, and curving saltbush of San Simon.

extensive lateral root systems and mesquite in addition may have deep tap roots. In certain areas wind-blown sand may collect around the stems of mesquite forming dunes up to 3 feet in height and 10 to 15 feet in diameter. (Further east in New Mexico the dunes are frequently twice as large). The vegetation of the San Simon site was a mixture of sand-dune mesquite, creosotebush, tarbush, and four-wing saltbush (Fig. 4). The soils of this site were finer-textured and dune formation around mesquite was slight.

It was necessary in the beginning of the program to evaluate several methods of brush control. This control was for the express purpose of establishment and maintenance of subsequent seeded species which, according to principles of revegetation, would require some manner of seed-bed preparation. Mechanical shrub control was therefore given major emphasis to facilitate and utilize consequent soil disturbances. Also necessary was the determination whether complete eradication or moderate control would be adequate for the successful seeding of a perennial grass. Thus, seeding studies were made in conjunction with the brush control treatments but seeding results will be reported later.

The initial studies on shrub control employed the root plow, anchor chain, pitting disk, and rotary brush chopper as control implements. The root plowing was accomplished with a Fleco Root Plow at depths of 10 inches for creosotebush and 14 to 18 inches for sand-dune mesquite and mixed-shrub communities. The anchor chain weighing about 100 pounds per link was dragged over the vegetation twice, the second pass was in the opposite direction over the first pass. The pitting disk was custom made having 30-inch disks with a portion of each disk

Table 1. Average percent control of shrubs by various methods at the Bowie Site for the period 1963-1966.

Year Treated	Method of Treatment	Shrub	
		Mesquite	Creosotebush
1963	Root plowed	98	86
1964	Root plowed	86	78
	Disk plowed	NT ¹	72
	Chained: pitted	13	40
1965	Root plowed	89	80
	Disk plowed	83	79
	Chained: pitted	40	37
1966	Root plowed	90	94
	Disk plowed	91	95
	Chained: pitted	NT	34

¹ NT: Treatment not included or rejected.

cut off to create interrupted furrows or pits.

Precipitation in this area is biseasonal with about 58% in July through September and the remaining 42% during the winter. The seasonal effect on mechanical shrub control was evaluated. The first treatments of the year were in March while some soil moisture remained from winter precipitation but temperatures were too low for appreciable growth on mesquite and creosotebush. The second treatments were in June when soil moisture was extremely low but temperatures were favorable for growth.

Each shrub control method was conducted on plots measuring 100 by 200 feet and each was replicated four times under experimental designs facilitating statistical analysis of data. Various aspects of these treatments were continued from 1963 through 1966. In 1964 a large disk plow was added to the list of implements for shrub control studies.

While it was recognized that these shrubs would resprout after removal of top growth, the rate of recovery was not known. Early observations indicated brush chopping or chaining were ineffective control measures for

mesquite and creosotebush. These measures removed top growth with very little damage to the crown of the plants. Initial regrowth during 1963 was vigorous and by 1967 shrubs receiving these treatments had nearly regained their original size and density.

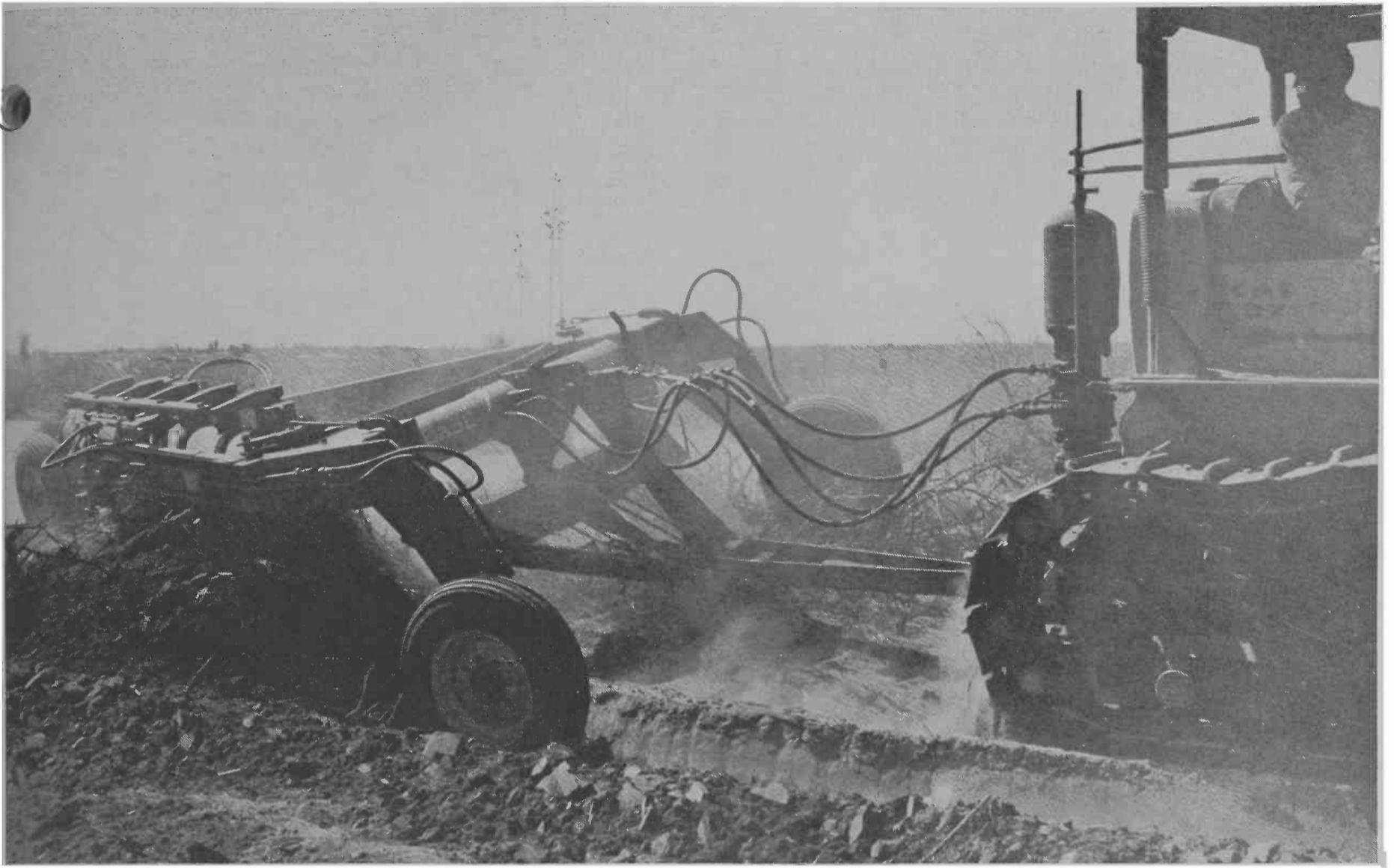
The use of the pitting disk was a very inefficient shrub control methods. While numerous depressions were created for detention of surface water, only an occasional shrub was uprooted or damaged.

A combination of chaining and pitting decreased the density of mesquite from none to 40% and creosotebush about 50%. This degree of shrub control was not considered adequate but the pits were generally deeper and more effective in moisture retention in this combination. In years having above average rainfall, fair stands of grass could be established on such treatments. Regrowth of shrubs, however, could restore the original shrub cover in 3 to 6 years, especially sand-dune mesquite. When the longevity of control is considered, anything less than 90% is believed inadequate for any control method. Otherwise, regrowth and reinvasion might occur rapidly enough to nullify the initial expense.

Experience and observations indicate that 95% or better control can be achieved and should be the minimum accepted. Both root plowing and disk plowing can achieve this level if conscientious work is performed. Only those methods which sever the crown of the plant from the roots appear promising for long-term control. It was necessary to plow mesquite at depths of 12 to 16 inches and creosotebush at depths of 8 to 12 inches in order to cut below the crowns (Fig. 5 and 6). It is of additional importance

Table 2. Average percent control of shrubs by various methods at the San Simon site for the period 1963-1966.

Year Treated	Method of Treatment	Shrub		
		Mesquite	Creosotebush	Tarbush
1963	Root plowed	93	90	100
1964	Root plowed	97	99	95
	Disk plowed	77	96	96
	Chained: pitted	30	69	80
1965	Root plowed	93	94	93
	Disk plowed	75	77	80
	Chained: pitted	23	50	61
1966	Root plowed	93	86	88
	Disk plowed	97	97	98
	Chained: pitted	24	54	70



with the disk plow to cut below the crown level to avoid undue stress on equipment. A proper-sized disk plow would weigh 1000 pounds or more per foot of swath.

Summarized in Tables 1 and 2 is the percent control afforded by the better control procedures studied at the Bowie and San Simon sites. Limited observations indicate that fourwing saltbush was not well controlled by plowing or other treatments. The sprouting characteristics of this shrub are apparently different than creosotebush or mesquite. However, this is a fortunate circumstance because this is a palatable browse plant and a desirable component of the vegetation.

Generally there were no significant differences between March or June shrub control treatments. Exceptions to this were from treatments removing primarily the top growth or from inadequate plowing treatments during years when soil moisture was much higher than normal in March. Partially uprooted plants can recover if adequate soil moisture is present. During June the soil moisture is below the wilting point, the level for incipient plant growth, and partially uprooted plants generally die. Mechan-

ical shrub control tends to be more effective when soil moisture is low unless a conscientious job of plowing is performed under higher soil moisture conditions.

Figure 5. A large two-way disk plow effectively cutting and uprooting sand-dune mesquite, above, and Figure 6, below, shows the root plowing in a creosotebush community with the cutting and lifting action demonstrating effective shrub control.

