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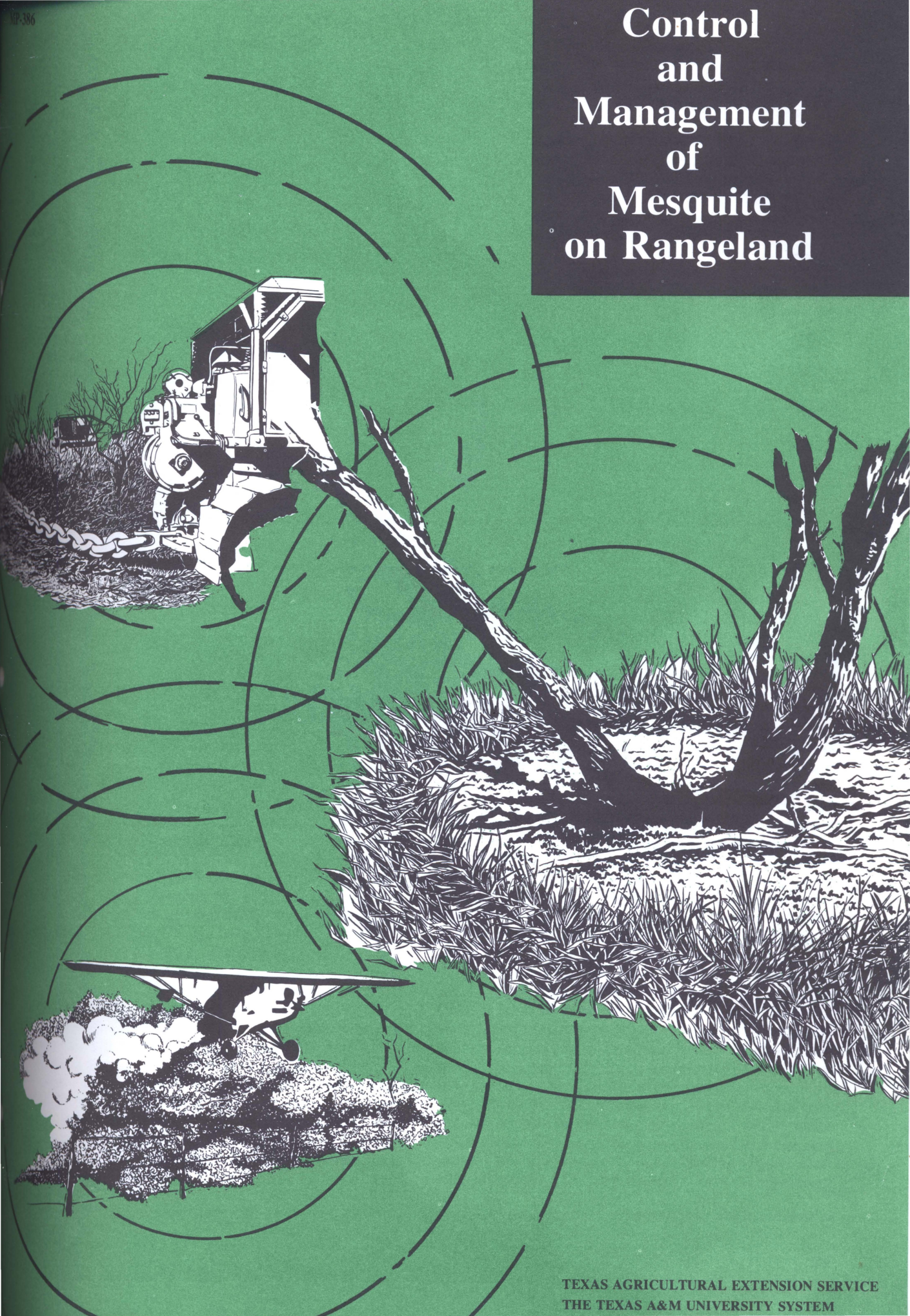
Control and Management of Mesquite on Rangeland



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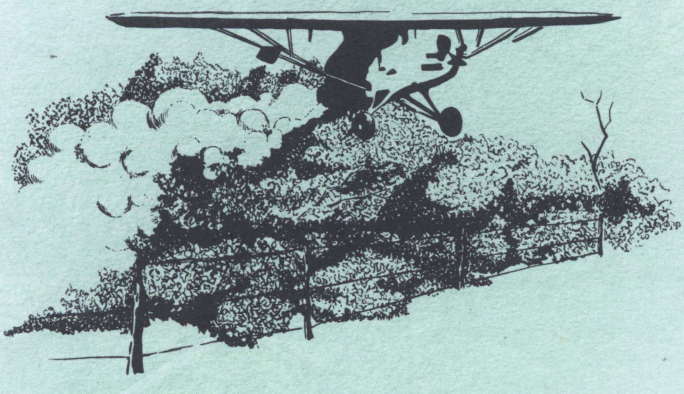

Control and Management of Mesquite on Rangeland

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Mesquite *(Prosopis glandulosa var. glandulosa Torr.)* is a natural component of most rangeland vegetation in Texas. Mesquite, honey, western honey, velvet and creeping all grow in Texas. Honey mesquite is the most widespread, with creeping growing in the Frio-Nueces river watersheds and with velvet and western honey occurring west of the Pecos River. In this publication, honey, western honey and velvet mesquites will all be referred to as *mesquite*.

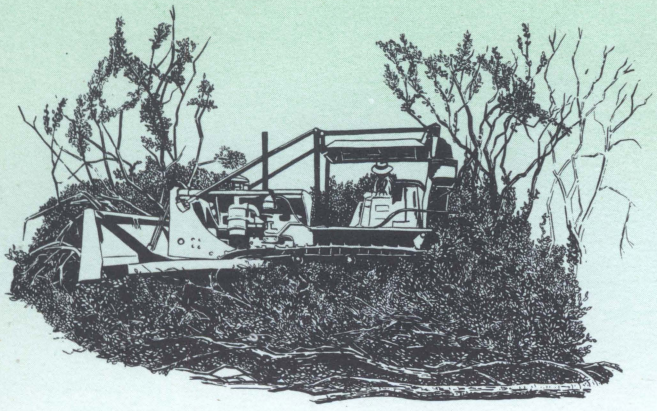
Mismanagement of grazing lands, protection from fire, drouth, heavy concentration of livestock, fencing and a combination of these factors have favored encroachment of mesquite. It is a problem on some 56 million acres of Texas rangelands. Grasslands that are heavily infested with mesquite often produce inadequate amounts of desirable forage for economic livestock production and provide poor habitat for wildlife.

Ecologically, mesquite is a strong competitor for water and plant nutrients; it is a profuse seed producer; it is a prolific sprouter; and it is not a preferred food item in the diet of any animal except at specific times during the year. At times, mesquite beans can even become toxic to grazing animals. However, mesquite has been utilized as a source of food for humans, animals and birds. It also has been used for fuel, medicine, bleaching agent, charcoal, bowling pins, spurs, building material, fence posts, gun stocks and golf clubs.

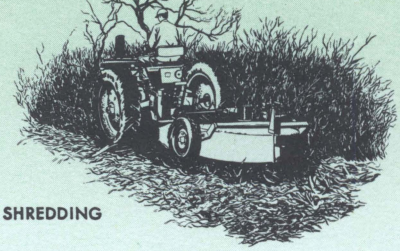
Mesquite is an aggressive, deeply tap-rooted plant with many lateral roots. Since the seeds do not germinate readily unless scarified, they may lie dormant in the soil for periods of from 10 to 40 years. Established mesquite plants sprout profusely following damage of top growth. Although mesquite will sprout along the stem the main bud zone which is from 2 to 12 inches beneath the soil surface, is the main sprouting part. To be successful, then any control method must kill or destroy the top as well as the sprouting root-collar bud zone. Growth and reproduction characteristics of mesquite make it impossible to eradicate. However, control programs that reduce mesquite density also enhance the productivity of grassland ecosystems and are economically desirable for ranchmen to operate at a profitable level. To produce a pound of mesquite foliage requires two to four times more water than the production of a pound of desirable native forage, and the foliage of mesquite is low in palatability and of little value to livestock or wildlife except for shade.

Attempts at controlling mesquite with fire, mechanical, chemical and biological methods date back at least 40 years and probably earlier. Because of the sprouting regrowth characteristics of mesquite plant, fire as a control method is less effective than mechanical methods, such as grubbing, root plowing, stacking, chaining, etc., which remove the bud zone from the soil. Chemicals, both contact and growth regulator-types, have been used widely since 1947. Contact-type herbicides, such as kerosene and diesel fuel oil, give excellent control but require considerable labor for application. Growth-regulating

*The author acknowledges that research monograph 1. 1973. Mesquite, Texas Agricultural Experiment Station, 84/pp was used as reference material.



BULLDOZING



SHREDDING

chemicals give only moderate control but can be applied by aircraft so that such herbicides can be used to treat large acreages with low labor expenditures. The search for a biological means of control is continuing.

It is likely that every owner or manager of rangelands would like to eradicate or selectively control mesquite with a single treatment and forget the problem. However, mesquite control is a complex problem. In northern areas of Texas, mesquite may be the only problem species while in the southern part of the state, mesquite may be only one of many species to be treated. In mixed stands of woody plants where mesquite is controlled the development of resistant species may rapidly become the major brush problem.

While mesquite cannot be eradicated, it can be controlled and managed. The control of weeds and other competing vegetation in agronomic crops is considered a production expense, and the same is true in the control of mesquite. While good range management is essential, management alone is not sufficient to overcome the mesquite problem. Once mesquite is established, no amount of management will thin it out or remove it. Control programs must be adapted to an area coupled with good range management. Such a program, considering cost-production-return, should extend over at least 20 years. Mesquite is capable of reestablishing itself from seed for at least 10 to 40 years even if no new seed is produced on the area. An example is following research conducted by the Texas Agricultural Experiment Station at Spur:

1940-218 trees removed
1945-109 seedlings removed
1952-185 additional seedlings removed
1964-107 additional seedlings removed
1972-107 additional seedlings needed to be removed

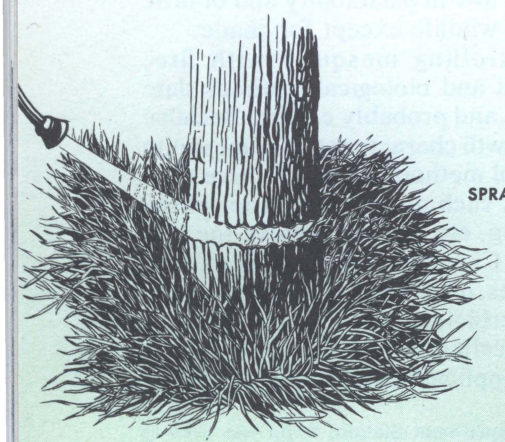
Mesquite bean seeds possibly could have been introduced into the area by rodents, birds and other wildlife animals over the 32-year period.

A program of mesquite control, coupled with good range management, provides the following advantages:

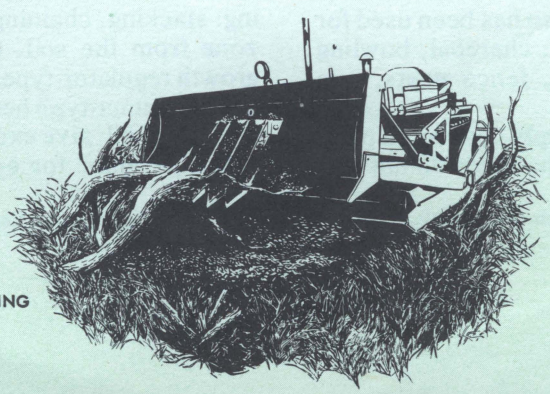
- Increases offspring weaning weights
- Permits an increase in stocking rates
- Increases desirable forage plants
- Reduces labor costs for handling of livestock
- Allows better distribution of livestock and utilization of forage
- Improves wildlife habitat
- Allows more efficient use of breeding males
- Reduces cover for predators and rustlers
- Improves water utilization with increased ground water yields
- Improves and enhances the total rangeland environment

MECHANICAL METHODS

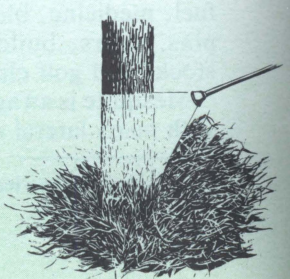
Mechanical methods for mesquite control include hand grubbing, use of rolling choppers, root cutters, anchor chains, bulldozers, stackers, shredders, rakes, tree or stinger dozers, root plows or specialized adaptations of these methods. Mechanical treatments should be applied when conditions are such that existing grassland forage plants can make the fastest recovery and obtain the highest degree of mesquite reduction. Seeding with adapted, high-producing forage grasses to achieve fast range recovery is necessary at the time of mechanical operations which destroy native grass turf. Generally,



SPRAYING IN FRILL

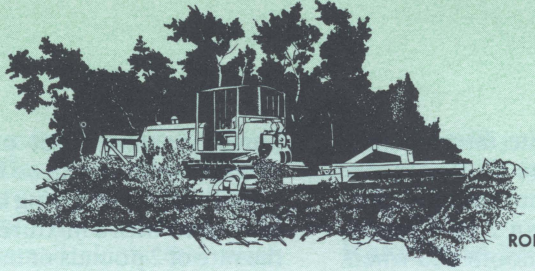


STINGER DOZING

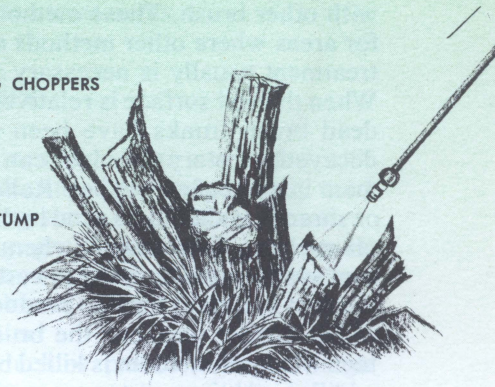


SPRAYING ON TRUNK BASE

ROOT PLOWING



ROLLING CHOPPERS



SPRAYING CUT STUMP

heavy weed growth will follow such mechanical operations unless seeded forage species are not immediately established. Control of weeds by chemicals or grazing methods to reduce competition with grass seedlings is necessary for range improvement.

The selection of mechanical control methods and equipment should be based on mesquite density and extent of land renovation desired. Generally, mechanical treatments are expensive because of slow operation and high initial cost of equipment; however, many methods are effective for removal of mesquite plants. Generally, the duration of control is longer than for some of the chemical control methods. Mechanical methods should be used if mesquite grows near susceptible crops that can be affected with growth regulator-type herbicides.

Chain

Used for the past 30 years, chaining is a low-cost method which gives effective economical control on dense stands of large single-stemmed, partially dead mesquite. Chaining removes dead tops of mesquite on areas treated with aerial broadcast chemical methods and also smoothes land that has been root-plowed or grubbed for improvement of a seedbed. Under favorable soil moisture conditions, chaining has uprooted as much as 70 percent of large single-stemmed mesquite trees; but the overall degree of control generally varies from 20 to 40 percent root-kill. The duration of the control varies from 4 to 8 years and the initial cost per acre varies, depending on tree size, soil type and terrain, as well as on the number of acres to be treated without movement of equipment from one area to another.

Heavy anchor chains 200 to 500 feet in length and weighing 40 to 65 pounds per foot drawn in a U-shape between two large crawler-type tractors can be used to accomplish mesquite-control operation. Effective control can be obtained by anchoring one end of the chain to a large tree and moving in a circle pulling the chain with only one tractor.

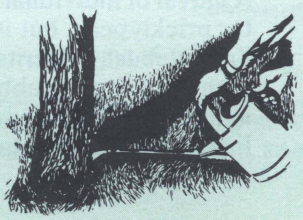
The single-loop chain pulled two ways, opposite directions, gives the best mesquite uprooting and breakages of the lateral roots. One-way chaining with the single loop leaves many plants partially rooted and subsequent raking is not advised because of rake breakage. The double-loop chain (that is, the first loop is approximately half the length of second loop) appears to uproot a higher percentage of the large mesquite trees, plus it tends to partially windrow the brush. Time-cost studies of double-loop, one-way chaining plus raking and of single-loop, two-way chaining plus raking compare favorably in total cost.

Chaining chemically treated areas at the end of three growing seasons is most economical. It also increases the degree of control over either method if applied alone. Chaining the sprayed mesquite allows easier working of livestock. Chemical spraying of sprouts 2 to 5 years after chaining has proved an effective combination of control practices which increases duration of control for 6 to 12 years. The chained area should be deferred from grazing to allow native forage species to make seed. Annual weeds may become a problem following chaining. Weeds should be controlled with herbicides for maximum forage production and range improvement.

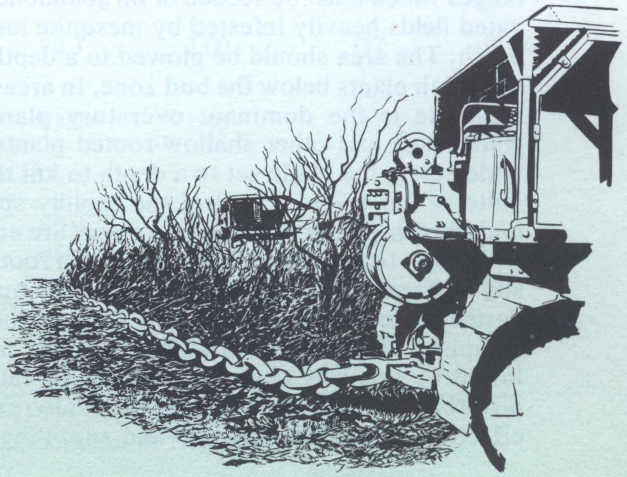
Choppers, Cutters and Shredders

Heavy roller brush cutters, choppers and shredders offer an effective means of control in dense

AERIAL SPRAYING



BASAL POURING OF OIL



CHAINING

stands of small or regrowth mesquite intermingled with other brush. These methods are also effective for areas where other methods are not feasible. Retreatment usually is necessary within 2 to 4 years. When the soil surface is relatively smooth and when dead brush trunks have been stacked, burned or decayed, a rotary shredder can be used for retreatment instead of a chopper. Roller choppers, cutters or shredders should be used in the spring after brush plants have fully leafed, when food reserve in the root system usually is the lowest. Food remaining in the root system is used to produce added top growth which further weakens the brush plants' root system. Mesquite seldom is killed by these methods. In addition, the juvenile top growth is prevented from developing beans and causes less competition to forage plants. Some mixed brush species can be killed with repeated chopping, cutting and shredding treatments. Shredding, however, tends to increase the number of woody stems from a single tree root system. Roller chopping following root plowing and seeding prepares a firm seedbed for the establishment of forage grasses.

Mesquite and shin oak growing together in the Edwards Plateau can be controlled by continuation of shredding and by grazing goats on certain range sites. Newly developed oak growth after shredding is a good source of feed for all kinds of grazing animals. Once the initial shredding is done, any additional operations can be relatively fast and more economical. Shredders that apply chemical mixtures in thickened sprays produce a higher degree of plant kill than shredding alone. Also, spraying regrowth with herbicides produces excellent root kill of limestone shin oak at a low cost per acre.

Root Plow

Root plowing is a most effective method to control mesquite and mixed brush that cannot be controlled effectively by other methods. Root plowing costs per acre vary depending on soil type, brush densities and previous brush control treatments. Use this method on sites with high potential production, on depleted ranges which must be seeded or on abandoned cultivated fields heavily infested by mesquite and other brush. The area should be plowed to a depth to cut the brush plants below the bud zone. In areas where mesquite is the dominant overstory plant, with whitebrush and other shallow-rooted plants in the understory, the blade set to a depth to kill the mesquite is too deep to control the rapidly sprouting underbrush. Many existing root plows are equipped with three to five fins to bring the brush roots to the soil surface. This method completely disturbs and destroys the existing native turf. Using a root plow equipped with a very thin blade without fins, followed by one-way chaining, appears to cause less disturbance to native forage plants. It also produces effective control of mesquite and sprouting underbrush species. Root plowing should be done in winter months because forage species can make fast reestablishment during spring rains. The area should be seeded with a mixture of adapted forage species at the rate of 2 pounds or more of pure live seed per acre after the plowed area has been rolled-chopped to obtain a firm seedbed. Should the first seeding fail, reseeding should be done as soon as possible to restore the land to a productive condition. A brush-control retreatment could be necessary in 5 to 10 years to control seedlings and sprouts of mesquite. Root-plowing has been the most effective mechanical practice in the South Texas Plains Vegetational Area and in areas adjacent to agronomic crops.

In other areas of Texas, the root-plowing of range sites that receive additional runoff water may be advisable. These areas would be managed intensively in a rotation to allow deferment of other parts of the ranch. The plowed areas should be seeded to a species that will produce maximum amount of good forage. Since heavy herbaceous weed infestations often follow the root-plowing operation, chemical weed-control methods should be used to insure establishment of forage species.

The root-plowed area should be deferred from grazing until native and seeded species have become established. The plowed area can be grazed during the first winter, but it should be deferred again the following spring. After forage species are fully established, area should be stocked with the proper number and kinds of livestock to maintain high production.

Grubbing

Grubbing offers an excellent opportunity to remove mesquite growing in open stands where there is a desirable cover of forage grasses and to control reinfestation following other methods of control.

Grubbing is the uprooting of trees with a front-mounted U-shaped blade attached to crawler-type tractors. These cut the roots 4 to 14 inches underground. This practice is also known as *treedozing, stinger dozing* and *bulldozing;* however, bulldozing or stinger dozing usually implies that a U-shaped blade is attached to bulldozer blade. The bulldozer blade approach destroys more turf, is slower and, consequently, is more expensive.

On open stands of mesquite, grubbing can be economical (see table 1). Grubbing is less effective and more expensive in moderate stands of mesquite which are growing in association with lotebush, algerita, pricklypear, catclaw, yucca and other species since dense thickets of plants prevent the removal of individual plants. Grubbing tends to scatter pricklypear, but it is fairly effective for controlling lotebush, algerita and catclaw. On rocky, low, stony hill sites, grubbing reduces the canopy cover, and plant kill of all species is only fair because of the inability of the grubber blade to sever all plant roots

deeply enough between the many rocks.

Although grubbing is an effective method of control for mesquite which is growing in open stands, retreatment is often necessary within 5 years to control reinfestation either by small plants that were missed or by seedlings that emerged following initial treatment. The primary objection to grubbing is that the surface is left with "pot holes." Low-cost chaining or brush raking following grubbing smooths the surface and pulls up some mesquite plants with lateral roots still attached to the soil.

Low-energy grubbing is so named because a small, 65- to 75-horsepower crawler tractor is utilized instead of the normal 100-plus horsepower tractor. This approach is effective and economical in removing small plants from previously cleared pastures. The small front-mounted, U-shaped blade can sever tree roots 3- to 5-inches in diameter. Plant infestation of approximately 50 trees per acre and up to 6 feet tall is well suited to this maintenance practice. This type of infestation occurs on area previously root-plowed, grubbed, oiled, hand-grubbed or aerial-sprayed and chained where larger stumps were removed. Farm tractors equipped with a stinger or root cutter can be used to control regrowth mesquite. This equipment is as effective as a large crawler-type tractor, but is more economical to operate. Many acres of regrowth mesquite can be controlled with this or similar equipment.

Hand grubbing can be effective for young mesquite seedlings since only one stroke with a hoe is usually necessary to remove the bud zone. A retreatment of sprouts and seedlings usually is necessary in 4 to 8 years, but the area can be kept free of mesquite with repeated treatments.

Rakes and Stackers

Many different names have been associated with rakes used in brush clearing. They are generally used preceding or following some major brush practice, such as root plowing, grubbing, aerial spraying or chaining. Their function is to stack logs and stumps to make subsequent brush-control practices or livestock operations easier.

The root rake, which is pulled behind a large crawler-type tractor removes stumps and roots from the soil following root plowing. The 21-foot-wide rakes which are very effective, especially in mixed brush, are widely used in brushland conversion to tame pastures and cultivation fields.

Brush stackers vary in width from 10 to 19 feet. They are attached to the front of a crawler-type tractor. The stackers, with teeth spaced 5 to 9 inches apart are flat at the base. They skim along the top of the ground collecting logs, tree limbs and partially rooted stumps and lateral roots. Rakes and front-end stackers are used to pile brush for burning or provide cover for wildlife. The tractor operator should empty the rake or stacker often to prevent excess piling of soil.

Brush rakes are used following chaining to clean up pastures of moderate-to-dense mesquite infestation preceding root plowing and seeding, or following the combination of aerial spraying and chaining.

Table 1. Percent plant kill, acres grubbed per hour and cost of grubbing different growth forms of mesquite*

Location	Number of trees per acre	Type of infestation	Percent plant-kill	Acres grubbed per hour	Types of equipment	Estimated cost/acre
		High-energy Grubbing				
Barnhart	236	Small trees and many seedling-type plants	82.6	2.94	D6C	6.12
Guthrie	275	Regrowth, 3-6 feet tall after chaining	80.3	2.00	D7	10.00
Menard	172	Medium trees, with lotebush, algerita and catclaw acacia understory	87.2	1.43	D7	14.00
Stamford and Throckmorton**	250	Initial grubbing	80.0	1.82	D7	n.a.
		Clean-up grubbing	95.0	2.62	D7	n.a.
		Low-energy Grubbing				
Guthrie	35	Seedling, 1-6 feet tall	94.3	11.1	JD450	1.13

*_Brush Control Research on Rangeland_, TAES, MP1043, August 1972

**Information furnished by the SMS Land and Cattle Company, Stamford, Texas (treatment on 73,000 acres).

These rakes are used also following the grubbing of moderate stands of mesquite for seedbed preparation, as well as for cleanup operations and land smoothing.

A modification used on some brush rakes employs a flat, sharp blade welded across the bottom of the rake and slightly ahead of the teeth. The blade, which skims along the surface of the soil, cuts off many small plants which would normally pass between the rake's teeth. The modification is popular in mixed brush areas because of increased brush control effectiveness. It is currently being used in place of a chaining, especially where brush is small. An area stacked with this type of stacker operation generally would require seeding because this method destroys the existing turf. Front-end stackers appear to remove more mesquite stumps from root-plowed areas than rakes that are pulled. Many stumps are pressed into the soil with tractors pulling rakes.

The various control methods mentioned above when used in combination with stacking and raking have been effective for control of mixed brush species.

Mechanical brush-control operations must be planned to leave food and cover plants for wildlife game animals and birds. Strips of brush about 300 feet wide with connecting strips should be left for big game animal cover. Water areas should be provided with sufficient cover for wildlife to have free movement to and from water and grazing areas. Many landowners want motts of brush, but these should be large enough that wildlife animals can have sufficient cover to hide and to hole up during daylight hours. Although motts should have connecting strips for wildlife to have cover when moving from one to the other, they should be arranged so that working of livestock is not made more difficult. Since wildlife should be considered as another cash value crop from rangeland, domestic animal stocking rates must also be considered when big game animals are grazing the same area. For good range management, harvesting of both domestic and wild animals must be in proper proportion.

FOLIAGE SPRAYING

Use of Mesquite from Controlled Areas

Mesquite wood should be utilized as a source providing heating fuel rather than permitting a massive burning to remove wood from a controlled area. After suitable fuel wood has been removed, the remaining woody debris could then be raked, piled and burned to allow easier working of controlled area. Large single-stemmed trees should be properly cured and stored for future use in the manufacture of furniture and flooring. Trees to be cured should be placed in a shady area and each end of the tree sealed with wax to prevent excess cracking and splitting during curing period.

CHEMICALS

Chemical control of mesquite is practical and economical over large areas of rangeland infested to varying degrees with mesquite. Chemical control methods include broadcast and individual-plant treatments, with most popular method being aerial application of foliar herbicides. Individual plant treatment, although highly effective, increases labor costs and usually prevents this from being economically feasible on dense stands. Chemicals for mesquite control include contact oils and growth-regulator herbicides of 2,4,5-T, silvex, monuron, dicamba: 2,4,5-T mixture and picloram: 2,4,5-T mixture which translocate throughout the plant system.

Contact Oils

Kerosene or diesel fuel oil kills mesquite by contact rather than by trans-location within the tree. For best results, apply the oil around the base of the tree in sufficient quantity to penetrate to the lowest underground buds. A 90 percent root kill or more is possible from a thorough application. Proper application may require ½ gallon of oil or more for large trees.

Kerosene or diesel fuel oil works best on sandy loam or gravelly soils. On bottomland or heavy clay soils, the amount of oil required is excessive. Since penetration is much slower in clay soils and the buds usually are deeper, kills may be poor. Oil treatment still is probably the most effective method of control for mesquite on porous open soils, where the trees are large and single-stemmed and occur in stands of 100 trees per acre or less. Retreatment will be necessary in 3 to 5 years to control sprouts and seedlings. Mesquite should be treated when the soil is dry, preferably during the summer because moist soil in contact with base of the tree restricts the downward movement of the oil.

Growth Regulators

Research on the chemical control of mesquite with growth regulator herbicides was begun in 1947 by the

Texas Agricultural Experiment Station at Spur. Various herbicides have been tested, including 2,4,5-T, 2,4-D, 2,4-DP, silvex, trichlorobenzoic acid, AMS, substituted ureas, picloram, dicamba and mixtures or picloram or dicamba with 2,4,5-T and others. Monuron, 2,4,5-T, dicamba: 2,4,5-T mixture and picloram: 2,4,5-T mixture have been the most effective. The addition of ammonium thiocyanate to 2,4,5-T solution has increased control on creeping mesquite, but the results in most areas have been erratic for tree-type mesquite. The addition of nicotinic acid and other vitamins has shown promise of increasing root kills. If these inexpensive additives show increased mesquite kills in an area, they should be used according to guidelines provided by the researcher conducting the study.

Herbicides currently registered for mesquite control on grasslands are monuron, 2,4,5-T and dicamba used alone, 2,4,5-T: picloram mixture and 2,4,5-T: dicamba mixture.

Herbicides used on grasslands present no known toxic problem to humans, livestock or wildlife. Herbicides degrade rapidly in the environment, with decomposition increasing under increased temperature, time, soil organic matter, moisture and sunlight. It appears that no detectable residues of herbicides suggested for use would remain in the soil for longer than 6 months if used in accordance with directions on the approved herbicide label.

The highest detectable residues of herbicides in water have been observed following the first rainfall that produced runoff shortly after application. Residues decrease with each succeeding rain. The longer the period between application and rainfall, the smaller the amount of residue in the first runoff water.

Animals to be sold for slaughter should not be allowed to graze on the area treated with herbicide for a period of 30 days prior to sale. This restriction is stipulated to assure that there is no possibility of residues of herbicide remaining in animal tissues.

Animals should be removed from treated pastures during spraying operations and until all broadleaf weeds are dried because herbicides may cause chemical changes in certain plants making them more palatable. Because of this chemical change, animals might consume poisonous plants after they have been treated with a herbicide.

The amounts of allowable herbicide residues permissible on forage following a broadcast application of herbicides are:

2,4-D	0
2,4,5-T	0
Dicamba	40 80 parts per million
Picloram	~~40~~ parts per million

METHODS OF CHEMICAL APPLICATION

Aerial

Aerial application of herbicides is fast and economical. This method is adaptable for control of large acreages of moderate-to-dense stands of mesquite. Herbicides should be applied in accordance to approved label direction. Provisions should be made to deposit herbicidal sprays on the target area, but provisions of the State Herbicide Regulation should be followed when making herbicide applications.

1. **Tree-type mesquite.** All tree-type mesquite, single or multi-stemmed trees or sprouts at least 4 feet tall and 4 to 6 years old with dense foliage, should be sprayed with 0.5 to 1.0 pound of an approved herbicide mixed in 6 to 7 pints of diesel fuel oil and water to make a standard volume of 4 to 5 gallons of solution per acre. The heavier rate should be used on dense mesquite growing on heavy clay soils or on range sites where results have been poor with a rate of 0.5 lb. per acre. Retreatment would be necessary the following year if the top kill were less than 50 percent with the initial application. Herbicidal application costs per acre vary with the kind and amount of herbicide, the number of acres treated and the amount of labor supplied by landowner while the spraying operation is in progress. The landowner has a choice of three herbicides to use for mesquite control on rangeland: 2,4,5-T alone, a 2,4,5-T: dicamba mixture or a 2,4,5-T: picloram mixture.

The herbicide should be applied in swath widths and at a height above the mesquite growth which would obtain complete coverage of the entire foliage by the spray solution. The aerial applicator must know the exact swath width necessary to obtain coverage on the brush to be sprayed. In general, however, the swath width should not exceed 10 percent of the wing span of the airplane.

When undesirable weed growth needs to be controlled on the mesquite area and when the growth has

SOIL SURFACE SPRAYING

passed the optimum for using a rate of 0.5 to 1.0 pound per acre of 2,4,5-T alone, then the use of a picloram:2,4,5-T mixture or a dicamba:2,4,5-T mixture has produced satisfactory control on both mesquite and weeds. At times, perennial herbaceous weeds may retard the establishment of forage grasses following aerial spraying with 2,4,5-T. Range sites with mesquite and heavy infestations of perennial weeds should be treated with a picloram:2,4,5-T mixture or a dicamba:2,4,5-T mixture. Application of dicamba: 2,4,5-T mixture at the rates per acre suggested above will produce satisfactory perennial weed control when applied during September or October following effective rainfall, but it will not, however, affect mesquite.

2. **Creeping-type or running mesquite.** In the South Texas Plains, the creeping-type or running mesquite grows on alkaline or gypsum soils, with the largest infestations along the Frio and Nueces River watersheds. The creeping-type begins growth earlier than the tree-type mesquite. Based on 14 years of study near Tilden, Texas, the creeping-type mesquite can be controlled by using three successive annual applications of ⅔ pounds 2,4,5-T applied in 1 gallon of diesel oil and enough water to make a standard volume of 5 gallons of solution per acre. Complete coverage of the dense, lush foliage is essential. Chemical control methods are the only ones suggested for the control of creeping mesquite.

The comparative degree of control of creeping mesquite was shown when this type was treated with one application of 1.0 pound of the picloram:2,4,5-T mixture and 2,4,5-T alone; this produced a plant root-kill of about 30 percent for the 2,4,5-T and about 50 percent for the picloram:2,4,5-T mixture.

A test conducted at Tilden, comparing equal rates of a picloram:2,4,5-T mixture with 2,4,5-T alone showed that at the completion of three consecutive applications there was some advantage for using the picloram:2,4,5-T mixture for the creeping mesquite. To produce effective control of more than 85 percent root-kill, three consecutive applications of each herbicide were necessary. Three consecutive treatments with picloram:2,4,5-T mixture gave complete control of cacti species and satisfactory control on lotebush. Forage species of buffalograss and curlymesquite grass, however, made rapid reestablishment with repeated applications of each herbicide. The dicamba:2,4,5-T mixture has not been tested as long as other herbicides, but the degree of mesquite control possible with its use should be slightly greater than when 2,4,5-T is used alone. Also, the mixture would produce greater weed control than would 2,4,5-T application alone.

ALTERNATIVE FOR STANDARD OIL-WATER EMULSION

Water alone as a herbicide carrier can be used when it is impossible to obtain diesel fuel oil to make an oil-water emulsion. However, a surfactant should be added to the water-herbicide solution to reduce evaporation and to allow for better coverage of mesquite foliage.

The degree of mesquite control may be lower when water alone has been used as a carrier than when an oil-water emulsion has been used. When water alone is used, applications should be made when the air temperature is less than 80° F. when the relative humidity is 50 percent or greater. Pressure on the sprayer system should be lowered to produce large spray droplets and reduce the physical drift.

A low-volume, low-pressure application of 1 gallon of total solution per acre has proven to be effective for control of mesquite. While this method of application does not yet have federal approval, it does have state approval. Research results have shown that a mixture of 0.5 pound of 2,4,5-T (1 pint) plus 1 pint of diesel oil mixed with 6 pints of water per acre used as a low-volume, low-pressure application controlled mesquite as satisfactorily as the standard volume of 4 gallons per acre. The swath-width selected for use with a low-volume, low-pressure application must be more narrow than when an application with standard volume is being made. The aerial applicator must make adjustments in the sprayer system whenever the low-volume, low-pressure method is to be used. These changes are:

- No more than 20 nozzles per sprayer boom should be used.
- No more than 6 psi for zeigler or flapper-type nozzles or 15 psi or less for a diaphram system should be used.
- Whirl plates in diaphram nozzle must be removed.
- Last nozzle on the boom should be no closer than 3 to 5 feet from the wing tip.
- Nozzle orifices must be reduced as well as pressure for a 1-gallon total volume per acre to obtain satisfactory coverage of mesquite foliage.
- The Herbicide Division of the Texas Department of Agriculture should be contacted for additional requirements for the registration of airplane sprayers for making low-volume, low-pressure applications.

3. **Mesquite growth for aerial application.** The proper application time for an aerial application to control mesquite is 40 to 90 days after the first green growth has appeared at the buds in the spring or when the dense foliage has turned dark green.

The best root kills are obtained from aerial applications when the soil moisture is favorable for active mesquite growth and when the foliage has reached mature growth. Plant kills are reduced during a rainy spring, when the plants continue to add new leaf growth. Also root kills apparently are reduced when heavy clay soil temperatures are below 70° F.

Good conditions for spraying usually prevail when there is plenty of fall and early spring moisture. The rainfall should be good for at least 30 days prior to spraying. Mesquite leafs out and reaches maturity at

a definite time when growth conditions are ideal. At this stage, the approved herbicides are the most effective because the mesquite is replenishing the food reserve in the root system.

If rainfall occurs during the 50-day spraying season, spraying should be delayed until new growth on the tips of branches has developed fully, which usually requires 10 to 21 days before spraying.

If drouth prevails, spraying is not recommended because the results will be disappointing. If the trees are in poor foliage, which may result from hail, frost or insect damage, spraying should be postponed until next year.

Generally, higher percentage root kills can be obtained with mesquite growing on upland, sandy loam soils than on clays. Mesquite growing in soils with clay pans near the surface and in heavy bottomland soils are difficult to kill with broadcast application of approved herbicides.

Following the initial control applications, mesquite sprouts and new seedlings will need respraying in 5 to 10 years, depending largely on management and growth conditions.

A high percentage of top-kill results from the initial treatment, and a total root-kill ranging from 25 to 50 percent can be obtained when mesquite is sprayed with 2,4,5-T during good growing conditions. Plant root-kills have averaged up to 95 percent with 2 to 4 successive aerial applications in the Gulf Coast and South Texas Vegetational Areas. Retreatment root-kills, 4 or more years after the initial application, have averaged about 19 percent, with good top-kills using 2,4,5-T in the High and Rolling Plains. Successive applications of 2,4,5-T have not produced as effective control in north Texas as in south Texas. A higher percentage of total root-kill is obtained on young mesquite plants and seedlings.

Mesquite root-kills were increased by 10 to 100 percent when the application of a picloram:2,4,5-T mixture or a dicamba:2,4,5-T mixture was used instead of the 2,4,5-T application alone. It appears that forage production can be maintained longer on range sites treated with a picloram:2,4,5-T mixture or a dicamba: 2,4,5-T mixture than with the 2,4,5-T alone. The periods between retreatment can be extended from 1 to 3 years longer when a picloram:2,4,5-T or a dicamba:2,4,5-T mixture is used as compared to the use of 2,4,5-T alone.

4. **Suggested kinds and rates of herbicides used for mesquite control**

Range sites in vegetation area	Kinds of woody plants growing on range site	Herbicide and rate per acre to use for best results
All areas	Pure stand of mesquite	Use 0.5 to 1.0 pound of 2,4,5-T, or picloram:2,4,5-T mixture, or dicamba: 2,4,5-T mixture. Use 1.0 pound for herbaceous weed control in spring, or when 0.5-pound rate has not been successful.
High and Rolling Plains, Trans-Pecos	Mesquite-associated species of catclaw acacia, plains pricklypear, skunkbrush and tasajillo	Use 0.5 pound of the picloram:2,4,5-T mixture. If pricklypear plants are three or more pads tall, use 1.0 pound. Pricklypear growing on lighter soils appears to be easier to kill. Local area results should be checked to determine rate per acre to use. If associated species are not a severe problem the first application should be made with 2,4,5-T, and retreatment should follow in 2 to 4 years using picloram:2,4,5-T or dicamba:2,4,5-T mixture.
High and Rolling Plains, Trans-Pecos	Mesquite-associated species of sand shinnery oak, yucca and sand sagebrush	Use 0.5 to 1.0 pound 2,4,5-T. Retreat sand sage brush with 1.0 pound of 2,4-D l.v.e. 1 to 2 years later.
Edwards Plateau, Blackland and Central Prairies	Mesquite-associated species of limestone shin oak, live oak, catclaw acacia, pricklypear and tasajillo	Use 0.5 pound of 2,4,5-T to remove overstory of mesquite, followed with 1.0 pound of 2,4,5-T two or more successive years for oak control, followed with 1.0 pound of picloram:2,4,5-T mixture for the control of cacti species and catclaw.
Gulf Coast and South Texas Plains	Mesquite-associated species of blackbrush, granjeno, huisache, twisted acacia, pricklypear, tasajillo and perennial weeds	Use 0.5 to 1.0 pound of 2,4,5-T or dicamba:2,4,5-T mixture to remove overstory mesquite, followed in 1 to 2 years with 1.0 pound of picloram:2,4,5-T mixture. To maintain pricklypear in plant community, treat with 0.5 pound of picloram:2,4,5-T mixture followed with same treatment 1 to 2 years later.
South Texas Plains	Creeping-type mesquite associated species of lotebush, pricklypear, tasajillo, huisache, retama and perennial weeds.	Use 0.67 pound of 2,4,5-T for 3 annual treatments if associated species need to be maintained. Use 0.5 to 0.67 pound of picloram:2,4,5-T mixture for 3 annual treatments if all species are to be controlled.

5. **Preparing for an aerial application.** The first step in preparing for an aerial application is to locate a landing strip where maximum acreage can be sprayed without moving. The strip should be at least 2500 feet long and smooth enough that a pickup truck can be driven over it at 50-60 mph.

High-grade diesel fuel oil should be arranged for, as well as a good supply of clean, clear water that does not contain high content of salts which can precipitate herbicides from solution.

Flag lines to be cut parallel to each other should be arranged no more than one mile apart and preferably ½ mile apart. Three flagmen are necessary when the flight runs are longer than 1 mile. Flagmen should be well-trained as they are most important to the aerial application operation.

Only experienced operators with equipment adapted to provide proper application of the herbicide in coarse droplets at tree-top height should be employed.

Ground

A ground application of 2,4,5-T can be used to control individual mesquite trees with fairly effective results. This type of application is well-adapted for stands up to 125 trees per acre. This method can be used during the slack labor season or by an operator with a small acreage to treat around fields, stock watering places or corrals, and along utility rights-of-way and storage tank batteries. But, individual plant treatment is costly and laborious, although kills of up to 80 percent or more are possible with thorough applications. Retreatment is necessary, however, in about 5 years to control sprouts and seedlings.

For individual plant treatment applications of 8 pounds of 2,4,5-T low volatile ester acid equivalent should be mixed in 100 gallons of diesel fuel oil or kerosene. For smaller amounts, using herbicides with 4 pounds of acid equivalent per gallon, ⅓ cup 2,4,5-T should be mixed in 1 gallon of oil. A 3 to 5-gallon knapsack sprayer or a power sprayer can be used for individual tree treatment. The low-volatile ester of 2,4,5-T must be used to obtain best results when the herbicide is mixed in oil alone.

1. **Cut stump.** The most effective results are obtained by cutting or sawing off the trees near the ground line and applying the above mixture to the cutoff surface until the solution runs down the bark to the root crown. A gallon of the mixture should treat about forty, 4-inch trees. When trees are cleared in fence rights-of-way, the cut-off tree stumps should be treated to prevent sprouting and reduce the cost of fence maintenance.

2. **Trunk base and frill treatments.** Reasonably effective results on trees up to 5 inches in diameter are possible by spraying thoroughly all around the mesquite trunks from a height of 12 inches to the ground line. The solution should be allowed to soak down around the root crown. An extra amount should be sprayed at the ground line of the tree to insure better kills. If one side of the trunk is missed, it may sprout. A gallon of the mixture should treat about twenty, 4-inch trees. More herbicide solution is required with the trunk-base method, but the labor for cutting trees is saved. Trees with a trunk diameter of more than 5 inches should be frilled (overlapping axe cuts near the ground line all around the trees) and treated in the frill until the solution bubbles from the freshly made axe cuts. This should give quick, effective kills.

In the High and Rolling Plains over a 5-year period, an oil-water emulsion produced equally as satisfactory mesquite root-kills as did the oil mixture. It appeared to require slightly more solution per stem with the oil-water emulsion as it did with oil solution along. An oil-water emulsion should be mixed as 18 gallons diesel fuel oil, 2 gallons 2,4,5-T (8 pounds a.e.) and 80 gallons water. A manual agitator in the sprayer system is necessary to keep oil-water emulsion properly mixed. Generally, a sprayer pump bypass does not produce sufficient agitation to keep proper emulsion.

Cut-surface, trunk base or frill treatments can be applied at any season, but such treatments in winter and summer apparently give best results. Apply the herbicide solution immediately after cutting. Best results are obtained when the herbicide solution is applied during a dry period when the soil is not fused to the tree trunk. This allows the solution to penetrate deeper below the root crown. These methods give control of mesquite for about half the cost of the basal-pour treatment. Spraying is preferred over pouring the herbicide solution, because pouring is wasteful. A low sprayer pressure is necessary to produce coarse droplets.

The many-stemmed mesquite growing on heavy clay soils is difficult to control with this method of application.

3. **Foliage application.** Hand and power sprayers can be used for foliage applications on small areas not suited for broadcast application. Mesquite should be less than 6 feet tall. The leaves, stems and trunks should be covered with spray solution. The herbicide solution should be applied during the active growth stage in the spring under favorable soil-moisture conditions. A solution should be mixed using 3 pounds of low-volatile ester of 2,4,5-T or 2 pounds of the picloram:2,4,5-T mixture or 2 pounds of the dicamba:2,4,5-T mixture in 100 gallons of water, plus 4 to 16 ounces of surfactant. Spray the foliage until it is thoroughly wet. It may require 150 gallons or more of solution per acre to obtain full coverage.

The application of 1 pound of 2,4,5-T low-volatile ester mixed in 15 to 25 gallons of water per acre with broadcast spray equipment will suppress mesquite seedlings and sprouts and give effective weed control.

The application of 1.0 pound of a dicamba:2,4,5-T

mixture as broadcast will produce a satisfactory control of mesquite and associated species susceptible to the herbicide mixture.

Care must be taken, however, that wind does not cause a herbicide drift that will harm susceptible plants. The provisions of the State Herbicide Regulation and directions on federally approved herbicide labels, should be followed.

4. **Soil-surface method.** Monuron, a substituted urea, powder or pellet kills mesquite slowly since the chemical must be absorbed by the tree roots after being washed into the soil. It has a low toxicity level to livestock, however. The chemical should be applied on the soil surface at the base of the tree before the rainy season. Some sterilization of the soil around the trunk will result. Monuron requires about 2 years to kill the mesquite.

Favorable plant-kills have been obtained with 10 pounds of monuron wettable powder mixed with 100 gallons of water. This material forms a suspension in water and must be agitated often to keep the powder from settling to the bottom of the sprayer. The solution is sprayed at the base of the trunk in a 6-inch band around the tree until a gray film is visible. This control method works best on trees that are growing in fence rows near susceptible crops. One gallon of solution should treat about 10 trees. This suggested rate of herbicide will kill forage grasses for about 2 growing seasons.

Monuron granular herbicide should be applied at the rate of 1 tablespoon of 25 percent active ingredient for each 4-inch diameter of tree at the ground line.

Chemical brush control methods should be planned to allow for sufficient cover and to make sure food plants are left to wildlife. It appears that it is more difficult to protect certain plants when air broadcast control measures are being used. Prior planning with flagmen and the aerial applicator is most important with air broadcast. Strips of brush cover can be left, but it is most difficult for aerial applicator to leave motts of food plants unless these areas have been properly marked before spraying. Cover along waterways can be left very easily. Also, many of the woody plants necessary for wildlife food generally are not affected by herbicidal sprays if they are used at the rate necessary to control mesquite. Sites where turkeys roost must not be treated, however, or they will leave the roosting areas and not return where it has been disturbed.

Landowners and ranch managers have a most important job to plan for proper balance of total rangeland ecosystem.

RETURNS AND MANAGEMENT

Livestock production should increase during the second growing season following control of mesquite. A 14-year study at the Spur Experiment Station has indicated that steers grazed on treated pastures from May 1 to October 3 made about 5 pounds more gain per acre than steers grazing untreated mesquite pastures. During drouth years, beef production was 50 percent greater on treated pastures. Also, at Spur from 1961 to 1965, a cow-calf test showed that cleared pastures produced an added net return of 81 cents per acre per year over uncleared pastures.

In the Texas Panhandle, a complete, well-planned mesquite control program has been carried out on a ranch since 1957. First, 2,4,5-T was applied by air broadcast. If root-kills were good, the area was retreated by the individual-plant treatment method with ground equipment, using 2,4,5-T mixed in diesel fuel oil. This herbicide mixture and the rate selected were used to control regrowth mesquite, pricklypear, cholla, yucca, catclaw acacia and lotebush not controlled by the aerial spraying. Results from the long-term demonstration have indicated the following:

- Increased calf weights of 40 pounds per animal per year.
- Increased stocking rates of 30 percent.
- Increases in better forage grasses.
- Labor saved in working livestock—$1 per acre per year.

These results were produced using the partial-budget technique, with only aerial spraying, which gave mesquite control for 8 years before retreatment was necessary. The cost of spraying 640 acres was $220 per year. Gross returns from calf-weight gains and labor saving were $1,224 per year. A return of $1.55 per acre was realized. This return does not consider any increase in value to land for improved range conditions or the aesthetic value or value of increased food for quail and antelope.

The experimental results at nine locations in Rolling Plains, Edwards Plateau and Trans-Pecos Vegetational Areas comparing treated and untreated pasture showed that calf weights were 27 pounds more per head on treated pastures. These results were obtained when stocking rates on treated and untreated pastures were the same.

In Dewitt County, a mesquite-control demonstration begun in 1966 resulted in an increased beef-calf production weight of an average of 63 pounds per head per year, as compared to 49 pounds per head per year averaged on untreated pastures. This produced an increased return of $5.60 per head. Mesquite control cost $6.60 for two applications and control lasted for 5 years. This gave a gross return of an additional $4.28 per head per year over the uncontrolled pasture. The trend in range conditions was up in the controlled pasture and down in the uncontrolled pasture. Cows in the uncontrolled pasture had to be fed hay in winter, at the rate of 13.7 bales per head.

Control of creeping-type mesquite has indicated that range conditions can be improved from poor to good with three successive applications of 2,4,5-T. The degree of control was about 85 percent plant kill. The stocking rate of mother cows was increased 30

percent over the uncontrolled pasture. This increase, however, was made without a deferment following control. The same number of animals that grazed the area before spraying were maintained, but the stocking rates were increased at the end of 3 years. The ranchmen have indicated that mesquite control paid good dividends each year through heavier calves, lower feed bills, easier working of livestock and increase of hunting leases.

In Refugio County, mesquite control by the aerial application of 2,4,5-T on regrowth and original-stand mesquite produced the following results in each area.

One aerial spraying on regrowth mesquite gave control for 6 years. Before control, the area produced forage grass to carry one animal unit per 39 acres. With only one application in 1964, the area produced forage to carry one animal unit per 11 acres for 4 years. Then the acres per animal unit increased until carrying capacity was to 25 acres per animal unit 8 years after initial control. Results from this demonstration indicate that the mesquite plant kill was about 25 percent and that the beef cattle enterprise can be kept on a highly productive level. Additional 2,4,5-T applications, year after year, have produced additional mesquite plant kills up to 80 percent and have kept forage production to the equivalent of one animal unit per 7 acres.

One aerial application on an original stand of mesquite gave control for 4 years. The plant-kill the first year was only 10 percent, but this rate increased to 25 percent the second year. Before control, the area produced enough forage grass to carry one animal unit per 106 acres, but after control the forage production was sufficient to graze one animal to 12 acres. Additional yearly spraying increased plant-kills to 80 percent and improved range conditions from poor to good in 4 years.

Each area was deferred during the growing season and grazed during the winter. Better forage-grass species of little bluestem, switchgrass, vine-mesquite, sideoats grama, Arizona cottontop, and plains bristlegrass made rapid increase during the period from 1964 through 1969.

In Callahan County, a 5-year mesquite-control demonstration started in 1968 showed these results using a cow-calf operation as base herd and grazing excess forage with replacement animals. Since treated pasture could not be deferred following spraying, no additional animal grazing income was realized the first year. Increased calf weights of 20 pounds more per head in the treated pasture resulted in an increase of $0.5 per acre more than in the untreated pasture. The second year, calf weights were 12 pounds less in the treated pasture than in the untreated pasture, but excess forage allowed the credit of 5300 animal grazing days for treated pasture. The animal grazing day was valued at $0.10 per day, for return of $1.57 more per acre for treated pasture during second year. During the third year of the study, calf weights were 20 pounds more per animal in the treated pasture, as compared to the untreated pastures. The per-acre returns amounted to $4.18 for treated pasture, when compared to the untreated. During the 4 years reported, the per-acre returns were $4.97 per acre in favor of treated pasture.

A study near Alice on a mixed brush area, treated with a picloram:2,4,5-T mixture, compared with a similar untreated area produced these results during 1970-1971, the first year following treatment. In this area the brush was retreated 5 years later, 1974.

Livestock production and brush control were excellent for the treated areas in the South Texas Plains Area, as compared to the uncontrolled areas. The following table records some of the benefits of treated pasture. A comparison was made with one-sire herds on treated and untreated pastures.

	Treated	Untreated	Difference	Returned/ animal unit
Stocking Rate/Animal unit	8	25	17	—
Average Calf Wt. Lbs.-205 Days; $0.32/lb.	532	471	61 lb.	$19.52
Supplemental feed/animal/90 days	2 lb. CSC	2 lb.CSC+ burned pear	$15	15.00
Interest on investment/animal unit	$3	—	$ 3	-3.00
Total increased return/animal unit				$31.52
Cost of brush control/year/animal unit				-14.00
Return/animal unit/year				$17.52

The returns from mesquite control involve more than livestock gain per acre. Treated pastures show added benefits in (1) less labor required for working livestock, (2) more gentle livestock, (3) less injury to livestock, (4) fewer breeding males required, (5) less mesquite-bean poisoning, (6) percentage offspring crops usually higher, (7) usually increased grazing capacity and (8) reduction in supplemental feeding.

Livestock prefer the controlled and aerially sprayed areas. To prevent overgrazing, an entire pasture should be controlled at one time or livestock should be removed from the area, or the pasture that has only a portion controlled should be cross-fenced. Deferred grazing should be practiced during the first 2 growing seasons following control, to allow the existing native forage grasses to reestablish and

seed. The controlled area can be grazed moderately during the first winter, but livestock should be removed when the grass growth begins in the spring. After the native forage grasses have been reestablished, the controlled pasture should be properly stocked to obtain a moderate use of the available forage and sustain a high forage production. A systematic plan for deferred-rotation grazing with moderate and flexible stocking rates will prolong the need for retreatment of mesquite and improve range conditions for sustained yield, increased net returns and sustained returns from natural range resources.

Guides for Profitable Range Management*

Control brush, weeds and poisonous plants in the most economical way.

Know the range plants — where they grow and when, and how and what kind of livestock graze them.

Use range forage plants moderately — graze half and leave half (by weight) of the current year's growth.

Pracitice deferred rotation grazing with combinations of kinds of grazing animals.

Use proper stocking with flexible stocking rates.

Distribute livestock with salt, water and cross-fencing to attain uniform grazing.

Provide a forage reserve of cured grass for winter and during drouth.

Provide temporary pastures to relieve grazing pressure on native grass forage.

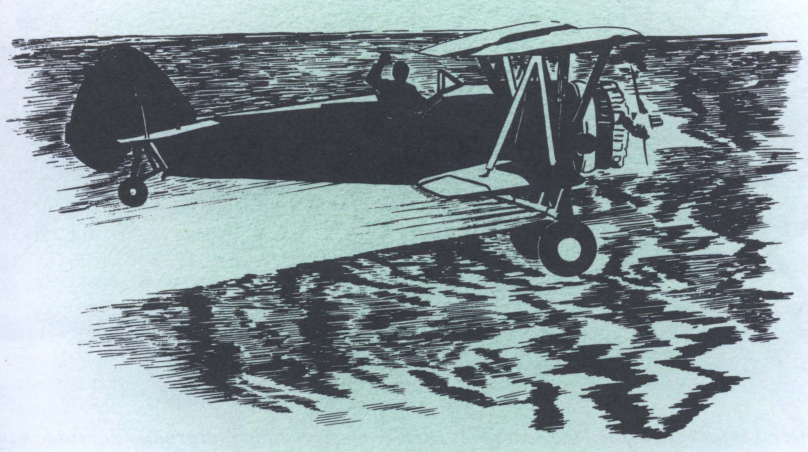
Use adapted native grasses for seeding depleted rangeland and abandoned cultivated fields.

Protect rangelands from fires — build and maintain fire guards.

Remember that pounds of productions, rather than numbers of head, count at the market.

Herbicide use suggestions are based upon the following: effectiveness of materials; avoidance of residues in excess of allowable tolerances; avoidance of toxicity to economic plants, animals and humans; and avoidance of detrimental side effects to the environment of the treated area. Herbicide use rates for Texas are usually below rates on approved labels. But the herbicide **user** is **always** responsible for the effects of residues on his own forage crop or livestock as well as for problems caused by drift or movement of the herbicide from his property to other properties. Should questions arise concerning the current label status of any approved herbicide, contact your county Extension agent or range specialists of the Texas Agricultural Extension Service.

*FOLLOW DIRECTIONS ON APPROVED LABELS ON HERBICIDE CONTAINERS. IF THESE PRECAUTIONS ARE OBSERVED, THERE SHOULD BE NO DANGER OF EXCESS RESIDUES.



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