The Mesquite Problem in the Southwest

C. E. FISHER

Texas Agricultural Experiment Station, Spur, Texas

THE invasion of mesquite into large areas of range and pasture lands in the Southwest has been progressing for many years, but only within recent years has it become of major concern to livestock raisers. In general mesquite is considered undesirable because it has reduced the carrying capacity by forming dense jungles of brush on once productive lowlands that have deep soils and favorable moisture conditions. Mesquite has hindered greatly the managing and caring for livestock and the use of desirable range improvement practices. In 1896 J. G. Smith (*15*), an agrostologist stationed at Abilene, Texas, called attention to the hardy, aggressive nature of mesquite and rather accurately predicted the mesquite problem we face today. In Texas alone recent surveys by the Soil Conservation Service (*2*) show that mesquite occurs on 55 million acres of grassland in 113 counties and that moderate or dense stands occupy approximately 30 million acres.

Description and Distribution

Mesquite (*Prosopis juliflora*) belongs to the Mimosa family, and it is distributed in warm, mostly dry climates of United States, Central America, West Indies, Africa, Persia, India, Chile, Hawaii and other countries of similar climate (*4, 17*). Three varieties occur in the United States according to Benson and Darrow (*3*): Honey mesquite (*P. juliflora var. glandulosa*), Velvet mesquite (*P. juliflora var. velutina*), and Western honey mesquite (*P. juliflora var. Torreyana*). Honey mesquite occurs for the most part east and northeast of the Rio Grande in central New Mexico and extends to south central Kansas on the north, Louisiana on the east and northeastern Mexico on the south. Velvet mesquite predominates in Arizona, extreme western New Mexico, lower California and in Mexico. Western honey mesquite is found in California, southern Nevada, western Arizona, southern New Mexico and in parts of Texas.

Mesquite is typically a deep-rooted, sprouting tree or shrub that has one to many stems from 10 to 15 feet tall. The growth form in all varieties varies from a many-stemmed bushy plant less than 5 feet tall to a large single-trunk tree 40 to 50 feet tall and 1 to 2 feet in diameter (Fig. 1). This variation in growth habit is influenced largely by differences in moisture, soils, killing of above ground growth by occasional low temperatures, and by mechanical injury induced by man, grazing animals, rodents and other means.

Mesquite has an extensive root system that enables it to withstand droughts, severe competition from grasses, and adverse conditions due to prolonged overgrazing of range and pasture lands. The roots on well-established plants may penetrate the soil vertically to depths of 20 to 60 feet and often extend laterally as much as 50 feet from the base of the tree (4).

The invasion of mesquite on native grassland within the past 40 years has taken place so rapidly that it is common knowledge among people of the southwest. The early introduction of key plants into open grassland by roving herds of buffalo, and by the Spanish horse and cattle during trail drives and, then, the subsequent spread from these initial localized areas are often mentioned among the more probable causes of recent rapid invasions (*5*). Other causes which have been suggested are: Lack of repeated burning of the grass, destruction of prairie dogs, floods, droughts, overgrazing, and rapid transportation of animals that may have large numbers of viable seed in their digestive tracts (*4, 11, 18*). It is not known just what role each of these factors, or others, may have played in accelerating the spread of mesquite, but it seems certain that not any one factor is wholly responsible. More likely, a combination of the early introduction of initial plants by roving animals followed by more intense use after fencing of the grasslands, extended droughts, and management of livestock largely account for the mesquite problem we face today.

Values of Mesquite

Mesquite provides some forage which consists chiefly of the seed pods that are relished by livestock and of limited amounts of browse consumed during extended drought periods. Formerly, much use was made of mesquite for fuel and posts.

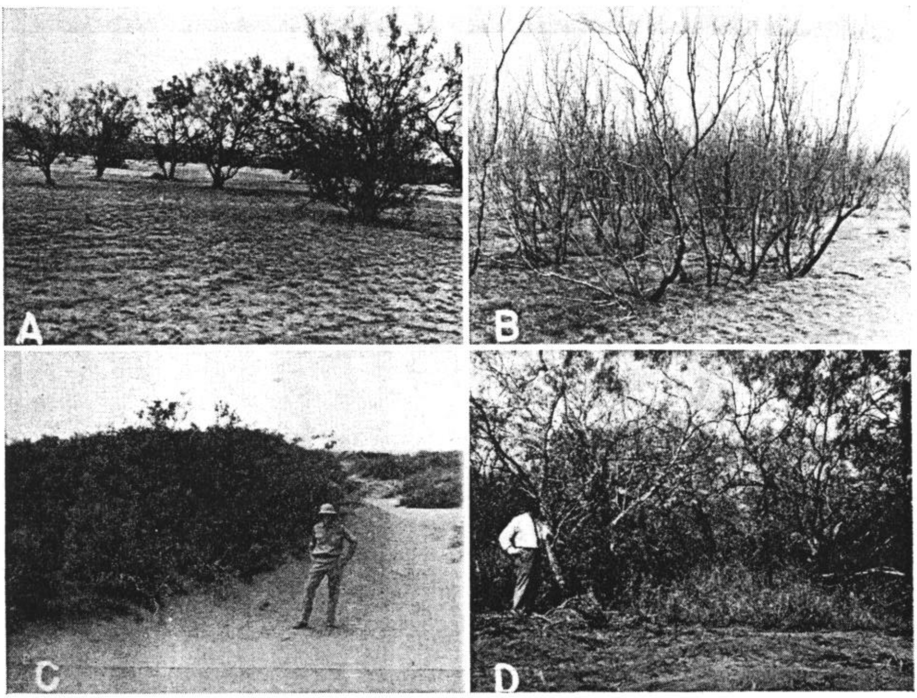

FIG. 1. FOUR TYPICAL GROWTH FORMS OF HONEY MESQUITE

(A) Trees in open stands. (B) Many-stemmed shrubs in dense stands. (C) Many-stemmed shrubs in sand dune area. (D) Trees intermingled with other brush species.

Encouraging the utilization of seed pods by grazing animals is questionable if control of mesquite is to be considered. Fisher (*6*), working with honey mesquite, found that a single tree produced as many as 20 pounds of air-dry seed pods in one crop and that 54, 45 and 12 percent of seeds fed in pods to horses, steers and lambs respectively passed through the digestive tracts and remained viable. Furthermore, Martin (*10*) found that seed of velvet mesquite germinated after being stored in a herbarium for a period of 44 years. The dissemination of viable seed by grazing animals, the apparent longevity of the seed, and the periodic emergence and survival of large numbers of seedlings, greatly increase the difficulty of obtaining lasting control of mesquite on extensive acreages (*6*).

Values of Control

There is a definite lack of factual information available on the value of controlling mesquite on grassland. In moderate to dense stands mesquite competes rather seriously with grass for moisture, light, and, to a lesser extent, for plant nutrients. Generally, where the annual rainfall is about 25 inches and, on more favorable sites under lower rainfall, there is enough moisture to support the growth of moderate stands of mesquite with slight reduction in productivity of grass. Under heavy shading, summer grasses give way largely to annual cool season species. In northwest Texas in a 21-inch rainbelt, Fisher (*6*) found that grasses growing in full sunlight produced slightly higher yields of forage than those grown under lath cages with moderate shade and markedly higher yields when compared with grasses grown in heavy shade. The grasses that grew in full sunshine were more tender, had 20.42 percent more starches and sugars, and 6.17 percent less crude fiber than grasses grown in heavy shade. In grazing trials yearling steers made 15 percent more gain over a four-year period on grassland cleared of a moderate stand of mesquite than on uncleared grassland (Fig. 2). During the fourth grazing season after the land was cleared, steer gains were increased 43 percent.

Under light rainfall, competition for water becomes more severe and the production of grass usually is greatly reduced even by moderately light stands of mesquite. In southern Arizona, Martin and Parker (*11*) found that under summer rainfall of 7.41 inches in July, August and September, removal of light stands of mesquite increased usable forage two and one-half times.

In addition to increasing the productivity of grass, control of mesquite permits more efficient management of livestock, the use of desirable range improvement practices and, under some conditions, checks surface erosion. It has been estimated by ranchmen who have cleared their land of brush that fully 20 to 25 percent of the value of mesquite control is due to more efficient management of livestock.

Method of Control

The vast acreage of mesquite-infested grassland, together with an ever-increasing abundance of seedlings on low-value land, definitely present a real challenge to science to develop a simple and economical method of control (Fig. 3).

The following methods of control have been used effectively on localized areas of range and pasture land to control invading plants, permit more efficient management of livestock, and increase the productivity of desirable forage plants on favorable sites. Complete control, however, on large infested areas very seldom has been possible with present known methods because the overall cost of such a program, in most instances, cannot be economically justified in the light of benefits that might be derived from such treatment within a reasonable period of time.

To effectively control mesquite it is necessary to kill the dormant sprout buds on the underground stem (*8*). These buds are small wart-like structures that give rise to new sprouts if the top-wood is killed. Mesquite common to the ranges and pastures in the southwest has a zone of buds that is generally located from three to eight inches below ground level and varies with growth form,

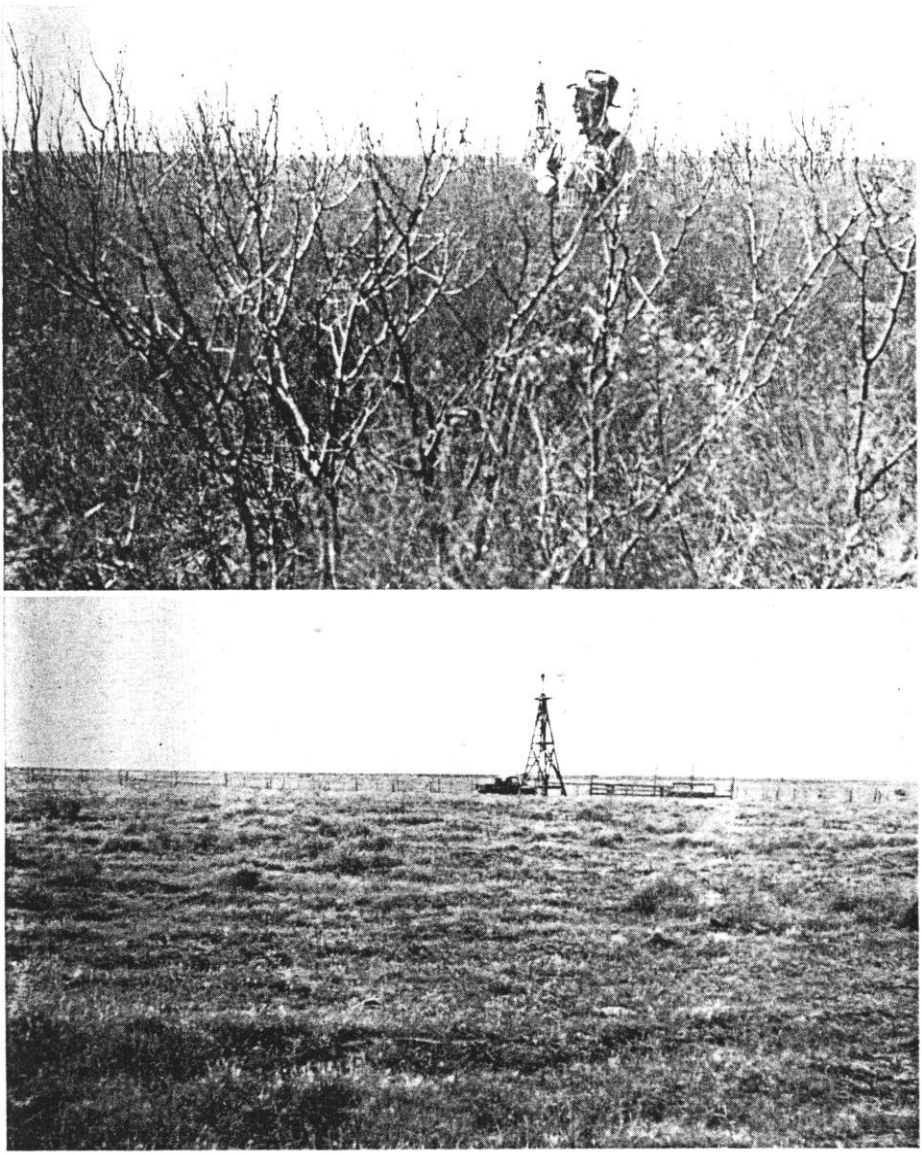

FIG. 2. GRASSLAND BEFORE AND AFTER CLEARING MANY-STEMMED HONEY MESQUITE BY REMOVING THE TOPWOOD AND POISONING THE STUMPS WITH SODIUM ARSENATE.

Gains of yearling steers were improved an average of 15 percent over a 4-year period by removal of the mesquite.

amount of soil deposition, and soil type, (Fig. 4).

Mesquite may be killed in at least two major ways: (1) By removing the whole plant deep enough to destroy all the buds, as in grubbing by hand or with power machinery; and (2), by applying chemical solutions or oils in such manner as to kill the dormant buds on the underground stem without removing it. The great variation in growth forms of mesquite and soil conditions from one locality to another certainly necessitates the use of different methods of attack if the present known treatments are to be effective and economical. There is no one best method of control.

Hand and Power-Machine Grubbing

Hand-grubbing is one of the oldest and most widely used methods of eradicating mesquite and other brush. It is practical for removing small seedlings and initial invading plants, and as a clean-up measure following cheaper methods of eradication.

Grubbing mesquite with heavy power machinery is governed by the same principles that apply to hand grubbing, that is, all dormant buds must be removed or destroyed. Rather extensive use has been made of a 24- to 36-inch cutting blade mounted on the front end of a crawler-type tractor. In light stands of mesquite only a small amount of grass is destroyed and highly effective kills are obtained. On the other hand, in dense stands of mesquite a high percentage of the grass turf is destroyed, a great many of the small plants are missed, and the operation is very costly. (Fig. 5).

Another type of root cutter used primarily on dense stands of brush consists of an 8-foot U-shaped blade that is pulled by a crawler-type tractor. The depth of the cutter blade may be adjusted to cut from 6 to 20 inches below the ground level. The entire area is treated as in plowing, and roots of all plants are severed at a designated depth. The root cutter treatment usually de-

FIG. 3. TWO YEARS AFTER GRASSLAND WAS CLEARED OF MODERATE STAND OF MESQUITE 2950 SEEDLINGS HAD EMERGED PER ACRE

Five years later 1250 seedlings still survived under protection from grazing. A seedling occurs at the base of each stake.

stroys a very high percentage of perennial grasses and, in many instances, the treatment is followed by a heavy emergence of mesquite seedlings and undesirable plants such as sunflowers, Russian thistles and other annuals. This type of equipment has been used primarily for clearing land for crops or where reseeding with grasses is successful and can be economically justified.

Cabling mesquite consists of using two heavy-duty crawler-type tractors that run parallel to each other about 100 feet apart dragging a loop made of one or two 300- to 400-foot steel cables. This method is suitable for treating large areas quickly at low cost and its use is limited to sites where trees with large, stiff trunks predominate. Properly used, cabling in combination with costly but more effective methods such as hand and power grubbing and oils may well reduce the expense of over all control, but alone, even under favorable conditions, cabling will seldom give satisfactory control.

On large land units that can support the heavy capital investment, these machines may be used to advantage for controlling mesquite (*6*, *9*). Custom work offers a possibility of clearing small areas of brush but usually it is too expensive for the average size ranch unit.

Mechanical methods, such as mowing with mobile tree saws, heavy-duty mowers, or stalk cutters, bulldozing, and others that destroy only the top growth, merely stimulate the growth of new sprouts and bring about a condition that is sooner or later more objectionable than the original growth, (Fig. 6). Repeated mowing and annual burning of established trees and seedlings for a 5-year period have failed to prevent rapid regrowth of mesquite. It is probable that frequent cutting would eventually kill mesquite but the cost would be prohibitive except on small maintenance areas.

Kerosene and Other Oils

Kerosene, diesel fuel or similar oils are contact agents and to be effective in killing mesquite must be applied in sufficient amounts to the ground and

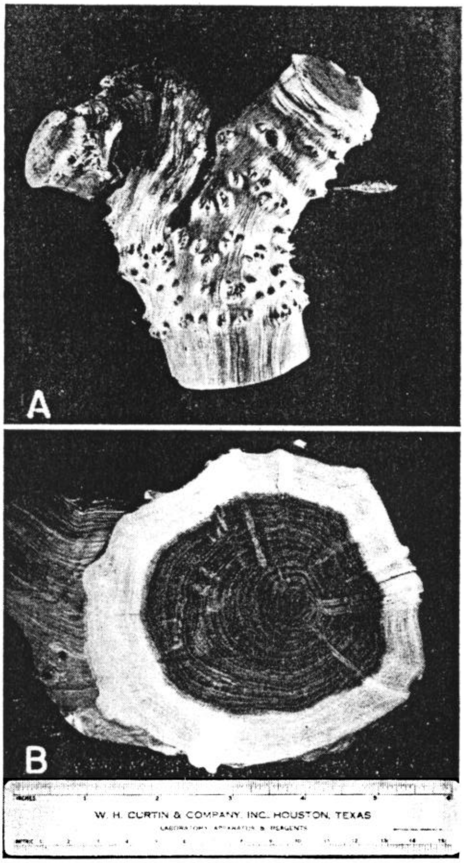

FIG. 4. (A) Dormant sprout buds on the underground stem of mesquite. These buds occur from 4 to 12 inches below ground level and must be destroyed either mechanically or chemically to prevent sprouting. (B) Cross section of underground stem of mesquite showing that the dormant buds originate from the pith of the stem.

underground stems of mesquite to soak through the bark and down to the lowest bud (*5*). Applications made to the aboveground growth give effective kills only when enough oil is used to reach the sprout buds.

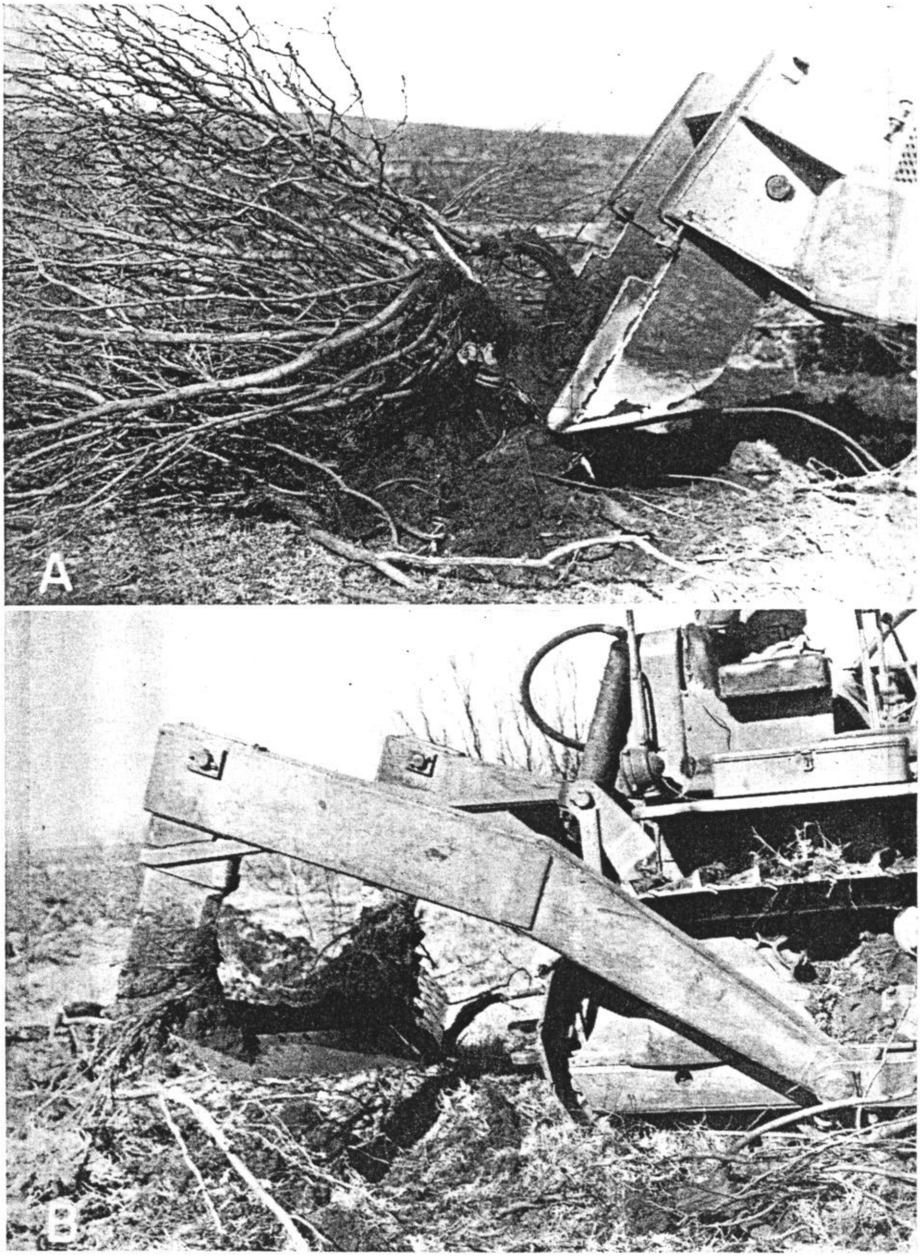

FIG. 5. Effective mechanical methods include, (A) Power grubbing with "stinger" attachment to uproot mesquite. (B) Root cutter that severs roots of all plants 6 to 15 inches below ground level.

The easiest and most economical method of using oil is to pour it with a spouted can on the ground and around the lower six inches of the mesquite trunk when the surface soil is relatively dry. For stands of predominantly single-stemmed trees growing on porous soils there is little question that excellent kills can be obtained at relatively low cost. On heavy impervious soils, especially where the mesquite is many-stemmed, usually excessive amounts of oil are required to get sufficient penetration of oil into the soil.

Excellent results at low cost have been obtained on few-stemmed, rough-barked mesquite on porous soils by using a combination bulldozer or cabling and oil treatment. Following the initial mechanical treatment the clean-up with oils should be made 6 to 12 months later to kill the remaining sprouted plants and seedlings.

Basins dug around the mesquite make it possible to apply the oil closer to the bud zone, reduce the amount of oil required and increase effectiveness of the treatment, but the method is slow, laborious and usually too expensive.

Sodium Arsenite

Of the many chemicals tested, sodium arsenite has been the most effective and economical when applied to the sapwood of trees and stumps (*5*, *14*). Unlike oils, it is quickly absorbed by mesquite plants and once in the sapstream spreads rapidly throughout the plant. The various methods of treatment, such as girdling, frilling, removing the topwood and then treating the sapwood with poison or pouring weak solutions around the base of trees, are adaptations which facilitate getting the sodium arsenite into the sapstream.

Many-stemmed, or brushy, mesquite

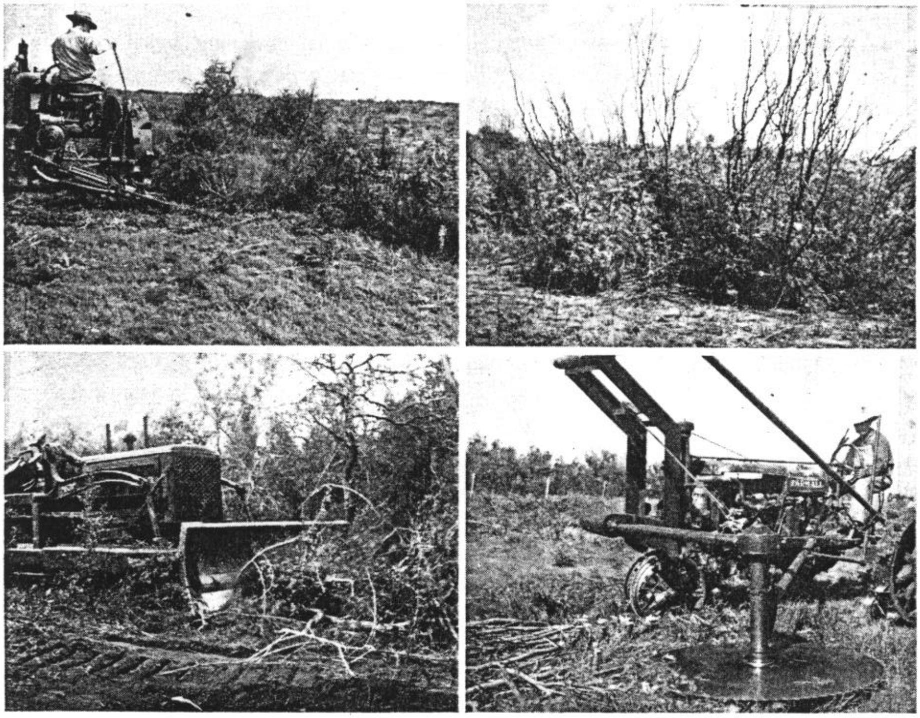

FIG. 6. MOWING, BURNING, BULLDOZING, AND SAWING DOWN THE TOPWOOD ANNUALLY HAVE NOT BEEN EFFECTIVE MEANS OF CONTROLLING MESQUITE

have been treated successfully at Spur, Texas at one-half the cost of grubbing when the topwood and all stems were removed back to the crown and the exposed sapwood was treated (*6*). Leaving a portion of exposed sapwood untreated will result in sprouting since there is little lateral movement of sodium arsenite in the tissues of mesquite.

Treating stubs and cut ends of branches on many-stemmed mesquite after the topwood is removed with a tree saw or other methods has not been very effective for two reasons: (1), The restricted movement of poison in tissues of forked stems, and (2), the increased distance the poison must travel to reach the lowest sprout bud.

On large, single-stemmed trees free of basal brush, the removal of the topwood at soil level or frilling with a hand axe and then treating the sapwood have given excellent results. Pouring diluted solutions around the base of single-stemmed trees may be effective on porous soils, but the large quantities of solution required render the method impractical in dense stands of mesquite. Sodium arsenite is highly poisonous to animals as well as plants. Its poisonous character greatly limits its use even though it is economical and highly effective on mesquite.

Ammonium Sulfamate

This chemical, more commonly known as Ammate, has been fairly effective on many-stemmed mesquite when a water solution containing 4 pounds per gallon is applied in sufficient amounts to thoroughly wet exposed sapwood after the topwood and all branches have been removed to the crown. Ammate is not readily taken up by the roots and does not penetrate the bark of established plants. It is not poisonous to livestock and not hazardous to handle but usually is more costly for control of brushy mesquite than sodium arsenite.

Chemical Treatment of Foliage

A reasonably effective chemical foliage treatment that will economically permit repeated application to destroy seedlings and any regrowth from plants that were previously treated seems to hold most promise for practical control of mesquite on range land.

Early studies with foliage treatments were largely concerned with the use of such standard weed chemicals as sodium chlorate, ammonium thiocyanate, ammonium sulfamate and many others to determine their effectiveness when applied to the foliage of sprout growth and trees. In 1945 formulations of 2,4-D and 2,4,5-T were added to these chemical studies.

From 1942 to 1948 treatments with chemicals applied to the foliage of trees and sprouts were made using knapsack, power, and more recently airplane spraying equipment on 3000 plats of less than one acre to over 20 acres on 80 different dates extending from March to November. Results of these studies show that effective kills of mesquite were obtained in only a few cases. The greatest single factor that influenced the absorption and translocation of such systemic chemicals as sodium arsenite, ammonium sulfamate, 2,4-D and 2,4,5-T has been the length of time that the chemicals remain in moist contact with the leaf surface of mesquite (*7*). Under conditions when these chemicals remained in moist contact with the leaf surface for as much as 8 hours, excellent kills of mesquite were obtained. Shorter periods of moist contact, 4 to 6 hours, invariably gave excellent kills of above ground parts but absorption and translocation of systemic chemicals were not sufficient to kill all the dormant sprout buds on the underground stem. Regrowth from these sprouting tissues usually took place 60 to 120 days later or even longer after treatment, depending upon the amount of tissues destroyed. Somewhat greater delay in regrowth from apparently undamaged tissues has been obtained with solutions of 2,4-D and 2,4,5-T than with those of sodium arsenite and ammonium sulfamate. With extremely short periods of moist contact, less than 15 minutes, usually only the leaves and young tender stems of mesquite were killed.

With the prevailing weather conditions in the southwest, moist contact of chemicals with leaves and tender stem tissues can be maintained for only short periods of time, 15 to 120 minutes, and effective kills are not obtained unless the foliage treatment is followed within 18 hours by heavy dews, light rains, fogs or high atmospheric humidity. The use of various penetrants and solvents such as light oils, water soluble waxes, acids, glycerine, calcium chloride, and others in combination with systemic chemicals, generally has not increased absorption and translocation sufficiently to increase materially the number of plants killed. Some of these materials, however, have increased the percentage kill of the aerial plant parts by more effective contact toxicity. However, retreatment would be necessary within 2 to 3 years following the initial application to control undesirable regrowth.

Factors of secondary importance, in most instances, were season of the year, the rate and stage of growth of mesquite, soil moisture, formulation and concentration of solutions, air temperature, and others.

Intensive research studies with 2,4-D and 2,4,5-T and closely related chemicals are underway because in many respects these chemicals fit the needs of mesquite control. Yet, further information and development of the foliage treatment is necessary before a practical method of control of mesquite is assured.

Summary

1. Invasion of mesquite on range and pasture land in the Southwest is of major concern to livestock raisers. Mesquite thrives in the dry climates of Southwestern United States and in many foreign countries with similar climate.

2. Mesquite is typically a sprouting tree or shrub that has a well-developed root system that enables it to compete effectively for moisture with perennial grasses. It takes on many growth forms due to variations in moisture, soils, low temperatures, fire and mechanical injury induced by man, grazing animals, rodents and other means.

3. The abundant production of and apparent longevity of the seed together with the periodic emergence and survival of large numbers of seedlings during favorable periods greatly increases the difficulty of obtaining lasting control of mesquite on extensive areas of rangelands.

4. The accelerated invasion of mesquite on rangelands is due in part to dissemination of seed by roving animals, over-use of grasslands, droughts and livestock management practices.

5. Effective control is dependent on destroying the dormant sprout buds on underground stems, either by removing the plant below the lowest bud or killing the buds through the use of chemicals or oils and controlling reinfestation by seedlings.

6. Light oils, kerosene, diesel fuel and others have been used successfully to control light stands of single to few-stemmed mesquite growing on porous soils.

7. Sodium arsenite is the most effective and economical chemical found to con-

trol mesquite. However, its use is limited by the poison hazards to man and livestock.

8. Grubbing mesquite either by hand or with machinery is an effective control measure but generally too costly. Root cutter machines may be used effectively to clear land for cultivated crops and under conditions where reseeding with desirable range grasses is successful and economically justified. Cabling and bulldozing are usually not effective control measures when used alone, but may greatly reduce overall control costs when used in combination with more expensive and effective methods.

9. Methods that destroy only the above ground growth offer little promise of effectively controlling mesquite. Such methods generally result in growth more objectionable than original plants.

10. The use of 2,4-D and 2,4,5-T for the control of mesquite is still in the experimental stage of development and is not yet a recommended method of control.

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