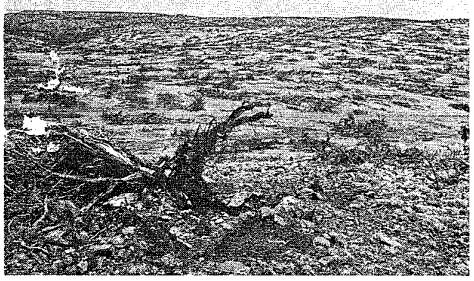
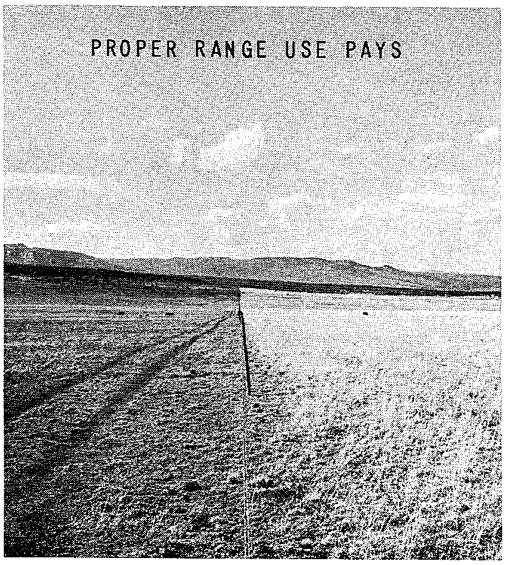
# RANGE CONSERVATION - TECHNICAL NOTES

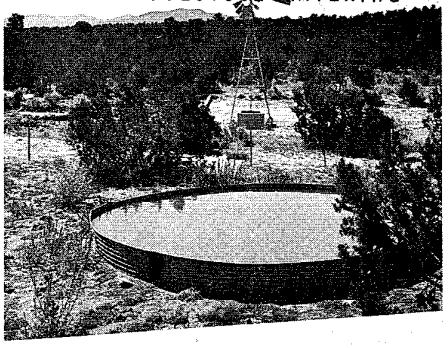
AL CHEMICAL PLANT CONTROL

CHAINING PINON JUNIPER






GOOD LIVESTOCK WATERING



CHOLLA CONTROL

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NEW MEXICO

NOTE NO. 45

January 5, 1971

RE: RANGE - Reports - Control of Shinnery Oak, Mesquite and Creosotebush in New Mexico

This Range Technical Note transmits Report No. 4 of the New Mexico Interagency Range Committee.

This report should be listed as reference in Section I-A of the Technical Guides.

Attachment

AO
Regional Range Conservationist
Adjoining States: Arizona, Colorado, Texas & Utah

REPORT NO. 4

November, 1970

# CONTROL OF SHINNERY OAK, MESQUITE, AND CREOSOTEBUSH IN NEW MEXICO

New Mexico Inter-Agency
Range Committee

Request Copies From:
Agriculture Research Service
U. S. Department of Agriculture
P. O. Box 698
Las Cruces, New Mexico 88001

TABLE OF CONTENTS

SUMMARY OF METHODS FOR SHINNERY OAK CONTROL

| Method | Type Equipment | Treatment: Herbicide | Rate | Carrier | Average Cost per acre | Limitations | Remarks |
|---|---|---|---|---|---|---|---|
| Chemical | Helicopter, or airplane | Silvex | 1/4 | 1 gallon of diesel oil or 1-3 gallon of oil-water emulsion | $2.00-2.50 | (1) Spray only plants that are growing vigorously and do not show injury from drought, frost, hail, insect, wind or livestock grazing.<br>(2) Spray after leaf color changes to blue-green until lower leaf snaps when bent double (May 1 to 25)<br>(3) Don't spray to kill more than 25-50% of shinnery on high sand dunes. | (1) Use 40-60 foot swath.<br>(2) Each spray treatment gives 20-30 % shinnery root kill. Two treatments in successive years gives control of yucca and sand sagebrush. Three years of treatment gives 90% shinnery control or better.<br>(3) Forage production usually doubled for 3-7 years by one treatment. |
| | | 2,4,5-T | 1/2 | Same as above | Same as above | Same as above | (1) Same as for silvex except it does not control yucca and sand sagebrush, but may control mesquite, and gives better weed control. |
| | | Dichlorprop (2,4-DP) | 1/2 | Same as silvex | Same as silvex | Same as silvex | (1) Same as for silvex except for less kill of shinnery and weeds |
| | | Silvex or 2,4,5-T | 1/4-1/2 | 1 gallon diesel oil | $0.90-2.00 | Same as above | (1) The 1/4 lb/A rate is often as effective as 1/2 lb/A. Good grass production results from treatments each 3 to 7 years. |

| Method | Type Equipment | Treatment | | | Average Cost per acre | Limitations | Remarks |
|---|---|---|---|---|---|---|---|
| | | Herbicide | Rate | Carrier | | | |
| | | 2,4-D | 1/ | Same as silvex (1) | Same as silvex | Same as silvex | (1) Less injurious to shinnery than silvex. Use when other materials not available. |
| | Ground sprayers | Same as for aircraft | | 3-5 gallon per acre or more | -- | Same as silvex | Same as silvex |
| Burning | Fire control equipment | -- | -- | -- | -- | Burn in April or May when enough grass residue to carry fire. | (1) Little difference between leadfire or backfire effects on grass production or shinnery growth. |

SUMMARY OF METHODS OF MESQUITE CONTROL

| Method | Type Equipment | Cost | Time of Treatment | Limit to | Remarks |
|---|---|---|---|---|---|
| Aerial Spraying | Airplane or helicopter | 2,4,5-T at 1/2 lb/A in 5 gallons spray - $2.00-2.50/A<br>Dicamba + 2,4,5-T at 1/4 lb/A each $3.30-3.80/A | Late spring; leaves fully developed and dark green; plants in full bloom until pods begin to fill. (About May 25-June 20) | Rather large areas with medium to dense stands; plants in good physiological condition; years of average or better, winter precipitation. | In good spray years, 20% or greater kill is expected from one application. Two or three treatments needed for high kills. |
| Mechanical Grubbing | Front end loader, with stinger blade | $0.50-12.00/A<br>$0.02-0.10/plant | Any time of year except when ground is frozen or too wet | Light and medium stands of small-medium size plants | Not suitable on dune mesquite. Mesquite roots must be cut off below bud zone. |
| | Farm tractor with stinger on drawbar | $0.40-8.00/A<br>$0.015-0.10/plant | Same as above | Small plants in light to medium stands | Costs reduced when used with front-end loader. |
| | Track-type tractor with stinger on dozer | $2.00-16.50/A | Same as above | Light and medium stands of small-large plants | Severe wind erosion may occur on duned areas |
| Soil treatment with dry herbicides | Measuring device as a teaspoon or tablespoon | Fenuron pellets or monuron powder 1 gram/foot canopy diameter $0.50 - 3.50/A on stands up to 70 plants/A | Mid-summer. Immediately prior to or early in expected rainy season | Light stands of small-medium size plants on sandy soil | 1 level teaspoon of fenuron or 1/2 teaspoon monuron equals 1 gram active ingredient. Monuron must be covered with soil. Higher rates needed on heavier soils. |

| Method | Type Equipment | Cost | Time of treatment | Limit to | Remarks |
|---|---|---|---|---|---|
| Ground Spraying | Boom-type sprayer for broadcast spraying | 2,4,5-T at 1/2 lb/A $1.50-4.00/A | Same as aerial spraying | Low growing plants on smooth terrain | Mesquite thorns damaging to pneumatic tires on equipment |
| | Hand gun sprayer for individual plant treatment | 2,4,5-T at 1 1/2 lb per 100 gallons $0.01 - 0.05 per plant | Same as aerial spraying | Light stands of small-medium size plants | Complete coverage o plant necessary. |
| Hand Grubbing | Mattock, grubbing hoe, etc. | $0.50-3.00/A | Any time of year except when soil is frozen | Small plants, less than 100 plants per acre. | Good supervision needed on large areas to avoid missing plants. Sever root below bud zone. |
| Root Plowing | Large track-type tractor with root plow | $6.00-12.00/A | Same as mechanical grubbing. At optimum time for seeding if done simultaneously. | Areas of mixed brush or sites with no desirable forage species or where species change desired. | All standing vegetation except cactus is killed. Don't do sandy areas with high wind erosion hazard. |

SUMMARY OF METHODS OF CONTROLLING CREOSOTEBUSH

| Method | Type Equipment | Cost | Time of Treatment | Limit to | Remarks |
|---|---|---|---|---|---|
| Root Plowing | Track-type tractor with root plow | $6.00-12.00/A | Optimum time for reseeding | (1) Sites with no desirable forage species<br>(2) Sites with good production potential, as run-in areas | Root plowing kills most plant species so seeding is needed to revegatate site. |
| Soil treatment with dry herbicides | Measuring device as teaspoon or tablespoon | Fenuron pellets or dicamba granules at rate of 1 gram per 1.5 feet of canopy diameter<br><br>$0.50-3.50/A on stands up to 70 plants/A | Mid-summer, immediately prior to or early in expected rainy season. | Light stands on sandy or sandy loam soils. | 1 level teaspoon of fenuron pellets equals 1 gram active ingredient |
| Chemical Spraying | Aircraft or ground equipment | Dicamba at 1/2 lb/A followed by 2 lb/A application the following year $20.00/A | Late August or early September | Sites with desirable forage species where selective control is desired | Preliminary information shows good revegetation response by forage species |
| Miscellaneous mechanical methods | Disk, plow, axe, mattock | $0.50-$4.00 | Any time of year | -- | Plants must be cut off 6 inches or more below crown. Plowed or disked areas will need to be seeded |

Walter L. Gould and Carlton H. Herbel - Co-Chairmen

# Control of Shinnery Oak, Mesquite and Creosotebush in New Mexico

## I. INTRODUCTION

This report presents an inter-agency field evaluation of various methods of controlling shinnery oak, mesquite, and creosotebush in southern New Mexico. The field tour was made on October 7-10, 1968, and included brush control work on both private and public lands. Control work was evaluated in Eddy, Lea, Roosevelt, Chaves, Sierra and Dona Ana Counties with the following persons attending:

Agricultural Research Service:

* Dr. Carlton Herbel, Range Scientist, Las Cruces, New Mexico
Dr. Wesley Keller, Research Agronomist, Logan, Utah
Dr. Howard Morton, Range Scientist, Tucson, Arizona

Bureau of Land Management:

* Myrvin Noble, Leader, Soil and Watershed Staff, Denver, Colorado
* Dale Kinnaman, Resource Development Specialist, Santa Fe, New Mexico
William Leifeste, District Office, Roswell, New Mexico
William Campbell, District Office, Roswell, New Mexico
Mack Wilemon, District Office, Roswell, New Mexico
Larry Hendrix, District Office, Roswell, New Mexico
Fred Wyatt, District Office, Roswell, New Mexico
Virgil Pate, District Office, Socorro, New Mexico
Harlen Smith, District Office, Las Cruces, New Mexico
Tom Birch, District Office, Las Cruces, New Mexico

US Forest Service:

* Wayne Hickey, Albuquerque, New Mexico
* Dr. Wayne Springfield, Albuquerque, New Mexico

New Mexico State Game & Fish Department:

* Sam Lamb, Federal Aid Coordinator, Santa Fe, New Mexico

New Mexico State University:

* Dr. Walter Gould, Weed Physiologist, Agricultural Experiment Station, Las Cruces, New Mexico

* Jesse Gerard, Agricultural Services, Las Cruces, New Mexico
Bob Henard, Assistant County Agent, Lovington, New Mexico

Soil Conservation Service:

* Don Robertson, Range Conservationist, Program Service Staff, Albuquerque, New Mexico
W. W. Hammond, District Conservationist, Lovington, New Mexico
Lee Mechem, District Conservationist, Portales, New Mexico
Charles Walker, District Conservationist, Elida, New Mexico
Phil Benfer, Range Conservationist, Clovis, New Mexico
Jim Hess, Range Conservationist, Clovis, New Mexico
Robert Bishop, Area Conservationist, Las Cruces, New Mexico
William Halliday, District Conservationist, Truth or Consequences, New Mexico

Others who attended and/or assisted with part of the meeting were:

R. E. Steger, Agricultural Extension Service, Ft. Stockton, Texas
J. H. Kirch, AMCHEM Products, Ambler, Pennsylvania
Cecil Meadors, AMCHEM Products, Dickens, Texas
Don Klebenow, Texas Tech, Lubbock, Texas
Dick Balduzzi, Texas Tech, Lubbock, Texas
Henry Wright, Texas Tech, Lubbock, Texas
John Waits, Rancher, Lovington, New Mexico
Jiggs Dinwiddie, Rancher, Jal, New Mexico
Mr. and Mrs. Adlong, Rancher, Hobbs, New Mexico
Tom Davis, Rancher, Elida, New Mexico

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* Members of Interagency Range Committee

## II. THE PROBLEM:

Extensive areas of semidesert rangeland in New Mexico have become infested with undesirable woody species during the past century. Some grasslands in excellent condition have changed to almost pure stands of desert shrubs which have little value for forage production or erosion control. Drought and livestock grazing have been contributing factors in the transformation to brushland.

Shinnery oak (Quercus havardi Rydb.), is found extensively in eastern New Mexico. It is found primarily on sandy soil sites east of the Pecos River, generally at elevations below 4000 feet. The area of infestation has increased by approximately twofold in the past century, but it is restricted to the general area of sandy soils on which it was originally recorded. Shinnery presents a double hazard to range management. First, the young buds, stems, and leaves are poisonous to livestock, so

shinnery range must be handled to avoid grazing during the period of leaf development. The acorns are also poisonous and are relished by livestock. Secondly, shinnery provides a considerable quantity of forage, but it competes with perennial grasses for moisture and nutrients. Significant increases in forage production have been obtained after spraying shinnery one or more times.

Shinnery oak is a small, thicket-forming shrub. It grows in sandy soils, spreads by underground stems, and the larger part of individual plants is underground. Propagation is by separation of the rootstocks and by acorns. The topgrowth can be destroyed by chemical or mechanical treatment, but new stems generally arise from the rootstock. A single properly applied spray treatment usually kills from 20 to 30 percent of the roots and 70 to 99 percent of the topgrowth. From one to fourfold increases in forage production have been obtained after spraying shinnery one or more times. An increase in prairie chicken population has been reported in western Oklahoma following shinnery spraying.

Honey mesquite (Prosopis juliflora (Swartz) DC. var. glandulosa (Torr.) Cockerell) is a shrub or small tree three to twelve feet tall. Its invasion of large areas in New Mexico has resulted in a substantial reduction in livestock carrying capacity. Livestock relish the mature mesquite beans and extensive infestations have resulted from mesquite seed dispersed by livestock in their droppings. After mesquite seedlings have become established in an area, the amount of bare soil increases as the plants grow. Mesquite is more competitive than grass for soil moisture. On sandy sites the grass cover is eventually reduced and the spring winds move the sand into dunes around the mesquite plant. Rodent and rabbit activity increases as the brush increases. Livestock losses, especially horses and cows, occur in years with heavy crops of mesquite beans due to compaction.

Revegetation of severly-duned, mesquite-infested sites with perennial grasses takes place remarkably fast after spraying, especially if the sprayed areas are deferred during the growing season. Livestock tend to congregate on the sprayed areas. Under good management an increase in grass cover may result with as little as five percent of mesquite plants killed; the rate and extent of increase is correlated with the percent control. The sand dunes have deteriorated and grass has become established on some sites with over 40 percent mesquite control.

Creosotebush (Larrea tridentata (DC.) Coville) occurs in the southern desert of New Mexico at elevations up to 7000 feet. It extends northward along the Rio Grande and Pecos River drainages to approximately 30 miles north of Albuquerque and Roswell, respectively. Creosotebush is an evergreen shrub, usually three to six feet tall, that spreads only from seed. The invasion of creosotebush takes the form of frontal advances along the margin of the larger creosotebush communities.

Originally, creosotebush was probably confined to rocky ridges that were porous and well-drained and would not support a good stand of grass. It is somewhat susceptible to burning and does not appear to be a strong competitor to grass. Grazing pressure and drought conditions have reduced the grass stand which permitted the expansion of the creosotebush community. Ecologically, creosotebush has replaced tarbush and mesquite on slopes subject to erosion and other adapted areas. Creosotebush commonly occurs in almost pure stands.

A growth-inhibitor is present in the leaves and stems of creosotebush. An aqueous extract of creosotebush parts inhibited the germination of several native grasses. This feature would contribute to the monoculture of creosotebush as the grass plants die from drouth, etc. Creosotebush sprouts profusely from the stems or root crown when the top growth is removed. Consequently, treatments which destroy only the topgrowth will not control creosotebush.

## SHINNERY OAK

### III. CONSIDERATIONS FOR TREATMENT RECOMMENDATIONS:

A. Present vegetation:

1. Kinds of vegetation:

a. Mesquite, yucca, sand sagebrush and various weeds are frequently associated with shinnery. The kind and rate of herbicide, the frequency of spraying, and the time of spraying will influence the degree of control on shinnery and one or more of these other species.

b. Shinnery control should be carried out only when there are desirable grasses in the understory.

c. Shinnery oak does provide a considerable amount of forage, and in drought years it may provide the only available forage. Research results in Oklahoma show greater forage production when shinnery makes up part of the vegetation than when grasses are alone on these soil types. Because of this, the objective in shinnery oak control may only be forage management rather than eradication. Consideration should be given to managing shinnery range so livestock losses are minimized, bur forage production is high. The period when shinnery is poisonous is usually limited to about six weeks each year.

2. Degree of infestation: The following categories of infestation have been recognized by the committee:

   a. Light - 5-14 percent canopy cover

   b. Medium - 15-30 percent canopy cover

   c. Heavy - over 30 percent canopy cover

3. Forage composition:

   a. There is a transition in the dominant grass species growing in association with shinnery oak which is located at approximately Highway 82. North of Highway 82, Andropogon species are the dominant grasses that come in after shinnery control. South of this highway Sporobolus species become dominant.

B. Soils:

1. Shinnery oak grows only on sandy soils. On most soils it grows in association with other vegetation. On high sand dunes, shinnery oak is often the only vegetation, and it serves to stabilize the dunes. Poor control of shinnery is often obtained on sites with high dunes.

C. Topography:

1. Poor coverage is obtained from aerial spray applications on strongly duned sites.

D. Weather:

1. A prerequisite for successful control of shinnery by aerial spraying is vigorous plant growth at the time of spraying. Moderate to heavy rainfall prior to spraying is needed to promote plant growth. Shinnery that is damaged by frost or hail is not susceptible to herbicide treatments.

E. Biotic factors:

1. Herbicide treatments are ineffective on plants that are damaged by insects, or otherwise are in poor vigor. Buck moth caterpillars (Hemileuca maia) will at times completely defoliate shinnery.

2. Wildlife:

The lesser prairie chicken inhabits grassland of the brush-prairie savanna type. Dense grass cover of mid-grasses should

be encouraged in the vicinity of booming grounds and for good nesting cover. A mosaic composed of different vegetal structural elements is preferred by prairie chicken. Shinnery oak motts are preferred over large blocks of closed brush canopy according to studies in western Oklahoma. Grassland areas treated to suppress shinnery oak and sand sagebrush consistently supported more prairie chickens than untreated areas. These studies indicated that large blocks of dense shinnery oak should be made heterogenous. This could be accomplished by herbicide treatment, mechanical means or fire. Until similar findings are confirmed in New Mexico, occasional areas of shinnery oak should be left untreated where large blocks are being treated.

F. Grazing Management:

1. Shinnery oak will cause tannic acid poisoning of livestock if grazed during the budding stage. The danger period is generally between March 1 and June 1.

2. Protection from grazing:

a. Sprayed areas should be deferred during the growing season following treatment.

3. Proper use:

a. Graze to obtain use of Aristida species during the period these species are preferred.

b. Use Andropogon or Sporobolus species as indicators of proper use.

G. Other considerations:

1. Structural features as farmstead, windmills, etc. that preclude proper application.

IV. METHODS OF CONTROLLING SHINNERY::

A. Aerial Spraying:

1. Time:

When leaves change from gray-green to a blue-green color, or the period when it is safe to put cattle back in the pasture. Cut-off date is when a lower leaf on plant cracks when the leaf is doubled over. These conditions generally occur May 1-15 in the vicinity of Jal and from May 7-20 near Milnesand.

2. Materials and rates of application:

   a. Silvex 1/2 lb/A.

   b. 2,4,5-T 1/2 lb/A. Nearly as good as silvex on shinnery oak. It may control mesquite and does give better control of weeds, but has little effect on yucca and sand sagebrush.

   c. Dichlorprop (2,4-DP) at 1/2 lb/A. Same as silvex on shinnery oak except there is slightly less kill on weeds and brush.

   d. Silvex or 2,4,5-T 1/4-1/2 lb/A in one gallon per acre of diesel oil. One application each three to seven years for forage production and shinnery suppression.

   e. 2,4-D 1/2 lb/A. To kill and injure some shinnery oak and improve grass production for two years. Excellent weed control if applied early. Use when other materials not available.

3. Carrier rate:

   a. Three gallons per acre of 1:2 diesel oil-water emulsion.

   b. One gallon per acre of diesel oil when the desired effect is primarily to suppress shinnery and increase grass production.

4. Limitations:

   a. Do not spray shinnery oak:

      1. In drought years
      2. After frost of hail damage
      3. If insect damaged
      4. After grazing of terminal growth
      5. Area which is primarily large dunes
      6. During high wind (above 8 mph)
      7. When temperature is above 80° to 90° F
      8. Near susceptible vegetation or crops
      9. With high volatile formulations

5. Results:

   a. Each application of silvex when properly applied usually kills 20-30 percent of the roots and most of the top growth of shinnery. Three treatments in successive years will usually give nearly complete control. Two successive

treatments will control yucca and sand sagebrush. The suppression of brush growth from a single treatment is evident for three to seven years. Shinnery poisoning seldom occurs in the spring after a successful spraying.

b. Grass production increases significantly after shinnery spraying. This production gradually declines as shinnery regrowth occurs.

6. Other chemical treatment considerations:

a. Apply according to appropriate laws and regulations.

B. Ground spraying:

1. Type of equipment:

a. Boom type sprayers

b. Cluster nozzle equipment

2. Time - same as aerial

3. Chemicals and rates are the same as for aerial spraying. Use three to five or more gallons of oil-water emulsion per acre with mechanical agitation. Use water as the carrier if the sprayer does not have a mechanical agitator.

4. Limitations same as for aerial (wind and temperature) but only smaller areas would be feasible.

5. Results:

Ground spraying can be as effective as aerial spraying.

C. Burning:

1. Equipment:

a. Fire-control equipment to prevent a wild fire.

2. Time:

a. April - May

3. Results:

There is little difference between backfire and a leadfire on either forage production or growth of shinnery oak. Burning

maintains shinnery oak as low-growing shrubs and prevents formation of acorns the year of the burn. Burning greatly increases availability and palatability of the range forage. At Woodward, Oklahoma, burning has generally increased production of sand bluestem and switchgrass about 300 pounds per acre and similarly decreased production of little bluestem with a net increase of total forage of about 20%. The increase in production lasts three to four years.

Shinnery ranges appear to be very fire hardy. The wise use of experience, skill, and judgment to combine the use of fire and herbicides can produce and maintain high quality and quantity of range forage on shinnery oak rangelands on a sustained basis (E. H. McIlvain, mimeo).

MESQUITE

V CONSIDERATIONS FOR TREATMENT RECOMMENDATIONS:

A. Present vegetation:

1. Kinds of vegetation:

a. Associated species:

(1) Grass - The type of treatment will depend upon the kind and amounts of grass and other forage species. Practices that completely destroy the vegetative cover should not be used if there are sufficient remnants of desirable vegetation to assure take over of the site.

(2) Other species of brush may influence the type of treatment. When undesirable species are present that may later be a problem, it may be best to use a treatment that will control all species. Where desirable species or those that do not pose a brush problem are present, selective types of treatments should be used.

b. Seeding should be done in conjunction with control when insufficient remnants of desirable vegetation remain to revegetate the site or natural revegetation is not likely to occur within a reasonable period of time. Seeding should be limited to areas where proven techniques assure reasonable probability of success.

c. Consideration should be given to seeding when a change in forage species is desired.

2. Amount of vegetation:

The following degrees of mesquite infestation are recognized by the Committee:

a. Light - 0 to 5 percent canopy cover or less than 100 plants per acre.

b. Medium - 6 to 10 percent canopy cover, or 100-200 plants per acre.

c. Dense - greater than ten percent canopy cover, or when mesquite canopy makes up more than 90 percent of the total perennial vegetative canopy.

3. Composition:

a. Treatment method will be determined by the number and size class of plants to be controlled.

b. The associated woody vegetation (cactus, oak, catclaw, four-wing saltbush, etc.) will influence the method and extent of treatment.

c. The need for range seeding following mesquite control will depend upon the amount of desirable species in the undercover.

B. Soil:

1. Depth - Very shallow soils (0-10 inches) may not be suitable for mechanical treatment. Because of the generally poorer soil moisture conditions and lower potential on shallow soils, spray treatments are less predictable.

2. Texture:

a. Sandy soils subject to wind erosion are not suitable for broadcast (overall) mechanical treatments. Generally, better control is obtained on sandy soils than on heavy soil with foliar application of systemic herbicides.

b. The effectiveness of chemical treatment is affected by soil texture and organic content; increased rates of granular herbicides are needed on heavy soils.

C. Topography:

1. Mechanical methods of control may be more suitable than chemicals on overflow sites. It is difficult to obtain good control with herbicides on flood plains.

2. Duned areas are best suited to aerial spraying.

3. Slope may influence the choice of method to control mesquite. Mechanical treatments are generally not suitable on steep slopes.

D. Climate:

1. Aerial spraying is most successful in years when the January through April precipitation is above the long-time average.

2. Northeastern New Mexico may be limited to mechanical control or treatment with soil-sterilant type herbicide, such as fenuron, because of the frequent incident of freezing after the plants break dormancy.

E. Biotic factors:

1. Insects:

Mesquite that has been damaged by insects prior to spraying should not be treated with foliar sprays. For example, a heavy infestation of web worm, aphids, or twig girdler will drastically reduce the effectiveness of foliar treatments.

2. Rodents:

a. The rodent population increases as mesquite invasion progresses and forb damage increases as rodents increase.

b. Heavy rodent damage on mesquite will reduce the effectiveness of spray treatments.

c. Rodents should be controlled on areas that are seeded.

3. Wildlife:

Mesquite beans are relished by many kinds of animals and the seeds are widely scattered in the droppings of wildlife and livestock. Because of the aggressive nature of mesquite, it should be replaced by other species which will furnish protection and forage for wildlife.

F. Grazing Management:

1. Protection from grazing.

a. All lands where a broadcast control method is used and the density of desirable forage species is below the potential for the area should be protected from grazing by domestic livestock for a minimum of a full growing season after treatment. Deferment during the growing season for several years will permit the treated area to reach maximum productivity in the shortest possible time.

b. If the treated area is seeded, it should be deferred from livestock use until the new species are well established.

2. Proper use:

When only part of a pasture is treated for brush control, livestock tend to congregate on the treated area. Forage utilization following the deferred grazing period should not exceed the proper limits for the key species on the treated area. The season of use should be regulated to favor the desirable species.

C. Other considerations:

1. Esthetics:

Where tall mesquite has been killed by aerial spraying, the appearance of the site will be enhanced by chaining the dead trees three or more years after spraying.

2. Watershed Management:

a. Mesquite control will increase the amount of water available for desirable plants. An increase in herbaceous plants will permit greater infiltration and may increase the ground water.

b. Revegetation by grass on mesquite-controlled areas will reduce runoff, sedimentation, and wind erosion.

## VI. METHODS OF CONTROLLING MESQUITE:

A. Aerial spraying:

1. Equipment and operation:

a. Aircraft equipped to spray conventional emulsions

b. Adequate flaggers with appropriate flagging materials.

c. Mixer equipment with adequate plumbing capacity to permit rapid loading of the aircraft and mechanical agitation for proper mixing

d. Adequate controls to facilitate calibration of the aircraft

2. Time of application:

Begin spraying after full leaf development and the leaves have turned to a dark green color, terminal growth is complete, and the plants are in full flower until the seed pods have

elongated but have not started to fill. Usually these conditions occur between June 1 and June 15. The period for spraying to get satisfactory kills is generally 2-3 weeks.

3. Materials and rates of application:

   a. Low volatile ester of 2,4,5-T at 1/2 lb/A in 5 gallons per acre of a 1:7 diesel oil-water emulsion. (Preliminary results indicate that 1/2 lb/A of 2,4,5-T in diesel oil at one gallon of spray material per acre is equally effective.)

   b. Dicamba plus 2,4,5-T at 1/4 lb/A of each in a 1:7 diesel oil-water emulsion is as effective or better than 2,4,5-T alone at 1/2 lb/A.

4. Limitations:

   a. Do not spray:

      (1) Plants that are not growing vigorously or have poor leaf cover.
      (2) In drought years when January through April precipitation is appreciably below average.
      (3) After late frost, hail or wind damage.
      (4) If plants are damaged by insects.
      (5) During high wind (average velocity above 5 mph).
      (6) At temperatures above 90° F.
      (7) Near susceptible vegetation or crops.
      (8) With volatile formulations.

   b. Light stands of mesquite are more effectively and efficiently controlled by other methods.

5. Results:

   a. Aerial spray treatments generally give 80-95 percent defoliation. The degree of kill will vary from a trace to more than 50 percent, depending upon the season.

   b. Grass production has increased significantly under proper grazing management due to the increase in available moisture after mesquite spraying, even when a low plant kill was obtained.

B. Spraying with ground equipment:

1. Equipment:

   a. Boom-type, broadcast sprayer

   b. Hand gun sprayer for individual plant spraying

2. Time of application - same as for aerial spraying

3. Materials and rates of application:

   a. For broadcast spraying use a low volatile ester of 2,4,5-T at 1/2 lb/A in an oil-water emulsion containing five pints of diesel oil per acre. The amount of water depends on the calibration of the spray equipment.

   b. For individual plant treatment use 1 1/4 pounds low volatile ester of 2,4,5-T per 100 gallons of water. Spray must cover all parts of the plants.

4. Limitations:

   Same as for aerial spraying, except that these methods are limited to low-growing plants and to smooth terrain. Ground applications are limited to light to medium stands of mesquite. Spray equipment with pneumatic tires is subject to flat tires because of the mesquite thorns.

5. Results:

   The degree of mesquite kill is generally equal to or better than by aerial spraying.

C. Soil treatment with dry herbicides:

1. Equipment:

   a. Any suitable measuring device, such as a teaspoon or tablespoon.

   b. Pelleted materials may be scattered by foot or from horseback.

2. Time of application:

   Immediately prior to or in the early part of an expected rainy period.

3. Materials and rate of application:

   a. Fenuron pellets should be scattered uniformly within the canopy area at a rate of 1 gram active ingredient per foot of canopy diameter on plants up to eight feet in diameter on sandy or sandy loam soils. A level teaspoon per foot of diameter will give a rate of 1 gram per foot. On larger plants (clones or dunes) apply 1 level tablespoon per square yard of mesquite canopy. Higher rates are needed on heavy soils.

b. Monuron powder - one gram active ingredient per foot of canopy diameter on plants up to eight feet in diameter on sandy soil. (One-half teaspoon of 80% monuron powder equals one gram). Monuron must be covered with soil to avoid photo-decomposition.

4. Limitations:

a. Treatments are best suited to light infestations or as a follow-up to other methods of treatment. Other treatment methods are cheaper when the mesquite population exceeds 100 plants per acre. The method is suited to areas where most of the mesquite are 1 - 4 feet in canopy diameter.

b. Higher rates of herbicide needed on clay or silty soils.

5. Results:

This method of treatment kills a high percentage (60-90%) of mesquite, depending on the precipitation. The action is very slow; it may take four years for fenuron to be fully effective, and up to seven years with monuron. Plants are repeatedly defoliated until death occurs.

D. Mechanical grubbing:

1. Equipment:

a. Wheel-type tractors with stinger blade must be large enough to uproot the plant.

(1) Front-end loader equipped with full-matched torque-converter is recommended.

(2) Farm-type tractor with stinger on the drawbar will handle small plants more economically than the larger equipment and can be used to advantage as a companion to heavier equipment.

b. Track-type tractor with stinger on the dozer blade is needed in duned mesquite.

2. Time:

Grubbing may be done at any time there is adequate soil moisture, but not when the ground is frozen or excessively wet.

3. Limitations:

a. Areas with a heavy stand of mesquite should not be mechanically grubbed.

b. Areas that are duned and areas subject to wind erosion should not be grubbed unless there are ample perennial grasses between the mesquite plants to inhibit erosion and assure revegetation within a reasonable time.

c. If there is extensive soil disturbance in grubbed areas they should be seeded at time of grubbing, and grubbing should be carried out at most favorable time for seeding.

4. Results:

Good control obtained when mesquite are grubbed below the root bud zone. Small plants are often missed, so follow-up is necessary.

E. Hand Grubbing:

1. Equipment:

Mattock, grubbing hoe or similar tool

2. Time:

Yearlong, when the soil is not frozen.

3. Limitations:

a. Mesquite must be cut off below the root bud zone, so only small plants (up to three feet diameter) can be grubbed economically.

b. Control is limited to very light stands (not over 100 plants per acre).

c. On large areas good supervision is needed to avoid missing plants.

4. Results:

a. Good kills of mesquite are obtained.

b. When labor is plentiful, this is a very effective and economical method to clean up a potential infestation while the plants are small and the stand is sparse.

F. Root plowing:

1. Equipment:

Track-type tractor with root plow, comparable in size to a D-8 or D-9. A drag chain, on swivels, behind the plow will increase the pull-up of plants.

2. Time:

Root plowing may be done at any time the soil is not frozen or excessively wet. When the plowed area is to be seeded at the time of root plowing, carry out the operation only at a suitable period for seedling establishment.

3. Limitations:

a. Root plowing destroys all standing vegetation except cactus and leaves the soil loose and fluffy. Seeding is necessary following root-plowing.

b. Root plowing is suitable only on areas not subject to erosion.

c. It is essential to root plow at depths below the root budding zone.

d. Usually, root plowing should be done on areas with little or no desirable vegetation.

4. Results:

Good kill of mesquite and associated vegetation is obtained. Seeding success in hot, arid areas is enhanced with an improved microenvironment. Windrowing dead brush over seeded swaths and seeding in basin pits improves the chances of seeding success.

CREOSOTEBUSH

## VII. CONSIDERATIONS FOR TREATMENT RECOMMENDATIONS:

A. Present vegetation:

1. Kinds of vegetation:

a. Where creosotebush occurs as isolated infestations in grassland, or is otherwise invading grassland, control methods used should not be injurious to the desirable perennial grasses.

b. Control of pure stands should be restricted to sites where proven techniques assure a reasonable probability of success in establishment of a grass seeding.

2. Amount of vegetation:

The following categories of infestation are recognized by the Committee:

a. Light - up to 100 plants per acre

b. Medium - 100 to 250 plants per acre

c. Dense - over 250 plants per acre

The degree of infestation will influence the choice of control method.

3. Composition:

Primary consideration should be given to control on areas with sufficient remnants of desirable vegetation to assure take-over of the site in a reasonable period of time.

B. Soil:

1. Depth:

a. Areas with deeper, more productive soils should be treated in preference to those with shallow soils.

b. Soil depth will influence the choice of method best suited to a given site, e. g. root plowing is not suited to very shallow soils.

2. Texture - On gravelly, well-drained soils, control methods should be used that do not injure desirable vegetation, where present.

C. Topography:

Slope is a factor in creosotebush control only on the sharp breaks where it limits the movement of machinery or spray equipment.

D. Climate:

1. Treatment with soil-applied sterilant-type materials should be done immediately prior to or early in the expected rainy season.

2. Total vegetation control should be limited to areas with sufficient rainfall to assure reasonable probability of success in seeding.

3. Seeding should be done prior to or early in the growing season.

E. Grazing Management:

1. Protection from grazing:

Grazing should be deferred on areas having medium-to-heavy stands so as to obtain the maximum benefit from the treatment. If a treated area is seeded, it should have livestock deferment until the seeded species are well established.

F. Other Considerations:

1. Watershed management:

Wind and water erosion are accelerated on most sites dominated by creosotebush.

2. Wildlife - Any treatment that increases the grasses and forbs should be helpful to wildlife. It is not necessary to leave areas untreated.

## VIII. METHODS OF CONTROLLING CREOSOTEBUSH:

A. Root plowing:

1. Equipment:

Track-type tractor, comparable in size to a D-6 or larger, with a root plow. A drag chain, on swivels, behind the plow increases the pull-up of plants.

2. Depth:

Plow to a depth of 7 to 10 inches.

3. Time:

Seeding, when accompanying rootplowing, should be done just prior to or in the early part of the growing season.

4. Limitations:

a. Rootplowing kills all standing vegetation except cactus and leaves the soil loose and fluffy.

b. Rootplowing is suitable only on soils not subject to erosion.

c. Maximum slope depend on erodibility of the soil.

5. Results:

Good kill of creosotebush and associated vegetation is obtained. Seeding success in hot, arid areas is enhanced with an improved microenvironment. Since the seedbed is loose and fluffy after rootplowing, good success has been obtained with press-wheel seeding. Windrowing the plowed brush over the seeded swaths and seeding in basin pits improve the chances for seeding success. Species adapted for seeding on creosotebush sites include: boer and lehmann lovegrass, black and sideoats grama, and fourwing saltbrush.

E. Individual plant treatments with dry herbicides:

1. Equipment:

a. Any suitable measuring device as a teaspoon or tablespoon.

b. Pelleted materials may be scattered by foot or from horseback.

2. Time of application:

Immediately prior to or in the early part of an expected rainy period.

3. Materials:

Fenuron, dicamba

4. Rate of application:

One gram active ingredient per 1 1/2 feet canopy diameter (one gram a.i. 25% fenuron pellets = one level teaspoon) on sandy loam or loamy soils. Heavier rate may be needed on heavier soils.

5. Limitations:

This treatment is ideal for light infestations, localized areas of heavier infestations, or as a follow-up to other treatments.

6. Results:

This method of control kills a high percentage of creosotebush plants (70-90%).

C. Aerial spraying (preliminary information)

1. Equipment and operation:

a. Aircraft equipped to spray conventional emulsions

b. Adequate flaggers with appropriate flagging materials

c. Mixer equipment with adequate plumbing capacity to permit rapid loading of the aircraft and mechanical agitation for proper mixing

d. Adequate controls to facilitate calibration of the aircraft

2. Time of application:

When plants are actively growing, about 25-40 days following significant growing season rainfall. Mid-August to mid-September has been most effective period.

3. Materials and rate of application:

Dicamba at 1/2 lb/A in a total volume of five gallons per acre, followed the next year with dicamba at 2 lb/A. (Contact the New Mexico Agricultural Experiment Station for most recent information).

4. Limitations:

a. Light stands of creosotebush are more effectively controlled by other methods.

b. This is an expensive treatment.

5. Results:

50-70 percent of creosotebush plants have been killed. Significant increase in grass cover has occurred on treated areas.

D. Miscellaneous methods:

Good creosotebush kills may also be obtained with disking with a double-disc to a minimum depth of six inches; mechanical grubbing of individual plants; hand grubbing of individual plants, and completely ringing the base of the stem with diesel oil following frost in the fall of the year.

## IX. RESEARCH NEEDS:

A. General:

1. Guidelines for determining the potential of a site after improvement through brush control. What can be expected in the change of productivity by converting brushland to grassland?

2. Determine the relationship between level of brush control and increase in forage production for different sites under various levels of precipitation.

3. What can we afford to invest in brush control on sites with various potentials for forage production considering short-term and long-term benefits.

E. Shinnery oak:

Research on shinnery oak control has been carried on for many years at the Southern Great Plains Agricultural Experiment Station, Woodward, Oklahoma. Various methods of control have been investigated and the effect on associated vegetation has been measured. Shinnery control from aerial spray treatments in Eastern New Mexico are similar to results in Oklahoma, and improved herbaceous cover has been observed in both states. Shinnery control in Oklahoma appears to improve the habitat for lesser prairie chicken. Studies needed under New Mexico conditions include:

1. The effect of fire on shinnery oak and associated vegetation.

2. The effect of shinnery oak control on the habitat and population of prairie chicken, quail and other wildlife species.

Does control have the same effect on prairie chicken as found in Oklahoma?

3. Methods are needed to determine the degree of shinnery control from chemical treatments, and to correlate the degree of control to forage productivity.

4. Are browsing animals, such as goats, effective for shinnery control?

C. Mesquite:

1. Establish more effective control treatments for mesquite and determine the influence of growth form, soil type and various environmental factors on the susceptibility to treatment.

2. Correlate phenology in various areas of the state with susceptibility to herbicide treatments.

3. Determine the effect of mesquite control on wildlife populations, runoff, sedimentation, ground water recharge, and soil movement by wind.

4. Determine the effect of rodent activity on the mesquite control from herbicide treatment and on subsequent revegetation by desirable plant species.

5. Develop methods of seeding desirable forage species to improve the rate of revegetation after control treatments are applied.

D. Creosotebush:

1. Develop effective and economical methods of control.

2. Determine the effect of creosotebush control on forage production as a result of soil moisture changes.

3. Determine the effect of control on water yield, erosion, sedimentation, and water table levels.

4. Since little use of creosotebush by wildlife has been reported, what would be the effect of control on game bird population and other wildlife?

X. AERIAL SPRAYING:

Aerial spraying is an effective method of applying herbicides to brush species that are susceptible to foliar-applied chemicals. This method is especially suited for spraying mesquite and shinnery oak

because the sandy soil on which these species are found is frequently too uneven and difficult to traverse to use ground equipment. On areas with dense growth and variable size of brush the only practical method to apply foliar herbicides is from aircraft.

Aerial spraying is a specialized job and requires specialized attention. Factors which must be considered regardless of the species being sprayed include:

1. Application equipment - The application equipment on the aircraft should be in good condition with positive shut-off nozzles and no leaky parts. The aircraft should have adequate controls, pressure regulators, pressure gauges, etc., to control the output of the system. Droplet size is affected by the nozzle pressure, size of nozzle, nozzle orientation and speed of aircraft. Best droplet size is obtained with low pressure (20 - 30 psi) and nozzles oriented slightly aft. Nozzles should be properly spaced to give a uniform pattern. Proper spacing of the nozzles will tend to reduce the vortices effect, so the chance of drift is reduced.

2. Weather conditions - Best coverage will result if spraying is done under calm, cool conditions. As the temperature increases, more of the spray material will volatilize (if an aqueous carrier) and consequently less will hit the target. As the wind increases the spray pattern may become variable and the drift hazard increases. Application should be halted when the average wind velocity exceeds 5-8 mph and the temperature exceeds 80° F at low relative humidity or 90° F at high relative humidity. Don't spray when a rain storm is imminent.

3. Swath width - The aircraft must be calibrated and the swath width determined so as to get the proper gallonage of spray material per unit area. When the spray equipment is properly adjusted and the correct flight height is used, the aircraft should deliver a relatively uniform pattern. The proper swath width is maintained by flagging at proper intervals between swaths.

4. Flagging - Flagging is extremely important to obtain uniform coverage on the spray area. Flaggers should use bright flagging material and wave their flags vigorously in order to be spotted by the pilot. On sunny days a mirror may be used instead of a flag. The number of flaggers to use on a flight swath will depend upon the evenness of the terrain. In rolling country a flagger may be needed every half mile, while on flat terrain flaggers might be a mile apart. Care must be taken that the flaggers are measuring the proper swath width.

5. Flight height - The aircraft should fly as low as safety will permit, but not more than ten feet above the top of the brush.

When the height is increased, more spray material will evaporate before it hits the target, and the drift hazard increases.

6. Mixing equipment - The mixing equipment needs to be large enough and have ample plumbing capacity so as to reduce the aircraft down time to a minimum while loading. The equipment must have adequate agitation to mix emulsions and suspensions properly and quickly. Stratification of the spray material due to improper mixing can cause poor results when other factors of application are ideal. Mechanical agitation is recommended when oil in water emulsions are used.

7. Spray material - The herbicide must be mixed with the carrier materials in the proper order to get a suitable spray material so follow recommended mixing instructions. Good quality water is essential. Dirty water may clog up the spray system, and if too salty it may cause the herbicide to precipitate out. Potable water is generally acceptable for aerial spraying.

8. Plant condition and stage of growth - Plants that are robust and growing vigorously are usually more susceptible to herbicides, especially the translocated, hormone-type materials, than are plants in poor growing condition. These is an optimum time for spraying most plant species, and treatments either too early or too late are ineffective. Different spray dates are frequently needed when two or more brush species grow in association in order to control all species. Poor results can be expected if the treated plants are under stress from drought, disease, frost, insect or wind damage.

9. Associated species - When considering herbicide spraying it is important to consider the plant species growing in association with the target species. Some desirable species may be present that are susceptible to one herbicide but not to another, or the period of susceptibility for the two species may be sufficiently different that the desired results can be obtained with proper timing. More often, two or more undesirable species that have different periods of susceptibility and/or require different herbicides are growing in close association. When one species is removed, the second species may take over and a degradation of range condition result.

10. Proximity to cropland - The hormone-type herbicides are toxic to a broad range of species. Many broad-leaved crop species are susceptible at very low rates. Drift during application, volatilization from the soil or target species and subsequent drift of the fumes, or dust blown from treated fields have been observed to cause damage to highly sensitive crops. It is important to know how close the nearest sensitive crop is and in what direction relative to the dominant wind direction when aerial spraying is considered. A non-volatile herbicide could be used very closely

to a sensitive crop provided the wind direction is appropriate at the time of spraying. Conversely, damage may result several miles downwind due to drift during application.

11. Reputable applicators - Contract your spraying to a reputable operator. A local operator that has been in business for a number of years will probably do you a good job. An applicator with several planes that are apparently in top condition is probably reputable or he would not be in business. If you don't know an applicator, request references before you enter an agreement.

12. Treatment objectives - Brush control can mean anything from topgrowth suppression to root kill. In some cases you are justified to obtain only topkill of the problem species in order to release the desirable forage species. More frequently, you will want to kill part or all of the target species. The timing of application, kind and rate of herbicide used, swath width, amount or type of carrier and various other factors may be influenced by the objectives sought.

13. Management, prior to and following treatment - The management of a pasture before or after spraying may influence the effectiveness of the treatment in improving the condition of the pasture. It may be desirable to defer a pasture during the growing season prior to spraying to permit the production of a grass seed crop and improve grass vigor. After spraying it is extremely important that the treated pasture be deferred during the growing season until the perennial grasses have become adequately established. The number of growing seasons of deferment will depend upon the stand of grass present when sprayed, the precipitation after treating, and the degree of improvement desired.

14. Don't spray over livestock - The toxicity of herbicides used on pastures and applied aerially is relatively low. It is unlikely, but conceivable, that damage to livestock could occur. To assure that livestock are not injured by the applied herbicide or by plants that develop an increase in poisonous properties after spraying, it is advisable to defer a pasture for 60 to 90 days after spraying to allow for the degredation of the herbicide and reduce the chance of plant poisoning.

15. READ THE LABEL ON THE HERBICIDE CONTAINER - Pesticides have been developed for particular uses and the recommended rates and instructions for use are indicated on the label. Use only materials that are approved in the manner prescribed on the label.

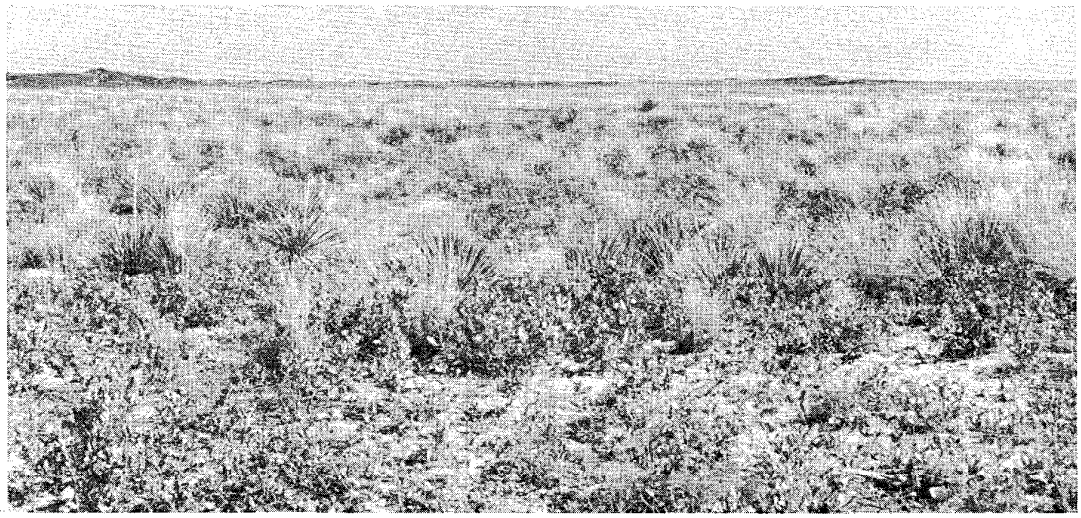

Figure 1. Untreated area of shinnery oak showing sparse stand of grass near Milnesand, New Mexico.

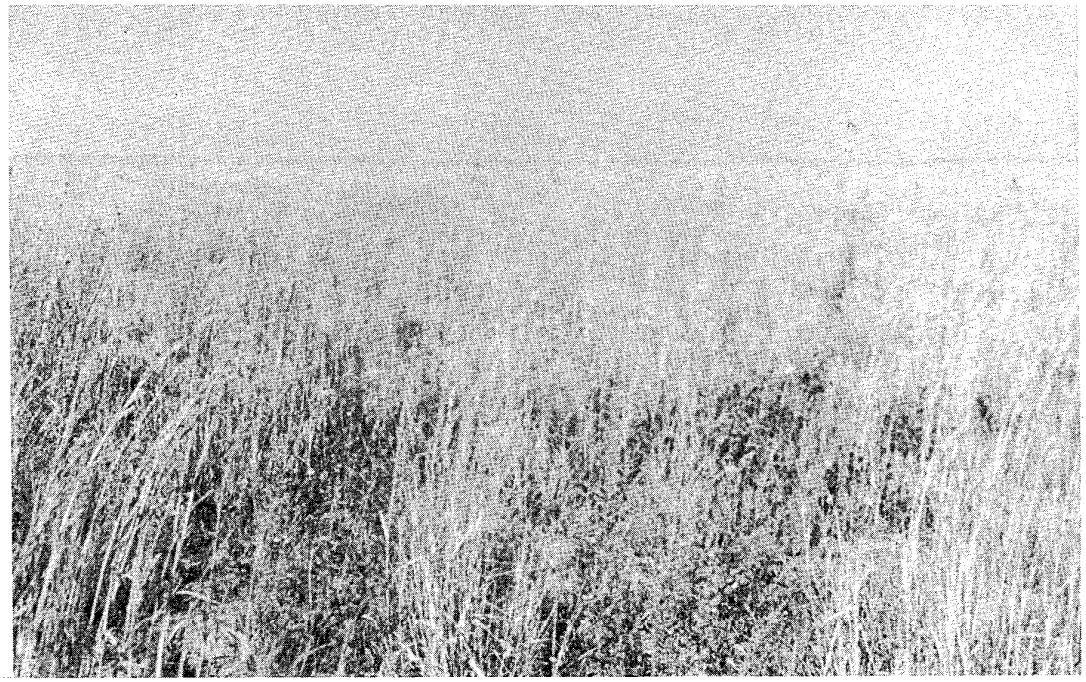

Figure 2. Area aerially sprayed for shinnery control showing a good stand of grass near Milnesand, New Mexico. ARS PHOTOS


Figure 3. Front end loader equipped with blade to grub individual mesquite plants.

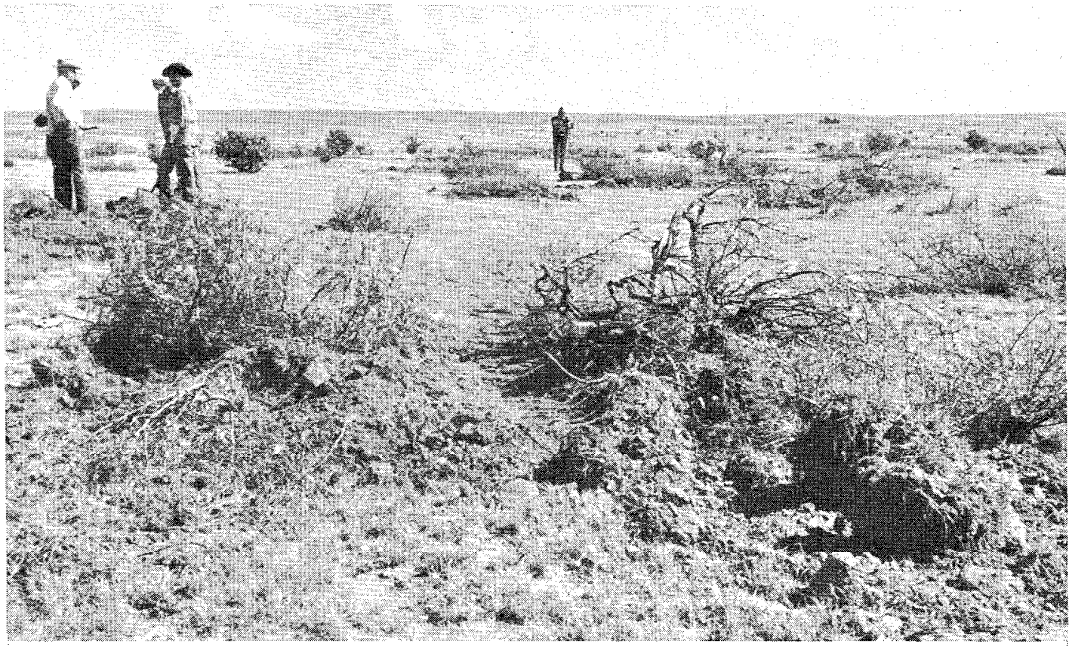

Figure 4. Area where individual mesquites were grubbed with front end loader equipped with blade near Elida, New Mexico.

ARS PHOTOS

Figure 5. Rootplowing creosotebush while simultaneously pitting, seeding, and windrowing brush on the seeded area.

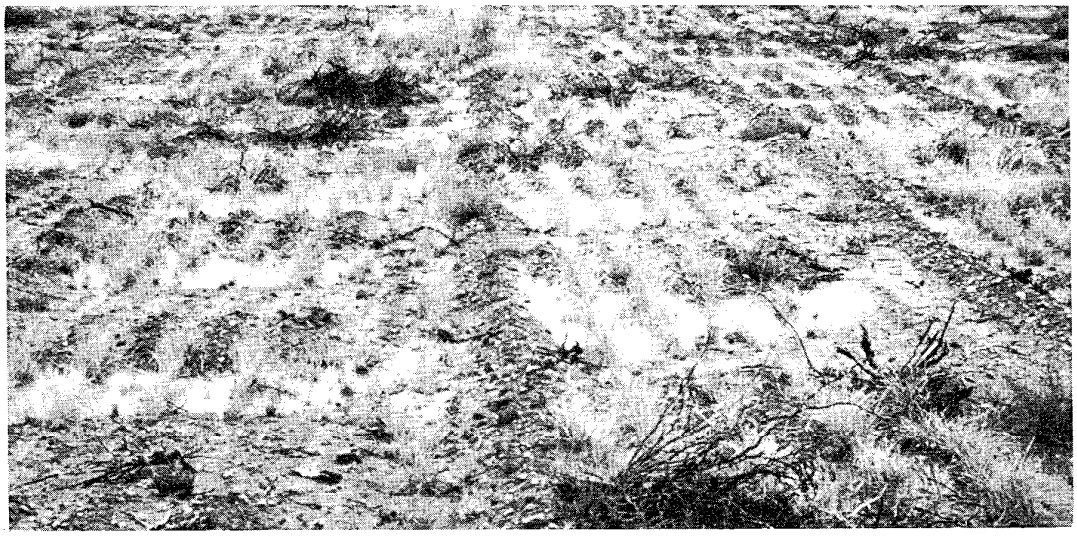

Figure 6. Area treated with equipment shown in Figure 5 showing ponded water and grass establishment on creosotebush site near Alamogordo, New Mexico. ARS PHOTOS

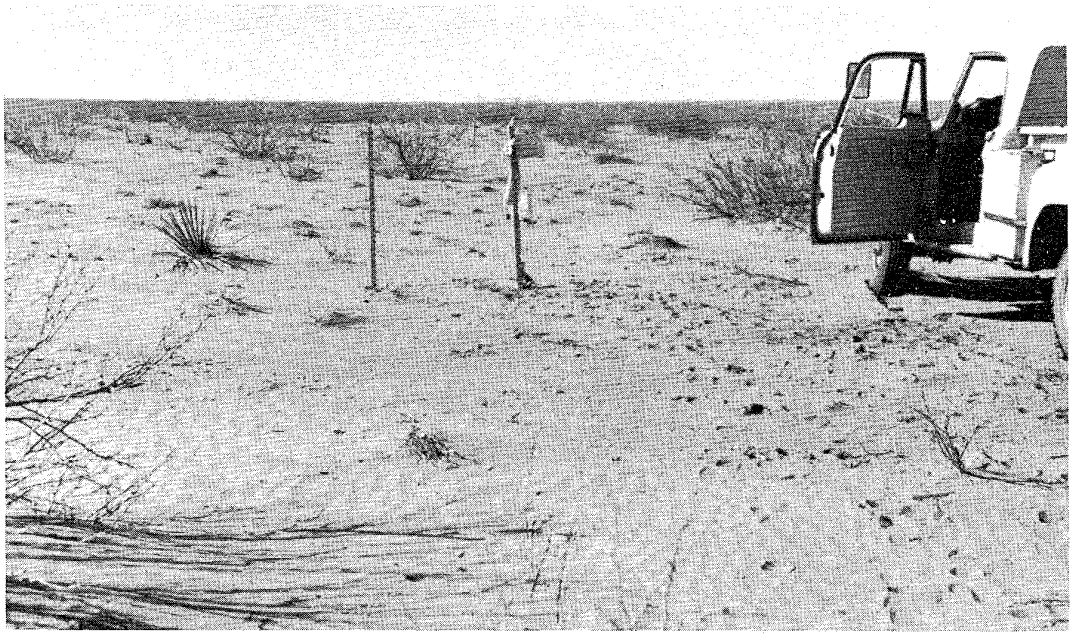

Figure 7. Mesquite infested rangeland, Brinninstool Ranch, southeastern New Mexico. Photo taken April, 1965.

Figure 8. Same photopoint as Figure 7 taken October, 1969. The area was aerially sprayed with 2,4,5-T June, 1965 with a repeat spray in June, 1968. A 50% mesquite kill was obtained with the 1965 spraying. The grasses are primarily mesa dropseed, black grama, and plains bristlegrass. ARS PHOTOS

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