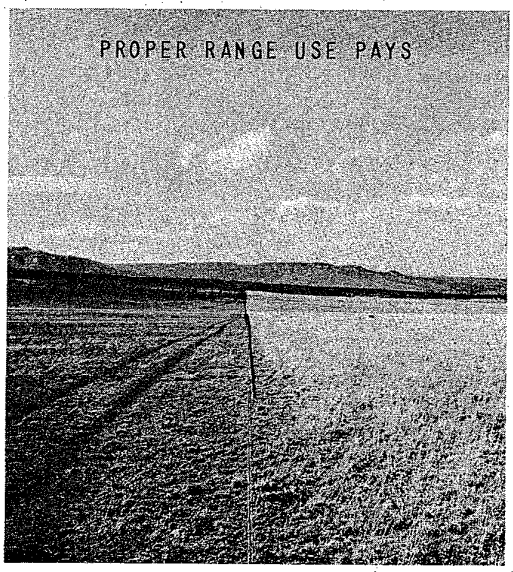
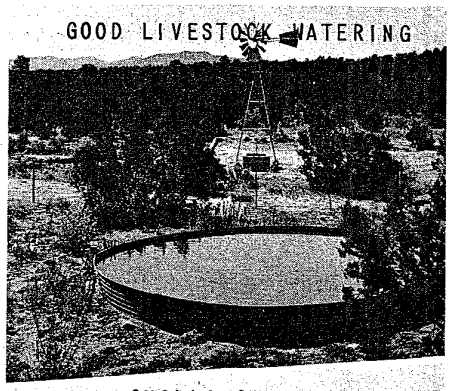
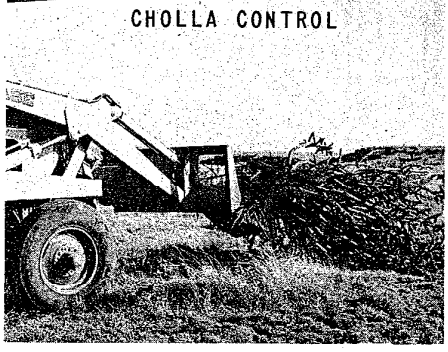
# RANGE CONSERVATION - TECHNICAL NOTES


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




RANGE TECHNICAL NOTE NO. 35

January 27, 1969

Subject: RANGE - Reports - New Mexico Inter-Agency Range Committee Reports

The New Mexico Inter-Agency Range Committee was formed by the cooperating agencies, including the Soil Conservation Service, in May 1967. The purpose of this group is to study, evaluate and report on selected range problems in New Mexico. It is the desire of this group to have each agency use the report as a guide in developing specifications for the concerned range practices.

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REPORT NO. 1

September 1967

# IMPROVING SAGEBRUSH RANGES

# IN NEW MEXICO

Inter-Agency Range Committee

Wilson C. Gutzman, Chairman

Request Copies From:
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# IMPROVING BIG SAGEBRUSH RANGES IN NEW MEXICO

## I. INTRODUCTION:

This study represents an interagency field evaluation of various methods of big sagebrush control and range seeding in areas of northern New Mexico. The need for such a review was felt necessary in order that the various organizations which furnish technical guidance in range management may benefit from a uniform set of specifications for New Mexico.

An Interagency Range Committee was assembled for the field review composed of the following members:

Bureau of Land Management:

1. Myrvin Noble, Acting Chief, Division of Standard & Technology, Denver, Colorado.
2. Dale Kinnaman, Resource Development Specialist, Santa Fe, New Mexico.
3. Duane Michaels, Range Conservationist, Albuquerque, New Mexico.

Soil Conservation Service:

1. Ivan Dodson, Range Conservationist, Program Service Staff, Albuquerque, New Mexico.
2. Don Merkel, Range Conservationist, Program Service Staff, Santa Fe, New Mexico.

U.S. Forest Service:

1. W. F. Currier, Branch Chief, Range Improvements, Albuquerque, New Mexico.
2. Jack Bohning, Range Staff Officer, Santa Fe, New Mexico.

New Mexico State Game and Fish Department:

1. Sam Lamb, Federal Aid Coordinator, Santa Fe, New Mexico.

Bureau of Indian Affairs:

1. Wilson C. Gutzman, Area Range Conservationist, Albuquerque, New Mexico.

Agriculture Research Service:

1. Dr. Carlton Herbel, Range Scientist, Las Cruces, New Mexico.

New Mexico State University:

1. Dr. Walt Gould, Department of Agronomy, Las Cruces, New Mexico.

Others Who Attended and Assisted with Part of the Meeting Were:

1. Larry Nunez - Work Unit Conservationist, SCS - Cuba.
2. Allen Elliott - Land Operations, BIA - Dulce.
3. Bill Holm - Soil Conservationist, BIA - Dulce.
4. Raymond Barnes - NMSU Extension Agent - Dulce.
5. Bill Chester - Engineering Technician, BLM - Albuquerque.
6. Bobby Robertson - District Range, USFS - Cuba.
7. Herman Atencio - Assistant Ranger, USFS - Cuba.
8. Larkin Salazar - Work Unit Conservationist, SCS - Taos.
9. Bill Cater, Chairman - Taos Soil and Water Conservationist District, Questa.
10. Bob Stewart - Biologist, New Mexico Department of Game and Fish - Santa Fe.
11. A. J. Garner - District Ranger, USFS - Tres Piedras.

II. BIG SAGEBRUSH CONTROL:

Big sagebrush occurs over broad areas of northwestern New Mexico. It occurs on a variety of soils and in association with numerous other species. Treatment of big sagebrush by the various federal and state agencies is being done for countless reasons. These include watershed management, increased esthetic values, improved wildlife habitat, and increase production of livestock forage. Forage production increase can be as much as 800% or more. Water is conserved and runoff prevented. Erosion is lessened, more productive use is made of space, moisture and soil nutrients. Livestock management and protection is enhanced. Income yield per acre is increased.

With the many land use objectives and wide distribution of big sagebrush, guidance is needed for treatment recommendations. The following are some of the items to consider and recommendations for evaluating treatment of infested areas:

III. SELECTION OF AREAS TO BE TREATED:

A. Present Vegetation:

1. Areas to be Seeded:

   a. When not enough remnants of desirable vegetation remain to assure take over of the site in a reasonable period of time.

   b. When change in vegetative composition is desired:

      Examples: (1) Warm season grasses to cool season grasses.

      (2) Need for additional production.

      (3) Kind of grazing animal.

2. Areas not to be Seeded:

   When released from undesirable plants, enough remnants of desirable vegetation remain that site take over is assured.

3. Areas that should not be treated in any manner:

   Areas with heavy alkaline or sodic soil covered with Artemisia - arbuscula and A. nova.

B. Soil:

1. Areas to be seeded:

   a. Depth - 18 inches or more to parent materials.

   b. Rock - When greater than 50% of the profile is rock, seed species other than grass.

   c. Texture - 12 inches or more to clay layers which restrict moisture penetration and root development.

   d. Inhibitory Factors - Chemical concentration within the tolerance of selected species for seeding.

   e. Erodibility - Soils not susceptible to excessive wind erosion (sand and loamy sands), when plowed.

2. Areas not to be seeded: Criteria for areas not to be seeded are the converse of areas to be seeded.

C. Topography:

1. Areas to be seeded: Slope - Generally up to 15 % unless the site is susceptible to excessive erosion.

2. Areas not to be seeded: Criteria for areas not to be seeded are the converse of areas to be seeded.

D. Climate:

1. Areas to be seeded: Precipitation - 12 inches or more. At lower rates hold to soils with good soil - plant relationships.

2. Areas not to be seeded: Criteria for areas not to be seeded are the converse of areas to be seeded.

E. Biotic Factors:

1. Rodents - Rodent control action should be taken if necessary.

2. Insects - Insect control action should be taken if necessary.

3. Wildlife - Control may be necessary during establishment of seeded species.

F. Grazing Management:

For all areas:

1. Protection during establishment - Continuous rest until plants are well established.

2. Proper Use - Includes time and degree of use. Generally take half and leave half, grazed at the proper season. Periodically, rest should be given during the growing season.

IV. OTHER CONSIDERATIONS:

For all areas:

A. Esthetics - Consider limiting chemical projects along public highways. Avoid straight edges along edges of control areas.

B. Watershed Management - Consider water quality, stream pollution and community needs.

C. Recreation - Evaluate impact of project or Recreation problems.

D. Wildlife - Leave strips and rough areas untreated for wildlife protection and use.

E. Treatment patterns - Avoid large block treatments where wildlife considerations are important.

F. Sagebrush eradication programs should be implemented in relation to overall development multi-use programs, where all facets of development are considered.

G. Sagebrush eradication should normally be limited to ranges used principally in the spring, summer, and fall. It is more applicable on cattle and horse ranges.

H. Ranges used chiefly by sheep and big game, during the winter, should first be studied closely and evaluated as to the desirability of eradication of the sage.

I. Most successful revegetation results are obtained on loamy sites with deep to moderately deep soils. Usually these sites also give the highest most consistent production yields. Heavy clay soils can be reseeded but success in reseeding and vegetative forage production is normally less than on moderate textured soils.

J. The presence of the crested wheatgrass bug (labops), may require seeding other than crested wheatgrass.

K. Normally shallow soils (soils full of stone and rock, heavy clay layers near soil surface, or hard pans) restrict plan growth severely, particularly in drouthy years. These sites should be avoided for clearing and seeding.

L. Unless it is a small inclusion in a large project, areas receiving salt concentrations should be avoided for seeding purposes for most grasses except the salt tolerant species.

V. TREATMENT OF SAGEBRUSH AREAS NEEDING SEEDING:

With the exception of ground denuded by construction activities, or wildfire, every area that is in need of seeding has some type of plant cover. Stands of hardy annuals, herbaceous or shrubbery perennials are generally fully utilizing soil moisture. This plant cover must be reduced to permit seedlings of seeded species to become established.

Today many combinations of techniques and types of equipment are available to seed range areas. The objective is to get satisfactory stands by the most economical method keeping in mind the basic principles of seeding on a firm seed bed and covering the seed to proper depth.

Methods of Reducing Competition:

A. Mechanical:

1. Plowing - Cultivation generally with some type of disc plow has been used for many years in preparing a site for seeding. Competitive vegetation is reduced to a minimum by this method. On heavy or compacted soils in poor physical condition, plowing improves the structure of the surface soil. This in turn improves water absorption and aeration conditions so necessary for seeding success. On many depleted range areas cultivation is absolutely necessary to get moisture into the soil. On the other hand, the structure of some silt soils is destroyed by cultivation. Such

soils run together like jelly and allow little or no water infiltration.

Plowing when done too deep may actually be detrimental by creating a loose seed bed which loses moisture too rapidly. The soil conditions and the kind of competitive vegetation being eliminated will dictate whether cultivation should be used and the type of plow equipment that should be selected to prepare the site.

Plowing equipment can be conveniently broken down into the following categories:

a. Wheatland or Disc Tiller Plows. This type of equipment is best suited to the removal of brush on fairly rock-free ground. Under such conditions, brush kills of 80 - 90 percent can be obtained. Because of the number of adjustments, the fairly light frame and rigidity of design, breakage, and inefficient operation are often common. If this equipment is used, it should weigh at least 300 pounds per foot of cutting width, equipped with discs not less than 26" in diameter, preferably 28".

b. Offset Disc Harrows. This equipment is best adapted for heavily crusted or compacted rock-free soils. The size of the brush is much more limiting than that treated with the heavier disc tillers or brushland plows. Depth of plowing is not easily controlled unless depth regulators are used. The offset disc should weigh 500 pounds or more per foot of cutting width. Discs should not be less than 26" in diameter.

c. Brushland Plow. This machine is primarily adapted for plowing brushlands. It will tolerate considerable rock without excessive breakage. Brush removal will run from 90-100 percent. The initial cost of the Brushland Plow is high. The plow is not now commercially available, but it may be readily secured by special order. This is the most desirable equipment for plowing sagebrush. Horse-power requirement of a single plow is that of a D6 or comparable tractor.

d. Time to Plow: Spring and fall.

e. Depth: Deep enough to control undesirable plants.

2. Chaining:

a. Type of equipment. Chaining is an economical technique for eradicating mature big sagebrush. A recent technique

is to use two to three large anchor chains 300-600 feet long rolled together and pulled in a loop between two large crawler tractors of 150 or more drawbar horsepower. The chain is attached to the tractor by a hitch which will allow the chain to roll continuously. This not only keeps the chain free from collecting large piles of sagebrush but also helps to pull the sage out of the soil so that most of the roots are exposed to the air. The practice is to cover the same area twice by reversing the direction immediately back over the same area. Results to date show better than 90% kill of the sage. Chaining works well for reducing competition on area where a good understory of native grasses is present or on rocky terrain that cannot be plowed and reseeding is needed.

b. Timing - Two periods can be used:

(1) After first killing frost until ground freezes up, about four weeks.

(2) After soil has thawed in spring and until active growth begins, about 4 to 6 weeks.

c. Type of Stand: Mature, brittle stands with little or no young plants.

3. Chopping - Marden Brush Chopper:

a. Use on rocky land and where maneuverability is needed.

b. Restricted to old, brittle mature stands.

c. Timing - Late winter and early spring.

4. Roto-Beater and Roto-Cutter:

a. Limit to areas with good understory of grass with no rabbit brush or rock.

b. Can be used for followup treatment.

c. Limit to mature even-age stands.

5. Railing:

a. Limit to mature stands.

b. Time - Winter and early spring before frost goes out.

c. Limited to relatively level land.

d. Normally limited to areas that do not need reseeding.

6. Harrowing - (Dixie or Pipe Harrow): Limited to rocky soils where other methods are not applicable.

7. Scalping - Road Maintaineer: Very limited application to level areas, with mature stands.

B. Chemical:

1. Limited to areas free of appreciable stands of rabbit brush.

2. Limited to areas of big sagebrush.

3. Limited to areas free of significant amounts of valuable browse and forb species.

4. Wildlife requirements must be evaluated before spraying.

5. Project timing:

a. Stage of big sage growth - Spray when new growth is 2 to 3 inches in length.

b. Soil Moisture - Sufficient to support vigorous continued growth - moisture in upper 12 inches of soil.

6. Rates: Two (2) pounds acid equivalent 2,4-D low volatile ester - total solution application five (5) gallons per acre, minimum of one (1) gallon of diesel oil in mixture.

7. Other limitations:

a. Pollution - Avoid spraying live streams where they are significant to irrigation and culinary use.

b. Drift Damage: Attention should be paid to susceptible crops.

(1) Wind velocities are limited to 7 miles per hour with conventional spraying. With invert materials, the wind velocities are limited to 15 miles per hour.

(2) When upward air current is noted, spraying should stop.

RECOMMENDED METHODS FOR TREATING AREAS NEEDING SEEDING

| Method | Type of Equipment (listed by Preference) | Average Cost Per Acre | Time | Depth or Rate | Limited To | Remarks |
|---|---|---|---|---|---|---|
| Plowing | Brushland plow, offset disc. Wheatland plow, tandem disc | $4.75-$6.00 | Spring & Fall | Deep enough to control undesirable plants. | Areas rather free of stone & large enough to maneuver equipment. | Plowing gives best results. |
| Chopping | Marden Brush Chopper, Fleco Brush | $7.00 $7.00 | Late winter Early spring | Full depth of blades | Stoney land or areas too small for plowing. Where sagebrush is mature & brittle & free of rabbitbrush. Few young sage. | Good where maneuverability is needed. Place seeds between drums. |
| Root Plowing | Root plow | $14.00 | - - | - - | Field trials and research | Not recommended at present. |
| Chemical | Helicopter Fixed Wing (where it can be operated safely) Ground applicator (where economical). | $4.75 $3.00 | Spray when new growth of big sagebrush is 2 to 3" in length and soil moisture will support continued vigorous growth (wet in upper 12"). Phlox in bloom. | 2# acid equivalent 2,4-D low volatile ester-total solution application of 5 gallons per acre; minimum of 1 gallon of diesel oil in mixture. | Areas free of appreciable stands of rabbitbrush and valuable browse and forb species. Times when wind velocities are less than 7 miles per hour with conventional spraying or 15 miles per hour for invert materials and when there are no upward air currents. | Wildlife requirements must be evaluated before spraying. Avoid spraying live streams where they are significant to irrigation & culinary use. Evaluate possible damage to susceptible crops. Stop spraying when spray drift is upward. |

RECOMMENDED METHODS FOR TREATING AREAS NOT NEEDING SEEDING

| Method | Type of Equipment | Average Cost Per Acre | Time | Limited To | Remarks |
|---|---|---|---|---|---|
| Chaining 2/Crawler Tractors | Chain at least 70 lbs/ft. Preferably 2 or 3 chains with roller hitch. | $2.00-$2.50 | Winter and early spring, or first killing frost-to-ground freeze. After spring thaw before growth begins. | Area with good understory of desirable grass, free of rabbitbrush with very few young plants. | Maintain speed of at least 3 miles per hour. May be used in areas in need of seeding. |
| Rotobeater and Rotocutter | Rotobeater with chain highway-type mower. | $3.50 | Spring | Areas with good understory of desirable grass with no rabbitbrush or rock. Mature, even-age stands of big sagebrush. | Can be used as follow-up treatment. |
| Railing | Rail made of railroad rails. | $3.00 | Winter and early spring (before spring thaw). | Mature sagebrush stands with good understory of desirable grass. Relatively level land without hummocks. | Normally limit to areas not in need of reseeding and free of undesirable shrubs, such as rabbitbrush. |
| Harrowing | Dixie or Pipe Harrow. | | | Rocky soils where other methods not applicable. | Very limited application. |
| Scalping | Road maintainer. | $5.00 | Spring | Level areas with mature stands. | Very limited application. |
| Chemical | Same as areas in need of seeding. | $3.50-$4.75 | Same as areas in need of seeding. | Same as areas in need of seeding. | Same as areas in need of seeding. |

## VI. SEEDING SAGEBRUSH AREAS:

Range seeding is directed primarily at depleted areas where forage production cannot be restored by rest or improved livestock management within a reasonable period of time.

Range seeding is an excellent tool for speeding range recovery, but is not a cure for all range ills. It is expensive; it is not universally applicable; and there is a calculated risk that success can be achieved. On the other hand, if the following general principles are carefully observed, chances of success can be high.

### A. General Principles for Seeding:

1. Use Adapted Grasses and Legumes. It is important to use only those species that are well adapted to the soil, climate, and topography of the specific site being seeded.

   New Mexico can be broken down into broad climatic zones. Each broad climatic zone must further be broken down as to topography and soils in order to be specific in species recommendations.

   a. Important climatic factors are: (1) Amount of precipitation.
      (2) Kind and season pattern of precipitation.
      (3) Frost free period (growing season).
      (4) Temperature.
      (5) Wind.

   b. Soil considerations are: (1) Parent material.
      (2) Depth.
      (3) Texture.
      (4) Structure.
      (5) PH.

   c. Topographic factors are: (1) Aspect.
      (2) Position.
      (3) Elevation.

2. Amount of Seed. It is important to use enough seed to get a good stand, but not more than necessary. Too much seed may produce a stand of seedlings so thick that the individual seedlings will compete with each other to the detriment of all. Moreover, when seed costs are high, the use of too much seed increases costs unnecessarily.

   Species of grass used, number of seeds per pound, and potential productivity of the site are the major factors determining rate of seeding. More pounds per acre are required for large-seeded species, such as bromegrass or pubescent wheatgrass, than for such small-seeded species as timothy and hard fescue. More seed can be used on meadows with high potential productivity than should be used on sites of low potential productivity.

Since seeding rate is important, it is advisable to keep up-to-date tests on germination, especially when seed is held in warehouses for more than one year. Seed should be stored in cool, dry places, but even at best our storage spaces are not optimum. Some seed lots decline rather rapidly in viability. Consequently, as the seed gets older, more pounds per acre will be needed to provide the same number of live, pure seed.

Generally speaking, the rapidly developing short-lived grass seed will lose its viability faster than those of the slowly developing long-lived grasses.

3. Depth of Seeding. Plant each species at its proper depth. For optimum emergence, small-seeded species such as timothy and orchardgrass should not be planted deeper than one-quarter inch, whereas such species as smooth bromegrass and crested wheatgrass do best when seeded at a depth of one-half to three-quarters of an inch. Optimum depth of seeding is roughly proportional to seed size. Plantings in the spring should generally be deeper than those in the fall. Plantings can be deeper in light, sandy soils than in the heavier clay soils. Where a mixture of small-seeded and large-seeded species is planned, seed to the depth directed by the small-seeded species.

4. Seed Distribution. Uniform distribution of seed is essential. Proper seeding rate per acre but poor distribution will result in too much seed in one spot and not enough in another. This is often the result when seed is broadcast by airplane, by hand, or with a motorized broadcaster unless care is taken and the relative distribution of the seed checked frequently. The most uniform distribution of seed is gained through the use of a drill, or drill-like seeder box. These should be used wherever possible.

   Even in drilling, care should be taken to check constantly the performance of the drill; some furrow openers may clog if seed slides to one side of the drill box on sloping land.

   In seeding mixtures made up of species with seed of widely different sizes, the smaller, heavier seeds generally sift to the bottom of the drill box or broadcaster hopper, and the larger, lighter seeds sift to the top. This results in poor distribution of each species, even though the overall rate per acre may be satisfactory. This can be avoided by putting the smaller seeded species in the legume box attachment, and running the larger through the main grass seed box.

5. Season of Seeding. Proper season varies with the area and species being sown. On drier areas, in particular, it is important to pay attention to moisture and temperature patterns. These two factors will usually dictate the proper planting season. Moisture and temperature must be sufficient to germinate the seed, and then keep the seeding growing to establish itself before adverse conditions occur.

B. Seeding Method and Time.

1. Drilling.

a. By far the superior method where site permits because:

(1) Seed is covered to proper depth by drill control.
(2) Distribution is uniform.
(3) Amount applied is under control.
(4) Compaction can be applied if needed.

b. Drill Limitations.

(1) Proper speed must be maintained - approximately 3 miles per hour.
(2) Needs frequent checking to see that drill is not plugged and is operating properly.

c. Drill Timing.

Applied to take advantage of summer storms rather than winter moisture.

d. Drilling Equipment and Other Considerations.

There are several types of drills which are suitable for seeding on plowed or loose seed beds. The Oregon Press Drill, developed by the Agri-Engineering Department of Oregon State University, was built for such situations. A heavy press wheel packs the soil. The seed is placed in the packed furrow, and an adjustable drag covers the seed to the desired depth. Another piece of seeding equipment, the rangeland drill, has given satisfactory results on rough plowed seedbeds. This drill was developed by the Range Reseeding Equipment Committee, an interagency group.

e. Deep Furrow Drill.

On sites where competitive vegetation is not too severe, successful stands of grass have been established on unprepared seedbeds. This has been made possible by the adaptation of the rangeland drill to deep-furrow seeding. The rangeland drill is a rugged seeder with high clearance, designed to work on rough sites. This drill is converted to a deep furrow implement by removing the depth bands. The discs are cupped and canted enough to make satisfactory furrows. The depth of the furrow is controlled by adding or taping of the disc arm weights. Disc arm weights, up to 70 pounds, have been used under some conditions.

The ordinary grain drills used on cultivated areas are too lightly constructed for this type of seeding. Grain drills will perform satisfactorily on smooth ground surfaces, free from brush. When seeding brushy, rough ground, the rangeland drill is much better suited to properly place the seed in the ground, and more economical because there is less breakage.

The deep furrow rangeland drill eliminates sufficient vegetative competition in the drill furrow for seedlings to become established. It places seed on firm moist soil. Better use is made of moisture with the furrows catching and holding moisture. The furrow affords some protection to the seedlings from winds and temperatures.

This method of seeding is not successful on areas with heavy clay soils, or where the surface soil is compacted. Such areas need cultivation for moisture absorption.

f. Spray and Deep Furrow Drill.

On many deteriorated ranges, it is not desirable to prepare a seedbed by conventional cultivation methods. Such cultivation leaves the area in a condition to erode before a new cover can be established. Because of the rocky surface conditions of some areas, it is physically impossible to plow. For these reasons, other seeding methods were sought which would be practical to large scale operations, and at the same time economical. Two developments gave the tools necessary to work out the answer. The number one development was the rangeland drill and its modification to deep furrow seeding. The second tool, chemical control of range weeds and certain brush, has given effective reduction of competitive vegetation in lieu of cultivation.

The combination of spray and drill has been effective on sagebrush areas, rabbitbrush areas, and parks and meadows which have deteriorated mainly to weeds and low forms of brush. By expanding and modifying the timing of the drilling and spraying, the flexibility of this technique can be more completely explored.

2. Broadcasting.

a. Not recommended when the site can be drilled.

(1) Distribution: Recommend dribble[1/] method of application, rather than exhaust or fan.
(2) Helicopter application rather than fixed-wing plane is recommended for aerial application.
(3) Timing: Recommend seed be applied at time of seedbed preparation.

1/ Dribble method is done by using regular drill with furrow openers removed.

b. Broadcast limitations.

(1) Requires heavier rate of seeding.
(2) Cover of seed is poor compared to drilling.
(3) Distribution is often poor.
(4) Rodent loss a hazard.
(5) Establishment is slower.

c. Conditions under which broadcasting recommended.

Broadcasting Seed on Disturbed Areas and Areas Burned by Fire: Broadcasting seed either by aerial or ground operation has been successful when the competing vegetation has been eliminated and the ground left bare. This condition usually exists after fire, logging, and road construction. The important thing is to seed immediately after the disturbance, before the soil has a chance to crust or seal over. Small seeded species lend themselves to broadcast seeding much better than large seeded species, simply because small seeds are covered by the natural stuff of disturbed areas much better than large seeds.

Under severe conditions, some type of a mulch has been found very beneficial to use in connection with broadcast seeding.

## VII. SPECIES SELECTION AND SEEDING RATE

| Species | Seeding[1] Rate PLA/Ac | 8 to 10" precipitation Soil Texture Groups | | | 10 to 14" precipitation Soil Texture Groups | | | 14 to 18" precipitation Soil Texture Groups | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sandy | Loam | Clay Bottom | Sandy | Loam | Clay Bottom | Sandy | Loam | Clay Bottom |
| Crested Wheatgrass (desertorium) | 5 | | x | | x | x | | | | |
| Indian Ricegrass | 8 | x | x | | x | x | | | | |
| Western Wheatgrass | 8 | | x | x | | x | x | | | |
| Alkali Sacaton | 1 | | | x | | | x | | | |
| Sand Dropseed | 1 | x | | | | | | | | |
| Sideoats Grama | 5 | x | x | | x | x | | | | |
| Blue Grama | 1½ | x | x | | | | | | | |
| Fourwing Saltbush | 6 | x | x | x | x | x | x | | | |
| Pubescent Wheatgrass | 9 | | | | | x | x | | x | x |
| Stiffhair Wheatgrass | | | | | | x | x | | | |
| Russian Wildrye | 6 | | | | x | x | | | | |
| Bitterbrush (seed in pure stands) | | | | | | x | | | | |
| Alfalfa | | | | | | x | | | | |
| Big Bluegrass | | | | | | x | | | x | |
| Smooth Brome | 8 | | | | | | | | x | |
| Intermediate Wheatgrass | 9 | | | | | | | | x | |
| Tall Wheatgrass | 10 | | | | | | | | x | x |
| Spike Muhly | 2 | | | | | | x | | x | x |
| Mountain Mahogany | | | | | | | | (x) | x | |
| Burnett | | | | | | | | | x | |

( ) Indicates additions

1/ Pure live seed per acre when drilled as single species. Increase this rate by 30 percent when seed is broadcast.

Mixtures should be of grasses having similar palatibility ratings, similar seasons of use, and similar growth habits. When possible, shrub and forb species should be included in the mixture.

## II. PLANT NAME LIST

| | | | |
|---|---|---|---|
| 1. | Crested Wheatgrass | - | Agropyron desertorium |
| 2. | Indian Ricegrass | - | Oryzopsis Hymenoides |
| 3. | Western Wheatgrass | - | Agropyron smithii |
| 4. | Alkali Sacaton | - | Sporobolus airoides |
| 5. | Sand Dropseed | - | Sporobolus cryptandrus |
| 6. | Sideoats Grama | - | Bouteloua curtipendula |
| 7. | Blue Grama | - | Bouteloua gracillis |
| 8. | Fourwing Saltbush | - | Atriplex canescens |
| 9. | Pubescent Wheatgrass | - | Agropyron trichophorum |
| 10. | Stiffhair Wheatgrass | - | Agropyron subsecundum |
| 11. | Russian Wildrye | - | Elymus junceus |
| 12. | Bitterbrush | - | Purshia tridentata |
| 13. | Alfalfa | - | Medicago sativa |
| 14. | Big Bluegrass | - | Poa ampla |
| 15. | Smooth Brome | - | Bromus inermis |
| 16. | Intermediate Wheatgrass | - | Agropyron intermedium |
| 17. | Tall Wheatgrass | - | Agropyron elongatum |
| 18. | Spike Muhly | - | Muhlenbergia wrightii |
| 19. | Mountain Mahogany | - | Cercocarpus montanus |
| 20. | Burnett | - | Sanguisorba minor |

## IX. BIBLIOGRAPHY.


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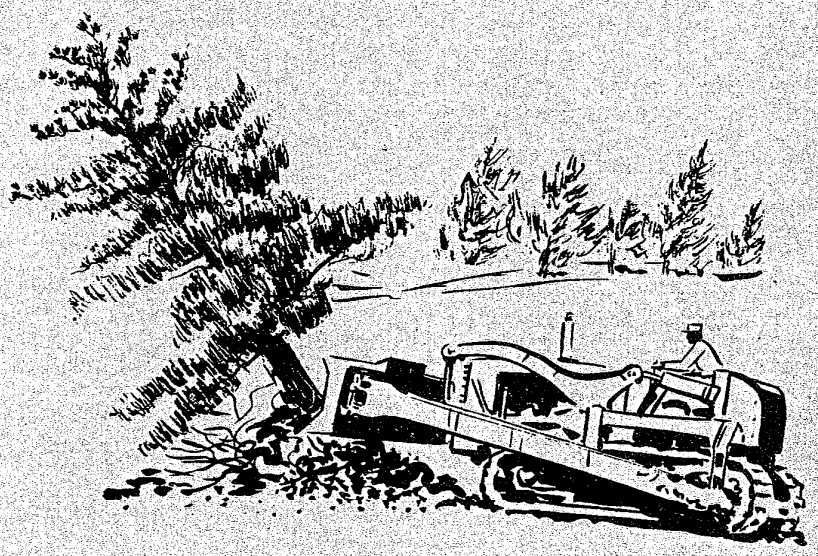
# *Improving Pinyon - Juniper Range in New Mexico*



REPORT NO. II APRIL, 1968

# IMPROVING PINYON-JUNIPER RANGES IN NEW MEXICO

Inter-Agency Range Committee
Samuel H. Lamb, Chairman

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# IMPROVING PINYON-JUNIPER RANGES IN NEW MEXICO

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NEW MEXICO INTER-AGENCY RANGE COMMITTEE
REPORT NO. 2
SAM LAMB, CHAIRMAN

# IMPROVING PINYON-JUNIPER RANGES IN NEW MEXICO

## I. Introduction

This study represents an inter-agency field evaluation of various methods of controlling pinyon-juniper in south central New Mexico. This September 25-26, 1967, field study included brush control work on both private and federal lands. The major areas included in this tour were: Capitan, Carrizozo, Corona, and Rowe Mesa, south of Santa Fe.

The following attended all or part of this New Mexico Inter-Agency Range Committee meeting:

Department of Game and Fish
Sam Lamb, Santa Fe Federal Air Coordinator

Bureau of Land Management
--Myrvin E. Noble, Soil and Watershed Staff, Denver Service Center, Denver
--Dale H. Kinnaman, Head, Soil and Watershed Staff, Santa Fe
--Richard Kerr, Biologist, State Office, Santa Fe

Agricultural Research Service
--Carlton H. Herbel, Range Scientist, Jornada Experiment Station, Las Cruces

New Mexico State University
--Walter L. Gould, Agronomist, Department of Agronomy Las Cruces

Forest Service
--Jack Bohning, Range Staff, Santa Fe National Forest, Santa Fe
--Farris E. McDermain, Range Staff, Lincoln National Forest, Alamogordo
--Dick Beauibein, District Ranger, Smokey Bear Ranger District, Capitan
--Clay Baxter, Assistant Ranger, Smokey Bear Ranger District, Capitan
--John Drake, Assistant Ranger, Smokey Bear Ranger District, Capitan
--Paul Jones, General District Assistant, Smokey Bear Ranger District, Capitan

Bureau of Indian Affairs
--Wilson C. Gutzman, Area Range Conservationist, Albuquerque, Area Office, Albuquerque
--Don Moon, Range Staff, Mescalero

Mescalero Tribal Council
Sampson Miller, Vice President, Mescalero

Soil Conservation Service
--Bob Scott, Area Conservationist, Area 3, Roswell
--Howard Harkey, Work Unit Conservationist, Carrizozo
--Dalton Morgan, Work Unit Conservationist, Capitan
--Leslie C. Armstrong, Range Conservationist, Capitan
--James A. Martin, Range Conservationist, Capitan
--Daniel L. Merkel, Range Conservationist, Program Services Staff, Santa Fe.

Brush Control Contractor
M. Wesley Dross, Carrizozo

II. Pinyon-Juniper Control

Pinyon pine Pinus edulis, one-seeded juniper Juniperus monosperma, Utah juniper Juniperus osteosperma and Alligator juniper Juniperus deppeana, occur at high elevations throughout New Mexico. They grow on a variety of soils and in association with numerous other species. Extensive control of pinyon and juniper has been practiced by many state and federal agencies for severl years. Results have varied from very good to very poor. Treatment is usually expensive, normally ranging from $3.50 to $14 per acre. The extensive use, high cost, varied results and abundance of available methods and equipment were the main reasons for selecting these species for study. Based on their field study and experience, the Committee recommends the following considerations be made when evaluating an infested area for treatment:

III. Treatment Recommendations:
A. Present Vegetation
1. Kinds of Vegetation
a. In some cases, consideration should be given to management of pinyon stands for nuts, (both for harvest and for game food) Christmas trees, firewood and nursery stock rather than practicing complete control.

b. Seeding will be done in conjunction with control when insufficient remnants of desirable vegetation remain to assure take over of the site in a reasonable period of time. Seeding will be limited to areas where proven techniques assure reasonable probability of success.

c. Consideration should be given to seeding when a change in vegetation composition is desired.

2. Amount of Vegetation
   The following degrees of infestation are recognized by the Committee:
   a. Light - Up to 100 stems per acre or 0 to 12% cover
   b. Medium - 101 to 250 stems per acre of 12% to 30% cover
   c. Dense - 251 or more stems per acre or over 30% cover

3. Composition
   a. Treatment method and extent will be determined by the number, size class and species of trees to be controlled.

   b. The woody understory vegetation, (cactus, oak, plus other desirable browse species, etc.) will influence the method and extent of treatment.

   c. The need for range seeding following control of pinyon and juniper will depend upon the desirable species in the understory composition and planned use of the area.

B. Soil
   1. Depth--Treatment should be limited to soils 18 inches or more in depth to parent material when grass production is the prime objective. Shallower soils favor browse production and may be treated where this is the objective.

   2. Texture--Mechanical control should not be practiced on deep sandy soils that do not have a perennial understory.

   3. Inhibitory Factors--Special consideration should be given to treatment methods on areas with an excessive needle mulch. Species used in seeding should be selected on basis of tolerance to growth inhibitors.

   4. Erodibility--Areas with sandy soils or steep slopes should usually be avoided when using mechanical treatment.

C. Topography
   1. Slope
      a. The reduced benefit resulting from brush control on steep slopes limits its feasibility on such areas.

      b. Moderate and steep slopes should be left untreated for wildlife cover if wildlife use is a factor.

   2. Exposure
      a. A northeastern exposure (if it supports an adequate feed supply) is preferred by wildlife and livestock and control should be avoided here.

      b. It is desirable to leave some areas of southern exposure untreated for winter livestock protection.

D. Climate--Species selection and time of planting will recognize season and amount of precipitation where seeding is done in conjunction with control.

E. Biotic Factors

1. Wildlife--Consider leaving untreated some areas of 100-200 stems per acre for game habitat. With control planning the range can generally be improved for game and domestic stock concurrently.

2. Rodents--Control of rodents is an important factor if seeding is to be done following control.

3. Insects--If insect damage on pinyons is a factor, leave a 1/4 mile buffer strip around intensive pinyon use areas.

F. Grazing Management

1. Protection from Grazing

a. All lands on which control is practiced should be protected from grazing by domestic livestock for a minimum of a full growing season after treatment.

b. If the area is also seeded, it should be deferred from livestock until the new grass is well established.

2. Proper Use

Grazing use following the deferred grazing period should not exceed the proper limits for the concerned species and season of use.

G. Other Considerations

1. Esthetics

a. Screens formed by untreated areas may be desirable along highways and well traveled secondary roads.

b. The method of control and type of equipment used can greatly affect the esthetic value of the finished job. The tree crusher or complete burning gives esthetically desirable results. Leaving a few taller trees for beauty and shade will enhance the area. On the other hand, leaving slash on the ground will improve the area for game.

2. Treatment Patterns

a. Treatment boundaries should be designed to blend into the landscape as much as feasible.

b. It is desirable to plan treatment areas of a size and shape beneficial to wildlife. It is desirable to have stringer escape routes 250 to 300 feet wide fitted to topography and drainage. If islands are left, they should be long and slender in shape and at least ten acres in size for deer; and 20 acres for elk.

Maximum width of unprotected openings should not exceed 1600 feet where optimum game use is an objective.

c. The rate of reinvasion is one of several factors related to the size and shape of the control area. Therefore, if rate of invasion is expected to be rapid, slender, stringer type openings should be avoided.

3. Recreation--Areas with high recreation values should either be left untreated or pruned and thinned.

4. Watershed Management--Successful pinyon-juniper control may reduce the moisture yield from a watershed. Therefore, water yield should be weighed against forage needs.

IV. Methods of Controlling Pinyon and Juniper (For Summary/see Append. I.)

A. Tree Crushing

1. Type of Equipment

The only suitable machine presently available is the modified tree crusher. The modifications include an adjustable "saw-tooth" push bar, changes in the size, spacing, and patterns of the wheel blades and the addition of a broadcast seeder.

2. Time

Control should be timed according to the growth requirements of species being seeded when seeding is part of the treatment. The soil should be wet enough for trees to be pushed out of the ground, but dry enough to limit damage to the understory vegetation and to keep the wheel blades from becoming mud packed.

3. Limitations

The tree crusher is limited to areas of non-stony soils, large acreage blocks and slopes of less than 15 percent. The best cost-benefit ratio is achieved where applied to very dense stands.

4. Results

Tree crushing results have been good using the modified machine. It is well suited when esthetics of the area are important. Care must be exercised or control may be too complete for optimum wildlife habitat.

B. Burning--This includes individual tree burning, controlled stand burning and burning following chaining or cabling.

1. Type of Equipment

a. Torches

Pickup mounted propoane torches are suitable for individual tree burning.

b. Fire Control Equipment

Adequate fire control equipment is necessary.

2. Time
Although the best kill is obtained at times of low humidity and high temperatures, full consideration must be given to fire safety and follow-up treatments.

3. Esthetics
Where the burned trees are left standing, an area is unsightly. Therefore, this treatment should be avoided in areas of high esthetic value.

4. Limitations
   a. Individual Tree Burning
   The relatively high cost of individual tree burning of trees over ten feet in height limits its use to light infestations of small trees. Optimum cost-benefit ratio is realized where used in stand of 1 to 4% tree cover.

   b. Stand burning
   This treatment is rarely used because of the difficulty of obtaining a clean burn under less than extreme fire hazard conditions.

   c. Burning Downed Trees
   Seeding is required following burning.

5. Results
Burning has given good results and warrants much wider use.

C. Chaining and Cabling
1. Type of Equipment
   a. A chain weighing 70 or more pounds per link should be used.
   b. A heavy weight cable has also been used (See Results).

2. Time
   a. When range seeding is to be done in conjunction with control, the time of treatment must be related to the proper seeding date for the species.
   b. Control of pinyon-juniper should be done when there is adequate soil moisture to uproot the trees but dry enough not to damage understory vegetation.

3. Treatment methods
   a. Single chaining (or cabling) involves one pass over an area.
   b. Double chaining (or cabling) requires two passes over an area in opposite directions. The second chaining may be done soon after the first or delayed for one to three years.
   c. Chaining(or cabling) combined with burning has given good results. The woody material is best consumed when burning is done after the needles dry but before they drop from the dead trees. When seeding is done in conjunction with this control, the results are greatly improved by chaining the area again after burning.

4. Limitations
   a. Chaining (or cabling) is most effective on large, mature trees.
   b. Usually it is not economically feasible to control small acreages by chaining.
   c. Treatment should be avoided when soil is frozen.
   d. Optimum cost-benefit ratio is achieved where applied to stands with 3 to 11% tree cover.

5. Results
   a. Chaining usually gives a better kill than cabling. The percent kill from one pass with either a chain or cable is less than other methods. This may be desirable where wildlife is a major factor.
   b. Desirable vegetation is often covered by downed trees decreasing the amount of available forage, thus indicating a need for follow-up treatment. Without follow-up, a decrease in stocking of the treated area will be indicated. However, debris provides seed source protection and small game cover.

D. Chopping
   1. Type of Equipment--Drum brush cutters

   2. Time
      When range seeding is a part of the treatment, chopping should be done at the proper seeding time for the species being planted.

   3. Limitations
      Chopping is most effective on small trees. It is most suitable for use in small, odd-shaped areas because of its maneuverability.

   4. Results
      Although chopping has, in some cases, given good results, this method has only limited application.

E. Roto-Cutter
   1. Type of Equipment
      a. Highway type mower.
      b. Heavy duty rotary mowers.

   2. Time
      Treat when the mowing is least harmful to related desirable species.

   3. Limitations
      Use of the roto-cutter is limited to rock free areas with small trees. This treatment will not give satisfactory results on alligator juniper.

   4. Results
      The percentage kill is satisfactory where the trees can be cut below the bottom branches. This is a suitable treatment for recent invasion.

F. Pushing (dozing) Individual Trees

1. Type of Equipment

Wheel or track type tractors, equipped with a dozer blade or "stinger" should be large enough to uproot the trees with a minimum of damage to the grass. The trees, degree of infestation, soil texture, soil moisture, etc.

2. Time

Pushing of pinyon and juniper may be done at any time there is adequate soil moisture, but not when the ground is frozen or excessively wet.

3. Limitations

Because of the relatively high initial cost and excessive soil disturbance of this treatment in dense stands, it is suited to light and medium stands. The best cost-benefit ratio results when dozing is done on stands with 3 to 11% tree cover.

4. Results

This treatment gives excellent results when properly done.

5. Related Treatment

Because of the excessive amount of forage covered by downed trees, it may be desirable to stack, windrow and/or burn the trees after they have been pushed. Stacks should be limited to five per acre. Burning is most effective when done before the needles drop. Stacking and burning are usually not necessary in areas where there is an appreciable demand for firewood. Complete cleanup reduces the value of the area for wildlife.

G. Hand Grubbing

1. Type of Equipment

A grubbing how or similar tool is suitable.

2. Time

Grubbing is best done when the soil is moist but not frozen.

3. Limitations

This control is limited to light stands of small trees.

4. Results

This gives good results as a follow-up treatment on small trees or on areas or recent invasion.

H. Hand Cutting (Above Ground)

1. Type of Equipment

Cutting one-seed juniper, Utah juniper or pinyon with an axe or saw is acceptable.

2. Time

Time is not a factor with this treatment.

3. Limitations
This treatment is best suited to light infestations. Above ground cutting of alligator juniper does not give a satisfactory kill unless the stumps are treated. See Chemical Control for stump treatment.

4. Results
The kill is good if the tree is cut close to the crown. Removal of wood products, such as posts, Christmas trees, and firewood, may help offset the cost of this treatment.

I. Chemical (Soil sterilant treatment for standing trees)

1. Type of Equipment
This treatment does not require any special equipment.

2. Time
July, August, and September are the most suitable months for application in areas where summer moisture is dominant. Otherwise treat in late fall or early winter.

3. Rate of Application
a. For trees up to 12 feet in height, one tablespoon of Femuron per 3 feet of height should be placed at the base of each tree on light and medium textured soils. Two tablespoons should be used on heavy textured soils.

b. All chemicals shall be applied in accordance with Federal regulations or specifications given on the label.

4. Limitations
Because of the high cost of this treatment, it is best suited to light infestations or as a follow-up to mechanical control. Caution: Do not use close to Ponderosa pine scheduled to be saved.

5. Results
This treatment gives fair to good kill depending upon precipitation and other factors. Usually a higher percent kill occurs on pinyon than juniper.

6. Other Chemical Treatment Considerations
A more detailed discussion of chemical control of pinyon and juniper is included in Chemical Control of Range Weeds, 1966 issue: Juniper (pp. 22 and 23) and Pinyon (pg. 30).

J. Chemical Treatment of Alligator Juniper Stumps

1. Type of Equipment
This treatment does not require any special equipment.

2. Time
Stumps should be treated at the time the tree is cut.

3. Rate of Application

a. A suitable treatment consists of saturating the cut surface with diesel oil fortified with 2,4-D or 2,4,5-T at the rate of 12 pounds parent acid per 100 gallons of oil.

b. Another treatment consists of covering the cut surface with ammate crystals.

4. Limitations

None

5. Results

This treatment is highly effective when properly applied.

V. Range Seeding in Pinyon-Juniper Areas

A. Seeding Method

1. Drilling

Drilling is the most desirable method of seeding areas following pinyon-juniper control where complete cleanup is accomplished.

a. Rangeland Drill

This drill is a rugged seeder with high clearance, designed to work on rough sites and trashy surface. It is not designed to plant light seed such as grama.

b. Grass Drill for Prepared Seed Beds

Drills with picker type agitator to facilitate planting of light, fluffy seed and equipped with fine seed boxes for planting small seeds are available. These drills are not adaptable to rough sites and trashy seed beds.

c. Browse Seeders

Where the stand of grass is adequate but a browse component is needed, specially designed browse seeders are available. These can be used with scalpers to remove grass competition in the row.

2. Broadcasting

a. Ground application broadcasters are mounted on many types of control equipment. The success of seeding with these tools depends on good principles of range seeding being followed.

b. Aerial application of seed may be done by either fixed wing planes or helicopters. The best aerial seedings usually result from placing the seed in fresh cool ashes or by chaining or dragging an area following seeding.

c. Limitations of Broadcast Seeding:
   (1) Seeding rate should be increased when broadcast method is used.
   (2) The seed is not covered as well as when a drill is used.
   (3) Broadcasting often results in a poorer distribution of seed than when it is drilled.
   (4) The seed lost to rodents and birds is usually great when seed is broadcast.
   (5) Establishment of a stand is slower when seeded by broadcasting than by drilling.

B. Time

Range seeding must be done at a time most suitable for the species being planted and area being treated. Seeding in most part of New Mexico will be timed to take the advantage of summer storms rather than winter moisture. Refer to Probability of Selected Prescipitation Amounts in the Western Region of the United States.

C. Species Selection and Rate (See Appendix II)
   1. Single species seedings should be limited to special objectives or use of certain introduced species.
   2. A mixture of species is desirable where the mix meets the ojective of the planting and the resulting vegetative composition can be properly managed.
   3. Introduced species are often desirable when the planting is to serve a special purpose; e.g., when a stand of cool season grass is needed or where wildlife grazing is a major factor.
   4. Certain native and introduced species seeded in mixtures usually furnish good erosion control and provide high forage production.
   5. Browse species may be seeded near the edges of remnant cover for wildlife forage.

VI. Consideration for Follow-Up Treatment:

A. Amount of Original Woody Plant Stand Following Treatment

Several treatments such as chaining and chopping, leave a significantly high percentage of live trees. Follow-up treatment should be planned at the time the original control is programmed, if effective control is desired.

B. Degree and Size of Reinvasion

Control of invasion is usually much cheaper and more effective if follow-up treatment is done when trees are small and scattered. The removal of small trees as Christmas trees or nursery stock should be considered.

C. Loss of Desirable Species

An invasion or increase in pinyon-juniper will alter the herbaceous composition of an area. Follow-up treatment should be done before there is a major loss of production.

D. Loss of Production

As pinyon-juniper becomes more abundant, there is a reduction in understory forage production. Control of reinvasion should be carried out before there is a major loss of production.

E. Availability of Alternate Treatment Sites

A determination usually must be made between treating new areas or doing follow-up on other areas which have been treated in the past. An evaluation of the cost-benefit of each alternative will give a guide to the most feasible area for treatment.

F. Management Requirements

Deferred grazing and proper grazing use requirements are the same after follow-up treatment as they are following the original control.

G. Erosion

Erosion hazards and control should receive the same consideration during follow-up treatment as they do on the original application of the practice.

H. Wildlife

The wildlife value of the area may be enhanced by post-ponement of follow-up treatment to encourage establish-ment of better game cover.

VII. Economic Feasibility

The Inter-Agency Committee considers that a study of the economic feasibility aspects of pinyon-juniper control have been completed in the past. Millions of acres remain to be done. There are, however, insufficient data for guidance to the economics of this practice. A few of the questions to be answered by such a study follow:

a. On what sites is brush control feasible?
b. What method of control gives the greatest return for the cost involved?
c. How much increased production can be expected from different degrees of kill?
d. When and by what method does follow-up give the best returns?
e. What patterns of control will best safeguard wildlife and esthetic values?
f. What seeding methods will give the most economic returns?
g. What are the guidelines for leaving selected pinyons for nut crops in areas where individual tree control is being practiced?
h. How much do other effects contribute to the overall benefit of control; e.g., wildlife, esthetics, recreation, and watershed?

APPENDIX I

SUMMARY OF METHODS OF PINTON-JUNIPER CONTROL

| METHOD | TYPE OF EQUIP. | AVE. COST PER ACRE | TIME | LIMITED TO: | REMARKS |
|---|---|---|---|---|---|
| Tree Crushing | Modified Tree Crusher | $7.50 to $10.00 | Proper Seeding Time | Large acreages of non-stony soils on slopes of less than 15 percent. Optimum benefit-cost ratio in very dense stands | Use when there is good soil moisture, but not wet. Gives good results with high esthetic values. |
| Burning | Propane torches; fire control equipment. | *$1.90<br>** 1.75<br>*** 1.75 | Stand: spring or summer<br>Ind.: fall | Light infestations for individual tree burning. Optimum benefit-cost ratio with stands of 1-4% tree cover. | Gives good results and warrants wider use. May be used following chaining. |
| Chaining (Cabling) | Chain weighing 70 lbs. or more per link | $3.50 for single pass | Proper Seeding Time | Large acreages of mature trees. Optimum benefit cost ratio with stands 3-11% tree cover. | Use when there is good soil moisture, but not wet. Burning is desireable. Gives fair results. |
| Chopping | Brush Chopper | $7.00 | Proper Seeding Time | Little trees in small odd shaped areas. | Limited application; gives fair results, except poor results on alligator juniper. |

APPENDIX I

SUMMARY OF METHODS OF PINYON-JUNIPER CONTROL
(continued)

| METHOD | TYPE OF EQUIP. | AVE. COST PER ACRE | TIME | LIMITED TO: | REMARKS |
|---|---|---|---|---|---|
| Roto Cutter | Highway type mower. Heavy duty rotary mower | $3.50 | When least damage to grass will result. | Areas with small trees and no stones. | Gives good results. Will not kill alligator juniper. Desirable treatment for new invasion. |
| Pushing (Dozing) | Wheel or Track type w/blade or "stinger" | $5.00 to 7.00 | All yr. except when frozen | Light and medium infestation. Optimum benefit-cost ratio w/stands 3-11% tree cover. | Stacking, burning or windrowing is desirable. This may increase cost to $14. Gives excellent results. Also desirable in other control methods. |
| Hand Grubbing | Grubbing Hoe | $6.00 | All yr. except when frozen. | Light & medium infestation of small trees. | Gives good results. Use as follow-up treatment or on new invasion. |
| Hand Cutting | Ax or Saw | Up to $6.00 | All yr. | Light infestations | Gives good results except on alligator juniper where it is ineffective. Wood products may return part of cost. |

APPENDIX I

SUMMARY OF METHODS OF PINYON-JUNIPER CONTROL
(continued)

| METHOD | TYPE OF EQUIP. | AVE. COST PER ACRE | TIME | LIMITED TO: | REMARKS |
|---|---|---|---|---|---|
| Chemical Soil Sterilant | Fenuron | $4.50 | July August, Sept. or late fall & early winter. | Light stands only | For other chemical treatment, see pp. 22, 23 & 30 of Chemical Control of Range Weeds. |
| | | | | | Rate--Trees less than 6 ft. high, (1) tbls.. on light & medium soils; (2) tbls. on heavy soils. For trees 6 to 12 ft. high, double above amounts. |
| Chemical Stump Treatment | Ammate Crystals or 2,4-D & 2,4,5-T with diesel oil. | Up to $5.00 | At time of cutting. | Light stands only | Alligator Juniper only. |

APPENDIX II

SPECIES SELECTION AND SEEDING RATE

| SPECIES | SEEDING RATE 1/ PLS/Ac. | 12" to 14" PRECIPITATION SOIL TEXTURE GROUPS Sandy | Loam | Clay | 14" to 18" PRECIPITATION SOIL TEXTURE GROUPS Sandy | Loam | Clay | OVER 18" PRECIPITATION SOIL TEXTURE GROUPS Sandy | Loam | Clay |
|---|---|---|---|---|---|---|---|---|---|---|
| Arizona fescue (Festuca arizonica) | 5 | | | | | | | | x | |
| *Beardless wheatgrass (Agropyron inerme) | 6 | | | | x | x | | | | |
| Big bluestem (Andropogon gerardii) | 6 | | | | x | | | x | x | |
| Black grama (Bouteloua eripoda) | 1 | | x | x | x | x | | | | |
| Blue grama (Bouteloua gracilis) | 1½ | | x | x | | x | | | | |
| Caucasian bluestem (Andropogon ischaemum) | 1 | | x | x | | | | | | |
| *Crested wheatgrass (Agropyron desertorum) | 5 | | x | x | | | | | | |
| Deergrass (Muhlenbergia rigens) | 2 | | | | | x | | | | |

## APPENDIX II

SPECIES SELECTION AND SEEDING RATE
(continued)

| SPECIES | SEEDING RATE 1/ PLS/Ac. | 12" to 14" PRECIPITATION SOIL TEXTURE GROUPS | | | 14" to 18" PRECIPITATION SOIL TEXTURE GROUPS | | | OVER 18" PRECIPITATION SOIL TEXTURE GROUPS | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sandy | Loam | Clay | Sandy | Loam | Clay | Sandy | Loam | Clay |
| Galleta (Hilaria jamesii) | 4 | | x | x | x | x | | | | |
| *Indian ricegrass (Oryzopsis hymenoides) | 8 | x | | | x | x | | | | |
| *Intermediate wheatgrass (Agropyron intermedium) | 9 | | | | | x | | x | | |
| Lehman lovegrass (Eragrostis lehmanniana) | 1 | x | x | | | | | | | |
| Little bluestem (Andropogon scoparius) | 3 | | | | x | | | x | x | |
| Mesa dropseed (Sporobolus flexuosus) | 1 | x | | | x | | | | | |
| Metcalf muhly (Muhlenbergia metcalfei) | 2 | | | | x | | | x | x | |
| *Mountain brome (Bromus marginatus) | 12 | | | | | | | | x | |

APPENDIX II

SPECIES SELECTION AND SEEDING RATE
(continued)

| SPECIES | SEEDING RATE 1/ PLS/Ac. | 12" to 14" PRECIPITATION SOIL TEXTURE GROUPS | | | 14" to 18" PRECIPITATION SOIL TEXTURE GROUPS | | | OVER 18" PRECIPITATION SOIL TEXTURE GROUPS | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sandy | Loam | Clay | Sandy | Loam | Clay | Sandy | Loam | Clay |
| Mountain muhly (Muhlenbergia montana) | 2 | | | | | | | x | x | |
| *Muttengrass (Poa fendleriana) | 2 | | | | | x | | | x | |
| *Needle and thread (Stipa comata) | 7 | | x | | | x | | | x | |
| *Orchard grass (Dactylis glomerata) | 5 | | | | | | | x | x | |
| Parry oatgrass (Danthonia perryi) | 7 | | | | | x | | | x | |
| Pine dropseed (Blepharoneuron tricholepia) | 4 | | | | | | | x | x | |
| *Prairie junegrass (Koeleria cristata) | 3 | | | | | | | x | x | |
| *Pubescent wheatgrass (Agropyron trichaphorum) | 9 | | x | x | | x | x | | x | x |

APPENDIX II

SPECIES SELECTION AND SEEDING RATE
(continued)

| SPECIES | SEEDING RATE 1/ PLS/Ac. | 12" to 14" PRECIPITATION SOIL TEXTURE GROUPS | | | 14" to 18" PRECIPITATION SOIL TEXTURE GROUPS | | | OVER 18" PRECIPITATION SOIL TEXTURE GROUPS | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sandy | Loam | Clay | Sandy | Loam | Clay | Sandy | Loam | Clay |
| *Russian wildrye (Elymus junceus | 6 | | x | x | | | | | | |
| Sand bluestem (Andropogon hallii) | 7 | | | | x | | | x | | |
| Sand dropseed (Sporobolus cryptandrus) | 1 | x | x | | x | | | | | |
| *Scribner needlegrass (Stipa scribneri) | 5 | | | | x | x | | x | x | |
| *Siberian wheatgrass (Agropyron sibericum) | 5 | x | x | | | | | | | |
| Sideoats grama (Bouteloua curtipendula) | 5 | x | x | | x | x | | x | x | |
| *Slender wheatgrass (Agropyron trachycaulum) | 6 | | | | | x | | | x | |
| *Smooth brome (Bromus inermis) | 8 | | | | | x | | x | x | |

APPENDIX II

SPECIES SELECTION AND SEEDING RATE
(continued)

| SPECIES | SEEDING RATE 1/ PLS/Ac. | 12" to 14" PRECIPITATION SOIL TEXTURE GROUPS | | | 14" to 18" PRECIPITATION SOIL TEXTURE GROUPS | | | OVER 18" PRECIPITATION SOIL TEXTURE GROUPS | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sandy | Loam | Clay | Sandy | Loam | Clay | Sandy | Loam | Clay |
| Spike muhly (Muhlenbergia wrightii) | 2 | | | | | x | x | | | x |
| Weeping lovegrass (Eragrostis curvula) | 1 | x | | | x | | | | | |
| *Western wheatgrass (Agropyron smithii) | 8 | | x | x | | x | x | | x | x |
| Yellow Indiangrass (Sorghastrum nutens) | 5 | | | | x | | | x | x | |
| Alfalfa (Rambler) | 5<br>1 in mix | | | | x | x | | x | x | |
| Bitterbrush (Purshia tridentata) | 10# in pure stands | | | | | x | | x | x | |
| Burnett (Sanguisorba minor) | 1 in mix | | | | | | | x | x | |
| Fourwing saltbush (Atriplex canescens) | 6 | x | | x | | x | x | | | |

APPENDIX II

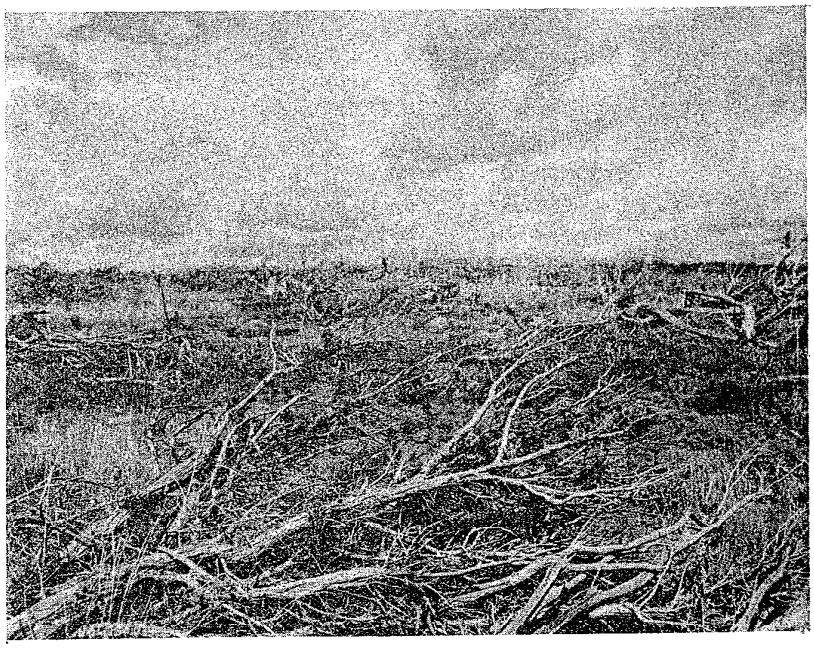
SPECIES SELECTION AND SEEDING RATE
(continued)

| SPECIES | SEEDING RATE 1/ PLS/Ac. | 12" to 14" PRECIPITATION SOIL TEXTURE GROUPS | | | 14" to 18" PRECIPITATION SOIL TEXTURE GROUPS | | | OVER 18" PRECIPITATION SOIL TEXTURE GROUPS | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sandy | Loam | Clay | Sandy | Loam | Clay | Sandy | Loam | Clay |
| Mountain mahogany (Cercocarpus betuloides) | 3 | | | | | x | | x | x | |
| Yellow sweetclover (Melileus efficinalis) | 2 | | | | x | x | x | | | |
| Winterfat (Eurotia lanata) | 8 | | x | x | x | x | x | | | |

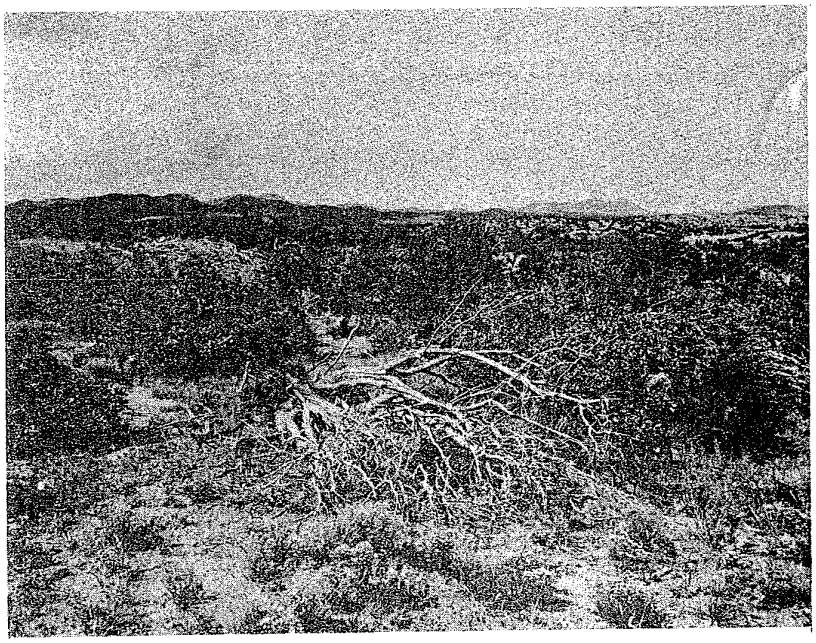
1/ Pure Live Seed per acre when drilled as single species. Increase this rate by 30 percent when seed is broadcast.

Mixtures should be of grasses having similar palatibility ratings, similar seasons of use and similar growth habits. When possible, shrub and forb species should be included in the mixture.

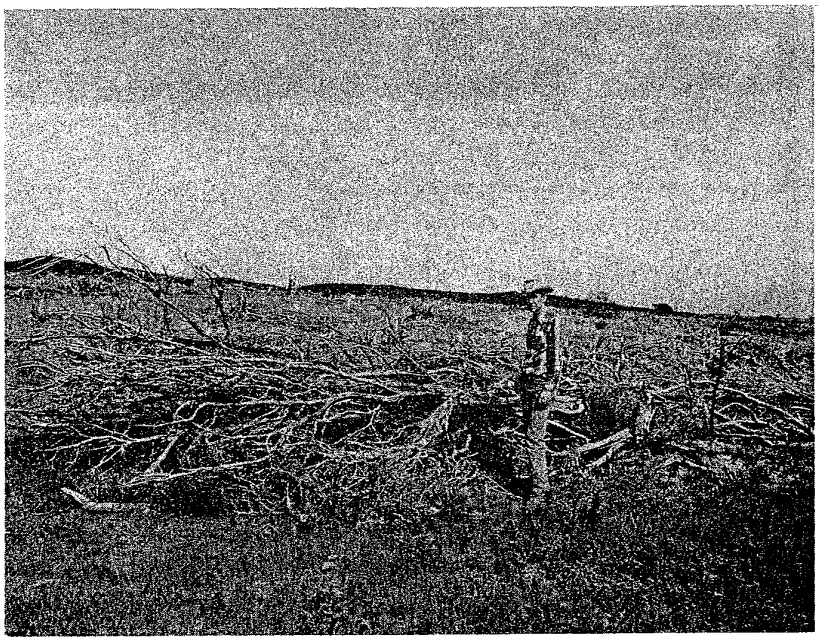
(*) Cool season producers--should be planted where winter moisture predominates. These areas are characterized by predominance of pinyon over juniper and big sagebrush understory. Preferred species selections for seeding in three moisture zones subdivided into three soil types.



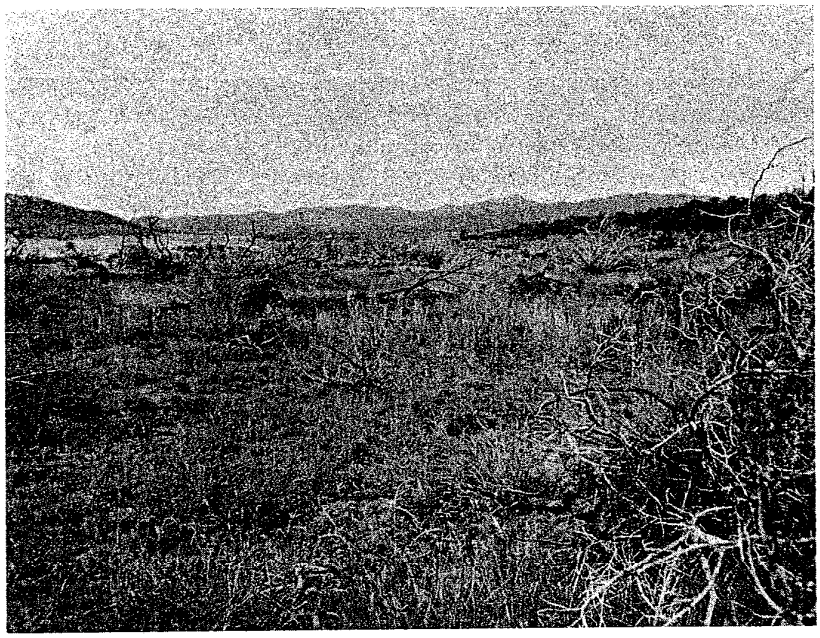
A loamy site in good condition northwest of Carrizozo chained one direction in 1964 under a Bureau of Land Management contract. Cost of treatment was $2.60 per acre.



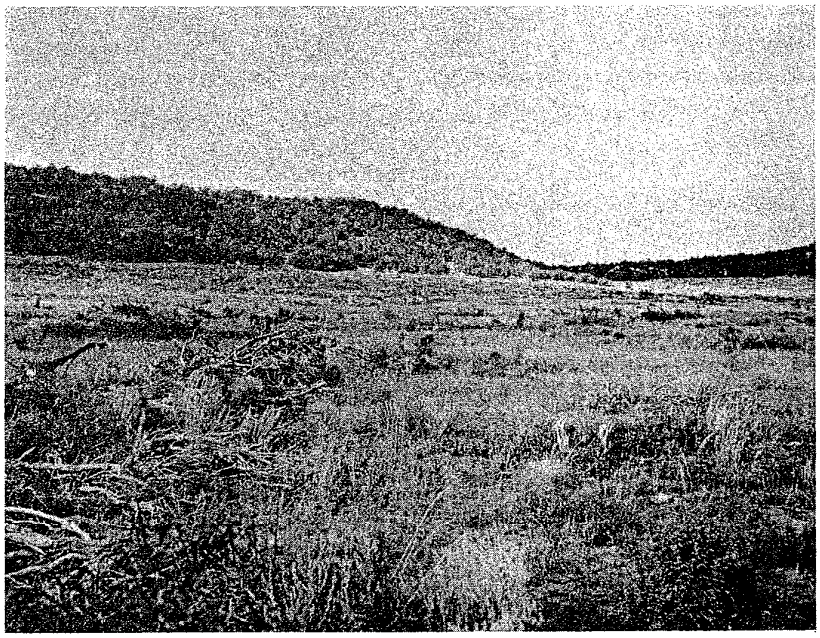
Area northeast of Carrizozo chained one direction in 1960 under U.S.Forest Service contract at a cost of $1.91 per acre. The chain was made from old crawler type tractor tracks. Before treatment the area had 390 trees per acre. Oak (Quercus spp.) has been released by this treatment.



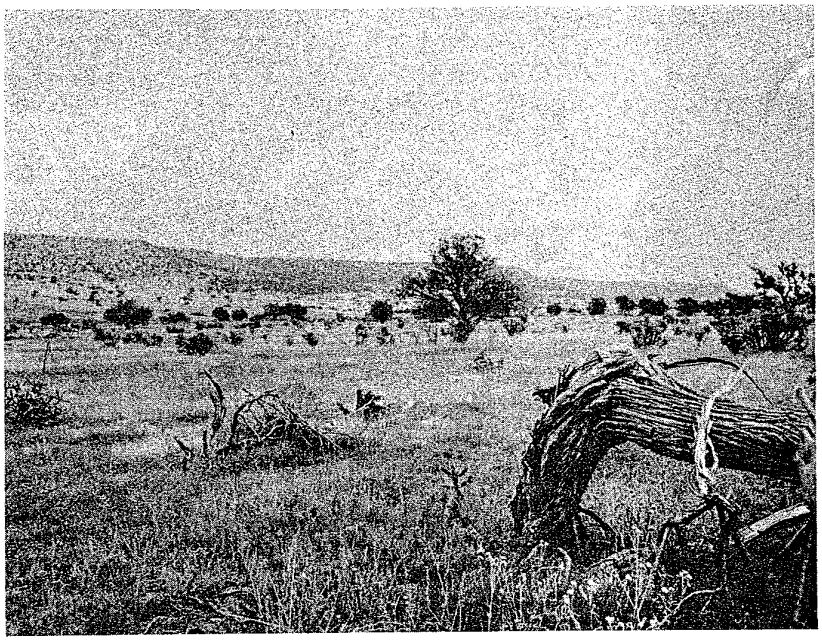
A Mountain loam site northeast of Carrizozo which was chained one direction in 1960 and followed up by pushing in 1965. Chaining was done with crawler type tractor track at a cost of $2.00 per acre. Pushing cost was $5.95 per acre. Original stand had 255 stems per acre. Both jobs were U.S.Forest Service contracts.



A Mountain Loam site NE of Carrizozo on which the pinyon-juniper was pushed in 1965 and 1966. The downed trees, 275 per acre, were then individually burned. This U.S.Forest Service contract was $4.85 per acre for pushing and $1.25 per acre for burning.



Area west of Corona treated by tree crushing at a cost of $7.50 per acre. This U.S.Forest Service contract resulted in an 80 percent kill.



Area east of Corona where trees were pushed, stacked and burned on private land in 1966. Note the trees left for shade and winter protection.

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Range Tech Note
#35

# Cholla Cactus Control in New Mexico

REPORT NO. 3

November, 1968

# CHOLLA CACTUS CONTROL

# In

# New Mexico

Inter-Agency Range Committee
J. W. Bohning, Chairman

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

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New Mexico State University

TABLE OF CONTENTS

# CHOLLA CACTUS CONTROL

In

New Mexico

## I. INTRODUCTION:

This study represents an interagency field evaluation of various methods of cholla cactus control in New Mexico. A review was felt necessary to provide the various organizations which furnish technical guidance in range management a uniform set of specifications for New Mexico.

An Interagency Range Committee composed of the following members was assembled for the field review:

Agricultural Research Service:

1. Dr. Carlton Herbel, Range Scientist, Las Cruces, New Mexico

Bureau of Land Management:

1. Myrvin Noble, Leader, Soil & Watershed Staff, Denver, Colorado
2. Dale Kinnaman, Resource Development Specialist, Santa Fe, New Mexico

U. S. Forest Service:

1. W. F. Currier, Branch Chief, Range Improvements, Albuquerque, New Mexico
2. Jack Bohning, Range Staff Officer, Santa Fe, New Mexico
3. C. E. Rice, District Ranger, Santa Fe, New Mexico
4. Greg McKenzie, Range Conservationist, Pecos, New Mexico

New Mexico State Game and Fish Department:

1. Sam Lamb, Federal Aid Coordinator, Santa Fe, New Mexico

New Mexico State University Extension Service:

1. Charles Gay, Range Management Specialist, Las Cruces, New Mexico

New Mexico State University Agricultural Experiment Station:

1. Dr. Walter Gould, Department of Agronomy, Las Cruces, New Mexico

New Mexico State University Agricultural Services:

1. Jesse Gerard, Las Cruces, New Mexico

Soil Conservation Service:

1. Don Robertson, Range Conservationist, Program Service Staff, Albuquerque, New Mexico
2. Dan Merkel, Range Conservationist, Program Service Staff, Santa Fe, New Mexico

Tucumcari Area:

Soil Conservation Service:

1. Howard Abercrombie, Work Unit Conservationist, Tucumcari, New Mexico
2. Frank Lucas, Range Conservationist, Tucumcari, New Mexico

Ranchers:

1. George Ellis, Manager, Bell Ranch, Conchas, New Mexico
2. Phil Bidegain, Montoya, New Mexico
3. Jimmy Randals, Montoya, New Mexico

Santa Rosa Area:

Soil Conservation Service:

1. Richard Bowen, Work Unit Conservationist, Santa Rosa, New Mexico
2. Noel Marsh, Work Unit Conservationist, Santa Fe, New Mexico

Ranchers:

1. A. J. Irwin, Santa Rosa, New Mexico

## II. THE PROBLEM:

Cholla cactus, Opuntia imbricata (Haw.), D.C., is widely distributed in New Mexico, second only to pinyon-juniper. Historical references show that it has become much more widespread in the last century. Cholla causes several problems in the management of livestock. It may make much of the forage unavailable for grazing and the handling of livestock difficult. On cholla-infested areas, grazed by sheep, the damage to and loss of wool is often great.

The life history and ecology of cholla cactus have not been adequately explored. Relationships with soil, moisture, and wildlife need further study, to name just a few.

The effect of cholla on the production of desirable forage is not definitely known at this time. Early results of a study by New Mexico State University indicate forage production on a blue grama range may not be reduced by cholla competition. This study is being continued

and expanded to learn more about the effects of this species on associated vegetation.

Until recently most cholla cactus control work was done by pushing with wheel tractors. Control efforts by cabling and chemicals are fairly recent, but show much promise.

## III. CONSIDERATIONS FOR CHOLLA CONTROL AND TREATMENT METHODS:

### A. Present Vegetation:

1. Kinds of Vegetation

   a. Unless a complete seeding job is to be done, cholla treatment should be limited to areas where desirable forage species occur in the understory.

   b. Where cactus occurs with other undesirable species, it should normally be controlled first to avoid scattering joints incidental to other plant control treatments.

   c. Associated woody species may prohibit cactus control.

   d. Cactus density may be too low to warrant control. Control criteria depend on planned land use and control method.

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

   a. Light - up to 100 stems per acre.

   b. Medium - 100 to 250 stems per acre.

   c. Dense - over 250 stems per acre.

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

3. Size: Determination of treatment method and extent of application will be influenced by the predominant size class of plants to be controlled.

### 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. cholla pushing is not suited to very shallow soils.

2. Texture:

   a. Texture will influence the choice of method best suited to a given site. New plant establishment by joint sprouting is more rapid on fine textured soils. Pushing and stacking are more effective than cabling on these soils.

C. Topography:

Slope is not usually a factor in cholla control, except where it limits the movement of machinery or where watershed improvement is a factor.

D. Climate will influence choice of time and method of treatment (See methods of control).

E. Biotic Factors:

Game animals - Quail and other small game populations should be considered in choice of a control method. Where management for quail is an objective, untreated areas may be left for food and cover. Stacking cholla on controlled areas provides temporary quail cover until stacks deteriorate, usually 5 to 10 years.

F. Grazing Management:

1. Overgrazed ranges - The level of management should be improved to assure benefit from cactus control before overgrazed ranges are treated.

2. Ranges under a deferred grazing system should have control done prior to a deferred period so the area will be rested at least for the growing season during or following control.

3. Class of livestock and methods of handling will influence choice of control methods. On treated areas grazed by sheep, pushed cholla should be stacked. In areas where livestock movement is restricted by high cactus density, mechanical treatment is better than chemical.

G. Other Considerations:

1. Esthetics:

   a. Scenic strips formed by untreated areas may be desirable along highways, scenic trails, and in other scenic areas.

   b. The method of control and type of equipment used can greatly affect the esthetic value of the finished job.

(1) Chemical control is the least desirable method in mature stands.

(2) Pushing without stacking detracts from the esthetic values, especially on medium or dense infestations.

2. Watershed: Mechanical methods temporarily improve infiltration.

3. Recreation: Cholla control is often necessary in the development of recreation areas.

4. Treatment Patterns: Blend treatment patterns into the landscape.

IV METHODS OF CONTROL:

A. Cabling:

1. Types of equipment:

a. Double loop of 1 - 1¼ inch cable.

b. Flexible cable (rope core) is most effective.

c. Effectiveness is increased by adding weight to the shorter loop.

d. The addition of swivels and short lengths of anchor chain at the ends of the cables increases effectiveness.

e. High pulling power is not critical since the length of the cables can be adjusted depending on power available.

2. Time:

a. Cabling is most effective during late fall or early winter. There appears to be less plant breakup during cabling at this time and it provides maximum time for dessication when low temperature is not conducive for plant growth or rooting of joints.

b. Early spring to early fall treatment should be avoided to forestall joint sprouting.

3. Limitations:

a. The effective season of treatment is short.

b. Effectiveness decreases with a decrease in average plant size. The cable skips over small plants.

c. Cabling is generally restricted to sites lacking other woody species. Exceptions may occur where low densities of other species exist.

d. Control may be restricted by physical aspects of the site, such as rock outcrops and small boulders.

e. This treatment is not suited to clearing recreation sites.

4. Results:

a. One-way cabling gives acceptable results but two-way cabling is more effective. Effectiveness is not doubled by two-way cabling, however.

b. Most effective kills are obtained on mature stands.

c. Cabling is only moderately acceptable esthetically.

d. This treatment is highly destructive to quail habitat.

B. Chaining: Chaining with anchor chain is not as effective as cabling in killing cholla.

C. Pushing (grubbing):

1. Types of equipment:

a. Wheel tractor equipped with a:

(1) V-blade on frontend hydraulic lift;

(2) Shoe on dozer blade; or

(3) Shoe on frontend and hydraulic lift; and

(4) Buck rake for stacking.

2. Time:

a. Late fall and early winter treatment is most suitable without doing stacking.

b. Pushing with stacking can be done yearlong, except when ground is frozen.

3. Limitations:

a. Stacking is required when pushing is done other than during fall or winter.

b. The season for treatment is short when pushing is done without stacking.

c. Pushing is restricted to deep, rock-free soils.

d. This control is not economically acceptable on very dense stands of cholla (275+/Ac.).

e. Cost of pushing cholla becomes economically unacceptable where associated with medium and dense stands of pinon-juniper.

4. Results without stacking:

a. The treatment is effective on all size classes.

b. The type of equipment used causes soil disturbance and grass uprooting. Shoe type equipment, in this respect, is inferior to the V-blade.

c. The V-blade tends to break off more cholla than the shoe.

d. Pushing without stacking is esthetically less acceptable than cabling.

5. Results with stacking:

a. Pushing with stacking is the most acceptable treatment, esthetically.

b. This treatment gives acceptable control for recreation areas.

c. The stacks provide cover for small mammals and birds. By stacking the cholla, adequate quail cover is maintained for several years after treatment.

d. Stacking extends the effective working season.

e. Control results are best when adequate time is allowed between pushing and stacking to reduce rooting of joints and plant breakup.

D. Chemical Control:

1. Types of equipment designed for treatment of individual plants by using an:

a. Invert emulsion or a

b. Normal emulsion system.

2. Time:

   a. Invert emulsion. There is no limitation other than freezing effect on equipment.

   b. Normal emulsion. This treatment is limited to the cholla growing season.

3. Materials, rate, and volume:

   a. 2,4,5-T applied in the invert formulation should be mixed as follows:

      (1) 3 pounds active ingredient
      7 gallons diesel oil
      72 gallons water

      (2) Volume - Treat so some spray solution contacts each joint.

   b. 2,4,5-T or 2,4-DP applied in the standard emulsion should be mixed as follows:

      (1) 4 pounds active ingredient
      10 gallons diesel oil
      90 gallons water

      (2) Volume - Enough spray solution must be used to obtain thorough wetting of the entire plant to get a satisfactory kill.

   c. MSMA (monosodium methane arsenate) -(This chemical has been cleared for cholla control by individual plant treatment but not for broadcast application.) Mixed as follows:

      (1) 2 parts of MSMA with 15 parts of water.

      (2) Volume - Enough spray solution must be used to contact each joint.

4. Limitations:

   a. Cost of this treatment is economically acceptable only on light stands of mature plants (Less than 100 plants per acre).

   b. Chemical control is generally unsuited to recreation areas. It may be used to control invading plants while they are still small.

   c. Effectiveness is limited by the need for careful and thorough coverage.

5. Results

   a. Consistently effective results have been obtained from properly applied invert emulsions.

   b. Normal emulsions give effective control when properly applied during the cholla growing season.

   c. Spraying is recommended for followup after other methods of control.

E. Burning:

Burning effectively controls small plants less than 12 inches tall, but is usually ineffective on larger cholla. Stands may be treated by broadcast burning when there is adequate vegetation to carry the fire.

F. Hand Grubbing:

1. Types of equipment:

   a. Mattock

   b. Axe

   c. Brush hook

2. Time: There are no time limitations if the joints are properly cleaned up.

3. Limitations:

   a. The plant size should be less than handle length of equipment.

   b. This treatment is economically acceptable on light stands only.

4. Results:

   a. Hand grubbing gives excellent control results when properly applied.

   b. This treatment is well suited to recreation or high-value area control.

   c. It is well suited to cleanup following other methods.

V. RESEARCH NEEDS:

A. Life history and ecology:

1. Water consumption - amount and timing vs. water yield.

2. Effect on the plant community under varying conditions of cholla infestation.

3. Effect of various cholla treatments on wildlife.

   a. Food and cover needs of various species

4. Soil - cholla relationships.

   a. Soil texture requirements
   b. Root penetration and spread

5. Seed viability and persistence.

6. Methods of seed distribution.

7. Sprouting habits (related to control methods).

8. Population dynamics.

B. Control Measures:

1. Evaluating potential chemical treatments.

2. Equipment development.

3. Optimum times of control for treatment methods.

C. Economic considerations:

1. Cholla products (silage, lamps, furniture, beverages).

2. Effect of cholla infestation on forage production by species.

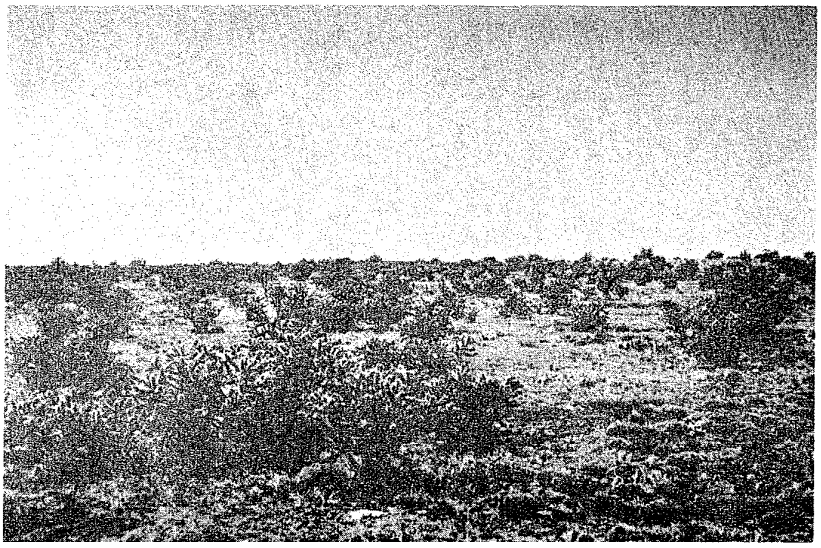
3. Treatment cost vs. related benefits.

4. Effect of cholla on livestock handling.

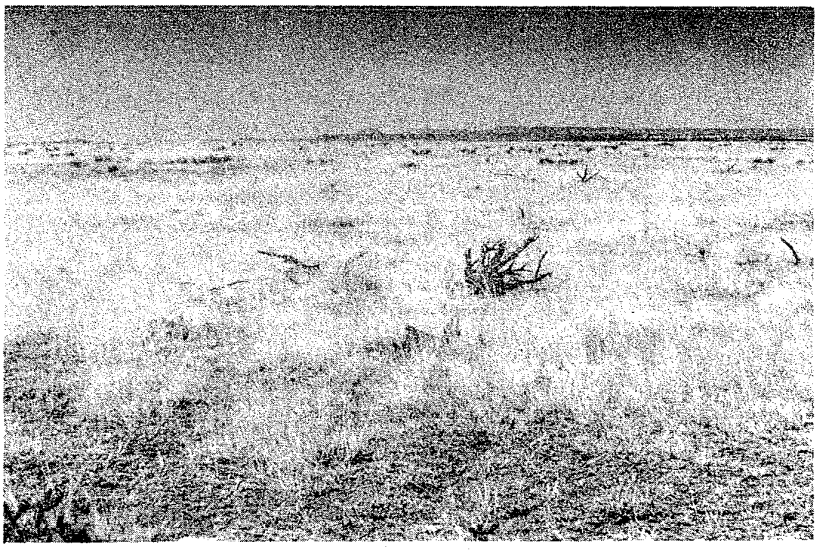
APPENDIX

SUMMARY OF METHODS OF CHOLLA CACTUS CONTROL

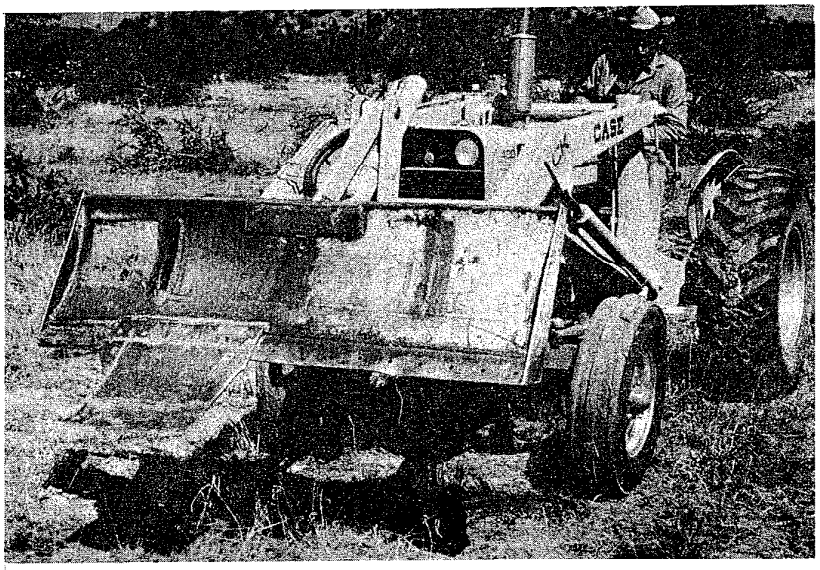
| Method | Type of Equipment | Average Cost Per Acre | Time | Limited To | Remarks |
|---|---|---|---|---|---|
| Cabling | Double loop of 1-1¼ inch cable wheel tractor | $1.00/ pass | Late fall or early winter | Large plants; areas without other woody species or physical restrictions. | Two way cabling is more effective than one pass. Destructive to quail habitat. |
| Pushing (Grubbing) | Wheel tractor with V-blade or shoe on hydraulic lift, or dozer blade; buck rake | Pushing- 1-1½¢/plant Stacking- 1-1½¢/plant ($5-6/acre) | Without Stacking- late fall and early winter With stacking- yearlong | Deep, rock-free soils, stands of less than 275 plants per acre Areas free of medium and dense stands of pinyon-juniper. | Gives effective kill on all size classes. Without stacking it is esthetically less acceptable than cabling |
| Chemical Control | Ground applicator for individual plant treatment | 2,4,5-T: Invert or standard emulsion- 3¢/plant MSMA - 2¢/plant | Invert emulsion- No limitation Standard emulsion- During cholla growing season | Stands of less than 100 plants per acre Application by well trained help. | Good kills result when chemicals are properly applied. Recommended for cleanup following other control methods. |
| Burning | Fire control equipment | $1.50/acre | Spring | Plants less than 12 inches high | Not effective on large plants |
| Hand Grubbing | Mattock Axe Brush hook | 1-2¢/plant | No limitations | Light stands of small to medium sized plants | Gives good kills when properly done and joints are cleaned up. Recommended following other control measures. |



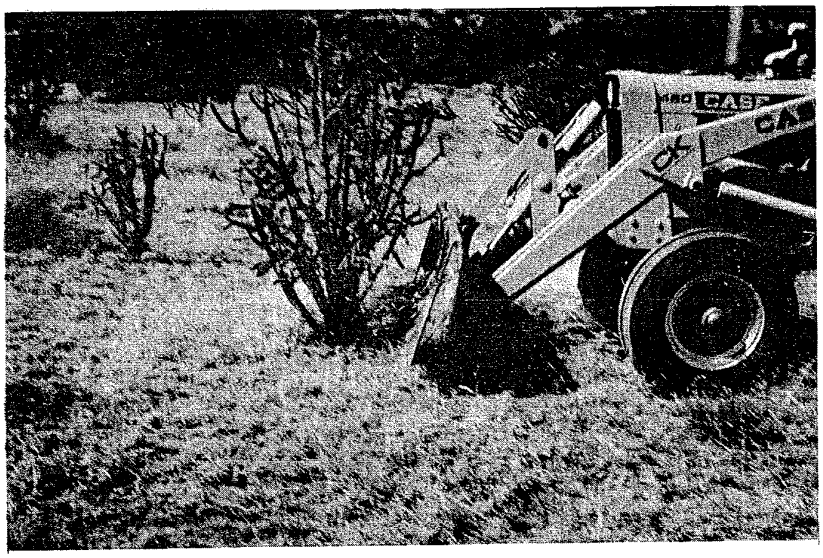
No. 1. Stand of cholla *Opuntia imbricata* on the Bidegan Ranch near Montoya, New Mexico.



No. 2. Cabled cholla.




No. 3. Wheel tractor w/blade equipped with shoe and "window" for pushing cholla. Santa Fe, New Mexico

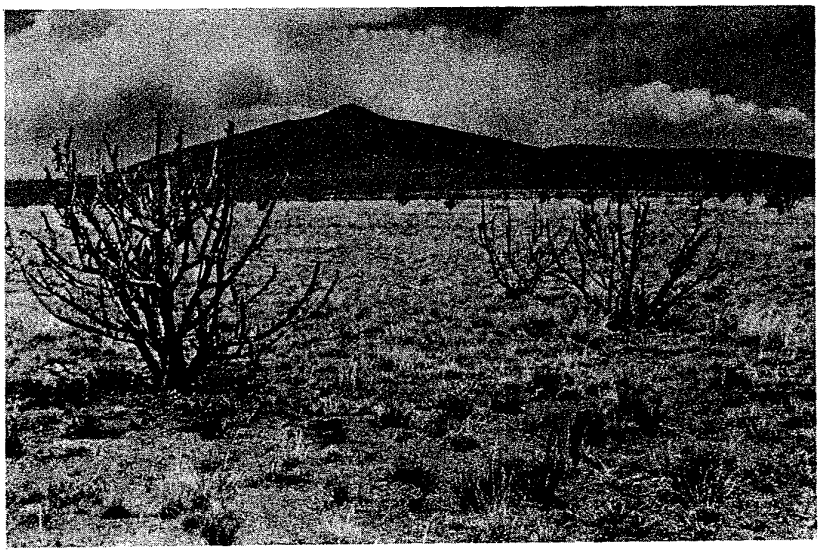



No. 4. Wheel tractor pushing cholla near Santa Fe, New Mexico.

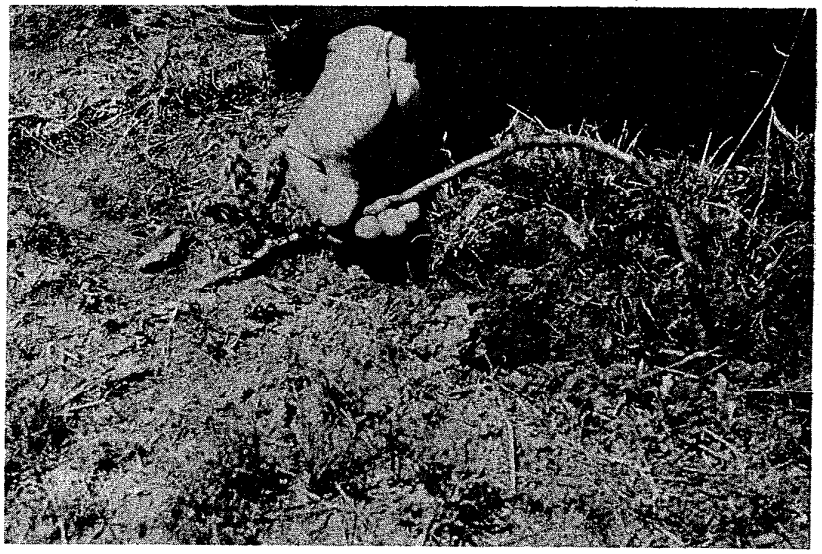
No. 5. Buck rake for stacking pushed cholla operating near Santa Fe, New Mexico.

No. 6. Pushed and stacked cholla on Caja del Rio Grant near Santa Fe, New Mexico.

No. 7. Spraying cholla with invert emulsion of 2,4,5T near Santa Fe, New Mexico.



No. 8. Cholla cactus killed by spray application of 2,4,5T in an invert emulsion near Santa Fe, New Mexico.



No. 9. Sprout growth from root of pushed cholla cactus near Santa Rosa, New Mexico.

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