NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

BRUSH MANAGEMENT

(Acre)

CODE 314

DEFINITION

Removal, reduction, or manipulation of non-herbaceous plants.

PURPOSES

This practice may be applied as part of a conservation management system to accomplish one or more of the following purposes:

- Restore natural plant community balance.
- Create the desired plant community.
- Reduce competition for space, moisture, and sunlight between desired and unwanted plants.
- Manage noxious woody plants.
- Restore desired vegetative cover to protect soils, control erosion, reduce sediment, improve water quality and enhance stream flow.
- Maintain or enhance wildlife habitat including that associated with threatened and endangered species.
- Improve forage accessibility, quality and quantity for livestock.
- Protect life and property from wildfire hazards.
- Improve visibility and access for handling livestock.

CONDITIONS WHERE THIS PRACTICE APPLIES

On rangeland, native or naturalized pasture, pasture and haylands where removal or reduction of excessive woody (non-herbaceous) plants is desired.

CRITERIA

General Criteria Applicable for All the Purposes Stated Above.

Brush management will be designed to achieve the desired plant community in woody plant density, canopy cover, structure, or height.

Brush management will be applied in a manner to achieve the desired control of the target woody species while protecting desired species. This will be accomplished by mechanical, chemical, biological, prescribed burning or a combination of these methods:

1) Biological – When using goats, refer to Prescribed Grazing (528A) standard
2) Mechanical - Table 1
3) Chemical - Table 2, 3, 4, 5, & 6
4) Prescribed burning - see Conservation Practice (338) standard

Brush management is an essential practice when needed to control excessive erosion.

It should be understood that sometimes no single treatment of target species is adequate to solve a woody plant concern. A systems approach should be used which may include a combination of treatment alternatives applied over several years.

NRCS, OK
February 2004

Chart 1. Priority Classification

	Woody Plants	Juniper < 8 ft. tall
Priority	% canopy	Trees/ac
Low	<10	<100
Medium	10 - 30	100 - 199
High	>30	>200

Low priority represents brush that is not an immediate concern but could become a concern. **Medium priority** is brush that is in need of treatment, unless the brush is needed to facilitate other planned treatments, such as wildlife habitat management. **High priority** is brush that is in need of immediate treatment, unless needed to facilitate other planned treatments, such as wildlife habitat management.

It is often desirable to control unwanted brush species at less than medium priority to reduce the need of having to use more costly methods in the future. Examples of these species include juniper, mesquite, saltcedar, baccharis, blackberry, Osage orange, winged elm, honey locust, multiflora rose, and other aggressive species.

Brush management will be planned for the entire acreage containing medium or high priority brush unless an alternative use applies as described in other portions of this standard. The treated area will be managed according to its needs.

Where mixed brush exists, control measures will be prescribed for the species that is the greatest concern. Multiple treatments can be prescribed if they are compatible. Treatments for secondary species may be recommended if compatible.

Follow-up treatment will be needed for most brush species. Re-treatment will be delayed until adequate top growth has occurred to assure translocation of the herbicide. Do not apply brush treatment to root-sprouting species unless follow-up treatment is recommended.

The best chemical control of brush species is achieved when plants have adequate foliage and are actively growing when using translocated herbicides. Brush should not be mowed or brush-hogged during the growing season prior to treatment. Allow brush to return to short-shoot stage of growth before treating. Do not mow or brush-hog for at least 90 days post treatment.

Examples of follow-up treatment:

Plant	Maintenance interval
Mesquite	When trees return to short-shoot stage of growth. This can be 1 - 5 years following chemical treatment.
Redberry juniper	3 - 5 years following chaining or burning.
Postoak and Blackjack oak	When sprouts reach 4 ft. tall.
All other species	When the brush reaches medium priority densities.

On rangeland, do not remove more woody species than what is listed as historic for the site in the Ecological Site Description (Technical Range Site Description or Range Condition Class Guide).

Rootplowed areas must be planted to permanent vegetation. Refer to Range Planting (550) standard for guidance.

Mechanically disturbed areas may need to be replanted if 20% or more of the existing grass cover is destroyed and is not expected to recover in a reasonable amount of time. If the mechanical treatment coincides with the proper planting dates, then seeding must be done to the disturbed area according the Range Planting (550) standard. If mechanical brush management is done outside the proper planting dates, then the guidelines for seedbed preparation, etc., listed in the Range Planting (550) standard are to be followed.

Mechanical treatment of brush may result in excess slash and plant residue on the soil surface that will interfere with livestock access, replanting, or other needs. When treating high priority canopy brush, stacking or piling of the brush may be needed following the mechanical treatment.

Prescribed grazing shall be applied to assure the desired response from treatments. Refer to Prescribed Grazing (528A) standard.

Chemical brush management will be applied in accordance with all state and local laws and ordinances, including Restricted Areas for Application of Hormonal Type Pesticides.

Mechanical brush management is a ground disturbing activity and shall comply with NRCS policy on Cultural Resources.

Threatened and Endangered Species – Any brush management activity shall comply with the NRCS policy for endangered species found in GM 190 410.22. Section II of the FOTG contains information on listed species and location maps.

Additional Criteria for Improving Wildlife Habitat.

Where upland wildlife is a planned objective, brush management will be planned and applied in a manner to meet the habitat requirements of the target species. Mosaic patterns or corridors that connect habitat types and follow land contours are preferred. Refer to Wildlife Upland Habitat Management (645) standard and published Wildlife Habitat Appraisal Guides for guidance and species specific requirements. If a potentially invasive species, such as juniper, is used to meet cover requirement maintenance activities, to contain its spread are required.

Resource inventories and evaluations will be the basis for prescribing the location and amount of woody vegetation to be retained for wildlife.

Where the planned land use is for wildlife or recreation, and the client is interested in maintaining all woody plants for aesthetic values, brush management will not be required except where necessary to control excessive erosion.

Conservationists should fully explain the benefits of selective brush control on wildlife habitat, safety, and aesthetics.

Additional Criteria for Reducing Wildfire Hazards.

Conduct brush management operations in a manner that reduces the risk of wildfire. This includes removing volatile species, such as juniper, from the close proximity to vulnerable areas. If brush management results in large amounts of downed debris in a sensitive location, that would constitute a high risk of wildfire, removal shall be recommended. Refer to the Firebreak (394) standard for the width of the protection area.

Additional Criteria to Protect Water Resources

Environmental risk associated with the use of pesticides will be evaluated using the procedure outlined in the Pest Management (595) standard and specification, under the section entitled “Additional Criteria to Protect Water Resources”.

Medium and high densities of woody plants, not native to riparian zones, shall be addressed to restore natural hydrology.

CONSIDERATIONS

The timing and sequence of brush management in a pasture and/or the entire operating unit should be planned to ensure needed grazing management.

Brush canopy in excess of 30% impedes livestock accessibility.

A technical determination should be made to evaluate the impact of treatment on slopes. If it is determined that the method of treatment or the equipment to be used will cause excessive slope erosion, less destructive alternatives should be presented.

Brush management objectives and procedures will vary, depending upon the type of land and the use of the land. For example:

1) If the primary use of grazed range is for cattle, the objective may be to manipulate the distribution of brush to approximate that of the historic plant community for the site. If the primary use is for upland game, the objective may be to maintain more brush than is historic to the site and to manage the brush in a pattern on the land that favors habitat for these animals.
2) It is usually desirable to exclude all brush on pasture and hayland except for odd areas and motts left for shelter, shade, or aesthetic value. It should be noted that as little as three junipers per acre have been shown to displace some birds from their habitat, as the juniper serve as perch sites for predators in a prairie setting. Other tall woody plants may have the same effect.
3) Protecting present, secondary and future land use values should be considered in the planning process.

Mechanical, fire, chemical, biological and prescribed burning methods may be used alone or in combination, depending on such factors as:

- Kind of land and/or site

- Topography
- Species of woody plants (whether they are root-sprouters or non-sprouters).
- Size, abundance and distribution of woody plants.
- Hazards of treatment, (if any).
- Objectives of the land user.
- Costs in relation to expected benefits.
- Extent of existing erosion or erosion potential.

Broadcast applications of herbicides may reduce desirable forbs and woody species that are essential to wildlife habitat. Mechanical control can also reduce woody plants that can be essential to wildlife habitat.

Mechanical brush control operations should be timed so as to prevent exposure of bare soil for undue periods of time to reduce erosion and subsequent movement of soil into ponds, streams and reservoirs.

Safety: Certain aspects of brush management constitute potential pollutants to water and air. To avoid possible contamination and negative impact on the resources, and to protect people, livestock, wildlife and desirable plants against contamination, the following points will be considered by conservationists planning brush management:

1) Conservationists should caution clients using herbicides that if they are improperly handled or applied or if unused portions or containers are not disposed of properly, they may be injurious to humans, domestic animals, desirable plants, fish and other wildlife and may contaminate water supplies. Users of herbicides will be cautioned to follow the directions and heed all precautions on the container label, to respect all pesticide registrations and policies, and to abide by state and county regulations.
2) To reduce the possibility of pollution and to increase the effectiveness of the herbicide, chemical control methods should not be used during periods of unstable weather where there is a possibility of rain within 5 hours after application of the chemical.

PLANS AND SPECIFICATIONS

Plans and specifications will be prepared for each pasture where brush management will be applied based on goals and objectives of the client.

Plans and specifications will be based on the practice standard and will be documented using form OK CPA-16. Documentation in the case file will also contain the following data as a minimum:

Brush canopy and/or species count by low, medium and high priority with transect line locations and percent canopy and/or species numbers per acre of the target plant(s). Refer to Technical Note RANGE OK-14 for guidance in conducting brush surveys.

Prepare maps or overlays showing areas to be treated and areas to be left undisturbed.

Special precautions, such as treating in strips, block, or corridors, that must be taken to preserve habitat.

Documentation and certification of Brush Management is contained in GM 450, Part 407.

OPERATION AND MAINTENANCE.

Success of the practice shall be determined by evaluating regrowth or percent root kill of target species after sufficient time has passed to monitor the situation and gather reliable data. This will nearly always be the second season following treatment.

The deferment period prescribed on herbicide labels and the Prescribed Grazing (528A) standard shall be considered in planning.

Brush treatments can be applied over a long-term planning horizon of 10-20 years. Initial treatments must be followed by maintenance-type treatment, to prevent costly re-treatments. Timely maintenance treatments will extend the effective life of the primary treatment. Maintenance can include any combination of biological, chemical, mechanical, or prescribed burning.

Following initial application, some regrowth, resprouting, seedlings, or reoccurrence of brush should be expected. Individual plant treatment of areas needing retreatment should be done to maintain brush at desired densities. Aggressive follow-up with integrated treatments will greatly extend practice life.

Practice life will vary. Chemical treatments may have a 1 - 15 year life depending upon the efficacy of the chemical. Mechanical methods that uproot the plant may have a 20-year life.

REFERENCES

Combined Pesticide Law & Rules - http://www.oda.state.ok.us/laws-home.htm

Firewise http://www.firewise.org

Extension Agents' Handbook. OSU Extension Service, E-832, Stillwater, Oklahoma.

Flowers, T. L. A Rancher Friendly Method to Determine Timing of Sand Sagebrush Control. USDA Soil Conservation Service, Meade, Kansas.

OSU Rangeland Ecology and Management 2001.

Stritzke, J., and C. Rice. 1987. Forage Weed Control Report, Dept. of Agronomy, Oklahoma State University, Stillwater, OK.

Valentine, J. F. 1971, Range Development and Improvements. Brigham Young University Press, Provo, Utah.

Scifres, C. J. 1990. Brush Management. Texas A&M Press, College Station, Texas.

Sosebee, R. E. 1985. Timing - The Key to Herbicidal Control of Broom Snakeweed, Management Note 6, Texas Tech University, Lubbock, Texas.

Stevens, R., and S. Walker. 1998. Saltcedar Control. Rangelands 20(4) August.

Ueckert, D., and A. McGinty, Brush Busters. Texas A & M University, College Station Texas.

Research Highlights. Multiple years, Texas Tech University, Lubbock, Texas

Journal of Range Management. Multiple Journals. Denver, Colorado

Agricultural Research Service. Woodward, Oklahoma.

Table 1. Specification Guide For Mechanical Brush Management.

SPECIES	METHOD	TIME	TECHNIQUES OF OPERATION
baccharis, catclaw, lotebush, yaupon, and other low-growing, non-thicket forming brush species	Rootplow, treedoze, powergrub, hand grub	Anytime [1/]	Plow or grub below any resprouting zone. A heavy offset plow that cuts brush below the budzone is also acceptable. Rootplow blades should be equipped with kickers to bring roots to the surface. Fins should be attached at a 22-degree angle, not over 30" apart and long enough to project through the soil. Follow-up by repeat dozing, hand grubbing, fire, goats, or herbicides as necessary to control sprouts.
blackjack oak, post oak, winged elm, Osage orange, Russian olive, and other tree-type species	Rootplow, treedoze, powergrub, hand grub	Anytime [1/]	If needed, remove top growth prior to rootplowing. Follow-up to control sprouts. Plow 12-14 inches and 18 inches on deep sands. Rootplow must be equipped with fins at a 22-degree angle, not over 30 inches apart and long enough to extend through soil surface. Control sprouts with goats, chemicals, burning, or mechanical means.
	Chaining	Anytime [1/]	Chains must weight 50 lbs. per link or more. Chain two ways. Follow-up treatment will be necessary with goats, chemicals, burning or mechanical means.
junipers[2/], pinon pine	Chain one way	Anytime	Chains must weight 50 lbs. per link or more. Apply when ground is moist for effective control. Re-apply in the opposite direction 24 months or later if needed.
	Chain two ways	Anytime	Chains must weight 50 lbs. per link or more. Apply when ground is moist for effective control. A choice where junipers exceed 35% canopy and two-way chaining is needed to gain adequate initial control.
	Elevated Chain Chain one way	Anytime	A chain is pulled between two dozers, with a ball or cylinder in the middle that elevates the chain to impact the trees at about 3 ft. height. The weight of the chain is approximately 27 lbs. per foot. This treatment is for trees > 8 ft. tall and is used as a preparation to build fuel load prior to prescribed burning.
	Ax, saw, clip, treedoze, or powergrub	Anytime	Remove all green growth and the above ground foliage or sever the plant below the lowest limb. (Not applicable to redberry juniper.) For treedozing or powergrubbing, the tree is uprooted.

Table 1 (continued)

SPECIES	METHOD	TIME	TECHNIQUES OF OPERATION
Juniper, redberry [2/]	Treedozing	Anytime [1/]	Trees must be uprooted below the bud zone. Blades are not as desirable because they can destroy the seed source and remnant desirable plants located near the base of the tree.
Mesquite	Rootplow, powergrub, treedoze, hand grub.	Anytime [1/]	For rootplowing, the blade should be equipped with kickers or fins to bring roots to the surface. Fins should be attached at a 22-degree angle, not over 36" apart and long enough to project through the soil. If stand is predominantly seedling mesquite, plow 8" to 10" deep. Uproot trees below bud zone for power grubbing and hand grubbing.
Saltcedar	Rootplow, powergrub, treedoze	June, July, August	Plow at least 12" deep. Rootplow must be equipped with fins to bring roots to the surface. In moist soil, stem sprouting will occur. Follow-up treatment with sprout removal or chemical treatment will be necessary. Rootrake as needed to remove all roots.
	Integrated treatment Chaining or rollerchopping with chemical	June, July, August	Use chaining or rollerchopping to scrape one square inch of bark off of at least two stems. Broadcast apply 2, 4-D (65% AI.) 4 oz./gallon, within one hour of scraping.
Sand sage	Mowing	June	Mow for two successive years. Disadvantages are stobs that remain after mowing operation.
Shin oak	Shred, rollerchop	April 15 - July 15	Has only annual benefits. Follow up to control sprouts with chemicals, goats or additional mechanical treatment. Can be used to release herbaceous plants to build fuel load for prescribed burning.
	Deep plowing [1/]	Winter or summer	Not applicable to dune or blowout areas. Plow 20" to 30" deep. Follow-up to control re-sprouts.

[1/] These practices may require replanting because of the percent ground disturbance. Seeding will be done during the current or next applicable date. Schedule treatment in the fall or early winter if seeding is planned for the next spring.

[2/] Junipers will re-establish quickly from carry-over seed. Therefore, prescribed burning can be a companion practice for juniper control that must be applied within 1-5 years following treatment while fuel loads are sufficient and junipers are less than 6 feet tall. Chemical and follow-up mechanical control are also choices.

Table 2. Chemical specifications

For species or control methods not included in this standard, published Extension, University or Research station data may be used as long as label provisions are met. OSU publications include Fact Sheets, Extension Agent Handbooks or applicable web sites.

Some herbicides may become available in generic form or alternate formulations. If the generic formulation or alternate formulation is different than the patented formulation, adjust the mixture to achieve the same concentration of active ingredient listed in the specification. Trade names are intended to provide information and do not imply endorsement.

Herbicide identification references tables and select conversion factors.

Common Name	Product Name	Active Ingredient	Conversion Factors
imazapyr	Arsenal	2 lbs./gal.	1 ml. = 1 cc
clopyralid	Reclaim	3 lbs./gal.	2 cups = 1 pt.
2,4-D	Several, such as Weedone LV4EC Weedone LV6EC Esteron 99C	amine salts and esters Weedone LV4EC (4 lb./gal.) Weedone LV6EC (6 lb./gal.) Esteron 99C (acetic acid 65.9%)	2 pts. = 1 qt.
dicamba	Banvel	4 lbs. /gal.	4 qts. = 1 gal.
dicamba: 2,4-D (1:3)	Weedmaster	dicamba 1 lbs./gal., 2,4-D 2.87 lbs./gal	1 pt. = 16 o.
glyphosate	Roundup	4 lbs./gal.	1 qt. = 32 oz
hexazinone	Velpar L	2 lbs./gal.	1 gal. = 128 oz
hexazinone	Pronone Power Pellets	75% by weight	
metsulfuron methyl	Ally XP, Escort, Cimarron	60% by weight	
metsulfuron methyl (Part A) dicamba, 2,4-D (Part B)	Cimarron Max	Part A – 0.75% by weight Part B - 2.87 lbs./gal., 2,4-D, 1 lbs./gal. dicamba	.
picloram	Tordon 22K	2 lbs. /gal.	
picloram: 2,4-D (1:4)	Grazon P+D	2.5 lbs. /gal.	
tebuthiuron	Spike 20P	20% by weight	
triclopyr	Remedy	4 lbs./gal.	.

Table 3. EPA Registration Numbers and Restricted Use Pesticide Designation

Herbicide	EPA Reg. No.	Restricted Use Pesticide [3/]
Arsenal	241-346	
Ally XP	352-435	
Banvel	51036-289	
Cimarron	352-616	
Cimarron Max	352-615	
Escort	352-439	
Esteron 99C	62719-9-71368	
Grazon P+D	62719-182	Yes
Pronone Power Pellets	33560-41	
Reclaim	62719-83	
Remedy	62719-176	
Roundup	524-445	
Spike 20P	62719-121	
Tordon 22K	62719-6	Yes
Velpar L	352-392	
Weedone LV4EC	228-139-71368	
Weedone LV6EC	71368-11	
Weedmaster	7969-133	

[3/] Every effort has been made to insure that the chemical recommendations are compatible with the most current label. However, labels can change without notice, so in all cases the label dictates permissible use.

Table 4. Chemical Alternatives by Individual Species

Species	Chemical treatment reference number. Refer to Table 6 for more detailed information.
Ashe juniper	*3, 20, 61,*
Baccharis	*1, 3, 22,*
Blackberry	*4, 5, 6, 55,*
Black locust	*10,*
Blackjack oak	*11, 12, 51*
Girdled blackjack oak	*22*
Broom snakeweed	*13, 14,*
Buckbrush	*15*
Cottonwood	*22, 32,*
Eastern persimmon	*19, 20, 22,*
Eastern redcedar	*20, 61,*
Elm	*1, 2, 3, 7, 12, 16, 20, 51, 62*
Goldaster	*21, 52, 53, 54*
Greenbriar	*56,*
Honey locust	*19, 22,*
Jujube	*22,*
Mesquite	*2, 16, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 48, 49, 50*
Multiflora rose	*32, 33, 38,*
Osage orange	*11, 16, 18, 22, 34,*
Pecan	*22,*
Plum	*35,*
Post oak	*11, 12, 51,*
Pricklyash	*11,*
Prickly pear (unburned) and other cacti	*36, 37, 47,*

Table 4 (continued)

Species	Chemical treatment reference number. Refer to Table 6 for more detailed information.
Prickly pear (burned)	*17, 39,*
Redberry juniper	*3, 20, 60, 61,*
Russian olive	*16, 22,*
Saltcedar	*16, 22, 40, 58, 59,*
Sand sagebrush	*42, 43,*
Sand shinnery	*44, 45, 63*
Sumac, prairie, winged, etc.	*10, 64*
Willow	*57, 65*
Winged elm	*11, 12, 22, 51,*
Yucca	*46*

Table 5. Chemical Alternatives for Mixed Brush

Species	***Chemical treatment reference number. Refer to Table 6 for more detailed information.***
Blackberry, winged elm	*7*
Blackberry, sumac	*8, 9*
Blackberry, sericea lespedeza, sumac	*9*
Blackjack, post oak	*11, 12, 51, 62,*
Blackjack, post oak (regrowth)	*63*
Sumac, oak sprouts	*9,*
Sumac, persimmon	*9, 35,*
Winged elm, sumac or black locust	*32*

Table 6. Chemical Treatment Reference. This table is cross-referenced with Tables 4 & 5.

In the broadcast rate column, the concentration is listed first followed by the volume.

ID	Herbicide	Broadcast Rate/Ac	Spot/IPT	Efficacy [1/]	Timing	Remarks [2/]
1	2,4-D LVE	1.5 lbs. - 2 lbs. (3 – 4 pts.)			Between bud initiation and full flower	
2	Pronone Power Pellets		1 - 2 pellets per inch of stem diameter Also see Remarks.		Late winter to mid-spring	Apply 1 - 2 pellets per inch of trunk diameter approximately 36 inches from the base of single-stemmed plants. For multi-stemmed plants, apply 1-2 pellets for every 3 ft. of canopy or every 3 ft. of height near the base of the plants. Use higher rates on soils high in clay.
3	Velpar L		2 ml. per 3 ft. of height or canopy diameter		Late winter to mid-spring	Apply undiluted Velpar L to soil surface within 3 ft. of stem base. Use an exact delivery handgun applicator to apply the 2 ml. dose per application shot. If plant size requires more than a single 2 ml. application, apply subsequent applications equally spaced around the plant. Do not use on marshy or poorly drained sites or on soils classified as clays.
4	Roundup		1 to 1.5% in water		Plants must be actively growing	Thorough coverage is necessary. Grass in treated spot is also killed.
5	Remedy	½ - 1 lb. (1 to 2 pts.)		BVH	Mid-May to mid-June	Apply with adequate soil moisture. Use the higher concentrations for dense foliage.
6	Remedy		1% in water	KVH	Mid-May to mid-June	Apply with adequate soil moisture. Spray to wet all foliage. Respraying may be necessary to get satisfactory kill.
7	Grazon P+D + Remedy	2.5 + 1 lbs. (1 gal. + 1 qt.)			Mid-May to mid-June	Apply when plant has mature, fully developed, green leaves. One pint of Tordon 22K can be substituted for the Grazon P+D if the 2, 4-D is not needed.
8	Grazon P+D + Remedy	2.5 + ½ to 1 lb. (1 gal. + 1 pt. - 1 qt.)			Late-May to mid-June	Use low rate of Remedy when blackberry is present but not a major concern. Use higher rate when it is a major concern. One pint of Tordon 22K can be substituted for the Grazon P+D if the 2, 4-D is not needed.
9	Grazon P+D + Remedy	0.625 lbs. + ½ lb. (1 qt. + 1 pt.)			Late-May to mid-June	Optimum control, 3 gallons per acre total volume.
10	2,4-D LVE	1 lb. of 4 lb./gal. product (1qt.)		KVH	June	1 - 3 gallons per acre volume.
11	Velpar L		4 ml. per 1 inch stem diameter or 3 ft. of canopy diameter		Late winter to mid-spring	Apply undiluted Velpar L to soil surface within 3 ft. of stem base. Use an exact delivery handgun applicator to apply the 2 ml. dose per application shot. If plant size requires more than a single 2 ml. application, apply subsequent applications equally spaced around the plant. Do not use on marshy or poorly drained sites or on soils classified as clays.

ID	Herbicide	Broadcast Rate/Ac	Spot/IPT	Efficacy [1/]	Timing	Remarks [2/]
12	Spike 20P	2 to 4 lbs. (10 to 20 lbs. of pellets)		KVH	Anytime during the year, optimum period is Dec. 1 to Apr. 1	Best results achieved when trees are free of leaves. This option may not be effective on re-sprouts less than 10 ft. tall.
13	Tordon 22K	¼ - ½ lb. (1 pt. - 1 qt.)			During and after full flower stage in fall when growth conditions are good, or spring during peak plant growth when growth conditions are good.	Add emulsifier to oil for proper emulsion when oil-in-water emulsion is used. Use 1 pt. /acre of Tordon 22K in the fall. Use 1 qt. /acre of Tordon 22K in the spring.
14	Ally, Escort, or Cimarron	0.25 oz.			Optimum is in the fall, but may be applied in spring.	
15	2, 4-D LVE	1.5 - 2 lb. (1½ qts. to 2 qts.)			Treat as soon as leaves fully expand. Treatment is only effective for a two week period (generally end of April-first of May), when leaves are white or grayish color. No treatments should be made after May.	
16	Remedy (cut stump)		25% in diesel	KVH	Anytime - optimum mid summer	Apply immediately to freshly cut stumps. Not to the point of runoff.
17	Tordon 22K		½% in water	KVH	Within 5 months after the burn but no later than Apr. 30 (May 31 if new pads do not develop by Apr. 30).	Carry out prescribed burn in late winter. See Prescribed Burning (338) standard.
18	Remedy		1 pt. - 1 qt. in 100 gallons of water	KVH	June to July	Spray to thoroughly wet foliage and stems, but not to the point of runoff.
19	Grazon P+D + Remedy		1 gallon + 1 qt. in 100 gallons water		June to July	Spray to thoroughly wet foliage and stems, but not to the point of runoff.
20	Tordon 22K or Velpar L		4 ml. per 3 ft. height or 4 ml. per I in. stem dia.	KVH	Late winter to mid spring	Apply undiluted Tordon 22K or Velpar L to soil surface within 3 ft. of stem base. Use an exact delivery handgun applicator to apply the 4 ml. dose per application shot. If plant size requires more than a single 4 ml. application, apply subsequent applications equally spaced around the plant. Do not use Velpar L on marshy or poorly drained sites, frozen soils or on soils

ID	Herbicide	Broadcast Rate/Ac	Spot/IPT	Efficacy [1/]	Timing	Remarks [2/]
						classified as clays.
21	2,4-D LVE	1 lb. (1 qt.)			Treat during the bud stage (pre-bloom) which usually occurs during mid-May to early June.	
22	Remedy (basal)		20 - 25% w/diesel	KVH	Anytime. Optimum when temperatures are high.	Apply to base of trunk from ground level up to 12 inches above soil surface. Use a hollow cone nozzle. Apply to all sides of the trunk, but not enough to cause runoff and puddling. Effectiveness decreases on shaggy bark type trunks.
23	Remedy + Reclaim		½% + ½% in water with ¼% surfactant	KVH	After 75° F soil temperature at 12 inch depth	Best on mesquites less than 8 ft. tall. Wet the foliage of each plant until the leaves glisten but not to the point of dripping. Efficacy reduced during pod elongation. Avoid spraying when leaves are damaged.
24	Remedy + Reclaim		½% each, with 5% diesel, and 1 oz./gal. emulsifier per gal. diesel in water	KVH	After 75° F soil temperature at 12 inch depth	Best on mesquites less than 8 ft. tall. Wet the foliage of each plant until the leaves glisten but not to the point of dripping. Efficacy reduced during pod elongation. Avoid spraying when leaves are damaged.
25	Reclaim	½lbs. (1.3 pt.)		KH (62% avg.)	After 75° F soil temperature at 12 inch depth	This option is very selective for mesquite.
26	Reclaim + Remedy	¼lb. + ¼¼lb. (⅔ pt. + ½pt.)		KH (66% avg.)	After 75° F soil temperature at 12 inch depth.	If control of prickly pear is desired along with the mesquite, 2 pts. per acre of Tordon 22K can be tank-mixed.
27	Reclaim + Tordon 22K	¼lb. + ½ lb. (⅔ pt. + 2 pts.)		KVH (84% avg.)	After 75° F soil temperature at 12 inch depth	If prickly pear control is desired along with mesquite control, the Reclaim-Tordon 22K is preferred. Tordon 22K also enhances mesquite kill.
28	Remedy	½lb. (1 pt.)		KM (28% avg.)	After 75° F soil temperature at 12 inch depth.	
29	Remedy + Tordon 22K	½lb. + ¼-½lb. (1 pt. + 1 - 2 pts.		KM (35% avg.)	After 75° F soil temperature at 12 inch depth	The 2 pt. Rate of Tordon 22K provides higher and more uniform plant kills of pricklypear as well as enhanced kill of mesquite.
30	Grazon P+D	.468 - .937 lbs. (1.5 - 3 pts.)		KL	April - May	Apply when leaf is fully expanded and the color has changed from a light green to a darker green and soil moisture and temperatures are favorable for plant growth. Use the highest rate in dense mesquite or when growth conditions are less than optimal. Use only in Phenoxy Herbicide Restricted Areas or

ID	Herbicide	Broadcast Rate/Ac	Spot/IPT	Efficacy [1/]	Timing	Remarks [2/]
						when susceptible crops are near. Spray prior to emergence of susceptible crops. Spray annually for three consecutive years or spray at intervals not to exceed 4 years to maintain <10 % canopy. Refer to Job Sheet 314 01.
31	2,4-D LVE	1 lb. of 4 lb. /gal. product (1qt.)		KL	April - May	Apply when leaf is fully expanded and the color has changed from a light green to a darker green and soil moisture and temperatures are favorable for plant growth. Use the highest rate in dense mesquite or when growth conditions are less than optimal. Use only in Phenoxy Herbicide Restricted Areas or when susceptible crops are near. Spray prior to emergence of susceptible crops. Spray annually for three consecutive years or spray at intervals not to exceed 4 years to maintain <10 % canopy. Refer to Job Sheet 314 01.
32	Grazon P+D	2.5 lbs. (1 gal.)		KVH	Full leaf, good growing conditions.	Use 20 - 25 GPA for ground and 5 or more GPA for aerial equipment.
33	Tordon 22K + 2,4-D amine or LVE	½ lb. + 2 lbs. (1 qt. + 2 qts. of 4 lb. product)	2 - 4 lbs. of 4 lbs. /gal. product	KVH	Full leaf, good growing conditions.	Thorough and uniform spray coverage is essential. Poor control if plants are less than 3 feet tall. Use 20 - 25 GPA for ground and 5 or more GPA for aerial equipment.
34	Remedy	½ - 1 lbs. (1 pt. - 1 qt.)			June - July	Apply with adequate soil moisture. A drift control additive is recommended. Use the higher concentrations for dense foliage or on larger trees.
35	2,4-D	1 lb. - 2 lb. (1 - 2 qts. of 4 lbs. per gal. product)		KH	June	
36	Tordon 22K	½ lb. (2 pts.)		KH	Anytime	Control may take 2 years or longer.
37	Tordon 22K		1% in water, ¼% surfactant	KH	Anytime except during extremely cold weather.	Spray to thoroughly wet foliage and stems, but not to the point of runoff.
38	Grazon P+D		1 gal. mixed in 100 gallons of water.	KVH	Full leaf, good growing conditions.	Thorough and uniform spray coverage is essential. Poor control if plants are less than 3 feet tall
39	Tordon 22K	1/4 lb. (1 pt.)		KVH	Within 5 months after the burn but no later than Apr. 30 (May 31 if new pads do not develop by	Carry out prescribed burn in late winter. See Prescribed Burning (338).

ID	Herbicide	Broadcast Rate/Ac	Spot/IPT	Efficacy [1/]	Timing	Remarks [2/]
					Apr. 30).	
40	2,4-D	0.25 - 0.5 lb.		KL (mainly suppression)	During growing season, when leaves are fully developed.	Repeat applications every time trees re-leaf, usually spring, late summer and again the following spring.
42	2,4-D LVE	½ - 1 lb. (1 pt. - 1 qt. of 4 lb. product)	1qt. of 4 lb. product, mixed with 1-2 qts. surfactant in 100 gallons of water.	KH	Within two weeks of the end of spring bolting.	Do not spray when plants are defoliated by late freeze, hail or unfavorable growth conditions. Where secondary weed invasion is anticipated following treatment, add 1/8 to 1/4 lb. of dicamba to solution. 2 - 4 gal. broadcast, 1-5 diesel water ratio.
43	Grazon P+D	2 - 4 pts. (0.625 to 1.25 lbs.)		KH	Within two weeks of the end of spring bolting.	Do not spray when plants are defoliated by late freeze, hail, or unfavorable growth conditions.
44	Spike 20P	1 lb. - 1.5 lb. (5 to 7.5 lbs. of pellets)			November to March	The results with Spike on sand shinnery oak have not been as predictable as with the other oaks. Sometimes there is adequate root kill at low rate while on other sites it takes the high rate. Also, there appears to be grass suppression and damage at the higher rates. Some of this variation is probably due to variations in amount and depth of sand. Organic matter and clay particles tie up Spike 20P and reduce efficacy.
45	Remedy	1/4 - 1 lb. (½- 2 pts.)		KL	Late spring to mid-summer with full leaf development. Spray with good soil moisture.	Retreatment will be necessary because of re-sprouting. This rate gives fair to good top control but little root kill. Increased rates are not effective in increasing kill.
46	Remedy		2% Remedy 98% diesel	KVH	June to August	Complete coverage of leaves is not necessary. The crown of the plant must be thoroughly wet with the herbicide mixture.
47	Grazon P+D	2.5 lbs. (1 gal.)			Spring or early summer.	Use this option when broadleaf herbaceous plant control is desired along with pear.
48	Reclaim + Remedy	¼ + ½ lb. (⅔ pt. + 1 pt.)		KVH (80% avg.)	After 75° F soil temperature at 12 inch depth	
49	Reclaim + Tordon 22K	½ + ½ lbs. (1⅓ pt. + 2 pts.)		KVH (74% avg.)	After 75° F soil temperature at 12 inch depth	If prickly pear control is desired along with mesquite control, the Reclaim-Tordon 22K is preferred. Tordon 22K also enhances, mesquite kill.
50	Reclaim + Tordon 22K	¼+ ¼ lbs. (⅔ pt. + 1 pt.)		KVH (64% avg.)	After 75° F soil temperature at 12 inch depth	If prickly pear control is desired along with mesquite control, the Reclaim-Tordon 22K is preferred. Tordon 22K also enhances mesquite kill.
51	Spike 20P		½ oz of pellets		Anytime during the year,	Apply pellets evenly on the soil under the plant canopy and 1 ft.

ID	Herbicide	Broadcast Rate/Ac	Spot/IPT	Efficacy [1/]	Timing	Remarks [2/]
			($^1/_{10}$ oz.) per 45 sq. ft. or 2 - 4 inches of stem diameter		optimum period is Dec. 1 to Apr. 1	beyond canopy edge.
52	Tordon 22K	1/2 lb. (1 qt.)			Treat during the bud stage (pre-bloom) which usually occurs during mid-May to early June.	
53	Grazon P+D	2 - 4 pts. (.625 to 1.25 lbs.)			Treat during the bud stage (pre-bloom) which usually occurs during mid-May to early June.	
54	Tordon 22K + 2,4-D LVE	0.2 lb.+ 0.8 lb. (0.8 pt.+ 0.8 qt.)			Treat during the bud stage (pre-bloom) which usually occurs during mid-May to early June.	
55	Remedy + Ally	1 lb. (qt.) + .2 oz.			This option substitutes 1 pt. of Remedy with Ally.	
56	Grazon P+D + Remedy		2 gallons + 2 qts. + 2 qts. surfactant mixed in 100 gallons of water.	KL	Mid May - July	Spray to wet, but not to the point of runoff.
57	2,4-D		2 - 3 lbs. mixed in 100 gallons of water.		When leaves are fully expanded with good growing conditions. Wet foliage thoroughly.	
58	2,4-D	4 oz. per gallon	4 oz. per gallon	KVH	Within 1 hour of debarking in June, July, August	The bark must be injured. This can be done by pruning or scraping with methods such as chaining, rollerchopping, brush hogging, or chain sawing. At least 1 square inch of bark off of two or more stems per plant must be removed, then apply herbicide to the injured area. 3 - 4 gal. per acre broadcast, with 100 gallons of water, IPT.
59	Arsenal + Glyphosate		1/2% + 1/2% + 1/4% surfactant	KVH	July - September or until leaves turn yellow.	Thoroughly spray each plant but not to the point of dripping. Wet the terminal ends of all branches.
60	Tordon 22K (cut stump)		4% + ¼% surfactant in water		Anytime, but best results in the spring and summer. Spray immediately after cutting.	
61	Tordon 22K		1% in water,		Spring through summer	Use on juniper < 3 feet tall. Spray to wet, but not to the point of

ID	Herbicide	Broadcast Rate/Ac	Spot/IPT	Efficacy [1/]	Timing	Remarks [2/]
			¼% surfactant		when actively growing	runoff.
62	Remedy	2 lbs. (2 qts.)		Kill is variable 10 – 80%	When leaves are fully developed	Mature stands (greater than 5 feet tall) only.
63	Remedy	2 lbs. (2 qts.)		KL	When leaves are fully developed.	Regrowth stands, top growth must be > 4 ft. tall. Mainly suppression May require at least 3 consecutive treatments.
64	Grazon P+D	.625 lbs. (1 qt.)			June	
65	2,4-D	1 lb. (1 qt 4 gal. product.)		KVH	In the summer when leaves are fully developed.	

[1/] Efficacy K = Kill, B = Brownout, no permanent kill just defoliation for the year of treatment. L = 0-24%, M = 25-49%, H = 50-74, VH = 75-100%. Efficacy information is provided when available.

[2/] Labels generally provide volumes per acre and mixing instructions. In some cases, volumes are prescribed to provide optimum guidance. GPA = gallons per acre.