CHEMICAL CONTROL OF TREES AND BRUSH

Revised 3-5-79

Over 7 million acres of rangeland in the foothills surrounding California's great valleys are covered with stands of trees that have aesthetic appeal but limit production of animal protein that is a staple in human diets. On more than half of this area dense stands of oak trees severely limit grazing. These stands often number more than 100 trees per acre, and 200 trees per acre are not uncommon. The most common species are California black oak (dominant above an elevation of 2,000 feet), blue oak, and interior live oak (common throughout the area in dense stands).

Selective control of oaks and other common trees can greatly improve the grazing potential. Studies conducted in the Sierra foothills showed that annual forage production could be increased over 500 percent by chemically controlling oaks in stands that averaged 120 trees per acre (1). During the first season following treatment, forage production increased from 270 pounds per acre dry matter to 1,409 pounds per acre dry matter. This increased production was sustained for the three-year period of the study.

Management programs that include tree removal must consider the value of trees as habitat for numerous species of wildlife including songbirds, woodpeckers, cavity-nesting birds, birds of prey, and tree squirrels. Consideration should be given to wildlife values before trees are removed. Of special value are dead snags and trees along intermittent and perennial streams. These trees should be saved when possible unless their retention reduces water flows (by evapotranspiration) below management objectives.

More than 20 percent tree canopy cover can reduce forage production. Canopy not exceeding 20 percent will insure adequate shade for livestock in summer, enhance aesthetics of the range scene, and if healthy, productive trees are selected for retention, provide food and habitat for wildlife. A minimum of four to five trees per acre should be maintained. In exceptionally dry seasons, such as 1975-76 and 1976-77, forage production is greater beneath scattered trees than in open range areas. This supplemental feed can be very important and suggests an additional reason for retention

Studies at the University of California Hopland Field Station have shown that at current labor and material costs 2, 4-D amine applied by tree injector will cost between $8 and $11 per acre when stands average 120 trees per acre and individual trees average 7 inches in diameter (2).

Treatment of blue oak is the least expensive, about $8 per acre. Costs for treatment of California black oak and madrone are about $9.20 and $10 per acre, respectively. At $11 per acre, interior live oak is the most expensive to treat. Tests in the northern Sacramento Valley comparing the tree-injector with cut-surface treatment showed the former to be less expensive (1). Once use of the tree injector is mastered, labor costs usually are less. However, crew experience will influence the cost differential. Oak control can be combined with harvesting firewood to help defray costs.

Oak trees killed by injector or cut-surface application of 2, 4-D amine begin to decompose within one year of treatment. Small branches will begin to fall after one year. Entire trees usually begin to fall five to seven years after treatment. Some trees remain standing more than 20 years.

A summary of tree treatment appears in Table 1. Recommendations including materials and application techniques for control of specific woody weeds on rangeland are outlined in Table 2.

Accumulations of dead wood interfere with grazing. They should be burned or piled to permit access to forage. Piled dead wood and brush can be left on rocky areas, in gullies, or near ponds or waterways as habitat for quail and other birds. Excess wood that has been piled can be burned in spring during the greenfeed period to prevent spread of fire. If a great deal of debris exists, a broadcast burn may be necessary. Dry grass in late spring will provide sufficient fuel to ignite the wood. Conduct of such a burn should follow the recommendations and procedures for a range improvement brush burn.

1. Harvey, W. A., W. H. Johnson and F. L. Bell. 1959. Control of Oak Trees on California Foothill Range. Down to Earth 15(1):3-6.

2. McCorkle, C. O., Jr., A. H. Murphy, L. Rader and D. D. Caton. 1964. Cost of Tree Removal Through Chemicals. Journal of Range Management 17(5):242-244.

Table 2. Woody Weed Control on Rangeland[1]

Target species	Treatment	Pounds active ingredient/acre or per 100 gallons for spot treatment	Carrier[2]	Comments[3]
Blackberry	Silvex* ester or brushkiller* ester	4 lb/acre	Water + 1/2 gallon diesel	From late flowering period into late fall. Apply after berry stage if berries may be picked.
Buckeye - Trees	2,4-D* water soluble amine	--	Apply undiluted	Apply in frill cuts close to root crown or to cut stump surface immediately after falling each tree.
Resprouts and seedlings	Brushkiller* ester	3 lb/acre	Water + 1/2 gallon diesel	
Ceanothus - Mature (wedge leaf, whitethorn)	2,4,5-T* ester	3 lb/acre	Diesel oil	2,4,5-T effective on all species.
Resprouts and seedlings	2,4-D* ester	2 lb/acre	Diesel oil	One and two year old seedlings or resprouts.
Chamise - Resprouts and seedlings	Brushkiller* ester or 2,4-D* ester	4 lb/acre	Water + 1/2 gallon diesel	Best results with first year resprouts not over 10 inches tall. If resprouts are 3 years or older, reburn the range.
	Picloram* liquid form (Tordon® 22K)	1 fluid ounce in 10 gallons water	Water + 1/2% surfactant	For individual shrub treatments where brush is sparse and not over 4 feet tall, apply 1 pint of the solution onto each shrub covering 4 square feet of ground surface. Will prevent growth of clovers and other broadleaf plants for 1 to several years.
Conifers - digger pine, knob-cone pine	2,4-D* water soluble amine	--	Use undiluted	Apply in frill cuts.

SECTION V

BRUSH MANAGEMENT
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INTRODUCTION

Brush management is the management and manipulation of stands of brush by mechanical, chemical, or biological means or by prescribed burning. Included is the reduction of excess brush to restore plant community balance and the manipulation of brush stands through selective and patterned control methods.

Objectives of brush management include, but are not limited to, forage improvement, wildlife habitat improvement, forest management, wildfire protection watershed protection and maintenance, and prevention of accelerated soil erosion. The first three objectives usually are pursued for basic economic reasons; concentrations of brush are reduced or modified to either revitalize woody species or encourage growth of other species of greater value to livestock and/or wildlife. Fuel management includes wildfire protection and reduction of the threat of wildfire, and as a result, it affects sources of water and water quality and erosion. Successful fuel management means reduction of fire suppression costs, protection of valuable resources, and reduction of problems associated with accelerated erosion, e.g., flooding, sedimentation, and destruction of aquatic habitat. The value of these objectives is more difficult to assess in terms of simple cost/benefit measurements, but the incentive is no less economic than that represented by the first three objectives.

Management for any one objective or value has an influence on all other values. For example, the modification of woody plant communities, short of total type conversion, generally improves wildlife habitat. Reduction of brush concentrations definitely reduces the threat of wildfire holocausts. In addition, any reduction in brush canopy increases the amount of water reaching the soil surface by reducing interception losses (evaporation of rainfall from leaf surfaces) and reduces the use of water by deep-rooted woody plants. This improves the potential for greater water yield from watersheds.

Feasibility of brush stand modification and type conversion is determined by topography, soil erodibility, soil productivity, precipitation, and the amount and rate of

Local air pollution control districts require brush to be treated at least six months prior to the burn if economically and techanically feasible. Districts may designate a period between January 1 and May 31, during which time range improvement burning may be conducted by permit on a no-burn day, providing that more than 50 percent of the land has been brush treated.

After the initial burn, follow-up work is usually required in subsequent years to control sprouting brush and seedlings. The extent of follow-up and techniques used depend on management objectives. Common objectives include: (1) livestock production, (2) increased numbers and variety of wildlife, (3) a combination of 1 and 2, (4) protection of watershed values and reduction of wildfire potential, and (5) development of complex programs emphasizing many values and the specific management to enhance them. Regardless of objectives, all vegetation management influences multiply values, recognized or not.

Complete conversion to grasses (on suitable soils) for maximum production of livestock forage requires the most intensive follow-up. Elimination of brush sprouts and seedlings is the objective. This can be achieved with herbicides applied at intervals of no more than three years, frequent fires combined with grazing, or grazing alone, depending on the kind of livestock, local deer populations, and management.

Use of repeated fire in type conversions must be qualified. Burning to kill seedlings and injure or kill sprouts requires the range operator to leave adequate forage residues to carry a fire. Where perennial grass has been seeded, dry residues are usually inadequate for an effective fire. Annual grasses, which complete a life cycle each year, can provide the necessary fuel when dry, depending on grazing management and annual weather patterns.

Less intensive brush management will often produce adequate livestock forage at less cost. And retaining some brush will provide browse for both deer and livestock and cover for all wildlife. The amount and pattern of retained brush will be based on management considerations and the condition of wildlife populations in particular areas. When the right balance between brush and other forage is achieved, browsing animals will stimulate and maintain a continuous supply of seasonally available nutritious browse. The availability of annual forages which provide deer more nutrition than perennial forages, influences the grass/brush balance. To insure maximum consideration of wildlife values, the

Table 1. Mechanical Brush Treatment Techniques Summary

Manual and Mechanical Control or Preparation[1/]	Brush Density[2/]	Maximum Slope - %	Equipment	Time
Grubbing and hand cutting[3/]	All	No Restriction	Hand tools	Year-long.
Straight dozer blade or brush rake	All but large trees	30-35	Crawler tractor and straight dozer blade or brush rake	Year-long.
Brushland disk	Light to medium	30-35	Crawler tractor and brush disk.	Spring and fall.
Ball and chain	All but large trees	60	One crawler tractor, anchor chain and submarine net float.	Year-long but fall winter, early spri (before mid-May) i usual period.
Modified or smooth chain	All but large trees	30-35	Two crawler tractors and modified or smooth anchor chain.	Year-long but fall winter, early spri (before mid-May) i usual period.

1/ Direct cost comparisons among mechanical alternatives are difficult because terrain, soil productivity and brush density influence equipment choice, However, the modified or smooth chain or the ball and chain combined with prescribed burning are used extensively where large areas are involved. See Table 2 for mechanical brush treatment production rates.

2/ See Table 3 for a classification of brush by type and volume. Medium brush is 15-30 tons per acre (dry weight). Less than this is light brush, and more is heavy brush.

3/ Appropriate for difficult terrain, for small areas, for removing scattered trees or shrubs and for removal of scattered representatives of a particular species in solid stands of brush. This technique is probably the most costly of all.

Table 2. Mechanical Brush Treatment Production Rates [1/] [2/]

Method [3/]	Acres per Hour [4/]		
	Light Brush	Medium Brush	Heavy Brush
Straight Dozer Blade-crushing (180-275 flywheel H.P.)	--	2.5-3.0	2.0
Brush Rake-piling/windrowing (180-275 flywheel H.P.)	1.0-1.4	0.5-0.7	0.5-0.7
Brushland Disk (9'6" Towner Disk, Model No. 801-144 with 36" blades, requiring 150-180 flywheel H.P.)	0.7-1.5	0.7-0.9	0.3-0.5 (crushing & some incorporation)
Modified Chain (180' of 60-90 lb. chain requiring two 270 flywheel H.P. crawler tractors)	3.5-4.2	2.0-3.0	2.3-2.9
Ball and Chain (120-150' of 20-35 lb. chain with 5' water-filled marine net float requiring 270 flywheel H.P.)	1.2-1.5	0.6-1.2	0.5-0.7

1/ Summarized from data in: Roby, George A. and Lisle R. Green. 1976. Mechanical Methods of Chaparral Modification. USDA, Forest Service, Agr. Handbook No. 487, U.S. Government Printing Office.

2/ Costs of tractor operation can be calculated from data in "Farm Machinery Costs", Leaflet 2263, Division of Agricultural Sciences, University of California. To these costs should be added transporation, support equipment costs and pay for the operator and swamper. Computation of current costs will require consideration of the effect of inflation.

3/ All methods employ crawler tractors. Drawbar H.P. is 75-81 percent of flywheel H.P.

4/ With two exceptions, lower figures represent 25-35 percent slopes and higher figures represent 0-25 percent slopes. The ball and chain is more efficient on steep slopes. For this method, the lower figures represent slopes of less than 50 percent, and the higher figures are for slopes greater than 50 percent. Figures for the straight dozer blade represent rates on slopes of less than 30 percent.

Table 3. Brush classification by type and volume.

Vegetation Type[1/]	Vegetation loading[2/] Tons/acre (estimated) Low	Moderate	Heavy
Light to medium chamise (2.5' - 4' high)	<7	7-15	16-25
Low brush mixtures including combinations of big sagebrush, California sagebrush, California buckwheat, white sage, black sage, coyote brush, chamise, and sumac (2'-5' high).	<7	7-15	16-25
Mixed brush (4'-6' high) and scrub oak.	<10	10-25	--
Heavy pure chamise, manzanita or Ceanothus (4'-6' high).	---	20-30	31-40
Heavy mixed brush (6'-7' high)	---	20-35	36-55
Heaviest mixed brush with Ceanothus, toyon, oaks, big manzanita and madrone on north slopes at higher elevations and latitudes (8'-12' high).	---	30-45	46-60

1/ Adapted by Clive Countryman and Lisle Green, U.S. Forest Service, and T. E. Adams, Cooperative Extension, from Fireline Handbook, U.S. Forest Service.

2/ Prepared by Clive Countryman and Lisle Green, U.S. Forest Service.