
INTRODUCTION

Brush management through brush clearing or removal, usually in conjunction with a brush burning program, may involve several types of operations, each of which is best done by particular types of tools. Heavy, brushland disks may be used to knock down or incorporate low stands of material; dozing with the straight blade and brush rake in limited situations may be used to crush, clear, and pile brush; the chain or ball and chain equipment may be used to tear out and crush brush stands. For information on your particular needs, see also:

Brush Management—The Ball and Chain, leaflet 2920.

Brush Management—The Brushland Disk, leaflet 2921.

Brush Management—Modified and Smooth Chains, leaflet 2922.

Mechanical clearing of brush, usually in preparation for controlled or "prescribed" burning for range improvement and other programs, was first begun with the crawler tractor equipped with a straight dozer blade.

The straight blade's limitations, especially in rugged terrain, stimulated early modifications and led to development of the brush rake (see fig. 1); but the blade is still a useful tool.

The Straight Dozer Blade

The straight blade is well suited for compacting and crushing mature brush before prescribed burning. For this the blade is used 6 to 12 inches above the ground to knock down the brush and break it off at the soil surface. The tractor's tracks add to the crushing effect.

Other jobs for the straight blade are clearing and piling small, scattered stands of brush and removing unwanted, isolated trees up to 12 to 16 inches in trunk diameter (measured 4.5 feet from the ground). These are jobs not performed efficiently by the modified chain, ball and chain, or brushland disk.

For clearing and piling brush, the straight blade generally is limited to relatively small-scale projects. The process is slow and the blade often disturbs soil excessively. If slopes are steep and the soil highly erodible, the blade can contribute to accelerated erosion. Also, soil loosened by the blade frequently becomes mixed with the brush

during piling. Too much soil in the brush can lead to slow or incomplete burning and additional cleanup, all of which can add to clearing costs.

(Often, it is not intended that all brush and trees be eliminated. When piled, this material provides good cover for small game and gamebirds. On rangeland, unburned piles should not reduce grazing significantly and the resulting increase in wildlife often compensates for the small reduction in livestock carrying capacity.)

Tractor size. On U.S. Forest Service projects in southern California, tractors most commonly used with the straight blade are of the D7 or D8 size with 180 to 275 net engine horsepower. (Some operators rate equipment in drawbar horsepower. This is calculated as being 75 to 81 percent of net engine horsepower.)

Blades used with these tractors vary in cutting width from 12 to 14 feet. The wider blades are more efficient in moderate terrain, but create transportation problems because of load-width travel restrictions: wider blades must be detached from tractors and hauled separately.

Capabilities of dozer crushing. On slopes up to 35 percent the straight blade is effective in crushing all vegetative types (table 1) except young, flexible brush. Small stones are not a problem in crushing, but rocks larger than a foot in diameter are a nuisance, can be dangerous, and will decrease the amount of crushing. Pay particular attention to large, scattered boulders and rock outcroppings.

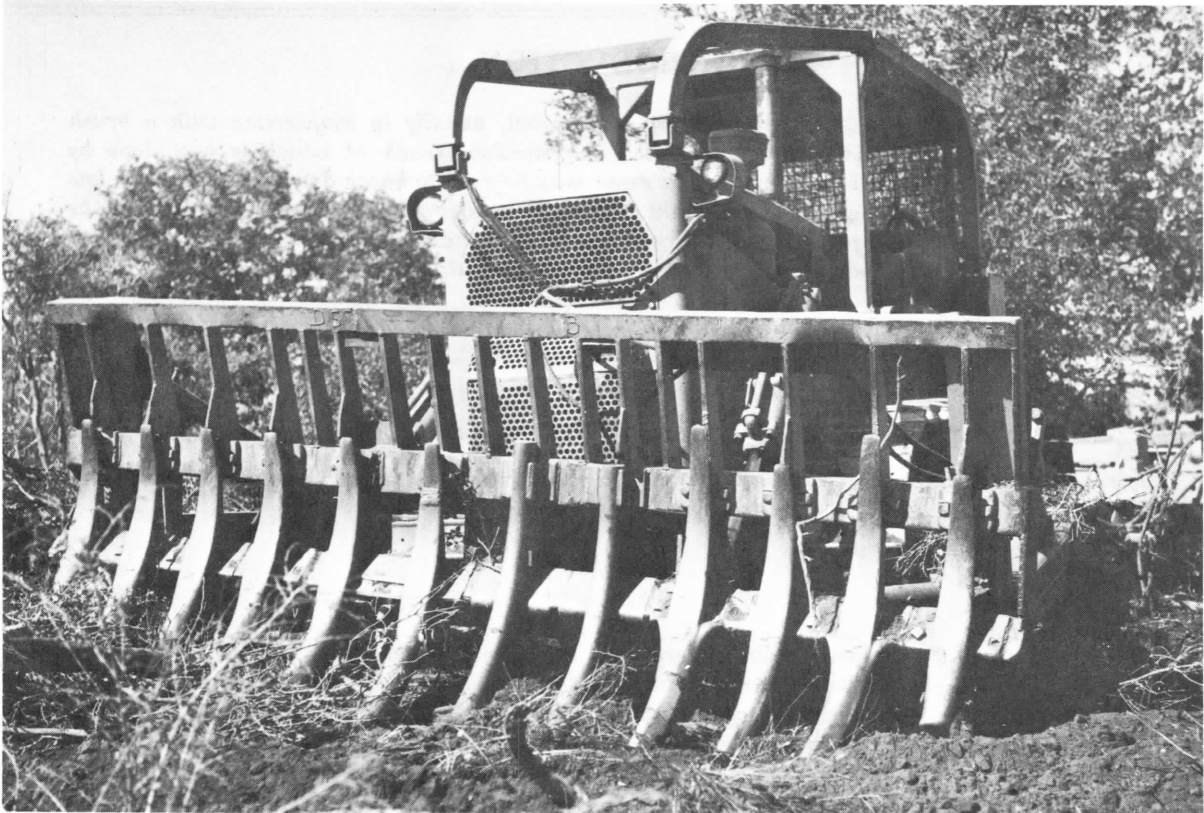


Fig. 1. Brush rakes with the least blade surface pick up a minimum of soil with the brush. Photo courtesy of the U.S. Forest Service.

TABLE 1. BRUSH CLASSIFICATION BY TYPE AND VOLUME.

Vegetation Type ¹	Vegetation loading ²		
	Light	Moderate	Heavy
	tons/acre (estimated)		
Light to medium chamise (2.5'-5' high)	—	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)	—	7-15	16-25
Mixed brush (4'-6' high) and scrub oak	10	11-25	—
Heavy pure chamise, manzanita or buckbrush (4'-8' high)	—	20-30	31-40
Heavy mixed brush (6'-8' high)	—	20-30	31-45
Heaviest mixed brush with 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.

Production rates and costs. U.S. Forest Service experience in the Mendocino National Forest in 1973 showed the following estimated rates and costs of crushing, using a D8 tractor with operator at a combined cost of \$35 per hour:

% slope	Fuel type	Acre/hr.	On-site costs \$/acre
0-30	Heavy, pure manzanita, chamise or <i>Ceanothus</i> sp. (20-40 T/A; 4-8 feet high)	3.0	\$12
0-30	Heavy, mixed brush (20-45 T/A; 6-8 feet high)	2.5	14
0-30	Heaviest mixed brush (30-45+ T/A; 8-12 feet high)	2.0	17

These costs do not include a swamper, support equipment, or transportation. Current cost estimates must include inflationary increases since 1973. Additional information on figuring costs of tractor operations may be found in the publication, "Farm Machinery Costs," L2263, Division of Agricultural Sciences, University of California.

Production rates on two California Division of Forestry projects reflect the capability of smaller power units. In western Fresno County a D6-C with 120 net engine horsepower crushed about 1.5 acres per hour in heavy mixed brush 8 to 15 feet high, on slopes of less than 30 percent. In Madera County equipment equivalent to 86 to 93 net horsepower crushed about 0.75 acres per hour in heavy mixed brush 8 to 15 feet high, on slopes of 10 to 40 percent.

The Brush Rake

The brush rake (fig. 1) is an early straight-blade modification. This implement looks like a giant reinforced garden rake and mounts in place of the straight blade. The principal advantage of the brush rake is that it displaces less soil than the straight blade; it keeps down soil disturbance and reduces the accumulation of soil in brush piled for burning.

Rakes with the least blade surface are the most efficient and do the cleanest job, although the skill and attention of the tractor operator still influence the degree of soil dislocation.

Many sizes of brush and root rakes for clearing and stacking have been developed by manufacturers and private operators. Most of the implements

are in the 12- to 14-foot range for use on large tractors (D7 or D8 size). As with straight blades, the larger models may require removal from the tractor for highway travel.

Several types of rake attachments (fig. 2) also are available for use on the mounted straight dozer blade. Whereas they are not as efficient as regular rakes, they can be attached or removed fairly quickly. Attachments are useful when road construction, ditching, or other project activities that require a straight blade must be done with the same tractor.

Raking operations and capabilities. The brush rake is very effective in most types of brush. However, light sage, light chamise, and other light brush tend to slip through the rake. One solution is the addition of a narrow blade or root grubber welded across the bottom of the tines (fig. 3).

Brush can be piled in windrows or individual piles, depending on slope, type and volume of brush, equipment available, and operator skill. Tractors with brush rakes operate effectively on slopes up to 35 percent. Small rocks are not a problem but larger ones that do not pass through the tines are a nuisance when the operator is trying to keep them out of brush piles. Large rocks also slow production and are hard on equipment. However, the brush rake can work around large boulders and trees and is very selective in clearing large, solid stands.

Care should be taken that the operator does not remove too much of the crushed and broken material. Jobs that are too "clean" leave little debris to reduce erosion and replenish the soil's nutrients, and cost more.



Fig. 2. Brush rake attachments generally are less effective than brush rakes, but they can be removed, permitting the straight dozer blade to be used for other work. Photo courtesy of Fleco Corporation.

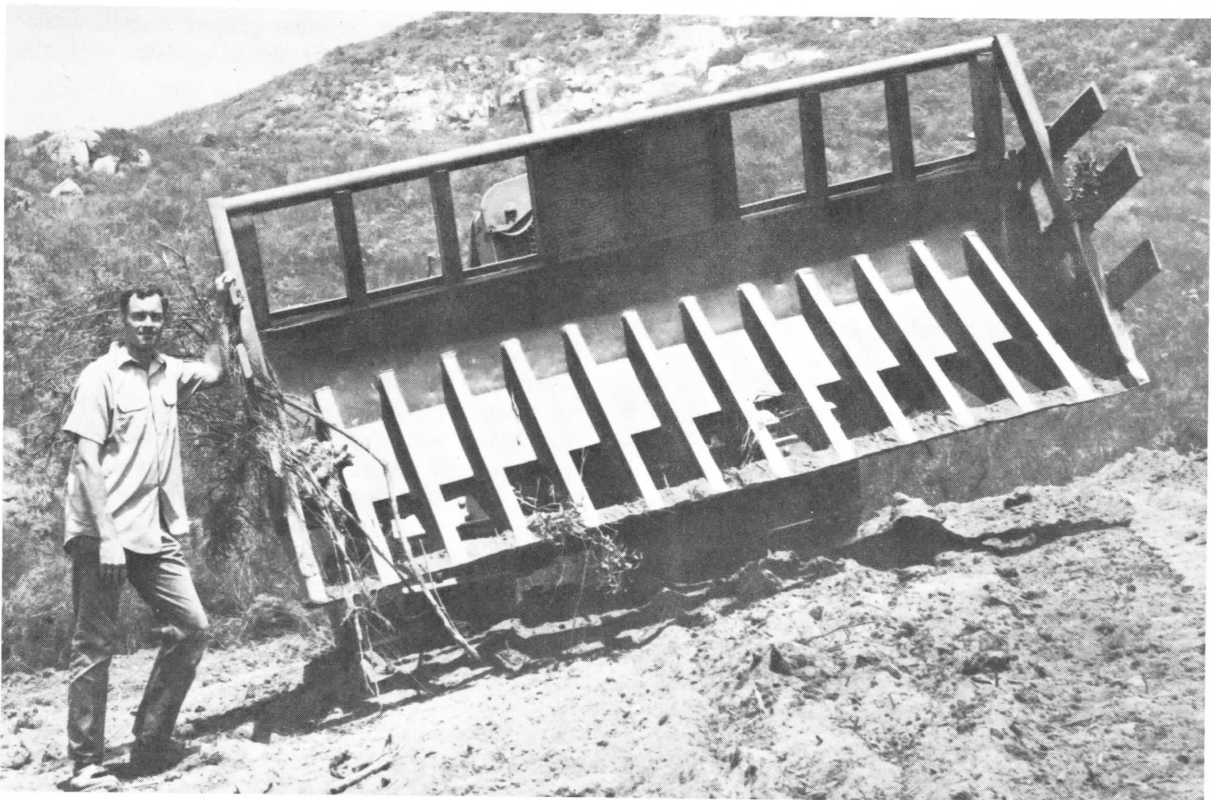


Fig. 3. A brush rake with root grabber welded across rake tines. This modification uproots or cuts off small or flexible shrubs that tend to slip through the rake. Photo courtesy of the San Diego County Department of Agriculture, Weights and Measures.

To avoid adding excessive soil to brush piles, wait until soil is dry enough to fall freely from the brush being piled. Otherwise costs will mount as burning time is increased, burning will be incomplete, and added cleanup will be required.

Production rates and costs. Rates for clearing and piling with the brush rake, reported by the Forest Service in southern California operations, vary from 1.0 to 1.4 acres per hour in light brush of less than 15 tons per acre, to 0.5 to 0.7 acres per hour in heavier stands. The lower figures in each case were on slopes of 25 to 35 percent; higher figures were on slopes of less than 25 percent.

On-site costs (through 1973) varied from \$23 to \$68 per acre in light brush and \$34 to \$150 per acre in heavier brush but not including large oak trees. These costs do not include expenses of subsequent burning activities. Costs of tractor operation can be calculated from data in the publication, "Farm Machinery Costs," L2263, Division of Agricultural Sciences, University of California. To tractor costs, however, should be added cost of transportation and support equipment, and pay for the driver and any swamper employed.

Advantages and disadvantages of crushing and clearing brush with the tractor and brush rake:

Advantages

- Highly maneuverable.
- Effective for creating an irregular edge effect — scalloping, feathering, etc. — which benefits wildlife and improves aesthetics.
- Allows cleanup according to desired aesthetic effects.
- Less dirt in burn piles or windrows than with straight dozer blade.
- Piles or windrows of brush can be burned when wildfire is not a hazard.
- Some piles may be left for wildlife.
- Economical to transport compared with tractor and disk, tractors and modified chain, or tractor with ball and chain.
- Usually leaves a good seedbed.

Disadvantages

- Limited by slopes and soil conditions.
- Can be expensive.
- Unwanted brush piles must be burned.
- Extra care necessary when burning if brush mixed with soil, to insure no smoldering embers.
- May increase erosion potential by compacting soil and reducing infiltration, by disturbing surface unnecessarily, or by creating channels parallel to the slope.
- In some cases cleanup may be too thorough — not enough debris is left to dissipate rainfall energy, to give erosion protection, or to recycle nutrients from plant materials.

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