14000.

The authors report on the control of oak trees on California rangeland with the application of concentrated mixtures of 2,4-D amine to frill girdles (cut surface). The method is economical, selective and results in substantial increases in forage produced when land is freed of competition from oaks. —*Editor*

Control Of OAK TREES On California Foothill Range

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Seven and one-half million acres of grass-woodland (2) along the foothills of California's great valleys may add to the scenic beauty of the area but offer a minimum of forage for the livestock farmer using them for grazing land. More than half of this area is covered with oak trees, often in dense stands of 100 to 200 trees per acre. The most common species at lower elevations (300 to 1,500 feet) is blue oak (*Quercus douglasii*) (3). Black oak (*Quercus kelloggii*) occurs as a dominant species above 2,000 feet and interior live oak (*Quercus wizlizenii*) occurs throughout the area in dense stands. This latter species is a vigorous sprouter and stands of second growth live oak brush may be so thick that livestock and even saddle horses cannot move through the area (4).

Grass beneath the canopy of oaks is usually limited in quantity and not readily selected by livestock. Historically, these areas have been partially reclaimed as grazing land by bulldozing and windrowing the smaller trees and then by burning. To a limited extent goats have been used to keep down the sprout growth (2). Larger trees are usually left standing. Girdling of small areas of oaks is not uncommon but is expensive in terms of time required and must be carefully done to avoid sprouting. Each year some acreage is cleared by wood cutters for domestic use and charcoal production. However, unless some follow-up treatment is used the sprouts may produce a second growth stand of oak brush worse than the original stand of trees.

Chemical methods of control for oaks were of no importance until the development of 2,4-D and related compounds. Even with these materials, early attempts at control were generally unsatisfactory. Airplane applications of low volume sprays gave only a partial kill of the leaf canopy and did not prevent resprouting. In one recent experiment three annual applications of silvex ester‡‡ have resulted in only a 37 per cent kill of blue oak trees although most trees have been partially killed and the understory of forage considerably increased. The kill with 2,4,5-T and 2,4-D was considerably poorer. Ground applications of foliage sprays have been successful on small trees and sprouts, using one gallon of brush-killer, one gallon of diesel oil and 98 gallons of water, but only if all the vegetation is

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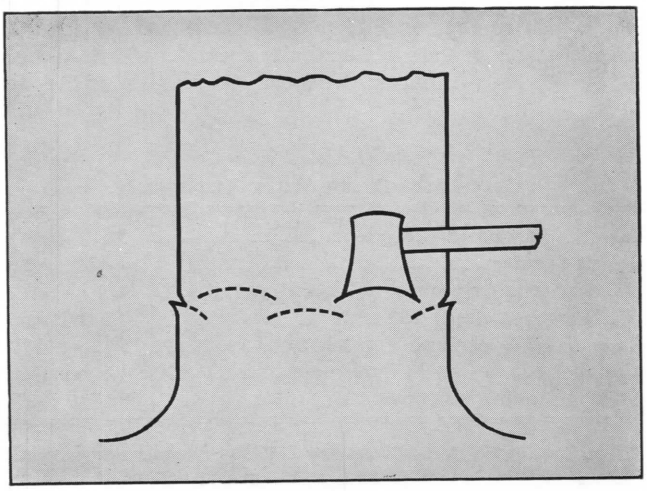
‡‡ Kuron, furnished by The Dow Chemical Company was the product used in these tests.

Axe cuts must form an overlapping frill all around the tree. Uncut sections may remain alive and the cut eventually heal over. Drawing courtesy California Farmer.



completely covered with the spray (9). Usually retreatments are necessary.

Timing of these foliage sprays is critical. Blue oak sprouts can be controlled most effectively by spraying during the period of active growth, about May 15 to June 15 in the foothills on the east side of the Valley. Live oak sprouts can be controlled by fall sprays—September to November—but in mixed stands of oaks spring treatment has proved most effective. Because of the large volume of spray required, the critical timing and limited usefulness on trees, most of the foliage spraying is confined to spot treatment of sprouts following cutting, burning or bulldozing.

Basal sprays, likewise, are expensive and are effective only on young smooth-barked trees or sprouts.

STUMP TREATMENT

Stump treatment following cutting is now practiced in many of the wood cutting operations and included as part of the contract between the land owner and the cutters. Extensive testing of sprout control by stump treatment has shown about equal effectiveness for two different treatments. (4, 9)

1—2,4-D amine undiluted, applied by paint brush to the entire cut surface of small stumps or in a strip 2 to 4 inches wide around the circumference of the cut surface of large stumps, immediately after cutting.

2—2,4-D, 2,4,5-T Brush-Killer mixture at 1 gallon (4 pounds actual) in 24 gallons diesel oil applied as a typical basal spray over all of the stump including the cut surface.

COST OF CONTROL

The 2,4-D amine is both easier to use and cheaper than the over-all basal treatment and requires only a coffee can and a paint brush as equipment. As a result it is much more likely to be done than an operation requiring hauling diesel oil, mixing of spray, and careful and thorough coverage of the stump with the mixture.

The effectiveness of sprout control depends on the care with which the operation is carried out. If the trees are cut at an angle or the chemical applied in too small an amount or not uniformly, sprouting may occur. Cost varies with density of tree stand, and diameter. A series of tests in Placer County (4) over a period of three years involving a total of 1,127 stumps gave cost figures shown in Table I*.

These cost studies were run on a very dense stand of blue oak which resulted in higher than usual costs. In a stand of 100 ten inch trees per acre, the chemical cost would be $3.40 per acre. Labor costs depend on whether or not the treatment is a separate operation from the cutting or carried out by the cutters as they go.

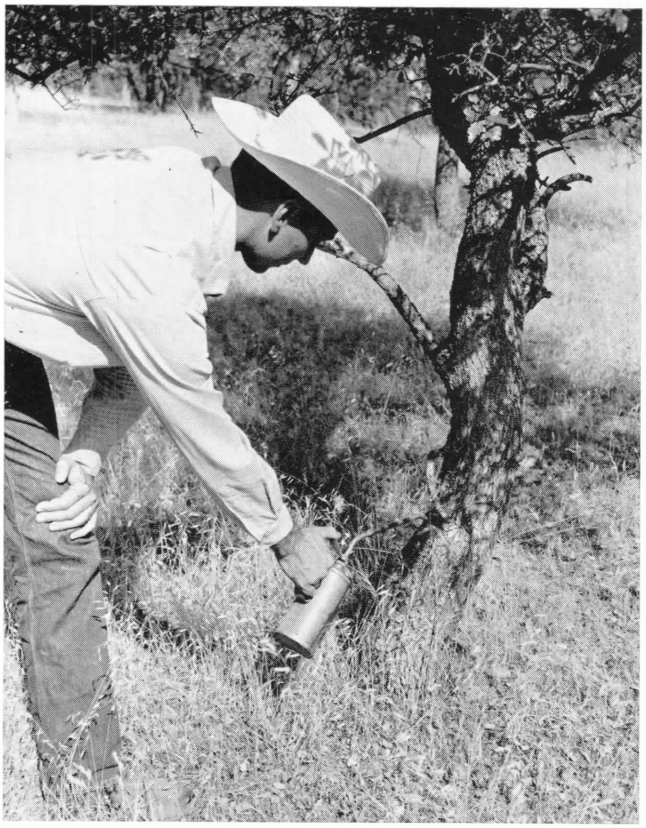
TABLE I

COST OF 2,4-D FOR STUMP TREATMENT

Number of stumps per acre	564
Diameter range	1 - 21 inches
Average diameter per stump	4.7 inches
2,4-D amine used per acre	2.6 gallons
Cost of 2,4-D per acre (@ $3.50/gal.)	$9.10
Cost of 2,4-D for one 10 inch stump	3.4 cents
Stumps showing no sprouts	97.7%

* The 2,4-D used in these tests was 2-4 Dow Weed Killer Formula 40, furnished by The Dow Chemical Company.

Although stump treatment to control sprouting is satisfactory if the trees are cut, this method of land clearing is economical only if the returns from the wood are sufficient to pay for the cutting, hauling, treating and clean up operations. In the studies mentioned above in Placer County total costs for the entire operation of hand clearing and treating ranged from $67.62 to $176.13 per acre. With wood at $20.00 per cord this required 3.38 cords to 8.8 cords of wood produced to break even. This is not always possible and, thus, although the method of stump treatment has been thoroughly investigated, it is practical and economical, only if the trees are to be cut for use as wood.



Axe cuts in the frill are filled with 2,4-D amine from a pump-type oil can.

CUT-SURFACE TREATMENT

As something of a last resort in methods of clearing oak woodlands we have spent considerable time on cut-surface treatment of individual trees. Somewhat to our surprise we have found cut-surface treatment to be the most economical method for control of blue oak. Detailed records on more than 3,000 trees in Placer County show a kill above 95 per cent from one treatment. The most startling result from the treatments has been the rapid and sizeable increase (five-fold the first season) in forage production which to date has continued through three seasons after treatment.

Early work by Dr. O. A. Leonard (6, 7, 8, 9) showed that individual trees of most species could be killed by applying chemicals to cuts in the bark. Detailed investi-

gations showed 2,4-D amine to be as effective as more expensive compounds or formulations. Success depended on spacing, depth of cut, height of cut above ground, volume of 2,4-D applied per cut and season of treatment. In general the axe cuts should be close together (a complete frill for live oak), should extend through the bark and about one-half inch into the wood, should be as close to ground level as possible, should be filled with undiluted amine. The treatment should be made in fall, winter or spring.

COST OF TREATMENT

Knowing what could be done with cut-surface treatment on individual trees, it was necessary to investigate the economics of such treatment on a field scale. Interest was great in Placer County where some 65,000 acres are covered by solid stands of oaks and 150,000 acres by more open stands of oak trees and brush (4). A 1955 trial on a one acre plot was so encouraging that in 1956 two larger areas, one 12.7 acres and the other 13.1 acres were established to more accurately measure costs. In all of these the cuts were made with an axe and filled with 2,4-D amine using a squirt-type oil can.

A summary of stand, labor and cost records for the three trials is included in Table II. These records are based on treatment of more than 3,000 trees. Costs are figured at $1.00 per hour for labor and $3.50 per gallon for the 2,4-D amine.*

TABLE II

CUT-SURFACE TREATMENT OF OAK TREES, PLACER CO.

	Cranston 1955 1 acre	*Gunther 1956 12.7 acres*	*Files 1956 13.1 acres*	*Average*
	per acre	*per acre*	*per acre*	*per acre*
Number of trees	130	118	115	121
Range in diameter, inches	1-30	2-51	1-49	1-51
Total inches of diameter	902	964	868	911
Average diameter, inches	6.9	8.2	7.5	7.5
2,4-D amine used, gallons	.42	.46	.53	.47
Labor to cut and treat, hours	1.50	1.42	2.21	1.71
Labor cost, dollars	1.50	1.42	2.21	1.71
Material cost, dollars	1.48	1.62	1.85	1.65
Total cost, dollars	2.98	3.04	4.06	3.36
	per tree	*per tree*	*per tree*	*per tree*
Labor, minutes	.69	.72	1.15	.85
2,4-D amine, ml.	12.3	14.9	17.4	14.9
Labor cost, cents	1.15	1.20	1.92	1.42
Material costs, cents	1.14	1.37	1.61	1.37
Total cost, cents	2.29	2.57	3.53	2.79
Number of trees treated per hour of labor	87	83	52	74
Kill of oak trees, percent	100	+95	+95	98

INCREASE IN FORAGE

The treated trees usually begin to disintegrate after two years and may be bulldozed and burned or left to fall naturally. They may also be cut and used for domestic firewood or charcoal production. The increase in feed for livestock is immediate, however. Feed production records were taken on the Files plot in 1957. (5) These results are shown in Table III.

* The 2,4-D used in these tests was 2-4 Dow Weed Killer, Formula 40, furnished by The Dow Chemical Company.

TABLE III

ANNUAL FORAGE PRODUCTION FOLLOWING CUT SURFACE TREATMENT OF BLUE OAK, FILES PLOT, PLACER CO., 1957

	Treated	*Control*	*Treated as Per Cent of Control*
Dry matter per acre, lbs.	1,409	278	506
Crude protein in forage, per cent	6.38	7.61	83.8
Total protein per acre, lbs.	89.9	21.2	424
Phosphorus in forage, percent	.309	.305	101
Total phosphorus per acre, lbs.	4.35	.85	512

This five-fold annual increase in forage produced under the dead trees has now persisted for three years. It is not known how long it will continue. The increased production is the result of earlier, more rapid growth in the spring and a greater density of forage. Actually, the ground cover has doubled under the treated trees with some change in botanical composition. Annual grasses and broad leaf filaree have increased while redstem filaree, bur clover and undesirable forbs have decreased.

TESTS IN GLENN COUNTY

A somewhat similar study of oak control in the foothills of Glenn County, on the west side of the valley, has produced similar cost figures. (1) In this study a comparison was made of the axe cut method and a tree injector tool that makes a cut through the bark and supplies the chemical from a built-in tank through an opening in the cutting blade. Labor costs have been less for the latter method once a crew has learned to use the tool. Difficulty with flow of the viscous undiluted amine into the cuts resulted in trials with dilutions of the 2,4-D amine with water as well as with 2,4,5-T in diesel oil. Results of six randomized 100 x 100 ft. replicates of six treatments are given in Table IV. The trees were all blue oak ranging in diameter from 2 to 38 inches. Treatments were made in late March and early April.

The costs were somewhat higher than on the Placer County plots for the axe cut, 2,4-D amine method, possibly due to a less experienced crew and a greater number of trees per acre. Using the injector cut labor costs in half over the use of the axe. This would appear to be a desirable improvement in treatment technique. Although dilution of the

TABLE IV

OAK TREE CONTROL IN GLENN COUNTY

	Trees per acre	*Average diameter, inches*	*Trees treated per hour*	*Cost per acre, dollars*	*Per cent kill, August observations*
Control	189	8.71	--	----	0
Girdled (no chemical)	164	8.24	30	$5.47	9
Cut surface, 2,4-D amine, axe cuts	136	9.27	38	6.92	100
Cut surface, 2,4-D amine, 1:1 dilution injector	97	10.31	73	3.51	100
Cut surface, 2,4-D amine, 1:2 dilution injector	134	9.14	84	3.40	100
Cut surface, 2,4,5-T ester in diesel oil, 1:6 axe cuts	140	9.40	45	5.35	96

Oak trees have virtually destroyed this range land. These oak trees have been killed. Leaves are retained by the dead or dying trees.

amine appears to cause no reduction in effectiveness, the saving is more apparent than real since a greater volume of the diluted material flows into the cuts. Previous work has shown that too great a dilution can reduce effectiveness. We would recommend diluting no more than necessary to get satisfactory flow through the injector possibly the 1:1 dilution used in these tests.

ADVANTAGES

The advantages of the cut-surface method are many:

- √ It is economical.
- √ No expensive equipment is required.
- √ No difficult techniques need be learned.
- √ As much or as little area as desired can be treated.
- √ Desirable trees can be left untreated.
- √ Control is possible over a long season — November to May.
- √ The work may be done a few trees or a few acres at a time when labor is available.
- √ Kill of trees is almost assured if application is carefully done.
- √ Increases in feed are immediate and sizeable.

The principal disadvantage is the debris created by falling limbs and trees which are burned or left to decay. Complete kill of blue oak is somewhat more readily achieved than with live oak. Both may be killed but with live oak the cuts must be very close together and as near the ground as possible. This is often easier with the injector than with an axe.

SUMMARY

In summary, the cut-surface technique using an axe or an injector with 2,4-D amine offers a method of oak tree control and range improvement that is both effective and economical. It is estimated that some 6,000,000 acres of our California woodland-grass foothill range could profit from such improvement.

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