Yield and Quality of Annual Range Forage Following 2,4-D Application on Blue Oak Trees

WALTER JOHNSON, CYRUS M. McKELL, RAYMOND A. EVANS, AND L. J. BERRY

Farm Advisor, Placer County, California Agr. Extension Service; Plant Physiologist, Crops Research Division, ARS, USDA, Davis; California; Assistant Specialist, Agronomy Department, University of California, Davis; and Extension Range Improvement Specialist, California Agr. Extension Service, Davis

Removal of woody vegetation and conversion to grassland has been advocated by many workers as a means of increasing the supply of livestock forage and improving watershed efficiency in the annual range type (Jones and Love, 1945; Love and Jones,, 1947; Biswell, 1950; Cornelius and Graham, 1951; Viehmeyer, 1953; Leonard and Harvey, 1956).

The demand for increased production from foothill rangelands poses the question: What effect would killing the overstory of blue oak trees *(Quercus douglasii)* have on forage production where a good stand of annual grasses and forbs already exists?

This paper deals with some aspects of the problems which pertain to quantity and quality of forage produced on the blue oak-annual grassland as a result of killing blue oak with 2,4-D.

Procedure

The rangeland area where this study was undertaken is in the Sierra-Nevada foothills where deciduous blue oaks are encountered at elevations of about 300 to 1,500 feet (Jepson, 1910). The study area, consisting of approximately 25 acres, was located in Placer County northeast of Lincoln, California, on the C. F. Files ranch at an elevation of 500 feet and with an average annual precipitation of 20-25 inches. Soils of the area are predominately non-calcic brown stony clay loam commonly considered to be in the Auburn series. Oak tree density averaged 115 trees per acre. Average diameter of trees was 7.5 inches.

Two adjacent pastures were chosen for their similarity of aspect, slope, and plant cover. One of the pastures was randomly chosen for treatment and the oak trees were killed (Fig. 1). The other pasture was untreated and served as a control. Blue oaks were treated by using the cut surface technique and applying 2,4-D amine[1] to the cut according to the method described by Leonard and Carlson (1955), and

[1]*The 2,4-D material used in this study was furnished by the Dow Chemical Company.*

FIGURE 1. Blue oak-annual grassland with a good understory of annual grasses and forbs. The bark of the dead blue oak trees is peeling off, and leaves are retained as a result of 2,4-D treatment. *(Photo by F. Leland Elam).*

Leonard and Harvey (1956). This treatment was administered in April 1956 at a calculated cost of about $4.06 per acre. No attempt was made to measure environmental factors involved in the study.

On February 27, 1957 one hundred sampling points were recorded on north and west facing slopes of each area for botanical composition using the step-point method (Evans and Love, 1957). Sampling at this time was to determine differences in early season response of annual range following treatment.

Four pairs of exclosures of approximately 400 square feet in treated and control pastures were established, immediately following step-point sampling, in each pasture under dense (65 percent) and sparse (35 percent) tree cover and on north and west facing slopes to obtain measures of forage production under the various conditions. Percent cover of woody vegetation was determined from aerial photos.

At the peak of the growing season, May 28, 1957, a strip was clipped with a power mower in each exclosure. Green weight, dry weight, percent moisture, percent nitrogen, and percent phosphorus of the clipped forage were recorded from these plots. Nitrogen in the samples was determined by the Kjeldahl method (Anon., 1955) and phosphorus by the method of Toth, *et al.* (1948). Yield, nitrogen, and phosphorus data were analyzed for significance using a t-test.

Results

Oak trees showed symptoms of severe 2,4-D injury two weeks after treatment and appeared to be dead within four weeks. Dead leaves were retained on the trees for a year or more after 2,4-D was applied. Although dead, trees remained standing during the study period.

The step-point sampling on February 27, at the beginning of the active growing season, indicated that there had been an increase in ground cover, an increase in the percent of grasses and a decrease in the percent of forbs on the treated areas (Table 1).

Forage yields taken at the peak of plant growth were significantly greater in all of the treated exclosures on north and west slopes and under sparse and dense tree cover. Quality of forage with respect to crude protein and percent phosphorus was not significantly different on untreated and treated areas (Table 2).

An increase in palatability was noted under 2,4-D treated trees three weeks after treatment and continued during the period of the study. Beneath the canopies of these trees a greater amount of forage was eaten than in openings between trees or beneath untreated trees.

Discussion

The blue oak-annual grassland, where this study was carried out, is in a summer drought region. Precipitation, ranging from 20 to 25 inches, occurs in the fall, winter and spring months. Most of the annual plants germinate in the fall and grow very little during the winter months. Rapid growth does not occur until soil temperatures increase in late winter or early spring. At this time and until maturity, light, soil nutrients, or

Table 1. Step-point analysis of blue oak-annual grassland under 2,4-D treated and non-treated blue oak trees showing percent ground cover and botanical composition of herbaceous vegetation.

Observations	Control			Treated		
	North	West	Mean	North	West	Mean
	Percent	Percent	Percent	Per cent	Percent	Percent
Ground cover	23	47	35	60	80	70
Botanical Composition:						
Annual grass	34	28	31	46	48	47
Broadleaf filaree	0	22	11	0	34	17
Redstem filaree	18	8	13	6	6	6
Bur clover	6	14	10	6	4	5
Other forbs	42	28	35	42	8	25

other factors of the environment may limit growth of various members of the plant community. Later in the season, competition for moisture between the blue oak and the understory plants may also become an important factor. Chemical control of oak trees, the dominant species in this woodland-grass community, obviously would improve the availability of light, moisture, heat, and soil nutrients to the remaining members of the community. In view of the large increase in forage production as a result of the 2,4-D treatment of the oak trees, the study points up the need for an understanding of some of the basic relationships between blue oak and annual forage plants.

An interesting comparison was made possible when a line of trees extending through the treated area on a north slope was not treated so it could be used for a future fence. On February 27, 1957 it was noted that forage under the live trees was definitely retarded in growth as compared to forage under the adjacent chemically treated trees. At this time the live trees had not yet produced leaves and the dead trees still retained the previous year's foliage.

Table 2. Yield, crude protein, and phosphorus of annual range forage under 2-4-D treated and non-treated blue oak trees.

Exposure and Cover of Sample areas	Dry matter Lbs./Acre		Percent Crude protein in forage		Percent Phosphorus in forage	
	Treated	Control	Treated	Control	Treated	Control
West Dense	1,318	277	6.56	6.88	.168	.388
Sparse	915	316	6.94	6.31	.382	.236
North Dense	1,630	138	6.75	7.63	.383	.376
Sparse	1,772	381	5.25	9.63	.303	.341
Mean	1,409	278	6.38	7.61	.309	.305
Significance[1]	**		N.S.		N.S.	

[1] This significance is based on observations that the two areas were alike prior to treatment. (** Significance at 1 percent level).

Treatment resulted in a five-fold increase in forage yield. Quality of forage with respect to crude protein and phosphorus content was not affected by the treatment.

Further study is underway to identify the particular factors responsible for greater plant growth under a canopy of dead blue oak trees *vs.* a canopy of live trees.

Summary

A field trial was established in blue oak-annual grassland to measure the quantity and quality of forage produced after killing blue oak trees using undiluted 2,4-D amine in a cut surface application technique.

LITERATURE CITED

ANONYMOUS. 1955. Official procedure No. 2.23. Improved Kjeldahl method for nitrate-free samples. A.O.A.C., Ed. 8.

BISWELL, H. H. 1950. Brush control in California. Report Second Cailf. Weed Conf. Pomona, 23-28.

CORNELIUS, D. R. AND C. A. GRAHAM. 1951. Selective herbicides for improving forest ranges. Jour. Range Mangt. 4: 95-100.

EVANS, R. A. AND R. M. LOVE. 1957. The step-point method of sampling—a practical tool in range research. Jour. Range Mangt. 10: 208-212.

JEPSON, WILLIS, L. 1910. The silva of California. Memoirs of Univ. of Calif. Vol. 2. Univ. Calif. Press, Berkeley. 480 pp.

JONES, B. L. AND R. M. LOVE. 1945. Improving California ranges. Calif. Agri. Exp. Sta. Circ. 129. 48 pp.

LEONARD, O. M. AND C. E. CARLSON. 1955. Chemical brush control techniques. Calif. Dept. of Nat. Resources, Div. of Forestry. 12 pp.

LEONARD, O. M. AND W. A. HARVEY. 1956. Chemical control of woody plants in California. Calif. Agri. Exp. Sta. Bul. 755. 40 pp.

LOVE, R. M. AND B. J. JONES. 1947. Improving California brush ranges. Calif. Agr. Exp. Sta. Circ. 371. 38 pp.

TOTH, S. S., A. L. PRINCE AND D. S. MIKKELSEN. 1948. Rapid quantitative determinations of eight mineral elements in plant tissue by a systematic procedure involving uses of a flame photometer. Soil Sci. 66: 459-466.

VEIHMEYER, F. J. 1953. Use of water by native vegetation versus grasses and forbs on watersheds. Trans Amer. Geophysical Union. 34 (a): 201-212.

Have You Paid Your 1959 Dues?

If you have not paid your 1959 dues, please mail them promptly to the Executive Secretary, P. O. Box 5041, Portland 13, Oregon. Prompt payment of your dues will prevent suspension as of February 15, will insure that you will receive all copies of the Journal, and will save your Society considerable expense.

JOHN G. CLOUSTON
Executive Secretary