

Sprout Growth of Shrub Live Oak as Influenced By Season of Burning and Chemical Treatments

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Burning of chaparral followed by establishment of perennial grasses through reseeding may result in significant but often temporary increases in grazing capacity of chaparral rangeland (Glendening and Lillie¹). The general practice has been to burn in late spring, although fall burning is now being tested on an experimental basis (Lindenmuth and Davis, 1962). Seeding is usually done immediately in the ash or at any rate before onset of summer rains.

While seeding burned chaparral has been somewhat successful in establishment of grass, the recovery of sprouting chaparral species in general, and of shrub live oak (*Quercus turbinella* Greene) in particular, has been shown to be rapid. For example, on one large burned and seeded area recovery of brush species after seven years allowed them to reoccupy the site to the virtual exclusion of the grass (Pond and Cable, 1962). Measurements on other similar areas in central Arizona show that follow-up treatments with chemicals, fire, mechanical devices or some combinations of these, will be necessary to effect any permanent conversion from brush to grass. Recent tests indicate that use of chemical desiccants will permit a prescribed burn to be made at seasons of the year other than

late spring or early summer when the chaparral reaches its maximum flammability under natural conditions (Lindenmuth and Glendening, 1962). This practice would greatly reduce the danger of fire escapes resulting from a prescribed burn. With this in mind, the following study was conducted to determine whether any differences in amount and vigor of sprouting of shrub live oak could be detected among various dates of top removal. A second objective was to determine whether the amount of sprouting after burning differed from that after mechanical top removal. Finally, chemical treatment of sprouts was included to evaluate the effect of chemical spraying on sprout regrowth.

Materials and Methods

The study was conducted on the Sierra Ancha Experimental Forest in central Arizona within a chaparral stand dominated by shrub live oak of moderate stature. On each of four dates, 60 individual shrub live oak bushes were marked and designated as plots. The bushes were then grouped into 30 pairs. Each pair was selected on the basis of proximity; that is, the first two marked bushes encountered were a pair, as were the second two bushes, and so forth, regardless of size. The bushes were then clipped to ground level with pruning shears and the tops removed from the plot. The 30 pairs of bushes were then divided into ten replications. One member of each pair was selected by flip of a coin for burning. Heat was applied with a kerosene-fueled torch to all stem bases in the area formerly occupied by the canopy of the bush (Figures 1 and 2). The intent was to heat all organic matter present to a red glow.

Clipping and burning were done at four seasons of the year.



FIGURE 1. Burning area formerly occupied by shrub live oak. Untreated shrubs in background.

¹ Glendening, George E., and Lillie, D. T. *Ecological aspects of chaparral control in Arizona. Manuscript in files, Rocky Mountain Forest and Range Experiment Station, Tempe, Arizona.*



FIGURE 2. Upper: Appearance of plot after clipping and burning. Lower: Plot which received only the clipping treatment.

The chemical follow-up treatments were subsequently applied when the five longest sprouts per clump averaged about 12 inches in length. The chemical treatments were 4 lb/A of the propylene glycol butyl ether (PGBE) ester of 2-(2, 4, 5-trichlorophenoxy) propionic acid² (silvex) and 6 lb/A of the dimethyl amine salt of 2, 3, 6-trichlorobenzoic acid³ (2, 3, 6-TBA). Thus, six combina-

tions of treatment were applied in ten replications of a split-plot experimental design, at each of four seasons of the year as follows:

² Chemical furnished by Dow Chemical Company, Midland, Michigan.

³ Chemical furnished by E. I. duPont deNemours and Company, Wilmington, Delaware.

1. Clipped
2. Clipped and burned
3. Clipped and regrowth sprayed with silvex
4. Clipped and regrowth sprayed with 2,3,6-TBA
5. Clipped, burned and regrowth sprayed with silvex
6. Clipped, burned and regrowth sprayed with 2,3,6-TBA

The dates of the top removal treatments and their corresponding chemical follow-up applications were as follows:

<i>Clipped and burned</i>	<i>Sprayed</i>
May 6, 1960	Sept. 9, 1960
June 30, 1960	Nov. 1, 1960
Sept. 7, 1960	June 9, 1961
Oct. 31, 1960	June 9, 1961

Sprouts were counted at the time of chemical treatment. Fresh weights of sprouts clipped at ground level were recorded on August 28, 29, and 30, 1962, approximately 14½ months after the last spray treatments.

Results and Discussion

The pre-spray counts of shrub live oak sprouts (Table 1) do not show consistent differences between clipping and clipping followed by burning. None of the comparisons were significant at the 5-percent probability level, although the comparison for September 7, 1960, is significant at the 10-percent probability level. This, together with the fact that the number of sprouts on the clipped and burned plots exceeded those on the clipped plots in three of the four cases, may indicate stimulation of sprouting by burning. Pond and Cable (1960) found burning alone to increase number of stems (sprouts) per clump.

There were no significant differences in the number of sprouts resulting from the May, June, and October treatments; but all three differed significantly from the September treat-

Table 1. Number of sprouts per bush resulting from top removal by clipping or clipping followed by burning at various seasons of the year.

Date of treatment	Date of Evaluation	Number of Sprouts ¹		
		Clipped and burned	Clipped only	Date-of-treatment mean
May 6, 1960	September 8, 1960	64	46	55
June 30, 1960	October 24, 1960	69	84	77
September 7, 1960	June 9, 1961	138	103	121
October 31, 1960	June 9, 1961	57	40	48
Treatment Mean		82	68	

¹Counts were made when the five longest sprouts per plot averaged approximately 12 inches in height.

ment. The number of sprouts increased from May through September and then dropped to a low point when tops were removed in October. Reasons for the differences in date-of-treatment means are not definitely known. The large number of sprouts resulting from the September treatment possibly reflects the initiation of many buds due to favorable soil moisture and temperature conditions during the immediate regrowth period, and the October low may be due to the onset of low winter temperatures following treatment. The small amount of sprouting after the June treatment was doubtless influenced by the lack of soil moisture which extended into mid-August. The low average count of 55 sprouts resulting from the May treatment could reflect the influence of top removal immediately following a period of maximum vegetative growth.

The mean fresh weight of sprouts in August 1962, after chemical follow up, showed a significant difference between all dates of top removal except the May 6, 1960, vs. the June 30, 1960, comparison (Table 2). Because all plots for each treatment date were grouped together, the between-date comparisons may have been confounded with site effects. However, since each of the four groups was on a relatively flat mesa with no plot more than 300

yards from any other, and the overall mean for each date of treatment represents 60 bushes, the greater sprout weights for the two spring dates appear

valid. The ratios of the differences among the unsprayed checks are similar to those among the overall means. This indicates that date of chemical follow up did not greatly influence the comparison.

The September date of top removal was associated with the greatest number of sprouts at the time of chemical follow up (Table 1), and with the least weight of sprouts after chemical treatments (Table 2). This may be due to the greater use of root carbohydrates during the two growing seasons between top removal and chemical treatment dates. It could also reflect a weakness of "numbers of sprouts" as a criterion for evalu-

Table 2. Weight of shrub live oak sprouts following chemical spraying of regrowth after top removal by clipping and burning treatments.

Date of top removal	Follow-up Chemical Treatment		Sprout Production by Treatments ¹				
	Date	Herbicide	Rate	Top-removal Method			Date- of-top- removal mean ²
				Clipped	Clipped and burned	Mean	
			Lb/A	Gr.	Gr.	Gr.	Gr.
5/ 6/50	9/ 9/60	Silvex	4	171	262	216	
		2,3,6-TBA	8	238	336	287	
		None	0	450	655	552	
		Mean		286	418		352
6/30/60	11/ 1/60	Silvex	4	338	210	274	
		2,3,6-TBA	8	446	309	377	
		None	0	748	611	680	
		Mean		511	377		444
9/ 7/60	6/ 9/61	Silvex	4	36	67	52	
		2,3,6-TBA	8	131	87	109	
		None	0	220	197	209	
		Mean		129	117		123
10/31/60	6/ 9/61	Silvex	4	184	185	185	
		2,3,6-TBA	8	79	76	77	
		None	0	197	184	191	
		Mean		154	148		151
Top-removal-method		mean		270	265		

¹Harvested August 28-30, 1962.

²Differences between all combinations of "date of top-removal" means are highly significant, except September 7 versus October 31, 1960 (significant at .05 level) and May 6 versus June 30, 1960 (not significant).

ating regrowth. Though not determined, it is possible that the larger number of sprouts actually weighed least at the time of counting.

Tests of chemical desiccation followed by prescribed burning in the Arizona chaparral have been concentrated largely in the late-summer to early-fall period to take advantage of the more favorable fire-safety conditions at that time. The data from this study indicate that fall burning, followed by chemical spraying the next spring, offers the additional advantage of less vigorous regrowth and may thus have practical application in chaparral management.

Weight of sprouts was generally unaffected by method of top removal. However, there was a significantly greater weight of sprouts on the clipped and burned than on the clipped-only plots for the May 5, 1960, treatment. There were no significant differences for any of the other treatment dates. The overall mean weight of sprouts on plots that were clipped only was 270 grams as compared with 265 grams on the clipped and burned plots.

Chemical follow-up treatment of sprouts with 2,3,6-TBA or silvex reduced sprout weight to less than half that on the unsprayed plots. Fresh weight of sprouts averaged 197 grams on sprayed plots and 408 grams on unsprayed plots. Comparisons of unsprayed with sprayed plots

were significant for all dates of treatment.

The overall fresh weight of sprouts averaged 181 grams on silvex plots and 213 grams on 2,3,6-TBA plots. The difference was not significant although weight of sprouts was greater on the 2,3,6-TBA plots on three of the four treatment dates. Weight of sprouts for the October 31, 1960 treatment was significantly greater on the 2,3,6-TBA plots.

Summary

During 1960, on each of two spring and two fall dates, 60 individual shrub live oak bushes were selected and clipped to ground level. The bushes were divided into 10 replications, each consisting of three pairs. The stem bases of one member of each pair were burned. Later, when the five longest sprouts per bush averaged about 12 inches in length, one each of the three pairs was (a) sprayed with 4 lb/A of PGBE ester of silvex; (b) sprayed with 6 lb/A of the dimethyl amine salt of 2,3,6-TBA; or (c) left unsprayed.

Sprouts were counted at the time of chemical follow-up treatment. The sprouts were harvested and weighed the end of August, 1962, 14½ months after the last spray application.

At the time of chemical follow up, there was a significantly greater number of sprouts on plots where the top-removal treatment was applied during early fall (September 7), but no

differences among other treatment dates. The difference between plots that were clipped only and those clipped and burned was not statistically significant.

At 14½ months after chemical follow up, fresh weight of sprouts from the two spring dates of top removal was more than twice as great as that from the two fall dates. There was no consistent difference between the two chemical treatments, but both reduced sprout weight to less than half that on the unsprayed plots. Weight of sprouts was nearly identical on the clipped plots and the clipped-and-burned plots, thus indicating that method of top removal before spraying was not important.

LITERATURE CITED

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The meaning of meekness is generally misinterpreted, for the meek who will one day inherit the earth will be only outwardly quiet, having learned the foolishness of wasteful strife with either men or facts. Within they will enjoy a serene intensity of awareness and creative thought that even now comes through to some of us once in a while.—N. J. Berri.