Forest Service Photo by Clark H. Gleason.
Wildfire in mixed chaparral.

Costs of Cont

records reveal comparative and wildfire suppression a

The cost of controlled burning—the planned application of fire to a preselected area to clear the land of unwanted brush—is considerably higher than is usually assumed.

It has been generally conceded that controlled burning is a relatively cheap means of brush control—especially on terrain unsuitable to other methods of brush removal—but there has been little information available on the actual costs of burning.

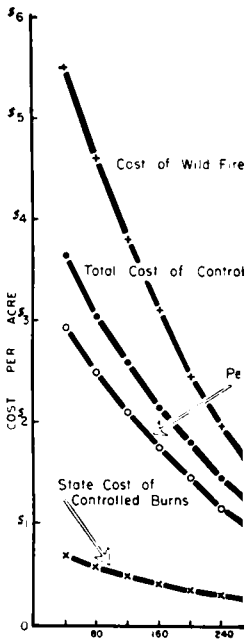
From 1945—when controlled burning became legally permissible—through 1953, a total of 3,117 permits were used by ranchers who burned 827,102 acres of brushland. In the last three years, the annual acreages controlled burned in the state were 133,855, 181,710, and 178,354. Some additional acreage is burned each year during the winter months when no permit is required.

Each controlled burn made under permit since 1945 has been recorded by the California Division of Forestry. The records include the man-hours of labor, hours of equipment-use, and other items of expense—to the rancher and to the State—on most of the burns.

An analysis of 190 records—comprising all controlled burns made in northern California during 1947 and 1948—revealed that controlled burns of 40 acres cost $3.65 per acre. The cost per acre decreased to 60¢ for burns of 440 acres and then increased to $1.20 per acre for those of 640 acres. There is some indication that the cost per acre decreases again for areas larger than 640 acres, but there was not a sufficient number of cases of larger burns to firmly establish this. Since burning costs are measurably lower per acre on areas larger than about 300 acres, cooperative controlled burns on lands of adjoining owners would reduce the per acre cost.

Although the last three years have demonstrated a trend toward more burns in the most economical size classes—about 320 to 520 acres—by far the greater number is of small, uneconomic sizes. As stockmen come to recognize more clearly the importance of site quality, it seems probable that—after controlled burning—the larger areas will be subdivided into relatively small units of superior sites for improvement by reseeding and other intensive follow-up methods, as needs indicate.

An analysis of fire-suppression costs on 513 wildfires in the foothill range area affords a comparison with costs of controlled burning under permit. These wildfires occurred during the same period as that for which data on costs of controlled burning were obtained. A sample of wildfire records was taken from the same area as that for the controlled burn. It contained the same proportion from each county, from each dominant plant association, and from each size-class as did the sample of controlled burns. The results apply only to wildfires in northern California on areas not larger than 640 acres. But this includes a great majority of them, since only about 4.8% of the wildfires in the California foothills are larger than 300 acres in size.



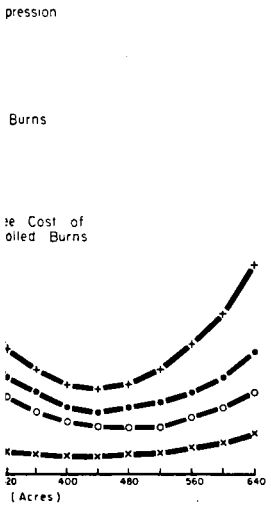
Comparison of and of wildfire C

***Left:* Area dominated by chamise where controlled burning is planned for late summer. *Right:* Same area, after controlled burn was completed.**

olled Burning

costs of controlled burns affected by acreage

L. T. Burcham and Arthur W. Sampson



of controlled burns
ression in northern
rnia.

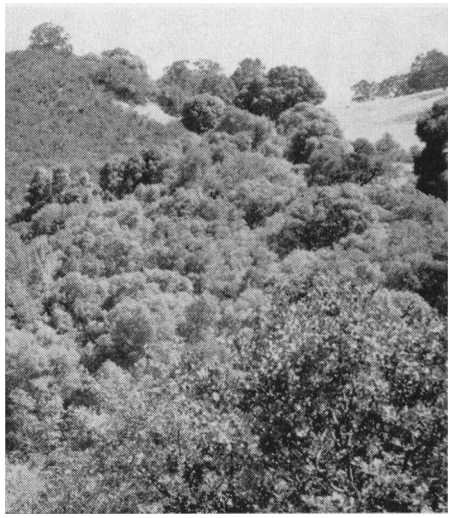
The data presented in the accompanying table and graph show that the costs per acre of controlled burning are closely comparable with those of suppressing wildfires of similar size. The costs of wildfire suppression are somewhat higher, on a per acre basis, and there is appreciably more variation between individual cases. But the spread between costs of controlled burning and of wildfire suppression is much smaller than generally supposed.

Controlled burning of brushlands has been advocated as a means of aiding in control of wildfires, on the basis that cheap, effective firebreaks would be provided thereby and that periodic controlled burning was markedly cheaper than wildfire suppression costs.

However, it is highly questionable whether controlled burning can be advocated for fire-hazard reduction on areas of appreciable size, on the basis of savings in fire-suppression cost alone.

The brush-suppression effort is directed primarily against what is commonly known as chaparral—several species of extensively branched woody shrubs, mostly evergreens with simple sclerophyllous leaves, extensive root systems, and ability to endure long periods of hot, rainless weather. In the chaparral association, dense stands of such brush are the dominant cover over extensive areas; elsewhere, chaparral species have invaded areas of woodland-grass and other plant covers.

The best available information indicates that the brush problem of the foothill ranges centers in an area of some 20 million acres lying—mostly 500′ to 2,500′ above sea level—outside the commercial timber zone. About 55%—11 million acres—of this problem area is dominated by plant covers made up chiefly of brush species, while the remaining 45% is dominated by plant covers containing mixtures of noncommercial hardwood trees, brush, and grass. It appears that the total acreage of brushland subject to some degree of economic improvement for livestock does not exceed about nine million acres.



Oak brush area indicating suitable range for controlled burning.

Only a small proportion of this acreage may be considered highly productive for forage. This estimate is a preliminary one, derived from limited information available at the present time, and is based on the character of the brush cover, soil and vegetation surveys, physiographic location of brush fields, and on the observation, study, and experience in brush manipulation and brushland management.

Legalized controlled burning has made an important contribution toward reducing the acreage burned by incendiary fires each year. Since legislation authorizing controlled burning under permit was enacted, the average annual acreage burned by incendiary fires has decreased by almost one third; during this same period there has been no significant reduction in the average acreage of man-caused fires each year nor in the proportion of incendiary fires occurring annually. There is some evidence that the

Concluded on page 15

***Left:* Burning out grass inside the control line in preparation for firing of brush. *Right:* Preparation of line for controlled burning. Line is well out in the grass, where control is easier than in the brush.**

of the collapsed trees—100%—may actually have lost some of their mineral content through leaching and therefore have a lower sodium content than the trees 75% declined.

These data lend support to previous results obtained at Riverside indicating that relatively high sodium content of roots was associated with a high degree of decline in lemon trees. Although a high sodium content of roots has been found to be associated with trees exhibiting severe decline symptoms, this is not critical evidence that sodium is the cause of decline.

A known direct cause of tree collapse is root deterioration resulting from the girdling action of sieve tube necrosis at or near the bud union. It is possible that increased sodium absorption by roots—instead of being the cause of sieve tube necrosis—may be a result of a change in the physiology of root cells. The root cells may have become depleted of reserve carbohydrates after the sieve tube necrosis—caused by unknown factors—has reduced the movement of carbohydrates from the leaves to the roots.

The question of the relationship of sodium to decline and collapse of lemon trees is being further investigated by observing the effect of varying the amount of sodium in the soil and by periodic analyses of roots in an orchard where collapse is occurring.

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The above progress report is based on Research Project No. 1544.

STOCKS

Continued from page 10

sium; the weight of the plants decreased and deficiency symptoms developed.

Stocks appear to be among those plants tolerant to sodium as well as those requiring moderate to large amounts of potassium and nitrogen.

A compilation of the information from the available experimental data suggests that 3.5% potassium in the dry leaf would appear to be a desirable amount for promoting optimum growth and flower production. However, the necessary concentration of potassium needed in the soil to maintain 3.5% potassium in the plant could not be easily determined. The reason for this seemed to be due to the influence of other cations, principally calcium, in the available fraction of the soil.

As shown by the table of correlation coefficients on page 10, calculated from the data of the field survey, the total potassium present in the plant was not correlated with the ammonium acetate extractable soil potassium—a coefficient of .050 in the top leaves; .094 in the bottom leaves. Thus it is possible for the extractable soil potassium to be high but the plant potassium to remain low or the extractable soil potassium to appear low and the plant potassium to be high.

The calcium-potassium ratio in the soil, however, produced a highly significant coefficient— –.708—as did the cation-potassium ratio— –.706—when compared with the potassium content of the lower leaves. These ratios, by comparison, greatly influenced the absorption of potassium by the plant. A high ratio—of calcium to potassium—was associated with low plant potassium and a low ratio with high plant potassium. Therefore, excessively high calcium in the presence of moderate to low potassium may decrease potassium absorption sufficiently to induce potassium deficiency. Under such circumstances as these, the soil potassium measurement alone would not necessarily reflect a true picture of the potassium needs of the plant. Sodium and calcium in the plant were found to be significantly correlated with sodium and calcium in the soil.

The value of soil analysis in predicting the availability of soil potassium for stocks appears to be indicated by the calcium-potassium ratio more than any other measurement used.

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BURNS

Continued from page 9

character of incendiary fires in the foothill range area has changed somewhat in the last eight years.

Size acres	Costs of controlled burns per acre			Cost of wildfire suppression per acre
	To permittee	To state	Total cost	
40	$2.95	$.70	$3.65	$5.50
80	2.50	.55	3.05	4.60
120	2.10	.50	2.60	3.80
160	1.75	.40	2.15	3.10
200	1.45	.35	1.80	2.45
240	1.15	.30	1.45	1.95
280	.95	.25	1.20	1.55
320	.75	.20	.95	1.20
360	.60	.20	.80	1.00
400	.50	.15	.65	.85
440	.45	.15	.60	.80
480	.45	.20	.65	.85
520	.45	.20	.65	1.00
560	.55	.25	.80	1.25
600	.65	.30	.95	1.60
640	.80	.40	1.20	2.05

The study clearly demonstrated that firing of brushlands with no plan or effort thereafter to maintain an open cover to favor invasions of desirable herbaceous vegetation is likely to be wasteful of time and money. Moreover, burning of inferior sites, such as those occupied by chamise or manzanita where the soil is thin and the slopes are steep, as is often done, is seldom profitable for livestock grazing.

There is still much room for better management of burned areas, such as reseeding for soil protection and for increasing forage yield; proper grazing use; and treatment to control seedlings and sprouts, though there is a definite trend toward an improvement of this situation. As more information becomes available, through research presently in progress, the acreage of unmanaged burns should decrease.

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The foregoing study was a cooperative project between the California Division of Forestry and the University of California, Department of Forestry research project No. 1294.

KHAPRA BEETLE

Continued from page 7

surface deposit of 1,000 micrograms per square centimeter of DDT, malathion, lindane, aldrin, dieldrin, parathion, chlordane, methoxychlor, DDD, and allethrin.

In the use of admixed dusts, 40 days were required to kill 90% of the larvae confined on wheat treated with eight ppm — parts per million — malathion dust, and at two ppm only 26% were killed. Similar experiments on the adults of rice weevil, granary weevil and lesser grain borer when exposed nine days to wheat treated with two ppm malathion dust resulted in 100% kill.

In the fumigation experiments, several times as much acrylonitrile or methyl bromide was required to kill 95% of the larvae as was required to kill adults of the rice weevil, granary weevil and lesser grain borer.

Both the contact and fumigation tests were conducted on larvae collected at Imperial in early March 1954, and these may have been overwintering larvae which are possibly more resistant to insecticides than the more active larval stages.

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