MATERIALS REMOVED, LABOR REQUIRED, AND CALCULATED COSTS OF MANIPULATION ON FOUR TENTH-OF-AN-ACRE PLOTS IN SECOND-GROWTH GIANT SEQUOIA.

Material removed	Plot 1	Plot 2	Plot 3	Plot 4
Number of live trees cut	41	125	93	119
Number of dead standing trees cut	17	55	36	112
Total trees cut	58	180	129	231
Estimated weight of dead material (lbs)	3,225	3,965	5,070	1,770
Estimated weight of live material (lbs)	20	1,235	730	1,600
Total weight of material burned	3,245	5,200	5,800	3,370
Man-hours of labor				
Man-hours required to cut standing trees* (with chain saw)	0.42	0.83	1.33	1.50
Man-hours required to buck up material (with chain saw)	1.67	0.84	1.67	0.74
Man-hours to pile material on fires	1.30	1.96	1.43	1.45
Man-hours to tend fires and complete burning	0.37	0.97	0.45	0.47
Total man-hours	3.76	4.60	4.88	4.16
Number of fires built on plots	7	9	5	7
Calculated costs (Labor at $2.38 per hour, chain saw at $2.00/hr.)				
Labor to cut standing trees	$1.00	$1.98	$3.16	$3.57
Chain saw costs for standing trees	0.84	0.84	1.32	1.50
Total thinning costs	$1.84	$2.82	$4.48	$5.07
Labor for bucking up material	3.97	2.00	3.97	1.76
Chain saw costs for bucking up	1.68	0.84	1.68	0.74
Total bucking up costs	$5.65	$2.84	$5.65	$2.50
Labor for piling material	3.09	4.66	3.40	3.45
Labor for tending fires	0.88	2.31	1.07	1.12
Total costs (supervisory costs not included)	$11.46	$12.63	$14.60	$12.14
Cost per ton of material removed	7.07	4.85	5.03	7.23

* A two-man crew on chain saw with the exception of cutting standing trees on plot 1 where only one man was needed.

fore the white man intervened. Increasing the reproduction of giant sequoia is not a special objective of the manipulation on this forest, although some may result from the disturbances. The forest is well stocked with second-growth redwood, far more than are necessary to replace those which were logged off.

To determine the man-hours of labor required to perform the minimum treatment, four tenth-of-an-acre plots were marked off for manipulation. Plots were selected where debris, dead trees, or understory trees were fairly representative of maximum conditions encountered. A careful record was made of the time required to perform each step in the manipulation operation. Weight of material to be burned was estimated, after a period of training with scales.

The results obtained are presented in the table. Assuming a labor cost of $2.38 per hour and chain-saw cost of $2.00 per hour, the calculated cost ranged from $114 to $146 per acre. This does not include costs of supervision, etc. These figures approach the maximum cost since few areas would have more material to dispose of. The average amount of fuel removed from the four plots was 44,040 lbs per acre. The average number of trees cut per acre were: living, 945; dead, 550.

While the cost of treatment appears high, it should be borne in mind that the manipulation removed 80 years' accumulation of debris and lowered the fire hazard conditions for many years to come. Also, there has been an improvement in aesthetic values. No monetary value can be placed on giant sequoias because they are a priceless heritage to be preserved at almost any cost.

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GREENHOUSE DIAGNOSE PROBLEMS

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Greenhouse tests point to potassium deficiency as the probable cause of "bronzing" of sugar beets in Delta soils, and indicate that responses to lime may be due in part to increased uptake of nitrates because of enhanced microbial activity.

BRONZING SYMPTOMS in sugar beets grown on acid organic soils of the Sacramento-San Joaquin Delta have been observed for many years. As these symptoms develop, sugar beet leaves are commonly smaller than normal, dark bluish-green in color, and may show a graininess when held up to bright sunlight. Later, leaves develop a brownish or bronze color, and older leaves may die prematurely. Often, brown necrotic areas occur around the margins of leaf blades.

For study of the bronzing problem in the greenhouse, an Egbert muck soil was collected from an area in a sugar beet field where bronzing symptoms had appeared. The characteristics of the soil were: pH, 5.0; exchangeable potassium, 80 ppm; and water-soluble phosphorus, 0.5 ppm. The potassium and phosphorus values are below critical levels for beets.

For greenhouse assay, the soil was divided into lots which received the following treatments: check—untreated; 200 ppm phosphorus (dry-soil basis) as mono calcium phosphate; 200 ppm potassium as potassium sulfate; and phosphorus plus potassium. Lime—calcium carbonate—at the rate of 10,000 ppm was added to half of each treatment. These test soils were placed in 6-inch clay pots and sugar beets grown in them. Nitrogen was applied to all pots several times in an attempt to maintain an adequate supply during the growing period. The initial N application was as ammonium sulfate; subsequent additions were as ammonium nitrate.

ASSAYS SUGAR BEET IN DELTA SOILS

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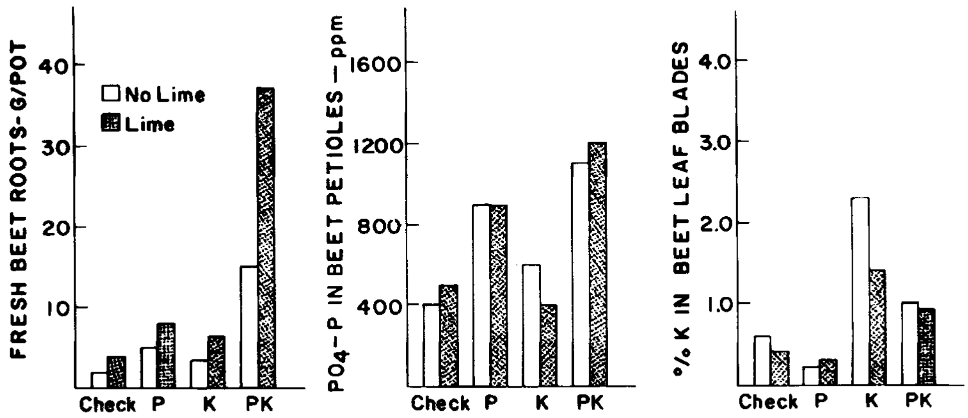

Graph 1. Egbert muck data, showing weights of beet roots (left), PO_4-P in the beet petioles (center), and K in the leaf blades (right).

Beet root weights and plant analysis data are shown in graph 1. In both the limed and unlimed series, there was little growth response to phosphorus or potassium when either was applied singly, but simultaneous additions of P and K caused striking increases in growth, indicating that this soil was seriously deficient in both nutrients. When lime was added with phosphorus and potassium, a further striking growth response occurred. One of the possible reasons for this increased growth may be an increased release of nitrogen, caused by the effect of liming on microbial activity. Apparently, the nitrogen additions, alone, were not sufficient to keep the plants from becoming nitrogen deficient.

The results of the plant analyses correlate well with the observed growth responses (graph 1). Where P was omitted, PO_4–P concentrations in the petioles were below the critical level of 750 ppm. Where K was omitted, the K concentrations in leaf blades were below the critical level of 1%. Bronzing symptoms occurred only on the check and P treatments but not where K was supplied.

Field samples of beet leaf tissue indicated that bronzed plants had a higher level of manganese than non-bronzed plants. To test the possibility that bronzing might be due in part to high concentrations of manganese in the plant, 2,000 ppm of manganese sulfate were added to all pots, after which they were again planted to sugar beets. As before, bronzing occurred only when potassium had not been applied, despite a concentration of 2,700 ppm Mn in leaf blades of plants fertilized with phosphorus and potassium. In addition, bronzing symptoms or toxic effects could not be produced by large applications of aluminum sulfate (2,000 ppm), iron sulfate (2,000 ppm), zinc sulfate (500 ppm), or strontium chloride (1,000 ppm)—if adequate P and K were supplied. No toxic effects occurred, even when all of these materials were added to the same pot.

Lime causes N release

In a 1960 field experiment in a Ryde clay loam soil on Ryer Island, sugar beets responded to an 8.5-tons-per-acre application of "sugar beet lime," which is a by-product of the sugar refinery. Since sugar beet lime contains approximately 0.3% P, and 0.4% K it was of interest to know whether the response was to these nutrients or to some other effect of the sugar beet lime. Soil was collected from this field and brought to the greenhouse for assay. Chemical analysis of the soil indicated the following: pH, 4.5; exchangeable K, 202 ppm; water-soluble P, 0.5 ppm. Based on this analysis, we would not expect sugar beets to respond to potassium fertilization but would expect a response to phosphorus.

A greenhouse trial was established with the same treatments used for the previous experiment. As expected, the sugar beets responded to phosphorus but did not respond to potassium (graph 2). There was a significant response to lime. Analysis of sugar beet petioles showed that whenever lime was applied the nitrate-nitrogen content of the petiole tissue increased markedly. The very low concentration of nitrate-nitrogen in petioles of plants that had received P and K but no lime (compared with the more than twofold increase in nitrate-nitrogen concentration in plants that received P and K plus lime) indicates that the lime response was indirectly due to an increase in the nitrogen supply.

In summary, these greenhouse studies indicate that the bronzing problem in sugar beets grown in an Egbert muck soil was due to potassium deficiency. Concentrations of manganese in beet leaves approaching 3,000 ppm did not appear to be toxic. On a Ryde clay loam soil, phosphorus was the principal deficiency. Liming acid-organic soils tends to increase the nitrogen supply.

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Graph 2. Ryde clay loam data: weights of beet roots (upper left), NO_3-N in petioles (upper right), PO_4-P in petioles (lower left) and K in leaf blades (lower right).