

SEQUOIA AND DEERBRUSH SEEDLING RESPONSE TO 1969 BURNING AT REDWOOD MOUNTAIN

Plot No.	Size acres	Mature sequoia*		Seedling sequoia		Seedling deerbrush	
		no. per plot	no. per acre	no. per transect	no. per acre	no. per transect	no. per acre
Burn #1	3.75	11	2.9	138	7,514	120	6,534
Burn #2	6.10	28	4.6	337	18,350	53	2,886
Burn #3	6.25	58	9.3	737	40,130	4	218
Burn plots totals	16.10	97		1,212		177	
Means			6.0		21,998		3,213
Control	5.30	31	5.8

* Trees more than six feet diameter at a height of 4.5 ft.

lings germinating in plot 3 were probably related to both ideal seedbed conditions and heavy seedfall. From 50 to more than 200 seedlings were counted in a number of the 4-ft-square microplots. The greater numbers of deerbrush seedlings on the lightly burned area is explained by the fact that heavy burning conditions destroy seeds, while lesser temperatures crack seed coats and allow germination.

In addition to deerbrush, smaller numbers of littleleaf ceanothus and greenleaf manzanita were also found on the burn plots. A few seedling white fir germinated in each burn area, thus confirming earlier findings that white fir also benefit by conditions following burning. For giant sequoia, however, such conditions are almost essential.

Dry weight samples of ground fuels from unburned sites adjacent to the burned plots indicated that more than 12 tons of flash fuels and 36 tons of duff are found per acre in this giant sequoia forest, prior to burning. This does not include logs more than 12 inches in diameter. After burning, samples from

heavy and moderately burned segments of the burn plots indicated about 2 tons of flash fuels per acre and 7½ tons of duff per acre remained. This is an 80 per cent decrease in ground fuels, presumably resulting in a considerable decrease in fire hazard in the area.

These results confirm the importance of fire in the early stages of establishment of giant sequoia and various brush species found in the mixed conifer forest in California. The Park Service policy of trying to restore natural environmental processes to natural areas of the national parks should (1) aid the re-establishment of shrubs as a significant part of the habitat of these montane forests, (2) insure a continual supply of young sequoias to replace the 2,000-year-old mature trees, and (3) decrease the unnaturally high fire hazard in these forests.

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The extreme density of sequoia seedlings which germinated in certain areas after burning is shown in this photo of a 1-sq-ft sampling frame. More than 50 seedlings are shown here.



MECHANICAL

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HARVEST TRIALS were started in Ventura County in February, 1970 using several citrus varieties at various stages of fruit maturity. Some tests were made with the catching frame shaker, but most of the trials were with the Mono-Boom trunk shaker (see photos). Both shakers were manufactured by Orchard Machinery Corp.

Variations in shaker frequency of stroke, duration and number of shakes, plus different tree attachment heights were tried. The amount of fruit removal varied between varieties and even between different trees of the same variety. The amount of crop on the tree and the maturity, length, and structure of main scaffold branches, plus the length of the fruit-bearing twig itself, affected ease of removal. Where crops of both ripe fruit and young fruit occurred on the tree at the same time—as in Valencias, lemons, and young grapefruit—there was often excessive damage and loss of the next season's crop.

Amount of fruit damage varied with variety. Navels showed the most rind damage from limb punctures. Rind damage and rot while in storage was fairly high for lemons. Damage to Valencias and grapefruit—while higher than for hand-picked fruit—was commercially acceptable. Stem separation on all varieties was generally acceptable. Very often the break occurred at, or just inside the button. Most shake-harvested fruit retained the button, except grapefruit.

Since most of California's citrus is sold fresh, methods of mechanical harvest should not cause excessive rind damage. Numerous trials with fungicides to in-

SHAKING TRIALS

CITRUS HARVESTING

VENTURA COUNTY

R. M. BURNS

Preliminary shaking tests in 1970 for citrus harvesting in Ventura County did not produce the desired percentage of fruit removal without damage to fruit or foliage. There was excessive damage to mature navel oranges during removal, and also damage to small green Valencia oranges, grapefruit, and lemons that would have matured into the next season's crop. However, separation of mature fruit from the stem was acceptable for all varieties. Further equipment modifications and abscission chemicals will be necessary to provide efficient harvesting of more mature, good quality fruit with less damage to the immature fruit that should remain on the tree. Research is continuing with growth regulators to find a successful abscission-producing material that would loosen the mature fruit—with minimum peel damage—as an aid to shake-harvesting. Successful commercial abscission trials using cycloheximide on oranges have recently been reported in Florida.

hibit decay indicate that a slight amount of rind damage can be tolerated. Benlate (benomyl) is one of the newer materials which has been successful in inhibiting decay in stored fruit.

In the Valencia orange and lemon trials, the fruit was subsequently processed at the packing house. Facilities were not available for commercial grapefruit packing, and the rind damage on

navel oranges was so high that it ruled out processing and storage.

Lemon shake-harvest

Mature lemons at the Leavens Ranch near Santa Paula were the first trees to be shake-harvested (February 18, 1970) in these tests. The fruit was almost completely removed with the catching frame shaker—four field boxes per tree. Unfortunately this included much of the small and immature fruit—thus ruling out the possibility of any appreciable harvest later in the season. However, an evaluation of the trees seven months later did show moderate to heavy fruit set for the coming winter and spring harvest.

More extensive trials with lemons were made in March 1970 on the Limoneira Ranch near Santa Paula. Heavy shaking produced an average of five boxes of mature fruit per tree and approximately 0.8 box of small and medium-sized green fruit. Moderate to heavy leaf and twig damage also occurred.

Navel orange tests

Mature navel orange trees at the Camulos Ranch in Piru were shake-harvested in February 1970 with both the catching frame and trunk shakers. Initial tests were on the less vigorous trees which were affected with quick decline (Tristeza virus). These trees had been selectively hand harvested prior to shaking and the shaking operation removed only a moderate amount of the fruit which had been left on the tree.

Subsequently, three mature navel orange trees in an adjacent block, unaffected by Tristeza, were shake-har-

vested. The catching frame was used exclusively on the first two trees and the trunk shaker was used after an initial catching-frame shake on the third tree. A little over 50% of the total crop was removed. Pruning might have helped fruit removal since much of the fruit was on long hanging limbs, and was difficult to remove by shaking. Fruit damage caused by limb punctures on the rind was excessive. Storage tests comparing hand-clipped with shake-harvested fruit showed 40% rot in the shaken fruit compared with 1.5% rot in the hand-clipped fruit.

Valencia trials

On February 26, ten mature Valencia orange trees were shake-harvested at the Camulos Ranch. Fruit in this block had been heavily damaged by the freeze in December, 1968, and had not been harvested. The object of this harvest was to shake off frozen fruit so the 1970 crop could mature normally. Shaking with the Mono-Boom trunk shaker resulted in an average removal of 3.8 field boxes per tree of the older frozen fruit and only 0.5 field box per tree of the young 1970 crop. This practice is suggested for growers as an economical method of frozen fruit removal. No skirt pruning is necessary since no catching frame is used.

The most extensive Valencia shake-harvest trials were at the Limoneira Ranch near Santa Paula. Periodic tests were made from May to September of 1970 on a block of 33-year-old Valencia trees. The first test on May 23 resulted in removal of less than 70% of the mature fruit being harvested with the trunk



OMC tree (trunk) shaker used in most of citrus fruit harvest trials in Ventura County during 1970. Picture taken in July 1970 in a Valencia orange block at the Limoneira Ranch near Santa Paula.

shaker. There was also a moderate amount of thinning of the small ($\frac{1}{4}$ - to $\frac{3}{8}$ -inch diameter) fruit for the 1971 season.

A shaking of Valencia trees on June 19, adjacent to those previously shaken in May, removed 60% to 70% of the mature fruit. However, many young green fruit were removed and many more remaining on the tree had excessive stem damage which would prevent maturing. This fruit was approximately $\frac{1}{2}$ -inch in diameter and June drop had already occurred. On July 17, 1970, four more Valencia trees in the same block were shaken. A higher percentage of mature fruit was removed at this date, but there was still excessive drop and stem damage on the next season's crop.

One tree shaken on September 8 produced a total of 2.6 field boxes of mature fruit. It was estimated that more than two field boxes remained on the tree. Again, many immature fruit were removed and most of those left on the trees suffered stem damage.

Four trees were shaken September 17 by the trunk shaker which had been modified so that the shaking amplitude or stroke was lengthened. Mature fruit removal was estimated at from 65% to 95%, and averaged close to 75%. However, an average of almost 300 small

green fruit was removed from each tree shake-harvested—which would seriously affect the following season's crop.

Early season trials in Ventura County on Valencias when the green fruit on the tree was pea size or smaller caused less fruit drop. However, rind scarring did occur and was evident as the fruit grew larger. As soon as the young Valencia fruit reached marble size or larger, there was excessive removal of small fruit and stem damage during harvesting.

Grapefruit shake harvesting

Two mature Frost Marsh grapefruit trees were shake-harvested on June 19 with the trunk shaker at Noel and Associates Ranch in Barsdale. This was early in the season, although fruit met legal maturity standards.

One of the two trees had been pruned heavily in the fall of 1968, and it was hoped that this would increase the percentage of fruit removal and lessen rind damage. Shaking removed six field boxes of mature fruit from each tree with an estimated one box remaining unharvested per tree. Most of the fruit came off with no stems and with the buttons still attached to the fruit. There was very little rind damage. Many immature fruit were removed as the trees were shaken.

Two boxes of fruit from each tree were

evaluated for stems and buttons. Out of a total of 141 fruit from the pruned tree, 24 had stems, 71 had buttons, and 43 were plugged or without buttons. Of 144 fruit from the unpruned tree, 30 had stems, 45 had buttons, and 69 were plugged or without stems. Fruit samples (two field boxes per tree) stored in a packing house cold room at 45°F showed very little rot after seven weeks.

On September 17, a very large 38-year-old Marsh grapefruit tree was shake harvested at Rancho Sespe near Fillmore. This fruit was at peak maturity. The trunk shaker with experimental weights giving a longer shaker stroke was used. Three relatively hard shakes removed 8.3 field boxes, or approximately 60% of the mature fruit. However, 2.2 field boxes of immature fruit, which would have matured next season, were also removed.

Fruit stem abscission

The separation of mature fruit from the stem was commercially acceptable for all varieties. A large percentage of the mature fruit shake-harvested retained the button and had no stems. In many cases, the stem separated just inside the button of the fruit.

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Catching frame tree shaker in position for shake harvest of navel orange tree. Picture taken February 25, 1970, at the Camulos Ranch in Piru.