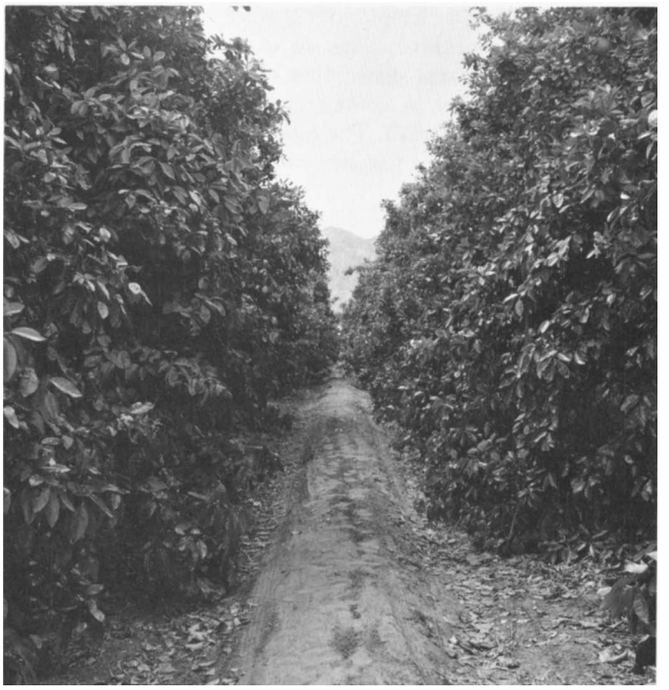
Close-planted hedgerow of desert grapefruit (planting distance 13½ × 24 ft). Trees are crowded in-row and between-row crowding is becoming a problem.



Light hand pruning has opened area between rows. Selective cuts have minimized foliage loss.

DESERT GRAPEFRUIT PRUNING AND ORCHARD THINNING TRIALS

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TABLE 1. SUMMARY OF DOLLAR RETURNS PER FIELD BOX BY ROOTSTOCK, SPACING AND YEARS—LANDES PLOT (INCLUDING ALL PRUNING TREATMENTS)

Year of harvest	Return to packing house	Packing house charges	On tree return
	Cleopatra Mandarin rootstick single-set block		
	$	$	$
1967	2.09	1.50	.59
1969	2.66	1.57	1.10
1970	2.72	1.54	1.18
Ave. '69 & '70	2.69	1.56	1.14
	Rough lemon rootstock single-set block		
1967	1.61	1.24	.37
1969	1.97	1.24	.73
1970	2.48	1.45	1.03
Ave. '69 & '70	2.23	1.35	.89
	Both rootstocks Double-set block		
1967		Not done	
1969	2.33	1.43	.90
1970	2.46	1.43	1.03
Ave. '69 & '70	2.40	1.43	.97

PULLING ALTERNATE TREES and pruning to increase the amount of sunlight available to each tree failed to increase per-acre yield or grower returns over a four-year period in a red grapefruit grove near Coachella. The grove was planted in 1956 on fertile soil at a spacing of 13.5 × 24 ft with the expectation that alternate trees would be thinned out when the grove began to be crowded. The grower originally planned to interplant trees on rough lemon alternated with trees on Cleopatra mandarin. The trees on rough lemon were expected to give high early production and to be eliminated at thinning time, allowing the Cleopatra mandarin trees to remain for the permanent orchard. By 1967 when the plot work was undertaken, no trees had been pulled, and the grove was overcrowded and too shady.

In April after the 1966–67 crop was harvested, the owner removed alternate trees from each of six rows with a chain saw. In one block of three rows, the Cleopatra mandarin trees were removed, in

TABLE 2. SUMMARY OF DOLLAR RETURNS PER ACRE/YEAR BY ROOTSTOCK AND SPACING, AVERAGE OF FOUR YEARS, 1968–71, LANDES PLOT (INCLUDING ALL PRUNING TREATMENTS)

Spacing and rootstock	On-tree return per field box*	Per-acre yield in field boxes†	Average on tree return per acre/year
	$	no.	$
Cleopatra mandarin single spaced	1.14	519	592
Rough lemon single spaced	.89	728	648
Both, double spaced (control)	.97	697	676

* Based on average of the returns from the two years 1969–70. See table 1.

† Based on actual yield, average of four years, 1968–71.

another the rough lemon trees were thinned out. In a third block of three rows, no thinning was done; this block served as the control. A commercial operator shredded the brush. The total cost was estimated at $2.50 per tree or $168 per acre.

The six replications or blocks were laid across the irrigation run to eliminate the effects of the soil and irrigation variables which were evident at the start of the experiment. The center row in each of the three row blocks was used as the record row, in which the production of each tree was obtained separately from 1967 through 1971. The individual plot size was four trees in the double set block and two trees in the thinned or single set blocks.

In 1967 the pruning treatments consisted of removal of dead wood and some interlocking branches in the hand-pruned block at a cost of 50 cents per tree. The machine-pruned trees were topped and hedged at a cost of 20 cents per tree.

In 1968 the cutting was somewhat heavier in the hand-pruned blocks, in an attempt to keep some space between trees. The cost again was 50 cents per tree. The machine topping was not repeated because of the substantial yield loss experienced from this treatment the previous year. Some light hedging was done by hand in this block.

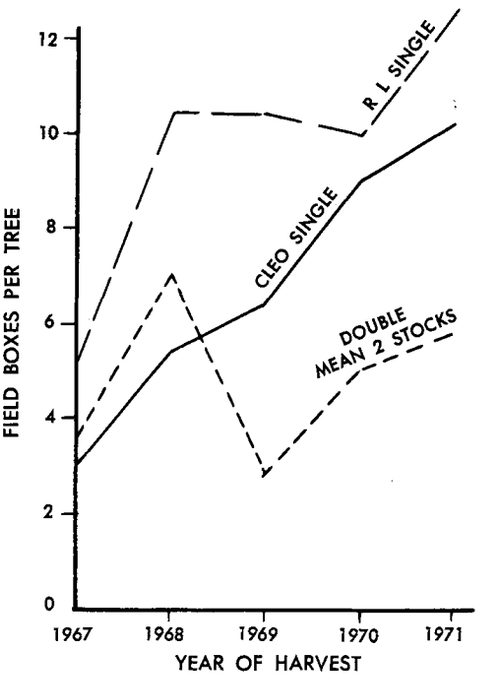
In 1969 a commercial pruning crew of considerable experience was hired to do the hand pruning at a cost of $1.57 per tree. A branch was removed from the north side of each tree top to let in more light. The machine-pruned portion was lightly hedged. There were also control blocks which were not pruned at all during the years of the experiment.

Pruning and thinning substantially improved the appearance and accessibility of the grove. Trees which had lost lower fruiting wood on the side toward the neighboring tree regained it after the adjacent tree was pulled. The pruned trees were also improved in appearance and were easier to harvest since it is possible to pick the canopy from both inside and outside. This was prevented before pruning by the dead wood in the dark interior of the tree.

However, these operations have failed to show an increase either in mean per-acre yield, or income, over the four years subsequent to thinning. Per-tree yield increased dramatically the year following thinning in the rough lemon block, and more slowly in the Cleo block, but not sufficiently to give a higher mean yield per acre over four years. Graph 2 shows that the single-set blocks produce as much fruit as the double-set on half the number of trees per acre.

None of the pruning treatments showed increases in yield or effects on fruit quality which might result in a higher return per box. There was a reduction in yield amounting to nearly half the crop in 1968 and to a lesser degree in 1969—caused by machine topping and hedging. When close planted and crowded, these trees bear a large portion of their fruit in the upper and better-lighted portions of the tree. Topping therefore depresses yield, even when not heavy (as in this case where only about 3 ft of the tallest trees were removed).

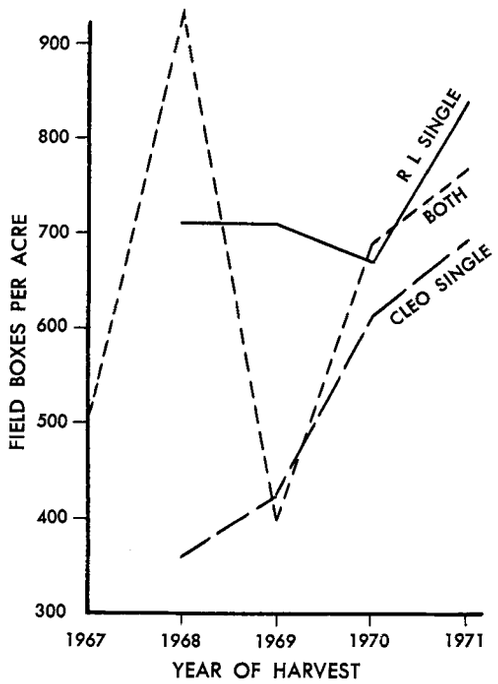
GRAPH 1. EFFECTS OF ROOTSTOCKS AND SPACING ON PER-TREE YIELD OF LANDES GRAPEFRUIT PLOT (INCLUDING ALL PRUNING TREATMENTS)



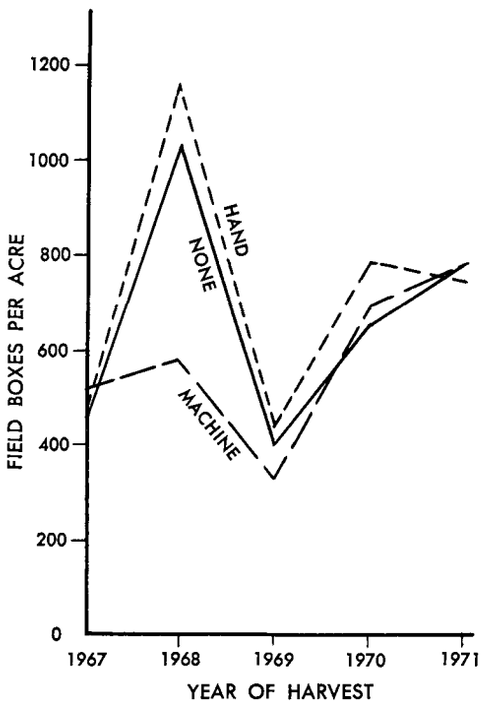
Orchard thinned by removing trees on the diagonal. Close-planted hedgerow in background.

Skirt dieback resulting from shading by adjacent tree which has been removed.

GRAPH 2. EFFECTS OF ROOTSTOCKS AND SPACING ON PER-ACRE YIELD OF LANDES PLOT (INCLUDING ALL PRUNING TREATMENTS)



GRAPH 3. EFFECTS OF PRUNING ON PER-ACRE YIELD OF LANDES PLOT (INCLUDING ALL SPACINGS AND ROOTSTOCKS)



Rough lemon

The rough lemon rootstock trees consistently yielded significantly higher than the Cleopatra mandarins. However, fruit from the two rootstocks was packed separately in each of three years, 1967 through 1969, and the Cleo fruit brought consistently higher on-tree returns per field box than either the rough lemon or the mixed fruit from the double-set block. Rough lemon, when interset with Cleo, has a disproportionately negative effect on both tree size and yield of the less vigorous Cleo. It therefore takes the trees on Cleo longer to recover an acceptable per-acre yield after the rough lemon interplants are pulled out. However, when the Cleo trees eventually occupy their full space in the grove, their yield should approximate that of the rough lemon. If this proves to be true and if the differential in return per field box persists, the Cleo trees may finally surpass the rough lemon trees in returns per acre.

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SUMMARY

In summary, this work leads to the following conclusions: (1) The number of trees per acre is not an important factor in determining per-acre yield over a considerable range in spacing, once the available space in the grove is utilized and the ground fully shaded. Increased tree count probably raises per-acre yield only in the very first years of production since adjacent trees quickly begin to compete with each other, reducing both the growth rate and per-tree yield at an early age.

(2) Pruning is not likely to increase yield in crowded grapefruit groves. Pruning may affect the location of the bearing surface and the ease of harvest. Pruning reduces yield if much leaf surface is removed, particularly if removal is from that portion of the tree receiving the most light.

(3) It then follows from points 1 and 2 that dramatic profits should not be expected from either grove thinning or pruning of grapefruit—at least over the period covered by this experiment (12 to 16-year-old trees). These operations—amounting to $168 per acre for tree removal and as much as $541 per acre for pruning (total of $2.57 per tree × 134 trees in double-set plot)—should be assessed on the basis of their effect on the appearance of the grove, the reduction of wear and tear on grove equipment and operators, the better coverage in pest control applications, greater ease in inspecting and treating trunk diseases, and the improvement of the lot of the fruit picker.

(4) Rootstocks affect both yield and fruit quality principally only in the early years of the orchard, while tree size and vigor of growth may influence both factors. These effects are not insignificant, however, especially if the time value for money is taken into account (not attempted in this article).

(5) In a double-set grove interplanted with different varieties or rootstocks differing markedly in on-tree returns, the results of this trial suggest the less profitable trees should be pulled promptly in the expectation that the per-tree yield of the more profitable trees remaining will rapidly increase, thus improving total returns.