



Typical 6-year-old Campbell Valencia on trifoliolate orange (left) and Campbell Valencia on Troyer citrange (right)—both photographed from the same relative position. Note difference in tree size and defoliation.

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Citrus Problems in West Fresno County

THE POTENTIAL for citrus on the eastern slopes of the coast range in Fresno County was stimulated about five years ago because: (1) cotton allotments were being reduced, thus creating a need for information on high-income tree crops; (2) the development of the San Luis reservoir and canal system promised good quality water for the area; (3) virgin soil was available if water was supplied; and (4) the existence of a thermal belt seemed likely. (In the past, crops on the eastern slopes of the coast range seemed to come through frost periods with little damage.)

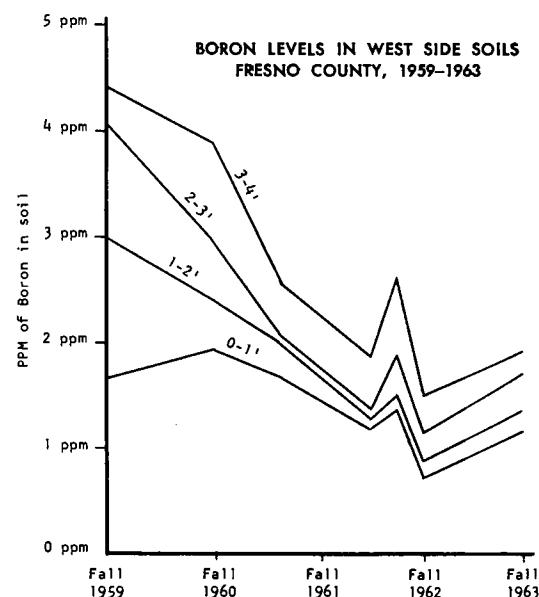
Most of the soil in this area is deep, well drained and fertile. While it has been used primarily for the successful production of cotton and other field crops, three problems with respect to citrus needed to be researched: the high boron levels (tolerated by field crops on the west side) might make citrus growing impractical; weather conditions might not be appropriate for the sensitive citrus trees; and the scion-rootstock combinations most commonly used today needed investigation regarding their adaptability to the area. Trials were started in 1959 at the Linneman Ranches at Oro

Loma and data are still being collected on the adaptability of citrus strains and rootstocks, tree growth rate, boron levels in soil and tissue, and tree reactions to both boron excess and weather conditions.

Boron levels

It has not been known whether generous amounts of water would leach the boron down below the root zone. The graph shows that during the four years of the study period, the original boron levels were reduced approximately one half. During this period the irrigation

The possibility of growing citrus crops on the eastern slopes of the coast range in Fresno County has gained considerable attention since the cotton allotment reductions. The deep, well-drained, fertile soil; a good water supply from the San Luis reservoir and canal system; and a possible thermal belt are some of the advantages found in the area. However, many questions remain to be answered. The citrus specialists at Riverside, cooperating with the Fresno County farm advisor, are currently engaged in investigations to determine whether the high boron levels in this area might preclude citrus crops; how weather conditions there would affect citrus; and which of the commonly used scion-rootstock combinations could be adapted. Preliminary studies reported here indicate: (1) that proper leaching with good quality water could reduce boron damage; (2) that high wind velocities probably can be controlled with windbreaks; and (3) that of the 47 scion-rootstock combinations observed, Valencia and navel on trifoliolate orange rootstock made the best showing. However, much research remains to be accomplished before definite conclusions can be stated.



water may have contained more boron at times than desirable for good leaching. This could account for the rises shown in the graph, though the general trend is downward. Heavier and more frequent irrigations than those applied might have hastened the boron leaching.

Scion-rootstock comparisons

A distinct difference in rootstock uptake of boron was noted between the four major rootstocks compared. Navel and Valencia trees on trifoliolate orange rootstock showed much less damage from excess boron than the other three rootstocks. This visual observation was reinforced by tissue analysis, which indicated lower boron levels in all trees on trifoliolate rootstock. Trifoliolate orange showed the least boron in excess of need; with Cleopatra mandarin, Rough lemon and Troyer citrange showing about equal amounts of boron.

In comparing the citrus scion varieties, Valencia oranges showed less severe boron toxicity symptoms than navels. Therefore, Valencia on trifoliolate orange shows mild boron toxicity symptoms, and navels on Troyer citrange and Rough lemon show severe excess boron symptoms. Excess boron symptoms were noted, and defoliation rating and photographs were made during winter months when maximum boron had accumulated in leaves. The accompanying photos show the trees at maximum leaf drop.

Growth comparisons

Trunk diameters are still being measured to establish differences in rate of growth of the scion-rootstock combinations. Trees on trifoliolate orange have grown more slowly to date than those on Troyer citrange or Rough lemon. Actual measurements showed navels on trifoliolate have trunk diameters 25% smaller than navels on Troyer and 34% smaller than those on Rough lemon. In general, trees have grown at a rate comparable to young trees in established citrus districts on the east side of the valley.

Weather data

A weather station was established at the plot site to record maximum and minimum air temperatures, wind velocity, soil temperature, relative humidity, and rainfall. Table 2 shows the extremely high winds which usually come during the month of May. High winds are notorious for causing fruit scarring and defoliation and could thus be a limiting factor in citrus production. The number of hours annually with temperatures

Typical 6-year-old Frost Navel on trifoliolate orange (left) and Frost Navel on Troyer citrange (right). Navels on all stocks show more excess-boron symptoms, and defoliation, than Valencias.

TABLE 1, EXCESS BORON AND DEFOLIATION IN ROOTSTOCKS

Scion	Rootstock	Trunk Circum. 6" above union to nearest 1/2 cm.	Boron excess* symptoms	Defoliation*	Boron in leaves (ppm)†
MARSH NUCELLAR GRAPEFRUIT	Carrizo citrange	32.5	3	3	...
	Cleopatra mandarin	31	1.4	1.5	...
	Sweet orange	31.5	1.5	1.4	...
	Troyer citrange	30.5	3	2.8	...
	Rough lemon	31.5	2	2.1	...
CAMPBELL NUCELLAR VALENCIA	Sour orange	30.5	2.5	3	...
	Cleopatra mandarin	27.5	1.4	1.2	320
	Rough lemon	31	1.4	1.3	400
	Trifoliolate orange	23.5	1.1	1	300
FROST NUCELLAR NAVEL	Troyer citrange	29.5	1.5	1.7	666
	Cleopatra mandarin	28	1.8	2.2	480
	Rough lemon	32	1.9	2.3	800
	Trifoliolate orange	21	1.3	1.3	400
DANCY TANGERINE (FROST)	Troyer citrange	28.5	2.4	2.4	700
	Cleopatra mandarin	28.5	1.7	2.1	...
	Sweet orange	33	1.7	2	...
	Trifoliolate orange	22.5	1.8	1.9	...
ALGERIAN TANGERINE	Cleopatra mandarin	25.5	1.4	1.7	...
	Sweet orange	29.5	2.7	2.0	...
FROST SATSUMA MANDARIN	Cleopatra mandarin	24	1.8	2.2	...
	Rough lemon	26.5	2.1	2.1	...

* 1 = slight.
2 = moderate.
3 = severe.

† 5-7—month—old bloom cycle leaves from nonfruiting terminals.

TABLE 2, CLIMATE SUMMARY, 1960-1963

Weather station	Total miles* of wind movement for windiest month 80 inches above ground level				Lowest minimum temperature (°F)				Annual hours 28° or below		
	1960	1961	1962	1963	1960	1961	1962	1963	1961	1962	1963
Oro Loma (Fresno Co.)	May 4462	May 4171	May 3473	May 3164	23°	25°	19°	22°	19	39	85
Lindsay (Tulare Co.)	May 575	Feb. 1095	May 524	May 799	20°	25°	20°	19°	34	141	227
Berenda (Madera Co.)	May 5872	May 5691	May 4786	June 4102	21°	24°	23°	22°	92	91	89
San Emidio (Kern Co.)	Apr. 749	June 291	May 341	June 293	22°	20°	18°	18°	67	134	87

* Figures for wind movement are useful as relative readings only—largest numbers indicate most wind movement.

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28°F and below indicates that in most years the Oro Loma station is warmer than the other three test sites with which it was being compared. Wind readings notwithstanding, the climate seems favorable for citrus growing.

Fruit production

The trees began to produce in 1964 on all selections. Generally, the fruit compares with that from any five-year-old trees in established citrus-growing areas. There is no evidence of extreme early maturity or superior fruit-holding capabilities for the trees. Grapefruit strains have the same rind-breakdown problems as on the east side of the valley. Fruit size is also comparable to that produced by the same bud lines in other areas.

These citrus trials have shown that excessive boron is a definite hazard, but that leaching with good quality water may overcome this problem. Also, high wind velocities may necessitate wind-breaks to protect the trees from foliage and fruit damage. Of the 47 scion-rootstock combinations observed, Valencia orange on trifoliolate orange rootstock has made the best showing—even though the fruit is smaller. Navel on trifoliolate roots also looks promising.

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