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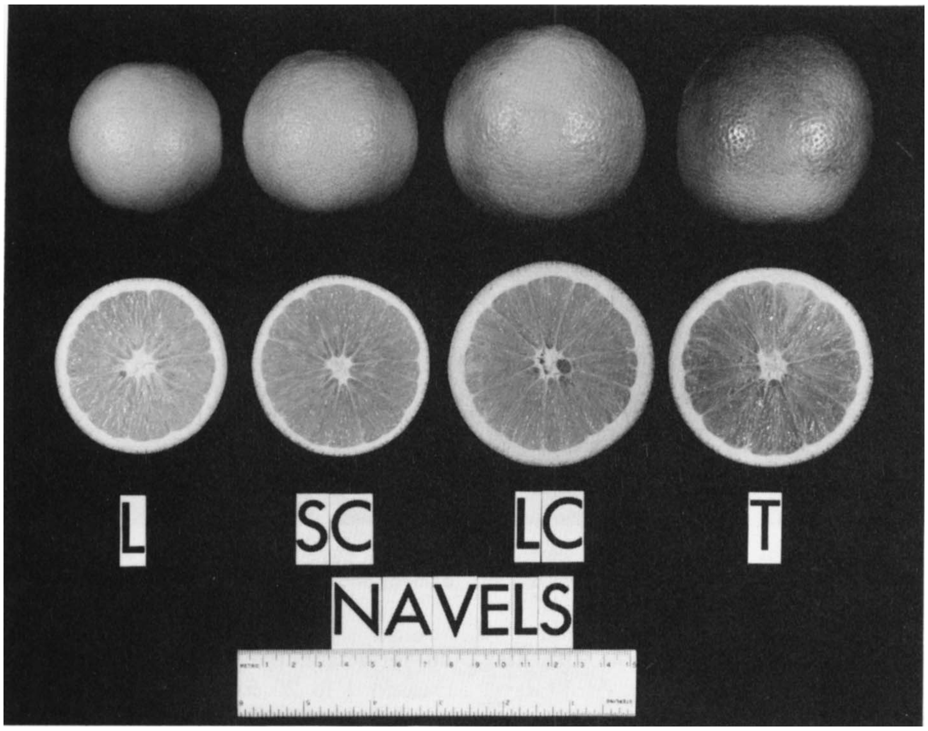

Fruit picked in early December, 1971, at Limoneira, South Coast, Lindcove, and Thermal, respectively.

CALIFORNIA MARKETS fresh oranges every week of the year, and yet grows only two varieties. This is made possible by (1) holding the fruit on the tree after it reaches legal maturity, (2) storing the fruit after picking, and (3) taking advantage of the different maturity dates in different climatic zones. The range and types of variations in fruit maturity and quality due to climatic differences in California have not yet been carefully studied and extensively reported.

One of the major problems encountered in studying the effect of climate on fruit maturity and quality is that it is often difficult or impossible to distinguish climatic effects from the results of soil differences, and differences in water quality, cultural practices, diseases, insects, annual weather variations, scion source, rootstock, tree age, and crop load. However, a number of studies in recent years indicate that climate is the most important single factor influencing variations in fruit maturity and quality within a variety—providing that the trees are reasonably well cared for; that reasonably valid estimates regarding climatic influences can be obtained even when a single, well selected orchard in each climatic zone is used, and provided that the varieties and rootstocks are comparable. These studies indicate that variance in fruit maturity and quality among climatic zones is generally greater than variance among orchards within a climatic zone.

About 10 years ago, University of California researchers at Riverside established foundation budwood source orchards in several locations in California as a part of the Citrus Variety Improvement Program. These orchards are particularly useful in studying climatic effects, since variability due to scion source and rootstock are eliminated, and other non-climatic variables are minimized.

Beginning with the 1967-68 crop year, fruit was harvested at approximately 6-week intervals throughout each season and was brought to the laboratory for maturity and quality analyses. Differences among locations were at times very striking. This first report deals with navel orange fruit collected from four trees at each of four locations, over a period of four crop seasons. Work is continuing with Valencia oranges, grapefruit, mandarins, and lemons, and will be reported later.

The locations compared were the Limoneira Ranch near Santa Paula in Ventura County, South Coast Field Station near Irvine in Orange County, Lindcove Field Station in Tulare County, and a commercial nursery near Thermal in the Coachella Valley of Riverside County. Unfortunately no comparable planting was available in an intermediate valley climatic zone such as is found in Riverside. Because of heavy fruit drop in early summer, sufficient navel orange fruit was available at Thermal during only one season, 1970–71, and no fruit was left for sampling in March. Navel oranges are not adapted to the Coachella Valley, and are not grown there commercially.

The Limoneira and South Coast locations both represent relatively cool coastal valley plant climatic zones; Lindcove is located in the hot Central Valley of California; and Thermal represents the very hot, interior low elevation desert. There were several marked differences between Limoneira and South Coast fruit, indicating the important effect of microclimate within a broad climatic zone on fruit maturity and quality. The South Coast Field Station is located on a plain and is somewhat warmer than the hillside Limoneira location. Graphs 1 and 2 compare temperature regimes for the four years of sampling from the nearest available weather station to the four fruit sampling locations.

Fruit samples were collected on approximately the same dates each season: October 27 to November 2, December 5 to 12, January 18 to 28, and March 5 to 16. Because of the distances involved, it

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NAVEL ORANGES

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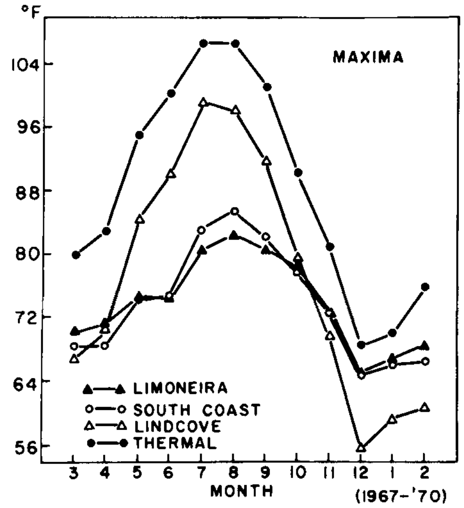
GRAPH 1. COMPARISON OF MONTHLY MEAN MAXIMA TEMPERATURES FOR THE FOUR NAVEL ORANGE FRUIT SAMPLING LOCATIONS. (Sources: Lindcove and South Coast Field Station weather records; Climatological Data, U. S. Department of Commerce, Thermal Airport for Thermal and Santa Paula for Limoneira.)



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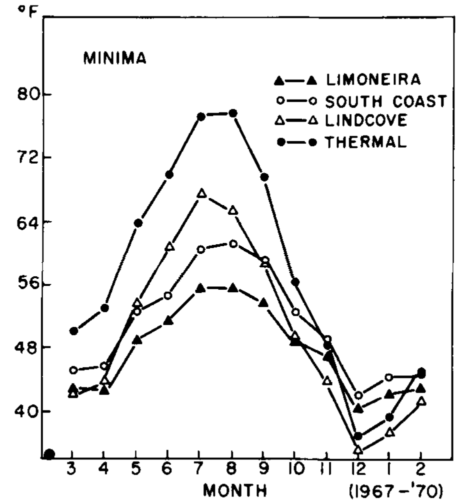


was not possible to collect all the fruit the same day.

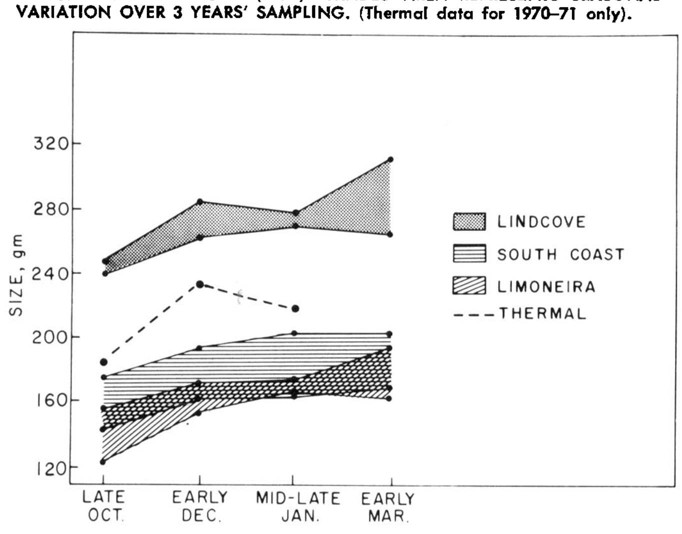
At each sampling, the fruit and extracted juice was weighed; length, width, and rind thickness were measured; and rind color, rind texture, flesh color, and flesh texture were rated. The juice was tasted and rated for palatability, and concentrations of total soluble solids, citric acid, and ascorbic acid (vitamin C) were assayed.

The photo illustrates typical differences in fruit harvested in December from Limoneira, South Coast, Lindcove, and Thermal.

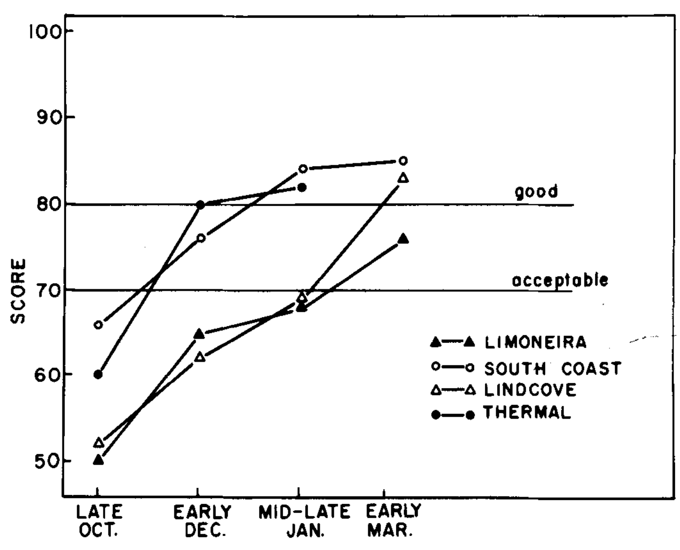
In the four years covered in this study, differences in fruit size among major climatic zones were much greater than differences among seasons (graph 3). The largest fruit was produced at Lindcove; Thermal fruit was intermediate in size, while fruit from the two coastal locations were similar in size and smaller than fruit from the more interior locations.

Fruit shape, as represented by length-width ratio, also was influenced by cli-

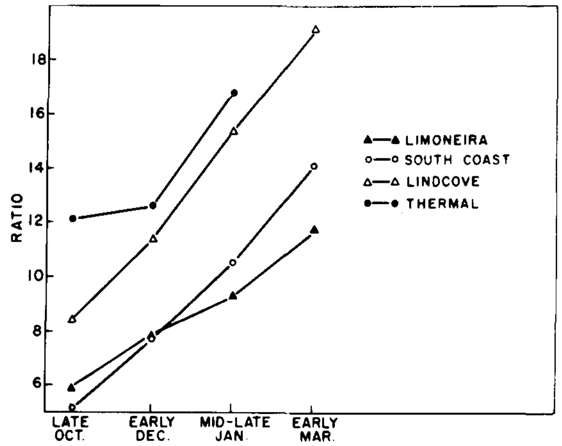
GRAPH 3. NAVEL FRUIT SIZE (GMS)—SHADED AREA REPRESENTS SEASONAL VARIATION OVER 3 YEARS' SAMPLING. (Thermal data for 1970–71 only).



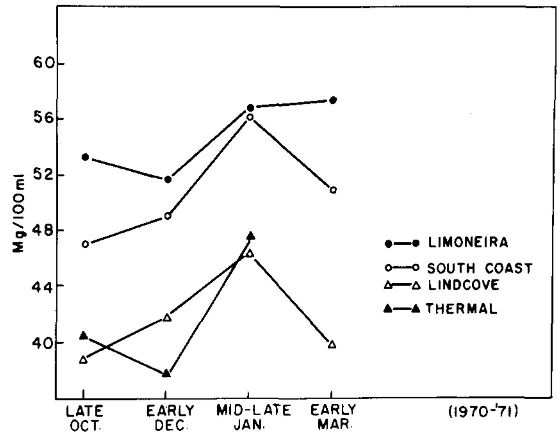
GRAPH 4. NAVEL TASTE RATINGS. (Average of three seasons except for Thermal which is 1970-71 only).



GRAPH 5. TOTAL SOLUBLE SOLIDS TO ACID RATIO. (Average of three seasons except for Thermal which is 1970-71 only).



GRAPH 6. ASCORBIC ACID (VITAMIN C) CONTENT OF NAVEL ORANGE JUICE.



matic zone more than by seasonal variations. Fruit grown in the warmer interior locations tended to be longer from button to stylar end (rounder) and those from the cooler coastal locations shorter (flatter). Average length-width ratio for all fruit harvested was: Thermal, 1.033; Lindcove, 1.019; South Coast, 0.979; Limoneira, 0.977. During the period of October to March, fruit became more elongate as size increased.

Rind color, texture, thickness

Rind color was rated by eye on the basis of a photographic color chart which ranged from dark green to reddish orange. All four locations produced good to excellent rind color for market, but the best market color developed at Lindcove. The largest color change occurred during the 6 weeks from late October to early December at all locations, coincident with the onset of chilly nights. In the period from late January to early March there was some indication of slight re-greening at Lindcove and South Coast.

Rind texture was visually rated by comparing each fruit with a series of 6 photographs of fruit ranging from very smooth to very coarse and pebbly. Fruit grown at Lindcove was coarsest, but still well within the market acceptability range. South Coast fruit was the smoothest of the four locations, while Thermal and Limoneira fruit were intermediate.

Rind thickness varied considerably more among climatic zones than among seasons. Fruit produced at Lindcove consistently had the thickest rind while South Coast fruit rind always was thinnest. Rind thickness at Thermal and Limoneira was intermediate and similar even though Thermal fruit was considerably larger than Limoneira fruit on the average.

Rind color, texture, and thickness data are summarized in table 1. These are averages for three seasons, except Thermal which is one season only.

TABLE 1. SUMMARY OF NAVEL ORANGE RIND COLOR, TEXTURE, AND THICKNESS DATA AT FOUR TEST LOCATIONS

	Rind Color Index.*				Rind Texture Index†				Rind Thickness (mm)			
	Limon.	So.Co.	Lind.	Therm.	Limon.	So.Co.	Lind.	Therm.	Limon.	So.Co.	Lind.	Therm.
Late Oct.	6.1	5.7	5.8	4.6	2.2	2.0	2.2	1.8	5.2	4.3	5.6	4.0
Early Dec.	9.6	9.4	10.5	8.2	2.0	1.7	2.2	2.4	5.1	4.3	5.6	5.3
Mid-Late Jan.	10.4	10.8	11.2	10.8	2.3	2.1	2.5	2.4	5.5	4.7	6.2	5.0
Early Mar.	10.6	10.6	10.9	—	2.3	2.1	2.8	—	5.5	4.8	6.1	—

* Color index: 4 = light green, 12 = dark orange
† Texture index: 1 = very smooth, 6 = very rough and pebbly

TABLE 2. TOTAL SOLUBLE SOLIDS, PERCENT ACID, AND SOLIDS-ACID RATIO OF NAVEL ORANGES FOR 1968–69, 1969–70, AND 1970–71 SEASONS AT FOUR TEST LOCATIONS

	Total soluble solids (%)				Citric acid (%)				Solids-acid ratio			
	Limon.	So.Co.	Lind.	Therm.	Limon.	So.Co.	Lind.	Therm.	Limon.	So.Co.	Lind.	Therm.
1968–69												
Late Oct.	11.6	9.7	9.7	—	1.72	1.58	1.15	—	6.7	6.1	8.4	—
Early Dec.	13.3	10.7	10.3	—	1.56	1.23	0.94	—	8.5	8.7	11.0	—
Mid-Late Jan.	12.5	11.4	11.1	—	1.50	0.99	0.77	—	8.3	11.5	14.4	—
Early Mar.	12.9	12.2	11.9	—	1.12	0.78	0.61	—	11.5	15.6	19.5	—
1969–70												
Late Oct.	11.3	8.8	10.0	—	2.13	1.98	1.18	—	5.3	4.4	8.5	—
Early Dec.	12.3	10.4	11.1	—	1.52	1.33	0.93	—	8.1	7.8	11.9	—
Mid-Late Jan.	13.2	11.7	12.2	10.6	1.29	1.10	0.72	0.65	10.2	10.6	16.9	16.3
Early Mar.	13.7	11.8	12.5	—	1.06	0.83	0.63	—	12.9	14.2	19.8	—
1970–71												
Late Oct.	11.7	9.1	9.4	8.8	2.12	1.78	1.15	0.73	5.5	5.1	8.2	12.1
Early Dec.	13.0	9.7	10.7	9.6	1.90	1.48	0.97	0.76	6.8	6.6	11.0	12.6
Mid-Late Jan.	13.5	10.6	11.2	11.6	1.45	1.13	0.77	0.69	9.3	9.4	14.6	16.8
Early Mar.	14.4	11.9	12.0	—	1.33	0.95	0.66	—	10.8	12.5	18.2	—

Internal quality

Flesh color trends followed rind color trends early in the season. By the January sampling, and in March, fruits from all locations were very similar in internal color.

Fruit was rated for flesh texture by eye as fine, average, or coarse textured. On this basis, navels grown at Thermal were coarsest-textured while Limoneira-grown fruit was the finest textured. Flesh texture at all locations was rated as coarser in October and March than in December and January.

Juice percentage was consistently lower at Thermal than at the other locations. At Lindcove and Thermal, juice percentage reached its maximum of 48.0% and 43.5% respectively, in October. At Limoneira and South Coast, juice content increased from 41.5% in later October to 48.4% in early December.

Juice was rated for flavor on a scale of 50 to 100, with 70 being acceptable; 80, good; 90, excellent. Graphs four and five compare average taste ratings with sugar-acid ratios for three seasons combined; 1967–68 is excluded as taste testing was not begun until 1968–69. Juice from Thermal and Lindcove reached acceptability about mid-November while juice from South Coast and Limoneira was not acceptable on the basis of this taste test until about the end of January. Although Thermal fruit showed a higher ratio of soluble solids to acid at all picking dates, it was not rated better by taste index than Lindcove fruit. This was probably due to the fact that desert grown navels are low in both solids and acid, giving them a somewhat bland or flat flavor. Both solids and acid were considerably higher at Limoneira than at all other locations.

Total soluble solids, acid, and solids-acid ratio showed much less variation among seasons than among climatic zones; these data are given in table 2. Ascorbic acid (vitamin C) content in navel orange juice was higher in fruit grown at the coastal locations than in fruit grown at the interior locations at all samplings throughout the season. Graph 6 shows ascorbic acid results for 1970–71, the only season for which complete data covering all locations and sampling dates were available.

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NITROFEN HERBICIDE *for control of Yellow Oxalis in greenhouse roses*

JACK L. BIVINS • CLYDE ELMORE

YELLOW OXALIS (*Oxalis corniculata*) is frequently a serious pest in greenhouse rose production. When steam fumigation precedes planting, the oxalis seedlings and plants are killed. However, due to the three to five year interval between steam treatments, when the roses are producing, reinfestation occurs by seed from adjacent beds. The seed is ejected from the seed pod with sufficient force to carry for several feet into previously clean beds. The seeds cling to clothing and often to animals, enabling them to be spread throughout the greenhouse and even to be introduced from the outside.

A preliminary study was started with the cooperation of Paul Nielson of Groen Rose Co., on March 4, 1971 to evaluate four herbicides, Nitrofen at 6 and 18 lbs active ingredient per acre, pebulate at 1 and 3 lbs, propachlor at 1 and 3 lbs, and chloramben at 6 and 18 lbs. The herbicides were sprayed over the soil surface, over new canes, and on lower leaves of the four-year-old, Happiness variety rose plants. The plots were immediately watered with an Ohio State watering system, applying 3 quarts of water per sq ft.

Observations made April 14, 1971 showed Nitrofen had killed established oxalis plants in the flowering and early seed pod stage and gave preemergence control. Pebulate controlled emerging seedlings but was ineffective against established oxalis plants. Propachlor and Chloramben did not control seedlings or established oxalis. None of the herbicides evaluated caused visible symptoms of injury to the rose plants. On the basis of this preliminary study, a more extensive trial was established April 28, 1971 using two rates of Nitrofen at 3 and 9 lbs active ingredient per acre, replicated three times. Plots were 3 × 28 ft in ground beds with 8-inch concrete siding. Established four year old Happiness variety roses had been planted into a mix of redwood shavings and Baywood loamy sand soil in ground beds. A one-inch top dressing of redwood shavings was maintained around the plants. The herbicides were sprayed onto a solid stand of oxalis in early bloom and seed pod stage. All treatments were applied with a 2 gallon, X-Pert Hudson sprayer, equipped with an 8002 Tee-jet nozzle and immediately watered in with ¾-inch per sq ft of water through an Ohio State sprinkler system.

Weed count and crop phytoxicity ratings were taken at intervals after herbicide application (see table). Crop phytoxicity ratings were made May 4, June 11, and August 20, 1971. Weed counts were made June 11 and August 20, 1971.

When evaluated 44 days after treatment, Nitrofen at 3 lbs active ingredients per acre killed about 50% of the mature yellow oxalis plants. At 9 lbs, over 95% control was achieved. Four months following the treatment, Nitrofen at 3 lbs was not effectively controlling oxalis, however the 9-lb rate continued to control better than 98% of the germinating seed. Observations made as early as one week following treatment showed that mature oxalis plants were affected by the herbicide. No visible symptoms of damage to mature or new rose canes were observed.

Effective *Oxalis corniculata* control of both mature plants and germinating seedlings was achieved with 9 lbs active ingredient per acre of Nitrofen for a four-month duration. At 3 lbs, partial control was achieved for 44 days, however, regrowth and new seedlings emerged by four months.

From the results of these experiments, Nitrofen appears to be a promising herbicide for pre- or postemergence control of *Oxalis corniculata.*

Nitrofen is most effective on weeds when applied preemergence or early postemergence. If the herbicide is mixed into the soil it becomes ineffective. It is presently registered on several California crops and registration is pending on several ornamental crops.

The University of California cannot currently recommend Nitrofen on greenhouse roses until registration and further research on roses is available.

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AVERAGE OXALIS CORNICULATA PLANTS PER PLOT AND PER CENT CONTROL FROM SPRAYING HAPPINESS ROSES WITH TWO RATES OF NITROFEN

Herbicide Treatment	Rate	Mature plants (June 11, 1971) Avg plants per plot	Mature plants (June 11, 1971) Control	New seedlings (August 20, 1971) Avg. plants per plot	New seedlings (August 20, 1971) Control
	ai/A	no.	%	no.	%
Control	–	468	–	320	–
Nitrofen	3	220	53.1	209	34.7
Nitrofen	9	20	95.8	6	98.2