

Splitting of Navel Oranges

studies indicate local temperature and humidity more closely related to incidence of injury than is soil moisture content

O. C. Taylor, G. A. Cahoon, and L. H. Stolzy

Crop loss—of 20% or more—from the splitting of Navel oranges is no new problem. The trouble has plagued orange growers the world over and the general opinion seems to be that internal pressure develops within the fruit—probably as a result of extreme changes in moisture content associated with certain weather and soil moisture conditions—which ruptures the rind at the weakest point, the navel opening. Once started, the split usually expands rapidly dividing the fruit into two or more segments.

It has been suggested that careful irrigation to maintain optimum soil moisture conditions during the growing season would greatly reduce fruit splitting. Therefore—in an effort to determine the effectiveness of soil moisture conditions in reducing the number of splits—an irrigation experiment was conducted in a mature Navel orange grove near Highland during the years of 1955 and 1956. Basins were constructed beneath each of the treatment trees, leaving the furrows open for normal irrigation. The basins were filled

with water from the irrigation furrow, or by tank truck if the need for moisture did not coincide with a scheduled irrigation date. Soil moisture conditions were determined with tensiometers installed at the 1' depth in the northwest, southwest and southeast corners of the basins and at comparable locations around the check trees. The basins were filled when the soil moisture in the top foot of soil was only partially depleted—when the tensiometers reached approximately 0.5 bar. By comparison, except in the immediate vicinity of the furrow, the soil under the check trees was dry to at least the 1' depth—tensiometers exceeded 0.85 bar—most of the time from July to December. All of the trees received normal furrow irrigation on a 15-day schedule.

The intent of this experiment was to maintain some plots of Navel orange trees with high soil moisture conditions in the major portion of the root zone and to observe—among other things—the number of split fruits in comparison to check plots irrigated less frequently.

Fruit splitting was very light in all

Effect of Supplemental Irrigation on Navel Orange Splitting, Fruit Size and Total Production
High soil moisture conditions maintained in the majority of the root zone

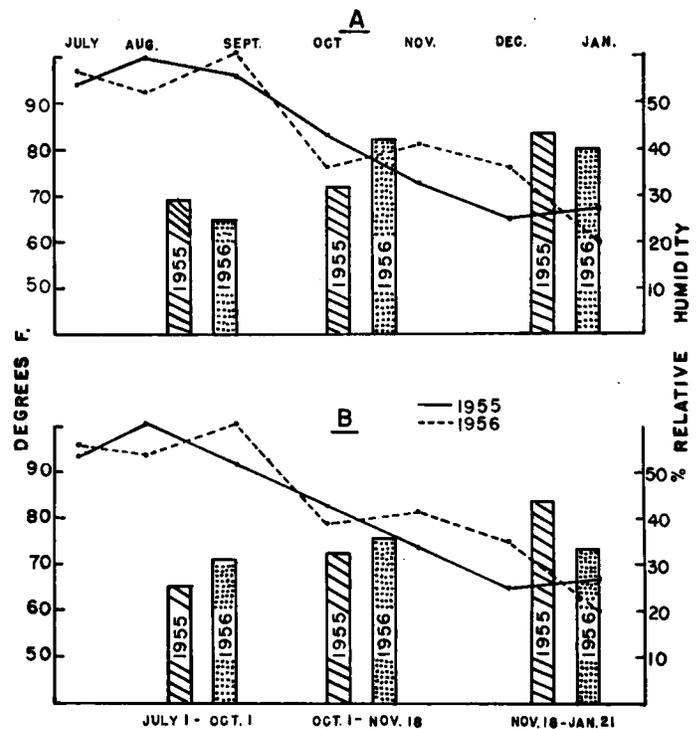
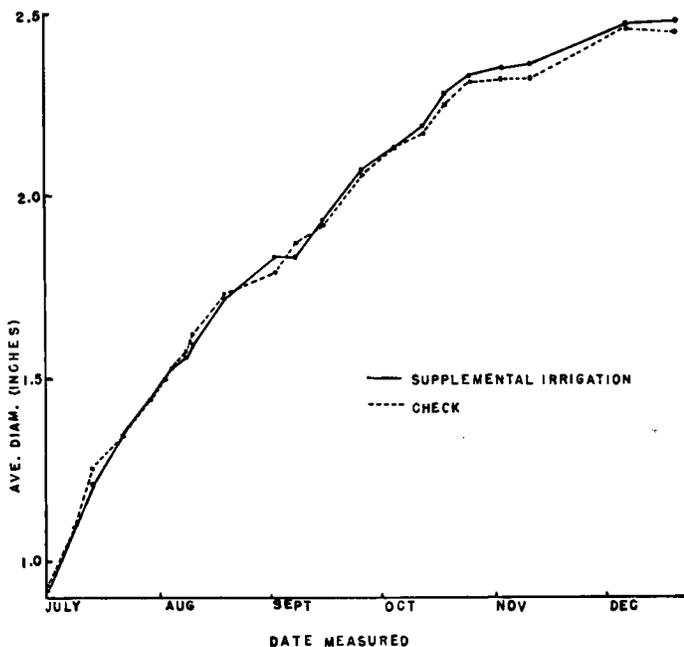
	1955 treatment		1956 treatment	
	Supplemental irrigation	Normal furrow irrigation	Supplemental irrigation	Normal furrow irrigation
Ave. no. of split fruits per tree	23	20	195	201
Fruit size 220 and larger %	75*	68	33	29
Ave. production in field boxes per tree	5.3	5.9	4.6	4.5

* Statistical computations indicate this mean is significantly greater than that of the normal furrow irrigation treatment by odds of 19 to 1.

Navel orange districts of southern California in 1955 and the supplemental irrigation in the experimental plot had

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Left, below—diameter increase of Navel oranges from trees receiving supplemental and normal furrow irrigation. Each point represents the average diameter measurement of 120 fruits. Highland grove, 1955. **Right**—monthly average of mean maximum temperature, line graph, and average per cent relative humidity, bar graph, calculated from daily maximum temperatures. A—Highland; B—Redlands.



NONTILLAGE

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sults. Under sprinkler irrigation, a surface seal may result from particle size separation.

Yields, Fruit Size and Quality

In this experiment yields were highly correlated with water intake. In any single comparison, the greater the water intake, the greater the yield. When the production for all the covercropped plots

was set at 100 the production on the clean-tilled plots was approximately 30% less. After one year in nontillage, production was only 5% less but after two years it was 30% greater. For the third year, production was only 5% greater, which may be related to alternate bearing or to too much water in those nontilled plots which had the greatest amount of water intake.

Fruit quality is influenced by nontillage. When compared to covercropped plots, fruit from the nontilled plots—which received more water—have a thin-

ner peel, a higher percentage of juice, and a higher soluble solids-acid ratio than fruit from winter covercropped plots. Nontillage thus results in early fruit maturity.

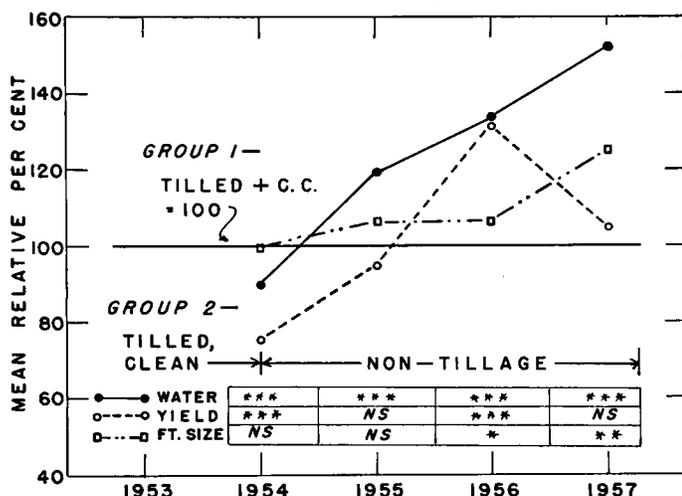
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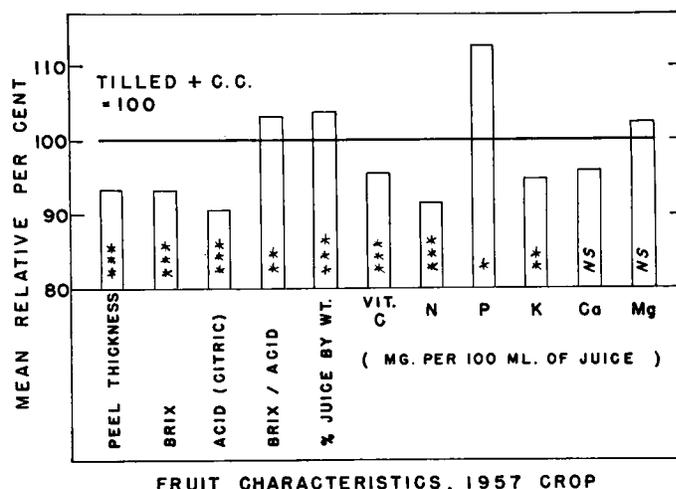
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The relation of cultural practices to water intake, yields, and fruit size over a 4-year period. Statistical symbols: NS—nonsignificant; *—significant at the 5% level; **—significant at the 1% level; and ***—significant at the 0.1% level or higher.



The relation of cultural practices to fruit quality. Fruit from the 1957 harvest. Statistical symbols: NS—nonsignificant; *—significant at the 5% level; **—significant at the 1% level; and ***—significant at the 0.1% level or higher.



SPLITTING

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no effect on the number of splits, or total production. Trees which received the supplemental irrigation tended to produce somewhat larger fruit. The rate of fruit growth on the check trees lagged behind that of fruits on treatment trees in October and November and this difference was not overcome completely during the following spring months.

In 1956 fruit splitting was heavy in the Highland area as in many other Navel orange districts, but again, supplemental irrigation apparently had no effect on the number of splits per tree, total production, or increase in fruit size. Evidently, other factors—perhaps climatic—seem to have had a greater influence on the development of splits than did soil moisture content or amount of root system which was kept moist.

Preliminary results from only two years of data suggest that sudden large changes in per cent relative humidity may cause splitting.

In 1955, a year of very few splits, the average relative humidity—calculated from the daily mean maximum dry bulb

and wet bulb temperatures—increased from 29% during the summer months of July, August and September to 32% during the fall months of October and November. By contrast, in 1956, a year of heavy splitting, the average relative humidity increased 17%—from 25% in the summer months to 42% in the fall months. The suggestion that average relative humidity influences splitting is intensified by the fact that relatively few splits developed in 1955 or in 1956 in a Redlands grove where the per cent relative humidity was almost identical with that in the Highland grove in 1955. Serious splitting occurred in 1956 in the Highland grove where the average relative humidity increased rapidly during the first week of October but splitting did not occur in the Redlands grove where the change in relative humidity was small.

Splitting of Navel oranges may occur at any time during the growing season but in southern California the period of greatest splitting is between October 1 and December 1. The beginning of this period appears to correspond quite well with a definite drop in mean maximum temperature and an increase in per cent

relative humidity, and with approximately a 50% decrease in the rate of fruit growth.

The differences in mean maximum temperature and relative humidity which existed between the Highland and Redlands groves—a distance of only about five miles—emphasize the importance of certain localized weather conditions on the performance of orchards in a particular area.

The higher relative humidities probably reflect greater incidence of fog and dew, which would tend to reduce transpiration and favor the building up of turgor pressure within the fruit during the night. Similarly soil temperatures in the principal root zone decrease slowly during the fall months and favor active moisture uptake by the tree.

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Weather data obtained from Citrus Grove Rejuvenation weather stations operated by Joseph R. Orlando, Technician in Horticulture, University of California, Riverside.