

Effect of Nontillage of Navels

relation of some tillage practices to water infiltration, yield, and quality of oranges part of fertilizer experiment

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In the course of a long-term fertilizer experiment with Washington Navel oranges at Riverside, studies were made—during the period 1953–1957—on the relation of tillage and fertilizer treatments to the rate of water intake by the soil and to yield and fruit quality.

In the studies, it was found that winter cover crops increased yields when compared to clean cultivation by tillage. Also, several fertilizer practices, each with and without winter cover crops, resulted in various degrees of soil structural breakdown. The soil—Ramona loam—of the experimental orchard characteristically has a hardpan and is subject to a deterioration in physical structure under certain cultural and fertilizer practices.

Cultural Practices Changed

In the spring of 1954 clean cultivated plots in this experiment were changed to nontillage.

Water was applied in furrows at 3-week intervals during the summer months and at longer intervals during the rainy season. Each irrigation run was for 48 hours and the amount of water intake was determined at each irrigation.

During the first season the net water

The Relation of Water Intake to Yields as Influenced by Cultural Practices and Fertilizers. 1953–1954*

Fertilizer treatment	Water Net acre-inches /acre/irrigation		Fruit yield Pounds/tree	
	Clean cultivated	Cover-cropped	Clean cultivated	Cover-cropped
Ammonium sulfate ...	1.68	2.00	70	152
Ammonium sulfate + calcium carbonate	2.53	2.37	179	186
Sodium nitrate ...	1.69	1.93	44	98
Sodium nitrate + calcium sulfate	2.38	2.95	72	125
Urea	2.39	2.71	150	201
Calcium nitrate ...	2.65	3.06	238	227
Manure	3.68	3.74	258	297

* The effects of both culture and fertilizer on water intake and on yield are statistically very highly significant.

intake by the clean cultivated plots was less than that by the winter covercropped plots. However, during the second season, the water intake by the covercropped plots was less than the intake by the nontilled plots.

Both the cultural practice and the fer-

The Relation of Water Intake to Yields as Influenced by Cultural Practices and Fertilizers. 1955–1956*

Fertilizer treatment	Water Net acre-inches /acre/irrigation		Fruit yield Pounds/tree	
	Non-tilled	Cover-cropped	Non-tilled	Cover-cropped
Ammonium sulfate ..	3.05	2.76	301	176
Ammonium sulfate + calcium carbonate	4.46	2.87	252	200
Sodium nitrate ..	2.97	2.04	144	76
Sodium nitrate + calcium sulfate	3.41	3.03	160	152
Urea	3.50	3.03	262	228
Calcium nitrate ..	4.08	3.37	310	203
Manure ...	6.65	3.55	280	234

* The effects of both culture and fertilizer on water intake and on yield are statistically very highly significant.

tizer practice had a strong effect on net water intake. It was evident that tillage operations reduce the ability of a soil to absorb water rapidly and that covercrops partially overcome some of this bad effect of tillage.

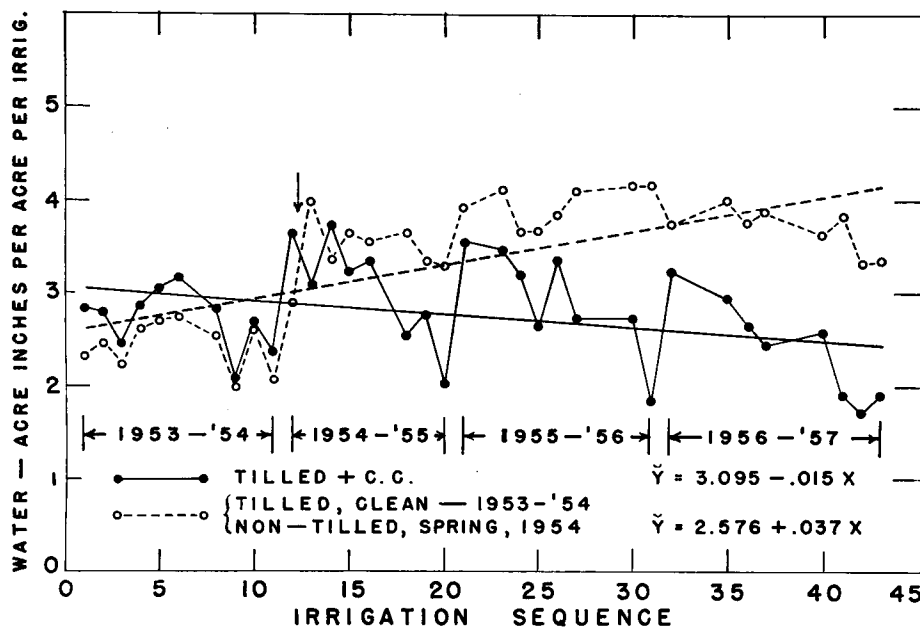
For the 4-year period the trend for water intake was up for the nontilled plots and down for the covercropped plots. The water intake in the covercropped plots was greater at the beginning of an irrigation season than at the end. There was some recovery following the growth of the winter covercrop—but not complete—resulting in a downward trend for the 4-year period and indicating a gradual deterioration in soil structure under the winter covercrop system of culture. At the end of the 4-year period the water intake was approximately 50% greater in the nontilled plots than in the covercropped plots.

Surface Seals Possible

Under some soil conditions, nontillage may result in a reduced water intake. For instance when soil is aggregated because of a slight saline condition, it may be dispersed by the use of nonsaline irrigation water and a surface seal re-

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The relation of cultural practices to water intake over a 4-year period.



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.

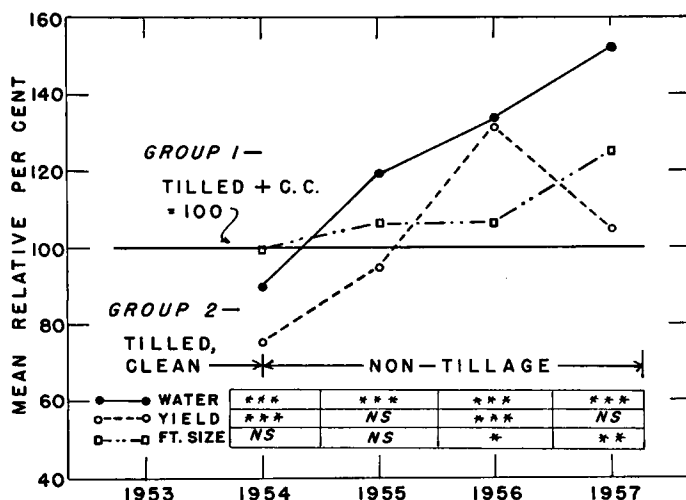
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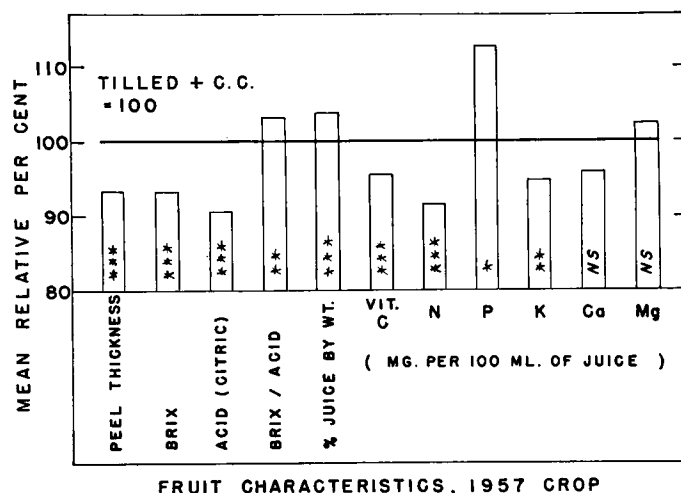
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The relation of cultural practices to water intake, yields, and fruit size over a 4-year period. Statistical symbols: NS—nonsignificant; *—significant at the 5% level; **—significant at the 1% level; and ***—significant at the 0.1% level or higher.



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.