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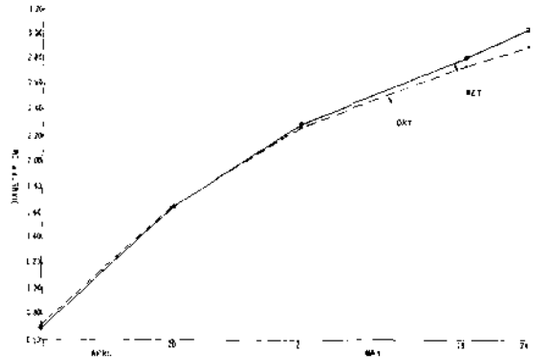
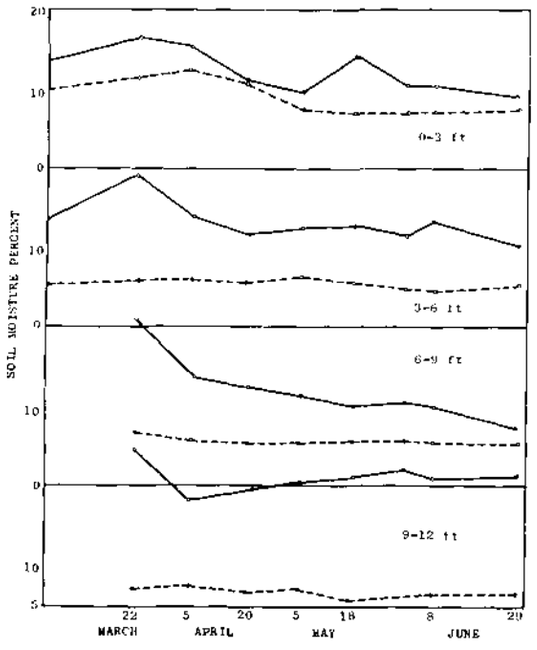
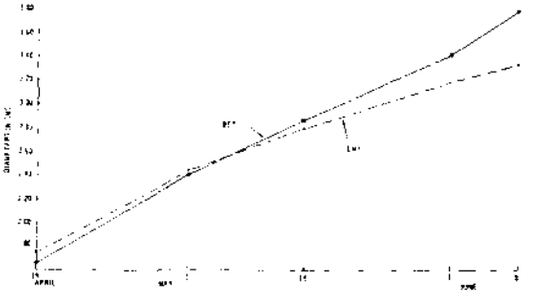
F. J. VEIHMEYER



GRAPH 1. GROWTH OF PLUMS DURING THE FIRST-YEAR TRIAL



GRAPH 2. SOIL MOISTURE CONDITIONS AT 3-FT DEPTHS DURING SECOND-YEAR TRIAL (SOLID LINE = WET PLOT; DOTTED LINE = DRY PLOT)



GRAPH 3. GROWTH OF PLUMS DURING THE SECOND-YEAR TRIAL

TESTS WERE MADE to determine the effect of different amounts of readily available soil moisture on the growth of plums in California's dry San Joaquin Valley. In the first and second years, when there was practically no available soil moisture in the 6- to 12-ft depth, the dry-treatment plums were not significantly smaller in diameter than the wet-treatment ones. But when the soil moisture was exhausted to a depth of 12 ft, the dry treatment plums were significantly smaller. The combination of Japanese plums on apricot rootstock evidently produces a deep-rooted tree, with moisture below the 6-ft depth constituting an important source of supply.

The most economical irrigation schedule under the conditions reported here was one in which the soil was moistened to field capacity to a depth of about 12 ft during the winter, or early spring, and then irrigated once before harvest. Thereafter, one or two irrigations were necessary to keep the soil moisture above the PWP.

In the experiment reported here, one treatment showed the readily available soil moisture in plums was well above the permanent wilting point (point at which trees wilt and do not revive until the soil is wetted, usually referred to as PWP). In the other treatment, soil moisture was reduced to close to the PWP.

The tests were conducted for three years, during which the average temperatures were 56.7°F in March, 62.8°F in April, 69.8°F in May, 77.6°F in June and 84.0°F in July. For the same months rainfall averages in inches were .94, .58, .46 and .01.

Japanese Santa Rosa plums, 15 years old when the trials started, were used. The trees were 24 ft apart and were on apricot root. The trials took place in two plots of ten trees each. Trees bordering the ones used for measurement were given the same treatment as the trees in the trial. The diameters of 25 fruit on each of four trees in each plot were measured between 8:00 a.m. and 9:00 a.m.

Soil moisture samples were taken from six places in each plot in one-foot increments to a depth of 6 ft. and in three-foot increments between 6 and 12 ft. The soil was an Arvin loamy fine sand. Layers of fine textured material (locally called "slickings"), varying in thickness, occur in the third and fourth foot of soil. These layers caused difficulty in interpreting some of the soil moisture data and retarded the downward movement of water.

First year

In the dry treatment during the first year, the average amount of readily available moisture stored in the soil to a depth of 12 ft from February 18 to May 19 was 4.39 inches, or 28% of the total amount (15.68 inches) that the soil would hold at field capacity. The average amount of readily available moisture in the wet treatment for the same period was 10.30 inches, or 66% of field capacity. On May 18, the dry treatment held 3.01 inches, or 19% of field capacity, in the top 12 ft; the wet treatment held 9.61 inches, or 61%. By February 28 the trees were in full bloom. By March 23 they were well covered by leaves about one inch in diameter. The wet treatment plums were irrigated March 20, May 12, and June 3.

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The dry ones were irrigated only once, on March 20. The fruit was thinned uniformly in both the wet and dry treatments.

The growth of the plums during the first-year trial is indicated in graph 1. On May 18 the average diameter of the wet treatment plums was .07 cm larger than that of the dry ones. To be significant at the 1% level, this difference would have to amount to .082 cm. On May 18 in the dry plot there was almost no readily available soil moisture (.19 inches) in the 6- to 12-ft depth. The average for the entire 12-ft depth was .38 inches. The dry plums may be considered to be on soil very close to the PWP at this date, but the plums were not significantly smaller than those in the wet treatment. The wet treatment plums on May 18 were in soil with about three times more moisture than the dry ones.

By May 25 the available soil moisture in the 6- to 12-ft depth was exhausted. The average for the entire 12 ft of soil in the dry plot had shrunk to .27 inches. In the wet plot the average amount for the entire 12 ft was 1.34 inches. The wet plums on this date were .13 larger than the dry ones, a significant difference, since it is above the .092 cm required for significance.

Second year

In the second year of the tests, the amount of readily available soil moisture in the wet plot was considerably greater than in the dry plot. Graph 2 shows the soil moisture levels on the dates of sampling. For dry treatment plums between February 15 and May 18, the average amount in the top 12 ft of soil was 2.72 inches, or 17% of the field capacity. For the wet treatment plums the figures were 13.74 inches and 87%, respectively. The wet treatment trees were irrigated on March 20, May 12 and June 3. The dry ones were irrigated once, on March 20. The growth of the plums is indicated in graph 3. On May 18 the dry treatment contained an average of 1.44 inches of readily available moisture in the top 12 ft of soil, or 9% of soil capacity, but there was no readily available moisture between 6 and 12 ft. In the wet treatment there were 16.08 inches of readily available moisture, or about 100%.

Wet treatment

On May 18 the wet treatment plums were 2.85 cm in diameter, and the dry ones were 2.71 cm. The difference of .14 cm is not significant, since a difference of .23 cm is required for significance at the 5% level. By June 1, the average diameter of the wet treatment plums was 3.41 cm and that of the dry ones was 3.01 cm. The difference of .40 cm is significant at the 1% level, where only .29 is required for significance. The difference in size of plums on June 8, when the fruit was harvested, was .39 cm, which is significant. On that date, the amount of available moisture in the top 12 ft of soil in the dry treatment averaged only .02 inches per ft. The total for the 12-ft depth was 1.19 inches, or 9% of field capacity, with no readily available moisture present between 4 and 12 ft deep. The wet treatment was fully wet.

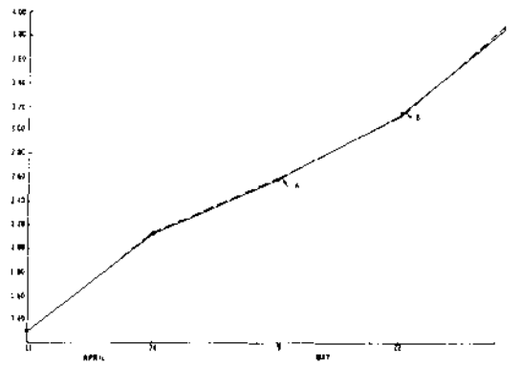
Third year

During the last year of the trials, an attempt was made to find out if an irrigation given close to harvest would accelerate plum growth in soil containing an appreciable amount of readily available moisture. For this purpose the wet plot was designated "A" and the dry plot "B." The soil moisture conditions were about the same in both plots, with both receiving the same amount of irrigation up to May 24. On that date, the B treatment plums were irrigated, but not the A ones. When the plums were picked on June 4, the B trees were on soil containing 13.73 inches of readily available moisture, while the A plot had 6.61 inches within the top six ft of soil. The growth of the plums is indicated in graph 4. The B plums averaged 4.12 cm in diameter and the A plums 4.09 cm. Clearly, the irrigation close to the time of harvest did not induce the fruit to grow at a faster rate than the ones not irrigated at this time.

The most economical irrigation schedule under the conditions reported here is one in which the soil is moistened to its field capacity to a depth of about 12 ft during the winter or early spring, and then irrigated once before harvest. Thereafter, one or two irrigations are necessary to keep the soil moisture above the PWP.

The results of these trials support the view that soil moisture above the PWP is readily available to plants and that the amount of moisture is not the determining factor in the growth of fruit.

F. J. Veihmeyer is Professor Emeritus, Department of Water Science and Engineering, University of California at Davis. The studies reported here were done in cooperation with Dr. A. H. Hendrickson, who died before this manuscript was written.



GRAPH 4. GROWTH OF PLUMS DURING THIRD-YEAR TRIAL. A AND B TREATMENTS WERE IRRIGATED THE SAME UP TO MAY 22, WHEN ONLY THE B PLOT WAS IRRIGATED