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Irrigating New Avocado Orchards

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Efficient water application depends on precise knowledge of water needs and use by trees.

Trials on Hass and Reed avocados determined monthly water requirements of drip and sprinkler-irrigated orchards.

The drought has raised many questions about actual water needs, particularly for permanent crops such as orchards and vineyards. A substantial fraction of the crop acreage in some water districts consists of recently-planted trees whose water requirements increase at the same time water restrictions are occurring. Thus these districts need information about water requirements for 1 to 10-year-old orchards—the latter age representing a reasonably full tree canopy development. (Trees may continue to grow larger but their water requirements no longer increase appreciably.)



Avocado drip trial.

Some answers are now available from a study in San Diego County which compared drip and sprinkler irrigation on avocados grown on a complex of Fallbrook and Vista sandy loam soils. The study, which began in 1970, was described in the July 1972 issue of *California Agriculture*. By the time the experiment was completed in June 1976, the tree canopies were joined in the rows and occupied about three-fourths of the space between rows. The present report provides data specifically on water use.

In the study, drip and sprinkler irrigation schedules were guided by readings from 16 tensiometers used in each irrigation; the tensiometers were installed in pairs, at depths of 12 and 24 inches, situated 12 inches from the nearest emitter and just inside the tree canopy drip line. Daily irrigation of the drip plots was aimed at keeping soil suction levels at both depths between 15 and 20 centibars (cb). Weekly irrigation of the sprinkler plots was intended to keep soil suction readings at both depths from exceeding 40 cb before irrigation. Volume was measured by recording meters as water was applied to the four drip-irrigated plots, which contained 349 trees, and the four sprinkler-irrigated plots, which contained 325 trees. Trees in each plot were about equally divided between Hass and Reed cultivars and were spaced 15 feet apart in the row with 20 feet between rows.



Trendel avocado trees beside weather station.

Table 1 shows average daily volume of water applied for each month in the drip-irrigated plots, and table 2 gives volumes for the sprinkler-irrigated plots.

The data in tables 1 and 2 can be useful for those wanting to predict about how much water will be needed for young orchards of various ages, the months during which it will be needed, and the increased requirement as trees age. The data are specific for the particular time and weather in which they were obtained; in the field, volumes should be adjusted by current soil water measurements in response to changing weather conditions.

It is sometimes more advantageous to show water use in acre-inches per acre, particularly when figures on annual use are desired. Tables 3 and 4 show water applied to all plots in inches per month and the total for each year.

TABLE 1. Average Daily Water Applied by Drip Irrigation—Gallons Per Day Per Tree

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1971 | 0.90 | 0.80 | 1.26 | 1.84 | 2.23 | 2.57 | 2.90 | 2.87 | 3.00 | 2.61 | 2.00 | 1.60 |
| 1972 | 0.00 | 0.50 | 1.20 | 2.05 | 2.62 | 4.80 | 5.65 | 11.40 | 7.50 | 11.60 | 2.28 | 1.60 |
| 1973 | 1.60 | 0.90 | 0.00 | 5.10 | 9.00 | 9.50 | 11.90 | 12.70 | 12.60 | 13.30 | 6.20 | 6.30 |
| 1974 | 1.20 | 2.90 | 1.00 | 4.60 | 7.20 | 12.70 | 15.70 | 15.50 | 16.60 | 7.80 | 7.40 | 15.70 |
| 1975 | 8.80 | 6.40 | 6.80 | 5.40 | 8.60 | 9.90 | 11.30 | 13.40 | 23.10 | 21.00 | 21.40 | 11.10 |
| 1976 | 9.40 | 4.70 | 7.70 | 7.60 | 10.30 | 14.40 | | | | | | |

TABLE 4. Average Monthly Water Applied by Sprinkler Irrigation—Acre Inches Per Acre

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| 1971 | 0.13 | 0.13 | 0.47 | 0.63 | 0.50 | 0.61 | 0.82 | 1.03 | 1.02 | 1.13 | 0.91 | 0.56 | 7.94 |
| 1972 | 0.00 | 0.30 | 0.55 | 0.69 | 1.09 | 1.34 | 1.62 | 2.31 | 1.68 | 1.79 | 1.35 | 0.74 | 13.46 |
| 1973 | 0.41 | 0.31 | 0.00 | 1.57 | 0.98 | 1.89 | 2.74 | 3.90 | 2.10 | 2.60 | 1.17 | 1.34 | 19.01 |
| 1974 | 0.51 | 1.78 | 1.16 | 2.16 | 2.35 | 2.19 | 4.74 | 4.10 | 3.78 | 3.54 | 2.50 | 2.05 | 30.86 |
| 1975 | 2.71 | 1.90 | 0.51 | 1.20 | 2.30 | 2.78 | 3.79 | 4.10 | 4.02 | 3.62 | 3.41 | 1.95 | 32.29 |
| 1976 | 1.95 | 0.70 | 1.82 | 2.11 | 3.07 | 3.02 | | | | | | | |

TABLE 2. Average Daily Water Applied by Sprinkler-Irrigation—Gallons Per Day Per Tree

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1971 | 0.90 | 0.90 | 2.83 | 3.94 | 3.04 | 3.84 | 4.96 | 6.23 | 6.38 | 6.85 | 5.67 | 3.40 |
| 1972 | 0.00 | 2.00 | 3.30 | 4.34 | 6.57 | 8.40 | 9.80 | 14.00 | 10.50 | 10.80 | 8.43 | 4.50 |
| 1973 | 2.50 | 2.10 | 0.00 | 9.80 | 5.90 | 11.80 | 16.60 | 23.60 | 13.10 | 15.70 | 7.30 | 8.10 |
| 1974 | 3.10 | 11.90 | 7.00 | 13.50 | 14.20 | 13.70 | 28.70 | 24.80 | 23.60 | 21.40 | 15.60 | 12.40 |
| 1975 | 16.40 | 12.70 | 3.10 | 7.50 | 13.90 | 17.40 | 22.90 | 24.80 | 25.10 | 21.90 | 21.30 | 11.80 |
| 1976 | 11.80 | 4.70 | 11.00 | 13.20 | 18.60 | 18.90 | | | | | | |

TABLE 5. Trelend Avocado Orchard, San Diego County—Average Daily Evaporation in Inches *

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1973 | 0.163 | 0.090 | 0.176 | 0.124 | 0.160 | 0.211 | 0.252 | 0.248 | 0.176 | 0.185 | 0.119 | 0.114 | 61.66 |
| 1974 | 0.090 | 0.156 | 0.121 | 0.208 | 0.204 | 0.205 | 0.281 | 0.238 | 0.199 | 0.142 | 0.100 | 0.081 | 61.60 |
| 1975 | 0.110 | 0.121 | 0.112 | 0.148 | 0.177 | 0.200 | 0.252 | 0.231 | 0.211 | 0.140 | 0.120 | 0.104 | 58.66 |

*Class A, USWB pan.

TABLE 3. Average Monthly Water Applied by Drip Irrigation—Acre Inches Per Acre

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| 1971 | 0.15 | 0.12 | 0.21 | 0.29 | 0.37 | 0.41 | 0.48 | 0.47 | 0.48 | 0.43 | 0.32 | 0.26 | 3.99 |
| 1972 | 0.00 | 0.07 | 0.20 | 0.33 | 0.43 | 0.77 | 0.93 | 1.88 | 1.20 | 1.92 | 0.36 | 0.26 | 8.35 |
| 1973 | 0.26 | 0.13 | 0.00 | 0.82 | 1.49 | 1.52 | 1.97 | 2.10 | 2.02 | 2.20 | 0.99 | 1.04 | 14.54 |
| 1974 | 0.20 | 0.43 | 0.16 | 0.74 | 1.19 | 2.03 | 2.60 | 2.56 | 2.66 | 1.30 | 1.18 | 2.60 | 17.65 |
| 1975 | 1.45 | 0.96 | 1.12 | 0.86 | 1.42 | 1.58 | 1.87 | 2.21 | 3.70 | 3.47 | 3.42 | 1.83 | 23.89 |
| 1976 | 1.55 | 0.70 | 1.27 | 1.22 | 1.70 | 2.30 | | | | | | | |

TABLE 6. Trelend Avocado Orchard, San Diego County—Rain in Inches

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| 1971 | 1.12 | 0.57 | 0.33 | 1.46 | 0.75 | 0.44 | 0.00 | 0.00 | 0.00 | 0.78 | 0.25 | 4.18 | 9.88 |
| 1972 | 2.88 | 0.00 | 0.00 | 0.35 | 0.08 | 0.26 | 0.00 | 0.03 | 0.46 | 0.20 | 2.08 | 2.26 | 8.60 |
| 1973 | 1.85 | 2.04 | 4.71 | 0.31 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.07 | 0.14 | 11.27 |
| 1974 | 1.45 | 0.34 | 3.54 | 0.58 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.22 | 0.37 | 1.00 | 8.50 |
| 1975 | 0.90 | 1.50 | 3.07 | 2.83 | 0.17 | 0.11 | 0.00 | 0.00 | 0.08 | 0.06 | 0.89 | 0.96 | 10.57 |
| 1976 | 0.00 | 4.85 | 1.60 | 1.63 | 0.09 | 0.02 | | | | | | | |

Trees in the trial grew well during the study. Some tip burn, characteristic of avocados, occurred in the fall but was not a serious factor. There was a slightly greater growth and yield for sprinkled than for drip-irrigated trees, but this was not consistent between varieties and years. The difference appears more likely to be due to insufficient soil volume wetted by too few emitters (four per tree) rather than by insufficient water applied, but controlled experimentation to prove this point is lacking. However, most orchards are now provided with six emitters per tree. The greater water application in sprinkler plots in 1974 reflects a change in sprinkler heads from fixed jet "spitters" to rotating sprinklers that covered a much larger area. Until the trees' root systems spread into larger areas in response to this change, more water was applied than was used because some was entering soil that roots had not yet penetrated.

Peak monthly use occurred several times in September or October, rather than in July as usual (see table 5 for July evaporation peaks). Greater use in September and October may result from a peculiarity of avocado trees which have a growth flush in September.

Because irrigation-water applications are also influenced by rainfall, rainfall at the experimental orchard during the study is also reported (table 6).

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