

## ORCHARD IRRIGATION

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Irrigation is probably the most important and most difficult cultural practice to accomplish correctly in the growing of avocados. General rules on how to irrigate avocado orchards are hazardous, as each orchard is an individual problem and should be handled accordingly. There are basic principles of soil-water-plant relationships which should be considered in developing a sound irrigation program. These relationships depend upon soil factors, such as texture, structure, depth, water intake rate, and drainability. They are also affected by water quality and factors which influence the use of water by trees, such as humidity, temperature, wind, and tree health. Proper operation of the irrigation system is also a very important part of an efficient irrigation program.

The amount of water used for irrigating avocados varies from one area to another and also within a given area. From figures obtained in an avocado-growing area of San Diego County, the annual applications varied from 1.5 to 3.5 acre-feet per acre, and averaged about 2.5. Actually, the total amount of water used seasonally is not so important as the timing and quantities used in individual irrigations.

It has been noticed generally that where growers used large amounts of water, less leaf-burn was evident. The amount of water was an important factor, but in some cases salt injury occurred even where seemingly adequate amounts were used. Occasionally, even where the soil was uniform and well drained, the problem still persisted in a few trees. This may have been related to the interval between irrigations or the manner in which water was applied. Rootstocks and varietal differences may also have caused this difference in leaf-burn among trees.

To help answer the leaf-burn problem, an irrigation and salinity project was begun in February, 1956 with three avocado growers and continued for two years. Different irrigation frequencies and amounts were employed, based on calendar schedules. Soil samples were taken periodically to follow changes in soil salinity. While the data have not been completely analyzed, the following general statements can be made:

1. Frequent short irrigations on a one-week schedule resulted in the same or less total water applied, better tree vigor, and less leaf-burn than longer irrigations on a 2-week schedule.
2. Every 4 to 6 weeks a longer irrigation had to be applied on the one-week schedule to leach out accumulated salts. When this was done, salinity levels were no higher with the one-week schedule than with the 2-week schedule.
3. Frequent irrigations maintained the upper 12 to 20 inches of soil, in which most of

the avocado roots are located, in a relatively moist condition which kept the salts in a dilute state.

4. These results are applicable to the shallow and coarse to medium textured soils of the Vista and Fallbrook series and might not apply directly to other soils in other areas.

General recommendations for irrigation under various climatic, soil, and plant conditions are frequently made but are usually difficult for the grower to interpret in quantitative terms for his own situation. He is requested to know the water storage capacity of his soil, or his several soils, to consider the rates at which water is being used under the prevailing climatic conditions, and to combine these factors into a figure telling how much water to apply on any particular date. Too often this leaves nothing but confusion and frustration. Recent advances in soil-water-plant relations have shown that plant growth responds to the condition of the soil moisture, called "soil suction," rather than the total quantity of water stored in the soil. Research results and experience have gradually shown that the range of soil-suction values which avocado trees can tolerate, or under which they can thrive, is relatively narrow.

With these considerations and problems to face in growing avocados, it seemed likely that tensiometers, which measure soil-suction directly, might provide the necessary guidance for maintaining the proper range of suction to accommodate the requirements of avocado trees.

Tensiometers have been used in San Diego County during the past year in a cooperative project between the Agricultural Extension Service and several avocado growers. The primary purpose of the project has been the development of information on the use of tensiometers in avocado orchards. Points which it was hoped to learn were:

1. Determine to what extent growers may use the instruments as a guide to tell when to irrigate.
2. To evaluate present irrigation practices in terms of the range of soil-suction values maintained.
3. To determine whether use of the instruments can aid in eliminating or reducing leaf-burn through proper irrigation.
4. To determine proper installation techniques for tensiometers in avocados.

Included in the project were 13 cooperators, extending from Fallbrook to El Cajon, from the coast to the interior, with a total of approximately 100 instruments (*sixty-four of these were lent by the Bob Snow Engineering Company, Fallbrook*). Some of the cooperating growers were already participating in the irrigation and salinity project and have irrigated for a pre-determined number of hours on a more or less fixed schedule. Others have irrigated at a time when the readings from the tensiometers suggested that an irrigation was desirable and in an amount considered necessary to replenish the soil moisture used since the previous irrigation.



Figure 1. Tensiometers were installed just inside but fairly near the tree dripline.

Instruments were installed under avocado trees selected for their general good health and appearance comparable with the orchard as a whole, for their position with respect to starting of the irrigation lines, and for their location with respect to known soil variations within the orchard. When trees meeting these requirements were located, the instruments were installed just inside but fairly near the dripline of the tree, figure 1, in such a position that it would not fail to receive water from the sprinkler nearest to it, but on the other hand would not be in a position to receive abnormally large amounts of water from the sprinkler or from drip off the tree. Instruments were in pairs at all installations, figure 2. In most cases depths selected for each pair were 12 and 24 inches. A few instruments were placed at the 36-inch depth, mainly to evaluate possible excessive moisture contents at this depth. In one instance, on a very shallow soil, a 6-inch depth installation was used. Each pair of instruments was considered as a station, and the number of stations per orchard ranged from one to eight. Avocado trees have variable and non-uniform root systems. Sometimes an instrument may be placed in soil nearly devoid of roots, and this can usually be detected within a week or two by the way in which readings fail to show the usual cyclic pattern. In a few cases where this occurred, the instruments were relocated and thereafter performed satisfactorily.



Figure 2. Instruments were in pairs at all installations.

To obtain the maximum value from the use of tensiometers for following soil moisture conditions, the instruments should be read consistently and frequently, and the results of the readings plotted on a continuing chart. Cooperators maintained such charts. It is advisable to obtain readings at a consistent time of day, and early morning is best for this purpose. Reading intervals can vary with the season of the year, but should probably be every 1 or 2 days during peak water use seasons, and may be only once every week or two during the winter season.

In evaluating the soil moisture condition from tensiometer readings, it is important to realize that it is not so much a particular reading at any one time, but the rate at which readings are changing, that guides the need to irrigation. It is for this reason that charting of the readings is desirable and necessary. By studying the charts, the grower can determine 2 or 3 days in advance when an irrigation is likely to be needed. By examining the records after an irrigation, he can determine how adequate his irrigation was; then by adjustments on subsequent irrigations, he will soon arrive at the correct length of irrigation to replenish soil moisture without excess. This length can be expanded by 50% for the occasional leaching irrigation. From some of the cooperators'

charts, it was learned that some irrigations were applied before readings exceeded 20 and were earlier than necessary. Other irrigations were delayed until readings at both depths exceeded 70, which was too late. Some irrigations were insufficient, as indicated by failure of readings to drop back to approximately 10. The instruments have shown various cases where present practices resulted in both over and under-irrigation at different times on the same orchard.

The cooperators in the project who have been using these instruments, have found them definitely educational and useful to them in managing their irrigation. The general effect of using instruments in these orchards has been to create an awareness of the way soil-moisture conditions change at different times of the year, and to take corrective steps when the soil-suction values went beyond the desirable range. Leaf-burn has not been completely eliminated in orchards irrigated according to tensiometer readings, but its incidence is considerably less and trees in general have a good appearance. Finally, the readings and results found to be satisfactory by these scattered cooperators were nearly alike. This provides confidence that the results can be utilized by other avocado growers in their own conditions without complete re-evaluation for soil and climatic variations.