

# Irrigation of Walnut Orchards

**mature trees require large quantities of water  
daily throughout time they are in leaf**

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**After walnut trees come into leaf** they draw heavily upon the available supply of soil moisture.

During the long, hot days of summer, the amount of water withdrawn from the soil by a walnut tree and given off through the leaves is astonishingly large. As an example, mature walnut trees at Davis planted 48 feet apart use about 34 tons of water per acre daily—approximately 431 gallons for each tree—during July.

The trees continue to use the water as rapidly as possible until the supply is cut off. When a shortage occurs, the crop and trees may be damaged to some extent, depending on when the shortage occurs and upon the length of time that dry soil conditions prevail. The supply of moisture, therefore, should be replenished from time to time so that the trees do not suffer for any prolonged period.

Mature walnut trees, although generally planted considerably further apart than other fruit trees, extract moisture from all the soil between the trees. An experiment carried on at Davis a number of years ago showed that walnut trees withdrew moisture from the soil 20 feet from the trunk as rapidly as they did only eight feet from the trunk.

In another series of experiments conducted at the same time, considerable information was obtained about the depth to which walnut roots grow. It was found that the orchard at Davis on Yolo loam used moisture from at least 12 feet of soil. The soil moisture extraction curves showed that the readily available moisture in the unirrigated plots was exhausted to a depth of six feet about the middle of July. In the seventh, eighth and ninth feet it was exhausted a month later, or about the middle of August, and in the nine- to 12-foot depth the readily available moisture was used up about the middle of September.

These results indicate that while the extraction was slower from the lower depth than from the shallow ones, the readily available moisture was used up to a depth of at least 12 feet before the end of the growing season.

## Replenishment

The value of a deep and extensive root system in securing water for use by the

tree particularly late in the season is self-evident. However, provision must be made for the replenishment of water in this deep reservoir. A deep root system is of but little benefit unless there is a supply of water for it to use. It is probable that in many places in California the winter rainfall is not sufficient to wet a loam soil to a depth of 12 feet. If the grower wishes to make fullest use of the deep soil layers, additional water is generally necessary.

There is one situation in which the irrigation of walnuts differs from that of other trees, and that is, when the reservoir of soil moisture in a walnut orchard is depleted, considerably more water is needed to replenish the supply than is the case with trees that do not root so deeply.

As is the case with other fruit trees, the beneficial effects of good irrigation practice become evident rather slowly, while the harmful effects that follow neglect or inadequate irrigation may be noticeable the first year.

At Davis, the trees in the dry plots generally produce a larger proportion of blanks or partly filled nuts than those from the irrigated ones. In these experiments, however, size of the nuts has not been affected. This is because the young walnut fruit grows rapidly in the early part of the season and attains full size before the moisture from the winter rains is exhausted.

## Requirements

The general procedure in irrigating walnuts, even though the trees are large and the roots occupy a great volume of soil, is not essentially different from that followed in irrigating other kinds of fruit trees. Because of the depth of rooting of walnuts, it is good practice to wet the soil to a greater depth than may be necessary with other trees.

A study of the soil-moisture conditions in the fall by means of a soil tube or auger shows that the soil in many orchards is dry. This apparently dry soil actually contains some moisture, but, unfortunately this moisture is not readily available to the trees.

The amount of water in the soil under these conditions, when expressed as a percentage of the dry weight of soil, is known as the permanent wilting percentage. It is that percentage of water from which the roots cannot obtain moisture readily enough to maintain the tree in normal growing condition.

After the beginning of the winter rains, a further study of the soil-moisture conditions generally shows a moist layer on top of the dry soil beneath. Each succeeding rain causes the moist layer to increase in depth. The moist soil on top, after drainage has taken place, is filled to what is known as field capacity.

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**Furrow irrigation of walnuts. Considerably more water is needed to replenish the soil moisture supply for the walnut than for trees less deeply rooted.**



## IRRIGATION

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The top layers of soil are filled to field capacity before water moves downward to the dry soil beneath.

The depth of penetration depends largely upon the amount of water, whether by rain or irrigation and upon the texture of the soil. A light rain wets the soil to a shallower depth than a heavy one. Furthermore, a given amount of water wets a loam soil to a shallower depth than a sand. For example, in a loam soil an inch of rain may penetrate five or six inches, while in a sand it may penetrate a foot or more. Conversely, the readily available moisture from a given depth will ordinarily be exhausted more rapidly from a sand than from a loam.

After walnut trees come into leaf, moisture begins to leave the soil. Most of the water moves out through the leaves by the process of transpiration, but some is lost by direct evaporation from the soil.

The movement of water out from the soil is somewhat different than the movement into the soil from rain as the roots extract it more or less uniformly. This gradual, fairly regular reduction of soil moisture may be used in judging when the available supply will be exhausted and when the first irrigation will be necessary.

The permanent wilting percentage is a characteristic of the soil. All plants seem to have the ability to reduce the soil moisture to the same extent.

If weeds in a walnut orchard show signs of wilting, it may be assumed that the trees are close to that condition also. Weeds, being shallower rooted than trees, wilt first.

Trees reduce the soil moisture in a given orchard to the same moisture content year after year. The permanent wilting percentage is a soil moisture constant that does not change with the passing years. Drouth resistance in trees is not due to their ability to extract more water from the soil than other plants; but to their ability to withstand long periods of dry soil conditions without dying.

Under conditions at Davis about three irrigations—wetting the soil to a depth of seven or eight feet—are adequate. The first two irrigations are applied before harvest and the third one as soon as possible after the crop is gathered. If the soil is wetted to a shallower depth, or is coarser in texture than the loam soil at Davis, more frequent irrigations may be necessary. As a rule all of the moisture from the last irrigation is not used before leaf fall, and the remainder, together with the rainfall, is sufficient to provide enough water to start the trees with a reservoir that is full or nearly so.

The irrigation schedule should be

planned so as to interfere as little as possible with other orchard operations. Where spraying is necessary, irrigation water should be applied either sufficiently in advance of the spraying to allow the surface to dry before it is necessary to take the spray equipment into the orchard, or should be postponed until after the spray job is done. Likewise, the irrigation schedule should be so planned with regard to the harvest date that the nuts can be picked up from dry soil.

After harvest many growers feel that no more water is necessary. It should be pointed out that the leaves are still on the trees, and certain food manufacturing processes are still going on. While the leaves are on the trees, they use water whether there is a crop on the trees or not.

The last irrigation need not be as heavy as the early ones, but the exact amount may depend on the grower's ability to predict correctly the onset of winter rain. In most cases water not used during the fall months is not wasted, but is moved down by the winter rains and forms a part of the supply for the next season.

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## STAKES

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weathering. All treatments appeared to be of some benefit to these woods. In some cases, Douglas fir showed superiority to eucalyptus.

The creosote oil treatments maintained their reputations of being superior. The crankcase oil bath cannot be considered significant, because of its unreliability, as indicated by variable results. Another weakness of such treatments lies in the wide variation in chemical composition of different samples of crankcase oil. Zinc chloride home treatments are apparently ineffective, according to these tests.

A study was made to check the relation between the amount of preservative absorbed and stake strength after 12 years. There seemed to be no conclusive relation between these two variables, but when the various points were plotted, a few observations could be made. Under a heavy retention of the treatment, good durability always resulted. Under light treatments there was considerable variation. Many of the brush treatments were surprisingly effective. Crankcase oil treatments varied widely, apparently being not dependable.

Only a few methods were consistently

satisfactory. The creosote and Columbia baths were most consistent, followed by conservo, crankcase oil, selenium-tellurium, cold treater dust, and zinc chloride, in varying order for the three different kinds of wood.

Treatments listed in order of their values as preservatives considering average rank, dependability, and effect upon nondurable woods, are: creosote, Columbia, crankcase oil, conservo, selenium-tellurium, cold treater dust, zinc chloride.

Recommended methods of application are listed in the order of their effectiveness: pressure, hot and cold bath, hot bath, two brush, one brush, cold bath—steep.

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## INSECTS

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amounts of residue were present on the washed tomatoes and in the juice extracted from these tomatoes.

Considerably higher concentrations of residues were present in the pomace or residue from juice extraction, particularly with the new organic insecticides.

Arsenic was reduced to about the same level as the other insecticides after washing, but did not show as marked an increase in concentration in the pomace as did DDT, DDD and toxaphene.

It appears that there is no serious residue hazard involved with canning tomatoes where DDD, DDT or the DDT-toxaphene combination are used for the control of caterpillars attacking tomato. This is particularly true if these insecticides are not used at a concentration higher than recommended here.

In all cases in the samples from the commercial blocks, there were 0.05 ppm—parts per million—or less of residue in the juice and from 0.5 to 1.77 ppm in the pomace.

Because of the relatively higher residue in the tomato pomace, it probably should not be fed to livestock, particularly dairy cattle.

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