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IRRIGATION = DRAINAGE

THE SOIL AS A RESERVOIR FOR WATER

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In order to provide a proper foundation for the adoption of correct irrigation practices it is necessary to understand something of the behavior of water in the soil and the means by which it is removed from the soil. Between successive rainstorms or successive irrigations, plants must subsist on water stored in the ground. The soil, then, is a reservoir for water and as such has length and breadth and depth just like any other reservoir. The soil reservoir has another factor besides its cubic capacity and that is the amount of water yielded to plants by each cubic foot of soil. The capacity of our soil reservoir is determined by the spacing of trees or plants grown, the depth of rooting of those plants and the water yield per cubic foot of the soil.

The water yield per cubic foot of soil is not susceptible of direct measurement, but it is arrived at by ascertaining the difference in the amount of water in a given volume of soil when wetted to its Field Capacity and the amount of water in that soil when plants growing therein have wilted.

Field Capacity of a soil is the amount of water, expressed as a percentage of the dry weight of that soil, which will be retained in the soil against the downward pull of gravity. Any free draining soil can be wetted only to its Field Capacity. If more water than that representing the Field Capacity of a soil is added, the result is simply a deeper wetting. Each cubic foot to the full depth of wetting will be wetted to its Field Capacity.

The other constant of soil moisture is known as the Permanent Wilting Percentage. It represents the amount .of water in a soil, expressed in percentage of the dry weight, at which plants wilt. So far as is known this Permanent Wilting Percentage is the same for all plants; in other words, it is a function of soils and not of plants.

The water yield per cubic foot of soil may be readily computed if the Field Capacity and Permanent Wilting Percentages of the soil are determined.

For typical soils, the following examples of various soil types may be cited:

	Sandy Soils	Loam Soils	Clay Soils
Field Capacity	10%	22%	30%
Water Yield	5%	10%	13%
Permanent Wilting Percentage	5%	12%	17%

Hard and fast rules regarding the relationship between field capacity and wilting point

cannot be laid down, as soil types are very variable. While in many cases the Permanent Wilting Percentage is about one-half of Field Capacity, laboratory studies have disclosed some soils where the amount of water in a soil at Permanent Wilting Percentage was only 30% of Field Capacity, and in other soils the amount of Permanent Wilting Percentage was as great as 75% of Field Capacity.

In the matter of depth of rooting of trees or plants many factors must be considered, the principal ones being the kind of plant, type of soil, fertility and moisture conditions. As a matter of observation, sandy soils, while readily penetrated by moisture, usually develop shallow rooted plants because of lack of fertility. On the other hand, very heavy soils, while fertile, usually have shallow rooted plants because of lack of penetrability of such soils by water. The greatest depth of rooting of plants will be found in loam types of soil because they are fertile and are readily penetrated by water.

Water is used from the soil reservoir or passes below the influence of plant roots by the following means:

1. Evaporation.
2. Transpiration.
3. Deep Percolation.

A fourth loss by direct run-off at lower ends of furrows is sometimes a factor in poor irrigation. Of the above factors in irrigation only that water used in plant transpiration does useful work in growing crops. The others are losses.

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IRRIGATION—DRAINAGE

Irrigation: Sub-Irrigation Porous Pipes

November 22, 1930

Question: How about the use of porous sub-irrigation pipes in avocado groves?

Dr. Coit: There are places and conditions where I think it works very well. There are other places and conditions where we have seen it to be an entire failure. Where I saw it working best was on a comparatively level piece of land, rather sandy in nature. The water left the porous underground tile and it soaked out very nicely. The trees are doing well and yielding heavy crops. In another place where it was a failure, the soil was heavy clay on a steep hillside. The water did not soak out from the tiles satisfactorily. Even though they keep the water trickling through all the time, the trees got dry and had to be irrigated in basins anyway. In one or two places where it has been used on steep hillsides, it has saturated the sub-soils to such an extent that the hillside slipped off with a big landslide and landed in the valley—trees and all. On the hillside, you should look

out for this in connection with under-ground porous tile. I think there is a place for this type of irrigation but I don't think it ought to be used on all groves.

Question: Was the pipe laid right? Some claim if it is not laid just right, it won't work.

Dr. Coit: In this particular place the persons from whom the tile was bought supervised the laying of it. I might say that the under-ground porous pipe works best in the Kimball sandy loams such as you will find in Carlsbad, Encinitas, or the Solano Beach country.

Irrigation

November 22, 1930

Question: Should a tree in bloom have much water?

Dr. Coit: In my opinion it should not have much water though it should have some. It depends on the variety, soil type, and location. Some of us are coming to believe that our Fuertes have a tendency to set a larger proportion of their crop if they are not too wet during bloom.

March 10, 1931

Question: Speaking of tip-burn, isn't it possible that in some parts of Orange County where we have desert winds that the leaves burn while the wind is blowing because the leaves dry out through the wind faster than they can absorb moisture from the soil?

Mr. France: You are going to hear about that in another talk—all about the wilting point of soils. Theoretically a tree can take water clear down to the wilting point without suffering at all. Some trees can actually reach the wilting point and wilt and as soon as they get moisture again, they will be all right. Don't go clear down to the wilting point with your avocados for when they wilt, they lose their foliage and get quite a set-back.

Question: Which is the worst—to let the avocado tree wilt down or give it too much water?

Mr. France: Neither are very good. However, I should say as a choice of two evils, I would prefer wilting to too much water.

Question: Does a tree ever reach the wilting point when it is not apparent from observation?

Mr. France: Some trees and plants would. When the soil around the cactus causes it to reach the wilting point, the cactus doesn't wilt but just takes moisture out of its own material.

Question: The idea is that—we are told that as long as the soil contains moisture between the field capacity and the wilting point that the plant is never suffering from lack of moisture. But we do know that plants do suffer from lack of moisture and apparently they do not look like they were wilting. My question is this: Do they ever reach the wilting point and it isn't apparent in the appearance of the plant?

Mr. France: That certainly would not be true of the avocado tree.

Question: When the tree reaches the wilting point, is it true it draws the moisture from the fruit?

Mr. France: Yes, undoubtedly causing the fruit to drop.

May 16, 1931

Question: Has irrigation any effect on setting of fruit?

Answer: That is rather an obscure question to answer. It is obvious that irrigation does encourage the setting of fruit. If the question had been what kind of irrigation and when, we could have answered it a little more explicitly.

Questioner: I was talking to one of the avocado growers the other day and he advanced the theory that if you run a lot of cold water just as the fruit was setting close to the tree and let it get right under the tree, his idea was that it would so cool the ground that it would affect the setting of the fruit.

Dr. Coit: He is correct. I think a great many growers and I join them in the belief, that while the Fuerte avocado is completing blooming and setting fruit, it would be better to be a little on the dry side rather than on the wet side. The fruit sets better. Whether it is the temperature or some other factor, I do not know but they seem to set better on the dry side—not dry enough to cause the fruit to shrivel but rather than give a thorough irrigation at that time under the overhead irrigation system, we like to give just a little, enough just to "kid" them along a little and then irrigate thoroughly after the fruit is set. In the basin plan of irrigation, we fill the basin half full if necessary. In the case of the Fuerte we run just one furrow—just a little to keep them growing.

Question: One of my neighbors has ten acres of young avocado trees. He has a ditch-digging machine that digs a hole six feet deep, two feet wide in a minute. He is digging a hole by each one of these trees within a foot of the tree and putting in a fifth of a bale of alfalfa hay, then filling in with dirt again. Will that do any good?

Mr. France: I think he would do more good and have less expense by incorporating the hay through the soil mass rather than putting it just in one spot. Why is he doing it?

Questioner: I think he is doing it with the idea of furnishing drainage. It is a rather heavy soil.

Mr. France: I think a good tile drain would be better. Avocado trees will not put up with wet feet. I don't believe that is the way I would drain it or fertilize it.

*See T. U. Barber's article, page 123. Wahlberg's article, page 131. McCulloch's article, page 125.