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On Avocado Yields

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Although J. Eliot Coit as long ago as 1927 put forth the idea that the level of avocado yields was related to climatic conditions, it is only in recent years that some headway has been made to prove that this is in fact so. Sedgley and Annells (1981), Lomas (1988), Zamet (1990), and Lomas and Zamet (1994), have shown that pollination and avocado yields are affected by temperature or by climate in general. The first have shown this using growth chambers; the others by comparing yields to meteorological records.

Most people will respond, saying: "It's all very well showing that yields are affected by the climate, but how can the grower create change in the climate?" The answer to that question is that the grower can and does today change the climate. It is the author's opinion that far more can be done to change the orchard climate, and thus to improve our overall yields.

How can this be done simply and cheaply? First, we need to recognize how for years the grower has been changing the orchard climate.

In many parts of the avocado-growing world, avocados are irrigated for at least part of the year. In this way, we affect enormously one aspect of the climate: namely, soil moisture.

Before we plant a proposed area, we investigate the liability of the area to frost, floods, and strong winds. By so doing, we can avoid to a large extent such catastrophes.

Since the early 1960s, many orchards in Israel, especially those on heavy soil, have been planted on ridges. This procedure ensures better drainage and assists root growth.

The effects of pruning and non-pruning:

When we do *not* prune, and instead let our trees grow wild, the space between the trees closes, the lower parts of the trees lose their vitality, the soil is shaded, and fruit-if any-is mainly in the tops of the trees.

When we *do* prune, we let sunlight and warmth penetrate the orchard, we have green leaves down to soil level, and also fruit. There is a larger photosynthetic area, and carbohydrate assimilation can thus be higher in advance of the next crop. However, although it is generally accepted that light in the orchard is essential, little, if any, information is available as to what is the best light intensity regime for the avocado orchard to give maximum yields. Let us nevertheless have foremost in our minds that the sun's light and warmth can be our best and cheapest fertilizers.

Although it may seem at first an almost impossible task, probably the best and easiest way to change the orchard climate is by raising the soil temperature in the early spring (in areas where the minimum air temperature is frequently below 10°C). Lahav and Trochioulis (1992) have shown that under controlled conditions in the growth chamber, temperature affects root growth. With the initial rise in temperature (17°C day/10°C night 21°C day/14°C night), they found 150% increase in dry matter for Hass tree roots; above 21°C day/14°C night, root growth was reduced. The initial temperatures are a little above those found in the western Galilee in spring. Lomas and Zamet have shown that March soil temperature at 30 cm. depth can be correlated to Israeli national yield levels. During the 27-year period which they investigated, the maximum difference for the March average was only 5.0°C. In the spring of 1994, soil temperature measurements were made in a healthy ten-year-old orchard, still open between the rows, using standard meteorological soil thermometers. The measurements were made at 30 cm. depth under bare soil, and under litter-covered soil, and (later in May) also under the canopy close to the trunk. The litter-covered soil, and (later in May) also under the canopy close to the trunk. The litter-covered area usually had about half an hour more direct sunlight than the bare soil. At the beginning of February, the bare soil temperature was about one-half degree higher than the litter-covered soil. By the 17th of April, the difference had widened to 1 1/2 degrees; and by the end of May, to 2 degrees. Close to the trunk, the soil was 1 1/2 degrees cooler toward the end of May than the litter-covered soil. From the measurements made, it seems reasonable to assume that the average difference for March between the bare soil and under the canopy was in the region of 1 1/2 degrees. Most of the tree roots are found under the canopy. If we compare this difference of 1 1/2 degrees with the difference found by Lomas and Zamet, we have 30% of the maximum 27 year difference. If we compare it with the results found by Lahav and Trochioulis, where a four degree increase produced 150% increase in roots, then 1 1/2 degrees can give us about 50% more root activity! Whichever way we look at the findings, the increased soil temperature can mean a considerable increase in root activity just at the critical time of flowering and fruit set.

This spring on the Acco Experiment Station, burning of flowers was noticed after two short heat waves in early April, while after a much longer and heavier heat wave in the second half of the month, no such damage was noticed. It would seem likely, as suggested by the work of Lahav and Trochioulis, that in the short interval between the short and long heat waves, the soil had warmed up so as to allow sufficient root activity to supply the required moisture demand of the tree. Earlier root activity will also permit improved nutrient uptake that could also help to improve fruit set.

Warming up the soil seems an even bigger task than warming up the air. However, it is possible that even a one-half degree increase in soil temperature in 30 cm. depth could be critically important to the avocado crop level. In March, an average one degree difference was found between the bare and litter-covered soil; therefore, to change the temperature by this amount is relatively simple and can be carried out in several ways.

First, we need to prune our trees and let the sun's rays enter between the trees to warm up the soil (this will bring in its wake a small increase in air temperature). The trees should be kept as narrow as possible to allow maximum bare soil. Varieties that are difficult to keep narrow should be eliminated. Raising the tree skirt will enable the sun's

rays to penetrate there also. The soil between rows should be kept as clear as possible from litter, or the litter should be pushed to one side or cultivated into the soil. This should be done before flowering. The use of black plastic laid between rows could also help raise the soil temperature. A final possible way to warm the soil is by the use of heated irrigation water, especially when the minimum air temperature frequently falls below 10°C. The warm water would help raise the air temperature and also the immediate soil surface where many avocado roots are frequently found. Such irrigations would be best during the colder hours of the night.

Other people can probably think of still more ways to warm the orchard. If the report of at least one grower who claims an increase of 50% in yield after pruning this orchard is significant, then "orchard warming" would appear to be a "must" at least in those areas where low temperatures is the most likely reason for low crops.

To conclude: Today we feed our trees with various types of fertilizers, we moisture our soil by irrigating, we spray to reduce the weed population. Now it is suggested that we should also learn how to warm our soil in early spring-especially during the critical period of flowering and fruit set-thus enabling the avocado roots to become active early and allowing the frees to benefit from the fertilizers and water we have given.

Literature

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