California Avocado Society 1998 Yearbook 82: 161-164

On our awareness of the climatic affects of avocado yields

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For many years people interested in avocados have pondered on the connection between climate and avocado yields. Recent articles have added to our knowledge(1, 2, 3, 5). Nevertheless most people have the feeling that climate is something we cannot control. The result of this feeling is that very little is being done. Even when we carry out orchard management procedures which can have an affect on the orchard microclimate, we may only evaluate them on the basis of crop yield, and do little or nothing to understand why. Perhaps the imagined cost of altering the microclimate in an orchard tends to prevent more activity in this direction. Growers hesitate in spite of the large sums of money spent on wind-machines for frost protection in certain areas.

Among the procedures which can modify climate in the orchard and in use in recent years are planting on ridges and pruning. Both are essential in many instances. Planting on ridges, for example, was begun initially to improve drainage. Once the ridges are built and the trees planted, however, the drainage trough can begin to fill up and, sooner or later, become useless. This can happen due to soil being washed down from the ridge by rain or irrigation. Pruning litter can also be dropped in the trough and then the wind and rain bring more refuse till a small dam is built. Tractors and other farm equipment can push down soil from the ridge or, if crossing at right angles to the row, leave wheel marks which again form a small dam. The results of all of this is that water is held up, the soil becomes waterlogged, its temperature falls (4) and all kinds of problems follow. Root become asphyxiated, there is poor uptake of water and nutrients, and even the development of root rot. Finally one or more units of production give less than their maximum potential and the growers' income falls. When we consider pruning, we are up against the fact that a lot of pruning litter lying on the ground does not mean we have pruned well or even sufficiently. The grower frequently feels he has pruned heavily and let a lot of light into the orchard while the amount of light filtering down is still frequently less than 30% of the incident light outside the orchard. Thus the effect of pruning depends on how, how much, to what extent and with what frequency we carry it out. Let us not forget that light is our best and cheapest fertilizer. Without light there is no crop. We know that light is essential but not how much. We do not know if different cultivars need a different light level, after all they are not all the same shape or size. Even more importantly we do not know where and when to measure for light. Should it be near the trunk and under the canopy, between trees, or above the canopy? What time of day, in full sun or cloudy weather? We need to know which methods are best.

In order to evaluate a pruning procedure or tree shape, we need to know what effect it

has on light penetration. We need to know what happens to air temperature and soil temperature in the orchard. This author has found differences in air temperature of up to 2 1/2° C for the maximum, and up to 1° C for the minimum between an open and closed orchard. Soil temperatures at 30 cm depth have varied between bare soil in an open orchard and the soil in a closed orchard in mid summer by 2 1/2° C to 6° C when the closed orchard was compared to a nearby meteorological station. In winter the differences were smaller — about 1 - 2° C. We need to know what happens to water and nutrient uptake when we open the orchard. If, due to an increase soil temperature, root growth increases (as found by Lahav and Trochioulis), then this could be the reason for improved yields after pruning. The average Israeli yield in 1988 was only 2.2 tons per hectare. This yield came after a low yield of 5.6 tons the previous year. The 1986 yield, however reached the height of 19.8 tons per hectare. These differences in yield have been connected to climatic effects (3). Among these climatic effects are soil temperature which in March 1988 were five degrees lower than in 1986, at a depth of 30 cm. This can be calculated as a 3.5 ton increase or decrease in yield. Depending on which was we look, per one small degree in soil temperature. In other words, one small degree can be thought to be responsible for more than the entire 1988 crop.

It seems strange that, with such a small difference in temperature, nothing is done to evaluate the affect on yield when we prune. Pollinating insects are affected by climate. Therefore, when we carry out pollination studies we need to know what was the difference in temperature between plots and between rows of different pollinating cultivars. Perhaps the microclimatic differences are more important? At least they should be recorded and, not ignored.

Over 50 years ago, at East Mailing in England, work was carried out into the differences between apple rootstock. It was then known that there were rootstocks which gave small trees and those which gave large ones, naturally there were other characteristics which differed. The investigation at East Mailing showed that there was an anatomical difference between rootstocks and that this enabled them to begin a search to evaluate seedlings at a very early age for their possible usefulness as rootstocks and thus save an enormous amount of time and money. A vast amount of work has been carried out evaluating the potential of avocado rootstocks. Thousands and thousands of seedlings have been evaluated at an enormous cost in money and time. There have been some very important results. The adaptability of West Indian type rootstocks for salt tolerance, and the various rootstocks which have been found to be *Phythophthora* resistant. It is all very well to find a particular West Indian stock which is salt tolerant and give a good yield. The question is why? Why does one stock in a close genetic range give a good yield and another less? Lehav and Trochioulis found that using the same Guatemalan seedlings, Fuerte gave the best root growth at an ambient temperature range of 25/18° C, and the best overall growth at most temperatures tried. Hass, however, peaked at only 21/14° C. This could have been a varietal difference, but it also could have been due to the different composts used for each cultivar. The temperatures were measured as air temperatures, and it is possible that the different composts had slightly different heat retention.

During a three year period, the author recorded soil temperatures at a depth of 30 centimeters. The average temperatures in the month of March are as follows:

a) 15.2° C in and open orchard measured under a thick layer of litter

b) 15.7° C in an open orchard measured under bare soil aboutP/2 meters away from the first measurement site

c) 15.9° C at a meteorological station about 500 meters away.

Just by having the soil bare, it is possible to increase the soil temperature by a half a degree centigrade. According to what has been previously noted, this could mean an extra 1.75 tons of fruit per hectare. Perhaps this is wishful thinking. As Lomas and Zamet found, other climatic factors play a part, but soil temperature certainly demands some thought and trial.

From all of this it would seem very likely that the difference between avocado rootstocks, and their ability to affect the yield the yield of the cultivars grafted on them, is possibly due to the ability of one rootstock to begin growing in spring at a slightly lower temperature. This would mean better water uptake and nutrient supply to the canopy, earlier. We are looking here for a small temperature difference which could make a big difference in yield. Unpublished work by Lomas and Zamet shows a slightly higher temperature at the top of a five meter tall Ettinger tree then near the ground. Most avocado growers will agree that the largest fruit is found in the tree tops. It is the author's opinion that this is due to the small temperature difference.

In summary, the playwright Samuel Becket wrote: "Do not ignore the little things." One degree of too much frost means no yield. A soil temperature that is too low means a lower yield. Let us begin thinking about the "little things."

Literature

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