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Diurnal Changes in Leaf Thickness of Avocado

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Internal water relationships between various tissues of the plant structure frequently are reflected by a change in turgidity of the tissues concerned and can be manifest by visual differences in the leaf position and condition or modification of stem or root diameter, the latter determined with precision instruments. Studies on the moisture relationships within the fruit tissue (1,2) indicate the reduction in size of this major reservoir of water as moisture stress is developed within the plant system as a whole. Moisture from the fruit normally is transferred to the nearby leaves during the midday period when maximum water stress is developed as the result of increased ambient air temperatures and which induce higher rates of transpiration from the leaf. Thus at approximately midday, when the air temperature is maximum, there is a marked shrinking or reduction in size of all plant parts including smaller stems, trunk, roots, and fruits as moisture is lost to the air through transpiration via the stomatal openings in the leaf and younger stem parts and the fruit.

Likewise during the cooler evening and night period when transpiration is at a minimum the roots are able to absorb moisture, if available, and by translocation to the above ground stems, leaf, and fruit will replenish these tissues, all of which results in the regaining of original size of the plant parts at night and a detection of actual growth if the observation is made in early morning before sunup.

The rate of moisture loss from a plant as the result of transpiration does not depend entirely on air temperature at the given moment but may be affected by such factors as tissue temperature, light intensity, the rate of air movement across the leaf, stem, fruit surface, stomatal aperture, and the relative moisture content of the air (3).

The moisture status of the avocado leaf is of concern to the general normal functioning of the plant as a whole. The change in leaf moisture probably reflects the ability of that leaf to take up water from the soil through the several tissues by systems of the root and stem which are associated with the leaf in this process. A change in leaf thickness will result when there is a net gain or loss of water within the leaf tissues. This change will be reflected whenever the rate of transpiration from the leaf differs from the rate of water uptake from the soil. The leaf is probably thickest when the leaf tissue moisture content is greatest and becomes thinner under moisture stress in any of its tissues. Thus, under conditions where soil moisture continues to decrease from day to day, the predawn leaf thickness on consecutive days may decrease as the soil becomes drier.

The observations in the present experiment were made on avocado seedling plants growing in pots in a glasshouse or in the laboratory. The seedling plants were 3 to 5 feet tall. Machinist dial gauges were fixed on aluminum benches such that a leaf could lie

across the bench and the dial indicator could be placed either on the petiole or at any selected point on the leaf lamina. Vertical expansion of the leaf tissue was registered on the dial. Each unit on the dial indicated a difference of .001 inch. Observations on leaf thickness were made manually at intervals simultaneous with that of ambient air temperature determined with a Digi-Sense Thermistor Thermometer Model 8520 (Cole Farmer Instrument Co.).

An example of a daily observation for two consecutive days is given in Figure 1. The gauge was set near a leaf edge. The original leaf thickness was 0.0115 inches at 7:30 A.M. at the start of observations. At 2:30 P.M. of the first day, leaf thickness was reduced to 0.0090 inches, which reflects a shrinkage of approximately 24 percent. Complete recovery of original leaf thickness is not attained on consecutive days as the unirrigated plant was in a situation where soil moisture was decreasing.

A summary statement of the present Une of studies suggests that the fluctuation in thickness of the avocado leaf follows a general daily pattern with the general inverse relationship to the ambient air temperature. Leaf thickness increases during the dark hours with a maximum value attained at sunup. The increased transpiration which follows the incidence of light on the leaf surface results in water deficit in the several leaf tissues, loss of turgidity of the individual cells, and an observable reduction of leaf thickness as daylight period increases. A maximum reduction in leaf thickness is attained in early afternoon followed by a slow reestablishment of turgidity in the tissues as the lower ambient temperatures develop. Daily fluctuation in leaf thickness reflects internal leaf moisture stress which becomes progressively greater as soil moisture depletion continues over a period of time. Leaf thickness observed at the same time on consecutive days, therefore, becomes less as the soil moisture deficit increases over short periods of time until soil moisture is replenished.

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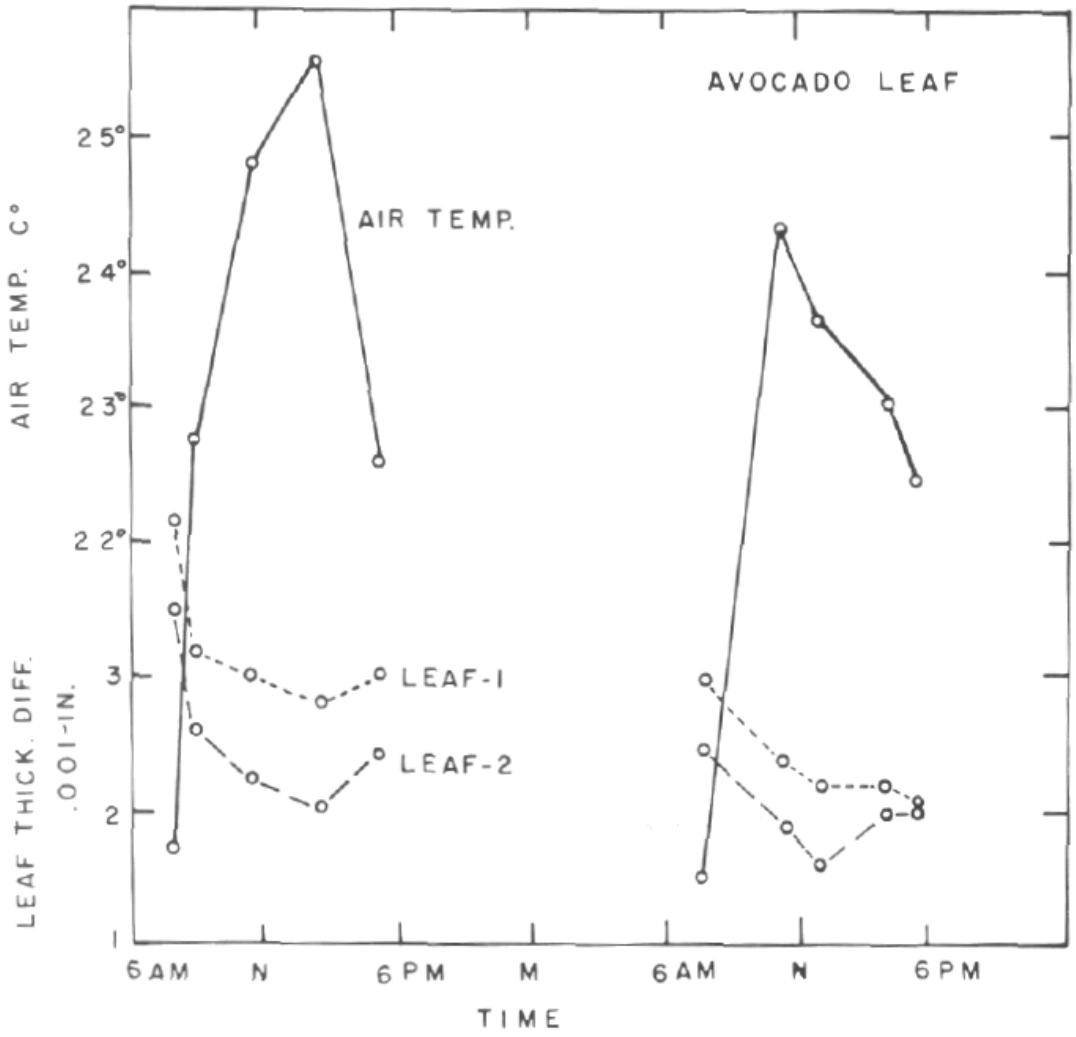

Figure 1. Diurnal variation in thickness of two avocado leaves on two consecutive days.