Temperature Changes in Fuerte Avocado From Tree to Market

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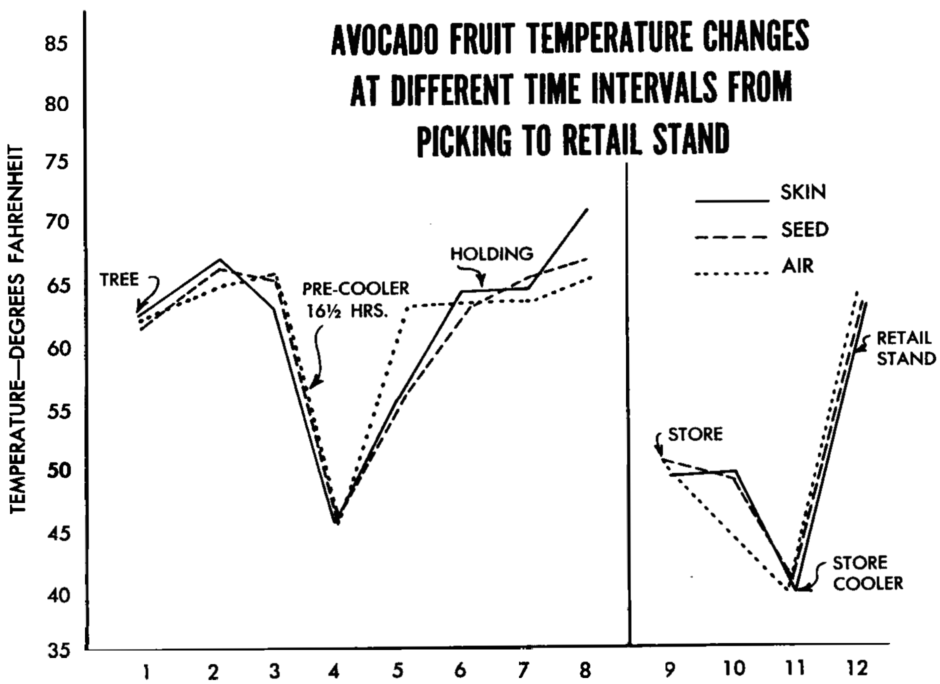
THE FUERTE AVOCADO often turns black as the fruit nears the ready-to-eat stage in certain years. Some losses from this dark discoloration occur at the retail stand while other fruit purchased at the store discolors and softens at home and the housewife often throws the fruit away. This situation has curtailed consumer demands for the avocado especially in markets farther away from California, where this black discoloration is present to an even greater degree.

Blemishes on the fruit such as limb rubs, sunburn, snail damage, insect injury and corkiness can be explained and certain measures taken to prevent them. However, the dark discoloration that seems to envelop the fruit, starting as a relatively small endspot and then gradually covering a large portion, has not been fully explained. This discoloration is by far the main reason for losses at the retail store level. Because of the increased advertising and sales promotion of the avocado during the past two years, it is of utmost importance that the product displayed on the retail shelf be the highest quality. The fruit should bring the highest return to the retailer and the greatest satisfaction to the housewife who has responded to the avocado advertising.

In December 1962, at the beginning of the Fuerte season, a project was undertaken by the Agricultural Extension Service of San Diego County in cooperation with Calavo Growers of California and two of its grower members: Mr. Charles Crytser and Mr. Jack Zieger, to learn more about what happens to the avocado as it makes the trip from tree to market. Objectives of this first test were to show the temperature changes taking place in the avocado during commercial handling from tree to the consumer, and the effects of these changes on fruit quality. Measurements were made of the temperature of the avocado flesh near the seed and another measurement just under the skin. Thermocouples were inserted into the fruit and the temperature read off in degrees Fahrenheit on a potentiometer. It was estimated that an avocado goes through a minimum of ten temperature changes from the time the fruit is picked until it reaches the consumer's shopping bag. Temperature readings were made at the following stages: (1) on the tree, (2) in the field box (after it had been picked and standing in an orchard for a day), (3) at the packing house dock (prior to being placed in the precooler), (4) when the fruit is taken out of the precooler, (5) at the beginning of the packing line, (6) at the end of the packing line, (7) when it comes out of the holding box, (8) upon arrival at the retail store, and (9) during holding at the retail store until it reaches the sales stand.

Temperature measurements were made on the fruit "in place," in each of the stages of handling. The fruit shipments to be tested were placed in a supermarket of the Food Basket chain, and another in De Falco's Food Giant chain, San Diego. This was the second of four tests made on the Jack Zieger orchard, formerly owned by Charles Crytser.

Results (summarized in the graph), showed that the avocado fruit responds very closely to the air temperature sur-



1—Fruit temperature was measured immediately upon removal of fruit from tree.

2—Fruit was commercially picked in the morning. It was placed in field boxes and stacked in the orchard until picked up in the afternoon around 4:30 p.m. Temperature readings were obtained on fruit in the boxes at 3:00 p.m.

3—Fruit was trucked about five miles to the packing house, arriving around 5:00 p.m. Temperatures were recorded when fruit arrived at dock, prior to placing fruit in pre-cooler.

4—Fruit was in pre-cooler from 5 p.m. to about 9 a.m. of the next day. Pre-cooler temperature was about 44° F. Temperature readings were made before fruit was taken from pre-cooler.

5—Readings were made on fruit just before it went into the packing line. Fruit had been taken out of the pre-cooler and placed in the unstacker.

6—Readings taken as fruit completed the packing line process.

7—Readings taken as fruit comes out of holding box.

8—Fruit transported to the retail store in San Diego—a half-hour's drive. Readings made on fruit upon arrival at store.

9—Another shipment from the same lot was sent by truck to a wholesaler in San Diego. He placed the fruit in his cooler overnight at 50° F.

10—Reading of fruit at store prior to placing in store cooler, which was around 38° F. (First Day)

11—In store cooler (38° F.) (4th Day)

12—Fruit placed on sales stand—air temperature around 65°–70° F. (8th Day).

rounding the fruit. Change is relatively quick and therefore any atmospheric temperature change will affect the avocado fruit. In another test, where the rate of heating and the rate of cooling in the avocado fruit were measured, the fruit temperature went from 41°F to 56°F within fifteen minutes in an atmosphere of around 67°F. In a measurement of the cooling rate, individual fruit temperatures dropped from 67°F to about 48°F in 45 minutes. Within the next two hours the fruit temperature had dropped to about 42°F in a cold box reading about 41°F.

Conclusions concerning the sensitivity of avocado fruit include the observation that the skin is subject to more temperature changes, and more rapid changes, than the interior of the fruit. On the other hand, the lag of the interior temperature is slight, and for all practical purposes, the entire fruit can be considered as being influenced by temperature changes. This test provides a basis for further studies into temperature effects on fruit quality. Tests are now under way to determine fruit reaction to a continuous high temperature, a continuous low temperature, or a temperature fluctuating between high and low.

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IRON ADDITIVES Influence Plant Reactions To 2,4-D Concentrations

Tests show that wheat and barley can withstand higher concentrations of 2,4-D when an iron additive is included in the spray solution—indicating the possibility of obtaining increased growth of cereals over a broader range of 2,4-D concentrations and increased efficiency of broad-leaved weed control.

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PREVIOUS UNIVERSITY RESEARCH has shown that inorganic and organic additives can markedly influence the stimulatory, inhibitory, and herbicidal effects of 2,4-D on intact plants. A metal, a chelated metal, or a chelating agent used in the 2,4-D spray increased the range of concentrations by 200-fold, resulting in increased growth of beans. Ammonium and phosphate ions increase, while iron, copper and zinc reportedly decrease the herbicidal effects of 2,4-D.

The study reported here has shown that the simultaneous application of an iron chelate, FeEDDHA, with 2,4-D can have one of several effects: it can increase the growth stimulatory range of 2,4-D concentrations on intact bean plants; decrease the injurious effects; have no effect; or increase the lethal effect of 2,4-D. The range of effects depended on the specific concentration of 2,4-D and were proportional to the concentration of FeEDDHA. At a predetermined growth-inhibitory concentration of 2,4-D, each molecule of FeEDDHA reversed the inhibitory effect of 100,000 molecules of 2,4-D on shoot length; however, shoot dry weight was only partially recovered. Shoot length measurements were not sufficient to determine recovery from injury by 2,4-D. Shoot length measurements were found earlier to be least satisfactory in determining growth stimulation by 2,4-D. Shoot dry weight was completely recovered only when the concentration of FeEDDHA was 100-fold greater than 2,4-D. The recovery effect attributed to FeEDDHA was noticeable throughout a concentration gradient of 10^{-9} to 10^{-2} M FeEDDHA. Restoration of dry weight was a more realistic measure of recovery than was shoot length, and much higher concentrations of an additive were required for recovery of the weight than the shoot length.

Inorganic ions

Inorganic ions as well as metal chelates and chelating agents are effective in preventing injury by 2,4-D. There are important aftereffects, however, which must be considered. Na_2SO_4 at 2.7×10^{-2}M caused a yellowing of the leaves about four to five days after treatment, whereas plants treated with FeEDDHA at 2.7×10^{-2}M remained green and healthy throughout the time of the growth periods. Glutamic acid and aspartic acid did not influence the injury induced by 2,4-D. Other workers have shown that nitrogenous compounds tend to increase the toxicity of 2,4-D.

The results showed that the interaction of 2,4-D and FeEDDHA was greatly dependent on the concentration of 2,4-D. As the concentrations of 2,4-D were increased from the growth-inhibitory to the lethal, the effect of FeEDDHA was progressively changed from that of protecting against 2,4-D injury, to no effect at all to increasing the toxicity of the 2,4-D. This is also in agreement with other workers who reported that a high concentration of chelating agent increased the growth-inhibitory effect of a high concentration of auxin on wheat root and coleoptile sections.

Other workers have reported that Fe can decrease the lethal effect of 2,4-D. Therefore, it is important to realize that Fe can protect from, or add to, the lethality of 2,4-D depending on the concentration of 2,4-D employed. The results also showed that the effects obtained with FeEDDHA greatly depend on its concentration. At 2×10^{-3}M 2,4-D, very low