

LOW TEMPERATURE STORAGE OF RIPE AVOCADO FRUIT

Roy E. Young and Suraphong Kosiyachinda

Assoc. Plant Physiol. and Graduate Student, respectively, University of California, Riverside

It is generally agreed that freshly picked Hass or Fuerte avocado fruit held at a temperature below 43 °F for a sufficiently long time will suffer chilling injury, i.e. it will turn brown, will not soften properly, will be bitter tasting or off-flavor and will not be acceptable to the consumer. We have, however, placed ripe fruit at temperatures below 43 °F and found them to maintain normal color, texture and flavor for many days if kept cool enough and protected from dessication.

These observations prompted us to study the effect of storing avocado fruit at several stages of ripeness at 36°F, a temperature which will always produce chilling injury in Hass and Fuerte cultivars when unripe fruit are used. Fruit in six stages of ripening were used: (1) freshly picked fruit, (2) an early stage of softening, (3) a late softening stage, (4) ideal "soft and edible" stage, (5) two days and (6) three days past the best ripe stage. At 5 day intervals, a few fruit from each group were transferred from 36° to 73°F. Fruit which were ripe at the time of transfer were evaluated for appearance and flavor after standing at 73°F for 24 hours, while unripe fruit were allowed to stand at room temperature until they ripened or showed evidence of chilling or decay. The number of days that fruit from each stage could be stored and results in acceptable quality are shown in Figure 1. Stage 1 fruit were still firm when removed at 26 days and ripened normally, but after 31 days showed chilling injury. Stage 2 fruit showed chilling injury after 27 days and nearly ripe fruit (stage 3) were the most sensitive and were unacceptable after only 20 days. Fruit that were fully ripe when placed at 36 °F remained acceptable for 42 days and never showed any chilling injury, but when stored for longer periods, succumbed rapidly to fungal decay upon transfer to room temperature. Stages 5 and 6 were 2 and 3 days past their best edibly ripe stage when placed at 36°F were somewhat more susceptible to fungal invasion and had 5 to 7 days less of useful storage life at 36°F. These results make clear that ripe fruit do not suffer chilling injury and can best be stored at a temperature just above freezing.

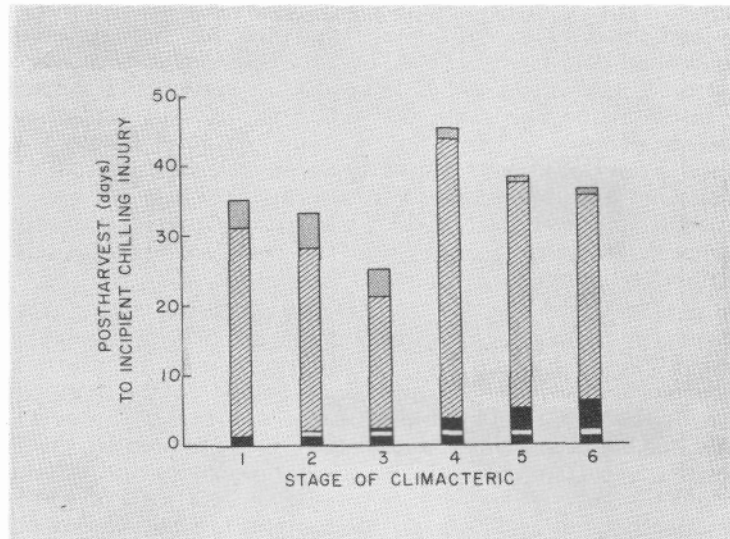


Figure 1. Low temperature storage of Hass avocado fruit at various stages of ripening; 1, freshly picked fruit; 2, an early stage of softening; 3, a late stage of softening; 4, soft and edible stage; 5, two days past best soft and edible; and 6, three days past best and edible stage. Shadings in the bars refer to conditions as follows: ■, air at 68°F; □, room temperature 73°F; ▨, ethylene treatment; ▩, 36°F storage.

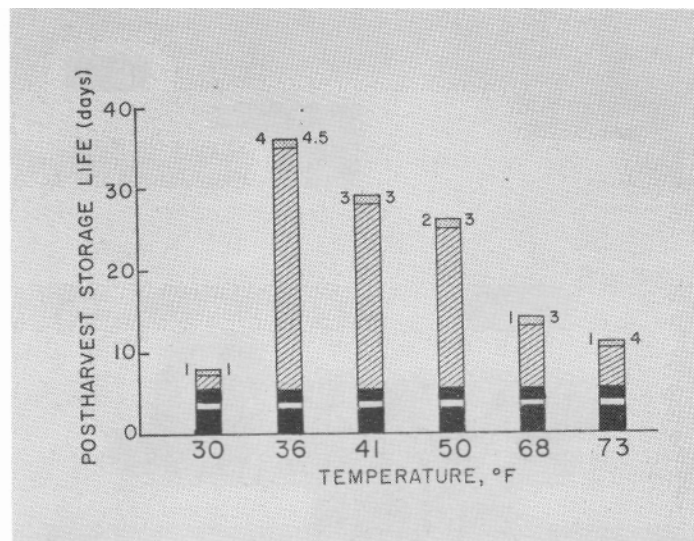


Figure 2. The effect of temperature on the storage life of ripe Fuerte avocado fruit. Shadings of the bars are as in Figure 1. The number to the left of each bar refers to external appearance and that to the right to internal appearance and flavor on a scale of 1 to 5 with 1 being unacceptable and 5 ideal.

We next explored a wider temperature range for storing ripe fruit as is shown in Figure 2. Fruit were kept at 68°F for 2 days, then treated with ethylene for 24 hours to initiate rapid and uniform ripening. After softening at 68°F they were placed at the temperatures shown in Figure 2. Four fruit were transferred every 4th day to 73°F and evaluated for appearance and flavor. The number on the left of each bar of Figure 2 refers to the external appearance and the number on the right the internal appearance and flavor on a scale of 1 to 5 with 1 being unacceptable and 5 being ideal quality. Fruit placed at 30°F were unacceptable on the 8th day after picking or only 2 days of low

temperature; those held at 36°F were of excellent quality for 36 days while the 41 °F and 50°F were of acceptable quality for 27 and 24 days respectively. Fruit held at 68 and 73°F turned brown rapidly. It should be noted that external appearance, vital to consumer acceptance, decreased more rapidly than the internal quality of the fruit. These results make clear that 36°F is the lowest temperature safe for holding ripe fruit and that 36°F is considerably better than 40°F.

For the experiments shown in Figure 2, fruit were treated with ethylene immediately after picking to initiate rapid and uniform ripening—to make sure that all fruit were past their chilling sensitive period before treatment at 36°F. Results of Figure 1 suggest that the maximum storage life could be obtained by storing unripe fruit at 46°F, just above the chilling temperature, until fruit started to soften and then treat with ethylene to obtain uniform and rapid ripening followed by transfer of the ripe fruit to 36°F.

The results of our best experiment are shown in Figure 3 and are for Hass fruit picked on July 2 at the South Coast Field Station. Bar A of this figure shows that fruit ripened with ethylene just after picking and then held at 36°F were still in an acceptable condition 53 days after picking. Bar B shows that fruit could be held at 46°F for 30 days, at which time several fruit were softening. The entire batch was then treated with ethylene at 68°F to get them through their chilling sensitive stage rapidly, followed by storage at 36°F. After 51 days at 36°F, or 73 days from picking, most of the fruit retained acceptable flavor and appearance.

We want to make clear that these were unusually sound fruit which were very carefully handled and thus allowed a longer than average storage period. We present these data to emphasize that ripe fruit can be stored for long periods without development of off flavors, physiological disorders or serious fungal invasion providing the proper temperature is carefully maintained.

We also want to make clear that we do not recommend long storage of ripe fruit, but use these data to emphasize that if ripe fruit can be shipped to the retail outlets properly packaged, refrigerated and protected from desiccation, they can be held in the store or home refrigerator with no fear of loss through either chilling injury or spoilage. We believe that if ripe fruit are always available in the markets and to restaurants, consumption will increase considerably.

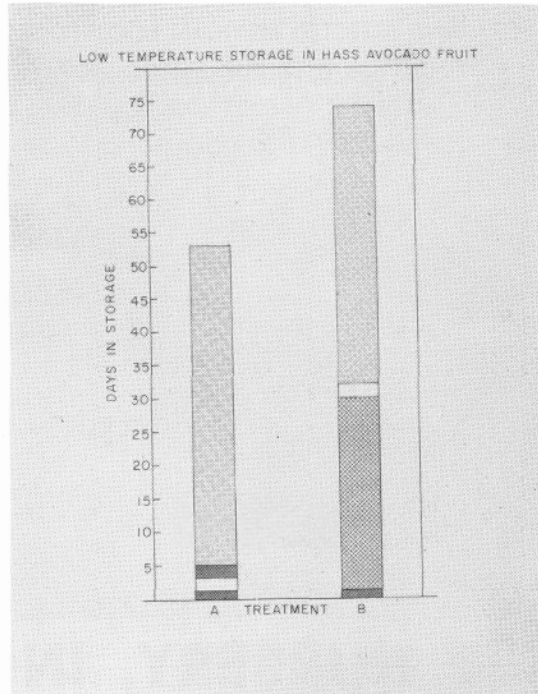


Figure 3. A comparison of the low temperature storage life of Hass fruit (A) ethylene ripening immediately after picking and (B) fruit allowed to ripen at a non chilling temperature followed by low temperature storage. Shading in bars refers to conditions as follows: ■, air at 68°F; □, ethylene treatment; ▨, 46°F storage; ▩, 36°F storage.