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Protecting the Postharvest Quality of Avocado Fruit

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In southern California, 'Hass' avocados may be left up to twelve hours or longer in the field after harvest. During periods of high temperatures, as commonly experienced during the summer months, fruit pulp temperatures may exceed 100°F when fruits are unprotected. We have conducted research over the last three years to examine the impact, if any, of these delays on the postharvest life of the avocado. During the summer of 1990 and 1991, we examined the influence of delays in cooling (up to 24 hours) and temperature (68°, 86°, 104°F) on the subsequent storage life of 'Hass' avocados. We evaluated various quality parameters such as firmness following storage, the incidence of delay and other physiological disorders, and the time to eating ripeness following storage. The occurrence of physiological disorders in avocados is the key factor limiting long term storage of the fruit. There are two types of internal breakdown associated with long-term storage: discoloration of the fruit flesh and discoloration of the vascular tissue. When severe, the appearance of these disorders can render the fruit unacceptable. When rating the fruit for internal deterioration, we graded the fruit either on a 0-5 scale for flesh discoloration or a 1-4 scale for vascular discoloration. A fruit with a score of 3 or greater in either category was judged to have moderate/severe discoloration.

Table 1 summarizes the data related to the duration of the cooling delay collected from this two year study. Note that fruit that is held for 24 hours prior to cooling results in softer fruit following 4 weeks at 41°F. Delaying cooling also impacts the development of internal disorders and decay. This difference is especially evident with the 12 and 24 hours delays.

Table 1. The influence of cooling delays on 'Hass' fruit quality following 4 weeks at 41 ^{o}F and ripening at 68 ^{o}F

Delay in Cooling (hr)	Firmness after storage (lbf)	Moderate/severe discoloration (%)	Decay (%)	Days to Eating Ripeness
0[z]	27.9	1.7	1.7	3.8
6	28.6	1.1	0.6	3.7
12	28.3	4.4	5.0	3.8
24	26.4	7.2	10.0	3.8

[z] Fruit cooled to 41 ^{o}F within 1.5 hours of harvest.

Table 2 summarizes the data related to the fruit pulp temperature during the cooling delay. Note that the warmer the fruit during the delay, the greater the subsequent fruit softening and physiological and pathological breakdown. This is especially evident when the fruits were held at 104°F.

Table 2. the influence of fruit pulp temperature during cooling delays on 'Hass' fruit quality following 4 weeks at 41 ^{o}F and ripening at 68 ^{o}F.

Fruit Pulp Temperature (F)	Firmness after storage (lbf)	Moderage / Severe discoloration (%)	Decay (%)	Days to Eating Ripeness
Control[z]	27.9	1.7	1.7	3.8
68	28.8	2.2	2.8	3.6
86	29.0	2.8	5.0	3.8
104	25.5	7.8	7.8	3.8

[z] Fruit cooled to 41 ^{o}F within 1.5 hours of harvest.

There are two conclusions that can be drawn from these results: 1) 'Hass' avocado fruit should be cooled within 6 hours of harvest to minimize subsequent loss in fruit quality; and 2), if delays should occur, fruit pulp temperatures should be kept below 86°F. A study conducted, by Irv Eaks (retired plant physiologist, UCR) a number of years ago demonstrated that when fruit are continuously kept at temperatures greater than 86°F after harvest, normal ripening may be inhibited.

We recognize that cooling the fruit within this time frame may not always be practical, and therefore conducted two small field studies to evaluate if there is any easy way to protect the fruit in the field once it is harvested. In year 1, we compared changes in pulp temperature when bins were covered with three different materials: brown wrapping paper, space blanket (reflective side up), and leaves/branches. Three fruits in either the bottom or top of the bin were used to follow changes in pulp temperature through- out the test. Thermocouples were placed in the fruit at the blossom end to a depth of approximately one inch. The fruits were picked in early morning and the test was running by 10:20 a.m. The thermocouples were removed from the fruit at 4:00 p.m. There was very little variation in pulp temperature between individual fruit for a given position/bin treatment. At the completion of the test, 30 fruit from each bin and each bin position were taken back to UCR and stored for 6 weeks at 41°F. After storage the fruits were held at 68'R until ripened (3 days) and then evaluated as outlined above.

Figures 1 and 2 show the pulp temperature as compared to ambient conditions for both the top and bottom of the bins. Note that the fruits at the bottom of the bins in all treatments were essentially identical throughout the test. One the other hand, note the large divergence in pulp temperatures at the top of the bin. At the end of the test, there was approximately a 40°F difference between the uncovered bin and the bin shaded by leaves/branches. The other two treatments were intermediate, with the brown paper similar to the uncovered bin (but resulting in few sunburned fruits) and the space blanket similar to the leaves/branches.

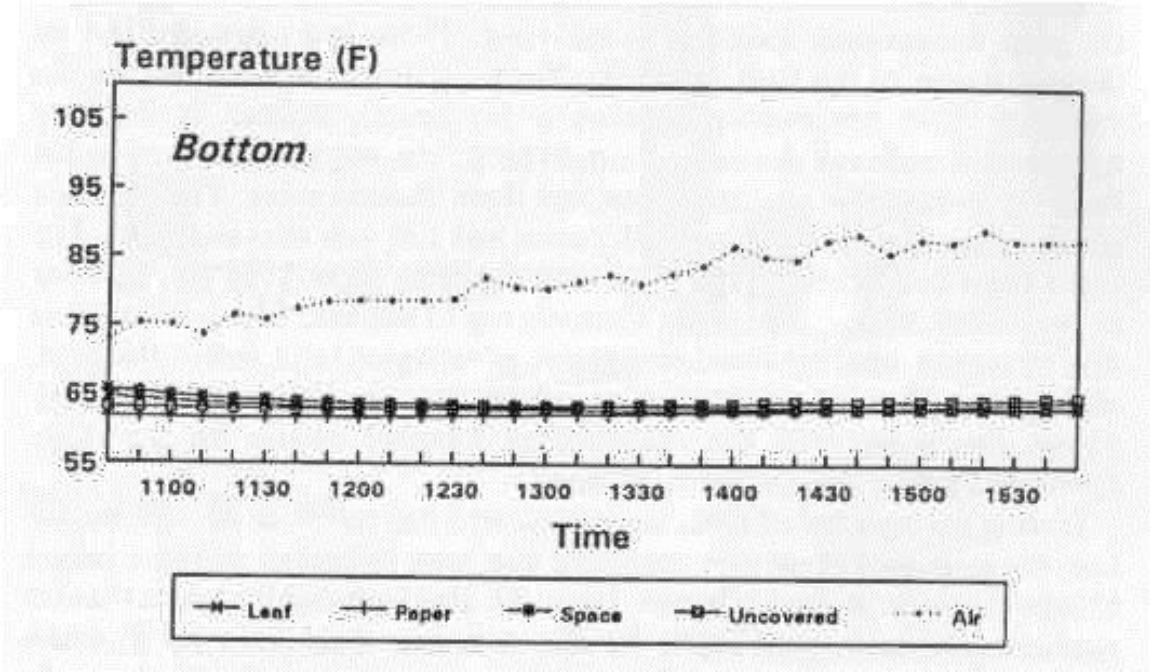

Figure 1. Changes in fruit pulp temperature in the bottom of the bin as influenced by bin covering.

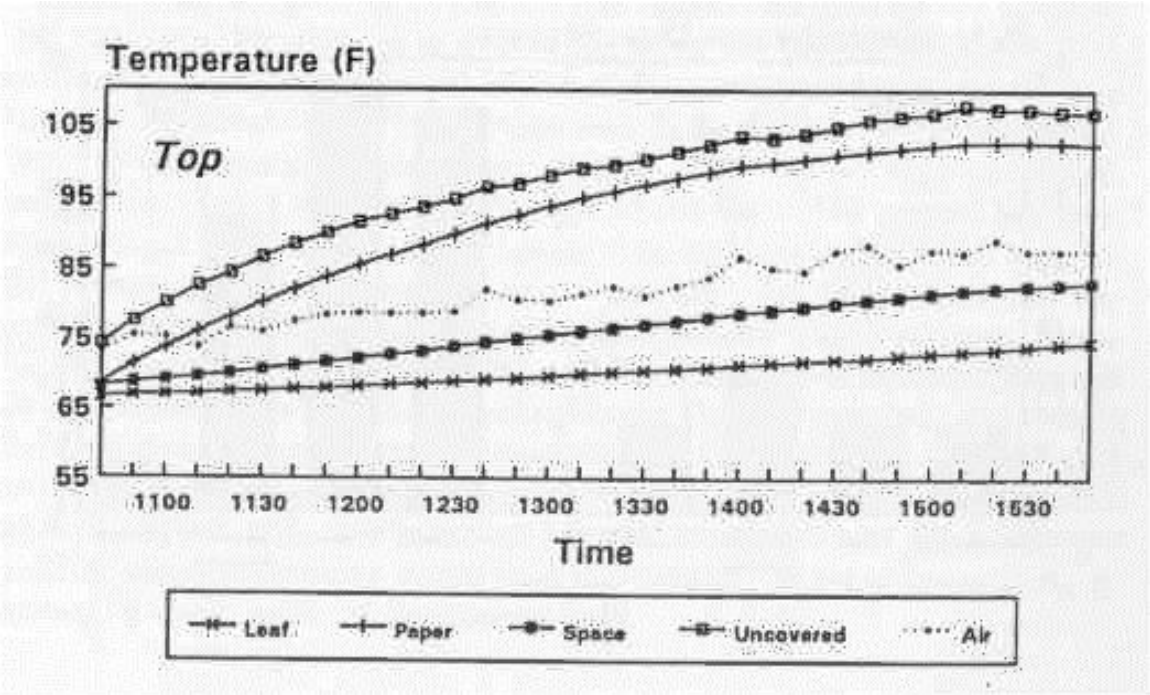

Figure 2. Changes in fruit pulp temperature in the top of the bin as influenced by bin covering.

Figures 3 and 4 show the amount of severe/moderate flesh discoloration (the percentage of fruit graded a score of 3 or greater) which occurred during storage. At the bottom of the bin the fruits from all four treatments were similar in quality, ranging from approximately 7% to 10% of the fruit falling in the moderate/severe category. This makes sense in light of the temperature data. Internal fruit quality from the top of the bin reflects the pulp temperature recorded in the field. There is a marked effect on the percentage of the fruit exhibiting flesh discoloration based on the bin covering. This relationship appears to be directly related to the pulp temperature patterns during the experiment; the warmer the fruit in the field, the greater the amount of internal flesh discoloration. The presence or absence of fruit decay (generally stem end rot) was also recorded. The fruits from the uncovered bin from both positions show a marked increase in percentage decay, especially from the top of the bin. Many fruits from this treatment also exhibited symptoms of collapse right below the peel, although an effort was made not to store fruit that were obviously sunburned. These data agree with the observations reported earlier for the study conducted under controlled conditions.

During the summer of 1992, we compared 5 bin covers to an unprotected bin. We evaluated three new materials that have reflective surfaces joined to either a single or double bubble layer. We also included the space blanket used the previous year. Fruits for this test were held only for 4 weeks at 41°F. Fruit were evaluated in a similar manner as outlined above. In addition, we monitored weight loss of the fruit from different positions of the bin. The results from this year are not as dramatic, but yielded similar information. As in the first year, the unprotected fruit warmed the most during the day while the bin covered with leaves remained the coolest. Fruit weight loss in the bin was influenced both by bin position and bin cover. Weight loss in fruit at the top of the bin varied from 0.60 % (uncovered) to approximately 0. 30 % in the covered bins during the 8 hours the test was conducted. Fruit weight loss at the bottom of the bin varied little between treatments and averaged 0. 14 %. This may not seem like much weight loss, but if the total fruit weight in the bin is 500 pounds the total fruit weight loss during an eight hour field holding could be as high as 3.0 pounds per bin. Depending on the market price of the fruit and the tonnage per acre, this could amount to a substantial loss in revenue. Since we only held the fruit for 4 weeks at 41 "F. we observed minimal internal deterioration following storage and ripening. For all parameters evaluated, the fruit that came from the bin covered with leaves had the least amount of final weight loss and internal breakdown. The fruit from the bins covered with the various reflective materials behaved erratically and did not always yield results significantly better than the control. We plan more detailed testing of these materials in 1993.

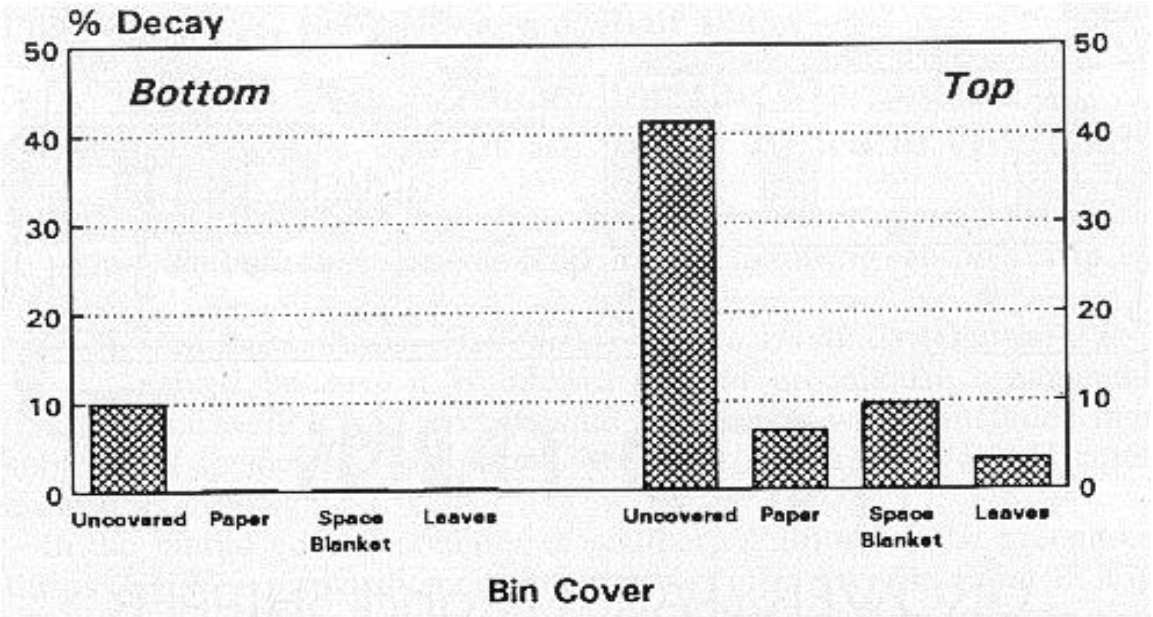

Figure 3. The influence of bin coverings/pulp temperature on fruit quality following storage.

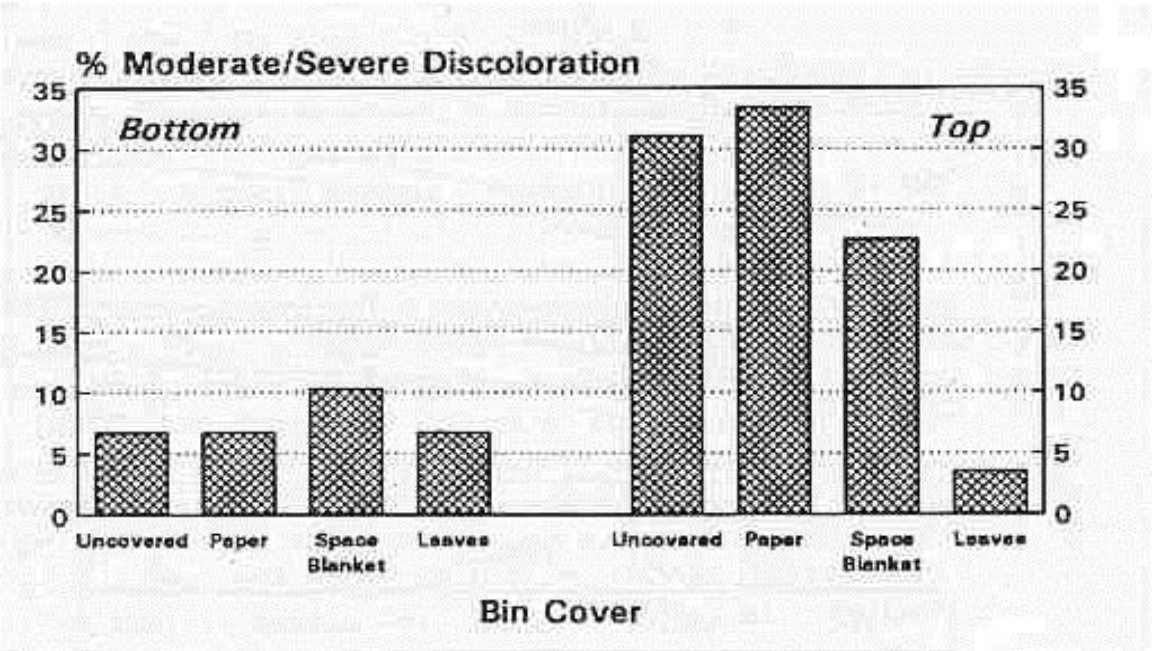

Figure 4. The influence of bin coverings/pulp temperature on the incidence of decay following storage.