

The Use of Controlled Atmosphere for Long-Term Storage of 'Hass' Avocados

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Progress Report

The primary focus of this four-year project is to evaluate the potential of controlled atmosphere storage (CA) for California avocados. We are in the process of completing the three objectives outlined for the first year, which were: (a) screen various combinations of low oxygen (O_2) and high carbon dioxide (CO_2); (b) conduct a preliminary evaluation of the impact of ethylene (C_2H_4) during CA storage, and (c) evaluate the influence of fruit maturity on the response to CA storage.

We obtained 'Hass' fruit three times during 1990 (February 9, April 27, and July 2) from a commercial grove in Santa Paula, California. At each harvest, the fruit were size picked for uniformity. The fruit utilized in all tests came from the same group of trees, allowing us to evaluate the possible relationship of fruit maturity to CA performance. The treatments which were evaluated from each harvest are shown in Table 1. The harvest % dry weight for each harvest was 31.5% (2/9/90), 34.4% (4/27/90), and 34.7% (7/2/90). Fruit evaluations for the final harvest were not completed at the time of this report.

All fruit were stored at 5°C (41°F). Fruit were evaluated after 0, 3, 6, or 9 weeks of storage. Flesh softening was monitored throughout storage using a UC Pressure Tester. At each storage evaluation, an additional sample of fruit was treated with 10-20 ppm C_2H_4 and examined after five days at 20°C (68°F). Upon ripening, fruit were rated for the development of both vascular and flesh discoloration. We have reported the data in Figures 3-6 as the percent of the fruit exhibiting either moderate or severe discoloration.

Figure 1 presents data relating to flesh softening from the February 7, 1990 harvest. The fruit held at constant CA (2% O_2 /2.5 or 10% CO_2) remained firm throughout the nine weeks of storage, as compared to the air control and the fruit treated with 25% CO_2 for three days. The results obtained with the short duration CO_2 treatment is in contrast to results reported from South Africa with 'Fuerte' avocados.

The softening patterns for selected treatments from the second harvest are shown in Figure 2. Again, no appreciable softening was observed when the fruit was held under constant CA (2% O_2 /2.5 or 10% CO_2), as compared to air storage. The beneficial effect of CA (2% O_2 /2.5% CO_2), however, in preventing flesh softening is lost when 10 ppm

C₂H₄ is added to the storage atmosphere. Similar responses to C₂H₄ under CA have been reported for other commodities (apples, kiwifruit).

Table 1. Controlled Atmosphere Storage Treatments at 5°C.

Storage Treatment			Harvest Date
O ₂ %	CO ₂ %	C ₂ H ₄ ^z ppm	
Air			2/9, 4/27, 7/2
2.0	2.5 5.0 7.5 10.0		2/9, 4/27, 7/2
2.0	2.5	1 10	4/27 4/27
2.0	1.5		4/27, 7/2
1.0	0.3 1.5 2.7		7/2 7/2 4/27, 7/2
4.0	2.5		4/27
21.0	10.0 ^y 15.0 20.0 25.0 30.0		2/9 2/9, 7/2 2/9 2/9, 7/2 2/9

^z Unless stated, no C₂H₄ was added to storage atmosphere. Ambient C₂H₄ concentrations were below 0.10 ppm.

^y Fruit held at 5 C for 3 days then transferred to air for duration of experiment.

Figures 3 and 4 present data for the percent of the fruit after ripening with moderate or severe vascular discoloration. Fruit from both harvests which were stored in 2% O₂/2.5% CO₂ exhibit the least amount of vascular discoloration. Although the 2% O₂/10% CO₂ combination had less discoloration than the air control, it was clearly not as good as the other O₂/CO₂ combination. Fruit given the three-day 25%CO₂ exposure had approximately the same amount of vascular discoloration as the control (Figure 3). This would be anticipated, given the results in Figure 1. Addition of C₂H₄ to the storage atmosphere resulted in a greater amount of vascular discoloration than the control (Figure 4).

Figure 1. Flesh firmness after storage at 5°C (41°F). Fruit harvested 2/9/90.

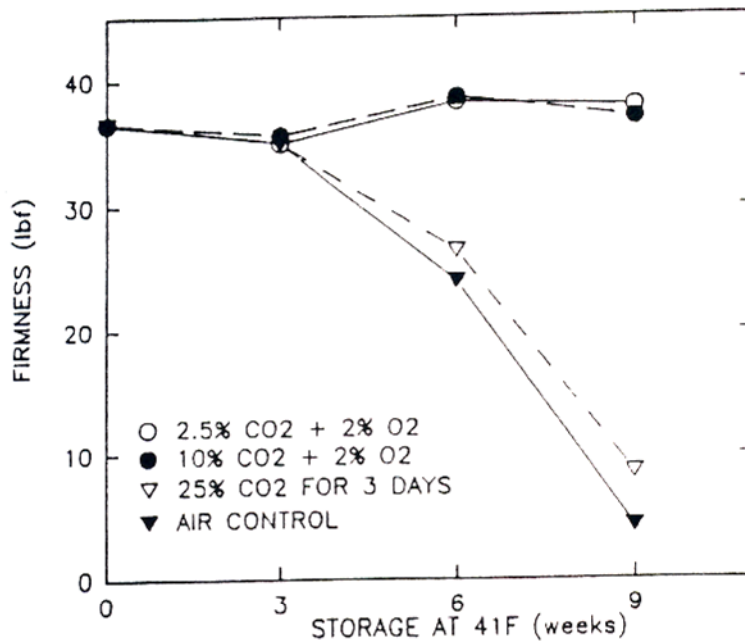


Figure 2. Flesh firmness after storage at 5°C (41°F). Fruit harvested 4/27/90.

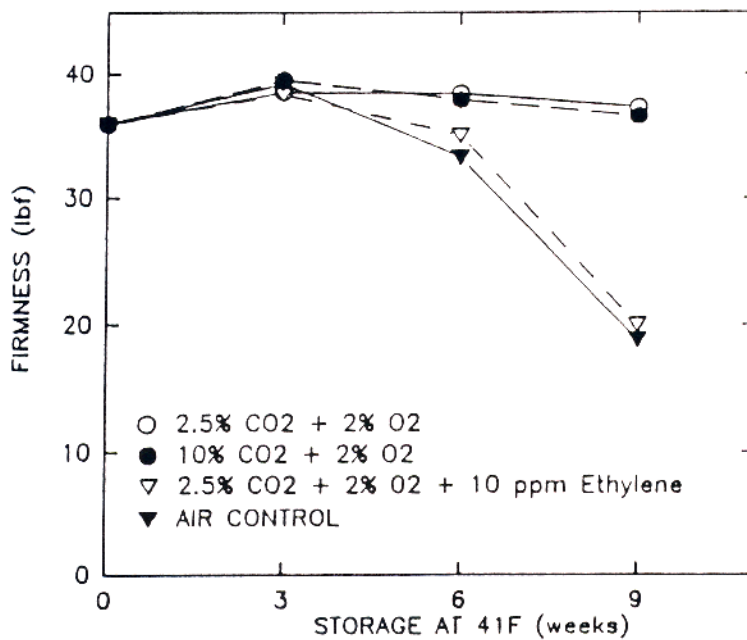


Figure 3. Vascular discoloration (% moderate or severe) after storage at 5°C (41°F) and 5 days at 20°C (68°F). Fruit harvested 2/9/90.

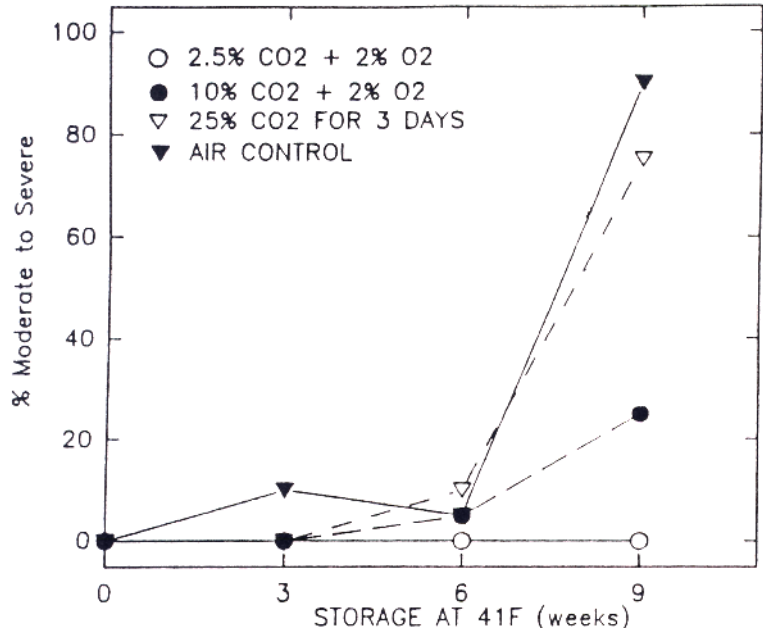


Figure 4. Vascular discoloration (% moderate or severe) after storage at 5°C (41°F) and 5 days at 20°C (68°F). Fruit harvested 4/27/90.

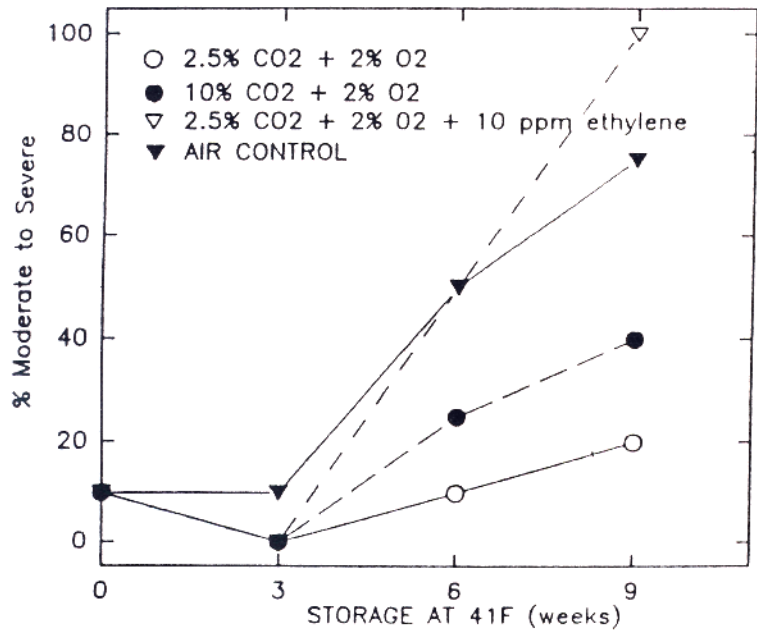


Figure 5. Flesh discoloration (% moderate or severe) after storage at 5°C (41°F) and 5 days at 20°C (68°F). Fruit harvested 2/9/90.

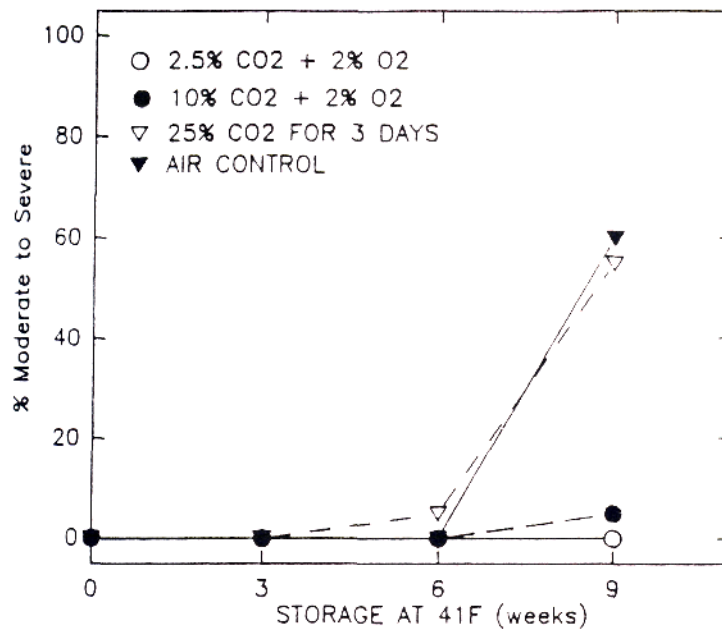
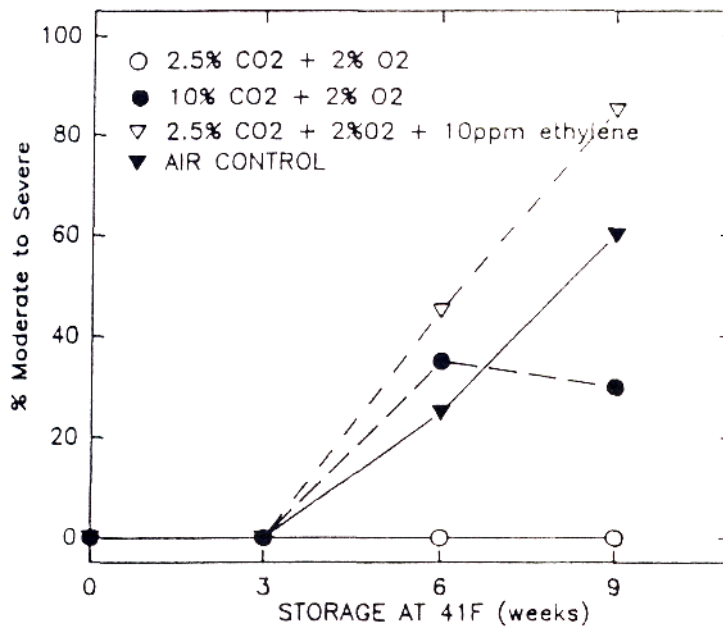


Figure 6. Flesh discoloration (% moderate or severe) after storage at 5°C (41°F) and 5 days at 20°C (68°F). Fruit harvested 4/27/90.



The percent of the fruit exhibiting moderate or severe flesh discoloration after ripening is shown in Figures 5 and 6. In general, results are similar to those reported for vascular

discoloration.

Practical Application and Summary

Exports constitute only a small segment of the entire market for California avocados, but they provide a needed outlet for fruit, especially in high-volume years. To ensure continued access to foreign markets, it is essential that fruit continue to arrive at destination at optimal quality. The use of CA may aid in maintaining fruit quality during long-periods of transit. The preliminary results from 1989-90 indicate that for California 'Hass' avocados, CO₂ levels above 5 % may increase the amount of vascular and flesh discoloration. It also appears that the presence of even 1 ppm C₂H₄ in the storage atmosphere (2 % O₂/2.5 %CO₂) may negate the positive effects of CA. Finally, it appears that the positive benefit of CO₂ "shock" treatments reported from South Africa on 'Fuerte' avocado does not apply to California 'Hass' avocado, since no significant difference between those treatments and the air control was observed.