

# Extending the storage life of late season 'Hass' avocados to increase the availability of pre-packed ready-to-eat fruit during the off-season

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## ABSTRACT

Extended storage of South African avocados at the end of the season will be of great benefit to local pre-packers, as it will reduce the need to import fruit from Northern hemisphere production areas during our off-season. The present study is a continuation of trials performed during 2005, aimed at establishing for how long South African 'Fuerte' and 'Hass' avocados can be stored when combining SmartFresh<sup>SM</sup> with controlled atmosphere.

During the 2006 season, emphasis was placed on reducing pathology that develops during storage for periods up to four months. To do this, 'Hass' fruit with a moisture content of 68% were dipped in tap water or solutions of either prochloraz (Omega, 180 ml/100 l) or thiabendazole (Tecto, 200 ml/100 l) for one minute prior to storage. Sub-samples of these fruit were then either re-treated on a monthly basis or dipped in the above solutions for a second time prior to ripening. In addition, a set of fruit were stored in a fungicidal atmosphere (10% CO<sub>2</sub> : 3% O<sub>2</sub> opposed to the 6% CO<sub>2</sub> and 4% O<sub>2</sub> combination used for commercial exports). SmartFresh<sup>SM</sup> was applied to most of the combinations, but it was not possible to perform a complete factorial design due to the space limitations posed by the two controlled atmosphere combinations.

The results showed that it is possible to store good quality 'Hass' fruit for up to three months when combining SmartFresh<sup>SM</sup> and controlled atmosphere. In terms of the fungicidal treatments, the second fungicide treatment, applied just before ripening, significantly augmented the pre-storage application. This was, however, not the case with the monthly treatments. The 10% CO<sub>2</sub> : 3% O<sub>2</sub> atmosphere was also shown to inhibit pathological disorders.

## INTRODUCTION

Currently, local pre-packers import fruit at high costs during the South African off-season in order to honour agreements to supply avocados year-round to retail outlets. Extended storage of avocados at the end of the season will therefore be of great benefit to South African pre-packers, as it will reduce the need to import fruit.

The present study is a continuation of trials performed during 2005 (Lemmer, *et al.*, 2006) aimed at establishing for how long South African 'Fuerte' and 'Hass' avocados can be stored when combining SmartFresh<sup>SM</sup> (SF) with controlled atmosphere (CA). Results obtained during the 2005 season indicated that good quality 'Hass' fruit can be stored for between two and three months, whereafter physiological and pathological disorders start to develop. Of the two, fungal infections are the most limiting. During the 2006 study period, emphasis was placed on reducing pathology that develops during storage for periods up to four months. The following aims were set:

- To upgrade the fungicide treatments applied to 'Hass' fruit stored for extended periods.
- To establish the efficacy of a fungicidal atmosphere of 10% CO<sub>2</sub> : 3% O<sub>2</sub> opposed to the currently used commercial export atmosphere of 6% CO<sub>2</sub> : 4% O<sub>2</sub>.

## MATERIALS AND METHODS

### Fruit

'Hass' fruit originating from a late maturing orchard located in

an elevated production region (Twycross, between Nelspruit and Sabie) was used for the trial. The moisture content of the fruit was 68%.

### Post-harvest treatments

The avocados were washed in a 0.5% hypochlorite solution, fan dried and dipped in either tap water or solutions of prochloraz (Omega, 180 ml/100 l) or thiabendazole (Tecto, 200 ml /100 l) for one minute prior to storage.

Carnauba wax was applied after the fungicidal treatment. SmartFresh<sup>SM</sup> was applied at the commercial dosage. It was not possible to perform a complete factorial design due to space limitations posed by CA storage.

During storage, sub-samples of the above fruit were re-treated with the above fungicides on either a monthly basis or once prior to ripening.

### Storage protocol

The fruit were stored for four months. During the first month the storage temperature was set at 5°C, followed by 4°C for the rest of the storage period.

The avocados were either stored in regular atmosphere (RA) or one of two CA combinations. The first was the currently used commercial export atmosphere of 6% CO<sub>2</sub> and 4% O<sub>2</sub> while the second was a more severe, supposedly fungicidal, atmosphere of 10% CO<sub>2</sub> and 3% O<sub>2</sub> (hereafter, the two CA combinations will be referred to as CA 6:4 and CA 10:3).



## Evaluation

Post-harvest assessments were carried out on a monthly basis. The fruit were first ripened at 20°C before being evaluated. The evaluation criteria included recording the number of days until the avocados were ready to eat, as well as the incidence of pathological and physiological disorders that developed during storage.

## RESULTS AND DISCUSSION

### Visual appearance

Figure 1 depicts the visual appearance of 'Hass' fruit after three months of cool storage. The following deductions can be made from the photograph:

- The synergistic effect of CA and SF is obvious. The CA + SF fruit were still green and firm by month three, while the RA fruit were soft with severe signs of pathology.
- Although the CA fruit deteriorated at a slower rate than the RA avocados, they compared poorly with the CA + SF combination.
- The CA 10:3 avocados showed a higher rate of skin browning than the CA 6:4 fruit.

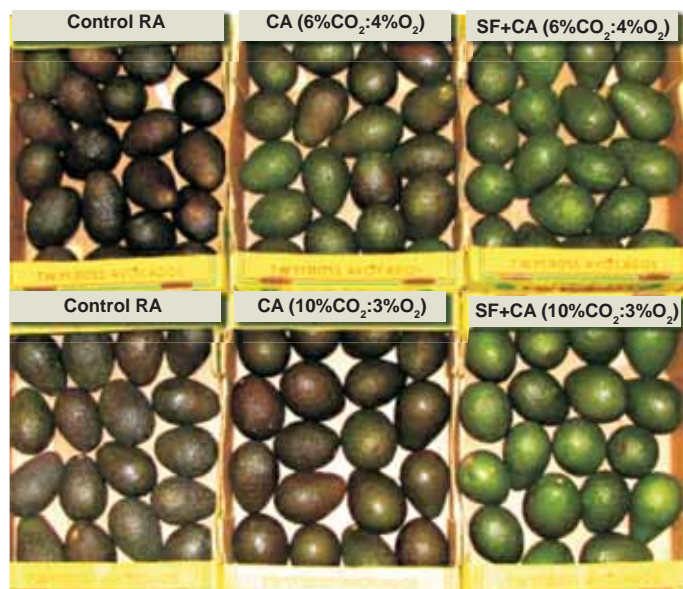


Figure 1: External appearance of 'Hass' fruit after three months of storage under regular atmosphere and two different controlled atmosphere regimes with or without the addition of SmartFresh<sup>SM</sup>.

### Stem-end rot

The incidence of stem-end rot is displayed in Figures 2a and 2b and Figures 3a and 3b. The following observations were made:

- Stem-end rot appeared earlier and the incidence increased at a faster rate in untreated and RA + SF avocados, compared to CA + SF fruit.
- With both thiabendazole and prochloraz the additional treatment applied prior to ripening gave complete control until the end of month 3 when used in combination with CA + SF.

### Anthracnose

The incidence of anthracnose is shown in Figures 4a and 4b and Figures 5a and 5b. The following observations were made:

- When comparing the infection rates of anthracnose and stem-end rot, it is clear that anthracnose was less of a problem than stem-end rot. The two fungicides were equally effective in inhibiting the onset of the disorder for up to three months.

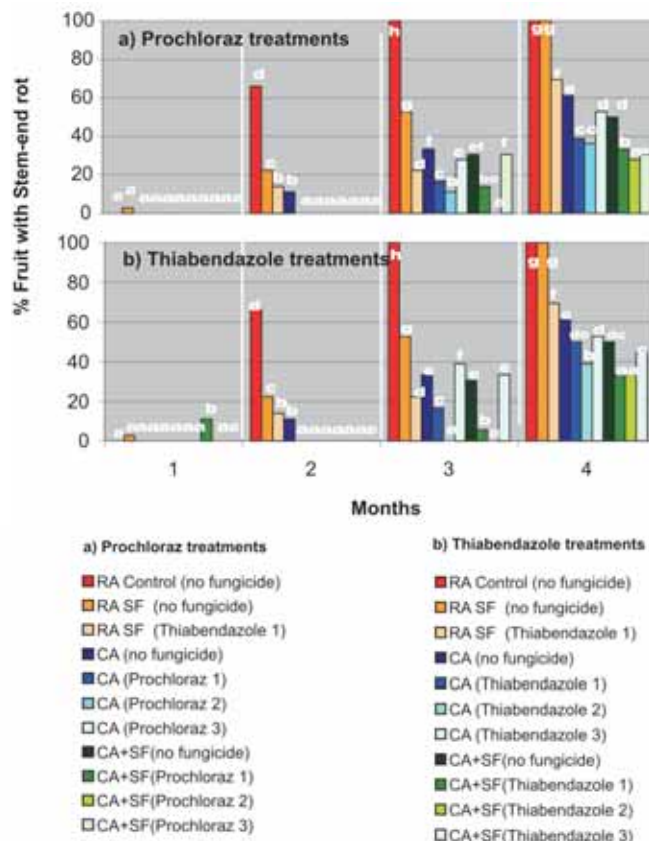


Figure 2: Comparison of the stem-end rot control capacities of a) prochloraz and b) thiabendazole when applied once before storage (Prochloraz 1 and Thiabendazole 1) and again prior to ripening (Prochloraz 2 and Thiabendazole 2) or as monthly repeat applications (Prochloraz 3 and Thiabendazole 3).

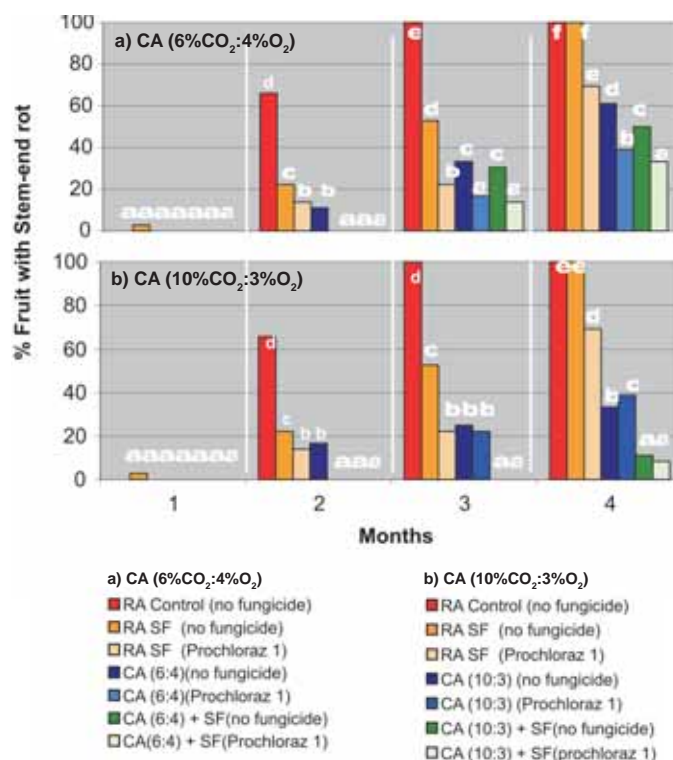


Figure 3: Stem-end rot control capacities of the commercial export 6% CO<sub>2</sub> : 4% O<sub>2</sub> (a) controlled atmosphere combination in comparison with the 10% CO<sub>2</sub> : 3% O<sub>2</sub> (b) combination.



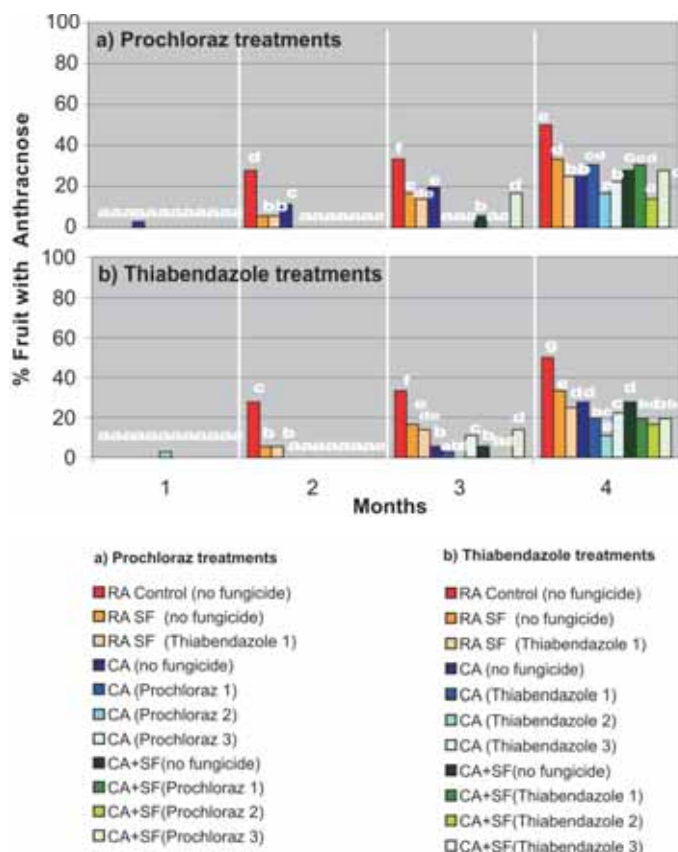


Figure 4: Comparison of the anthracnose control capacities of a) prochloraz and b) thiabendazole when applied once before storage (Prochloraz 1 and Thiabendazole 1) and again prior to ripening (Prochloraz 2 and Thiabendazole 2) or as monthly repeat applications (Prochloraz 3 and Thiabendazole 3).

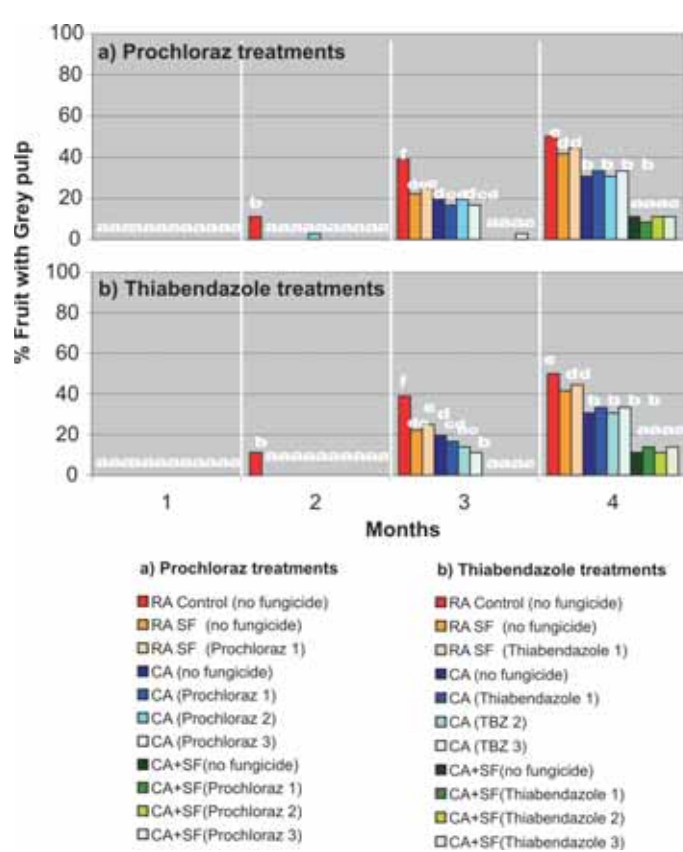


Figure 6: Incidence of grey pulp depicted in a similar format to Figures 2 and 4.

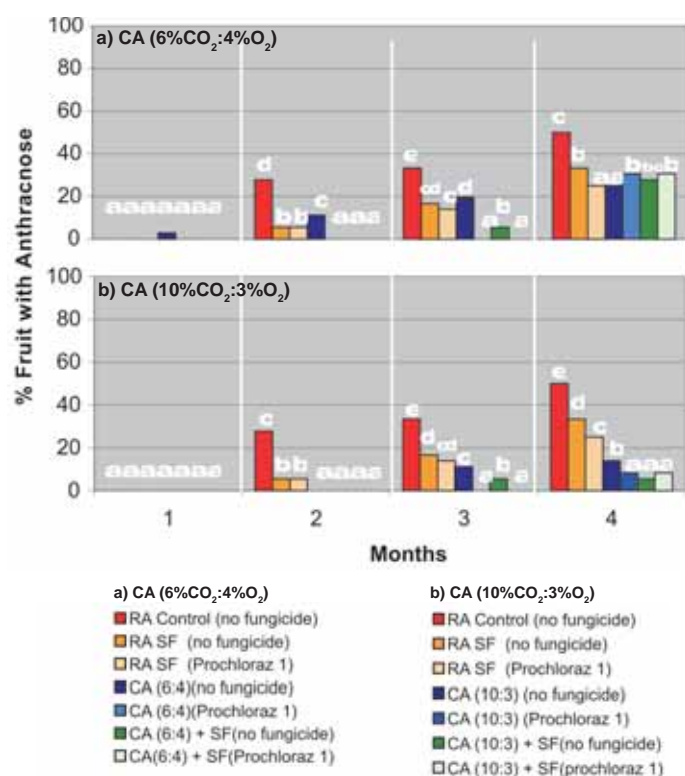


Figure 5: Anthracnose control capacities of the commercial export 6% CO<sub>2</sub> : 4% O<sub>2</sub> (a) controlled atmosphere combination in comparison with the 10% CO<sub>2</sub> : 3% O<sub>2</sub> (b) combination.

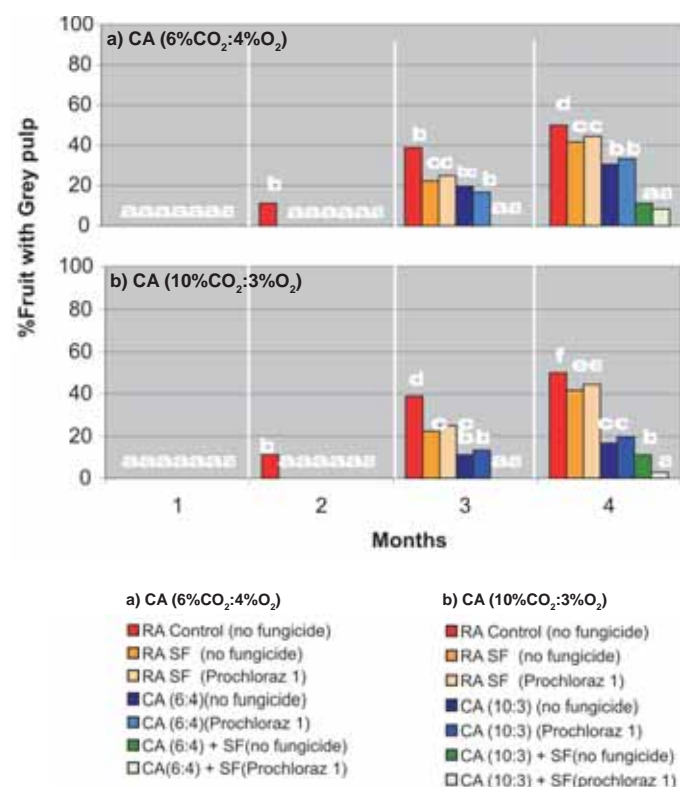


Figure 7: Grey pulp control capacities of the currently used 6% CO<sub>2</sub> : 4% O<sub>2</sub> (a) controlled atmosphere combination in comparison with the 10% CO<sub>2</sub> : 3% O<sub>2</sub> (b) combination.

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- The CA 10:3 combination effectively slowed down the onset of anthracnose infections. This was especially true for the CA + SF combination.

### Grey pulp

The percentages of fruit with grey pulp are displayed in **Figures 6a** and **6b** and **Figures 7a** and **7b**. The following conclusions may be drawn:

- The RA fruit remained free of grey pulp for one month. The CA and SF treatments remained free of the disorder for two months, while the CA + SF combination was clean for three months.
- The CO<sub>2</sub>:O<sub>2</sub> ratio of the CA atmosphere did not significantly influence the incidence of grey pulp.

### SUMMARY

The present trial corroborated last year's results, in that it demonstrated that it is possible to store good quality 'Hass' fruit for up to three months when combining CA and SF. The second fungicide treatment, applied prior to ripening, showed considerable promise in terms of inhibiting the onset of pathological disorders during ripening.

Prochloraz and thiabendazole were equally effective in inhibiting the two types of pathological disorders. However, thiabendazole is less soluble in water and needs to be continuously stirred. Prochloraz, therefore, remains the best option.

The CA 10:3 atmosphere was shown to inhibit pathological disorders to some extent. Because 'Hass' turns colour upon ripening, the darkening of the rind observed with this combination would not seem to be of commercial importance. More information is, however, required for the green skin cultivars.

Considerable scope for improvement still exists, especially in terms of orchard spray treatments. Care must be taken to ensure that all the recommended orchard sprays are applied at the correct intervals. The potential of late orchard sprays also needs to be investigated.

### LITERATURE CITED

Lemmer, D., Malumane, T.R., Nthandane, J. and Kruger, F.J. 2006. Extended storage trials with South African avocados. *South African Avocado Growers' Association Yearbook* 29: 10-13.

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**Praat met ons. Dit betaal.**



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