

# Extended storage trials with South African avocados

D Lemmer, R T Malumane, J Ntandane and F J Kruger

ARC-Institute for Tropical and Subtropical Crops  
Private Bag X11208, Nelspruit 1200, South Africa  
E-mail: daniel@arc.agric.za

## ABSTRACT

During the 2005 season, two long term storage trials were performed, one with 'Fuerte' (moisture content 68%) and the other with 'Hass' (moisture content 68%). The fruit were treated with Prochloraz (250 ml/100 l) and waxed. After this, SmartFresh™ was applied at the commercial dosage as well as at two higher dosages. The fruit were then stored under controlled atmosphere (CA) conditions (6% CO<sub>2</sub> and 4% O<sub>2</sub>) as well as under regular atmosphere. The 'Fuerte' fruit were stored for six months and the 'Hass' for 5 months. In the case of 'Fuerte', the fruit were stored at 7°C for the first month, 6°C for the second, 5°C for the third and 4°C for the fourth to sixth months. With 'Hass', the fruit were stored at 5°C for the first month, 4°C for the second and 3°C for the third to fifth months.

With both 'Fuerte' and 'Hass' it was possible to store the fruit for 2 months when combining CA with SmartFresh™, without any serious physiological and pathological disorders developing. At the end of the third month, approximately 15% of CA + SmartFresh™ 'Fuerte' and 5.5% of 'Hass' fruit developed pathological disorders. With 'Fuerte', this increased to respectively 30% by month 4, 60% by month 5 and 85% by month 6. In the case of Hass only 22% of the fruit were infected by month four and this increased to 65% by month 5. The 'Hass' trial was hereafter terminated.

In the case of 'Fuerte', traces of grey pulp appeared after two months. By month three, 22% of the fruit were affected and the incidence steadily increased to 100% by month 6. Very little grey pulp was recorded in 'Hass', but black cold injury symptoms did develop during the third month of storage. The storage temperature should therefore not be stepped down to 3°C.

From the results it would appear that it is possible to store good quality 'Fuerte' avocado fruit for at least 2 months, while 'Hass' can be stored for three months, when combining Smartfresh™ and CA. After this, physiological and pathological disorders start to develop. Of the two, fungal infections were most limiting. Upgrading the fungicide treatment will therefore receive special attention during future trials. Another potential avenue of research concerns the use of a fungicidal controlled atmosphere.

## INTRODUCTION

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 the Northern hemisphere production areas during the South African off-season.

The current study is a continuation of pilot trials initiated during 2004 and aim to establish for how long South African 'Fuerte' and 'Hass' can be stored when combining SmartFresh™ with controlled atmosphere (CA).

## MATERIALS AND METHODS

The 'Fuerte' trial was conducted with fruit sampled from the HLH Hall and Sons packhouse (Nelspruit) on 25 July 2005 (68% moisture content). The 'Hass' trial was carried out on fruit from the Twycross packhouse (Schagen) on 25 August 2005 (68% moisture content).

The packhouse treatment protocol included a 0.5% hypochlorite wash, 250 ml/100 l Prochloraz spray and waxing with carnauba wax.

The fruit were then treated with SmartFresh™ at the commercially registered dosage as well as at 2 higher concentrations. The treated and untreated fruit were then stored under normal atmosphere as well as under controlled atmosphere (6% CO<sub>2</sub> 4% O<sub>2</sub>).

In the case of 'Fuerte', the fruit were stored at 7°C for the first month, 6°C for the second, 5°C for the third and 4°C for the fourth to sixth months. With 'Hass', the fruit were stored at 5°C for the first month, 4°C for the second and 3°C for the third to fifth months. Post-harvest evaluations were carried out on a monthly basis. The evaluation criteria included the number of days to ripen, and all pathological and physiological disorders that developed.

## RESULTS AND DISCUSSION

### Visual appearance

Figures 1a and 1b depict the visual appearance of 'Hass' and 'Fuerte' fruit after storage for 5 months under regular or controlled atmosphere. The following observations could be made from studying the photographs:

- With both 'Fuerte' and 'Hass', the combination of SmartFresh™ and CA effectively inhibited the ripening of fruit while under storage. The SmartFresh™ + CA fruit were still green and firm by month five, while untreated fruit stored under RA were soft with severe signs of pathology.
- The SmartFresh™ treated fruit stored under RA deteriorated at a slower rate than the untreated RA fruit, but compared poorly with the CA + SmartFresh™ fruit.
- The 'Hass' fruit showed signs of black cold damage (Figure 1b), but the incidence and severity was lower in case of the combination treatment. In future trials, care must be taken not to use too low step-down temperature regimes.
- In the case of 'Fuerte' (Figure 1a), black cold damage developed as from month 3 in the RA fruit but not in the CA fruit.

### Anthracnose

The percentages of fruit with anthracnose are displayed in Figures 2a ('Fuerte') and 2b ('Hass'). The following deductions can be made:

- In both cultivars, the incidence of anthracnose appeared earlier and the incidence was higher in RA fruit, compared to CA and RA SmartFresh™ fruit.
- In the case of 'Fuerte', a low incidence of anthracnose was recorded in CA/SmartFresh™ combination, after three

months of storage.

- The onset of anthracnose infection was later in 'Hass', and only traces of anthracnose were visible after three months of storage for the CA/SmartFresh™ combination.

#### Stem-end rot

The percentages of fruit with stem-end rot are displayed in

**Figures 3a** ('Fuerte') and **3b** ('Hass'). The following observations could be made:

- In both cultivars, the incidence of stem-end rot appeared earlier and increased at a higher rate in untreated and SmartFresh™ treated fruit stored under RA, when compared with the CA/SmartFresh™ combination.
- After two months of storage, a lower rate of stem-end rot

#### a) 'Fuerte' trial



#### b) 'Hass' trial



**Figure 1.** The visual appearance of untreated and SmartFresh™ 'Fuerte' (a) and 'Hass' (b) fruit when stored under RA and CA conditions. The SmartFresh™ treatments included the commercially used concentration (SF) and two higher rates (SF+ and SF++).



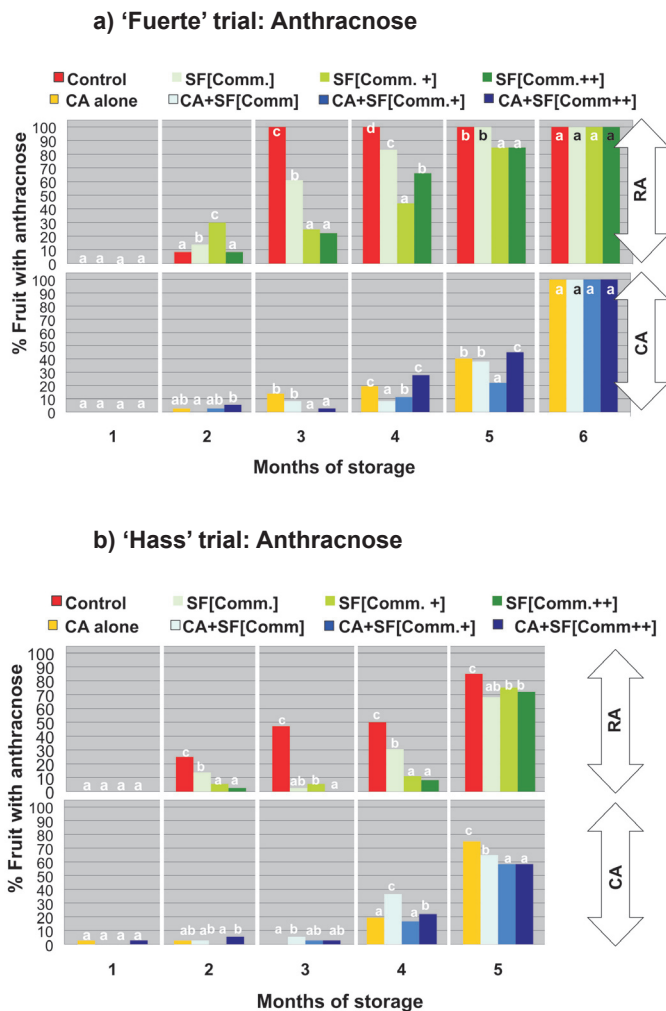


Figure 2. The percentage untreated and SmartFresh™ treated 'Fuerte' (a) and 'Hass' (b) fruit with anthracnose, after storage under RA and CA conditions. Bars marked with the same symbol are not significantly different. The statistics apply separately for CA and RA, as well as for each month of storage ( $\chi^2$ -test,  $P < 0.95$ ).

was recorded in 'Fuerte' fruit stored under the CA/Smart-Fresh™ combination.

- The onset of stem-end rot infection was later in 'Hass', and only traces of stem end rot were visible in the CA/Smart-Fresh™ combination after three months of storage.

### Grey pulp

The percentage of fruit with grey pulp is shown in **Figures 4a** ('Fuerte') and in **4b** ('Hass'). The following conclusions can be drawn:

- The effectiveness of SmartFresh™ at reducing grey pulp was again clearly illustrated in both trials.
- The combination of CA and Smartfresh™ retarded grey pulp more than CA on its own, especially in the 'Fuerte' trial.
- After two months of storage, between 5.5% and 10% of the CA/SmartFresh™ 'Fuerte' fruit showed signs of grey pulp.
- The onset of grey pulp was later in 'Hass', and only traces of the disorder were present in the CA/SmartFresh™ combination after three months of storage.
- In some cases, the higher SmartFresh™ rates resulted in less grey pulp when applied in combination with CA. However, at this stage, it is not to such an extent as to justify an increase in the registered rate.

### Number of days to ripen

The number of days to ripen 'Fuerte' and 'Hass' fruit is displayed in **Figures 5a** and **5b**. The following pertain:

- In both trials, the CA fruit took longer to ripen than the RA and RA+commercial SmartFresh™ treatments.
- CA/SmartFresh™ combinations led to an increased number of days to ripen.

### CONCLUSION

From the results it would appear realistic to store good quality 'Fuerte' avocado fruit for at least 2 months and 'Hass' for 3 months, when combining Smartfresh™ and CA. After this, physiological and pathological disorders start to develop. Of the two, fungal infections are the most limiting. Upgrading the fungicide treatment will therefore receive special attention during future trials.

The use of fungicidal storage atmospheres ( $O_2 < 4\%$  and  $CO_2$

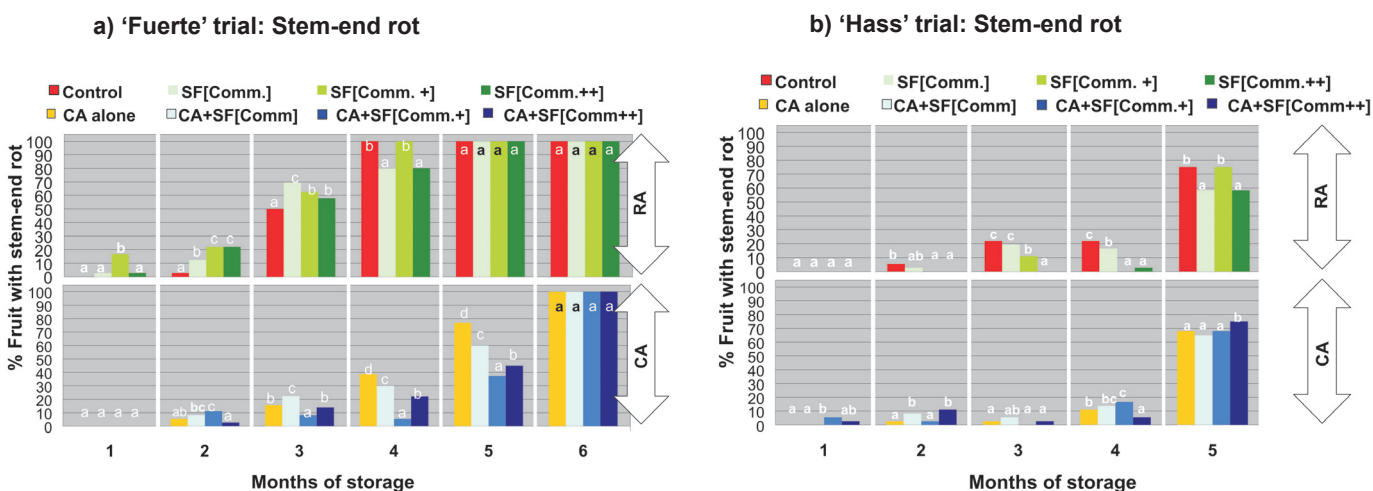


Figure 3. The percentage untreated and SmartFresh™ treated 'Fuerte' (a) and 'Hass' (b) fruit with stem-end rot, after storage under RA and CA conditions. Bars marked with the same symbol are not significantly different. The statistics apply separately for CA and RA, as well as for each month of storage ( $\chi^2$ -test,  $P < 0.95$ ).

> 10%) will also be investigated. Furthermore, trials with forced ripening using ethylene must also be carried out in order to try to shorten the number of days to ripen the CA/SmartFresh™ combination.

#### ACKNOWLEDGEMENTS

We would like thank Halls and Sons for donating funds to upgrade our controlled atmosphere system. The study was funded by the South African Avocado Growers' Association.

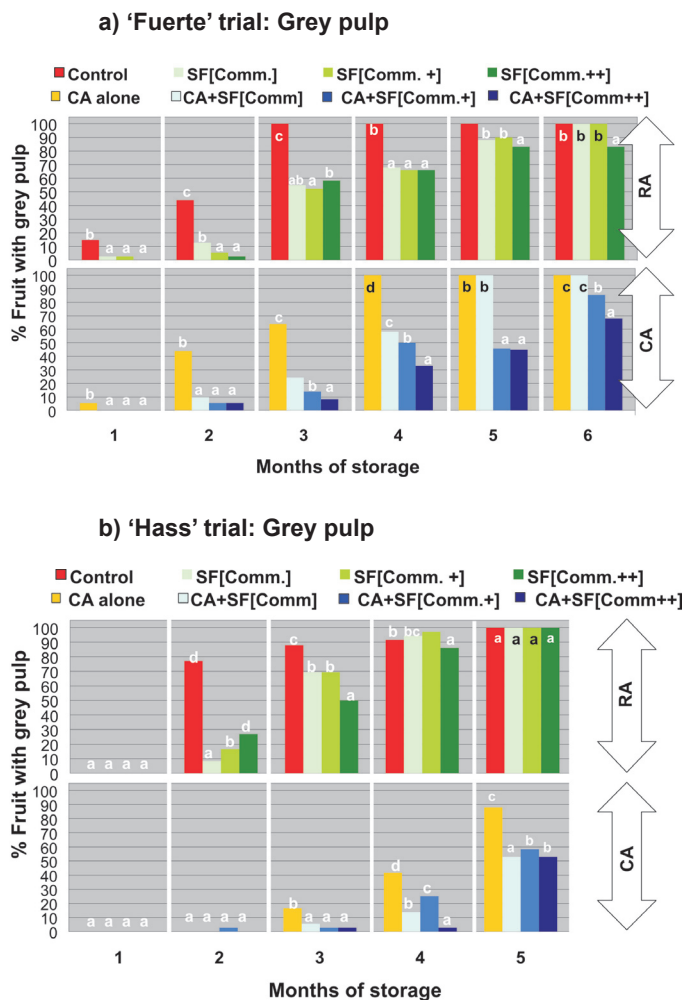


Figure 4. The percentage untreated and SmartFresh™ treated 'Fuerte' (a) and 'Hass' (b) fruit with grey pulp, after storage under RA and CA conditions. Bars marked with the same symbol are not significantly different. The statistics apply separately for CA and RA, as well as for each month of storage ( $\chi^2$ -test,  $P < 0.95$ ).

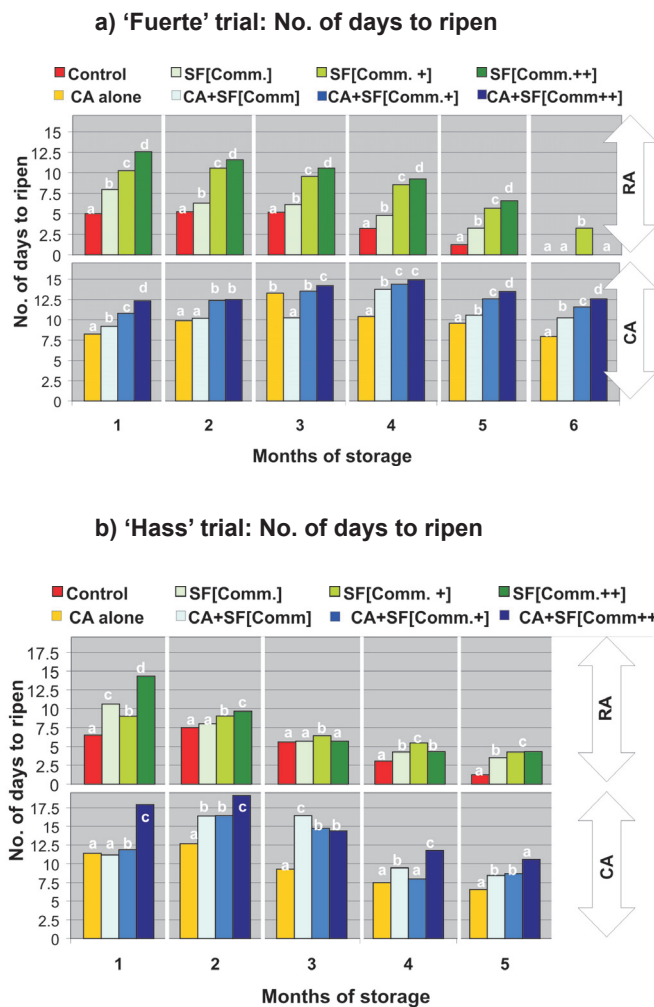


Figure 5. The average number of days to ripen untreated and SmartFresh™ treated 'Fuerte' (a) and 'Hass' (b) fruit with grey pulp, after storage under RA and CA conditions. Bars marked with the same symbol are not significantly different. The statistics apply separately for CA and RA, as well as for each month of storage (Student t-test,  $P > 0.05$ ).