

# Upgrading the 'Maluma' avocado export protocol: Determining the maximum allowable period from harvest to cooling and the (pre-harvest fruit quality dependent) maximum storage period

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## ABSTRACT

This project aimed to answer three questions, one of which was addressed in the previous season. Of the remaining two, the first concerns the period for which 'Maluma' fruit may be kept at ambient temperature before being placed into cool storage. The results suggest that fruit from normally fertilised older trees must be placed into cool storage within 8 hours of harvest. In the case of younger trees with a high nitrogen status, it is beneficial to shorten the harvest-to-cooling period to 4 hours (interestingly, the data showed that the 8 hour recommendation applies to 'Hass' as well). The second question dealt with the period for which 'Maluma' fruit may be stored before artificial ripening must commence. Storage of export samples from various producers indicated that fruit from older trees with a lower nitrogen status can be stored for 30 days, while fruit from younger trees with a high nitrogen status should not be stored for longer than 25 days.

## INTRODUCTION

The present study aims to answer the following questions:

1. For how long can 'Maluma' fruit be kept at ambient temperature after harvest before being placed into cool storage?
2. For how long can 'Maluma' fruit be cool stored before artificial ripening must commence?
3. How does the post-ripening 'soft life' of artificially ripened 'Maluma' fruit compare with that of the other commercial cultivars?

The third of the above questions was attended to last year and the results indicated that the post-ripening 'soft life' of artificially ripened 'Maluma' fruit is not inferior to that of 'Hass' or 'Fuerte'. Surprisingly, it appeared to be superior in certain of the trials (Kruger *et al.*, 2016).

The present report deals with the first two goals and aims to provide answers as to the maximum

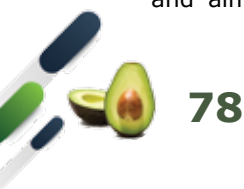
allowable period from harvest to refrigeration as well as the maximum storage period.

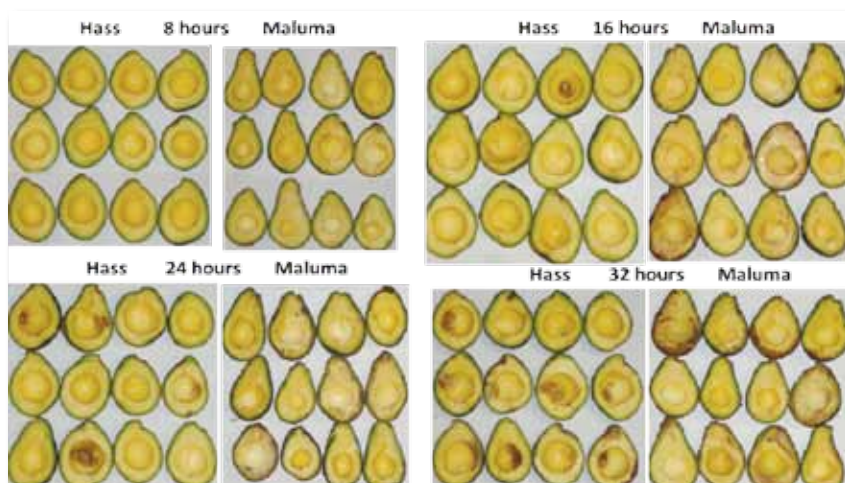
## MATERIALS AND METHODS

### Pre-cooling holding period

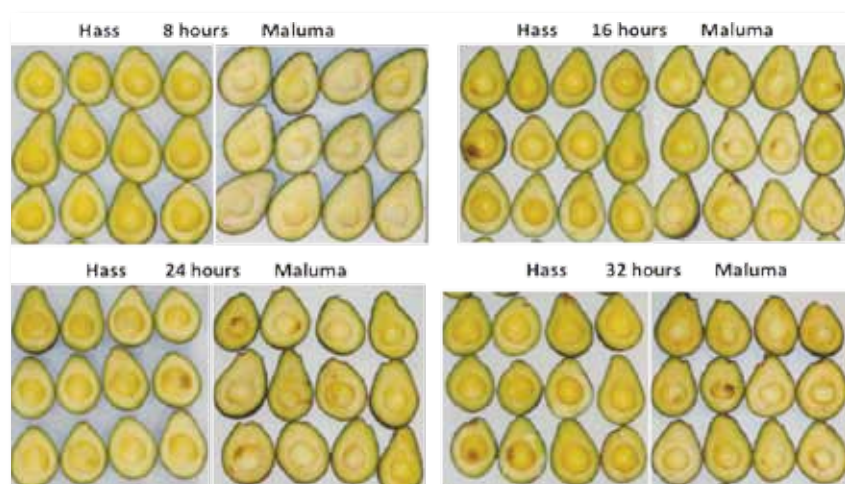
Six trials were conducted, two each with fruit from, respectively, the Mooketsi, Tzaneen and Nelspruit areas. Fruit from two orchards in each area were used for the Mooketsi and Tzaneen trials. The Tzaneen orchards were managed by two different producers while the two Mooketsi orchards were managed by the same producer. In the latter case orchards with, respectively, high and average nitrogen statuses were selected.

In the case of the Nelspruit trials, the fruit originated from an experimental mixed 'Maluma'/'Hass' orchard. In this instance, 'Hass' fruit were also included into the trials for comparative purposes. All the fruit were within the accepted export maturity range at the time of picking.

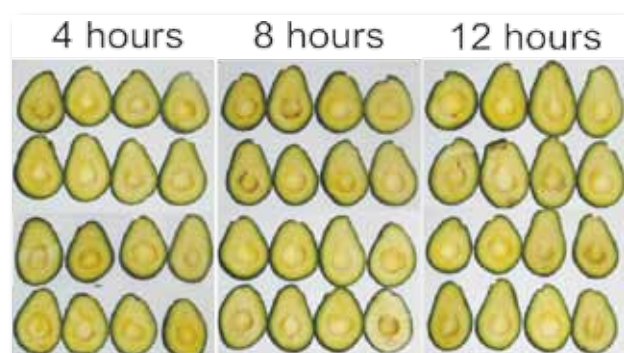




**Figure 1.** Internal quality of 'Maluma' and 'Hass' avocado fruit harvested during May from an experimental orchard in the Nelspruit area. Fruit were placed into cool storage at 8 hour intervals over a 32 hour period, followed by storage at 5°C for 30 days followed by ripening.



**Figure 2.** Internal quality of 'Maluma' and 'Hass' avocado fruit harvested during June from an experimental orchard in the Nelspruit area. Fruit were placed into cool storage at 8 hour intervals over a 32 hour period, followed by storage at 5°C for 30 days followed by ripening.



**Figure 3.** Internal quality of 'Maluma' avocado fruit from a normal nitrogen status orchard in the Mooketsi area. The fruit were placed into cool storage at 4 hour intervals over a 32 hour period (only the first 3 intervals are shown) followed by storage at 5°C for 30 days followed by ripening.



**Figure 4.** Internal quality of 'Maluma' avocado fruit from a high nitrogen status orchard in the Mooketsi area. The fruit were placed into cool storage at 4 hour intervals over a 32 hour period (only the first 3 intervals are shown) followed by storage at 5°C for 30 days followed by ripening.

With the Nelspruit and Tzaneen trials, the fruit were placed into cool storage at 8 hour intervals over a 32 hour period. With the Mooketsi trials, the intervals were shortened to 4 hours. In each case the fruit were stored for 30 days at 6°C before being ripened and evaluated.

### Maximum storage period

A total of 12 trials were conducted. Two trials each were performed with fruit from the Mooketsi and Nelspruit areas using samples from the same orchards that were used for the pre-cooling trials. In the case of the Nelspruit trials, the 'Hass' cultivar was again included for comparative purposes.

In Tzaneen, a total of 8 trials were conducted with fruit from 8 orchards belonging to four producers. In each case the fruit were stored for respectively 25, 30 and 35 days at 6°C after which they were ripened and evaluated.

## RESULTS AND DISCUSSION

### Period from harvest to cooling

The Nelspruit and Mooketsi samples (Fig. 1-4) rendered the most distinct results. In the case of the Nelspruit avocados (Fig. 1 & 2), the appearance based results indicated that 'Maluma' fruit (and for that matter, 'Hass' too) should be placed into cool storage within 8 hours after harvest. In so far as the Mooketsi fruit are concerned, the study clearly demonstrated the effect that pre-harvest quality has on postharvest storage potential. As for the Nelspruit trial above, the avocados from the lower nitrogen status orchard were of acceptable quality when placed into cool storage within



8 hours (Fig. 3). However, the poorer quality fruit from the high nitrogen orchard needed to be placed into cool storage within 4 hours (Fig. 4).

The above visual results recorded for the Nelspruit fruit were supported by the empirical (scoring) results attained for grey pulp (Fig. 5), stem-end rot (Fig. 6), vascular browning (Fig. 7) and anthracnose (Fig. 8). The incidences of the above disorders were similar between the two cultivars, provided that the fruit were placed into cool storage within 8 hours after harvest. However, with the exception of vascular browning, the incidences of the disorders increased at a faster rate in 'Maluma' than in 'Hass' as the period from harvest to storage increased.

### Maximum storage period

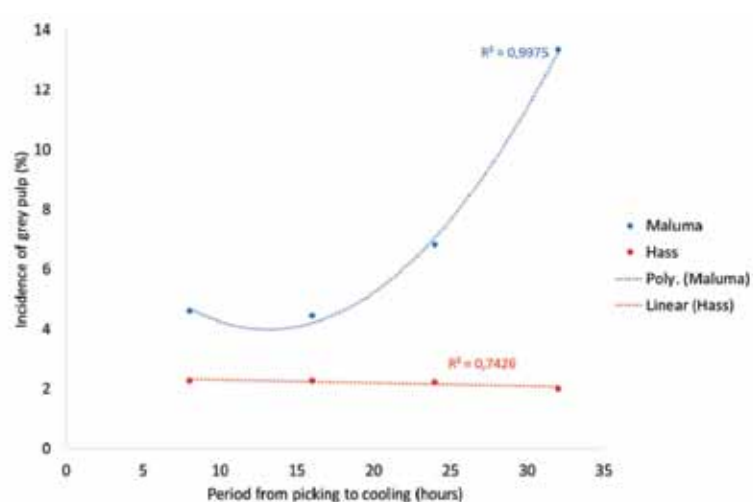
For this trial, the commercially sampled fruit originating from a range of producers in the Tzaneen area rendered the most useful results. Two disorders (bruising and grey pulp) were shown to be of particular importance. Although the mean incidence of bruising increased as the storage period lengthened (Fig. 9), the epidemiology was complex and is dealt with in a separate report (Kruger *et al.*, 2017).

The mean incidence of grey pulp also increased as the storage period lengthened. However, in this case, clear differences existed between fruit samples from different producers (Fig. 10). Fruit from older orchards with a lower nitrogen status exhibited a low incidence of the disorder when stored for 30-35 days, while fruit from younger trees with a high nitrogen status could not be stored for longer than 25 days.

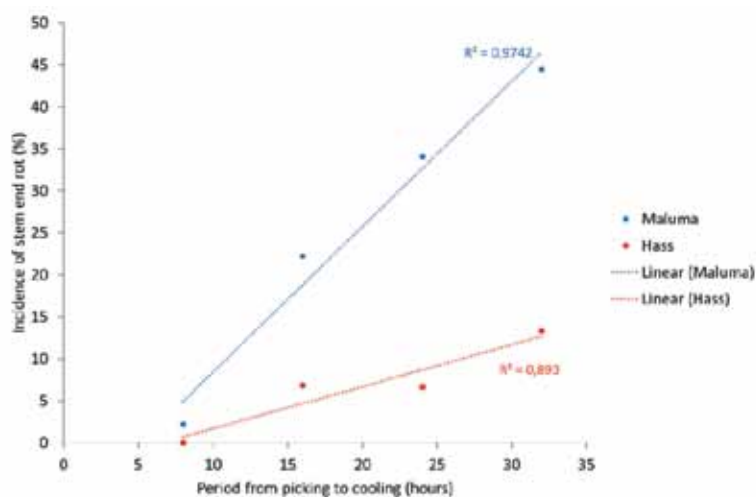
### RECOMMENDATIONS

From the results it is recommended that:

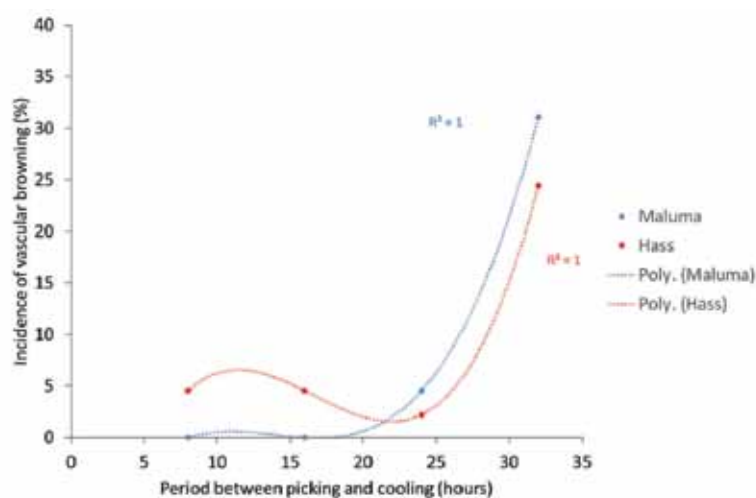
- 'Maluma' fruit from established orchards with a normal nitrogen status be placed into cool storage within 8 hours after harvest.
- 'Maluma' fruit from young orchards with a high nitrogen status be placed into cool storage within 4 hours after harvest.



**Figure 5.** Incidence of grey pulp in 'Maluma' and 'Hass' avocado fruit from the Nelspruit area that were placed into cool storage at 8 hour intervals over a 32 hour period, followed by storage at 5°C for 30 days and ripening.

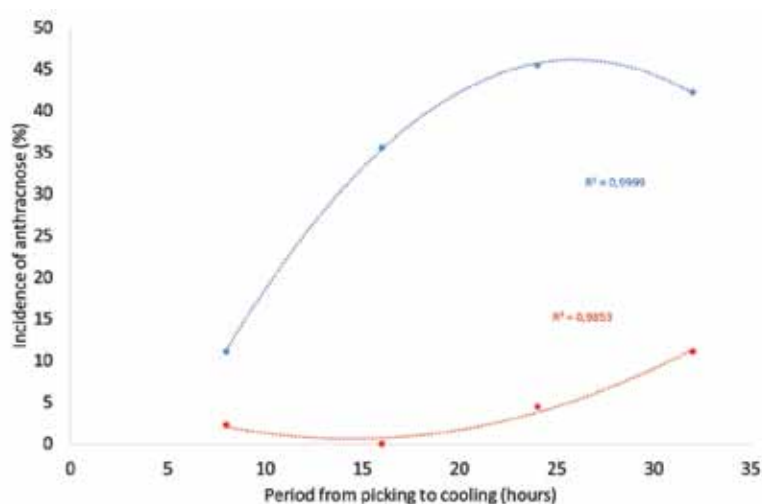


**Figure 6.** Incidence of stem-end rot in 'Maluma' and 'Hass' avocado fruit from the Nelspruit area that were placed into cool storage at 8 hour intervals over a 32 hour period, followed by storage at 5°C for 30 days and ripening.

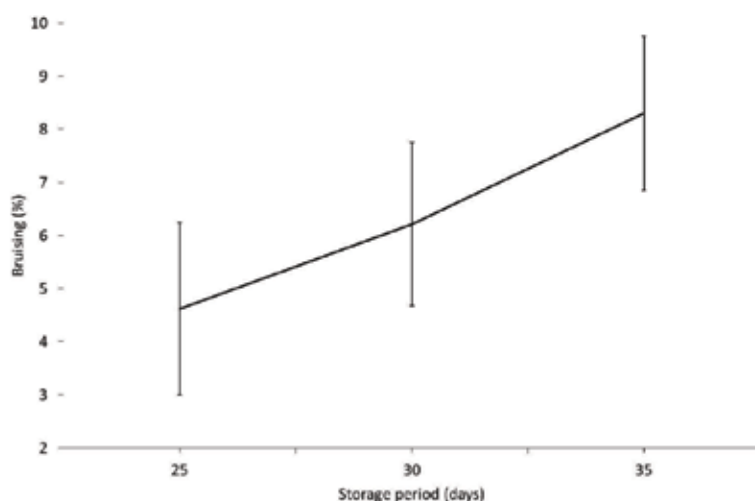


**Figure 7.** Incidence of vascular browning in 'Maluma' and 'Hass' avocado fruit from the Nelspruit area that were placed into cool storage at 8 hour intervals over a 32 hour period, followed by storage at 5°C for 30 days and ripening.

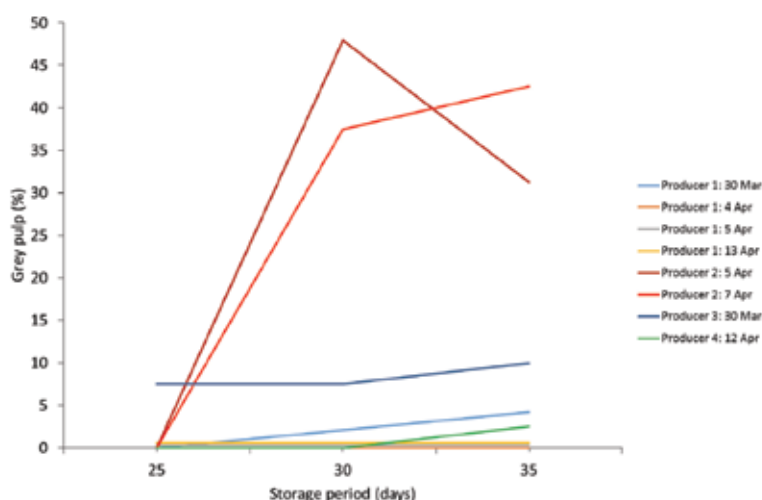




**Figure 8.** Incidence of anthracnose in 'Maluma' and 'Hass' avocado fruit from the Nelspruit area that were placed into cool storage at 8 hour intervals over a 32 hour period, followed by storage at 5°C for 30 days and ripening.



**Figure 9.** Mean incidence of bruising in 'Maluma' avocado fruit (8 orchards belonging to 4 producers) packed at a packinghouse in the Tzaneen area that were stored for either 25, 30 or 35 days at 6°C before being ripened at 20°C.



**Figure 10.** Incidence of grey pulp in 'Maluma' avocado fruit from 8 orchards belonging to 4 producers in the Tzaneen area that were stored for either 25, 30 or 35 days at 6°C before being ripened at 20°C.

- 'Maluma' fruit from established orchards with a normal nitrogen status be stored for a period of 30 days before artificial ripening must commence.
- 'Maluma' fruit from young orchards with a high nitrogen status not be stored for longer than 25 days before artificial ripening commences.

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