

# Further observations on the improvement of the late season marketing potential of 'Lamb Hass' avocado fruit

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## ABSTRACT

During the previous season it was established that 'Lamb Hass' fruit from well fertilised/irrigated high altitude orchards can be hung until October/November and then stored for 1 month. Alternatively, the fruit may be hung until December and stored for 2 weeks. It was found that a relatively high storage temperature (6°C for the entire period) is required in order to stop the development of stem-end rot infections. The present study tracked subsequent commercial exports from the original experimental orchards on Olyfberg in Mooketsi (1 400 meters above sea level) over the 2015 and 2016 seasons. The commercial export feedback confirmed that the above temperature setting is correct. The 6°C setting was also supported by a set of laboratory trials conducted with fruit from a second set of orchards in the Burgers Hall area (700 meters above sea level). It was further found that premature harvesting during a dry season such as 2016 results in excessive shrinking during ripening. The fruit must therefore be hung until the mean moisture content reduces to  $\pm 72\%$ . The project was subsequently extended so as to include a set of orchard-based pilot trials aimed at determining what influence late hanging has on alternate bearing, the preliminary results of which is shown in the present report.

## INTRODUCTION

The most important initial aim of this project was to develop appropriate local market storage protocols for the 'Reed' and 'Lamb Hass' cultivars. It was subsequently found that the 'Reed' cultivar does not have the necessary potential to be used for extended local market storage (Kruger *et al.*, 2016). In contrast, the 'Lamb Hass' cultivar exhibited good late season storage potential. A concerted effort was made to optimise the storage potential of this cultivar. It was determined that the most important mistake made during preceding seasons was the use of (too low) storage temperature settings normally applied to late season 'Hass' consignments. It was found that, although the low temperature setting may condense the ripening spread between individual fruit, the mean ripening period is longer, which results in an increased incidence of stem-end rot infections. By increasing the storage temperature to 6°C it was possible to store the fruit for up to 30 days when harvested during November and for two weeks when harvested as late as December (Kruger *et al.*, 2016).

The present study tracked commercial exports from the original experimental orchards on Olyfberg

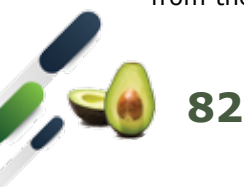
in Mooketsi (1 400 meters above sea level). A laboratory trial was also conducted with fruit from a second set of orchards in the Burgers Hall area (700 meters above sea level). Due to the positive results, the project was extended so as to also include an orchard-based pilot trial aimed at determining what influence late hanging has on alternate bearing.

## MATERIALS AND METHODS

### Commercial feedback of 'Lamb Hass' export consignments from the original experimental orchards on Olyfberg in Mooketsi (1 400 m above sea level) during the 2015 and 2016 seasons

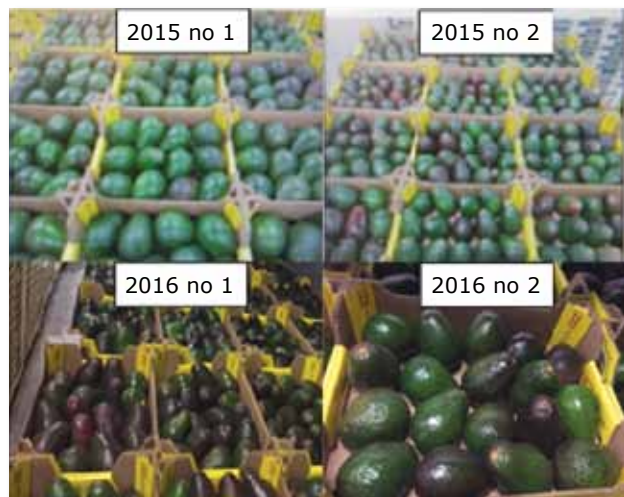
The maturation rates of fruit from the Olyfberg orchards were measured and plotted during the preceding months while the fruit were also tested for ripening uniformity before packing took place. Two consignments each were then tracked during, respectively, the 2015 and 2016 seasons.

Upon arrival in Europe, the ripeners documented the external colour of the fruit and measured the moisture content. They then proceeded with ripening the fruit and recorded the firmness spread and disorder profile prior to dispatching the fruit to their clients.



**Analysis of holdback samples from commercially exported 'Lamb Hass' consignments packed from an orchard in the Burgers Hall area (700 m above sea level) during the 2016 season**

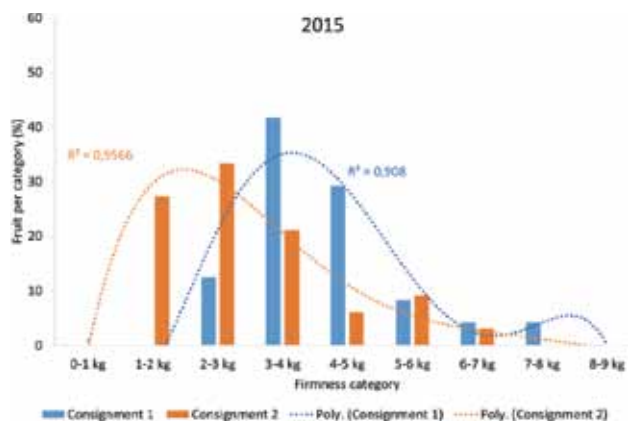
The maturation rate of the fruit was again measured and plotted during the 3 month period preceding export. After packing 12 cartons of fruit were stored at, respectively, 3°C and 6°C for 30 days followed by ripening.



**Figure 1.** External appearance of four consignments of 'Lamb Hass' avocado fruit exported to Europe during the 2015 and 2016 seasons.

**Pilot trials aimed at determining what influence late hanging has on alternate bearing**

During October 2014, the number of fruit on 134 'Lamb Hass' trees in an Olyfberg orchard (1 400 m) in Mooketsi were counted. Half of the trees (67) were harvested during the last week of November 2014 while the other half was allowed to hang until the beginning of January 2014. During October 2015, the number of fruit on each tree was again counted.



**Figure 2.** Pre-dispatch firmness profiles of two consignments of 'Lamb Hass' avocado fruit ripened by a European ripener during the 2015 season.

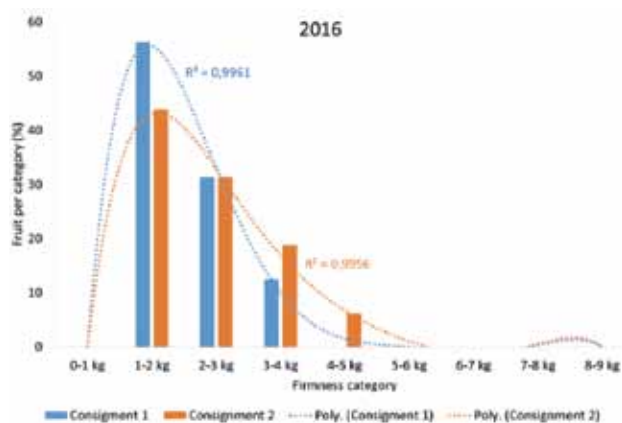
**Table 1.** Arrival quality aspects of the 'Lamb Hass' fruit in the first consignment exported to Europe during 2015.

Quality characteristic	Parameter	Incidence (%)						Average
		Count 12	Count 14	Count 18	Count 20	Count 22	Count 24	
External colour	Green	78	100	80	78	90	76	83.7
	Green + black	22	0	20	22	10	24	16.3
External lesions and marks	Netting	1.7	1.4	2.2	2	0.9	0.8	1.5
	Sunburn	3.3	1.4	2.2	4	1.8	2.5	2.5
	Chalk residue	0	14	0	0	0	0	2.3
	Deformed	0	0	2.2	0	0.9	0	0.5
	Skin damage >4 cm <sup>2</sup>	1.7	1.4	0	0	1.8	0	0.8
Pressure	> 9 kg	100	100	100	100	100	100	100

**Table 2.** Arrival quality aspects of the 'Lamb Hass' fruit in the second consignment exported to Europe during 2015.

Quality characteristic	Parameter	Incidence (%)					Average
		Count 10	Count 12	Count 14	Count 18	Count 20	
External colour	Green	57	58	71	63	66	63
	Green + black	43	42	29	37	34	37
External lesions and marks	Netting	0	5	2.9	2.2	2	2.4
	Sunburn	0	3.3	0	1.1	4	1.7
	Chalk residue	0	0	0	2.2	0	0.6
	Deformed	0	1.7	0	0	1	0.5
	Skin damage >4 cm <sup>2</sup>	0	3.3	7.1	1.1	1	2.5
Pressure	> 9 kg	100	100	100	100	100	100





**Figure 3.** Pre-dispatch firmness profiles of two consignments of 'Lamb Hass' avocado fruit ripened by a European ripener during the 2016 season.



**Figure 4.** Ripe quality of 'Lamb Hass' avocado fruit exported to Europe at 6°C during the 2015 season.

**Table 3.** Moisture content of 'Lamb Hass' fruit in two consignments exported during 2015 as measured by the commercial ripener upon arrival in Europe.

Consignment number	Number of fruit	Pulp moisture content (%)	
		Green fruit	Green + black fruit
1	10 (dried separately)	75.8 a	70.1 b
2	10 (pooled)	75.5	71.1

**Table 4.** Moisture content of 'Lamb Hass' fruit in two consignments exported during 2016 as measured by the commercial ripener upon arrival in Europe.

Consignment number	Green fruit		Green + black fruit	
	Number of fruit	Pulp moisture content (%)	Number of fruit	Pulp moisture content (%)
1	5 (dried separately)	74.4 a	5	71.3 b
2	2 (dried separately)	73 a	3	68.9 b
Total	7	74 a	8	70.4 b

**Table 5.** Incidence of stem-end rot in 'Lamb Hass' fruit grown at 700 m after storage for one month at two temperature settings.

Storage temperature (°C)	Stem-end rot (%)
3	12.5 a
6	4.7 b

## RESULTS AND DISCUSSION

### Commercial feedback from 'Lamb Hass' export consignments made from the original experimental orchards on Olyfberg in Mooketsi (1 400 m above sea level) during the 2015 and 2016 seasons

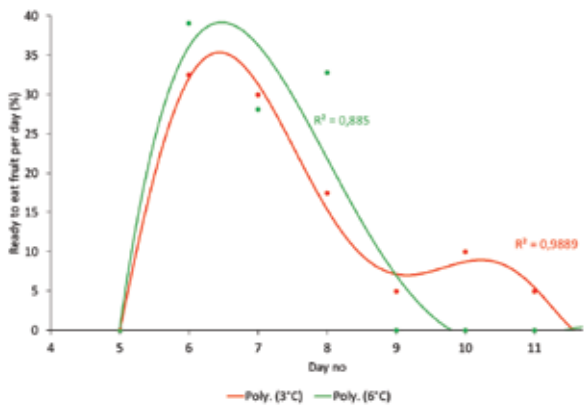
The appearance of the fruit in the four consignments, as recorded upon arrival at the ripener, is shown in Figure 1. The quality reports for the 2015 consignments are shown in Tables 1 and 2. It is important to note that, during both years, a percentage of fruit had started to colour upon arrival in Europe (a percentage of these already began to turn colour on the tree). However, what is important to note is that all fruit were above the 9 kg firmness level as required by the ripeners.

The maturity levels of the samples subjected to moisture content analyses by the ripener during 2015 are shown in Table 3, while those for the 2016 season are shown in Table 4. Interestingly, in both consignments for both years, the moisture contents of the green fruit were clustered around 75% while those of the coloured fruit congregated around  $\pm 70\%$ . Therefore, although all the fruit landed hard, there was a relatively large difference in maturity between the green and coloured fruit.

The ripening profiles are shown in Figures 2 and 3. As may be deduced from the figures, the fruit ripened more uniformly during the 2016 season than during the 2015 season. The ripener, however, was satisfied with the ripening rate and quality (Fig. 4) during both seasons.

**Analyses of holdback samples from commercially exported 'Lamb Hass' consignments packed in the Burgers Hall area (700 m above sea level) during the 2016 season**

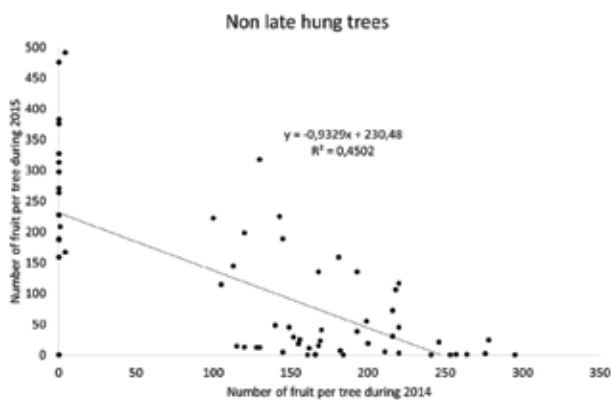
The ripening profile of the fruit is shown in Figure 5, while the stem-end rot infection rate is shown in Table 5. As was found during the previous season with the avocados from orchards cultivated at 1 400 m, the fruit kept at 6°C ripened faster and more uniformly than those stored at lower temperatures (Fig. 5). Most importantly, the incidence of stem-end rot was again higher in the fruit stored at 3°C compared



**Figure 5.** Ripening profiles of 'Lamb Hass' avocado fruit produced at 700 m after storage at 3°C and 6°C for one month.



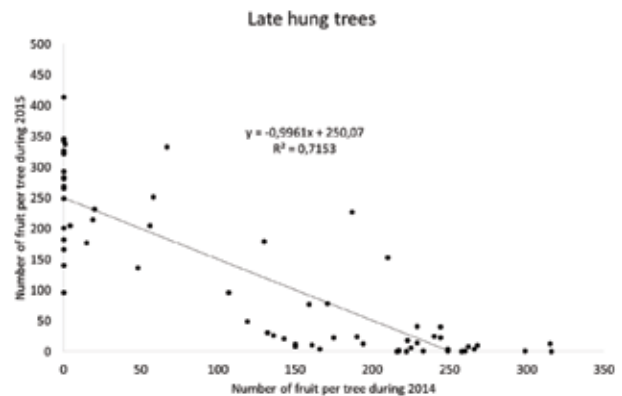
**Figure 6.** During the dry 2016 season it was noticed that shriveling is a problem when the fruit are harvested too early.



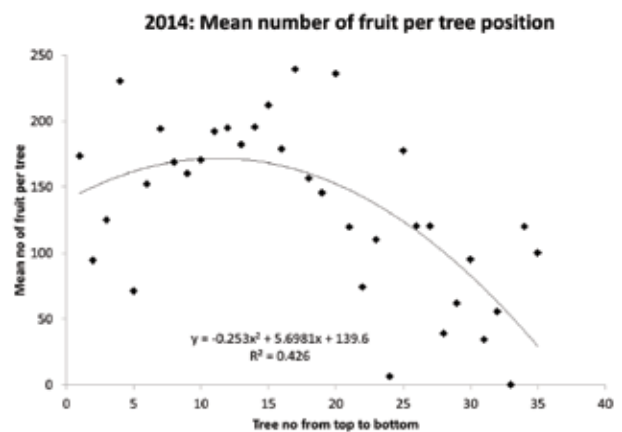
**Figure 7.** Relationship between the numbers of fruit recorded per non-late hung 'Lamb Hass' tree during the 2014 and 2015 seasons.

to those stored at 6°C (Table 5). These results support our previous observations regarding the relationship between storage temperature and ripening rate on the one hand and the incidence of stem-end rot on the other.

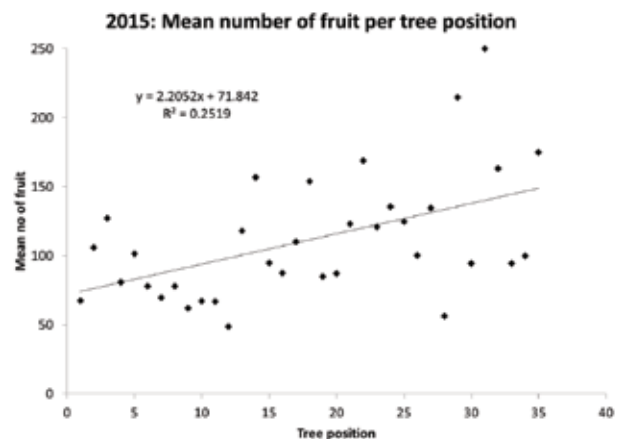
It was also noticed that the quality of the fruit grown at 700 m deteriorated earlier than those cultivated at 1 400 m. Whereas the fruit grown at



**Figure 8.** Relationship between the numbers of fruit recorded per late hung 'Lamb Hass' tree during the 2014 and 2015 seasons.



**Figure 9.** Relationship between the mean number of 'Lamb Hass' fruit recorded per tree (mean of 4 rows) and the tree number in the row during the 2014 season.



**Figure 10.** Relationship between the mean number of 'Lamb Hass' fruit recorded per tree (mean of 4 rows) and the tree number in the row during the 2015 season.



1 400 m could be stored for one month when picked in November and for two weeks when harvested in December, it would appear that the fruit grown at 700 m must be harvested a month earlier when stored for similar periods.

During the original laboratory trials conducted during the 2014 season, it was reported that shrinkage is not a problem in the 'Lamb Hass' cultivar. However, during the very dry 2016 season, it was noticed that shrivelling is a problem if the fruit are harvested too early (Fig. 6). The problem was overcome by ripening a sample of fruit on a weekly basis and only exporting the fruit when this maturity related symptom substantially decreased ( $\pm 72\%$  moisture content).

#### **Pilot trials aimed at determining what influence late hanging has on alternate bearing**

From the results it would appear that the trees exhibited an inter-tree alternate bearing pattern. In other words, trees that bore well during 2014 did not do so during 2015 and *vice versa* (Fig. 7 & 8). What is

important though, is that the alternate bearing patterns were similar between non-late hung (Fig. 7) and late hung (Fig. 8) trees. The fruit set pattern further seemed to be orchard position related. During 2014 (Fig. 9) the top end of the orchard set better than the bottom, while the opposite was true for the 2015 season (Fig. 10). This aspect requires further research.

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#### **REFERENCES**

- KRUGER, F.J., LEMMER, D. & VOLSCHENK, O. 2016. Development of storage protocols for ultra-late season 'Lamb Hass' and 'Reed' avocado fruit. *South African Avocado Growers' Association Yearbook* 39: 117-123.

