TRIANGLE TASTE TESTS PERFORMED WITH LOW AND HIGH-ALTITUDE 'HASS' FRUIT AT THE START OF THE 2021 EXPORT SEASON

Kruger, F.J., Volschenk, G.O. and Volschenk, E.

Lowveld Postharvest Services
PO Box 4001, Mbombela 1200, SOUTH AFRICA

fjkruger58@gmail.com

ABSTRACT

South Africa's traditional European midseason export market is under pressure due to high export volumes from South America. The industry is thus forced to export more fruit during the beginning of the season. Unfortunately, warmer, low altitude 'Hass' orchards generally bear poorly and it is therefore of cardinal importance to establish whether higher altitude 'Hass' orchards can be earlier harvested. During a previous project we noticed that fruit from orchards located at approximately 1 400 m above sea level ripen and taste satisfactory upon reaching a 20% dry matter (DM) content. A detailed study was subsequently launched and the initial results revealed that although high altitude fruit may be marginally more prone to shrivelling and stem-end rot at 20% DM, their taste scores were fairly similar to fruit from lower lying orchards that were at 23% DM at the time of sampling. During 2021, we started with more robust triangle testing. The short period that the fruit of the different orchards remained around the target maturity levels proved problematic, as it was quite challenging to synchronise the ripening of the samples so that they were at similar firmness at the time of tasting. We tested a number of procedures aimed at synchronising the softening rates and found differential ripening temperatures to satisfactorily synchronise the ripening. Panellists were presented with three samples: one from a lower altitude (700-900 m) and two from a higher altitude (1 200-1 400 m) (or *vice versa*). Due to the time we lost refining the firmness synchronisation, we soon had to resort to ultra-high orchards (1 400-1 600 m). During the triangle testing, the panellists were asked to pair the two samples that tasted similarly. A total of 91 such tests were performed. Of these, 29 were done during March and 62 during April. During March, only one third of the participants correctly identified the non-similar wedges in the triangle tests. This is the score to be expected when the two samples have similar taste. During April, the percentage of correct answers increased to around 50%, which bordered on statistical significance. However, the samples from these lower lying areas were from less well managed, atypical, slow maturing orchards. Another observation made during the study was that considerable variation in taste exists between individual fruit from the same location. This requires that substantially higher numbers of tests be performed during the 2022 season.

INTRODUCTION

During the last decade, the European market situation has significantly changed for South African producers. This is primarily due to the entry of South American production countries, especially Peru, to the market. One way of mitigating the situation is to decrease the volumes of South African 'Hass' marketed during the mid-season and to increase the volumes exported during the early season and, to a lesser extent, the late season. During the early season, acceptable taste is an important consideration when deciding when to start harvesting. The present study was launched after certain preliminary observations indicated that the sensory characteristics of 'Hass' fruit from high altitude orchards were acceptable before the mandatory 23% dry matter content level was reached (Kruger *et al.,* 2020).

During 2020, a taste survey was performed on seven 'Hass' orchards in the Mooketsi area (Kruger *et al.,* 2021). Three of these were located at altitudes between 700 m and 800 m while the remaining four orchards were located between 1 300 m and 1 500 m. Dry matter content evaluations were performed weekly between weeks 8 and 12 of the calendar year to serve as maturity reference points. For the last three sampling dates, ten fruits from each orchard were ripened to the ready to eat stage, after which the taste was scored. From the results it appeared that, during the eight-week sampling period, the dry matter contents of the orchards located between 700 m and 800 m remained approximately

two percent higher than those of the orchards located between 1 300 m and 1 500 m. However, the taste scores of the two groups did not show parallel trends. Instead, the taste scores of the higher lying orchards increased at a faster rate than those of the lower lying orchards. Upon reaching a mean dry matter content of 22%, the mean taste score of the higher lying orchards was comparable to that of the lower lying orchards when they were at a dry matter content of 24%. Although shrivelling was found to be maturity related (and thus higher in the higher lying orchards at DM = 22% than in lower lying orchards at DM = 24%), we are of the opinion that the intensity of the disorder was not such that it would negatively influence marketing. Stem-end rot also decreased linearly during the sampling period, but considerable variation occurred between samples.

During the 2021 season, we concentrated on taste and performed triangle tests with fruits from a series of orchards between 700 m and 1 600 m. Although this type of assessment is quite time consuming, it renders more reliable results than the above scoring method.

MATERIALS AND METHODS

The ripening methods that were experimented with are summarised in Table 1. The sampling dates, altitude ranges, weeks during which the triangle tests were performed, mean dry matter contents (ten fruit sample) and the ripening procedures used to generate test-ready fruit of similar firmness, are shown in Table 2. The number of tests that were performed on each date is shown in Table 3.

The triangle tests involved presenting each panellist with three samples. Of these, two originated from one of the altitude categories while the third was from the opposing altitude block. The panellists were asked to identify the two samples that were from the same altitude. The data were statistically analysed using the app provided by Calle (2018).

RESULTS AND DISCUSSION

In order to generate reliable results, it was essential to present fruit of similar firmness to the panellists. This aspect proved to be problematic, as the lower altitude samples that were around 23% dry matter at

Table 1: Ripening profiles of 'Hass' avocado fruit that were ripened under different conditions in an attempt to synchronise the softening rates of lower and higher altitude fruit

Harvest date	Ripening method	Orchard approximate altitude (m)	Ripening temperature (°C)	First fruit to ripen (day no)	Last fruit to ripen (day no)	Ready to eat fruit overlap (%)
9 March	Direct	700-900	20	13	24	22.5
		1200-1400	20	20	30	20
19 March	Direct	700-900	20	6	19	25
		1200-1400	20	15	28	12.5
12 April	Direct	700-900	18	10	25	72.5
		1500-1600	24	15	28	86.7
12 April	Stored first	700-900	20	4	16	56.4
		1500-1600	20	10	24	40

Table 2: Mean dry matter contents at which the fruit from different altitudes were sampled for triangle testing

Sampling date	Ripening method	Triangle test week	Mean dry matter (%)	
			Low altitude blocks (700-900 m)	High (1200-1400 m) and ultra-high (1400-1600 m) altitude blocks
9 March	All fruit directly ripened at 20 °C	First week of April	23.4	19.3
19 March	All fruit directly ripened at 20 °C	Second week of April	24.7	19.8
12 April	All fruit directly ripened at 20 °C	Last week of April	23.3	19.4
12 April	Low altitude fruit ripened at 18 °C High altitude fruit ripened at 24 °C	First week of May	23,3	19.4
12 April	All fruit stored for three weeks at 5 °C then ripened at 20 °C	Second week of May	23.3	19.4

the time of sampling, ripened faster than the higher altitude fruit that were around 20% dry matter at the time of sampling (Table 1). In certain cases, only one in eight fruit from a sample corresponded with fruit of similar firmness from the opposing sample. The short period during which the fruit's maturities remained near the target range further compounded the issue.

In an attempt to synchronise the softening rates, we introduced two mitigation procedures. The first was to initially store the fruits, while the second was to ripen the samples at different temperatures. To do this, we ripened the low altitude fruit at 18 °C and the high altitude fruit at 24 °C. Both methods rendered improved results, but the differential temperature ripening procedure rendered the best ripening synchronisation of the two methods.

Unfortunately, the above refinements resulted in us doing less than the intended number of triangle tests during March and we had to resort to the comparison of low altitude fruit with ultra-high altitude fruit during April (Table 2).

For the March harvest, only one third of the panellists correctly differentiated the low-altitude samples from the high-altitude samples (Table 3). This is what one would expect when purely guessing and indicates that the panellists could not distinguish between the two groups. Although this is encouraging, the sample size was small due to the time lost on ripening synchronisation.

In terms of the aims of the project, the comparisons between the low-altitude and ultra-high altitude orchards that were performed during April were less important. However, in this case, we were able to better synchronise the ripening and perform more tests. As shown in Table 3, about half of the panellists got it right this time round, which is higher than the above, but in most cases do not indicate that significant taste differences existed between the two groups. Also, the samples from lower lying areas were from less well managed, atypical, slow maturing orchards.

It is important to note that, during the taste sessions, we noticed that considerable variation in taste existed between individual fruit from the same location. This implies that substantially higher numbers of tests need to be performed during the 2022 season. In light of our improved ripening synchronisation techniques, we plan to conduct the majority of these tests during March and early April as exports during this period are critical to the industry in terms of financial returns. We will further upgrade the experimental protocol by treating individual fruit from the same block as separate entities so as to also record the extent of taste variation in each block.

ACKNOWLEDGEMENTS

The authors would like to thank ZZ2 and Letaba Packhouse for technical assistance, SAAGA for financial support and Mark Penter for editing the manuscript.

REFERENCES

CALLE, A. 2018. Sensory evaluation. https://play.google.com/store/apps/details?id= au.net.iinet.members.acalle.sensoryevaluationcalculations&hl=en_ZA&gl=US

KRUGER, F.J., VOLSCHENK, G.O. & VOLSCHENK, L.C. 2020. Effects of cultivar, season and altitude on avocado fruit's soluble solid contents and early season quality. South African avocado fruit. *SAAGA Yearb.* 43: 88-91.

KRUGER, F.J. & VOLSCHENK, G.O. 2021. Preliminary observations on the maturation rates, taste scores and shrivelling/stem end rot incidences of Hass fruit cultivated at lower and higher altitudes in the Mooketsi area. *SAAGA Yearb.* 44: 80-82.

Table 3: Results of the triangle tests that were performed during the 2021 season

Sampling and ripening periods	Mean dry matter (%)			Number of panellists	Incorrect answers (%)	Correct answers (%)	Correct answers required for a significant difference (Calle, 2018) ($p < 0.05$) (%)
	Low altitude (700-900 m)	High altitude (1200-1400 m)	Ultra-high altitude (1400-1600 m)				
Sampled mid-March: all fruit directly ripened at 20 °C	24.1	19.6		29	65.5	34.5	51.7
Sampled mid-April: all fruit directly ripened at 20 °C	23.3		19.4	31	51.6	48.4	51.6
Sampled mid-April: Low altitude fruit ripened at 18 °C and ultra-high altitude fruit ripened at 24 °C	23.3		19.4	31	48.4	51.6	51.6
Sampled mid-April: all fruit stored for three weeks at 5 °C then ripened at 20 °C	23.3		19.4	20	50	50	55

Together we grow and sustain your business

Our passion for excellence helps you grow your business and establish yourself as a preferred supplier of perishable products.

PPECB

45 Silwerboom Ave
Plattekloof, Cape Town
7560

Head Office
T +27 21 930 1134
F +27 21 939 6868

www.ppecb.com

IMPROVING WATER EFFICIENCY

WE ARE TAKING BOLD STEPS TO REDUCE WATER CONSUMPTION BY 50% ACROSS OUR GLOBAL OPERATIONS BY 2030.

TO LEARN MORE ABOUT OUR SUSTAINABILITY STORY, SCAN THE CODE: