

TRIANGLE TASTE TESTS PERFORMED WITH EARLY SEASON 'HASS' FRUIT FROM THREE ALTITUDE BANDS IN THE GREATER TZANEEN AREA DURING 2022

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ABSTRACT

This report concerns the final stage of a project aimed at establishing whether the taste of 'Hass' fruit from high altitude orchards that are at 20% dry matter at the time of harvest have comparable taste to fruit from low lying orchards that are at 23% dry matter at the time of harvest. During 2022, thirty-one triangle pairing and taste preference tests were performed with fruit from three altitude bands (± 700 , ± 100 & ± 400 metres above sea level) in the greater Tzaneen area. In general, the panellists were unable to distinguish between samples of varying maturity from different altitudes. There were only two instances where the 95% confidence level was breached during the triangle pairing as well as the taste preference tests. The results have significant ramifications for the South African avocado industry. The marketing of export fruit has become increasingly sophisticated over the last number of decades. During most of the previous century, the fruit were marketed unripened on the open market and it was necessary that strict maturity threshold values be enforced. However, during the present century, a large proportion of the 'Hass' crop is ordered by importers who ripen the fruit and supply the ripened product to their customers. These ripeners have established their own laboratories and have developed sophisticated quality control systems. It is therefore appropriate that exporters provide them with samples to ripen before the start of the harvest window. The exporters should then use the reports to apply for dispensation to export fruit that do not meet the present maturity threshold regulation of 23% dry matter at the time of harvest.

INTRODUCTION

This project aims to establish whether 'Hass' avocado fruit from higher lying orchards may be harvested at a lower dry matter content than the currently stipulated 23%.

The present study was launched after certain preliminary observations indicated that the sensory characteristics of 'Hass' fruit from high altitude 'Hass' orchards were acceptable before the mandatory 23% dry matter content level was reached (Kruger *et al.*, 2020).

During 2020, a postharvest survey was performed on seven 'Hass' orchards in the Mooketsi area (Kruger & Volschenk, 2021). Three of these were located at altitudes between 700 metres above sea level (masl) and 800 masl while the remaining four orchards were located between 1 300 masl and 1 500 masl. Dry matter (DM) content evaluations were performed over a five-week period between weeks 8 and 12 of the calendar year to serve as maturity

reference points. During the last three sampling sessions, ten fruit from each orchard were ripened to the ready to eat stage after which the taste was scored. During the sampling period, the dry matter contents of the orchards located between 700 masl and 800 masl remained approximately two percent higher than those of the orchards located between 1 300 masl and 1 500 masl. However, the taste scores of the two groups did not show similar 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 approximately 22%, the mean taste scores of the higher lying orchards were comparable to those of the lower lying orchards that were at dry matter contents of around 24% at the time. Although shrivelling was found to be maturity related and thus higher in the high-altitude orchards (DM = 22%) than in the lower lying orchards (DM = 24%), we were of the opinion that the intensities were not such

that it would have negatively influenced marketing. The incidence of stem-end rot was found to decrease as the fruit matured, but considerable variation occurred between samples.

During 2021, we started with more robust triangle testing (Kruger *et al.*, 2022). The short period that the fruit of the different orchards remained around the target maturity levels proved problematic and it was 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 synchronizing the softening rates and found differential ripening temperatures to satisfactorily synchronize the ripening. The triangle tests indicated that the panellists could not readily distinguish between fruit from higher and lower altitude orchards and that considerable variation in taste exists between individual fruit from the same location. This required that substantially higher numbers of tests be performed during the 2022 season.

The present report deals with a set of 31 triangle and taste preference tests that were performed with fruit from three altitude bands in the greater Tzaneen area during the 2022 season.

MATERIALS AND METHODS

Orchards located within three altitude bands were identified. As was the case during 2021, the first set of orchards were from a 'low altitude'. During 2022, four blocks that were located between ± 600 and ± 900 masl were selected for the purpose. Also, similarly to 2021, fruit from a second set of 'high altitude' orchards between $\pm 1\ 350$ and $\pm 1\ 500$ masl were evaluated. In addition, a third set of orchards of 'intermediate altitude' were included during 2022. Two blocks, located between $\pm 1\ 150$ and $\pm 1\ 250$ masl, were selected for the purpose.

The dry matter contents of fruit samples from the eight blocks were measured on a weekly basis as from mid-November until harvest.

As was the case in 2021, the fruit from the above eight orchards were stored and ripened at different temperature settings to generate avocados of similar firmness on the day of evaluation.

A total of 31 tests were performed during 2022. In each case, two fruit, one each from a lower and a higher altitude, were used. The first five tests were performed with 20 panellists, while the last 26 tests were done with 25 panellists. Large fruit were selected for dissection and the two fruit were cut into either 60 segments (40 from the one fruit and 20 from the other) when 20 panellists were involved or 75 segments (50 from the one fruit and 25 from the other) where 25 panellists were involved. Each panellist was presented with one segment from the one fruit and two from the other and asked to pair the samples. The results were statistically analysed using Chi-Square analyses.

In addition to the above, the panellists were requested to offer an opinion as to which of the two sample-groups tasted best. Only the opinions of the panellists who got the triangle pairing correct were considered when performing Chi-Square analyses on the taste preference data.

RESULTS AND DISCUSSION

The dry matter (DM) accumulation rates of the fruit are shown in Figure 1.

Three of the four low lying blocks reached 23% DM during mid-March. Interestingly, the fourth low lying orchard was only at 20% DM at the time.

One of the high lying orchards also attained 20% DM by mid-March while the second reached this level towards end-March.

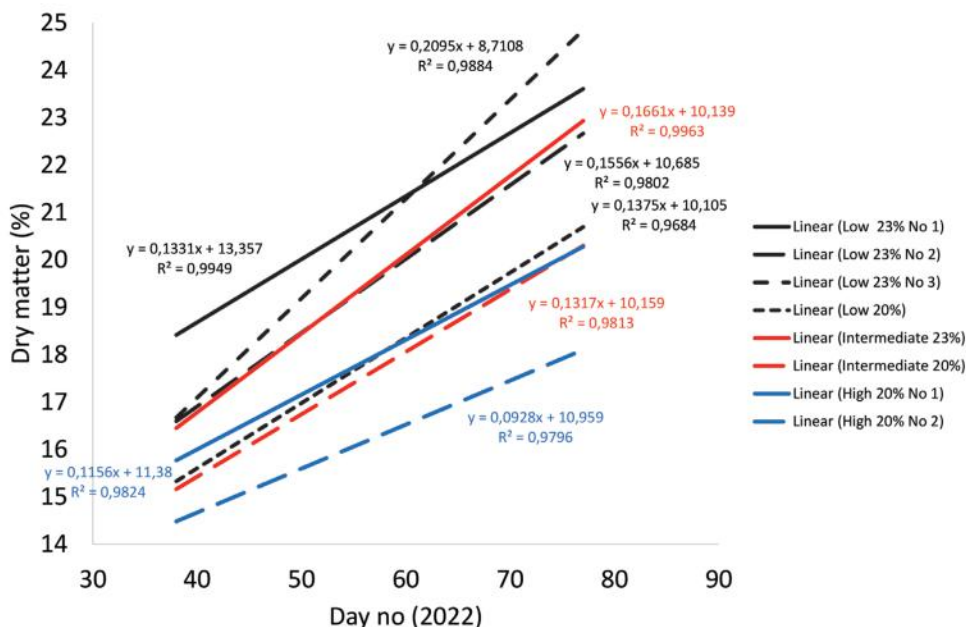


Figure 1: Maturation rates of the eight experimental blocks as recorded during the 2022 season.





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Of the two intermediate orchards, one attained 20% DM during mid-March while the second was already at 23% DM at the time.

The results from the triangle taste testing are shown in Table 1. The expected ratio for similar samples was 33.3% correct answers to 66.7% incorrect answers. In the case of the 20 person panels, 55% or more correct answers were required to meet the 95% confidence level. In the case of the 25 person panels, 52% or more correct answers were required to meet the 95% confidence level.

In addition to triangle taste testing, the taste preference statistics are also shown in Table 1. As only the opinions of the panellists that got the original combination correct were used, the percentages required for statistical significance varied according to the numbers of correct triangle test answers returned.

In general, the panellists were unable to distinguish between the fruit from the different blocks. There were only two instances where the 95% confidence level was breached during both the triangle tests as well as the taste preference tests. The first

Table 1: Triangle and taste preference test results recorded during the 2022 season. Statistically significant results are highlighted (Chi-square test $p < 0.05$)

Altitude group	Test no	N panellists	Triangle test results		Taste preference of accurate panellists	
			Correct answers (%)	Incorrect answers (%)	Prefer lower lying orchard (%)	Prefer higher lying orchard (%)
Low 23% vs Intermediate 20%	1	20	45	55	66,7	33,3
	2	25	40	60	37,5	62,5
	3	25	36	64	28,6	71,4
	4	25	36	64	100	0
	5	25	28	72	85,7	14,3
Low 23% vs Intermediate 23%	6	20	45	55	83,3	16,7
	7	20	55	45	33,3	66,7
	8	20	50	50	100	0
	9	25	32	68	66,7	33,3
	10	25	28	72	50,0	50,0
	11	25	24	76	33,3	66,7
Low 20% vs Intermediate 23%	12	25	48	52	50	50
Low 23% vs High 20%	13	25	44	56	33,3	66,7
	14	25	48	52	50	50
	15	25	48	52	80	20
	16	25	24	76	50	50
	17	25	24	76	66,7	33,3
	18	25	28	72	42,9	57,1
	19	25	36	64	37,5	62,5
	20	25	60	40	8,3	91,7
	21	25	32	68	0	100
	22	25	32	68	42,9	57,1
	23	25	20	80	75	25
Low 20% vs High 20%	24	25	28	72	16,7	83,3
	25	25	52	48	16,7	83,3
	26	25	28	72	83,3	16,7
Intermediate 23% vs High 20%	27	25	56	44	58,3	41,7
	28	25	24	76	25	75
	29	25	24	76	0	100
Intermediate 20% vs High 20%	30	25	40	60	25	75
	31	25	36	64	33,3	66,7



(Test no 20) concerned a comparison between one of the low altitude orchards that was at 23% dry matter at the time of sampling and a high-altitude orchard that was at 20%. The second (Test no 25) involved the low altitude orchard that was at 20% dry matter at the time of harvest and one of the high-altitude orchards that was also at 20% during the same period. In both the above cases, the panellist preferred the taste of the high-lying orchard to that of the low-lying orchard.

In addition to the above, there were isolated instances where statistically significant differences were recorded for the triangle tests but not the taste preference tests and *vice versa*. In two instances (Test numbers 7 and 27) the triangle tests were significant, but the taste preference tests were not. In three cases (Test numbers 4, 8, and 29) a clear taste preference was recorded by the correct panellists without the proportion of correct panellists being statistically significant. Two of these tests involved comparisons between low and intermediate orchards where all the correct panellists preferred the fruit from the low-lying block over that of the intermediate block. This indicates that there were individual fruit in the intermediately situated block that still had unacceptable taste at the time of sampling. The third (Test no 29) concerned a comparison between an intermediate altitude orchard and a high-altitude orchard. In this case, the correct panellists clearly preferred the fruit from the higher lying orchard. This indicates that there again were individual fruit in the intermediately situated block that still had unacceptable taste at the time of sampling. Interestingly, the two high lying orchards were situated on top of mountains while the two intermediate blocks were located on the south-eastern slope of a mountain.

Insofar as the commercial application of the

present results are concerned, avocado marketing is becoming increasingly sophisticated. During the previous century, the fruit were marketed unripened on the open market and it was necessary that strict maturity threshold values be enforced. However, during the last two decades, a large proportion of the 'Hass' crop is ordered by importers who ripen the fruit and supply the ripened product to their customers. These ripeners have established their own laboratories and have developed sophisticated quality control systems. It is therefore appropriate that exporters provide them in advance with samples to ripen and use their reports to apply for dispensation to export fruit that do not meet the present maturity threshold regulations. It is recommended that this approach be followed insofar as the present high-altitude orchards are concerned.

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