Effects of cultivar, season and altitude on South African avocado fruit's soluble solid contents and early season quality

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ABSTRACT

During 2018, the total soluble solids (TSS) content of a 'Maluma' orchard located at ± 700 m was measured over a three-month period. During 2019, a large number of orchards of all cultivars located at ± 700 m were sampled under commercial conditions. In addition to this, twenty samples were collected over a 6-month period from a 'Hass' orchard located at ± 1 400 m in the Tzaneen area. In the latter case, the samples were also ripened and evaluated. The results indicated that the TSS levels of the fruit from the ± 700 m orchards were lower during the low-bearing 2019 season, compared to the high-bearing 2018 season. In contrast, the fruit from the 'Hass' orchard located at ± 1 400 m exhibited significantly higher TSS values than the lower lying orchards. In addition, fruit from this orchard ripened satisfactorily and tasted acceptable at lower dry matter (DM) levels than the currently specified 23% entry level. It is recommended that the storage potential, ripening efficiency and taste attributes of pre-23% DM 'Hass' fruit from these high-bearing orchards located at elevated altitudes be thoroughly investigated with an eye to updating the current maturity regulation.

INTRODUCTION

The total soluble solids (TSS) content of avocado fruit exhibit a characteristic tick mark shaped pattern during the period directly prior to and during the commercial harvest window (Kruger *et al*., 2018; Kruger *et al.,* 2019). The present report aims to establish what effects the cultivar, growing season and orchard altitude have on the above trend. The results are then discussed in the context of yield and ripening related trends associated with high altitude 'Hass' orchards in the Tzaneen area.

MATERIALS AND METHODS

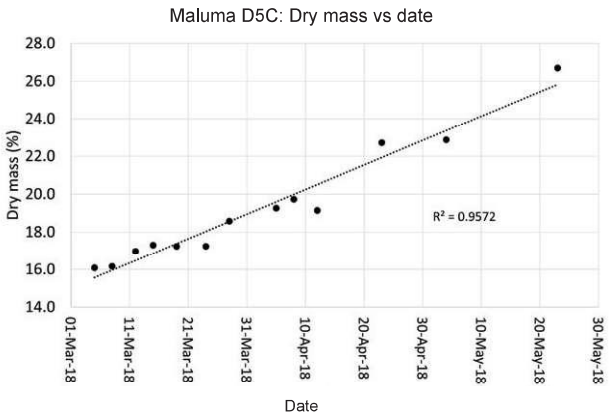
The TSS data contained in this report were generated from two sources. The first source involved measurements taken at a commercial pack-house located at ± 700 m in the Tzaneen area. Producers at this pack-house were requested to bring in samples on a weekly basis for a two-month period prior to the anticipated harvest date for dry matter (DM) analyses. During the 2019 season, the TSS content of 6 fruit per sample was determined in addition to the DM analyses.

The second part of the study concerned DM and TSS analyses that were performed on fruit from a 'Hass' orchard located at ± 1 400 m in the Tzaneen area. Twenty fruit were sampled on a regular basis as from the beginning of March to the beginning of September. Ten of the fruit were used for DM and TSS analyses and the rest were ripened at room temperature and evaluated for external ripe colour, shrivelling, pathology and taste.

RESULTS AND DISCUSSION

During 2018, the DM and TSS contents of a 'Maluma' orchard located at ± 700 m in the Tzaneen area were obtained (Kruger *et al.*, 2019). The results showed that, during this high yielding season, the dry matter increased from around 16% to approximately 26% from the beginning of March to the end of May. During the same period, the TSS values of the fruit first decreased from about 8.5°brix to approximately 7.8°brix over a three-week period in March. These then increased in a curvilinear fashion to reach a maximum 10.5°brix at the end of May (Fig. 1).

In contrast to the above, the TSS contents of 'Maluma' orchards located at ± 700 m were significantly lower during the low yielding 2019 season. The DM and TSS of three orchards located at ± 700 m are shown in Figure 2. In all three cases, the TSS content increased from around 7°brix in the middle of February to about 9ºbrix at the beginning of June.



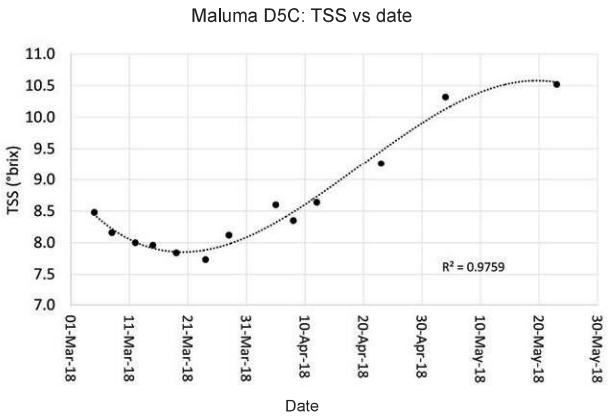
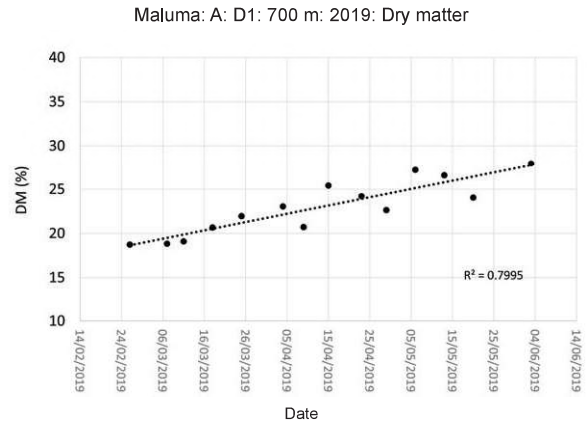
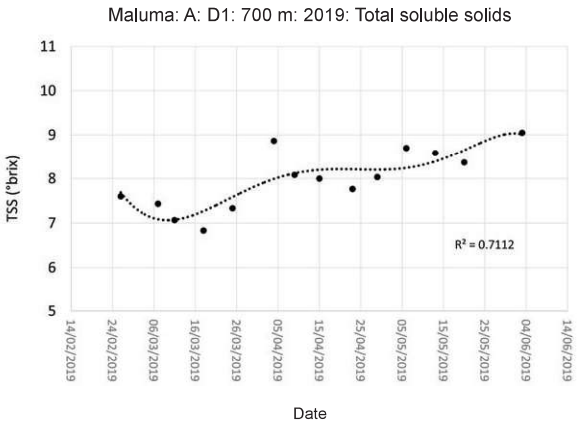
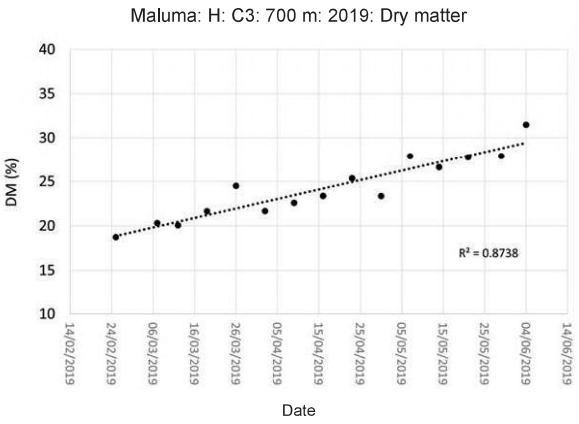
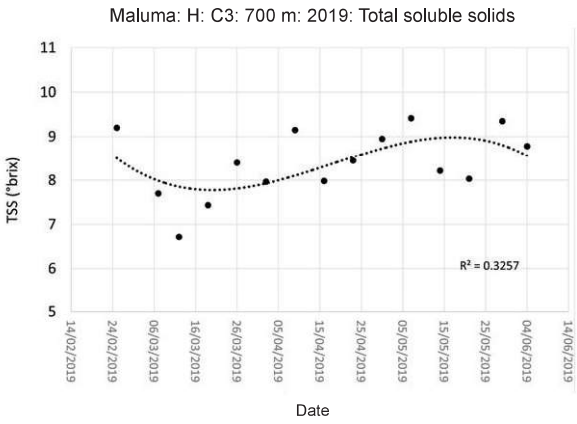


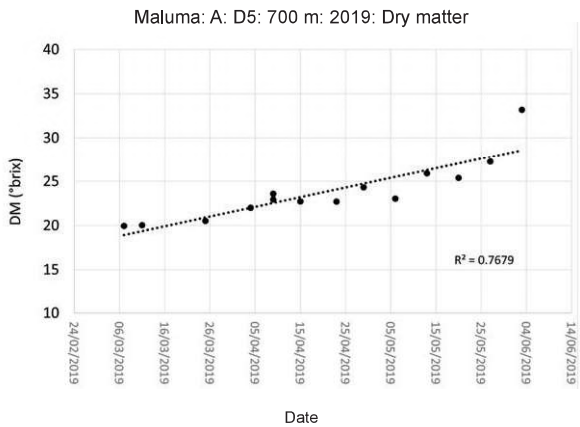
Figure 1: Dry matter and total soluble solids contents of 'Maluma' fruit collected from an orchard located at ± 700 m by the researchers during the 2018 season











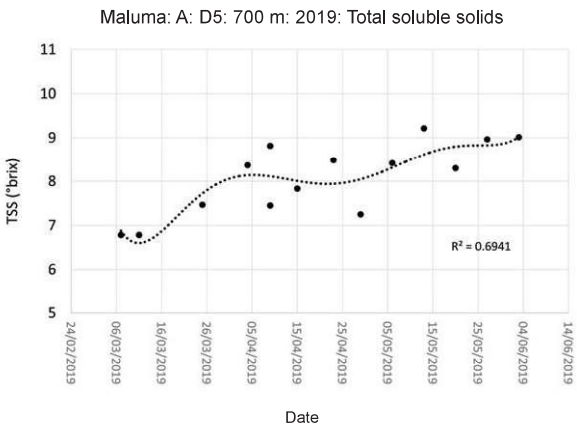


Figure 2: Dry matter and total soluble solids contents of 'Maluma' fruit samples from orchards located at ± 700 m that were delivered to a commercial pack-house in the Tzaneen area during the 2019 season

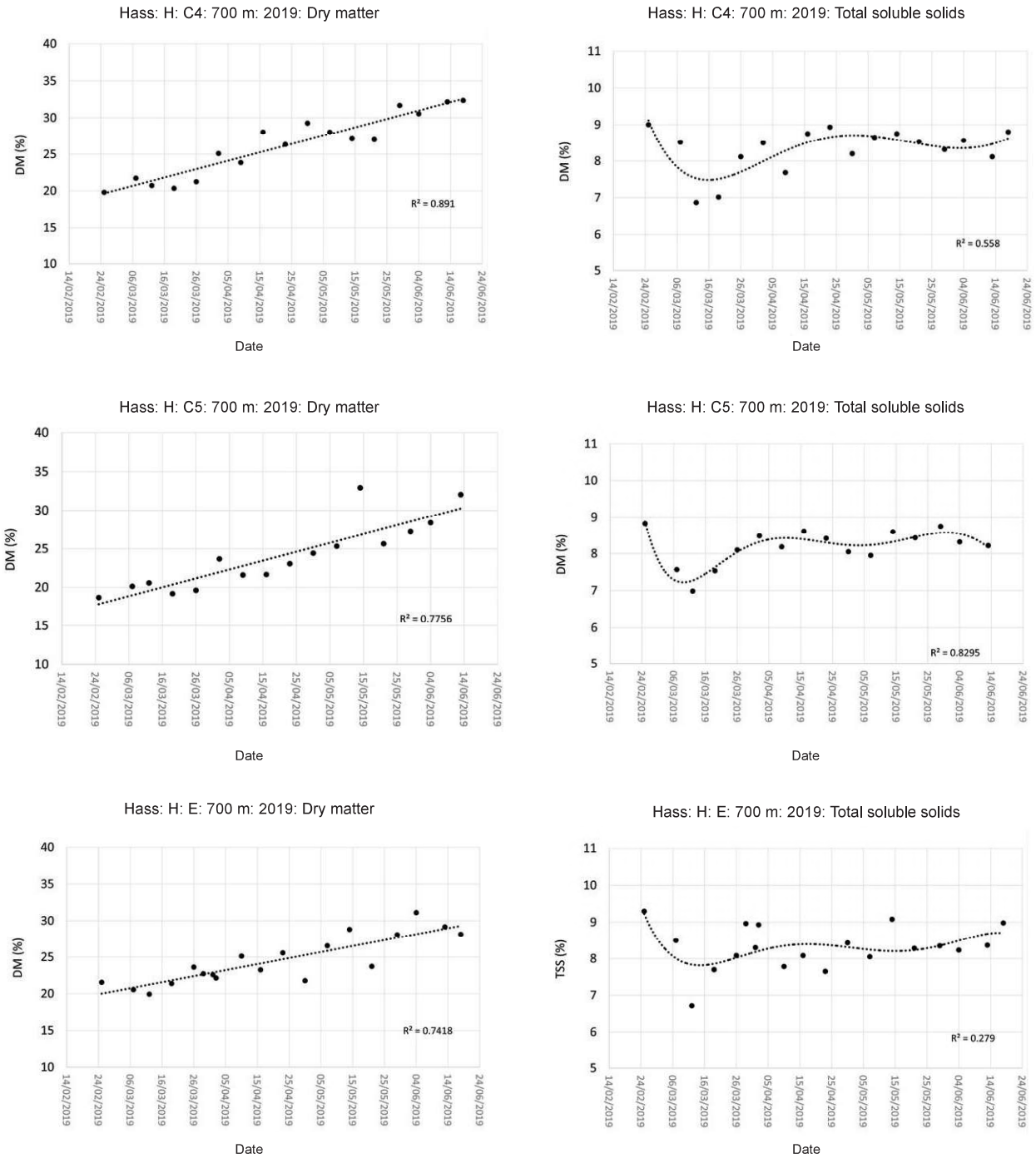


Figure 3: Dry matter and total soluble solids contents of 'Hass' fruit samples from orchards located at ± 700 m that were delivered to a commercial pack-house in the Tzaneen area during the 2019 season

A similar situation existed in the case of 'Hass' (Fig. 3). The "tick mark" pattern was again distinguishable from the commercial readings, albeit less distinct than that registered when the researchers did the sampling themselves during the 2018 season. As was the case with 'Maluma', the TSS values of 'Hass' varied between approximately 7% and 9% from the middle of February to the beginning of June.

A completely different scenario existed in the 'Hass' orchard located at ± 1 400 m (Fig. 4). During the above period, the TSS content of fruit from the trial orchard increased from approximately 8°brix to 11°brix. It then further increased to 12°brix during June where it remained until the beginning of September.

The ripening and fruit quality results of the first six samples from the ± 1 400 m 'Hass' orchard are shown in Table 1. From the beginning of March to the beginning of April, the DM increased from around 16.4% to around 22.3%. As the current threshold DM for 'Hass' is 23%, none of the samples would have qualified for export. However, all fruit in the different samples ripened, did not shrink, had acceptable external ripe colour and taste and no physiological or pathological disorders were recorded. It would thus not be unreasonable to

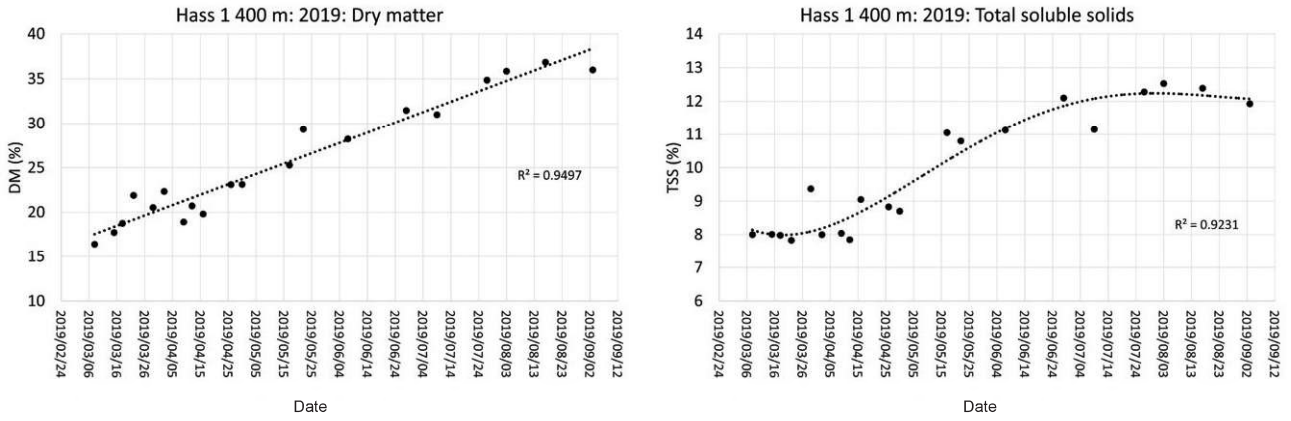


Figure 4: Dry matter and total soluble solids contents of 'Hass' fruit collected from an orchard located at ± 700 m by the researchers during the 2019 season

Table 1: Maturity, ripening quality and taste of six samples of 'Hass' fruit collected in an orchard located at ± 1 400 m in the Mooketsi area during March and April 2019

Date	Dry matter (%)	Ripening (%)	External colour (%)	Shrivel (%)	Taste (1-3)	Internal appearance
8 March	16,4	100	100	0	2	
15 March	17,7	100	100	0	2	
18 March	18,8	100	100	0	2	
22 March	21,9	100	100	0	2.8	
29 March	20,5	100	100	0	3	
2 April	22,3	100	100	0	3	

suggest that a study be conducted aiming to establishing whether high altitude 'Hass' orchards may be harvested at lower DM contents than the current minimum maturity level of 23% specified for 'Hass'. To do this, large sample sizes from a series of orchards located at different altitudes will have to be cool stored for 30 days and then evaluated.

Due to the high volumes of avocado fruit exported from South America to Europe during the middle of the South African season, producers have been attempting to export the bulk of their crop during the early and late season. It is customary to export 'Hass' fruit from warmer, low-altitude orchards during the early season, while fruit from cooler, high-altitude orchards are exported during the late season. However, there may be quality and marketing related problems during the late season and (compared to e.g. 'Lamb Hass') the 'Hass' trees are not particularly well suited for late-hanging. Since Kruger *et al.* (2020) found the present 'Hass' orchards located at ± 1 400 m to be more productive than orchards located at ± 700 m, it is of paramount importance that studies be performed to quantify the storage potential of pre-23% DM 'Hass' fruit from these highly productive high-altitude orchards.

Acknowledgements

The authors would like to thank all contributors and funders as well as Mark Penter who edited the manuscript.

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