Does orchard soil moisture content at the time of harvest influence the post-storage ripening pattern of 'Hass' avocado fruit?

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ABSTRACT
Avocado fruit are frequently ripened before being retailed. European wholesalers who ripen and repack the avocados expect the fruit to ripen evenly. Unfortunately, considerable variation occurs between batches from different growing regions, producers and seasons. A preliminary study was performed to establish what effect soil moisture content at the time of harvest has on the post-storage ripening of 'Hass' avocado fruit. To do this, two adjacent orchards in the Kiepersol area were subjected to different irrigation regimes. The avocados were harvested on a weekly basis throughout the season and stored for one month before being ripened. The results indicated that avocados from orchards that are not at field capacity at the time of harvest took longer to ripen and ripened more variably than fruit that were ripened while the orchard was at field capacity. It would further appear that soil type variation within an orchard exacerbated the situation. The current results were supported by information generated during preceding SmartFresh holdback sample ripening exercises.

INTRODUCTION

It is becoming increasingly important that avocados imported by ripeners in the United Kingdom and Europe ripen evenly and synchronized. The present paper deals with two studies that shed light on the influence that soil moisture content has on the ripening profiles of 'Hass' avocado fruit. The first study concerned the ripening patterns of hold-back samples from commercial SmartFresh applications that were conducted over the last number of seasons (Kruger & Volschenk, 2011). The second involved a trial that was originally performed to establish what effect soil moisture content has on the chilling injury incidence and intensity of 'Hass' avocado fruit.

MATERIALS AND METHODS

SmartFresh hold-back sample analyses

During the 2008 – 2011 seasons, two cartons each of control and SmartFresh (1-methylcyclopropene; 1-MCP) treated 'Hass' avocado fruit were retained from each application conducted in a pack house located in the Tzaneen area. One set of samples was immediately ripened while the second set was stored at 5°C for 30 days before being ripened at room temperature. Upon ripening, the number of days to ripen (DTR) each fruit was recorded and the mean (mDTR) calculated. The ripening profiles (percentage or fruit that ripened on each consecutive day) were also compiled.

Irrigation trial

This trial was originally designed and executed to establish what effect soil moisture content at the time of harvest has on the incidence and intensity of post-harvest chilling injury (black cold damage). Since no correlation was found between the two variables, the data was not presented as such. The trial, however, yielded some interesting information regarding the possible effect that soil moisture content at the time of harvest has on the ripening profiles of the fruit.

During 2007, two 'Hass' orchards in the Kiepersol area were selected for the study. The trial consisted of ten replicates of five trees each. Ten fruit per replicate were sampled on a weekly basis from the middle of April 2007 to the middle of August 2007 for moisture content analysis. During the above period, an additional 20 fruit per replicate were sampled on a one and a half weekly basis. The fruit were packed and stored for 30 days at 5°C before being ripened at room temperature.

The soil moisture content of the two orchards was kept within field capacity (0 to -10 kPa) as from the beginning of April until the beginning of May and again from the beginning of July until the middle of August. From the beginning of May until the end of June the orchards were allowed to alternately dehydrate before being restored to field capacity.

During the first week of June 2007, three temperature loggers were inserted into selected trees in the two trial orchards and the ambient canopy tempera-

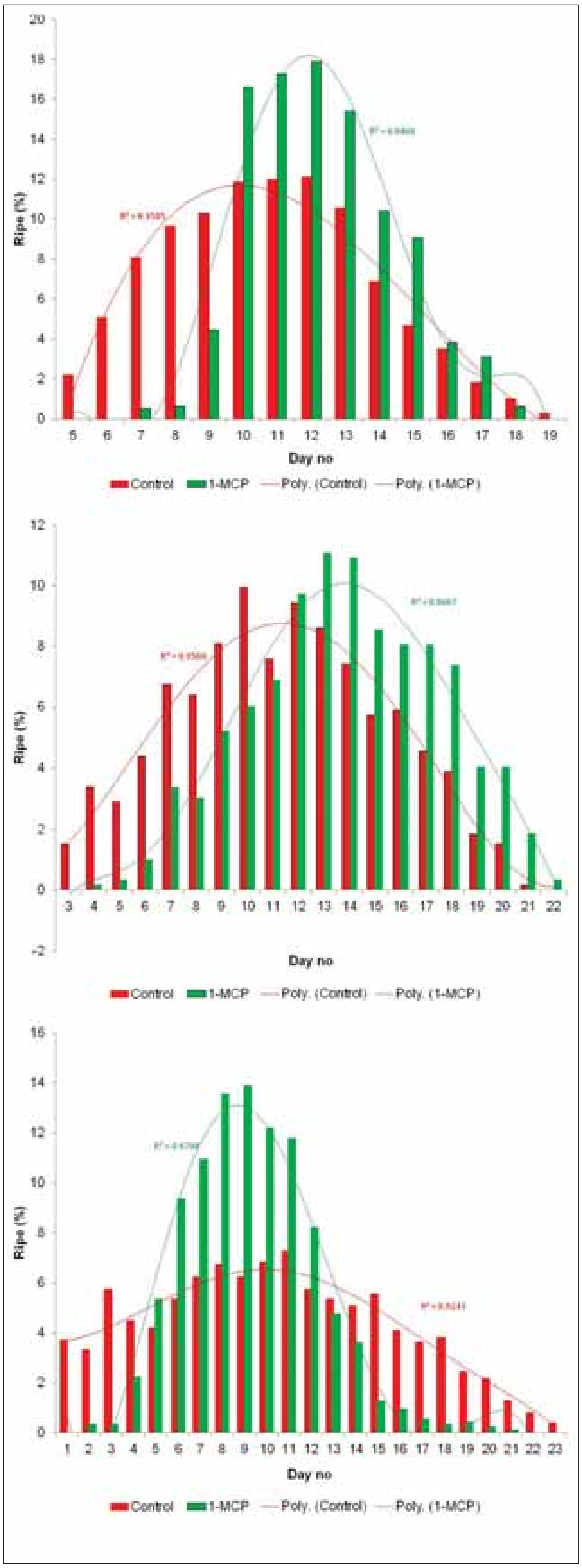

Figure 1. Post-storage seasonal ripening profiles of SmartFresh (1-MCP) treated and control 'Hass' avocado fruit samples from a pack house in the Tzaneen area as recorded during the 2008 (top), 2009 (middle) and 2010 (bottom) seasons.

ture measured at regular intervals during the day. Soil samples were further retrieved from five points within each orchard for mineral analysis.

RESULTS AND DISCUSSION

SmartFresh hold-back sample analyses

The combined seasonal ripening profiles of the SmartFresh treated and control samples for the 2008 – 2010 seasons are shown in Figure 1. Although a fair amount of variation occurred between seasons, a mutual trend was discernible. In all cases the SmartFresh application successfully delayed the onset of ripening. The SmartFresh treated samples further peaked either simultaneously or slightly before or after the control sample, but the application did not lengthen the range.

The combined ripening profiles of the 2011 season are shown in Figure 2. In contrast with the previous three seasons, the bell shaped curve is followed by a second, smaller peak towards the end of the ripening period. Analyses of each of the individual

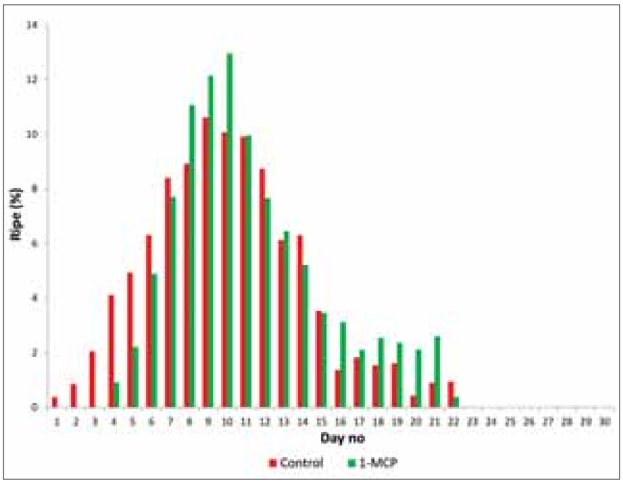

Figure 2. Combined post-storage seasonal ripening profiles of SmartFresh (1-MCP) treated and control 'Hass' avocado fruit samples from a pack house in the Tzaneen area as recorded during the 2011 season.

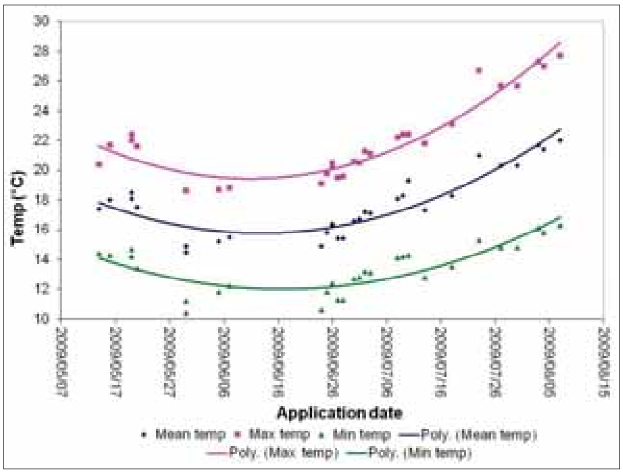

Figure 4. Minimum, maximum and mean temperature recorded in the ripening room during the 2009 season.

treatments (Figure 3) revealed that this was caused by a series of treatments conducted during the second half of June, as well as a single application performed on 22 July. Further analysis revealed that the slowest ripening application within the June anomaly and the July outlier originated from the same dryland orchard.

In order to correctly interpret the results it is important to be aware of the effect that varying ambient temperatures have on the mDTR readings of the samples. The 2009 season may serve as an example. During this season, the temperature in the ripening room steadily decreased until the middle of winter whereafter they started to gradually increase again (Figure 4). The mDTR values of the hold-back samples correspondingly increased and then decreased again (Figure 5). However, during the 2011 season this was not the case. During this season, both the directly ripened and stored samples showed ripening patterns that were not directly related to ripening temperature. What is important to take note of was that the directly ripened and post-storage curves were synchronised in terms of harvest date and not according to ripening initiation date (Figure 6). This implies that during the 2011 season, the ripening profiles of the fruit were influenced to a larger extend by pre-harvest factors than by prevailing ambient temperatures during ripening. Further analysis of the data revealed that the June anomaly occurred at the end of a dry spell following a good rainy season.

Irrigation trial

For convenience sake, the two experimental orchards are referred to as, respectively, the 'blue' (Orchard 1) and 'red' (Orchard 2) orchards.

As may be deduced from Figure 7, the blue orchard matured at a faster rate than the red orchard. This was most probably due to ambient conditions in the blue orchard being slightly warmer than that of the red orchard (Figure 8).

The tensiometer readings and the relative mDTR values are shown in Figure 9. (In this figure, the orchard that ripened fastest was designated a 100%

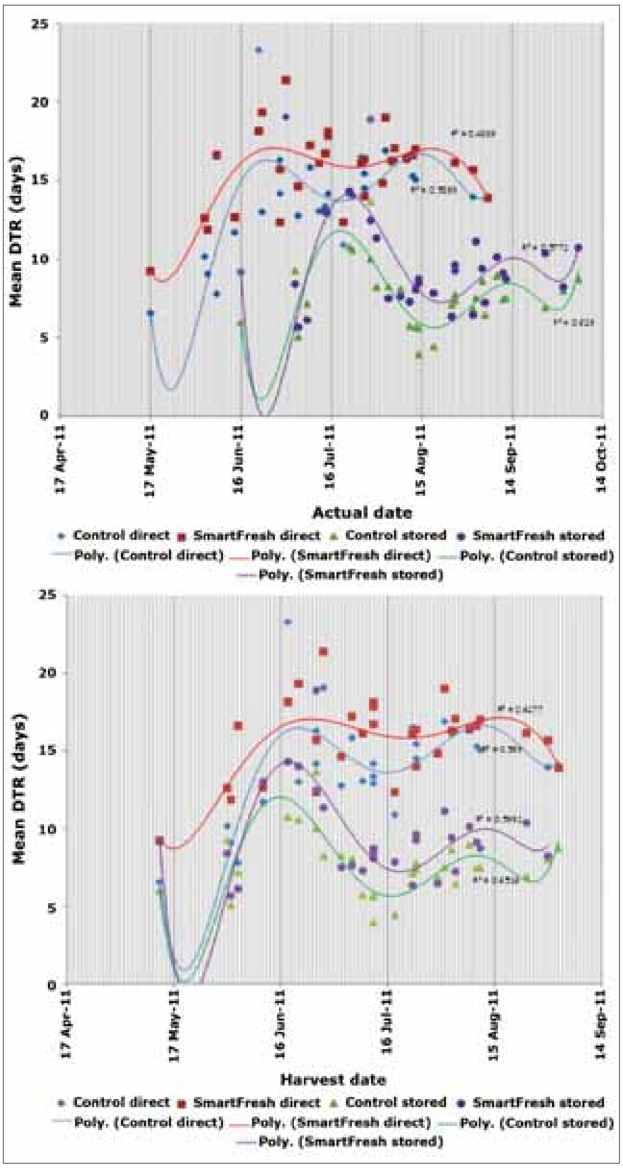

Figure 6. The mDTR values of directly ripened and stored 'Hass' avocado fruit as recorded during the 2011 season. In the top graph the values were plotted according to ripening initiation date while they are arranged according to application date in the bottom graph. (One value omitted)

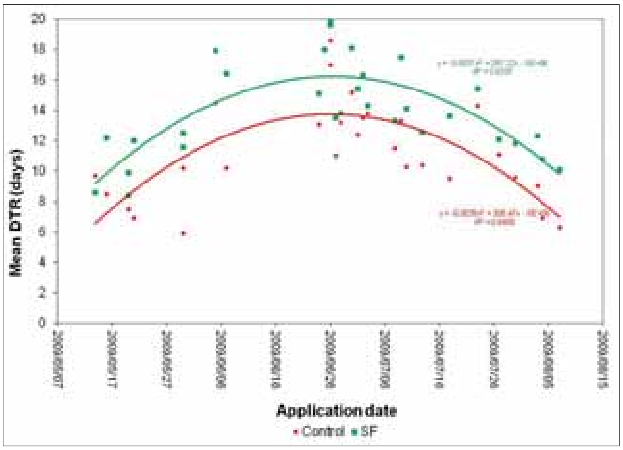

Figure 5. The mDTR values of holdback samples as recorded during the 2009 season.

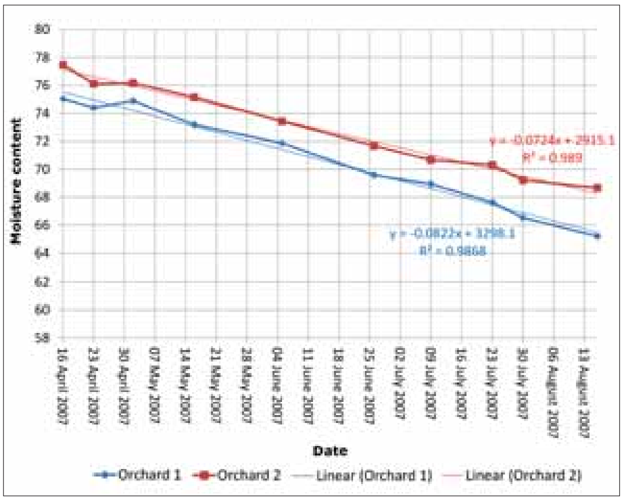

Figure 7. Maturation rate of two 'Hass' orchards in the Kiepersol area during the 2007 season.

Figure 3. Individual post-storage ripening profiles of SmartFresh and control 'Hass' avocado fruit samples from a pack house in the Tzaneen area as recorded during the 2011 season.

Application no	Treatment	Day no																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Control	0.0	1.9	5.6	7.4	13.9	16.7	13.0	7.4	25.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	12.7	19.4	21.8	24.2	13.3	0.0	0.0	8.5	0.0	0.0	0.0
2	Control	0.0	0.0	3.2	6.5	0.0	3.2	7.6	4.3	0.0	16.2	11.9	13.0	0.0	7.6	8.1	0.0	18.4
	SmartFresh	0.0	0.0	0.0	0.0	0.0	10.7	16.7	19.0	16.1	17.9	19.6	0.0	0.0	0.0	0.0	0.0	0.0
3	Control	2.0	4.0	3.0	11.9	9.9	23.8	27.7	0.0	17.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	7.1	17.7	5.3	24.8	21.2	23.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	Control	0.0	3.1	2.3	9.3	7.8	14.0	10.9	24.8	27.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	10.9	18.2	16.4	25.5	29.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	Control	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	7.7	8.4	13.8	14.9	16.1	17.2	12.3	6.5
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	3.5	0.0	12.7	13.8	15.0	16.2	17.3	18.5	0.0
6	Control	0.0	0.0	0.0	0.0	2.3	0.0	6.5	7.4	4.2	14.0	10.2	11.2	18.1	26.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.6	18.2	19.6	21.0	16.8	11.9
7	Control	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	14.2	21.1	17.4	25.3	13.7	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	20.6	22.2	23.8	19.0	0.0
8	Control	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	8.1	4.5	9.8	15.9	17.1	12.2	6.5	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4	10.0
9	Control	0.0	0.0	0.0	0.0	0.0	6.0	7.0	16.0	13.5	5.0	5.5	12.0	13.0	7.0	15.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	13.3	19.3	20.9	22.5	12.0	0.0	0.0
10	Control	0.0	0.0	0.0	5.4	6.8	4.1	9.5	16.2	12.2	6.8	14.9	24.3	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.2	19.6	16.2	11.8	25.5	13.7	0.0	0.0	0.0
11	Control	0.0	0.0	2.3	3.0	0.0	4.5	10.6	18.2	13.6	22.7	25.0	0.0	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	8.3	15.0	17.5	20.0	22.5	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	Control	0.0	1.4	0.0	8.3	6.9	0.0	14.5	11.0	6.2	0.0	7.6	16.6	17.9	9.7	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	7.3	13.1	15.3	23.4	26.3	14.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	Control	1.0	3.9	0.0	7.8	14.6	11.7	20.4	23.3	17.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	11.5	18.3	16.0	18.3	20.6	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	Control	2.0	2.0	5.9	7.8	4.9	11.8	13.7	23.5	8.8	19.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	16.6	14.5	16.6	24.8	27.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	Control	5.6	2.8	8.5	16.9	21.1	25.4	19.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	7.6	13.4	15.3	17.2	25.5	21.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Control	1.0	4.0	5.9	0.0	14.9	17.8	13.9	15.8	26.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	11.8	13.8	15.8	17.8	26.3	14.5	0.0	0.0	0.0	0.0	0.0	0.0
17	Control	2.5	7.5	3.8	15.0	18.8	15.0	17.5	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	7.1	12.8	9.9	22.7	19.1	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	Control	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6	4.1	0.0	9.5	5.1	10.8
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.9
19	Control	0.0	0.0	4.7	9.4	3.9	9.4	10.9	6.3	21.1	15.6	8.6	0.0	10.2	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	10.5	13.2	15.8	24.6	28.1	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	Control	0.0	0.0	1.9	2.6	6.5	7.7	18.1	15.5	11.6	6.5	14.2	15.5	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	15.1	17.3	14.6	16.2	23.8	13.0	0.0	0.0	0.0	0.0	0.0
21	Control	0.0	0.0	4.5	3.0	3.8	9.0	15.8	12.0	20.3	15.0	16.5	0.0	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	8.1	13.9	15.6	23.1	25.4	13.9	0.0	0.0	0.0	0.0	0.0
22	Control	0.8	4.9	4.9	3.3	0.0	0.0	11.4	13.0	22.0	8.1	8.9	0.0	0.0	22.8	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	10.3	12.9	15.5	18.1	27.6	15.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	Control	1.5	0.0	2.2	5.9	7.4	0.0	10.4	5.9	0.0	22.2	16.3	8.9	19.3	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	13.5	15.0	11.0	12.0	19.5	21.0	0.0	0.0	0.0
24	Control	0.0	0.0	3.9	2.6	6.5	0.0	9.0	10.3	5.8	6.5	21.3	15.5	0.0	9.0	9.7	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	12.4	9.5	21.3	23.7	26.0	7.1	0.0	0.0	0.0	0.0	0.0
25	Control	2.6	3.4	0.0	3.4	4.3	10.3	6.0	0.0	23.3	17.2	19.0	10.3	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	6.2	7.7	13.8	16.2	12.3	20.8	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	Control	0.0	0.0	0.0	5.0	9.3	3.7	4.3	9.9	0.0	12.4	13.7	7.5	8.1	26.1	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.2	19.8	16.5	24.2	26.4	0.0	0.0	0.0	0.0	0.0
27	Control	0.0	0.0	4.5	6.0	3.7	13.4	0.0	11.9	13.4	22.4	24.6	0.0	0.0	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	7.3	8.5	14.6	16.5	18.3	20.1	14.6	0.0	0.0	0.0	0.0	0.0
28	Control	0.0	0.0	4.4	5.9	11.1	8.9	5.2	0.0	13.3	14.8	8.1	17.8	0.0	10.4	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	11.5	8.9	15.3	17.2	19.1	28.0	0.0	0.0	0.0	0.0	0.0	0.0
29	Control	0.0	0.0	5.9	5.3	9.9	11.8	9.2	5.3	23.7	13.2	7.2	0.0	8.6	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	15.8	17.5	14.5	21.1	17.1	0.0	0.0	0.0	0.0
30	Control	0.0	0.0	2.1	5.6	3.5	12.5	9.7	0.0	12.5	20.8	15.3	8.3	0.0	9.7	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	12.2	18.9	16.2	18.2	27.0	7.4	0.0	0.0	0.0	0.0	0.0	0.0
31	Control	0.0	0.0	0.0	2.5	3.2	7.6	8.9	15.3	11.5	6.4	21.0	15.3	8.3	0.0	0.0	0.0	0.0
	SmartFresh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	14.0	15.5	17.1	24.9	20.2	0.0	0.0	0.0	0.0

18	19	20	21	22	23	24	25	26	27	28	29	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
14.6	7.7	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
21.2	16.8	17.6	18.5	6.5	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
11.4	18.0	6.3	13.3	13.9	0.0	0.0	0	0	0	0	0	0
21.0	22.2	17.5	24.5	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0

value while the mDTR of the slower ripening orchard was converted to a percentage that is proportionally higher than 100%.) During the first phase of the trial (April and beginning of May) the tensiometer readings of both orchards were between 0 and -10 kPa, thus within field capacity. It is noteworthy that during this period, the red orchard consistently ripened faster than the blue orchard. This was an unexpected observation, since the blue orchard matured at a faster rate than the red orchard.

Interesting patterns emerged in May and June during which the soil in the two orchards were alternately dehydrated and irrigated. During middle May, the blue

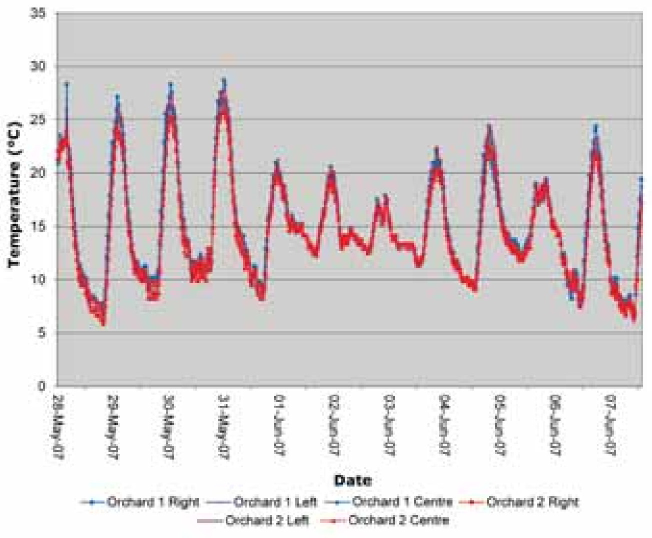

Figure 8. Ambient temperatures recorded in the canopies of three 'Hass' trees located in two orchards during the 2007 season.

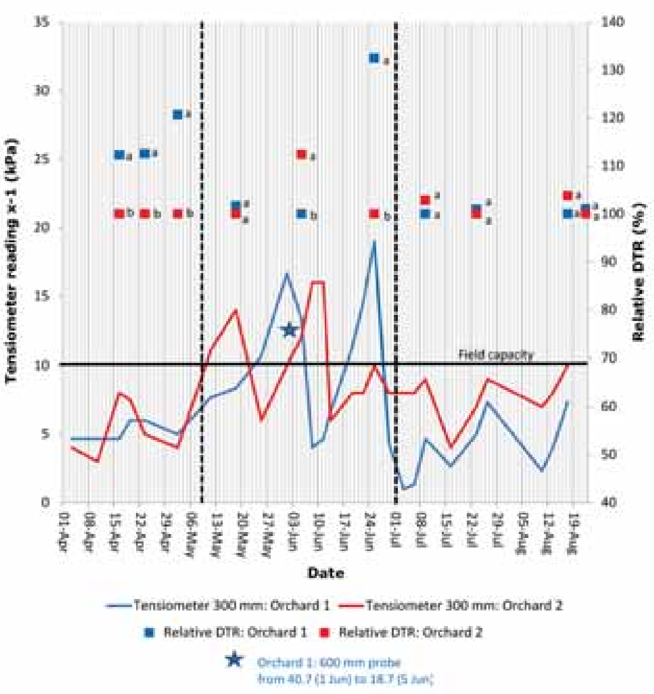

Figure 9. Tensiometer readings and relative mDTR values of two experimental orchards in the Kiepersol area during the 2007 season.

orchard was within field capacity while the red orchard was drier. This resulted in fruit from the previously faster ripening red orchard to ripen at the same rate as the blue orchard. As from middle May to the beginning of June, the soil of the blue orchard was progressively dehydrated. At the end of May this orchard was well irrigated and it again reached field capacity during the first week in June. During this week the red orchard was in the process of drying out. This was the only sampling date during the trial that the fruit from the red orchard took significantly longer to ripen than those of the blue orchard. By the end of June the soil of the blue orchard was again dehydrated. Fruit from this orchard harvested during this period took more than 30% longer to ripen than those sampled from the red orchard.

At the end of the season (July and August) the moisture content of both orchards were again within field capacity. During this period the mDTR values of the two orchards were similar.

In addition to taking longer to ripen, the avocados from the blue orchard ripened more variably (Table 1). The ripening patterns of the first six sampling days are shown in Figure 10. It is interesting to note that the ripening profiles of both orchards were basically similar. In other words, ripening peaks tended to occur on similar days in both samples. The most important difference between the orchards was that, during the sampling days when the red orchard's fruit ripened faster than those of the blue orchard, the first peak in the sequence was larger.

Soil analyses of the two orchards revealed that the soil of the slower and more variably ripening blue orchard varied considerably more than that of the faster and less variably ripening red orchard (Table 2). An orchard with a more variable silt and clay content is likely to show more variation in water retention capacity. This is an important observation in terms of the interpretation of the above results.

Table 1. Standard deviation (STD) in the mean number of days to ripen (mDTR) readings of 'Hass' fruit from two experimental orchards in the Kiepersol area.

	mDTR STD (between reps, not fruit)	
Date	Orchard 1 (Top orchard) (Matures faster) (Ripens slower & more variably)	Orchard 2 (Bottom orchard) (Matures slower) (Ripens faster & less variably)
16 April 2007	1.39	1.04
23 April 2007	1.68	1.39
02 May 2007	1.65	1.38
16 May 2007	1.58	0.85
05 June 2007	1.15	1.50
26 June 2007	1.59	1.22
09 July 2007	1.44	1.26
23 July 2007	1.99	1.34
30 July 2007	1.44	0.85
16 August 2007	1.01	0.65
Mean	1.49 a	1.15 b

Table 2. Silt and clay content of two experimental 'Hass' orchards in the Kiepersol area.

	Silt + clay content (%)	
Soil sample replicate	Orchard 1 (Top orchard) (Matures faster) (Ripens slower & more variably)	Orchard 2 (Bottom orchard) (Matures slower) (Ripens faster & less variably)
1	48	38
2	40	36
3	36	36
4	22	28
5	14	27
Mean	32 a	33 a
STD	13.8	5.1

CONCLUSIONS

The current results would seem to indicate that soil moisture content at the time of harvest may very well influence the post-storage ripening profiles of 'Hass' avocado fruit. Variable ripening may thus be aggravated in inefficiently irrigated orchards during relatively dry seasons.

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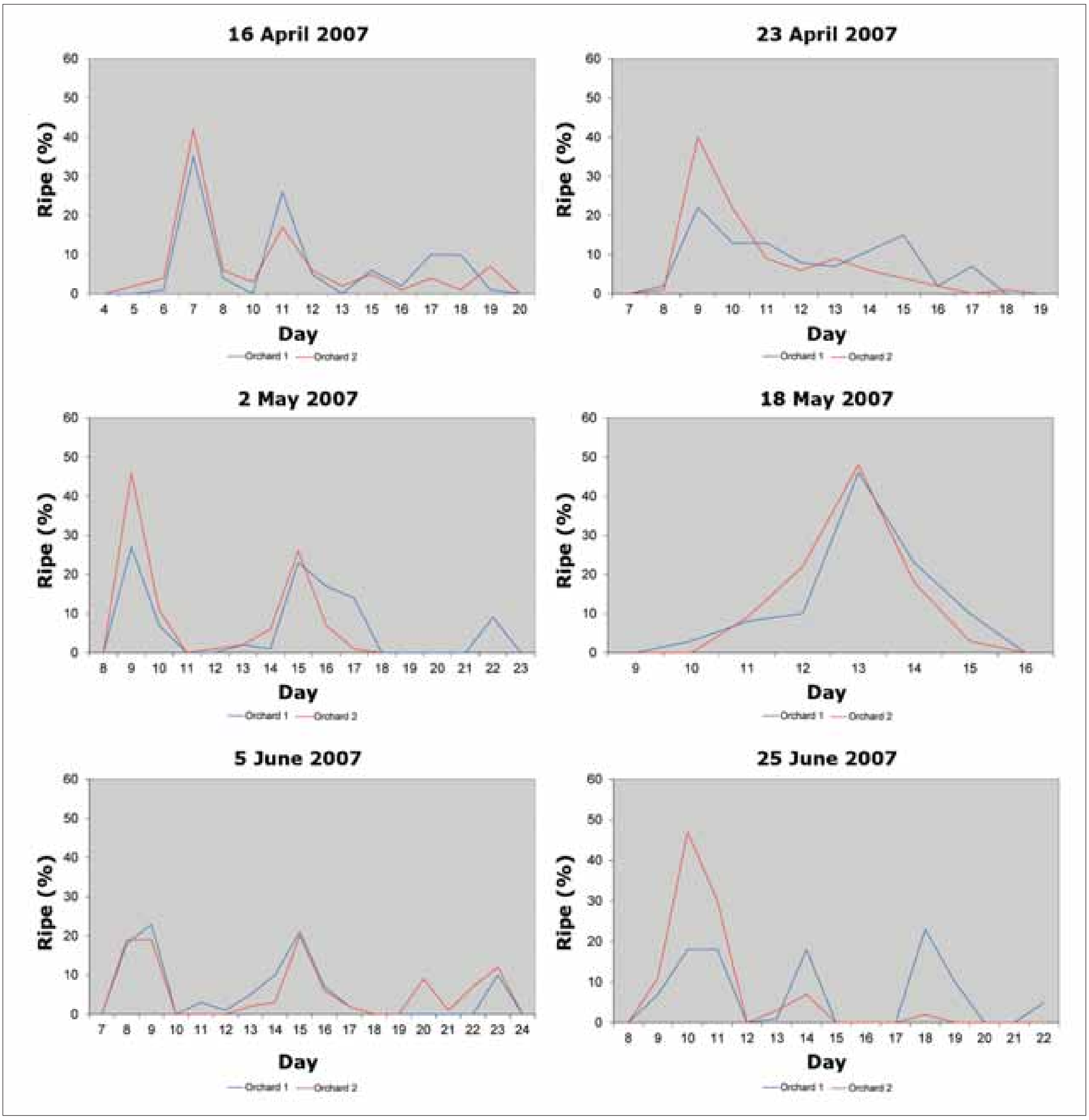

Figure 10. Ripening profiles of 'Hass' fruit from two orchards in the Kiepersol area during the 2007 season.