Commercial ripening trials with South African avocados in the United Kingdom

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ABSTRACT

Controlled atmosphere (CA) and 1-methyl cyclopropene (1-MCP; SmartFresh^{SM}) are routinely used by the South African avocado industry to prevent premature ripening and certain physiological disorders during exportation. Under certain conditions, however, the fruit may ripen sub-optimally when introduced into a commercial ripening program. A series of laboratory and commercial based trails were therefore launched to investigate this issue. The laboratory based trials demonstrated that CA and SmartFresh^{SM} fruit ripen quite similarly when a 70% moisture content (30% dry mass content) threshold value is reached. In order to confirm this under commercial conditions, one container each of controlled atmosphere (CA) and SmartFresh^{SM} 'Hass' and 'Fuerte' avocados were exported from Westfalia Estates in South Africa to two prepackers in the United Kingdom during July 2006. Each consignment contained 7 Hass and 3 Fuerte samples. The ripening patterns of the fruit were recorded by the two prepackers. The controlled atmosphere fruit took an average of 4.98 days to ripen while the SmartFresh^{SM} fruit required 5.44 days. Although considerable variation occurred between samples, certain of the cultivar/count combinations displayed very similar ripening patterns whether treated with SmartFresh^{SM} or stored under CA. In both cultivars, the largest SmartFresh^{SM} fruit ripened faster than the CA fruit while the reverse was true for the smallest counts. The commercial results thus confirmed the laboratory finding regarding the 70% moisture content (30% dry mass) threshold value for SmartFresh^{SM} fruit destined for the 'ripe and ready' market sector. The incidence of grey pulp (diffuse mesocarp discolouration) was low in the commercial trial. However, the laboratory trial clearly demonstrated the grey pulp reducing capacity of 1-MCP.

INTRODUCTION

During 2000/01, the Agricultural Research Council's Institute for Tropical and Subtropical Crops launched a number of laboratory based trials with the ethylene inhibitor 1-methylcyclopropene (Lemmer & Kruger, 2003). This was followed by semi-commercial trials in static containers at Westfalia Estates during 2003 (Lemmer *et al*., 2003). The first commercial 1-methylcyclopropene (1-MCP; SmartFresh^{SM}) based exports took place during 2003. The primary aim of the application is to prevent soft landings and reduce physiological disorders such as grey pulp (diffuse mesocarp discolouration) and pulp spot. Up to then, cold storage combined with controlled atmosphere (CA) was used for this purpose.

The first season's SmartFresh^{SM} (SF) consignments all landed hard and were well received in Europe. However, certain English ripeners complained that the avocados may take too long to ripen and may ripen unevenly under certain conditions. A number of research trials were therefore initiated to address this aspect. The present paper deals with two of these. The first part concerns a laboratory trial that was conducted to determine an appropriate maturity threshold value for the 'ripe and ready' market sector while the second involves a commercial trial to confirm the latter recommendation under commercial conditions.

MATERIALS AND METHODS

Laboratory based trials

During 2004, SF was applied to 52 Hass samples from the Burgershall production region ranging in moisture content (MC) from 76% to 62% (24-38% dry mass content). The fruit were stored under export simulation conditions and the mean number of days to ripen (DTR) determined. This was compared with that of untreated fruit stored at regular atmosphere (RA).

Commercial trial

During the second week of July 2006, SF was applied to 22 pallets of avocados destined for England. The container contained both Hass and Fuerte fruit originating from five farms managed by Westfalia Estates. The maturity levels of the samples varied between 71% and 62%. Upon arrival of the container in the United Kingdom during the first week of August, the content was split between Greencell (GC) in Spalding and Minor Weir and Willis (MWW) in Birmingham. Ripening was subsequently performed under commercial conditions. The evaluations entailed recording the DTR as well as scoring all physiological (lenticel damage, black cold injury, grey pulp and bruising) and pathological (anthracnose, stem-end rot and vascular browning) disorders.

RESULTS AND DISCUSSION

The DTR results of the laboratory trial are visually displayed in **Figure 1**. At the beginning of the season, RA fruit with a MC between 76% and 75% required around 10 -11 DTR. At the same maturity level, SF fruit took approximately 12-13 DTR (2 days longer). The mean DTR of both RA and SF fruit steadily decreased as the season progressed. The DTR of both RA and SF stabilized at a MC of around 70%. Between 70% and 64%, the mean DTR of the RA fruit remained around 7 days. During the same period, the mean DTR of SF fruit was around 8 days.

The incidence of grey pulp in Hass avocados from a selection of susceptible farms is shown in **Figure 2**. The disorder was found to become more prevalent as the season progressed but SF was found to reduce the incidence of grey pulp in predisposed fruit.

The results of the commercial trial are summarized in **Table 1**. A total of 19 samples originating from five farms were ripened. In order to simplify the interpretation of the results, the same count

originating from different farms are pooled in the table, resulting in ten sets of results. Four of these were of fruit ripened at GC (Fuerte count 14, Hass counts 14, 16 & 18) while the remaining six samples were ripened at MWW (Fuerte counts 12 & 16 and Hass counts 20, 22, 24 & 32).

The mean DTR of all CA fruit was 4.98 days whilst that of the SF fruit was 5.44 days. On average, the SF fruit thus took approximately half a day longer to ripen than the CA fruit, but the difference between the two means was not statistically different. The STD of the SF fruit was also half a day wider (±1.8 days) than that of the CA samples (±1.26), but the difference between the two mean STDs was not statistically significant either. Fruit count would seem to have influenced the differential ripening rate of the two treatments. In both Fuerte and Hass, the biggest SF fruit (Fuerte count 12 and Hass count 14) ripened slightly faster than their CA counterparts. In contrast, the smallest CA fruit (Hass 32) ripened faster than the SF fruit. Considerable variation occurred with regard to the intermediate counts, but it would appear that, on average, the CA fruit ripened approximately half a day faster than the SF fruit. There did not seem to be a relationship between the mean DTR (both CA and SF) and the MC of the avocados at harvest. Neither would there seem to be a relationship between the STD of the MC on the one hand and the STD of the DTR on the other.

The ripening patterns of the ten samples are displayed in **Figure 3 a – j**. In count 12 Fuerte (**Figure 3a**), the SF peaked on day 5 when more than 50% of the sample ripened. The CA peaked on day 4 when slightly less than 30% of the sample ripened. All SF fruit were ripe by day 5 while around 10% of CA fruit ripened on, respectively, days 6, 7 and 8. In the case of Fuerte count 14 (**Figure 3b**) the ripening patterns of the two samples were fairly similar in that around 45% of both samples ripened on day 5. In the case of CA, more fruit ripened during the three days preceding the peak while the SF treatment had a longer tail. With count 16 Fuerte (**Figure 3c**) both treatments peaked on days 4 and 5. However, the CA fruit yielded between 40% and 45% on these

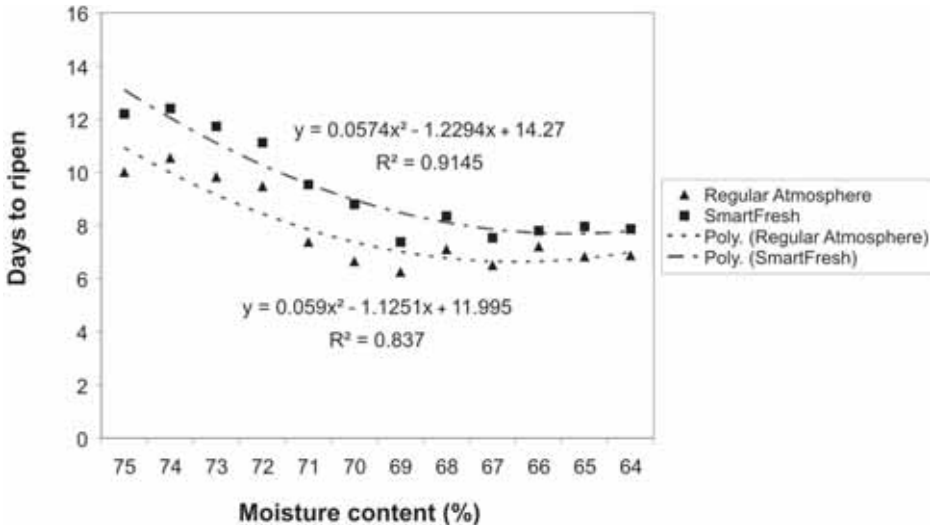

Figure 1: Mean number of days required to ripen Regular Atmosphere and SmartFresh℠ Hass avocados at different maturity stages.

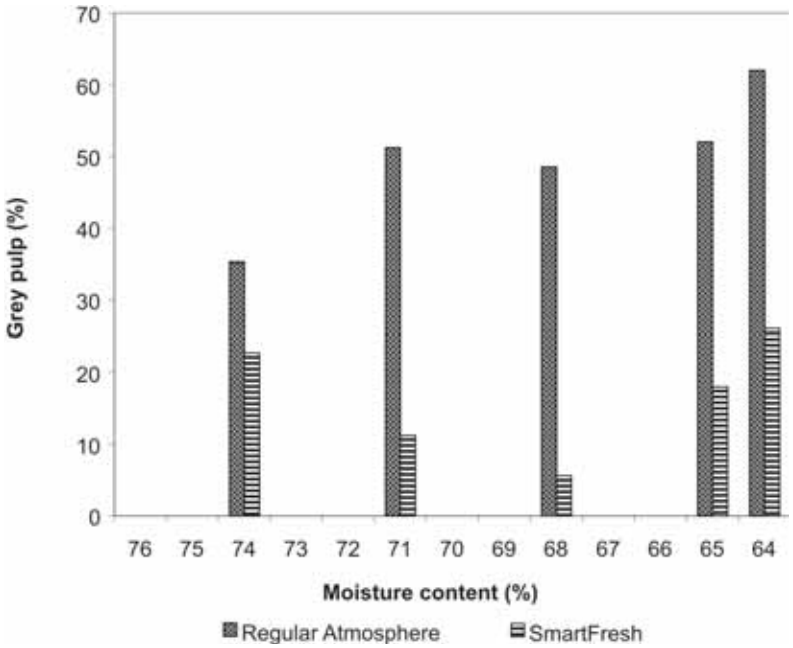

Figure 2: Incidence of grey pulp in Regular Atmosphere and SmartFresh℠ Hass avocados from specific farms after storage under export simulation conditions.

days while the SF fruit yielded between 25% and 30% during this period and another 10% during days 6 - 8. In the case of count 14 Hass (**Figure 3d**) the trend was opposite to the above. Both treatments again peaked on day 5 but the SF yielded between 35% – 40% while the CA treatment yielded between 20% – 25%. The CA fruit displayed a second smaller peak on days 9 and 10 during which approximately 10% of the fruit ripened per day. The pattern was again reversed with Hass count 16 (**Figure 3e**). In this case, the ripening peak occurred on day 4 when nearly 40% of CA fruit and close to 25% of the SF fruit ripened. Although SF yielded more than CA on days 2 and 3, a second flatter peak occurred during days 9 to 12. In Hass count 18 (**Figure 3f**), both the CA and SF fruit peaked on day 5 when around 20% of SF fruit and 25% of CA fruit were ready to eat. Both treatments had a relatively long tail with the SF treatment having an additional smaller peak around day 10. Both CA and SF count 20 Hass avocados (**Figure 3g**) displayed a flat but distinct peak during days 3, 4, 5 and 6 when all fruit ripened (between 20% and 30% per day) and no tail was present. With Hass count 22 (**Figure 3h**) a distinct peak occurred on day 5 when approximately 90% of the CA fruit ripened. In the case of SF, between 20% and 30% of the fruit ripened on day 3 and between 50% and 60% on day 6. All count 24 CA Hass fruit (**Figure 3i**) ripened between days 3 and 5 while slightly less than 40% of the SF fruit ripened on day 3 followed by slightly more than 20% on days 4 and 6. In Hass count 32 (**Figure 3j**) both treatments had two peaks. In the case of CA, the first peak of about 30% occurred on day 3 followed by a second peak on day 5 when slightly more than 50% of the fruit ripened. In the case of SF, the first peak on day 3 was smaller when only 10% of the fruit ripened with the bulk of fruit, around 80%, ripening during days 5 to 7.

The incidences of physiological and pathological disorders were low and no significant differences occurred between the two commercial treatments.

CONCLUSION

The results indicate that, although considerable variation occurred between fruit, certain of the samples displayed very similar ripening patterns, whether treated with SF or stored under CA. In both cultivars, the largest SF fruit ripened faster than the CA fruit while the reverse was true for the smallest avocados. It would appear that the 70% moisture content cut off point for SF fruit destined for the 'ripe and ready' market sector is valid. Although the incidences of physiological and pathological disorders were low during the commercial trial, SF was found to significantly reduce the incidence of grey pulp during the laboratory based trials.

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Table 1: Mean number of days required to ripen 3 samples of Fuerte and 7 samples of Hass avocados at two UK ripeners during August 2006.

Cultivar	Count	No of farms	N fruit CA/SF	Ripener	Maturity (% moist)	Days to ripen	
						CA	SmartFresh
Fuerte	12	1	24/24	MWW	63.9 ± 1.6	5.0 ± 1.4	4.8 ± 1.6
Fuerte	14	2	56/56	GC	65.6 ± 2.6	4.2 ± 0.8	5.1 ± 1.3
Fuerte	16	1	47/45	MWW	63.3 ± 3.3	4.3 ± 0.5	5.0 ± 1.5
Hass	14	5	140/140	GC	NS	6.0 ± 2.5	5.2 + 1.5
Hass	16	4	128/96	GC	67.7 ± 2.0	6.2 ± 2.0	7.0 ± 3.7
Hass	18	2	72/72	GC	67.3 ± 1.8	6.5 ± 2.1	7.5 ± 3.1
Hass	20	JP	34/30	MWW	71.5 ± 2.5	4.4 ± 1.1	4.4 ± 1.2
Hass	22	JP	35/30	MWW	70.1 ± 1.7	4.8 ± 0.5	5.1 ± 1.2
Hass	24	JP	47/43	MWW	68.3 ± 1.7	4.1 ± 0.8	4.6 ± 1.6
Hass	32	JP	70/75	MWW	67.5 ± 3.9	4.3 ± 0.9	5.7 ± 1.3
				Mean DTR		4.98 a	5.44 a
				Mean STD		1.26 a	1.80 a

CA: controlled atmosphere, SF: SmartFresh^{SM}, MWW: Minor Weir and Willis, GC: Greencell, JP: jumble pack, DTR: days to ripen, STD: standard deviation

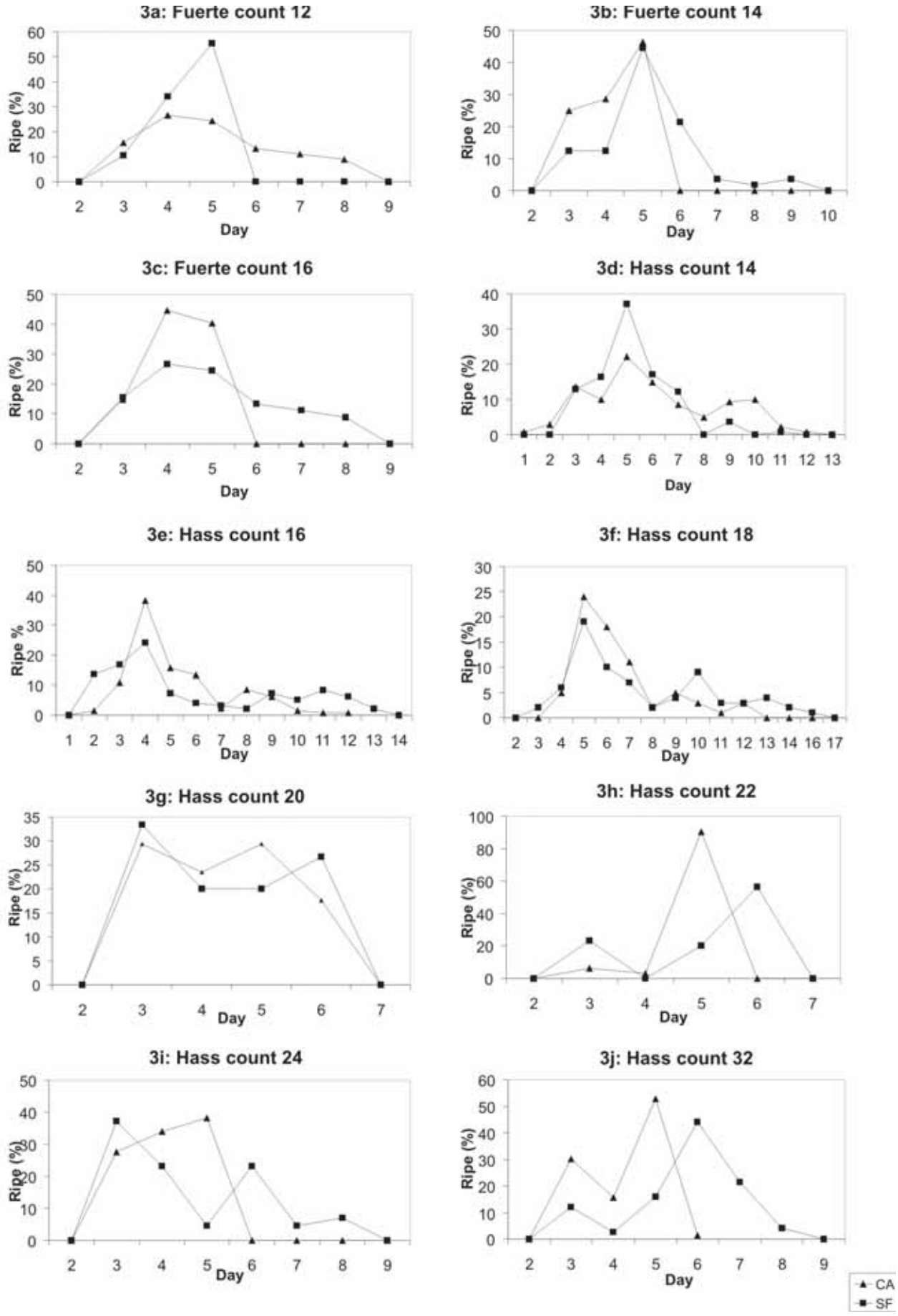

Figure 3: Ripening patterns of 3 samples of Fuerte and 7 samples of Hass avocados at two UK ripeners during August 2006.