UNIVERSITY OF CALIFORNIA AVOCADO CULTIVARS 'LAMB HASS' AND 'GEM' MATURITY AND FRUIT QUALITY RESULTS FROM NEW ZEALAND EVALUATION TRIALS

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ABSTRACT

The University of California cultivars 'Lamb Hass' and 'GEM' may have promise as new export cultivars from New Zealand. Storage trials have been undertaken to establish the basic storage conditions required for good quality fruit and to establish a harvest window for each cultivar. 'Lamb Hass' fruit are later maturing than 'Hass' fruit by about four months and are typically larger with a more 'blocky' shape. 'Lamb Hass' fruit size was not related to dry matter and there may be a regional influence on 'Lamb Hass' fruit maturity with Far North 'Lamb Hass' maturing earlier. It is suggested the minimum harvest dry matter be 27% which is when about two-thirds of the fruit have a mature seed coat. 'Lamb Hass' fruit require different storage conditions to 'Hass' fruit. 'Lamb Hass' fruit are ready to eat firmer by handfeel than 'Hass' indicating that consumers will need to be informed as to when 'Lamb Hass' fruit is ripe. Late season 'Lamb Hass' fruit stored best at 7°C with a minimum storage temperature to avoid external chilling injury of 3°C. The severity and incidence of ripe rots had a similar 'U' shaped quality profile with maturity as 'Hass'. The best quality was for about four months from the beginning of January to the end of April. The studies reported here are from two orchards and small numbers of trees. Further studies are required before a recommendation on the best storage conditions for 'Lamb Hass' can be made. 'GEM' fruit have a distinctive appearance with a smoother skin and a similar size to 'Hass' fruit. The maturity of 'GEM' fruit appears to be similar to 'Hass' fruit and the fruit have similar disorders as 'Hass' fruit. Further research is needed to establish the best storage conditions for 'GEM' fruit at different harvest maturities. There has not been enough trial work to suggest a minimum dry matter standard and storage conditions for 'GEM' fruit.

Keywords: *postharvest, temperature*

INTRODUCTION

The University of California has bred a number of new fruiting avocado varieties that have been imported into New Zealand for evaluation under New Zealand growing conditions. The trees are located in the industry geneblocks in Te Puke and the Far North regions. The cultivars 'Lamb Hass' and 'GEM' could be considered to have promise as new export cultivars from New Zealand. The commercialisation rights for 'Lamb Hass' and 'GEM' are exclusively held by Jempi Pty in Australia and New Zealand. The AIC holds and evaluates 'Lamb Hass' and 'GEM' trees and fruit under a testing agreement with the University of California.

The 'Lamb Hass' and 'GEM' trees in the geneblocks are now about 9 to 10 years old and have been producing fruit in sufficient numbers for the past 3 years to allow the dry matter accumulation curves of the fruit to be established for setting fruit maturity standards. Where there has been enough fruit, storage trials have been started to establish the basic storage conditions of lower temperature limits with respect to chilling injury and the ripe rots in relation to dry matter and harvest date to establish a harvest window based on the storability of the fruit. This paper reports on the first results for the quality of New Zealand grown 'Lamb Hass' and 'GEM' fruit.

'Hass', 'Lamb Hass' and 'GEM' fruit

MATERIALS AND METHODS

'Lamb Hass' and 'GEM' fruit were harvested from the trees in the Te Puke or Far North geneblocks.

2006-2007 harvest season
Samples of 20 ungraded 'Lamb Hass' and 'GEM' fruit harvested twice on 27/10/2006 and 16/1/2007 were assessed for their dry matter content (Mandemaker *et al.*, 2004), physical characteristics and mass (fruit weight).

2007-2008 harvest season
Samples of 20 ungraded 'Lamb Hass', 'GEM' and Hass fruit were harvested at intervals from early November to May from trees in the Te Puke geneblock. The time at which the fruit were harvested depended on how much fruit was available. For dry matter assessment 'Lamb Hass' fruit was harvested every two weeks from 8/11/2007 to 3/4/2008 with a final harvest on 12/5/2008. The 'GEM' fruit used for dry matter assessment was harvested every two weeks from 8/11/2007 to 8/1/2008. 'Hass' fruit was harvested as a point of reference for the 'Lamb Hass' and 'GEM' firstly on 8/11/2007, again on 18/12/2007 then every two weeks from 23/1/2008 to 3/4/3008.

Five hundred ungraded 'Lamb Hass' fruit were harvested on 12/5/2008 for storage at different temperatures. One hundred fruit were stored at 7°C, 5°C, 3°C and 2°C ± 0.5°C, 85% ± 5% relative humidity (RH) for 28 days then ripened at 20°C ± 1°C, 65% ± 5% RH for assessment of ripe fruit quality according to the AIC Fruit Assessment Manual 2003 (Dixon, 2003). A non-stored control sample of 100 ungraded 'Lamb Hass' fruit were ripened at 20°C ± 1°C, 65% ± 5% RH for assessment of ripe fruit quality immediately after harvest.

2008-2009 harvest season

Samples of 20 ungraded 'Lamb Hass', 'GEM' and 'Hass' fruit were harvested at intervals from September to August from trees in the Te Puke geneblock. The time at which the fruit were harvested depended on how much fruit was available. For dry matter assessment 'Lamb Hass' fruit was harvested about every two weeks from 29/1/2009 to 16/7/2009. The 'GEM' fruit used for dry matter assessment was harvested on 25/9/2008 to 28/10/2008. 'Hass' fruit was harvested on 22/6/2009 and 5/8/2009.

One hundred and forty ungraded 'Lamb Hass' fruit were harvested from the Te Puke geneblock about every two weeks starting on 16/1/2009 and finishing on 2/7/2009 for storage at 5°C ± 0.5°C, 85% ± 5% RH for 28 days then ripened at 20°C ± 1°C, 65% ± 5% RH for assessment of ripe fruit quality according to the AIC Fruit Assessment Manual 2003 (Dixon, 2003).

Two hundred ungraded 'GEM' fruit were harvested from the Te Puke geneblock on 13/1/2009 where 100 fruit were stored at 5°C ± 0.5°C, 85% ± 5% RH for 14 or 28 days then ripened at 20°C ± 1°C, 65% ± 5% RH for assessment of ripe fruit quality according to the AIC Fruit Assessment Manual 2003 (Dixon, 2003).

Eighty 'Lamb Hass' or 'Hass' fruit were harvested from the Te Puke geneblock on 14/5/2009 then ripened immediately after harvest at 20°C ± 1°C, 65% ± 5% RH. From four days after harvest the fruit were assessed for firmness by hand feel or firmometer using a 300g weight. Each day of ripening the fruit that had reached a reading of at least 40 on the firmometer were measured for flesh firmness after peeling off the skin using an Effegi FT 011 (0-5kg) penetrometer equipped with an 11mm head. The flesh from one quarter of each fruit was informally assessed for edibility based on how firm the flesh was to the bite.

Data analysis

Sample averages and the standard deviation were calculated using MicroSoft® Office Excel® 2007. The effects of storage temperature and harvest date on ripe fruit disorders were analysed by a One Way Analysis of Variance using Tukey's family error rate of 5% using MINITAB version 13.31. The severity of disorders was square root transformed for analysis, for incidence square root transformed tray averages were used. Untransformed averages are reported in the tables.

RESULTS

Dry matter and fruit size

The dry matter content of the sample of 'Lamb Hass' fruit from the Te Puke geneblock was lower by 5% when harvested in October and was 13.5% lower when harvested in January compared to the fruit sampled from the Far North (Table 1). 'Lamb

Table 1. Average dry matter and fruit mass of 'Lamb Hass' fruit harvested from the Far North and Te Puke geneblocks. Results based on a 20 fruit sample.

Region	Far North		Te Puke	
Date	27/10/2006	16/01/2007	27/10/2006	16/01/2007
	Mean (stdev)	Mean (stdev)	Mean (stdev)	Mean (stdev)
Dry Matter (%)	24.0 (1.9)	39.6 (2.3)	19.0 (1.4)	26.1 (2.6)
Fruit mass (g)	318.1 (36.7)	347.7 (54.9)	294.4 (35.7)	306.9 (43.8)
Fruit width (mm)	78.5	80.8	73.4	72.0
Fruit length (mm)	97.5	103.9	98.0	100.1
Seed width (mm)	38.2	40.4	35.7	37.8
Seed length (mm)	34.9	47.7	34.7	36.9
Fruit: Seed	2.1	2.0	2.1	2.0

Table 2. Average dry matter and fruit mass of 'GEM' fruit harvested from the Far North and Te Puke geneblocks. Results based on a 20 fruit sample.

Region	Far North		Te Puke	
Date	10/10/2006 Mean (stdev)	12/01/2007 Mean (stdev)	10/10/2006 Mean (stdev)	12/01/2007 Mean (stdev)
Dry Matter (%)	31.4 (2.1)	32.2 (1.5)	28.9 (2.1)	37.5 (2.2)
Fruit mass (g)	287.9 (52.4)	352.2 (57.3)	233.2 (36.5)	263.6 (43.2)
Fruit width (mm)	74.8	80.4	70.7	72.7
Fruit length (mm)	98.5	100.2	89.3	92.4
Seed width (mm)	37.5	41.5	35.1	35.9
Seed length (mm)	44.1	37.5	40.7	41.8
Fruit: Seed	2.0	1.9	2.0	2.0

Hass' fruit from the Far North had greater mass but similar length and width than the Te Puke 'Lamb Hass'. The 'GEM' fruit from the Far North geneblock had 2.5% greater dry matter than the Te Puke 'GEM' fruit harvested in October (Table 2). The 'GEM' fruit harvested from the Te Puke geneblock in January had 5.3% greater dry matter than the 'GEM' fruit from the Far North geneblock. The 'GEM' fruit from the Te Puke geneblock tended to be smaller than the 'GEM' fruit from the Far North geneblock.

'Lamb Hass' had a lower dry matter content than 'GEM' or 'Hass' fruit harvested at the same time (Table 3). 'Lamb Hass' fruit reached 33.1% dry matter on 12/5/2008 six months after 'GEM' and 'Hass' fruit reached 33.9% dry matter on 20/11/2007 and 8/11/2007. Fruit mass did not show a trend of increasing with each subsequent harvest (Table 3).

The 'Lamb Hass' fruit harvested in 2009 had a similar pattern of dry matter accumulation as in 2008 (Tables 3 and 4). 'Lamb Hass' fruit reached 33% dry matter on 23/4/2009 earlier than in 2008 where 33% dry matter was reached on 12/5/2008. 'GEM' fruit reached 29.5% dry matter on 28/10/2008 about four months earlier than the 'Lamb Hass' fruit that reached 30.2% dry matter on 16/2/2009 (Table 4).

Table 3. Average dry matter and fruit mass of avocado fruit harvested from the Te Puke geneblock in the 2007/08 harvest season. Results based on a 20 fruit sample at each harvest date.

Cultivar	'Lamb Hass'		'GEM'		'Hass'	
Date	Dry Matter (%)	Fruit mass (g)	Dry Matter (%)	Fruit Mass (g)	Dry Matter (%)	Fruit Mass (g)
8/11/2007	21.2	288.4	31.9	243.8	33.9	263.7
20/11/2007	22.0	326.6	33.9	256.3		
4/12/2007	22.2	332.6	34.6	235.7		
18/12/2007	23.2	316.3	34.0	242.6	38.1	213.8
8/1/2008	27.1	320.4	37.7	253.2		
23/1/2008	28.7	322.0			38.5	243.4
5/2/2008	29.3	345.4			36.3	259.3
20/2/2008	30.5	303.0			36.5	274.5
5/3/2008	30.6	345.2			36.9	257.3
18/3/2008	30.1	342.9			37.0	242.5
3/4/2008	31.8	319.3			36.5	272.5
12/5/2008	33.1	406.7				

Table 4. Average dry matter and fruit mass of avocado fruit harvested from the Te Puke geneblock in the 2008/09 harvest season. Results based on a 20 fruit sample.

Cultivar	'Lamb Hass'		'GEM'		'Hass'	
Date	Dry Matter (%)	Fruit mass (g)	Dry Matter (%)	Fruit Mass (g)	Dry Matter (%)	Fruit Mass (g)
25/9/2008			27.0	259.1		
28/10/2008			29.5	273.3		
29/1/2009	28.9	343.7				
16/2/2009	30.2	327.6				
26/2/2009	30.2	336.2				
19/3/2009	30.2	405.1				
26/3/2009	30.6	393.3				
8/4/2009	31.6	367.0				
23/4/2009	33.4	387.9				
14/5/2009	33.1	396.4				
4/6/2009	32.6	395.3				
18/6/2009	33.0	378.2				
22/6/2009					19.9	200.5
2/7/2009	32.2	345.2				
16/7/2009	32.7					
5/8/2009					23.2	243.3

The mass of individual fruit was not related to individual fruit dry matter content for 'GEM' (Figure 1a) or 'Lamb Hass' fruit (Figure 1b). The percentage of 'Lamb Hass' fruit harvested at each sampling date with a mature seed coat was used as an indication of fruit maturity to determine a minimum dry matter standard for harvest. The percentage of fruit with mature seed coats had a sigmoidal relationship with date of harvest. By the 20/2/2008 all of the fruit in the sample had mature seed coats (Figure 2). The percentage of fruit with a mature seed coat was positively related (r^2 = 0.9647, $p < 0.0001$) to the dry matter content of the fruit (Figure 2). Using the regression equation the

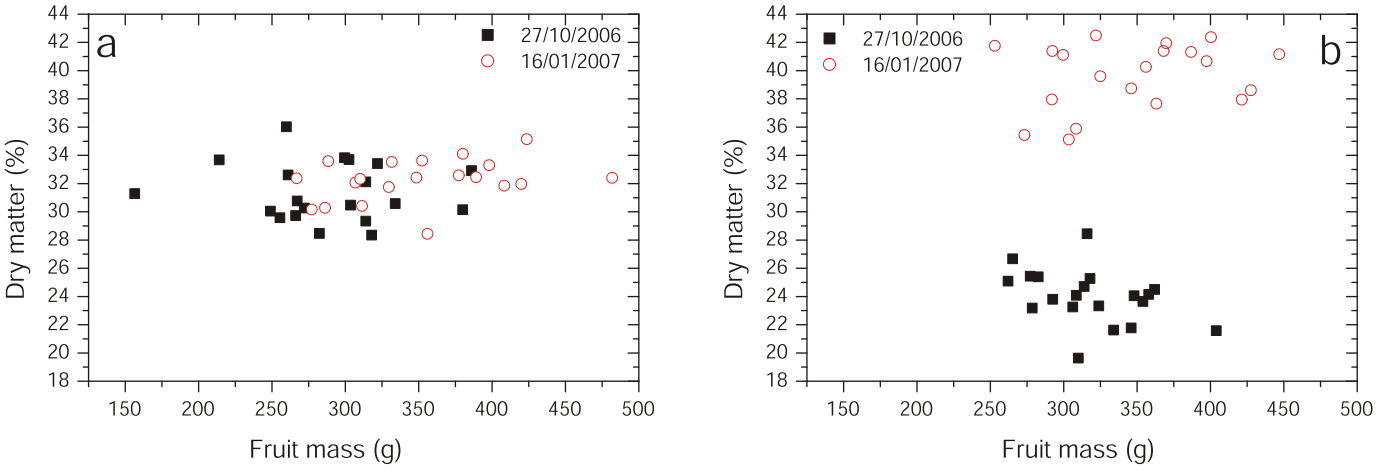

Figure 1. Relationship between dry matter and fruit mass of individual Far North (a) 'GEM' and (b) 'Lamb Hass' fruit harvested in the 2006/07 season.

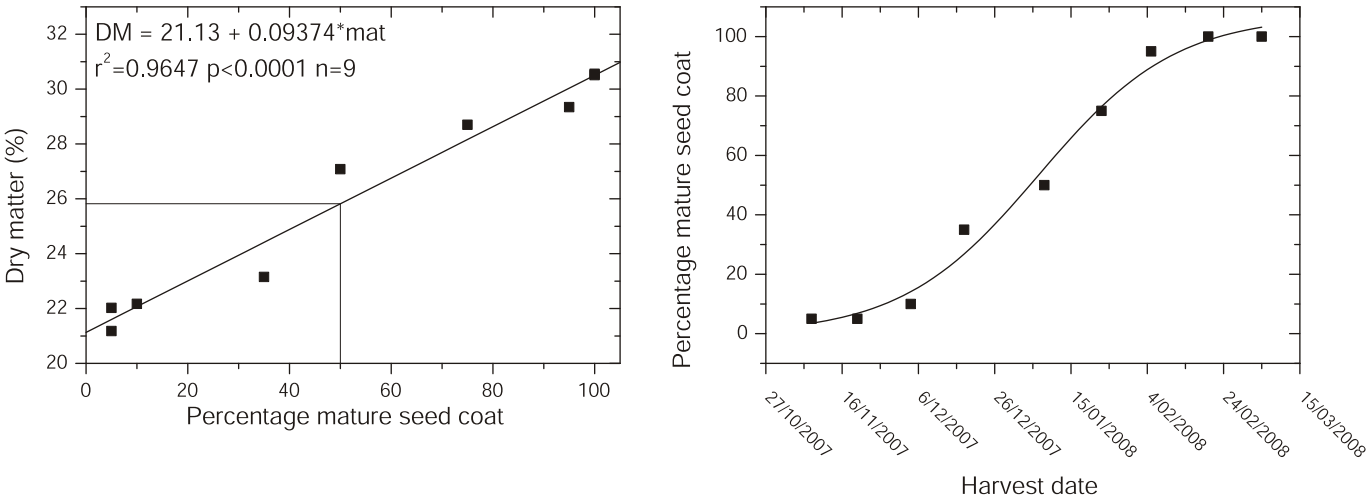

Figure 2. Relationship between average dry matter of 'Lamb Hass' fruit harvested from the Te Puke geneblock and the percentage of fruit with mature seed coats (left graph) and the percentage of fruit with mature seed coats at each harvest date (right graph).

average dry matter content of the fruit when 50% of the seed coats were mature is 25.82%.

Fruit assessment firmness

When assessing 'Lamb Hass' fruit it is notable that the fruit have a different shape and hand feel than 'Hass' or 'GEM' fruit. When judging avocado fruit are ready to eat by their softness an assessor needs to determine the softness of the flesh under the skin. Different avocado cultivars can have different skin thickness and smoothness which may alter the impression of the ripeness of the fruit. 'Lamb Hass' fruit were softer by handfeel at the same firmometer reading than 'Hass' fruit (Table 5). 'Hass' fruit are considered ready to eat at minimum hand feel firmness equivalent to a reading of 85 on a firmometer with a 300g weight. Hand feel firmness for 'Lamb Hass' when using a 'Hass' standard is underestimating the fruit firmness. It is estimated that 'Lamb Hass' fruit be assessed as ripe when they reach a hand feel firmness equivalent to a reading of 75 on a firmometer with a 300g weight.

Table 5. Percentage of soft fruit classed as potentially edible of ripening avocado fruit within different firmometer ranges.

Cultivar Firmometer range	Lamb Hass % soft[1]	Hass % soft
40-50	12	20
50-60	51	23
60-70	69	57
70-80	89	80
80-90	82	75
90-100	100	87
100-110	100	100

[1]The fruit flesh had less than 1.2 kg force using a low range (0-5 kg range) penetrometer equipped with an 11mm head.

Fruit quality

Non-stored 'Lamb Hass' had high levels of brown patches when harvested in May 2008 (Table 6). Similar batches of fruit when stored at 7°C had increased severity and incidence of stem end rot, brown patches and diffuse flesh discolouration compared to non-stored fruit. The fruit stored at 5°C and 3°C had similar severity and incidence of ripe rots and diffuse flesh discolouration. The fruit maintained at 2°C developed high levels of ripe rots and chilling injury disorders indicating that the fruit had been damaged (Table 6). At all temperatures there were very high severity and incidence of brown patches most likely due to the fruit being assessed when overripe.

Table 6. Average ripe rots, days to ripe and chilling injury (discrete patches) of 'Lamb Hass' avocado fruit harvested on the 12/5/2008 from the Te Puke geneblock after 28 days storage at different temperatures and ripened at 20°C.

Temperature	SER[1]		BP[2]		DP[3]		DFD[4]		DTR[5]
°C	Sev[6]	Inc[7]	Sev	Inc	Sev	Inc	Sev	Inc	days
Non-stored[8]	0.1d9	3.0c	5.9d	73.0b	0.0b	0.0b	0.0c	0.0b	10.5a
7	1.7c	42.0b	23.6c	96.0a	0.0b	0.0b	4.3ab	29.0a	3.7d
5	3.9b	64.0ab	35.7b	99.0a	0.2b	1.0b	2.4b	15.0a	7.0c
3	3.1bc	55.0b	31.6b	99.0a	0.1b	1.0b	2.9ab	29.0a	8.5b
2	20.6a	92.0a	61.3a	100.0a	12.8a	32.0a	6.1a	34.0a	8.5b

[1]SER = stem end rot, [2]BP = Brown patches, [3]DP = discrete patches, [4]DFD = diffuse flesh discolouration, [5]DTR = days to ripen, [6]Sev = severity (0-100%), [7]Inc = incidence (0-100%), [8]Non-stored = ripened at 20°C after harvest with no storage, [9]Means followed by the same letter within a column are not different according to a One Way Analysis of Variance using Tukey's family error rate of 5%.

The weight loss in storage decreased along with the decrease in storage temperature while the weight loss when ripening increased as did ripening times (Table 7).

'GEM' fruit stored at 5°C for 28 days had greater severity of stem end rot, severity and incidence of diffuse flesh discolouration and ripened faster than the fruit stored for 14 days (Table 8). Storage for 28 days did not increase incidence of stem end rot or severity and incidence of brown patches. As the harvest season progressed the time the fruit took to ripen decreased from an average of 7.4 days to 3.3 days indicating that fruit maturity was increasing (Table 9).

Table 7. Average mass loss during storage and ripening of 'Lamb Hass' fruit harvested on 12/5/2008 from the Te puke geneblock after 28 days storage at different temperatures and ripened at 20°C.

Temperature (°C)	Storage %	Ripe %
Non-stored[1]		8.7a
7	4.6b1	3.2d
5	5.7a	5.8c
3	3.6c	6.9b
2	3.1c	6.8b

[1]Non-stored = ripened at 20°C after harvest with no storage, [2]Means followed by the same letter within a column are not different according to a One Way Analysis of Variance using Tukey's family error rate of 5%.

Table 8. Average severity and incidence of ripe rots and days to ripen of 'GEM' fruit harvested on the 13/1/2009 from the Te Puke geneblock and stored at 5°C for 14 or 28 days then ripened at 20°C

Storage duration	SER[1]		BP[2]		DFD[3]		DTR[4]
Days	Sev[5]	Inc[6]	Sev	Inc	Sev	Inc	days
14	1.0b[7]	30.0	13.3	95.6	0.4b	2.8b	6.7a
28	2.5a	32.2	11.3	91.7	2.7a	21.7a	5.5b

[1]SER = stem end rot, [2]BP = Brown patches,[3]DFD = diffuse flesh discolouration (internal chilling injury), [4]DTR = days to ripen, [5]Sev = severity (0-100%), [6]Inc = incidence (0-100%), [7]Means followed by the same letter within a column are not different according to a One Way Analysis of Variance using Tukey's family error rate of 5%.

Table 9. Average days to ripen of 'Lamb Hass' avocado fruit harvested from the Te Puke geneblock.

Date	Days to ripen
16/01/2009	7.4
29/01/2009	5.2
26/02/2009	6.4
19/03/2009	5.8
26/03/2009	5.0
8/04/2009	5.2
23/04/2009	4.7
14/05/2009	4.5
22/05/2009	4.6
18/06/2009	3.7
2/07/2009	3.3

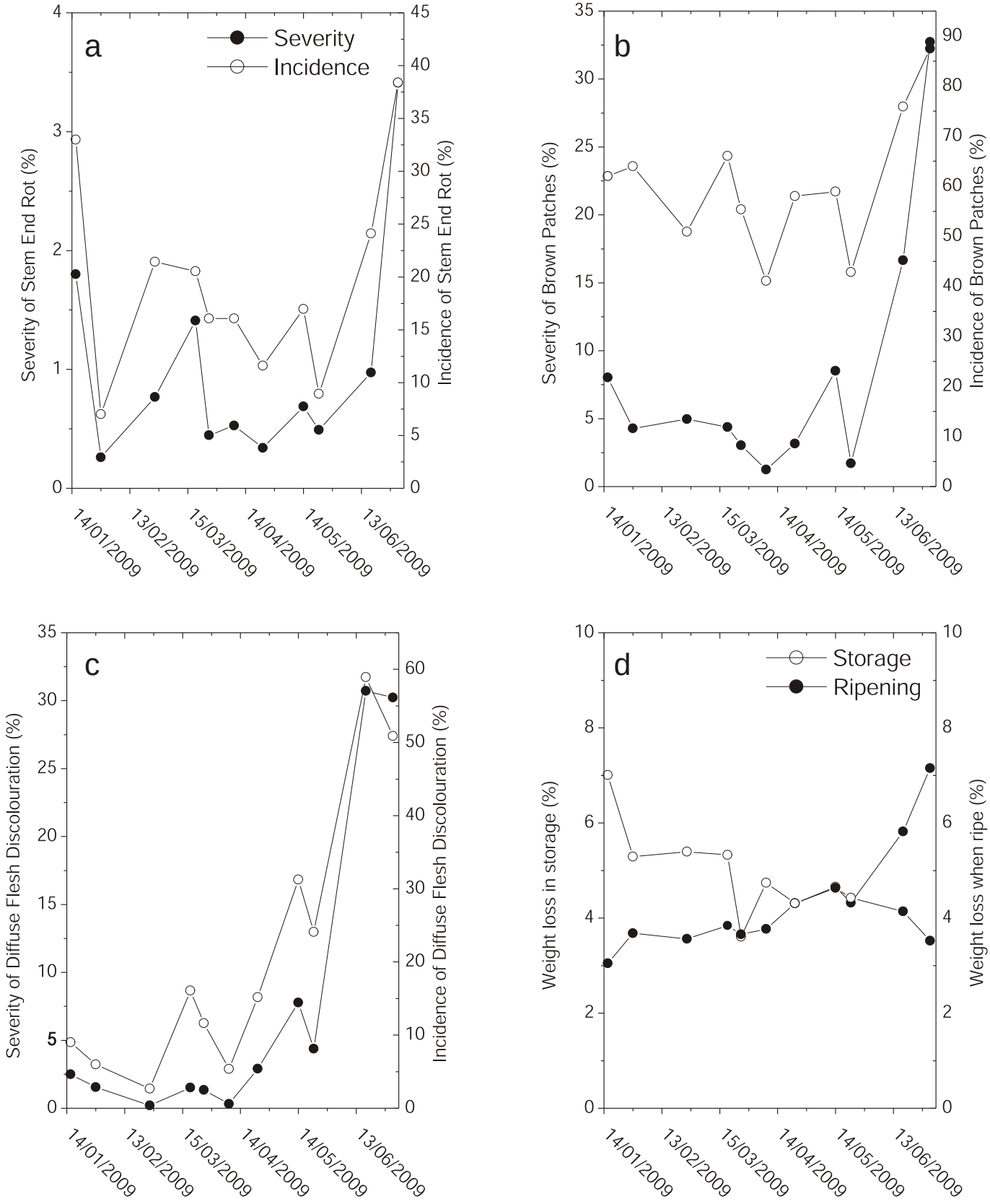

Figure 3. Average severity and incidence of ripe rots a) stem end rot, b) brown patches, c) diffuse flesh discolouration and d) weight loss after 28 days storage at 5°C and after ripening at 20°C of 'Lamb Hass' avocado fruit harvested from the Te Puke geneblock.

The average stem end rot severity and incidence was variable from one harvest to the next. The fruit harvested at the beginning of the trial in January and again at the end of the trial in June had the highest incidence and severity of stem end rot. There was a period from the end of March to the end of May where stem end rot severity was of less than 0.5% (Figure 3a). The severity of brown patches was below 8% from January to May and the incidence was within the range of 65% to 40%. The fruit from the last two harvests had increasing severity and incidence of brown patches indicating the fruit had become over mature (Figure 3b). Diffuse flesh discolouration increased in severity and incidence to high levels from the end of March (Figure 3c). The fruit harvested from May had increased weight loss in storage and decreased weight loss after ripening (Figure 3d). This was consistent with the increase in ripe rots and diffuse flesh discolouration after May.

DISCUSSION

'Lamb Hass'

The 'Lamb Hass' fruit have a different maturity profile, physical characteristics and postharvest quality response to storage than 'Hass' fruit. 'Lamb Hass' fruit are later maturing than 'Hass' fruit by about four months each year in agreement with 'Lamb Hass' maturity in California and South Africa when seasonal differences are taken into account (Hofshi *et al*., 2001; Kremer-Kohne and Kohne, 2001). 'Lamb Hass' fruit are typically larger and have a more 'blocky' shape than 'Hass' fruit of a comparative age. As with New Zealand 'Hass' fruit 'Lamb Hass' fruit size was not related to dry matter and suggests that fruit size is not an indicator of harvest maturity. There may be a regional influence on 'Lamb Hass' fruit maturity as the Far North 'Lamb Hass' had a greater amount of dry matter than the Te Puke 'Lamb Hass' fruit at the same harvest date. Further studies over several seasons would be required to confirm if the Far North 'Lamb Hass' fruit are consistently earlier than Bay of Plenty 'Lamb Hass' fruit. The pattern of dry matter accumulation was similar across the two years 2008 and 2009 but the time taken to reach a specific dry matter value varied by several weeks. This pattern is similar to that of 'Hass' as shown by the results of the AIC Maturity Monitoring programme. This would suggest that the start to the 'Lamb Hass' harvest season would change from year to year as it does for 'Hass'.

A minimum harvest maturity of just below 26% dry matter was calculated where 50% of fruit cut had a mature seed coat. A more conservative estimate of the minimum harvest dry matter would be to use the DM when two-thirds of the fruit have a mature seed coat. At this point the dry matter would be about 27%. This is similar to the minimum dry matter standard for South African 'Lamb Hass' (Kremer-Kohne, 2000). Based on the 2008 and 2009 dry matter accumulation the start of the harvest season of Te Puke 'Lamb Hass' would be at the beginning of January.

The results of the studies reported in this article, while only preliminary, indicate that 'Lamb Hass' fruit will not be suitable for storage under the same conditions and timelines as Hass fruit. 'Lamb Hass' fruit have different physical attributes to 'Hass' fruit. When assessing 'Lamb Hass' fruit for ripeness by hand feel the 'Lamb Hass' fruit are ready to eat firmer than 'Hass' fruit. If the 'Lamb Hass' fruit are cut as being ripe at the similar to hand feel to 'Hass' they are over ripe and will tend to have more quality problems. This may indicate that consumers will need to be educated as to when 'Lamb Hass' fruit are ripe for best quality.

'Lamb Hass' have the same range of disorders as 'Hass' fruit but may show slightly greater physiological flesh discolouration with storage duration, temperature and maturity. When late season 'Lamb Hass' fruit were stored at a range of temperatures the fruit with the least disorders overall had been maintained at 7°C. Further research is required to confirm 'Lamb Hass' fruit cannot be stored at the same temperatures as 'Hass' fruit. Early or middle season 'Lamb Hass' fruit may have different storage characteristics to late season 'Lamb Hass'. It is possible that 'Lamb Hass' fruit may not be suitable for storage at

progressively lower temperatures when they are most mature. This is in contrast to the temperature regimes used for New Zealand 'Hass' fruit where the storage temperatures are progressively lowered as the fruit become more mature. The minimum storage temperature at which the chilling injury symptom discrete patches has very low severity and incidence was similar to New Zealand 'Hass' fruit at 3°C (Dixon *et al.*, 2008). The severity and incidence of ripe rots had a similar 'U' shaped quality profile with maturity as does 'Hass' (Dixon *et al.*, 2003; Dixon *et al.*, 2004) with the best quality in relation to ripe rots from the end of January to the end of May. However, by April the internal disorder diffuse flesh discolouration became increasingly common and more severe. The presence of increasing disorders from April would suggest that the New Zealand 'Lamb Hass' harvest window in Te Puke is about four months from the beginning of January to the end of April. The results of the studies reported here are for fruit from two select orchards off a very small number of trees. Therefore, before a recommendation on the best storage temperatures for 'Lamb Hass' as the fruit becomes more mature can be made further studies are required.

'GEM'

There is more limited information on 'GEM' fruit as there are fewer fruit available for storage trials than were available for 'Lamb Hass' fruit. 'GEM' fruit have a distinctive appearance and are a similar size to 'Hass' fruit but with a smoother skin. Accumulation of dry matter for 'GEM' fruit appears to be similar to that for 'Hass' fruit. Both 'GEM' and 'Hass' fruit are likely to be mature at about the same time but further research is needed to confirm this. A minimum harvest maturity for 'GEM' cannot be estimated as yet. 'GEM' fruit appear to have the same range of disorders as 'Hass' fruit. The quality of 'GEM' fruit stored at 5°C was similar to what may be expected of 'Hass' fruit harvested at a similar time. At present while there is only limited information available on New Zealand grown 'GEM' it is expected that 'GEM' could have similar postharvest characteristics to 'Hass'. Considerable research is needed to establish the response of 'GEM' fruit to different storage temperatures and duration at different harvest maturities.

CONCLUSIONS

'Lamb Hass' and 'GEM' fruit appear to have promise as fruiting cultivars for New Zealand avocado growers. The postharvest characteristics of 'Lamb Hass' are different to 'Hass' fruit meaning the same storage conditions cannot be used for both types of fruit. 'Lamb Hass' minimum harvest maturity is suggested to be 27% dry matter with a harvest window of early January to the end of April for best fruit quality. There has not been enough trial work to suggest a minimum dry matter standard and storage conditions for 'GEM' fruit.

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'Lamb Hass' is protected by the New Zealand Plant Variety Right number AVO004.

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