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EFFECTS OF PRODUCTION LOCATION IN SOUTH-EAST QUEENSLAND ON POSTHARVEST QUALITY OF 'HASS' AVOCADO FRUIT

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Abstract

To test the effects of locality and/or cultural practices on 'Hass' avocado quality, fruit were harvested from orchards in different locations in south-east Queensland, at 3 stages of maturity (approx. 24, 29 and 34% dry matter; DM). Fruit were either ripened at 22ºC or stored at 7ºC for 3 weeks before ripening. Days to maximum ethylene production (DMEP), fruit skin colour, postharvest disease severity and fruit Ca concentrations varied between locations. Days to maximum ethylene production declined, with increasing maturity in fruit from most locations. Disease severity was low in early harvested fruit, but increased in later harvested fruit. Poor internal quality (disease and hard flesh around the seed) was found in late harvests from orchards in warmer climates. Correlations between DMEP and % DM and DMEP and flesh Ca concentration, were either non-significant, or negative and positive respectively, depending on locality. These results indicate the potential effect of production locality and/or cultural practices on fruit quality, but more detailed research is required to identify major factors involved.

1. Introduction

Successful marketing of horticultural products requires predictability and consistency of quality. Postharvest performance of fruit can be influenced by both cultural and climatic factors (Monselise and Goren, 1987; Hofman and Smith, 1994), and fruit mineral composition, particularly calcium, can play a major role (Ferguson, 1980). An understanding of the effects of production factors on quality will improve predictability of fruit response to postharvest handling. This paper reports some of the effects of production locality and/or cultural practices on postharvest quality of 'Hass' avocado fruit.

2. Materials and Methods

Five uniform 5 to 8-year-old 'Hass' avocado trees were selected from each of 5 commercial orchards in south-east Queensland between latitude 25-27.5ºS (table 1). Twenty fruit of 250-300 g mass each were harvested in 1993 at early, mid and late maturity (approx. 24, 29 and 34%

flesh DM respectively) from the northern aspect at 1.5 to 3 m above ground and 0 to 0.5 m into the canopy, and immediately dipped in 0.55 mL L^{-1} prochloraz for 30 sec. For each harvest, 2 fruit per tree were ripened at 22ºC under humidified, ethylene-free air in ventilated containers, and the other 2 fruit per tree stored at 7ºC for 3 weeks before ripening at 22ºC.

Days to eating soft was judged by hand pressure. Respiration and ethylene evolution were measured by gas chromatography. Fruit skin colour (1 = skin fully green; 9 = fully black), chilling injury (0 = none; 1 = 0-25%; 2 = 25-50%; 3 = 50-75%; and 4 = >75% of cut fruit flesh surface area with discolouration) and disease severity (0 = none; 1 = 0-5%; 2 = 5-10%; 3 = 10-25%; and 4 = >25% of fruit surface area affected) were recorded. Mineral concentration (by wet digestion and inductively coupled plasma emission spectroscopy) and % DM were determined on equatorial sections of fruit flesh.

3. Results

3.1 Days to maximum ethylene production

Days from harvest to maximum ethylene production (DUEP) was significantly affected by production location (figures I a & 2a). Days to maximum ethylene production was less in stored fruit and generally less in more mature fruit, except those from the Sunshine coast. There were significant negative correlations between % DM and DMEP in unstored and stored fruit, but not in all locations (table 2). Fruit reached eating soft about 5 days after maximum ethylene production, and days to eating soft and DMEP was correlated in both unstored and stored fruit (r = 0.95** & 0.58* respectively).

3.2 Fruit shape and skin colour

Fruit from cooler localities had higher length: diameter ratio (table 1). Fruit skin colour at eating soft differed markedly between locations (figures lb and 2b). More fruit developed a full dark skin colour following storage than when ripened following harvest.

3.3 Internal quality

Postharvest diseases (mainly anthracnose and stem end rot) were low in early- harvested fruit, but higher (up to >25% of fruit surface area affected) in late-harvested fruit from warmer regions, and in stored fruit (figures 1c and 2c). Fruit from warmer regions developed poor internal quality (firm flesh near seed, germinated seed and rancid flavour) in late harvests (data not presented). There was negligible chilling injury following storage (data not presented).

3.4 Flesh Ca concentration

Flesh Ca concentration was higher in fruit from the Sunshine coast than from other localities, and was less in more mature fruit (figure I d). A positive relationship between fruit Ca concentration and DN1EP was found in non-stored fruit from the Lockyer Valley and Toowoomba, and in stored fruit from Maleny (table 2). Correlations of r = 0.29* and 0.56** were obtained between Ca concentration and DMEP in non-stored and stored fruit respectively, over all localities.

4. Discussion

Significant effects of production locality and/or cultural practices have been noted in many fruits (e.g. Blaripied et al., 1987; Rowell, 1988). A reduction in shelf life with increasing maturity has been observed in avocado by Cutting et al. (1992), and in mango by Hofman et al.

(1995). Strong correlations between avocado flesh Ca concentration and days to ripe have been noted by Witney et al. (1990) and Cutting et al. (1992), and in other fruit (Hofman and Smith, 1994). However, our results indicate that while fruit Ca plays a role, yet to be identified production factors are also important in determining the dynamics of avocado fruit ripening.

Skin colour of 'Hass' is an important commercial consideration in Australia.

Consumers consider 'Hass' to be ready to eat when skin is very dark to black (Ledger and Barker, 1995), but the flesh is often over-ripe by this stage, and disease is likely to be more severe. Hence a delay in skin colour development relative to flesh softening may result in over-ripe fruit and a reduction in quality. The present results indicate that skin colour can be affected by production factors and maturity, and cold storage delays flesh softening to a greater extent than skin colour development, so that fully coloured, but over-soft fruit are less likely. There may be some potential to exploit this finding to better synchronise skin colour and flesh softening.

Disease was the major factor determining storage life in these experiments. The generally increased severity in warmer production areas and in more mature fruit, may partially result from a longer exposure time of fruit to inoculum with later harvests, and reduced physiological "vigour" of fruit when grown in warmer climates and when harvested later. However, disease severity can be influenced by pre-harvest and postharvest practices, so that the effect of the above factors can be minimised.

These results indicate the potential effect of climate and production factors on 'Hass' quality. The trial is currently being conducted over another season to evaluate climatic influences. More detailed studies involving specific manipulation of cultural practices are required to identify production factors that influence postharvest quality.

Acknowledgment

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Table 1 - The mean maximum temperature in January and June, average rainfall, and soil type of 'Hass' avocado orchard sites in SE Queensland, and average fruit mass and fruit length:diameter ratio. Values in rows followed by different letters are significantly different ($P \leq 0.05$)

	Lockyer Valley	Childers	Sunshine Coast	Maleny	Toowoomba
Mean max. °C: Jan	31	30	28	26	27
Mean max. °C: Jun	20	22	21	18	16
Rainfall (mm yr^{-1})	784	1084	1976	2080	969
Soil type	Sandy loam	Clay loam	Sandy loam	Clay loam	Clay loam
Av. fruit mass (g)	290 ab	297 b	282 a	329 c	333 c
Length:diameter ratio	1.39 a	1.30 a	1.40 ab	1.40 ab	1.50 b

Table 2 - Correlations (r) between % DM and days to maximum ethylene production (DMEP), and Ca concentration and days to maximum ethylene production in 'Hass' avocado fruit growing in five locations in SE Queensland. * and ** indicate significance at $P \leq 0.05$ and $P \leq 0.01$ respectively.

Location	% DM vs. DMEP		Fruit Ca vs. DMEP	
	Non-stored	Stored	Non-stored	Stored
Lockyer Valley	-0.46 ns	0.55 ns	0.55 *	-0.25 ns
Childers	-0.61 *	-0.60 *	0.42 ns	0.46 ns
Sunshine Coast	0.06 ns	-0.63 *	0.29 ns	0.27 ns
Maleny	-0.26 ns	-0.72 **	0.17 ns	0.73 *
Toowoomba	-0.61 *	-0.07 ns	0.79 **	0.05 ns

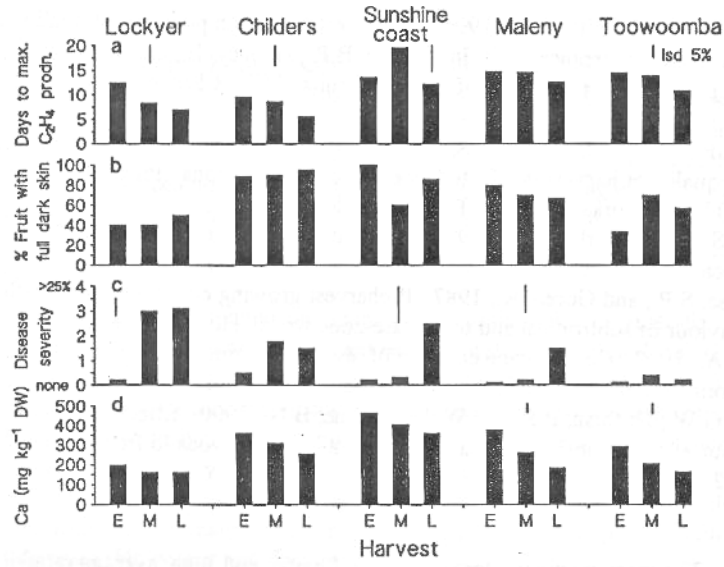

Figure 1 - Effects of production locality in SE Queensland on (a) days from harvest to maximum ethylene production; (b) % of fruit reaching black skin colour at eating soft; (c) disease severity (0 = nil, 4 = >25% of fruit affected); and (d) fruit flesh calcium concentration, of 'Hass' avocado fruit harvested at early (E), mid (M) and late (L) maturity, and held at 22°C. Bars indicate lsd (5%).

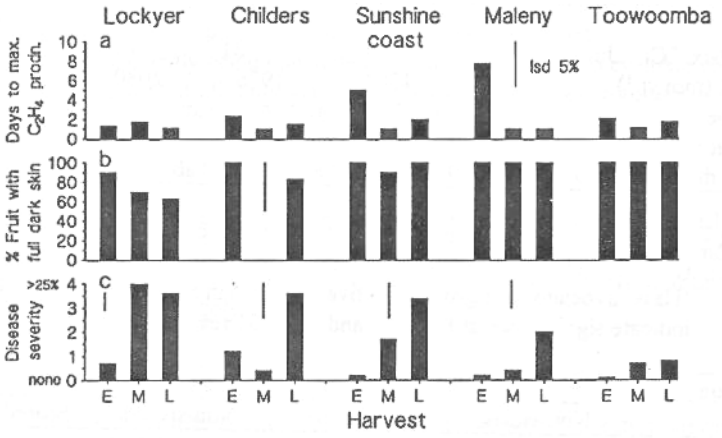

Figure 2 - Effects of production locality in SE Queensland on (a) days from harvest to maximum ethylene production; (b) % of fruit reaching black skin colour at eating soft; and (c) disease severity (0 = nil, 4 = >25% of fruit affected), of 'Hass' avocado fruit harvested at early (E), mid (M) and late (L) maturity, stored at 7°C for 3 weeks, then ripened at 22°C. Bars indicate lsd (5%)