EFFECT OF ROOTSTOCK CULTIVAR ON RIPE FRUIT QUALITY

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ABSTRACT

The amount of ripe rots on avocado fruit can be influenced by many pre-harvest factors. In Australia, it has been claimed an overriding factor is the rootstock where the amount of post harvest rots is greater with Mexican race rootstocks as they are the most susceptible to anthracnose infection on their leaves. For this reason, 'Hass' avocado fruit from trees with 'Zutano' rootstocks, the most common rootstock in New Zealand, are claimed to have poor fruit quality as the 'Zutano' rootstock has predominantly Mexican race genes. To determine if the rootstock has an overriding influence on New Zealand 'Hass' avocado fruit quality, a preliminary study compared 'Hass' fruit from trees of different rootstocks across several orchards. There were significant differences in the incidence and severity of stem end rot and brown patches within orchards in a particular year that may have been due to the rootstock. The best rootstock each year was not the same across orchards. Where 'Hass' trees were grown on rootstocks of similar parentage there were significant differences in the incidence and severity of ripe rots after storage. Therefore, apparent rootstock differences may reflect more on orchard factors that lead to greater ripe rots. It was concluded that the rootstock of the tree is unlikely to have an overriding effect on fruit quality but may partially explain differences in ripe rots of fruit. This is in contrast to the important role claimed for rootstocks in Australia.

Keywords: *Mexican, Guatemalan, Zutano, Reed, ripe rots*

INTRODUCTION

New Zealand avocado fruit, when ripening, can develop postharvest rots from a complex of at least five fungi (Everett *et al.*, 2003) the incidence and severity of which are thought to be set on the orchard. There are many pre-harvest factors that influence the amount of ripe rots on avocado fruit. In New Zealand, research has shown that the fungicide spray programme (Everett and Pak, 2001), fruit mineral content (Everett and Pak, 2001; Thorp *et al*., 1997) and rain before harvest (Pak *et al*., 2003) can affect the amount of ripe rots fruit that will develop. In Australia, it has been claimed that the rootstock of the avocado tree has a major influence on the amount of post harvest rots that avocado fruit develop when ripe (Whiley *et al*., 2007). The mechanism of rootstock influence has been postulated as a physiological incompatibility between the different avocado races, Mexican, Guatemalan and West Indian (Whiley *et al*., 2007). The differences in physiology lead to different fruit mineral profiles, change the starch accumulation profile (Lahav and Whiley, 2001; Whiley *et al*., 1997) and leaf anti-fungal diene levels (Willingham *et al*., 2001). These changes lead to greater or lesser crops (Smith, 1993) and low fruit calcium levels that are also associated with increased ripe rots (Hofman *et al*., 2002; Willingham *et al*., 2001). Mexican race avocado cultivars have been shown to be the most susceptible to anthracnose infection on their leaves followed by Guatemalan race cultivars with the West Indian race cultivars the most resistant (Whiley *et al.*, 2007). Based on the above information it has been claimed that 'Hass' avocado fruit from trees with 'Zutano' rootstocks, the most common rootstock in New Zealand, will have poor fruit quality as the 'Zutano' rootstock has predominantly Mexican race genes. It was recently confirmed in New Zealand that 'Hass' trees with leaves with high levels of anthracnose infection also have fruit with high levels of anthracnose infection (Everett *et al.*, 2003). Therefore it is possible that the rootstock of a tree is affecting the amount of rots the fruit develop when ripe. To determine if the rootstock has an overriding influence on New Zealand 'Hass' avocado fruit,

quality a preliminary study was conducted comparing 'Hass' fruit from trees composed of different rootstocks within several orchards.

MATERIALS AND METHODS

In 2004 and in 2005, 'Hass' avocado fruit from trees with different rootstock cultivars were harvested from commercial orchards located in the Bay of Plenty and Northland regions of New Zealand. Orchards A and E were located in the Bay of Plenty and orchards B, C and D were located in the Northland region. In 2004, 20 ungraded 'Hass' fruit, 4 fruit from each of 5 trees, from each rootstock on each of the orchards were placed into storage. The harvest dates were from 3/11/2004 to 15/11/2004. In 2005, 100 ungraded 'Hass' fruit, 20 fruit from each of 5 trees, from each rootstock on each of orchards were placed into storage. The harvest dates were from 14/12/2005 to 10/1/2005. There was only one harvest per orchard. Within 24 hours of harvest, fruit were packed into trays and then placed into a commercial coolstore maintained at 4°C ± 0.5°C, 85% RH for 28 days. After removal from storage the fruit was ripened at 20°C ± 1.0°C, 65% RH and the fruit quality assessed at eating ripeness. Ripeness was determined by firmometer when the fruit reached a softness reading of 85 using a 300g weight or by hand feel after calibration to a firmometer. Fruit were assessed for disorders according to the Avocado Industry Council Assessment Manual (Dixon, 2003).

Where there were fruit from 2 rootstocks for evaluation the results within each year for each orchard were analysed using a two sample t-Test assuming unequal variances. For more than 2 rootstocks within an orchard the results within each year were analysed using a One Way Analysis of Variance using MINITAB version 13.31.

RESULTS

There were significant differences in the incidence and severity of stem end rot and brown patches within orchards in a particular year that could be associated with the rootstock of the tree (Table 1).

The best rootstock each year was not consistently the same across orchards. Fruit from 'Zutano' rootstocks had the least ripe rots in orchards A, C, and D but had the greatest ripe rots in orchard B and E (Table 1). For the two orchards C and D the fruit harvested from trees with 'Reed' rootstocks generally had the greatest amounts of ripe rots. The incidence and severity of ripe rots from trees in orchard C that were 6 years old was not significantly different in the incidence of sound fruit between other 6 year old rootstocks (Table 1). By contrast the fruit harvested from trees in orchard C that were 16 years old were different with the fruit from 'Reed' rootstock trees having a greater incidence of sound fruit in 2004 than fruit from 'Zutano' rootstock trees (Table 1). In 2005, the fruit from 'Hass' rootstock trees had a greater incidence of sound fruit than the fruit from 'Reed' rootstock trees.

DISCUSSION

The orchards used in this study had different combinations of 'Hass' on rootstocks that allowed comparison of the influence of two avocado races, Mexican and Guatemalan, on the development of ripe rots when ripe. The results have been interpreted within each orchard and only general conclusions have been drawn across orchards with respect to rootstocks and fruit quality. Where there were 'Hass' trees grown on rootstocks of similar parentage, **M** x G in orchards A and B, there were significant differences in the incidence and severity of ripe rots after storage but the differences were not consistent from year to year. Therefore, on orchard factors that lead to greater ripe rots can be important in setting the level of rots fruit develop. These factors can include: tree age, inoculum levels, fungicide spray programme, crop load and fertiliser programme anyone of which may override a rootstock effect on fruit quality.

The fruit from orchards C and D were from trees of different rootstock parentage where Guatemalan and Mexican rootstocks could be compared within each orchard. There was no consistent pattern across years in each orchard of 'Hass' fruit from

Table 1. Incidence and severity of stem end rot and brown patches and the incidence of sound fruit using a disorder threshold of 5% of Hass avocado fruit grown on different rootstocks within each year of assessment.

Orchard	Year	Rootstock	Race[1]	Stem end rot		Brown patches		Sound fruit
				Inc[2]%	Sev[3]%	Inc%	Sev%	Inc%
A	2004	Fuerte	**M** x G	20.0	1.9	45.0	1.7	85.0
		Zutano	**M** x G	5.0	0.2	30.0	0.7	95.0
	2005	Fuerte	**M** x G	3.0	0.1	32.0	1.2	91.0
		Zutano	**M** x G	7.0	0.2	14.0**[4]	0.3*	96.0
B	2004	Vista	**M** x G	15.0	0.2	25.0	0.8	95.0
		Zutano	**M** x G	20.0	0.7	40.0	4.4	80.0
	2005	Vista	**M** x G	4.0	0.1	20.0	0.4	98.0
		Zutano	**M** x G	12.0*	0.5	28.0	1.2**	90.0*
C	2004	Hass 6y[5]	**G** x M	45.0b[6]	5.6ab	80.0b	1.9b	65.0ab
		Reed 16y	**G**	15.0b	1.1b	40.0a	0.2b	95.0a
		Reed 6y	**G**	55.0ab	3.0ab	70.0ab	2.4b	55.0b
		Zutano 16y	**M** x G	90.0a	9.0a	90.0b	11.4a	15.0c
		Zutano 6y	**M** x G	25.0b	1.7b	60.0ab	0.5b	80.0ab
	2005	Hass 16y	**G** x M	19.2c	2.4b	60.6	0.7c	80.8a
		Reed 16y	**G**	44.0b	9.5a	71.0	2.3bc	59.0b
		Reed 6y	**G**	71.0a	16.2a	76.0	5.2a	40.0c
		Zutano 6y	**M** x G	55.0ab	12.0a	70.0	2.8b	51.0bc
D	2004	Reed	**G**	75.0	3.9	90.0	8.4	60
		Zutano	**M** x G	60.0	2.5	85.0	4.2	60
	2005	Reed	**G**	39.0	1.9	54.0	3.4	67
		Zutano	**M** x G	25.0*	1.7	26.0***	2.0	82*
E	2005	Hass	**G** x M	1.8b	24.0b	1.1b	21.0b	83.0ab
		Hayes	**M** x G	0.3b	13.0b	1.4b	32.0b	92.0a
		Hopkins	**M** x G	1.2b	27.0b	4.6b	61.0a	75.0b
		Zutano	**M** x G	5.1a	56.0a	11.7a	50.0a	51.0c

*[1]**G** x M = predominantly Guatemalan Mexican cross, **M** x G = predominantly Mexican Guatemalan cross, **G** = Guatemalan; [2]Incidence; [3]Severity; [4]Significance levels * = p < 0.05, ** = p < 0.01, *** = p < 0.001; [5]y = years old; [6]Values in the same column with the same letter are not significantly different according to a One-Way analysis of variance where p = 0.05.*

Guatemalan rootstocks having fewer ripe rots than **M** x G or **G** x M rootstocks. The Guatemalan rootstock 'Reed' was both the best and worst rootstock with respect to fruit quality in each orchard depending on the year the fruit were sampled. There were similar general results on orchard E where the **M** x G rootstocks were better and worse than the **G** x M rootstock. Such results indicate that there are other influences on the levels of ripe rots 'Hass' fruit develop and that the rootstock of the tree is unlikely to have an overriding effect on fruit quality.

The results from this study do not rule out an important role that the rootstock may play on setting the incidence and severity of ripe rots on 'Hass' fruit after storage. As this study was preliminary, establishing the effect rootstocks have on fruit quality would require greater replication and more fruit samples to be evaluated from trees where the on orchard factors that influence rot levels in the ripe fruit are better controlled or known. However, based on the results reported here it is likely that the rootstock of the tree fruit are taken from will only partially explain differences in ripe rots of fruit from different trees in New Zealand avocado orchards. This is in contrast to the important role claimed for rootstocks in Australia where the race of the rootstock is considered to be closely related to the amount of postharvest rots 'Hass' avocado fruit develop (Whiley *et al.*, 2007). In particular, the rootstock 'Zutano' has been claimed to result in 'Hass' fruit with poor postharvest performance on the basis of 'Zutano' having predominantly Mexican genes (Whiley *et al.*, 2007). In this study 'Hass' fruit from trees with 'Zutano' seedling rootstock had the fewest ripe rots on three of the five orchards surveyed. The apparent variable influence of rootstock on fruit quality may be due to other as yet unknown orchard factors unrelated to the rootstock.

CONCLUSIONS

The rootstock of a 'Hass' avocado tree does not have an overriding influence on the amount of ripe rots 'Hass' avocado fruit develop after storage. There is other on orchard factors that are also likely to be important in determining levels of ripe rots.

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