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FIELD TESTING OF ROOT ROT TOLERANT AVOCADO ROOTSTOCKS AND EVALUATION OF NEW HASS-LIKE AVOCADO CULTIVARS IN SOUTH AFRICA

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SUMMARY

Vegetatively propagated rootstock selections grafted with Hass, are evaluated for their root rot tolerance and yield potential in an orchard heavily infested with *Phytophthora cinnamomi;* two plantings have been established to date. The rootstock selections are compared to the commercial standard (Duke 7) and susceptible controls (Edranol seedling rootstocks). In the first planting (established in 1996), trees were rated from the healthiest to the poorest: VC 256, VC 218, VC 805, VC 241, VC 207, VC 801, Duke 7, Edranol seedlings and VC 225. In the second planting (established in 1998), trees were rated from the healthiest to the poorest: Merensky II, Velvick, Merensky III, Merensky IV, Duke 7, Gordon, Edranol seedlings and Jovo. The new 'Hass'-like cultivars Lamb Hass, Iriet, Gil and 1.14.2 were topworked at Westfalia Estate in 1994. For comparison, trees have also been topworked with 'Hass'. Data on fruit maturity, yield, fruit size distribution and fruit quality after simulated export were collected. 'Lamb Hass' was found to be the most promising new 'Hass'-like cultivar. 'Lamb Hass' fruit matured from August to October, i.e. later in the year than 'Hass', and fruit mass (approximately 300 g) is higher than in 'Hass'. The cultivar Iriet also shows promise and further testing is warranted. The evaluation of 'Gil' and '1.14.2', however, has been discontinued due to poor performance. Topworking the new 'Hass'-like cultivars Harvest, Gem, Sir Prize, BL 667 and Bonus started in 1996, and the first crop is evaluated in 1999.

KEY WORDS: *Persea americana* Mill., genotypes, *Phytophthora cinnamomi* Rands., disease.

INTRODUCTION

Root rot of avocado, caused by *Phytophthora cinnamomi,* is the most important avocado disease in South Africa. Currently, the South African avocado industry relies on chemical control of root rot with phosphite compounds, and the use of the root rot tolerant Duke 7 rootstock. The long term solution would be a high yielding avocado rootstock with resistance to root rot. In this study, various vegetatively propagated rootstock selections are evaluated in the field for yield and root rot tolerance in comparison with the tolerant Duke 7 rootstock.

Hass trees produce a large percentage of undersized fruit, causing high financial losses in the South African avocado industry. In the long term, the Hass small fruit problem could be solved by replacing 'Hass' with a new 'Hass'-like cultivar with bigger fruit size. Therefore, the following new 'Hass'-like cultivars are currently tested at Westfalia Estate: 'Lamb Hass', 'Harvest', 'Gem', 'Sir Prize', 'BL 667', 'Iriet', 'Gil', '1.14.2' and 'Bonus'.

'Lamb Hass', 'Harvest', 'Gem', 'Sir Prize' and 'BL 667' originate from a Californian breeding program (Witney & Martin, 1995), while 'Iriet' (Lahav *et al.*, 1989) and 'Gil' (Lahav *et al.*, 1995) have been selected in Israel. Selection 1.14.2 originates from the Western Cape Province of South Africa (Smit, 1995), and 'Bonus' was selected at Westfalia Estate. This paper reports on the progress made with the evaluation of these 'Hass'-like selections and cultivars.

MATERIALS AND METHODS

The experimental orchards are situated at Westfalia Estate in the Northern Province of South Africa (latitude 24ºS). This is a summer rainfall area (average 1300 mm per year). The soil type is a fine-loamy, red, mixed paleudult with a clay content of approximately 40%. Irrigation is scheduled by means of tensiometers and applied by micro sprinklers.

Rootstocks

The rootstocks are tested in an old avocado orchard which is heavily infested with *Phytophthora cinnamomi.* Two experimental blocks of 0.8 hectare each have been planted. Each block contains a total of 250 trees on various clonal rootstocks, interplanted with 250 trees on root rot susceptible seedling rootstock ('Edranol'). For comparison, the current commercial standard rootstock, the tolerant Duke 7, was also included. Thirty clonal trees were used per rootstock and were planted in a randomised block design. All trees were grafted with Hass.

Block 1 was planted in October 1996, and contains the following productive and root rot tolerant rootstocks from Israel (Ben Ya'acov *et al.*, 1992): VC 207, VC 218, VC 225, VC 241, VC 256, VC 801 and VC 805. Block 2 was planted in February 1998, and contains the following South African rootstock selections (highly productive trees, selected at Westfalia Estate which escaped root rot): Dusa (Merensky II), Evstro (Merensky III), W 14 (Merensky IV), Jovo and Gordon. The Velvick rootstock from Australia was also included in Block 2.

To create harsh conditions for selection, no root rot treatments are applied in this orchard. Tree condition was rated in July, according to a disease index of zero (healthy) to 10 (dead) as described by Darvas *et al.* (1984). Tree yield will be recorded.

Cultivars

Four 'Hass'-like selections and cultivars ('Lamb Hass', 'Iriet', 'Gil' and '1.14.2'), and 'Hass' as standard, were topworked on 7-year old 'Hass' stumps on Duke 7 rootstock. Twenty trees were used per selection. Topworking started in 1993 and was completed in 1994. Data on fruit maturity, yield, fruit size distribution and fruit quality after simulated export were collected.

Moisture content was determined as an indication of fruit maturity. As in 'Hass', the maximum moisture content of 75% was used as a maturity index. At harvest, individual tree yields were taken. For 'Hass' and 'Lamb Hass', the fruit was then pooled per cultivar and sent over a mass sizer to determine the proportion of export size fruit (≥160g). For 'Iriet' and 'Gil', fruit samples were taken and fruit weighed individually to determine the fruit size distribution.

The fruit were stored for four weeks at 5.5 ºC to simulate sea shipment to Europe, and then the fruit were ripened at 18 ºC. Ripe fruit were inspected and assessed for anthracnose, stem end rot, black and brown cold damage symptoms as well as lenticel damage, and the internal physiological disorders pulp spot and grey pulp. The shelf-life

of the fruit was also evaluated.

Topworking the new 'Hass'-like cultivars Harvest, Gem, Sir Prize, BL 667 and Bonus started in 1996, and a first crop is produced in 1999 (data not yet available).

RESULTS

Rootstocks

Tree condition ratings of 'Hass' trees on rootstocks originating from Israel are presented in Table 1. In 1998 and 1999, trees were rated from the healthiest to the poorest: VC 256, VC 218, VC 805, VC 241, VC 207, VC 801, Duke 7, Edranol seedlings and VC 225. Tree condition ratings of the trees on Merensky rootstocks and Velvick are shown in Table 2. In 1999, trees were rated from the healthiest to the poorest: Merensky II, Velvick, Merensky III, Merensky IV, Duke 7, Gordon, Edranol seedlings and Jovo. These preliminary results are in accordance with findings of Menge (1999). No yield results are available as yet.

Table 1. Condition of Hass trees on various vegetatively propagated rootstocks (Block 1, planted 10/1996).

Rootstock	Tree condition[z]	
	1998	1999
VC 256	1.2±0.1	0.7±0.1
VC 218	1.2±0.2	0.9±0.3
VC 805	1.3±0.3	1.0±0.3
VC 241	1.8±0.3	1.3±0.4
VC 207	1.8±0.2	1.2±0.3
VC 801	2.0±0.4	1.2±0.5
Duke 7	2.5±0.6	3.0±0.7
Edranol seedling	3.7±0.7	3.7±0.7
VC 225	4.4±0.7	4.6±0.8

[z]Mean rating ±SE on a scale from 0 (healthy) to 10 (dead)

Table 2. Condition of Hass trees on various vegetatively propagated rootstocks in 1999 (Block 2, planted 02/1998).

Rootstock	Tree condition[z]
Dusa (Merensky II)	0.8±0.1
Velvick	0.8±0.1
Evstro (Merensky III)	0.9±0.1
W14 (Merensky IV)	0.9±0.1
Duke 7	1.0±0.1
Gordon	1.4±0.1
Edranol seedling	1.6±0.3
Jovo	2.7±0.5

[z]Mean rating ±SE on a scale from 0 (healthy) to 10 (dead).

Cultivars

'Lamb Hass' and 'Gil' trees are very upright growing trees of similar height to 'Hass',

whereas 'Iriet' trees are small to medium sized with slightly drooping branches. Trees of selection 1.14.2 are very vigorous and produce very few fruit; therefore its testing was discontinued in 1997.

'Hass' reached picking maturity at the end of May, while all new 'Hass'-like cultivars matured later than 'Hass': 'Lamb Hass' fruit matured from August to October, 'Iriet' fruit matured from July to September and 'Gil' fruit matured from August to September.

Yield data are presented in Table 3. All cultivars tested had an alternate bearing pattern. In December 1995, hail destroyed most of the 1996 crop, and 1996 would have been an 'on-year'. 'Lamb Hass' trees started bearing a crop two years earlier, and were thus more precocious, than trees of 'Hass' and the other new 'Hass'-like cultivars. Furthermore, 'Lamb Hass' trees produced a considerably higher cumulative yield than the other cultivars over a four-year period. The lower cumulative yields in 'Iriet' and 'Gil' could be compensated for by a closer tree spacing due to smaller tree size. With regard to the fruit size distribution, fruit size varies with crop size, but 'Lamb Hass' is typically larger than Hass. In 1998 however, Hass and Lamb Hass were very similar in their fruit size distribution (Figure 1). The percentage of fruit smaller than 160 g was 50% in 'Hass', and 30% in 'Lamb Hass' (1998). These high percentages of small fruit were due to the deteriorating tree condition in the test orchard but nevertheless show the difference between the two cultivars.

Table 3. Yields of avocado cultivars Hass, Lamb Hass, Iriet and Gil for the years 1995 through 1998.

Cultivar	Yield (trees·ha^{-1})^{z}				
	1995	1996^{y}	1997	1998	Cumulative
Hass	-	-	1.5	23.3	24.8
Lamb Hass	16.6	6.2	2.1	25.5	50.4
Iriet	-	-	3.0	11.9	14.9
Gil	-	-	3.8	10.4	14.2

^{z}extrapolated to 200 trees·ha^{-1}

^{y}hail

'Hass', 'Lamb Hass' and 'Iriet' fruit underwent simulated shipment and had good quality in 1997 and 1998 (data not shown). Particularly the fruit quality of 'Lamb Hass' compared favourably with the 'Hass' standard, although flesh fibres were more pronounced in 'Lamb Hass' than in 'Hass'. 'Iriet' fruit have an excellent flavour, but they tend to shrivel, similar to 'Gwen'. In 'Gil', however, about 30% of the fruit had brown pulp discolourations below the seed after storage. For this reason, the evaluation of 'Gil' was discontinued after the 1998 harvest.

CONCLUSIONS

Clear differences in the health condition of 'Hass' trees on various vegetatively propagated rootstock selections were observed within less than two years after planting. A first crop will be produced in the year 2000.

With regard to new 'Hass'-like cultivars, all cultivars which were tested matured later in the year than 'Hass'. 'Lamb Hass' was found to be the most promising new 'Hass'-like cultivar, while the cultivar Iriet also shows some promise and further testing is warranted.

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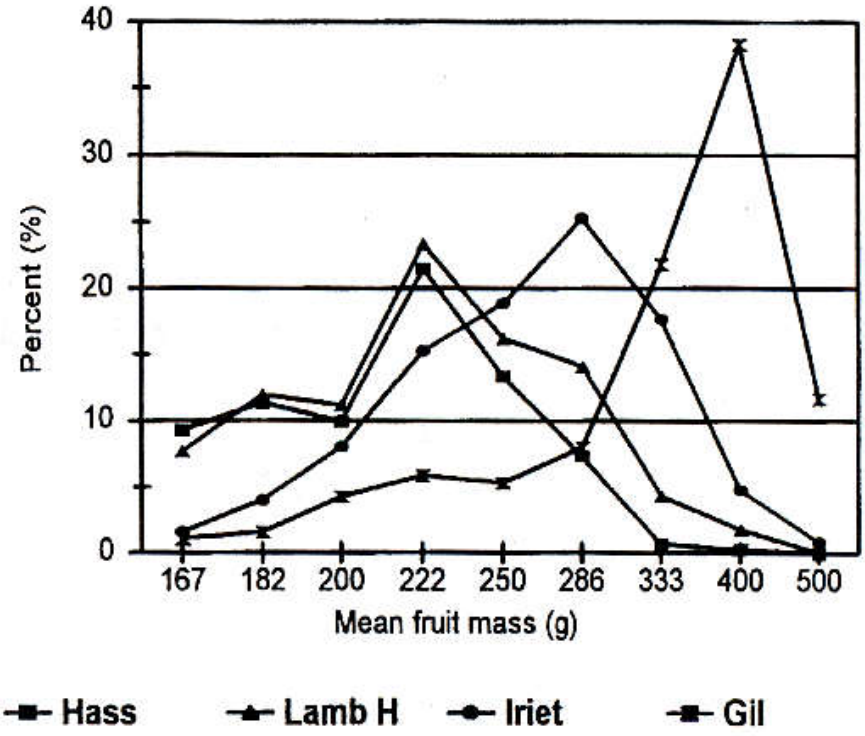

Figure 1. Fruit size distribution of the avocado cultivars Hass, Lamb Hass, Iriet and Gil (1998).