Session Four
New germplasm and global breeding programmes

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Rootstock Improvement for the Australian Avocado Industry - A Preliminary Report

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Webber, 1926

“no factor of the avocado industry is more important than rootstocks, and there is no problem that we know less about, or which requires a longer time to solve”.

Webber, 1926
80 years of learning

1. Rootstock differences in salinity and alkalinity tolerance
2. Rootstock differences in mineral nutrient uptake
3. Rootstock differences in concentrations of antifungal compounds
4. Rootstock differences on fruit quality
5. Rootstock differences on alternate bearing
Phytophthora root rot tolerance
Fantasy or fact?

After 40+ years of investment we are no closer to having rootstocks with commercial resistance to P.c.
Different evolutionary centres

Phytophthora cinnamomi

Persea americana
Botanical varieties = rootstock differences

Mexican

Guatemalan

West Indian
Botanical varieties = rootstock differences

Mexican    Guatemalan    West Indian

- Salinity
- Cold tolerance
- Soil boron uptake/translocation
- Anthracnose resistance
Horticultural vs Physiological Compatibility

Should we be worried?

Rootstock overgrowth  Scion overgrowth
Effect of graft union on roots

In most cases significant scion overgrowth results in strong alternate bearing

SHS
Servicing Horticulture
Scion overgrowth

‘Hass’ on ‘Mexcicola’

‘Hass’ on ‘Zutano’

SHS
Servicing
Horticulture
Rootstock challenges in Australia

Major differences in:

1. Climate
2. Soil types
3. Water quality
Test the effect of genetic diversity on:

1. Precocity
2. Sustainable yield
3. Fruit quality
4. Anthracnose resistance
5. Phytophthora tolerance
**Genetic diversity**

<table>
<thead>
<tr>
<th>Mexican</th>
<th>Guatemalan</th>
<th>WI</th>
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</thead>
<tbody>
<tr>
<td>‘Barr Duke’</td>
<td>‘A8’</td>
<td>‘Velvick’</td>
</tr>
<tr>
<td>‘Duke 7’</td>
<td>‘SHS 2’</td>
<td>‘SHS 4’</td>
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<tr>
<td>‘SHS 1’</td>
<td>‘Nabal’</td>
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<td>‘P1’</td>
<td>‘Peasley’</td>
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<tr>
<td>‘Toro Canyon’</td>
<td>‘Reed’</td>
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<tr>
<td>‘Thomas’</td>
<td>UC lines</td>
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</table>

**Hybrids**

- ‘Zutano’
- ‘A10’
- ‘Edranol’
- ‘Hass’
- ‘SHS 3’

**Hybrids**

- ‘Plowman’?
- ‘SHS 5’

SHS
Servicing
Horticulture
Field experiments planted 04/05

Seedling + cloned rootstocks – Hass & Shepard scions

Pemberton WA – Hass (180 trees)
Carabooda WA – Hass (90 trees)
Duranbah NSW – Hass (170 trees)
Hampton QLD – Hass (200 trees)
Childers QLD – Hass & Shepard (310 trees)
Walkamin QLD – Hass & Shepard (390 trees)
Other research - Propagation

Seed germination

- Control
- Seed top removed
- One side cut
- Four side cuts
- Seedcoat removal
- Heat treatment

Weeks after planting seed

%age germination

SHS
Servicing
Horticulture
Other research - Propagation

Cloning techniques

Mexican  Guatemalan  West Indian

Rooting difficulty

‘Duke 7’  ‘Velvick’
Other research - Propagation

Cloning techniques - wounding

Front

Back
Other research - Propagation

Cloning techniques - wounding

Collar of roots from 360° wound
Other research - Propagation

Cloning techniques - wounding

Double wounding/bottom KIBA
Other research - Anthracnose

20°C night/ 30°C night
> 90% RH
Other research - Anthracnose

Highly susceptible (5)  Very resistant (0)
### Other research - Anthracnose

#### Botanical variety x resistance

<table>
<thead>
<tr>
<th>Rst</th>
<th>Race</th>
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<tr>
<td>B. Duke</td>
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<tr>
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<td>A8</td>
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</table>
Other research - Anthracnose

Eco-evolutionary connections to *Colletotrichum* tolerance?

Mexican - 16°C, 786 mm

Guatemalan – 19.6°C, 1394 mm

West Indian - 28°C, 1137 mm
Susceptibility/resistance of botanical races to Anthracnose

Is it in the Chemistry?
Susceptibility of botanical races to Anthracnose

1. ‘Velvick’ has twice the leaf diene conc. of ‘Duke 6’  
   Coates et al. 2003

2. Higher concs. of phenolics in resistant rootstocks  
   Whiley, unpub.

3. Rootstocks change mineral nutrition profiles in fruit  
   Coates et al. 2003
The Bunny test!

3. No other Hass trees in this block were eaten

0 UT (S) 0 0 0 X E (S)
0 UT (S) 0 0 0
0 0 0 0 UT (S)
0 0 0 0
0 0 0 0
X PE (S) 0 0 0
0 0 0 0
0 0 0 0
X UT (S) X PE (S) 0 0
0 0 0 0
S = less than 0.75 m high
X = Duke 7 rootstock
0 = other rootstock

Data courtesy of G. Thomas
Conclusions

1. Scarification of avocado seed improves germination

2. There is significant potential to improve avocado yield, fruit quality and disease resistance through the selection of appropriate rootstocks

3. Rootstock attributes are strongly based on botanical races
Conclusions

4. There is a strong likelihood of rootstock chemistry playing an influential role in tree performance with more information required.

5. Be suspicious of rootstocks that produce a significant scion overgrowth – they could be under-performing.

6. Avoid Mexican race rootstocks or their hybrids in the summer-wet subtropics of Australia.
Acknowledgements

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