Rootstock Research at Westfalia, South Africa

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Westfalia Technological Services
www.westfaliainfo.com
Where is Westfalia, South Africa?
Introduction: Westfalia Ltd

• Westfalia Fruit Estate:
  – One of largest avocado producers in South Africa
  – ± 1 500 Ha avocado ($\frac{2}{3}$ Conventional and $\frac{1}{3}$ Organic)

• Westfalia Technological Services (WTS) is the research division of Westfalia

Privately funded
(± USD 2 million/year)
Introduction: SA avocado industry

- 13 000 ha
- 100 000 t/year
- 50% export
- greenskins and Hass-likes

*Majority of SA avocado production occurs in high rainfall areas (± 1 100 mm p.a.)
Rootstock research
...from seedling to clonal
Introduction: SA avocado industry

- Industry was initially based on seedling rootstocks
- By the late 1970’s the industry was almost crippled due to effect of *Phytophthora cinnamomi* (P.c.) root rot disease
  - Most limiting factor in avocado production in SA!
- 12 year orchard life expectancy

Unacceptable!
First clonal rootstocks in SA

• First clonal rootstocks were imported from California in 1970’s
  • E.g. Duke 6, Duke 7, G755, Thomas
• After much testing South African industry soon saw the advantages of clonal rootstocks
  – More P.c tolerance / improved tree health
  – More uniform and productive trees
• Duke 7 performed the best under our conditions and became the industry standard
Westfalia rootstock research

• 1980’s Westfalia also started looking out for "survivor trees" in diseased orchards (i.e. selection process)
• 1990’s Westfalia also started a breeding program.

Breeding Block

*Replanted 2011
Rootstock Research

• Westfalia Technological Services (WTS) is today the only institution in South Africa with such an active avocado rootstock breeding program
  —Our aim is to maintain high standards and to be seen as the “preferred” research collaborator
  —Collaborate with other international parties
    – E.g. University of California (USA),

• Rootstock breeding and evaluation is a long term process and requires much patience and dedication.

• A successful rootstock selection will take anything between 15 and 20 years before being released commercially
Rootstocks Research

• Important South African rootstock attributes
  – Productivity = higher profitability
  – Phytophthora root rot tolerance (Pc) / Tree health

• Secondary attributes
  – Salinity (E.g. USA)
  – Water logged conditions / Asphyxia (E.g. Chile)
  – Productivity under replant situations
  – Cold tolerance (E.g. New Zealand)

International collaboration important to test these secondary attributes under field conditions.
Why 15-20 years?

Rootstock research
Rootstock screening

Phase 1:
Seedlings are subjected to *P.c.* in a mistbed (6 weeks), and then retested and compared to the industry standard (Dusa®) = 2 years.
Rootstock screening

Phase 2:
Survivors are then put into a field trial, with high \( P.c. \) pressure, to test whether the trees bear well (‘Hass’ as scion)

= 6-8 years.

Killing fields

Healthy seedling selections cloned
Rootstock screening

• Phase 2:
  – Annually measure:
    • tree health,
    • yield efficiency,
    • fruit size,
    • graft compatibility.

Can’t afford to take short cuts.....
Rootstock screening:

Phase 3:
Successful selections are then planted on a semi-commercial scale, in various geographic areas, and compared to the industry standard. Not all trial sites have a high $P.c.$ pressure $= 6-8$ years.

Can’t afford to take short cuts....

Dusa® vs Duke 7
Field testing very important

Loss of trees: Hass/Duke 6 (early 1980s)
Stem pitting

Few fruit for big tree
Westfalia’s Dusa® followed the same rigorous testing.
Where are we now?
Westfalia’s Dusa® rootstock

• Dusa® has been planted commercially now for many years in different areas. Westfalia has continued to keep a close eye on tree performance compared to other commercially available rootstocks.

• So how did Dusa® do? Let me tell you
## Commercial evaluation

<table>
<thead>
<tr>
<th>Farm</th>
<th>Climate, soil, altitude</th>
<th>Rootstocks compared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tzaneen</td>
<td>Warm moist, clay soils, Alt. 800m.</td>
<td>Dusa®, Latas®</td>
</tr>
<tr>
<td>Mooketsi</td>
<td>Hot dry, sandy loam soil, Alt. 500m.</td>
<td>Dusa®, Rootstock B</td>
</tr>
<tr>
<td>Soekmekaar*</td>
<td>Cool moist, Clay loam soil, Alt. 1200m.</td>
<td>Dusa®, Duke 7</td>
</tr>
<tr>
<td>Politsi Valley</td>
<td>Cool wet, Clay oxisols, Alt. 1000m.</td>
<td>Dusa®, Duke 7</td>
</tr>
<tr>
<td>Schagen</td>
<td>Cool climate, sandy-clay loam, Alt. 800m.</td>
<td>Dusa®, Latas®, Rootstock B</td>
</tr>
</tbody>
</table>

*Low disease pressure*
Dusa® results from different areas

Yield (t/ha, 400 trees)

- Mooketsi 2005
- Tzaneen dam 2004
- Politsi 2003
- Soekmekaar 2003
- Schagen 2002

- Dusa
- Rootstock B
- Latas
- Duke 7
- Duke 7
- Dusa
- Dusa

- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011

- 73%
- -13%
- 39%
- -29%
- 5%
- 11%
Experience to date shows that Dusa® out-yields Duke 7 by at least 20% in replant situations in SA. Dusa® also recommended in replant sites in California.

Where low P.c. pressure/virgin soil some Duke 7 trees yield just as well.

Seedling trees not recommended and lack of tree uniformity still a problem.
Seedling vs Clonal rootstocks

Nabal seedlings

Dusa® clonals
Avocado tree sales (2009-2010)

Rootstock breakdown 2009-2010 Avocado tree sales

88% Clonal (57% Dusa, 25% Duke 7, 18% Bounty)
Dusa® success

• Dusa® is our most successful rootstock to date
  – Since mid 1990’s Dusa® took over from Duke 7 as the South African industry standard rootstock.
  – Sold across the world
    • USA, Spain, Chile, Australia, New Zealand

Grower receives 1 millionth avocado tree on Dusa® (2011)
International experience
New Zealand – Dusa® more cold tolerant
Poor soil structure – anoxia/asphyxia?

Chile – reports so far indicate that Dusa® is doing well.
Salt tolerance

- Trials conducted at UCR found that Dusa® showed relatively good salt tolerance
  (Menge et al. 2002).
Different management

• In USA plant growth regulators such as Sunny® aren’t registered/allowed
  – therefore tree “manipulation” different

• Same for organic orchards

Repeated girdling can lead to yellow trees
High pH conditions

• Dusa® trees can become very yellow depending on management
The road ahead
New Rootstock Developments

• Currently have 5 new WTS rootstocks in “Phase 2” screening, with 1 new Californian rootstock. (Grafted with 6 different scion cultivars).
• First crop 2011
• 5-10 years before commercialization!!
## Rootstocks – next chapter

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Year</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breeding Block : 20 rootstocks</td>
<td>1</td>
<td>Replanted 2011</td>
</tr>
<tr>
<td>Seedlings screened in Pc mistbed</td>
<td>2</td>
<td>± 7 500</td>
</tr>
<tr>
<td>10 copies / selection re-tested</td>
<td>4</td>
<td>± 5</td>
</tr>
<tr>
<td>Best selections (with Hass) planted in field trial</td>
<td>10</td>
<td>7 (planted 2011)</td>
</tr>
<tr>
<td>Pre-commercial testing</td>
<td>20</td>
<td>6 (plant 2012)</td>
</tr>
<tr>
<td>First commercial plantings producing</td>
<td>25</td>
<td>-</td>
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Rootstock development

• Encourage & assist in the development of clonal nurseries internationally
  – Changing preference for seedlings to clonals
• Find new rootstocks that perform better than the current selections.
• Be assured... Westfalia has some more exciting surprises up its’ sleeve!
  — Follow our progress on www.westfaliainfo.com
What is the right rootstock for you?

Soil

Climate

Disease

Management

Yield
Thank you – Any questions?