SESSION NINE
Session Nine
Fruit size and production

New Zealand and Australia Avocado Grower’s Conference’05
20-22 September 2005
Tauranga, New Zealand
An innovative system to achieve early precocity in avocado under the marginal growing environment in the Bay of Plenty, New Zealand

David J Sher

Presentation to the New Zealand and Australia Avocado Research Conference on 22 September, 2005
How cold is cool?

- Climate described as cool to cold subtropical by Wolstenholme rather than warm temperate.
- Climate characterised by cold, wet winters and mild, dry summers.
- Dec-Feb rainfall approx. 20% (300mm) of annual precipitation.
- Average daily maximum temperatures (>20°C) from November to April.
- Mean monthly temperatures below 12.5°C from May to September.
- Mean annual temperature of 14°C is coolest in the world for ‘Hass’ avocado (Wolstenholme 2002).
Ouch! Modified phenological behavior under a sub-optimal temperature regime

- Bias towards determinate flowering
- Limited pollination events
- Variability of synchronous dichogamy
- Longer flowering period
- Floral abortion and seedless fruitlets
- Truncated summer flush
- Late maturity of fruit
- Photo-inhibition of winter canopy
Manipulatory strategies to buffer against environmental stress and deliver increased productivity on a sustainable basis

- skill
- understanding of tree’s capacity for physiological adaptation
- amelioration of temperature through provision of shelter belts (windbreaks)
- use of nutritional inputs to drive phenological events
- successful development of an indigenous programme incorporating cultural modifications
- strong focus on root:shoot balance, ideal flowering wood, and photosynthetic function of the over-wintered leaves
‘Outing’ the orchard details

- Two pairs of adjoining orchards
- All situated on Oliver Road, Te Puna, Bay of Plenty
- All contoured to improve topography
- All sites required perimeter shelter belts
- Planting density of ±200 trees/ha
- Sprinkler irrigation and pollinizer trees
- Approx. establishment cost is $100-120 per tree
- Similar fertiliser practices and cultural regimes
- Phosphonic acid injection only exercised on one orchard (Hedge) due to imperfect drainage
Benefits of cultural modifications (large, fertilised planting holes at establishment) on young avocado tree performance

- improvements to leaf and trunk size
- much stronger early root growth
- better tree anchorage
- earlier expression of canopy complexity and fruitfulness
- enhanced buffering capacity against environmental constraints
Planting hole subsoil fertility analysis confirms need for pre-plant corrective measures to improve young tree performance

<table>
<thead>
<tr>
<th>Sample Name: A Sub South</th>
<th>Sample Type: Soil Avocado (S26)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analytes</strong></td>
<td><strong>Low</strong></td>
</tr>
<tr>
<td>pH</td>
<td>5.7</td>
</tr>
<tr>
<td>Olsen P (mg/L)</td>
<td>1</td>
</tr>
<tr>
<td>Phosphorus (mg/L)</td>
<td>2</td>
</tr>
<tr>
<td>Iron (Mehlich 3) (mg/L)</td>
<td>55.5</td>
</tr>
<tr>
<td>Manganese (Mehlich 3) (mg/L)</td>
<td>2.5</td>
</tr>
<tr>
<td>Zinc (Mehlich 3) (mg/L)</td>
<td>0.42</td>
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<tr>
<td>Copper (Mehlich 3) (mg/L)</td>
<td>0.25</td>
</tr>
<tr>
<td>Boron (Mehlich 3) (mg/L)</td>
<td>≤ 0.1</td>
</tr>
<tr>
<td>Cobalt (Mehlich 3) (mg/L)</td>
<td>≤ 0.02</td>
</tr>
<tr>
<td>Aluminium (Mehlich 3) (mg/L)</td>
<td>1780</td>
</tr>
<tr>
<td>Base Saturation (%)</td>
<td>11</td>
</tr>
<tr>
<td>Volume Weight (g/mL)</td>
<td>0.74</td>
</tr>
<tr>
<td>CEC (meq/100g)</td>
<td>8</td>
</tr>
</tbody>
</table>

The above nutrient graph compares the levels found with reference interpretation levels. NOTE: It is important that the correct sample type be assigned, and that the recommended sampling procedure has been followed. R.J. Hill Laboratories Limited does not accept any responsibility for the resulting information.

Courtesy of D H Lushington
Key establishment practices for early precocity - step 1

Picture 1: Planting hole (2 m square) excavated to a depth of 1 m then further deep-ripped to 2 m. After excavation add to the bottom of the hole (as shown): 7 kg lime, 5 kg Superphosphate and 1 kg ESTA® Kieserite prior to deep ripping.
Key establishment practices for early precocity - step 2

Picture 2: Add and mix thoroughly to the excavated soil: 0.5–0.75 cubic meter finely milled bark compost, 5 kg Lime, 5 kg Dolomite, 10 kg Superphosphate, 4 kg ESTA® Kieserite, 500 g boric acid and 500 g Zinc Sulphate Monohydrate
Key establishment practices for early precocity - step 3

Picture 3: Raised planting site, incorporated with compost and fertiliser, ready for planting
Key establishment practices for early precocity - step 4

Picture 4: A healthy young nursery tree suitable for planting, preferably in September.}

Courtesy of A. Barker
Key establishment practices for early precocity - step 5

Picture 5: A thriving young tree, 6 weeks after planting

Note:
(a) Tree is sprinkler irrigated
(b) Tree is planted on a mound and mulch applied

Courtesy of J. Hardy
Is the large, fertilised hole concept really necessary?
We go looking for answers below the soil surface
large, fertilised planting holes (Orchard A) with smaller, unfertilised planting holes (Orchard B)

39% and 73% increase for total root dry weight and estimated root mass for Orchard A

Sher and Dixon (2003)
The above-ground proportion of trees does not necessarily reflect the size of the root system below ground

Composite picture of a 9yr ‘Hass’ grafted onto ‘Zutano’ rootstock

Dixon and Sher (2003)
Over-winter frost protection of young trees during 1st season after planting
Sands orchard August 2004
Young bearing tree (>40 fruit) after 18 months from planting - Sands orchard
Example of leaf photo-oxidation at end of winter at Hedge Orchard (Sept 04)
Monitor tree at Hedge orchard (1st flowering = 45 fruit, 2nd flowering = 71 fruit, 3rd flowering = ? fruit)
Maunder orchard established 1999 (photo taken June 05)
Ideal syleptic spring-initiated flush unit at the Cutting orchard (April 03)
Aged, over-wintered leaves after 17 months on a fruitful determinate shoot
‘Plant growth is a function of two variables of nutrition; intensity and balance’

<table>
<thead>
<tr>
<th>season</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>S</th>
<th>Ca</th>
<th>Mg</th>
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<tr>
<td>1999/2000</td>
<td>105</td>
<td>28</td>
<td>89</td>
<td>28</td>
<td>37</td>
<td>12</td>
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<tr>
<td>2000/2001</td>
<td>334</td>
<td>81</td>
<td>338</td>
<td>84</td>
<td>110</td>
<td>35</td>
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<tr>
<td>2001/2002</td>
<td>381</td>
<td>96</td>
<td>702</td>
<td>190</td>
<td>144</td>
<td>48</td>
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<tr>
<td>2002/2003</td>
<td>381</td>
<td>96</td>
<td>765</td>
<td>477</td>
<td>144</td>
<td>243</td>
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<tr>
<td>2003/2004</td>
<td>447</td>
<td>122</td>
<td>867</td>
<td>552</td>
<td>136</td>
<td>314</td>
</tr>
<tr>
<td>2004/2005</td>
<td>460</td>
<td>122</td>
<td>905</td>
<td>502</td>
<td>136</td>
<td>276</td>
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</table>
How good is the innovative system?

The orchard yield data is revealed

Table 2: Total yield (tonnes/ha) for the Cutting and Maunder orchards since 2001.

<table>
<thead>
<tr>
<th>Harvest Date</th>
<th>Cutting orchard (est. 1998)</th>
<th>Maunder orchard (est. 1999)</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 2001</td>
<td>1.8</td>
<td>0.14</td>
</tr>
<tr>
<td>September 2002</td>
<td>4.0</td>
<td>1.76</td>
</tr>
<tr>
<td>October 2003</td>
<td>12.5</td>
<td>5.83</td>
</tr>
<tr>
<td>October 2004</td>
<td>15.9</td>
<td>9.16 (frost)</td>
</tr>
<tr>
<td>October 2005 (estimate)</td>
<td>20.0+</td>
<td>12.0+</td>
</tr>
</tbody>
</table>
A sample of New Zealand fruit destined for the Australian market!

(guaranteed free of spotting bug, fruit fly, red-shoudered leaf beetle, and tree climbing snakes)
Acknowledgements

J. G. M. Cutting
J. Dixon
A. Hedge
C. Maunder
R. Sands
Ravensdown Fertiliser Co-op Ltd
Sands orchard 18 months after establishment (May 2005)
Hedge orchard showing *phytophthora* infected trees in foreground (June 05)
Healthy, over-wintered leaves after 16 months on a fruitful determinate shoot
Ideal syleptic spring-initiated flush unit at the Cutting orchard (Sept 03)