SESSION NINE

Session Nine
Fruit size and production

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An innovative system to achieve early precocity in avocado under the marginal growing environment in the Bay of Plenty, New Zealand

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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 (>20ºC) from November to April
- Mean monthly temperatures below 12.5ºC 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
- Orchards planted in 1998, 1999, 2001, and 2003
- 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

Client:	New Dawn Orcherds	**Laboratory No.:**	229839/4
Address:	33C Main Road	**Registered:**	10-Oct-2003
	Tawa	**Reported:**	15-Oct-2003
	WELLINGTON	**Order No.:**	B26213
	New Zealand	**Submitted By:**	Veg-Gro Supplies Ltd
		Client Ref:	Avocado

Sample Name: A Sub South
Sample Type: SOIL Avocado (S28)

Analyte		Level Found	Medium Range	Low / Medium / High
pH		5.7	6.0 - 6.6	
Olsen P	(mg/L)	1	25 - 50	
Potassium	(me/100g)	0.08	0.50 - 0.80	
Calcium	(me/100g)	0.7	6.0 - 12.0	
Magnesium	(me/100g)	0.05	1.00 - 3.00	
Sodium	(me/100g)	0.09	0.00 - 0.50	
CEC	(me/100g)	8	12 - 25	
Base Saturation	(%)	11	80 - 86	
Volume Weight	(g/mL)	0.74	0.80 - 1.00	
Phosphorus (Mehlich 3)	(mg/L)	2	55 - 110	
Iron (Mehlich 3)	(mg/L)	56.5		
Manganese (Mehlich 3)	(mg/L)	2.5		
Zinc (Mehlich 3)	(mg/L)	0.42		
Copper (Mehlich 3)	(mg/L)	0.25		
Boron (Mehlich 3)	(mg/L)	< 0.1	2.5 - 4.0	
Cobalt (Mehlich 3)	(mg/L)	< 0.02		
Aluminium (Mehlich 3)	(mg/L)	1780	900 - 1300	
Base Saturation		K 1.0 Ca 8	Mg 0.7 Na 1.1	
MAF Units		K < 2 Ca < 2	Mg < 2 Na 3	

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 use of this 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

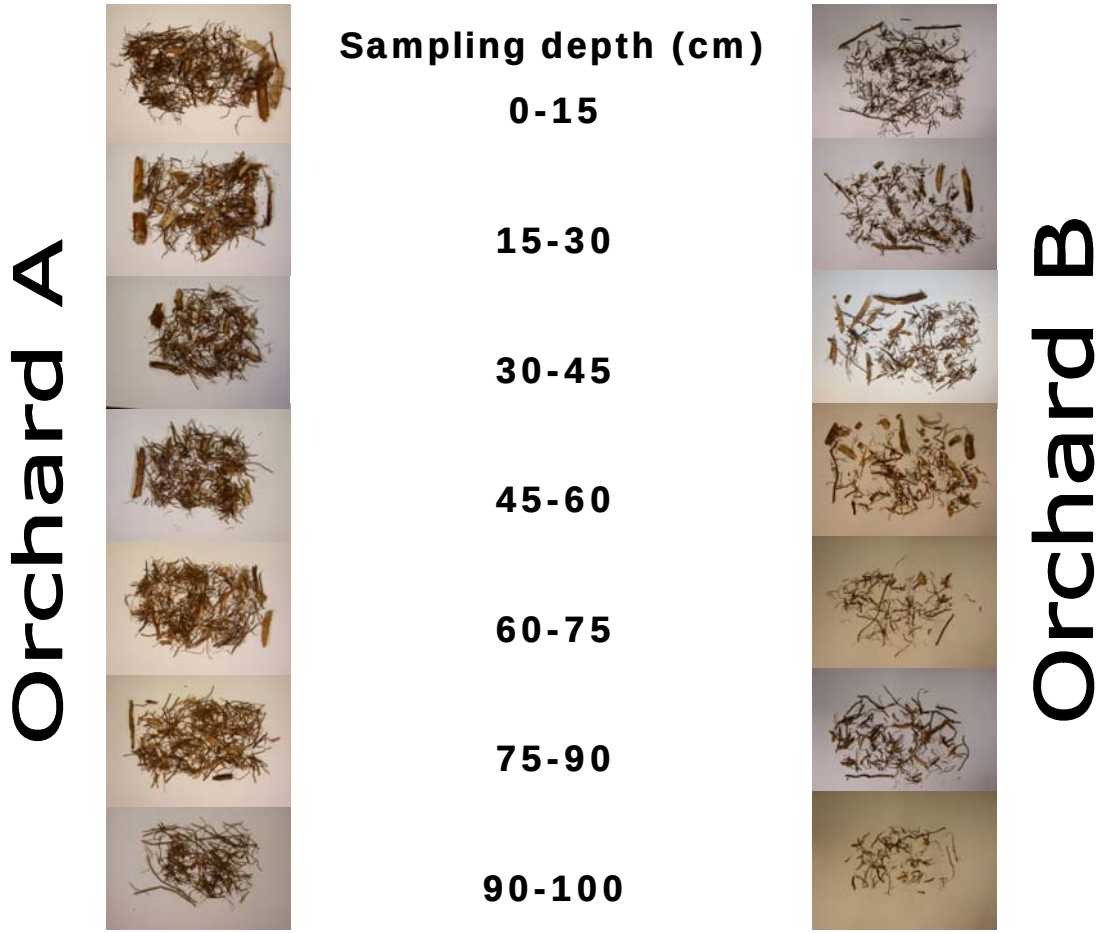
Picture 5: A thriving young tree, 6 weeks after planting
Note:
(a) Tree is sprinkler irrigated
(b) Tree is planted on a mound and mulch applied

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 sylleptic 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 1: Macro-nutrient inputs (g) per tree over 6 seasons at the Maunder orchard

season	N	P	K	S	Ca	Mg
1999/2000	105	28	89	28	37	12
2000/2001	334	81	338	84	110	35
2001/2002	381	96	702	190	144	48
2002/2003	381	96	765	477	144	243
2003/2004	447	122	867	552	136	314
2004/2005	460	122	905	502	136	276

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.

Harvest Date	Cutting orchard (est. 1998)	Maunder orchard (est. 1999)
September 2001	1.8	0.14
September 2002	4.0	1.76
October 2003	12.5	5.83
October 2004	15.9	9.16 (frost)
October 2005 (estimate)	20.0+	12.0+

A sample of New Zealand fruit destined for the Australian market!

(guaranteed free of spotting bug, fruit fly, red-shouldered 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 sylleptic spring-initiated flush unit at the Cutting orchard (Sept 03)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