Calculating Water Requirements for Maximum Production

OliveTec Australia

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Consultancy Services

Water Requirements for Olives

Olives are drought “tolerant”

In the Mediterranean countries olives are “Rainfed”

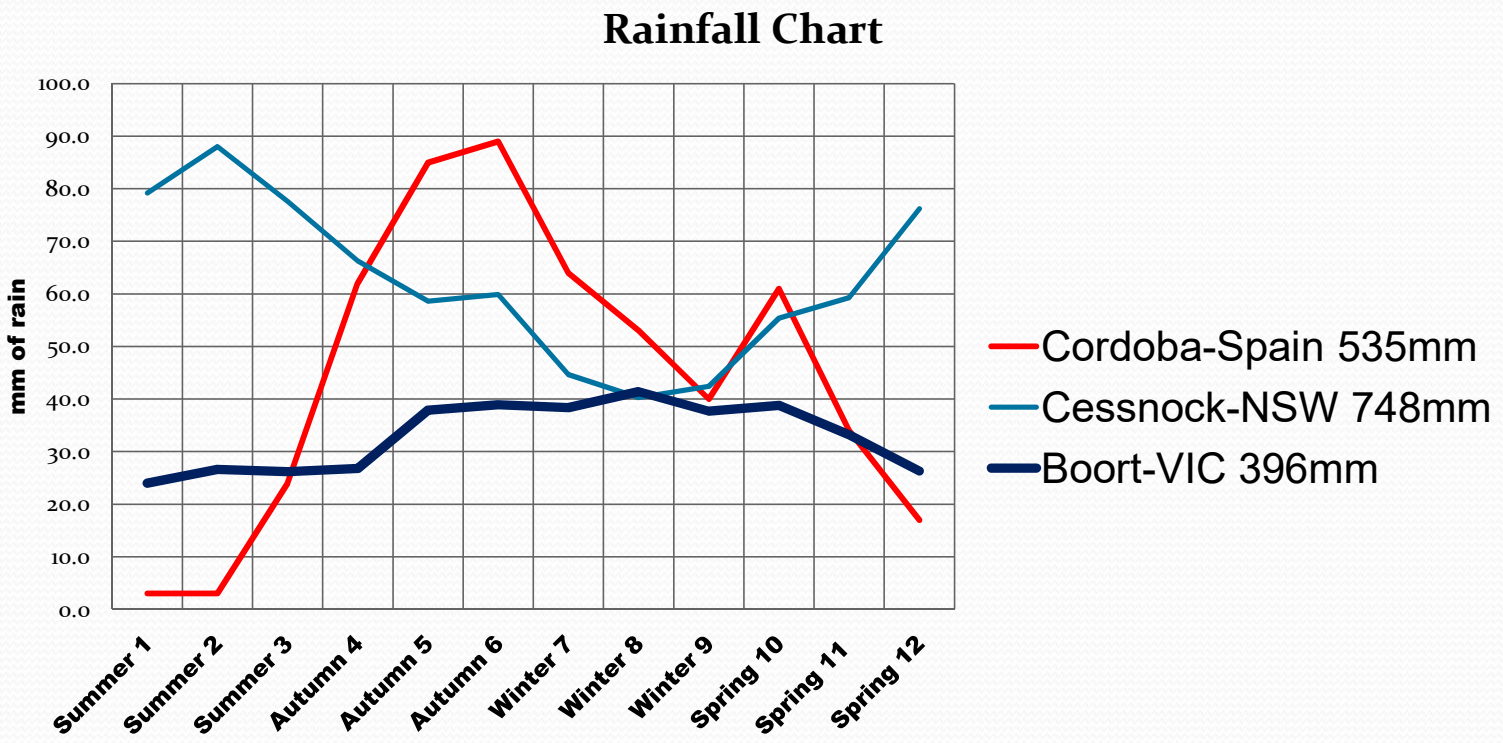
What growers don’t take into account is that:

“Winter rainfall” is crucial for Olive production

Soil profile “depth” is the most important factor after rain

Water Requirements for Olives

Australian Climatic Conditions vs. Cordoba Spain



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Water Requirements for Olives

What is the average yield in Spain?

Fruit = 2.67T/ha – Oil = 0.56T/ha = 600l/ha

What is the Quality of the oil produced?

35% EVOO - 32% Virgin Oil - 33% Lampante!!!

Water Requirements for Olives

Shallow Soil Profile and slopes?
Forget the rain!!!
"Generally speaking" Fully Mature Olives in Australia producing 10 Tonnes/hectare require *"approximately"* 5 (mL) Megalitres per Hectare of supplementary irrigation
1 mL = 1,000,000 litres = **1,000 m^3** = 100 mm
Tree spacing doesn't matter!!!
The canopy volume of a fully mature grove is about the same for Traditional 8 x 5 and SHD 3.5 x 1.5

Water Requirements for Olives

5mL seems like too much water

This is why a 10 years old grove looks like this

While a properly irrigated 8 years old grove looks like this

The reality is that 90% of them look like the first picture!

Water Requirements for Olives

What if I don't have 5mL/ha?

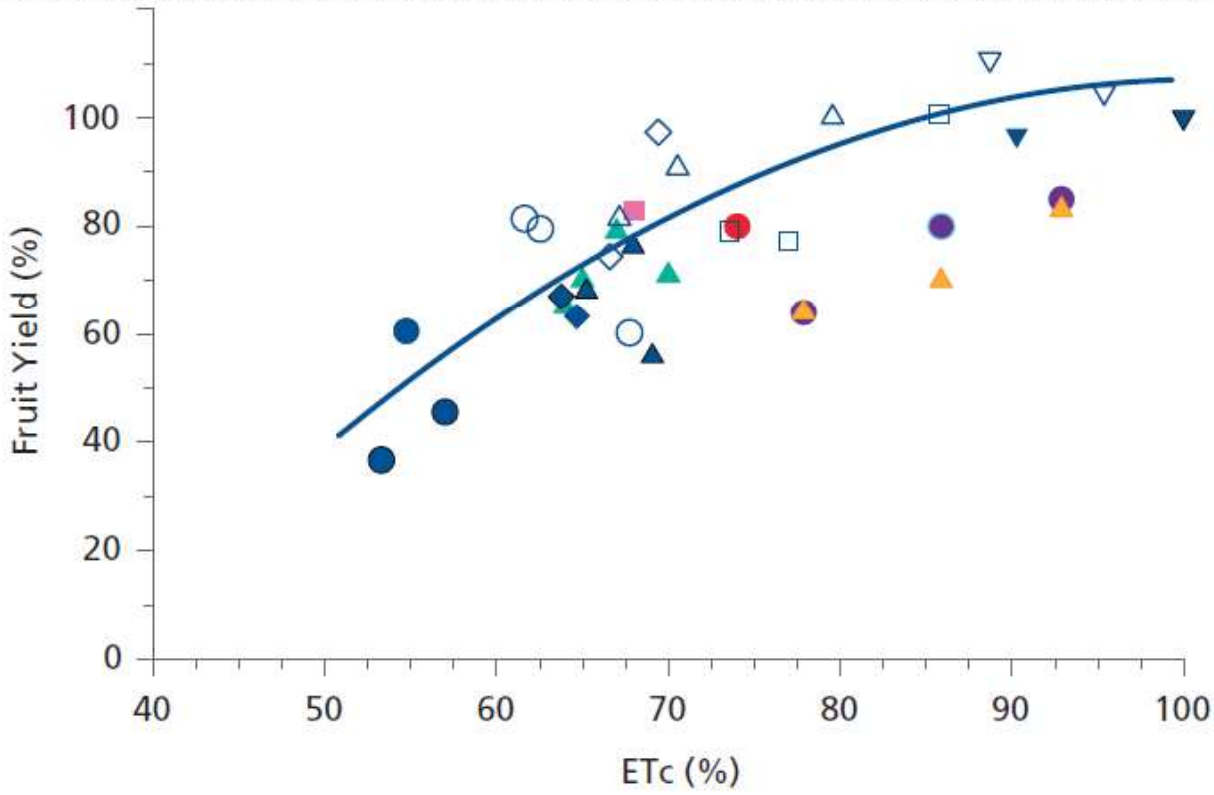
Yields are directly affected by water stress

Less water = Less crop

Less water = Increased Alternate Bearing

Less water = Less profit

Relationship between relative fruit yield and relative ET_c for olive. Curve was obtained for the cv. Picual in Cordoba, Spain (Moriana *et al.*, 2003), and data points obtained from additional studies (Lavee *et al.*, 2007; Iniesta *et al.*, 2009; Martin-Vertedor *et al.*, 2011; Gucci *et al.*, 2007 and Caruso *et al.*, 2011) for different cultivars, as shown in the graph.



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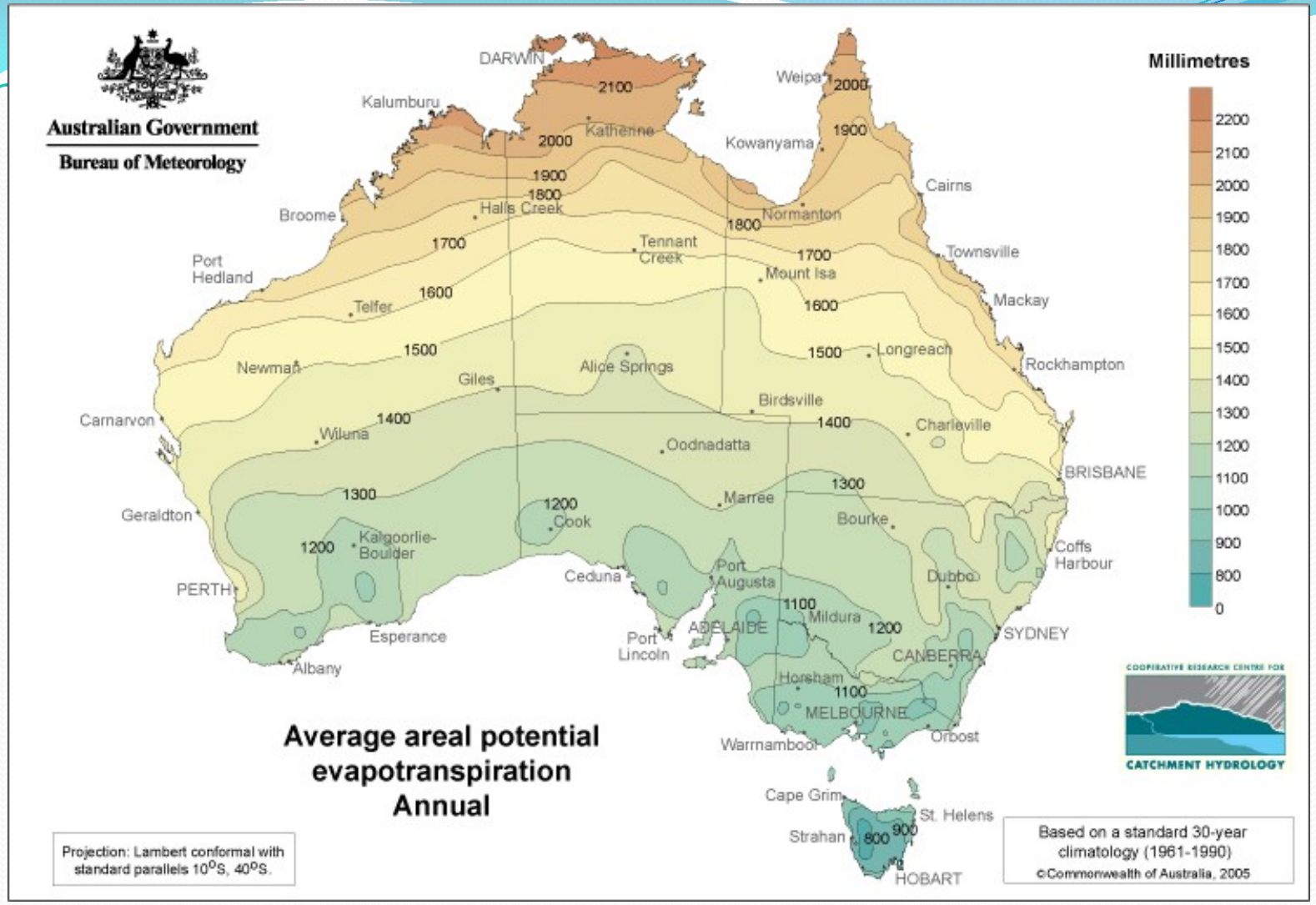
Water Requirements for Olives

How do we know Olives use approximately 5mL/ha?
Science/Research/Experience
Evapotranspiration (**ET_0**): Combined process of Evaporation from Soil and Transpiration from Plants
It is measured in mm/day. BOM produces this data and some Weather Stations automatically calculate it.
Crop Coefficient (**Kc**): Different plant species have different Evapotranspiration rates. Olives (**0.65**)
Ground Cover (**Gc**) also affects crop water usage.
Ground cover less than 50% - Multiply **Etc x 2xGc**



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Water Requirements for Olives

ET_0 1100mm to 1200mm - Most olive groves in Australia

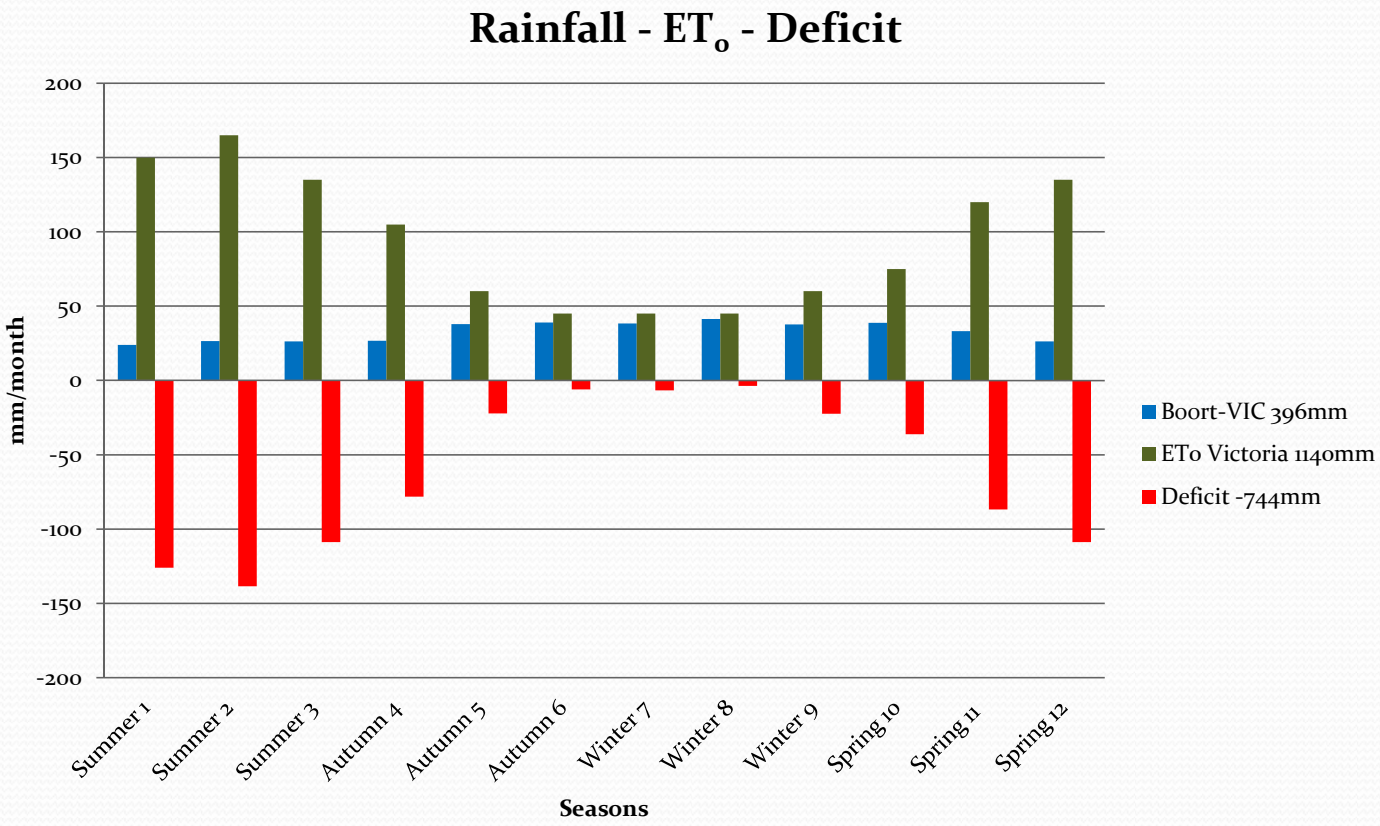
Olive Water Use: $ET_c = ET_0 \times K_c$

Example: ET_c= 1100mm x 0.65 = **715**mm = **7.15**mL/ha

Using Regulated Deficit Irrigation (RDI) it is possible to reduce water use by approximately **25%**

Olive Water Use: 7.15 x 0.75 = **5.36mL**

Water Requirements for Olives



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Olive Nutrition

What is a Nutrient?

- **It is a chemical element necessary for plant growth**

Which are the most important nutrients for Olives?

- **WATER!!!**
- **Nitrogen,**
- **Phosphorous,**
- **Potassium,**
- **Calcium**
- **Boron**

Nitrogen

- This element is required for:

- Shoot growth
- Bud break
- Fruit set

Phosphorous

- Promotes vigour
- Promotes active root growth
- Essential to young fruit
- Maintenance role in mature fruit

Potassium

- Increases Yields
- Promotes vigour
- Improves fruit size
- Increases tolerance to pests and diseases
- Increases tolerance to water stress
- Essential to plant nutrient balance – High K => Low Ca
- Visual Symptoms not reliable – Too late when they show

Calcium

- Calcium binds cells toghether
- Increases tolerance to physical stress
- Helps protecting against disease invasion (fungal diseases such as Anthracnose)
- Promotes healthy root growth
- Improves skin presentation
- Important for nutrient balance – High Ca => Low K

Calcium is not mobile in the plant, it follows water uptake and distribution in the plant

Boron

- This element is required for:
- Healthy root growth
- Improves nutrient uptake
- Improves Calcium uptake
- Improves Flower fertility and Fruit Set
- Higher yields

Leaf Samples

- Objectives:
- Check the nutritional status of the trees
- Detect deficiencies before they impact on yields
- Prepare a fertiliser program based on actual requirements
- Reduce wastage of fertiliser and protect the environment

Leaf Analysis

Guidelines

Element		Guide
Nitrogen	(%)	1.5 - 2
Phosphorus	(%)	0.1 - 0.3
Potassium	(%)	>0.8
Calcium	(%)	>1
Magnesium	(%)	>0.1
Sulphur	(%)	0.1
Boron	(ppm)	19 - 150
Copper	(ppm)	>5
Iron	(ppm)	50
Manganese	(ppm)	20
Zinc	(ppm)	>10
Sodium	(%)	<0.05
Chloride	(%)	<1.0

Leaf Analysis

Results

Compare data and detect trends

		Guide	2009	2010	TREND
Nitrogen	(%)	1.5	1.74	1.7	-0.04
Phosphor	(%)	0.1	0.18	0.17	-0.01
Potassiur	(%)	0.8	1.64	1.38	-0.26
Calcium	(%)	1	1.19	1.59	0.40
Magnesiu	(%)	0.1	0.14	0.2	0.06
Sulphur	(%)	0.1	0.16	0.16	0.00
Boron	(ppm)	19	21	33	12.00
Copper	(ppm)	4	5.7	8.3	2.60
Iron	(ppm)	50	53	76	23.00
Mangane	(ppm)	20	17	20	3.00
Molybden	(ppm)				
Zinc	(ppm)	10	17	15	-2.00
Sodium	(%)	<0.05	<0.05	<0.05	
Chloride	(%)	<1.0	0.17	0.2	0.03

Fertiliser Program

Objectives:

- Match nutritional requirements with fertiliser application
- Maximise effect of nutrients
- Minimise waste of fertiliser, leaching, runoff, etc
- Increase yields
- Increase fruit quality and oil content
- Reduce alternate bearing

Important things to remember

- Do Not Mix Varieties When Sampling
- Avoid Stressed Trees (Affected by Pests/Diseases/etc.)
- Take samples in January

- Soil Moisture: don't apply fertiliser if the soil is dry
- Use small doses of fertiliser. The fertiliser will leach, could cause toxicity or it could be washed away.
- Apply fertiliser only when the tree needs it. Soil content does not necessarily correlate with Leaf content.

Soil Samples

- Representative samples are difficult to obtain
- Most soils in Australia have a very shallow profile
- The most important parameters are:
- pH, EC, Organic Matter content and CEC

Soil Analysis

- **pH**: Soil acidity/alkalinity - Logarithmic
- Tests: pH ($CaCl_2$) is 0.5 to 1.2 units lower than pH (water)
- pH ($CaCl_2$) is considered more accurate in acid soils
- Olives grow well in Alkaline soils pH 7+
- Most soils in the olive growing regions of Australia are acidic

Soil Analysis

- **Electric Conductivity**: It is a measure of Soil Salinity
- It is measured in dS/m mS/cm
- Preferred levels: <3dS/m
- **Organic Mater**: (Improves Soil Structure and Water Retention Capacity)
- Preferred levels: > 3%
- **CEC** Cation Exchange Capacity: (Good indicator of Soil Fertility)
- Preferred levels: 10-30meq/100gr

Analysis	Result	Guideline	Interpretation	Comments
pH [1:5 H2O]	6.1	5.6 - 8.2	Normal	Ideal range is 5.6 - 8.0. pH is in the normal range.
pH [1:5 CaCl2]	4.9	5.0 - 7.6	Slightly Low	Ideal range is 5 - 7.5. This pH is marginal. Low pH can limit the availability of potassium, calcium, magnesium and molybdenum. Consider appropriate lime applications to raise the pH to a more suitable level.
Organic Matter (%)	4.1	3.0 - 8.0	Normal	Ideal range is 3 - 8%. Organic matter level is in the normal range.
CEC (meq/100g)	5.21	12.00 - 40.00	Low	Ideal range is 10 - 30 meq/100g. Indicates a soil with poor nutrient holding capacity. Regular (annual) fertilizer applications will help reduce leaching. Addition of organic matter will help.
EC [1:5 H2O] (dS/m)	0.04	0.90 - 3.00	Very Low	Ideal range is 0.9 - 3.0. No problems of salinity expected with this soil.
NO3-N (ppm)	5.0	15.0 - 70.0	Low	Low level indicates possible leaching of nitrate-nitrogen. If soil sampled at around 15cm, consider deeper sampling to ascertain subsoil nitrogen level.
Phosphorus [Olsen] (ppm)	25	20 - 70	Normal	Normal level of phosphorus is recorded.
Potassium[Am. Acet.] (meq/100g)	0.65	0.50 - 1.50	Normal	Normal level of potassium is recorded.
Calcium[Am. Acet.] (meq/100g)	3.26	6.00 - 15.00	Slightly Low	Slightly low level of calcium is recorded. Calcium is essential for normal crop development and plays an important role in ensuring quality and storability of many crops.
Magnesium[Am. Acet.] (meq/100g)	1.21	0.80 - 4.50	Normal	Level recorded is in the normal range.
Sulphur [MCP] (ppm)	9	8 - 20	Normal	Level of sulphur recorded is in the normal range.
Boron[CaCl2] (ppm)	0.2	1.0 - 5.0	Low	Low level of boron recorded. Boron is essential for normal crop development. Deficiency most often affects growing points causing stunting or mis-shapen plants. Flowering and pollination are commonly reduced.
Copper [DTPA] (ppm)	0.5	2.5 - 20.0	Low	Low level of copper recorded. Copper is essential for normal crop development. Deficiency affects photosynthesis and reduces yield and quality of production.
Iron [DTPA] (ppm)	74	5 - 120	Normal	Level of iron recorded is in the normal range.
Manganese [DTPA] (ppm)	6.1	5.0 - 60.0	Normal	Level of manganese recorded is in the normal range.
Zinc [DTPA] (ppm)	1.6	5.0 - 15.0	Very Low	Very low level of zinc recorded. Zinc is essential for normal crop development and often results in stunted crops with small leaves.

Summary

- Water management must be the main focus for growers.
- Stressed trees produce less fruit - many times no fruit
- Winter and Spring soil moisture content crucial to yields!
- Install a soil moisture monitoring system
- Use Drippers (95% Efficiency) vs. Sprinklers (50%)
- Remember 5mL/ha with sprinkles is **10mL/ha**
- Leaf samples in January – Do no mix varieties
- Soil samples not representative – Check pH/EC/OM/CEC
- **Thank you! For enquiries: rmberlanda@gmail.com**