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UNDERSTANDING SOIL ANALYSIS

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PISTACHIO NUTRITION – SOME BASIC PRINCIPLES

- **Important drivers**
  - Yield, nut quality, economics, tree establishment, early cropping, sustainability, biennial bearing
- **Macronutrients and micronutrients**
- **The 4 R's of nutrition management**
  - Applying the **R**ight rate of the **R**ight product at the **R**ight time in the **R**ight place
- **Potential yield determines fertiliser inputs**
- **How do plants take up nutrients from soil?**
  - Active roots. Roots need water and air to function.
  - Water is needed for nutrient uptake from soil
  - Nutrient mobility in soil

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PISTACHIO NUTRITION – SOME BASIC PRINCIPLES

- **Decision making tools**
  - Visual assessment
  - **Soil analysis**
    - **Indicates the amount of nutrient available to a plant in the soil**
  - Plant analysis
    - Measures the actual nutrient status of a tree at a particular point in time
  - Nutrient budgets
    - Predicting nutrient requirements based on crop estimates

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SOIL ANALYSIS

- **Soil analyses provide:**
  - A measure of the amount of nutrient available to a plant in the soil.
  - Information about other soil properties such as pH, sodicity (structural stability) and salinity
- **Each nutrient is present in the soil in various forms**
  - Soluble (in the soil solution)
  - Organic (needs to be broken down to be released)
  - Loosely held (exchangeable or slowly dissolving)
  - Tightly held (slowly exchangeable or very slowly dissolving)
  - Insoluble (component of soil minerals)
- **Soil analyses require calibration**

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SOIL SAMPLING

- **Understanding variation in soil**
- **Due to variation in the soil, you can not take a soil sample from just anywhere in the orchard**
- **Sampling strategies**
  - Adjust strategy according to the question being asked
  - Some of the questions commonly asked when considering soil analysis are:
    - What are the current reserves of nutrient in the soil?
    - Has the fertiliser applied recently increase soil nutrient reserves?
    - Have recent applications of lime increased pH?
    - Is acidification occurring under the drippers?
    - Is there a build up of salinity in the root zone?
    - Is the soil sodic and in need of gypsum?

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VARIATION IN SOIL

- **Soil pH in drip irrigated almond orchard**

Depth	Under dripper	Mid row	Native
0-15cm	5.1	6.1	7.9
15-30cm	5.3	6.8	7.7
30-45cm	5.7	7.2	7.9
45-60cm	6.8	8.2	8.1

- **Colwell phosphorus in drip irrigated orchard**

Depth	Under dripper	Mid row	Native
0-15cm	48	15	6
15-30cm	19	9	4
30-45cm	15	7	2
45-60cm	9	6	2

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SOIL SAMPLING

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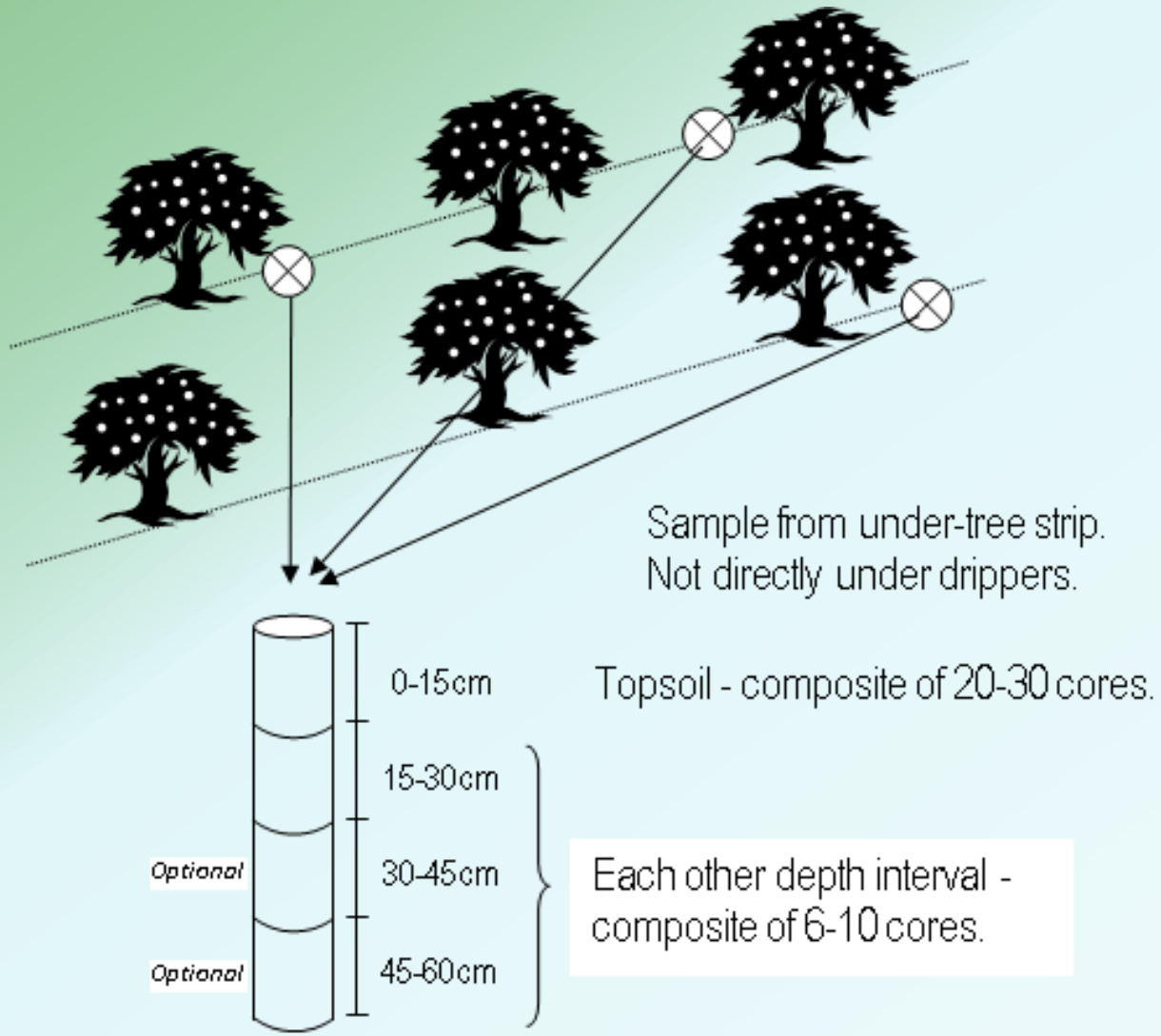
SOIL SAMPLING STRATEGIES

- **Do I need to apply fertiliser for my trees?**



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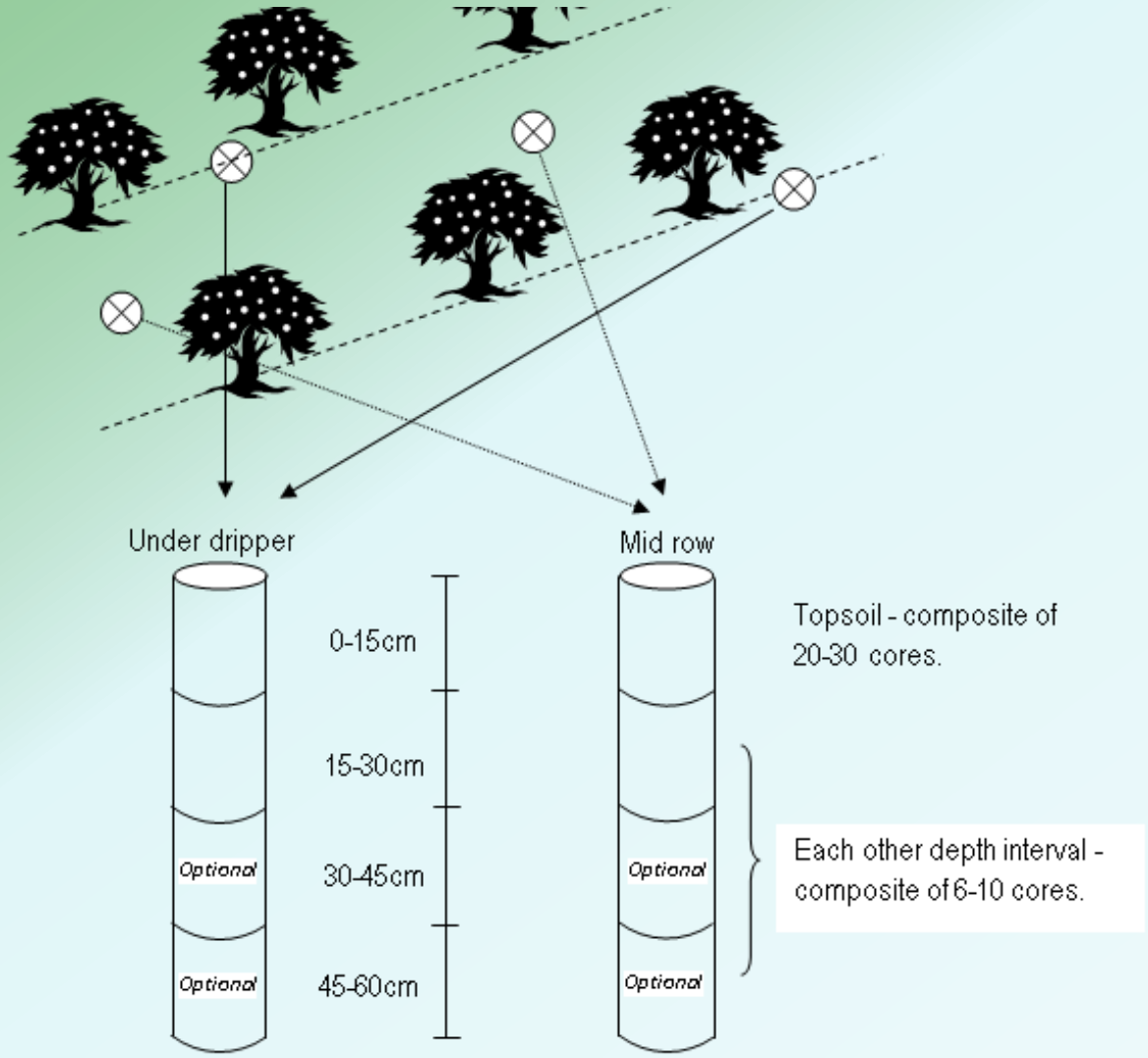
SOIL SAMPLING STRATEGIES

- **Is the soil underneath drippers being acidified?**



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USING SOIL ANALYSIS DATA

- **Nutrient concentrations**
  - Know your analysis method
- **Soil pH**
  - Influences the form and availability of nutrient in soil (e.g. aluminium in acidic soils)
  - Nitrogen fertiliser use, acidification and lime requirements
- **Sodicity and soil structural problems**
  - Gypsum requirements
- **Salinity**
  - Leaching irrigations, irrigation management
- **Monitoring**

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MONITORING

- **Changes in soil pH since 2008**

Depth	Soil $pH_{calcium\ chloride}$					
	2008	2012	2013	2014	2015	2016
0-15cm	7.1	6.2	4	6.9	5.1	5.6
15-30cm	7.8	7.1	4.2	7.5	6.4	6.5

- **Changes in Colwell potassium since 2013**

Depth	Colwell potassium (mg/kg)			
	2013	2014	2015	2016
0-15cm	309	152	161	124
15-30cm	285	121	152	114

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EXAMPLE SOIL ANALYSIS DATA

Element or Test	Topsoil	Subsoil A	Subsoil B
Depth - (cm)	0-15	15-30	30-45
pHcalcium chloride	5.0	5.8	7.2
Organic carbon - (%)	0.76	0.55	0.42
Colwell Phosphorus (P) - (mg/kg)	53	17	8
Colwell Potassium (K) - (mg/kg)	290	236	253
Extractable Sulfur (S) - (mg/kg)	50	4.2	10.2
Exchangeable Calcium (Ca) - (meq/100 g)	3.95	5.49	8.34
Exchangeable Magnesium (Mg) - (meq/100 g)	1.21	1.41	1.31
Exchangeable Potassium (K) - (meq/100g)	0.74	0.61	0.65
Exchangeable Sodium (Na) - (meq/100 g)	0.14	0.24	0.29
Cation exchange capacity - (meq/100 g)	6.04	7.75	10.59
Exchangeable sodium percentage	2.3	3.1	2.7
DTPA Extractable Copper (Cu) - (mg/kg)	2.96	1.01	0.87
DTPA Extractable Zinc (Zn) - (mg/kg)	1.58	0.42	0.36
DTPA Extractable Manganese (Mn) - (mg/kg)	21.49	26.15	6.39
DTPA Extractable Iron (Fe) - (mg/kg)	39.69	17.99	7.33
Extractable Boron (B) - (mg/kg)	0.69	0.45	0.47
Extractable Aluminium (Al) - (mg/kg)	0.21	< 0.20	< 0.20
ECe - (dS/m)	1.19	0.65	0.88
Chloride - (mg/kg)	27	48	30
Calcium Carbonate - (%)	0.27	0.25	0.4

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SUMMARY

- **The 4 R's of nutrition management**
  - Applying the **R**ight rate of the **R**ight product at the **R**ight time in the **R**ight place.
- **Soil analysis**
  - Indicates the amount of nutrient available to a plant in the soil
  - Provides information about other soil properties such as pH, sodicity and salinity
  - Variation in soil and sampling strategies. Adjust strategy according to the question being asked.
  - Using soil analysis data
    - Know your analysis method
    - Monitoring