

Sampling SIMPLY DIFFICULT!

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Sampling Challenges

- Rising costs
- Impartiality
- Time
- Labour
- Complexity



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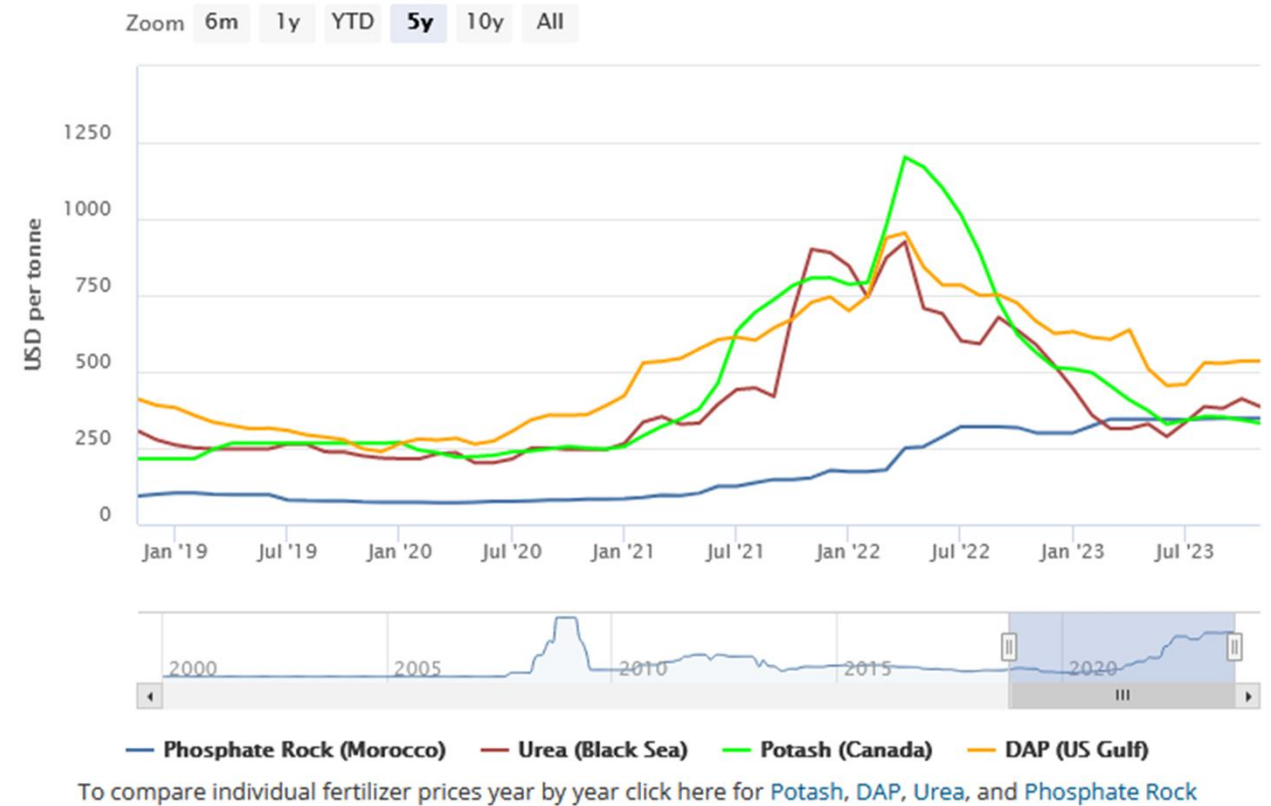


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Rising Costs

- Can we afford to ignore sampling if it affects production and future income?

Fertilizer Prices-FOB (Monthly)



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Impartiality

- Reputation, experience and position
- Agree on method
- Or D.I.Y.



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Time and Labour

- Use scouts
- Pool labour as a team
- The right tools and transport



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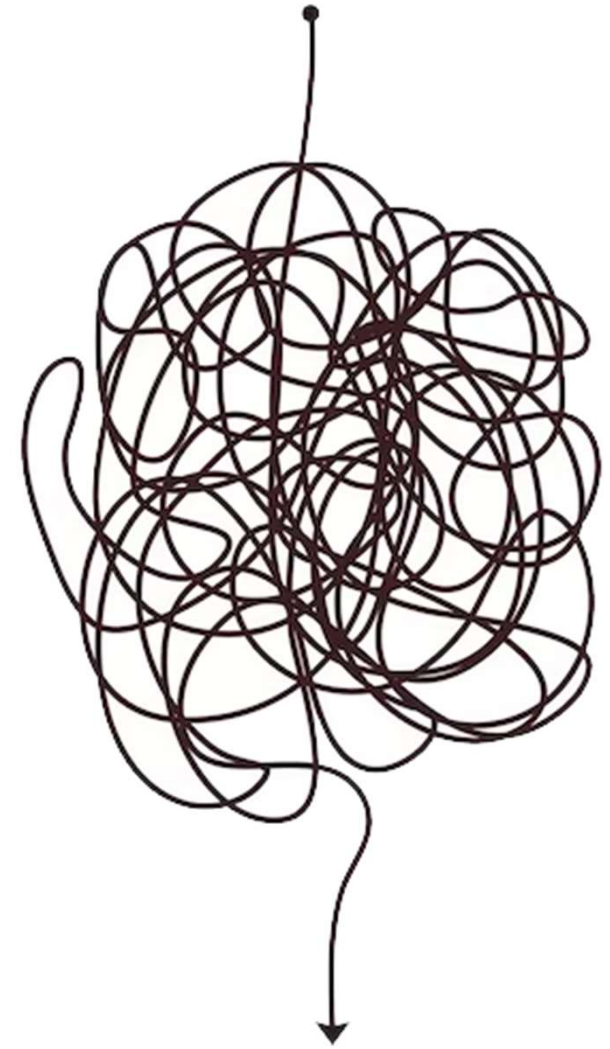
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Complexity

- **Practically it's about sampling number and location**
- **First step - plan sampling areas or zones to minimise variation (sampling error)**



Complexity

“The accuracy with which soil test results reflect the true condition of soils in the field is more dependent on the way in which the sample is collected and handled rather than on error associated with the laboratory analysis.”- Soil Sampling and Methods of Analysis (2nd ed.)



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Soil

- **Zone by: irrigation system**
- **Irrigation block, isobaric pressures and type of emitter**



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Soil

Zone by:

- Crop
- Cultivar
- Plant age



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Soil

- **Zone by: slope and altitude**
- **Drainage, nutrient retention, organic matter levels and soil redox conditions**



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Soil

- **Zone by: soil texture**



Soil Texture	Typical CEC (meq/ 100 g soil)
Sands	3-5
Loams	10-15
Silt loams	15-25
Clay and clay loams	20-50
Organic soils	50-100

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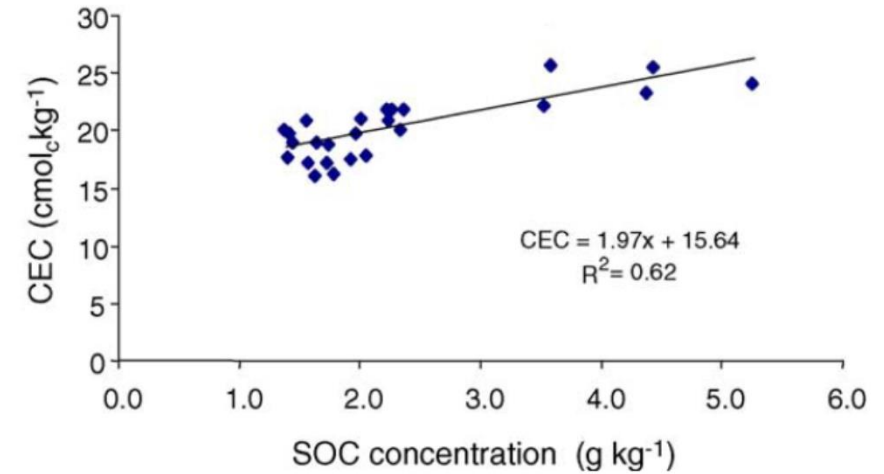
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Soil

- Zone by: organic material
- $\text{OrgC}\% \times 1.72 = \text{OM}\%$
- 20000 gal/ac = 187000 l/ha
- SOC 0.1% to 0.5% ~
+5 cmol+/kg on silt loam



Soil

- **Zone by: row orientation or aspect**
- **Organic matter breakdown, drainage**



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Soil

- **Zone by:
management
practices**



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Soil

- **Zone by: soil colour**
- **Soil colour is not always an indicator of differing soil properties, but it can be**



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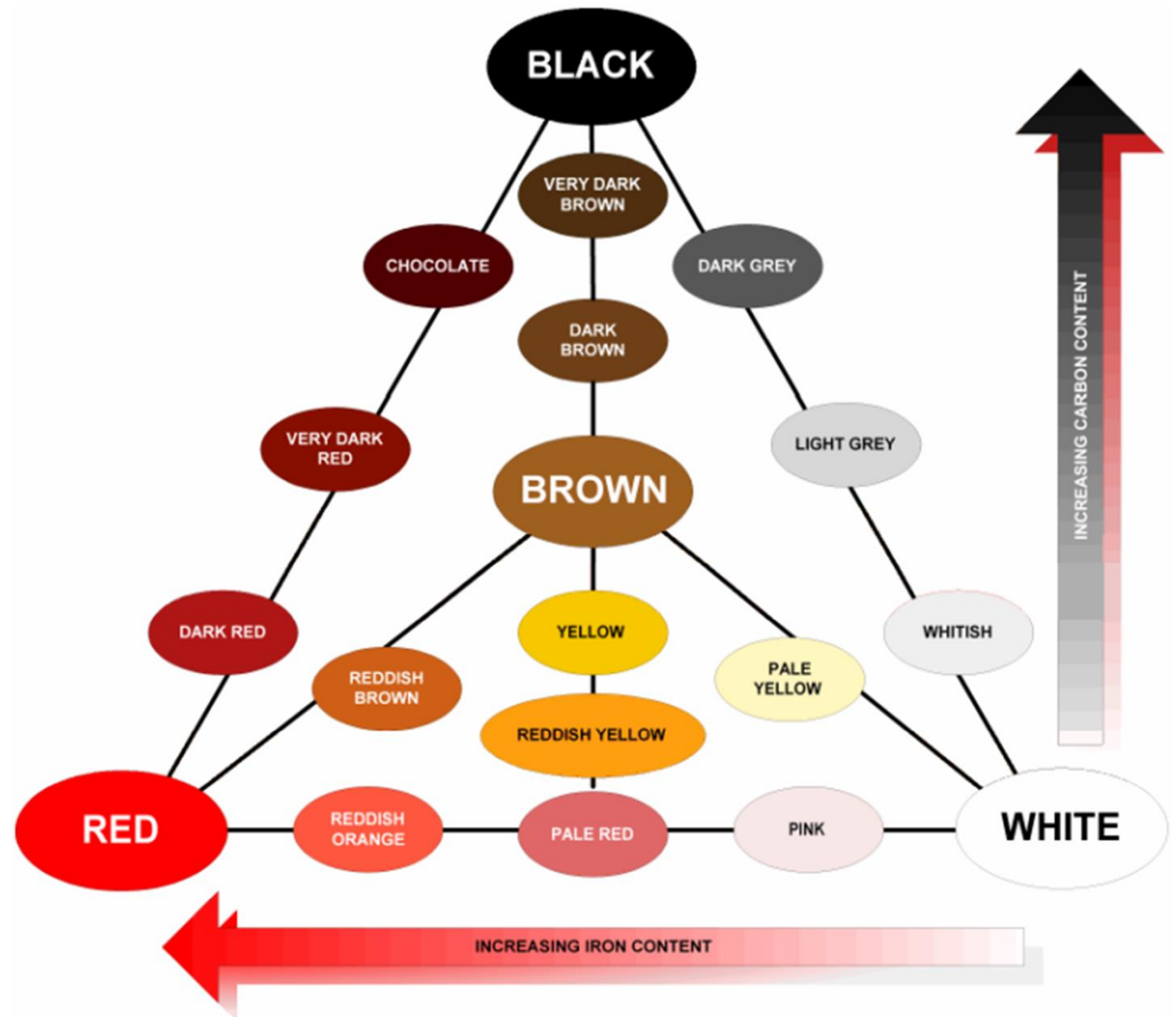
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Soil



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Soil

- Take samples at same time of year
- P&S released more during dry summer conditions
- pH and rainfall



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Soil

- Taupo ash soil - paddock

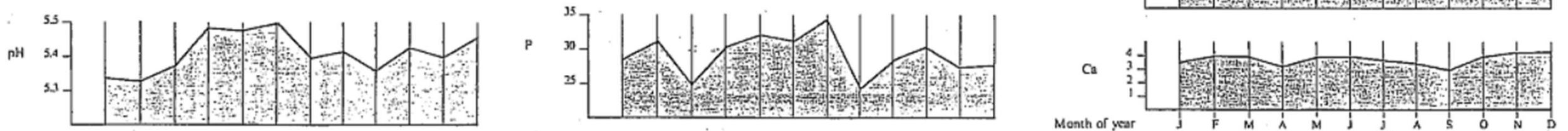
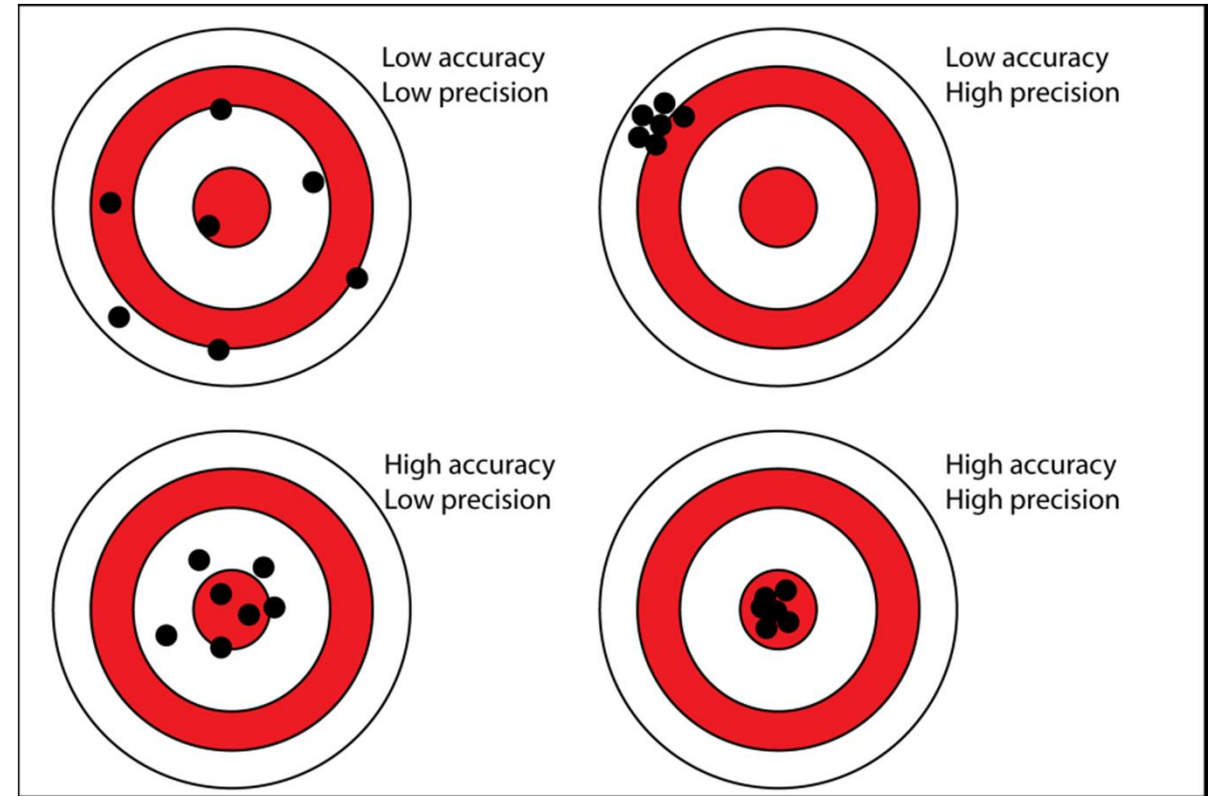


Fig 1. Variation in soil test values on a Taupo ash soil.



Soil

- **Zone size and number of subsamples**
- **Commonly 10-20 on 4-6ha**
- **Test: do a number of samples in an area**
- **Meet is weat**
- **Check RSD/CV**



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Soil • Meet is weet

$$s = \sqrt{\frac{\sum_{i=1}^N (x_i - \bar{x})^2}{N - 1}}$$

s = sample standard deviation

N = the number of observations

x_i = the observed values of a sample item

$\bar{x}$ = the mean value of the observations

$$\text{Coefficient of Variation (CV)} = \frac{\text{Standard Deviation (s)}}{\text{Sample Mean } (\bar{x})}$$

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TABLE 1.2 Variability of Soil Properties

Coefficient of variation			
Low (CV <15%)	Moderate (CV 15%–35%)	High (CV 35%–75%)	Very high (CV 75%–150%)
Soil hue and value ^a pH ^a	Sand content ^a Clay content ^a	Solum thickness ^a Exchangeable Ca, Mg, K ^a	Nitrous oxide flux ^b Electrical conductivity ^b
A horizon	CEC ^a	Soil nitrate N ^b	Saturated hydraulic conductivity ^b
Thickness ^a	% BS ^a	Soil-available P ^b	Solute dispersion coefficient ^b
Silt content ^a Porosity ^b Bulk density ^b	CaCO ₃ equivalent ^a Crop yield ^b Soil organic C ^b	Soil-available K ^b	

^a Adapted from Wilding, L.P. and Drees, L.R., in L.P. Wilding, N.E. Smeck, and G.F. Hall, (Eds.), *Pedogenesis and Soil Taxonomy. I. Concepts and Interactions*, Elsevier Science Publishing, New York, 1983, 83–116.

^b Adapted from Mulla, D.J. and McBratney, A.B., in M.E. Sumner (Ed.), *Handbook of Soil Science*, CRC Press, Boca Raton, Florida, 2000, A321–A352.

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	mg/kg or ppm							%	mS/cm
Sample	P	K	Ca	Mg	Na	B	S	Org C	EC
9	74	56	584	103	29	0.15	15	0.47	0.342
8	48	55	321	47	17	0.12	12	0.22	0.162
7	43	53	300	45	20	0.13	13	0.12	0.148
6	41	45	261	41	20	0.12	13	0.13	0.136
5	35	38	236	37	17	0.11	10	0.27	0.114
4	60	75	392	60	25	0.12	15	0.29	0.284
3	45	65	318	52	27	0.11	14	0.27	0.181
2	37	62	262	46	24	<0.10	13	0.29	0.159
1	173	152	694	124	27	0.22	19	0.53	0.923
SD	43.459	33.733	159.139	30.545	4.512	0.037	2.489	0.137	0.255
Mean	61.778	66.778	374.222	61.667	22.889	0.135	13.778	0.288	0.272
RSD	70%	51%	43%	50%	20%	27%	18%	48%	94%



	mg/kg or ppm							%	mS/cm
Sample	P	K	Ca	Mg	Na	B	S	Org C	EC
9	74	56	584	103	29	0.15	15	0.47	0.342
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2	37	62	262	46	24	<0.10	13	0.29	0.159
1	173	152	694	124	27	0.22	19	0.53	0.923
SD	8.295	12.469	52.083	7.471	3.952	0.008	1.574	0.074	0.055
Mean	44.143	56.143	298.571	46.857	21.429	0.118	12.857	0.227	0.169
RSD	19%	22%	17%	16%	18%	6%	12%	32%	32%



	mg/kg or ppm							%	mS/cm
Sample	P	K	Ca	Mg	Na	B	S	Org C	EC
9	74	56	584	103	29	0.15	15	0.47	0.342
8	48	55	321	47	17	0.12	12	0.22	0.162
7	43	53	300	45	20	0.13	13	0.12	0.148
6	41	45	261	41	20	0.12	13	0.13	0.136
5	35	38	236	37	17	0.11	10	0.27	0.114
4	60	75	392	60	25	0.12	15	0.29	0.284
3	45	65	318	52	27	0.11	14	0.27	0.181
2	37	62	262	46	24	<0.10	13	0.29	0.159
1	173	152	694	124	27	0.22	19	0.53	0.923
Mean	44.143	56.143	298.571	46.857	21.429	0.118	12.857	0.227	0.169
Mean	46.500	59.250	309.000	48.500	21.500	0.120	13.250	0.233	0.185
% difference	5%	6%	3%	4%	0%	1%	3%	2%	10%

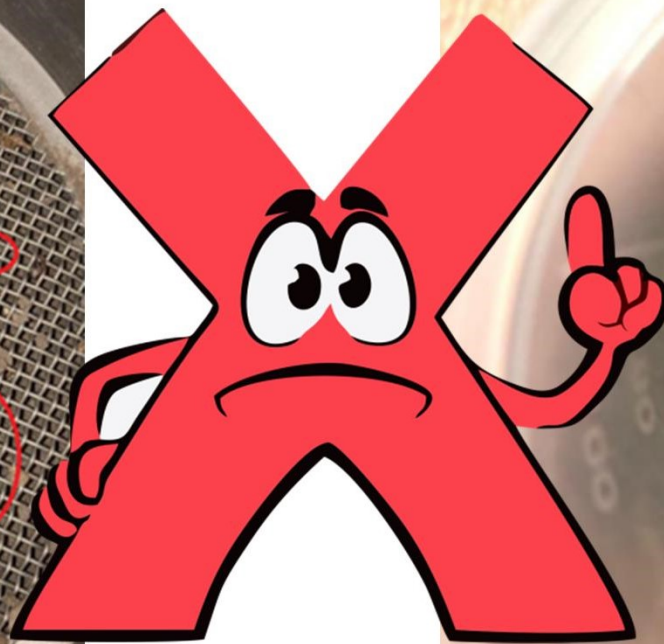


Soil

Procedure:

- Use a soil auger or a shovel - scrape surface first
- Zigzag, grid, transect pattern or at specific marker trees
- 30cm depth in root zone
- Don't sample fertiliser granules, don't use fertiliser bags
- Combine subsamples in plastic (not metal) bucket and mix
- Remove debris and place 500g in labeled bag
- Don't expose samples to moist or hot conditions and transport to lab





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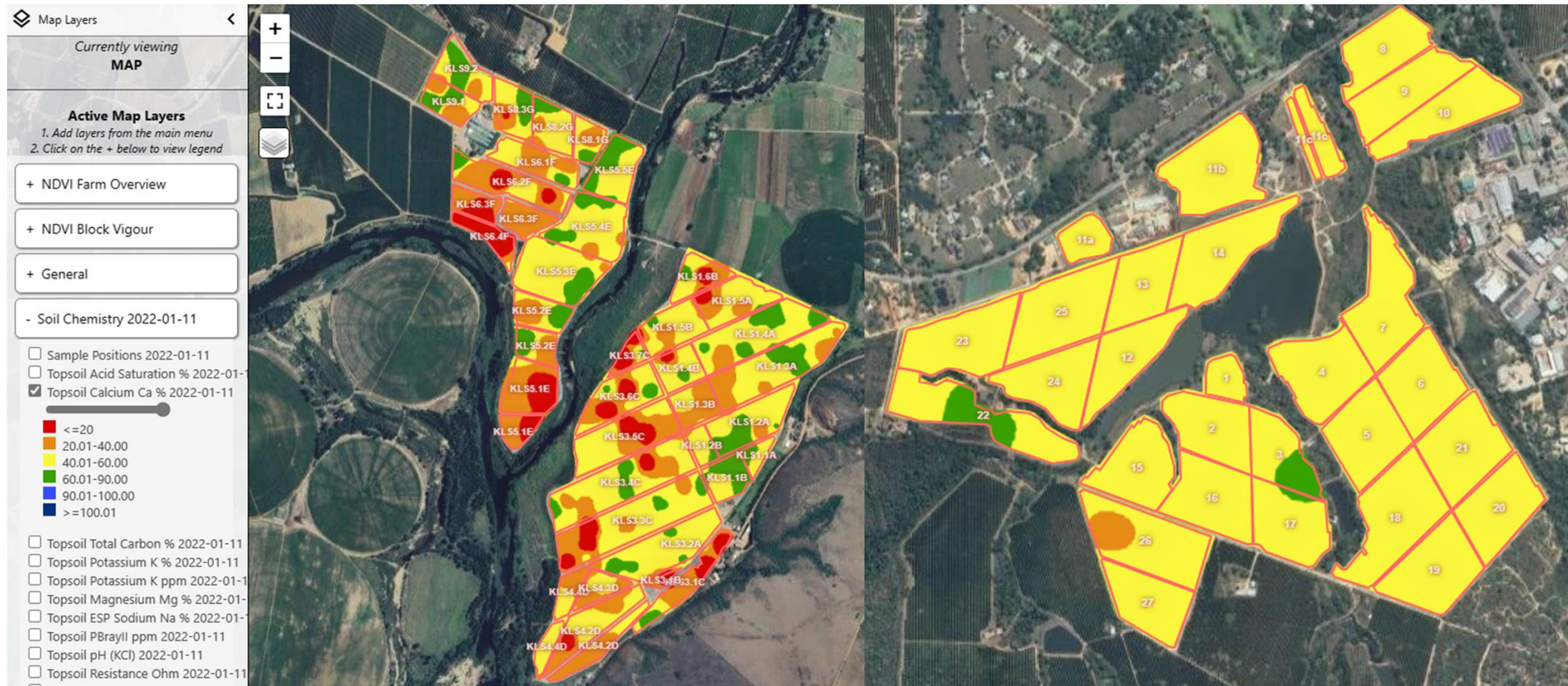
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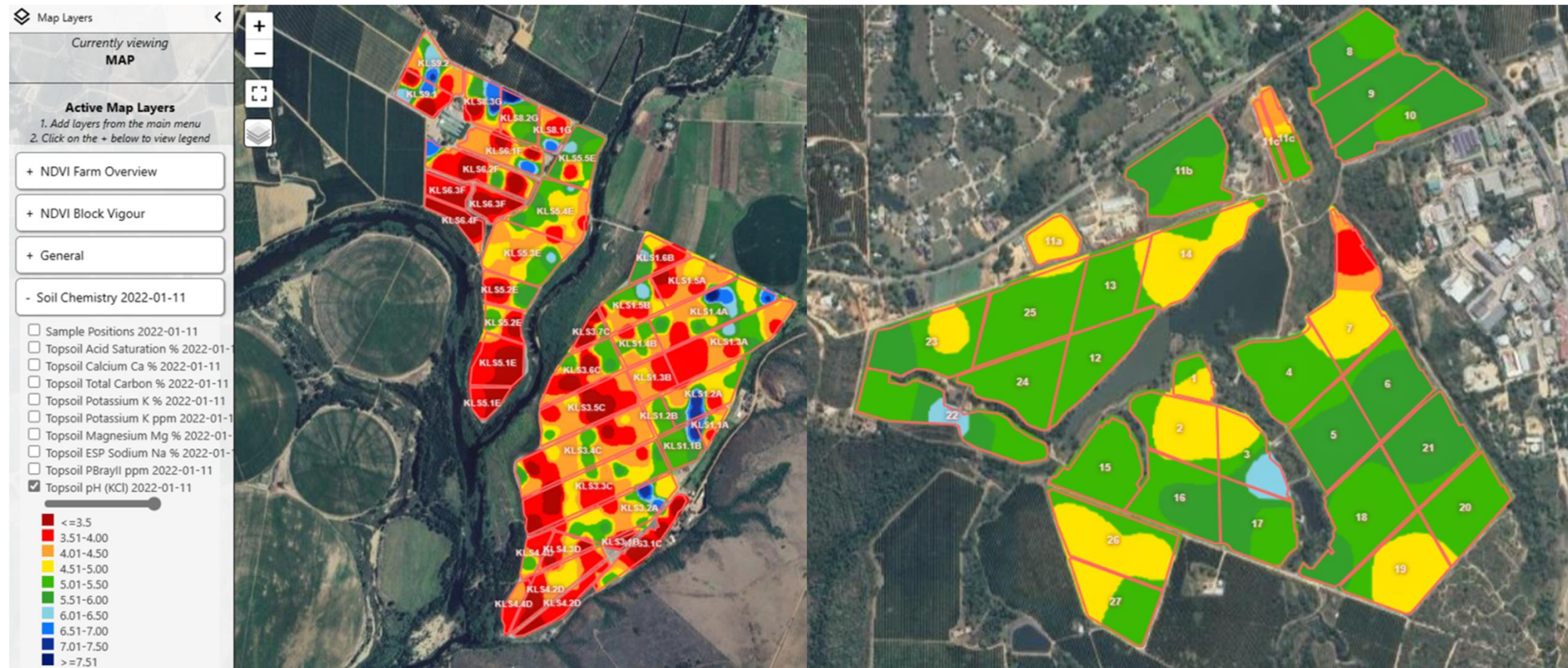
Practical variation

- Topsoil Ca %; 50 vs 150m grid: courtesy of Agrimotion



Practical variation

- Topsoil pH(KCl); 50m vs 150m grid: courtesy of Agrimotion



Avocado leaves

- Leaves are less variable than soil
- Apply similar principles
 - Cultivar, age, row orientation, management etc.
- Take samples on both sides of tree
- Mature leaves



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Avocado leaves

- **No flush, flowers or fruit (sinks) on branch**
- **Double handful**
- **Breathable bag**
- **Cool don't freeze**
- **Get to the lab**
- **For diseased: good and bad areas**



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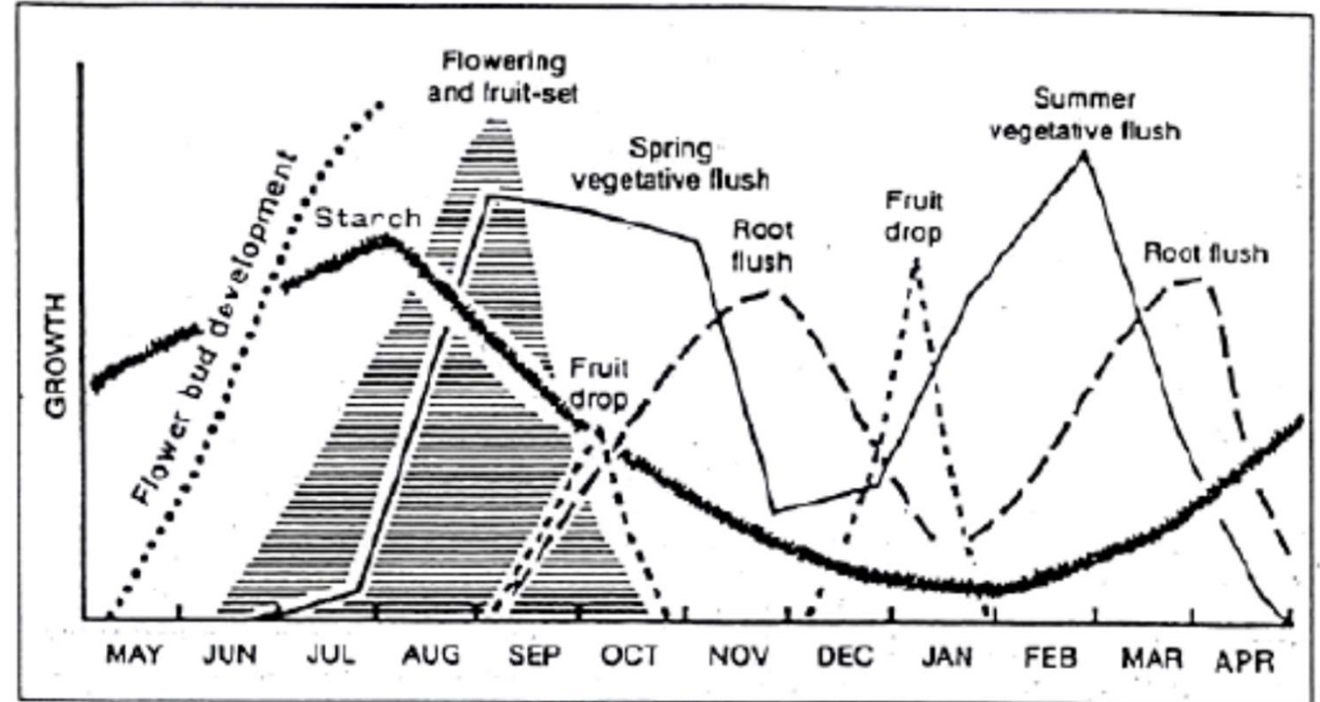
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Avocado leaves

- Spring leaf growth (leaves of 6-8 months old without fruit and without signs of new leaf growth)



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Hill Labs – N.Z.

Leaf

Sampling Time: April to May, when the summer flush has ceased.

Plant Part Youngest mature leaf (blade plus petiole).

Collect From: Shoots that are not flushing nor fruiting. Select from the canopy of the trees at shoulder height, and exclude boundary trees.

Quantity per Sample: 4-8 leaves from each of 20 trees selected at random from throughout the sampling area.

Recommended Tests: Basic Plant (BP), Chloride (Cl).

Comments: Select trees that are sampled and identify them so that they can be sampled again the following year.

Ensure leaves from each tree are taken evenly from the sunny and shaded sides.

Do not mix cultivars or trees of different ages in the samples.

To help diagnose an obvious problem, leaves showing the first signs of the distinctive symptoms should be collected as soon as abnormalities appear. If sampling outside the normal sampling time it is useful to take a second sample of similar, healthy leaves from nearby unaffected trees for analysis as a comparative standard.



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- Choose average-sized, healthy, undamaged leaves that are 4 – 6 months old and located on non-fruiting branches
- Do not sample a terminal leaf
- Do not choose the “worst looking” leaves on a tree as the reports from those leaves may mask the true cause of a tree’s decline (if a tree has deficiencies, those deficiencies are normally detected in healthy-looking samples as well)
- Choose one leaf per tree, selecting leaves that represent all four quadrants of the grove’s canopy

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