

MANGO SAMPLING, STATISTICS & DATA

23 July 2026

By Larne Auerswald

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Why monitor?

**It's about the Rands!
Make sense?**

The more you learn,
the more you earn.



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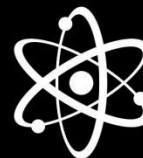
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Monitoring

“You can’t improve what you don’t measure!” – Pete Drucker

MEASURE
SUCCESS



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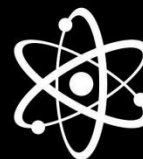
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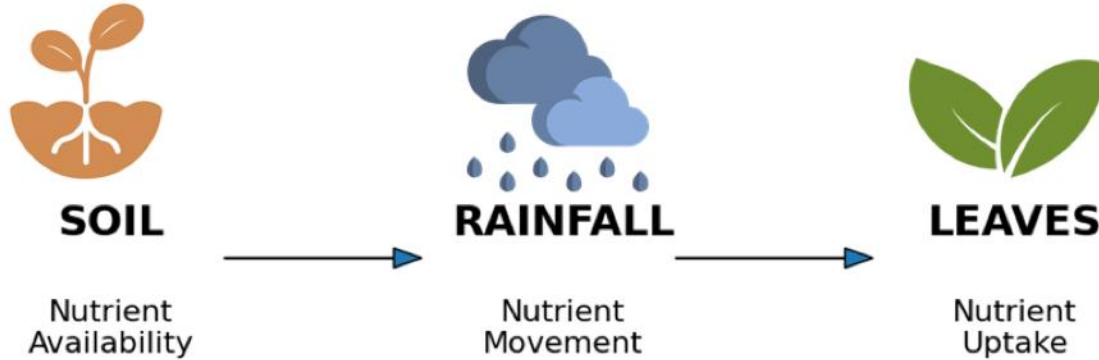
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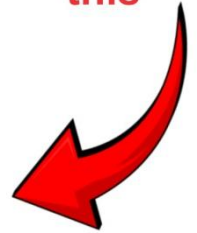


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Soils influence potential. Leaves reveal what happened.



**Remember
this**



*Our soil data explains what could happen.
Our leaf data shows what actually happened.*

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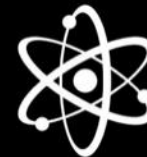
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Sampling

“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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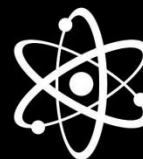
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Sampling



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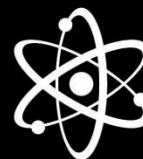
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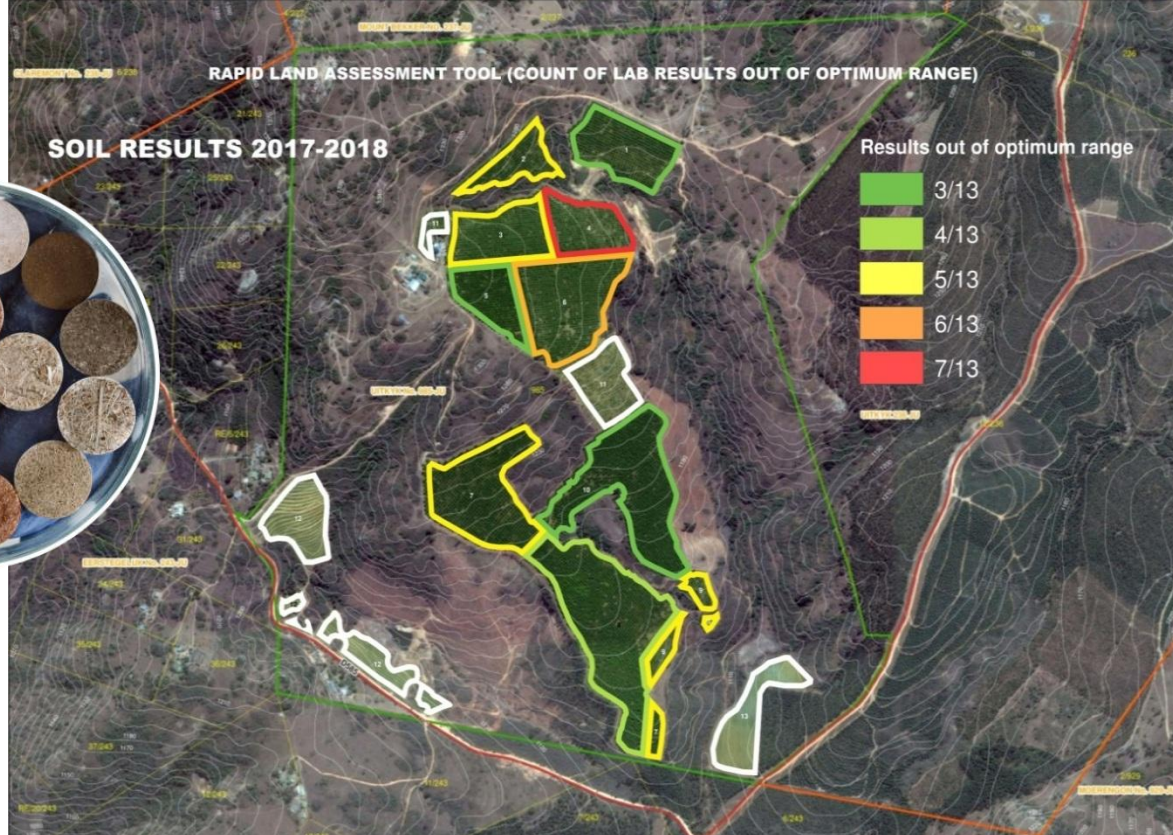
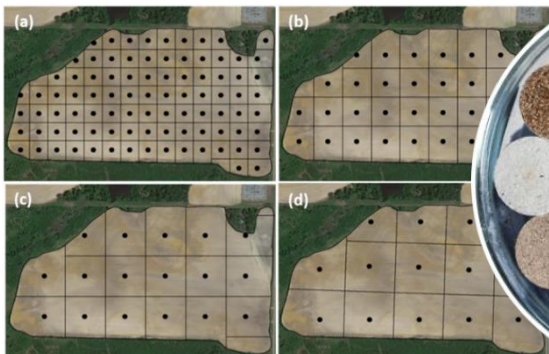
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Sampling soil



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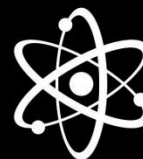
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Composite sampling

Zone by: irrigation system

- **Irrigation block,
isobaric pressures,
and type of emitter**



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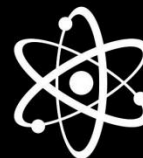
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Composite sampling

Zone by:

- Crop
- Cultivar
- Plant age



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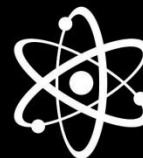
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Composite sampling

Zone by:
soil texture = “fridge size”



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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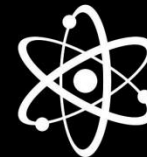
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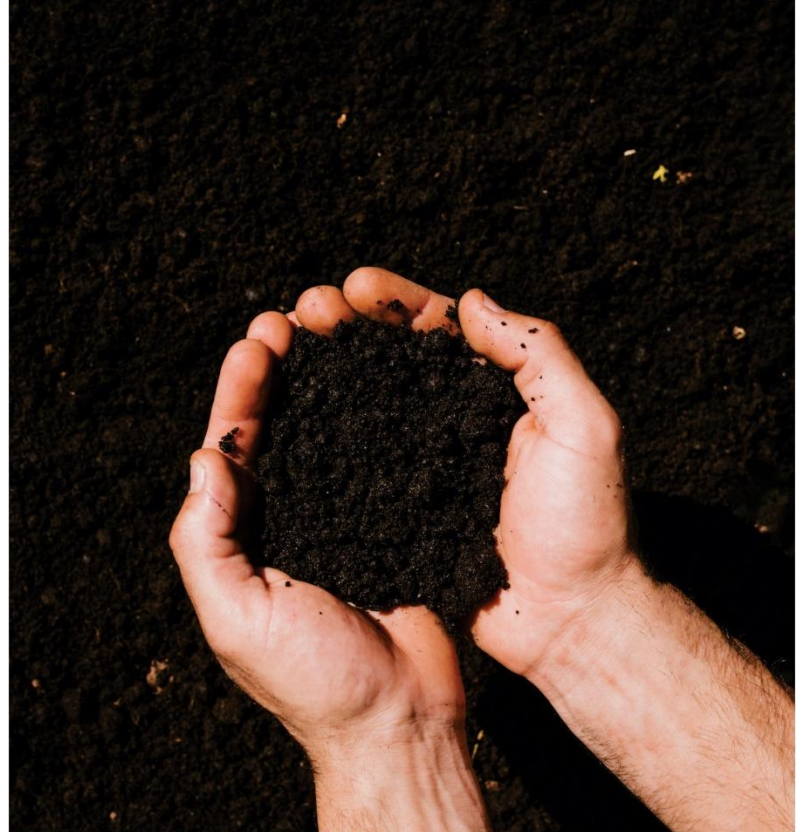


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Composite sampling

Zone by: organic material

- **$\text{OrgC\%} \times 1.72 = \text{OM\%}$**
- **Every 1% OM increases WHC by $\pm 190\ 000\ \text{Lt/Ha}$**



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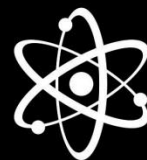
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Composite sampling SUMMARY

- **Zone size and number of subsamples**
- **Commonly 10-20 per zone**
- **Random, X or Z pattern**
- **Combine with index plants for leaf samples, same sampling time**
- **Avoid edge effects**
- **Use common sense**



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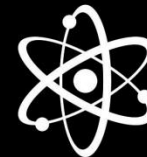
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Soil sampling



Procedure:

- Use a soil auger or a shovel - scrape surface first
- 60cm depth for pre-plant samples
- 30cm depth in root zone for established plants
- Don't sample fertiliser granules, don't use fertiliser bags
- Combine subsamples in plastic (not metal) bucket and mix
- Remove debris and rocks and place 1kg in labeled bag (Note approx Rock%)
- Transport to lab

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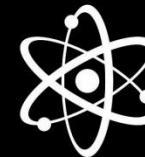
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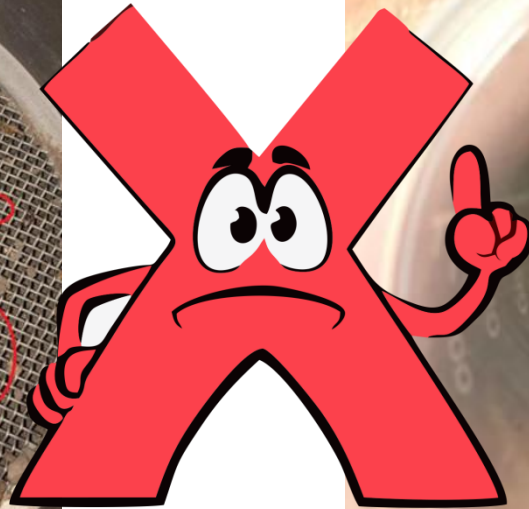
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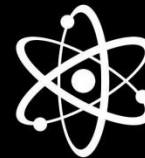
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Leaf sampling

- Leaves are less variable than soil
- Apply similar principles/same blocks as soil
Cultivar, age, row orientation, management etc.
- Take samples on both sides of plant
- Youngest mature leaves (see next slide)
- Pre-label, breathable bags
- ROUTINE: Same time every year - November for Mango
Mark +/- 20 **Representative** Index Trees (Double handful ~ 20-40 leaves)
- TROUBLE SHOOTING: Any time. Take ~20 leaves > 4 healthy and > 4 unhealthy trees



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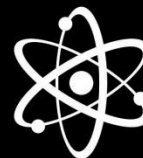
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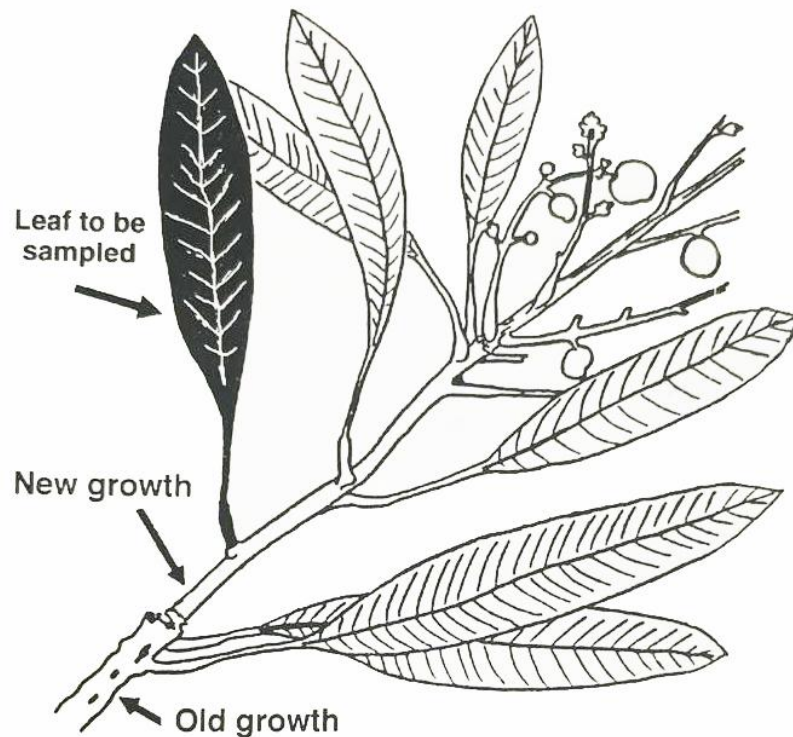
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Mango Leaf sampling

**Sample $\pm$ 7-month-old
fully developed hardened off
leaves from fruit-bearing twigs**

November

Source: ITSC (ARC-LNR). *The Cultivation of Mangoes* (De Villiers, Ed., 1998)



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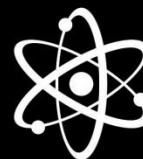
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So, what did we learn?



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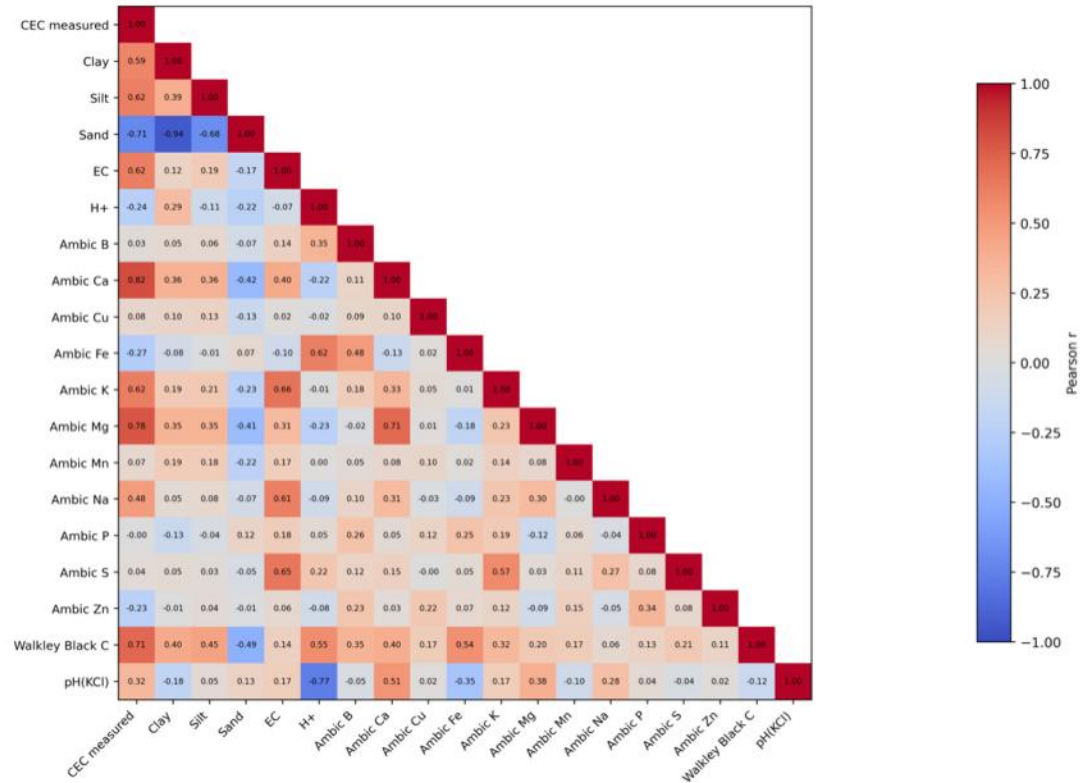
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Soils

- Over 17 000 samples
- Pearson correlation coefficient:
 - +1 = strong positive relationship
 - 0 = no relationship
 - -1 = strong negative relationship

$$\rho_{X,Y} = \frac{\text{cov}(X, Y)}{\sigma_X \sigma_Y}$$

Soil Parameter Correlation Matrix



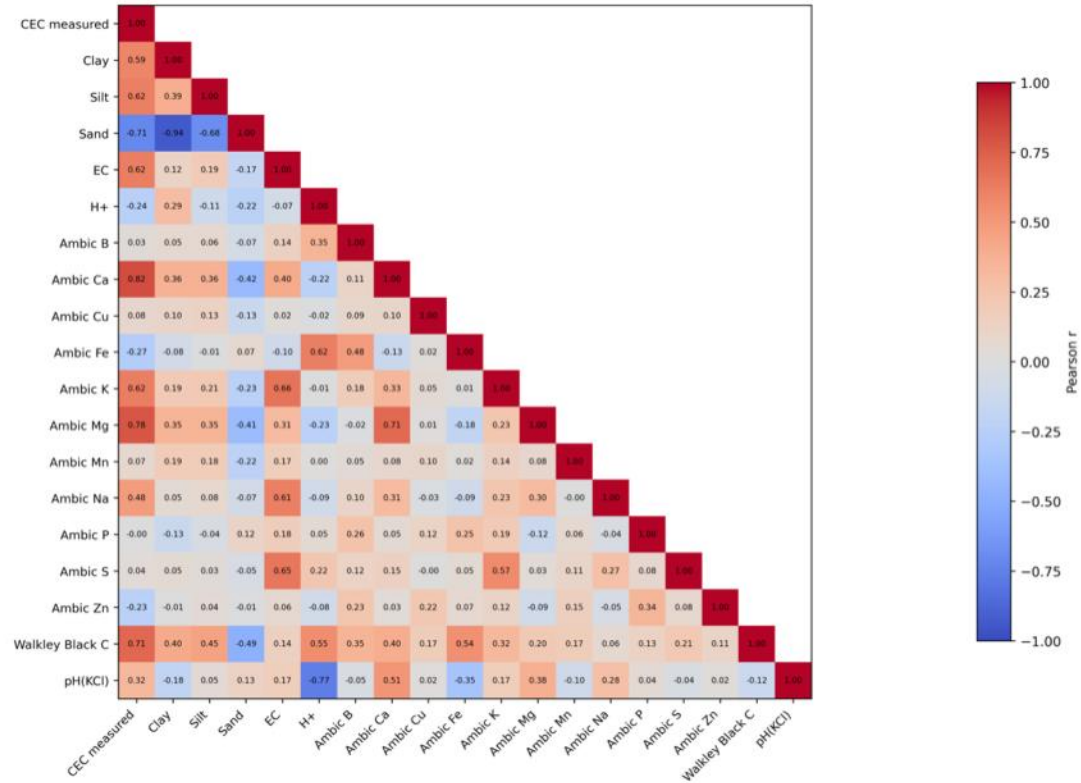
Soils

Key Observation:

Walkley Black C ($r = 0.71$) showed a stronger relationship with CEC than Clay % ($r = 0.59$).

While clay remains an important determinant of nutrient holding capacity, the stronger relationship between Walkley Black carbon and CEC suggests that soil organic matter may play an equally important role in nutrient retention. This supports current industry efforts to improve soil health and carbon levels.

Soil Parameter Correlation Matrix



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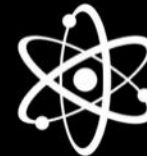
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Soils

	Extractable N ^a mg/kg	NH4-N ^b mg/kg	NO3-N ^b mg/kg	EC ^c mS/cm	Ambic Na mg/kg	pH(KCl) pH units	H ⁺ ^d cmol/kg	Ambic Mn mg/kg	Ambic S mg/kg	Ambic B mg/kg
2023	18	12.5	3.7	0.329	55	5.35	0.748	26	44	0.30
2024	22	13.2	4.7	0.454	50	5.34	0.731	25	56	0.46
2025	25	12.6	19.9	0.377	56	5.35	0.736	21	54	0.48

•2023 (4676) + 2025 (6985) + 2026 (5176):

Excluding the Cape, nurseries and possible chemical trials

^a Samples tested: 2023 (253) + 2024 (194) + 2026 (255)

^b Samples tested: 2023 (119) + 2024 (62) + 2026 (182)

^c Samples tested: 2023 (1431) + 2024 (1800) + 2026 (1382)

^d Samples tested: 2023 (1214) + 2024 (1873) + 2026 (1270)

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Soils

Key Findings:

- NO₃-N increased substantially (3.7 → 19.9 mg/kg)
- B increased consistently (0.30 → 0.48 mg/kg)
- pH & H⁺ remained stable
- Soil Mn declined while Leaf Mn increased

What the data suggests:

- Wet years may increase N availability
- Soil chemistry remained remarkably stable
- Nutrient availability can change without major changes in soil chemistry

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Mango

Various Mango leaf norms:

Table 12 Soil and foliar norms set by the ITSC

Soil parameter	Norm	Foliar nutrient	Norm
pH(H ₂ O)	6,0 - 6,8	N(%)	(3)
Resistance	800+	P(%)	0,09 - 0,11
Ca:Mg	2,5 - 5,0	K(%)	0,8 - 1,0
K(1) (mg/kg, sandy soil)	60 - 100	Ca(%)	2,0 - 2,8
K(1) (mg/kg, clay soil)	100 - 200	Mg(%)	0,2 - 0,35
P(2) (mg/kg)	20 - 50	Zn(mg/kg)	20 - 100
Al (mg/kg)	0 - 30	Cu(mg/kg)	10 - 20
		Mn(mg/kg)	60 - 200
		Fe(mg/kg)	70 - 100
		B(mg/kg)	30 - 100

1 If (Ca+Mg)/K > 8 (light soil) 5 (heavy soil), then K may need to be applied

2 Resin extraction

3 Young trees (<= 10 years old): 1,25 - 1,40%; Mature trees: 1,25 - 1,50% (> 10 years old)

Source: ITSC (ARC-LNR). *The Cultivation of Mangoes* (De Villiers, Ed., 1998), Table 12.

Mango Leaf Norms

Element	Unit	Norm
N	%	1.2 - 1.7
P	%	0.09 - 0.11
K	%	0.8 - 1.0
Ca	%	2.0 - 2.8
Mg	%	0.2 - 0.35
Zn	mg/kg	25 - 100
Cu	mg/kg	10 - 20
Mn	mg/kg	60 - 200
Fe	mg/kg	70 - 100
B	mg/kg	30 - 100

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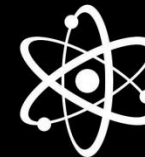
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Mango

Low
Norm
High

	N %	P %	K %	Ca %	Mg %	S %	Na mg/kg	Zn mg/kg	Cu mg/kg	Mn mg/kg	Fe mg/kg	B mg/kg	Mo* mg/kg
2023	1.52	0.11	0.65	1.81	0.19	0.16	373	31	135	320	86	74	0.26
2024	1.44	0.10	0.78	1.79	0.18	0.12	233	38	151	265	83	73	0.32
2025	1.60	0.11	0.71	1.85	0.20	0.16	289	36	226	258	129	64	0.39

2023 (151) + 2024 (200) + 2025 (143):

- October to December
- Excluding the Cape, nurseries and possible chemical trials
- *Samples tested: 2023 (51) + 2024 (155) + 2025 (131)



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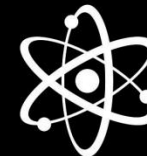
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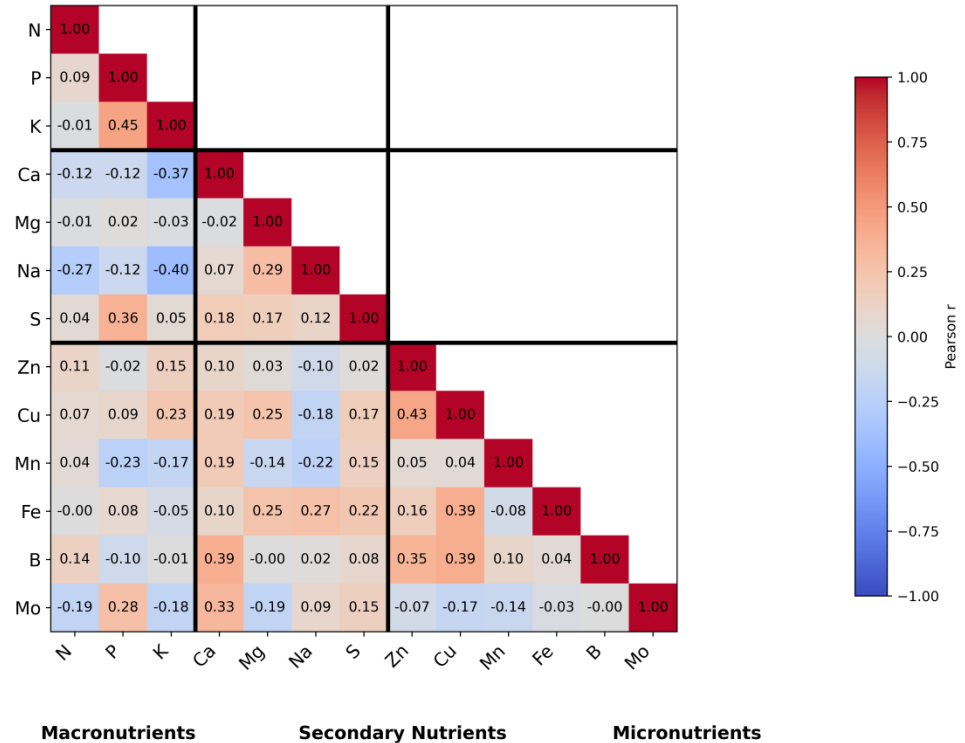


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Mango Leaf Nutrient Correlation Matrix (2023-2025)

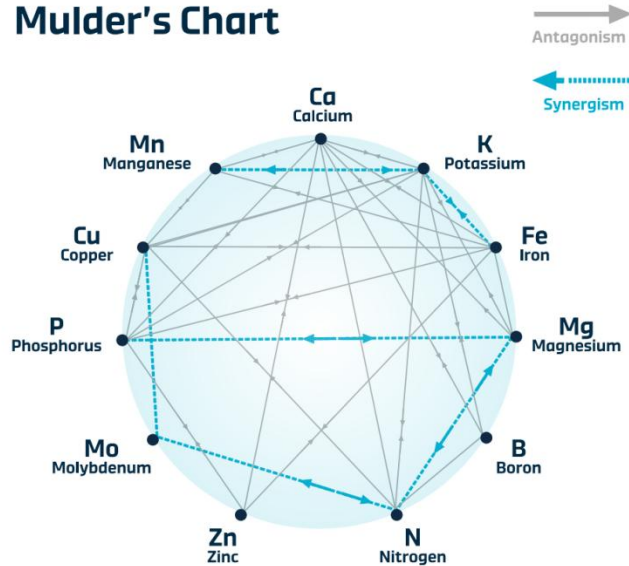
Mango

- 494 samples in dataset
- Pearson correlation coefficient:
 - +1 = strong positive relationship
 - 0 = no relationship
 - 1 = strong negative relationship



Mango

Mulder's Chart



Relationship	Mulder Prediction	Mango	Observation
P-K	Weak / antagonistic	0.45	Contradicts theory
K-Mg	Antagonism	-0.03	No evidence for predicted antagonism
P-Mg	Synergistic	0.02	No evidence for predicted synergy
K-Ca	Antagonism	-0.37	Strong support for predicted antagonism
Zn-Cu	Not emphasised	0.43	Emerging crop-specific relationship
Cu-B	Not emphasised	0.39	Emerging crop-specific relationship
Mo-Ca	Not emphasised	0.33	Emerging crop-specific relationship

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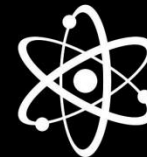
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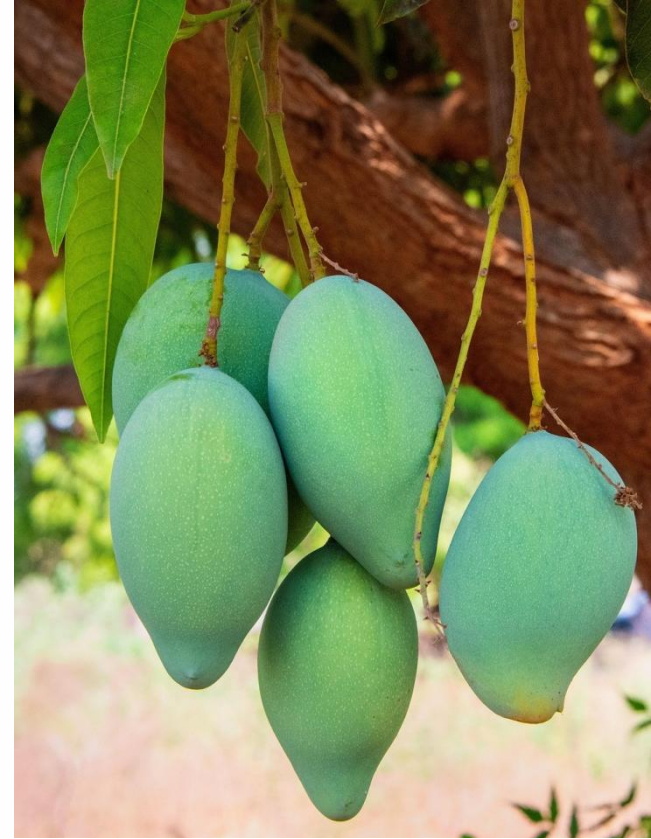
Leaves & Soil

What the Data Suggests

- ✓ Wet years promote stronger nitrogen uptake
- ✓ Nutrient balance shifts during wetter seasons
- ✓ Long-term trends are becoming more important than individual results
- ✓ Monitoring trends may be more valuable than relying only on fixed norms
- ✓ Climate variability is increasingly influencing nutrient management decisions

Take home message:

The data suggests that rainfall does not simply influence growth, it influences nutrient behaviour itself. As seasonal variability increases, nutrient interpretation may need to become more dynamic, crop-specific and season-specific



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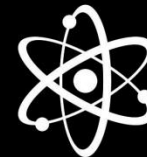
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Pesticide Residue Analysis Dashboard

Multi-Laboratory Data Integration

Select Data Source



Both
21,996 tests



Labserve
12,837 tests



Eurofins
9,159 tests

MRL Standard Selection

Select a regulatory standard to evaluate pesticide residue compliance

European Union
EU MRL Standards

✓ Active

Codex Alimentarius
International Standards

Select

South Africa
SA MRL Standards

Select

Commodity

Mango

Pesticide/Chemical

All Pesticides

Variety

All Varieties

Detection Status

All Results

Quick Search

Search anything...

TOTAL RESULTS

101

DETECTIONS

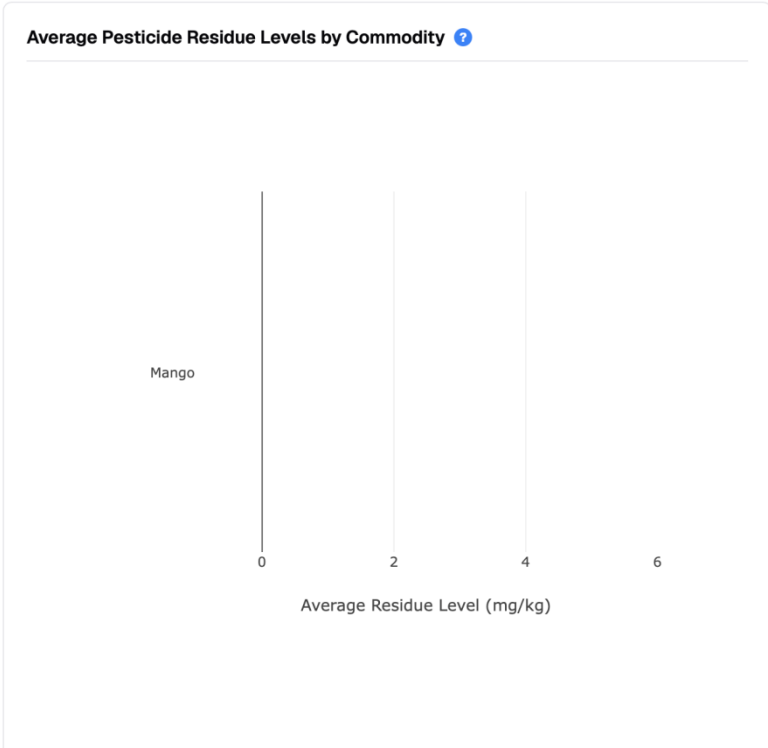
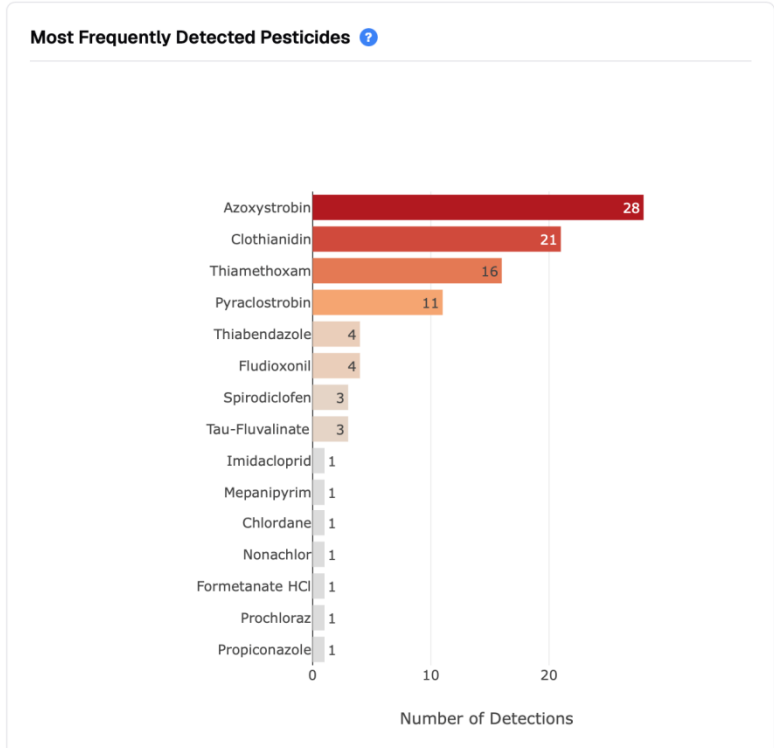
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VARIETIES

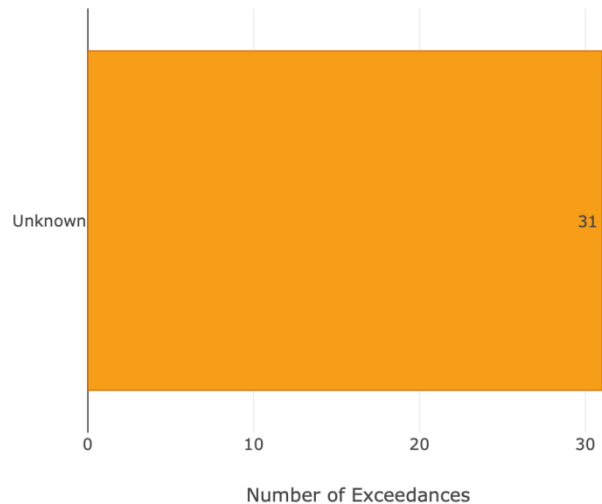
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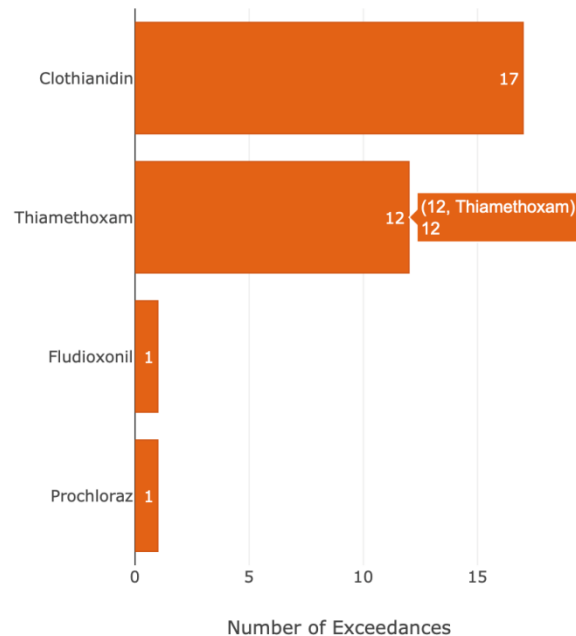
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MRL Compliance Violations by Variety ?



MRL Compliance Violations by Pesticide ?





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Welcome to Labserve Laboratories

We test Water

Portal access on website  www.labserve.net

Thank you • Dankie!

References:

Eurofins Graauw MRL data

Stock photos by Freepik.com

Labserve website & Client Portal

ITSC (ARC–LNR). *The Cultivation of Mangoes* (De Villiers, Ed., 1998)

The cultivation of Mangoes by the Institute for Tropical and Subtropical Crops ARC • LNR

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