

Cardy meters in Farming How & Why



Why do we need Cardy meters?

Cardy meters, cutting-edge tools for plant science, offer immediate insights and practical benefits:

Root Health Assurance:

Monitoring plant sap, Cardy meters ensure strong root systems for optimal nutrient uptake.

Instant Nutrient Intel:

Providing real-time data on key elements, Cardy meters empower quick decisions for precise nutrient management.

Balance Indicators:

Cardy meters detect plant balance, alerting growers to potential nutrient deficiencies or excesses.

Fertilization Precision:

Guiding fertilization plans, Cardy meters help optimize nutrient levels for sustained plant growth.

Performance Evaluation:

Cardy meters serve as performance indicators, allowing growers to assess and refine fertilization strategies for thriving crops.



How can we get the correct reading?

Timing:

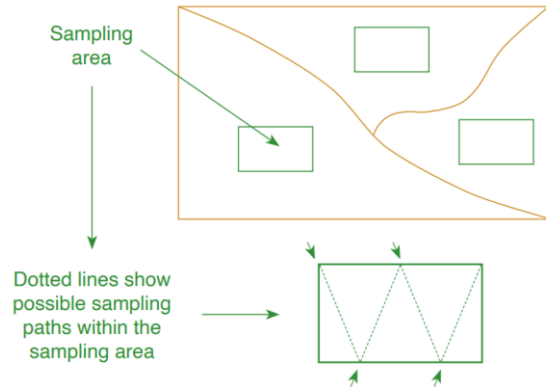
Understanding plant physiology is crucial for obtaining accurate readings. In tomato and pepper plants, sap movement begins when they receive sunlight at around 21 degrees Celsius. The optimal time to observe the highest sap flow is between 21 and 29 degrees Celsius, usually occurring from 7 AM to 10 AM, depending on the weather. Knowing these temperature details is important for obtaining precise readings, effectively monitoring the plants, and ensuring that you conduct sap tests at the right time and temperature.

Crop	Optimal Photosynthesis Temperature
Tomato	21°C to 29°C
Onion	15°C to 24°C
Pepper	21°C to 32°C
Cucumber	21°C to 32°C
Pumpkin	21°C to 32°C
Potato	15°C to 21°C
Wheat	15°C to 24°C



Plant parts used:

We need to determine the primary area where plants prioritize nutrient absorption. Testing this area and analyzing the data is consistent across all crops. The focus should be on two specific leaves: the youngest fully expanded leaf and the last mature leaf from the bottom (for mobile nutrient like Potassium)



MOBILITY OF NUTRIENTS

All nutrients are readily absorbed into the leaves, however some are more readily translocated within the plant than others.

Good Mobility:

- Nitrogen
- Phosphorus
- Potassium
- Magnesium
- Manganese

Poor Mobility:

- Calcium
- Boron
- Zinc
- Copper
- Iron
- Molybdenum
- Silicon

Testing the older leaves may help give a true indication of mobile nutrient deficiencies



Examples of typical plant parts to sample for Youngest Fully Expanded Leaf (YFEL)

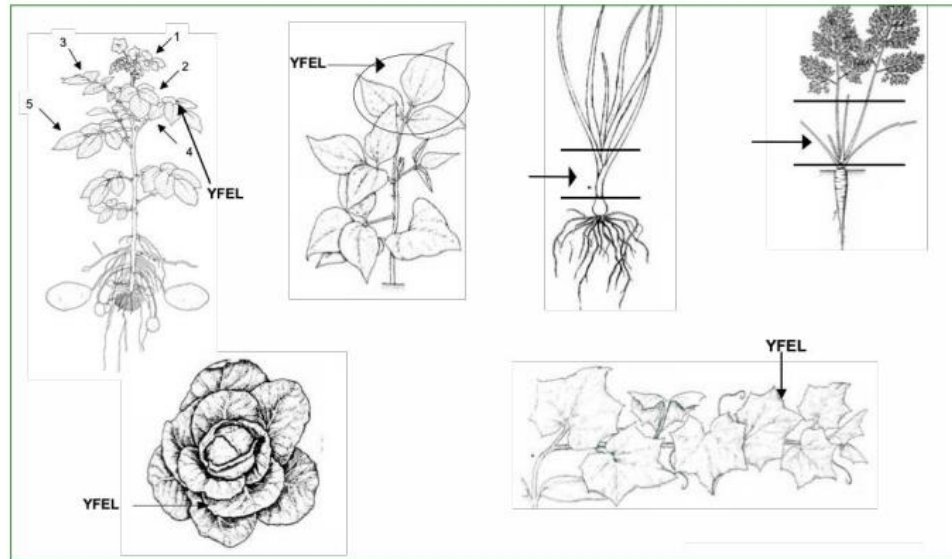
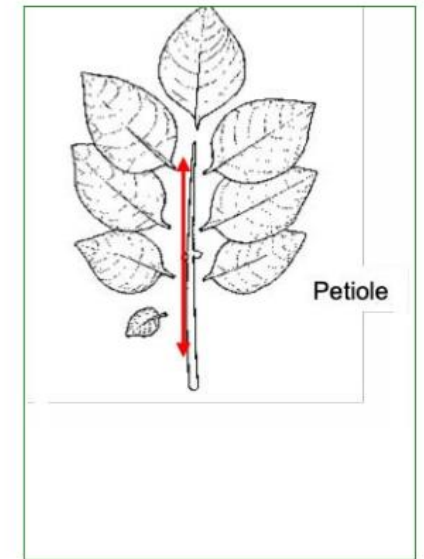


Figure 4 Example of petiole sampling method



Typical nutrient ranges in plants

Typical nutrient ranges in plants vary, and establishing a fixed norm involves considering numerous factors. Universities often compile figures based on different climate conditions to create norms. However, practical experience reveals the importance of monitoring plants and determining the appropriate norm based on weather conditions, soil fertility, rainfall, irrigation management, irrigation water quality, rooting depths, root distribution, and density, as well as physical constraints like compaction, low or high pH, pH changes in the profile, salinity, and the types of fertilizers used. Crop health and nutrient interactions also play vital roles.

Understanding the relationships among these factors is crucial for tailoring nutrient management practices to the specific needs of the plants in a given environment. This is achievable through experience.

Tomato			
ELEMENT	CONCENTRATION RANGE IN PLANT SAP ppm		
	Excess	Balanced	Shortage
K	>5000	2500 to 5000	<2500
No3	>6000	3500 to 6000	<3500
Ca2	>600	150 - 350	<150
Na	>125	20 - 125	<20
PH	>7	6.2 – 6.5	<6.5
EC	>2.0	2.0 to 6.0	<6.0
Salinity	Need to be less than 5.0 Deci Siemens per meter		

Pepper			
ELEMENT	CONCENTRATION RANGE IN PLANT SAP		
	Excess	Balanced	Shortage
K	>4000	2500 to 4000	<2500
No3	>7000	4000 to 7000	<4000
Ca2	>300	100 - 300	<100
Na	>125	20 - 125	<20
PH	>7	6.2 – 6.5	<6.5
EC	>2.0	2.0 to 6.0	<6.0
Salinity	Need to be less than 5.0 Deci Siemens per meter		



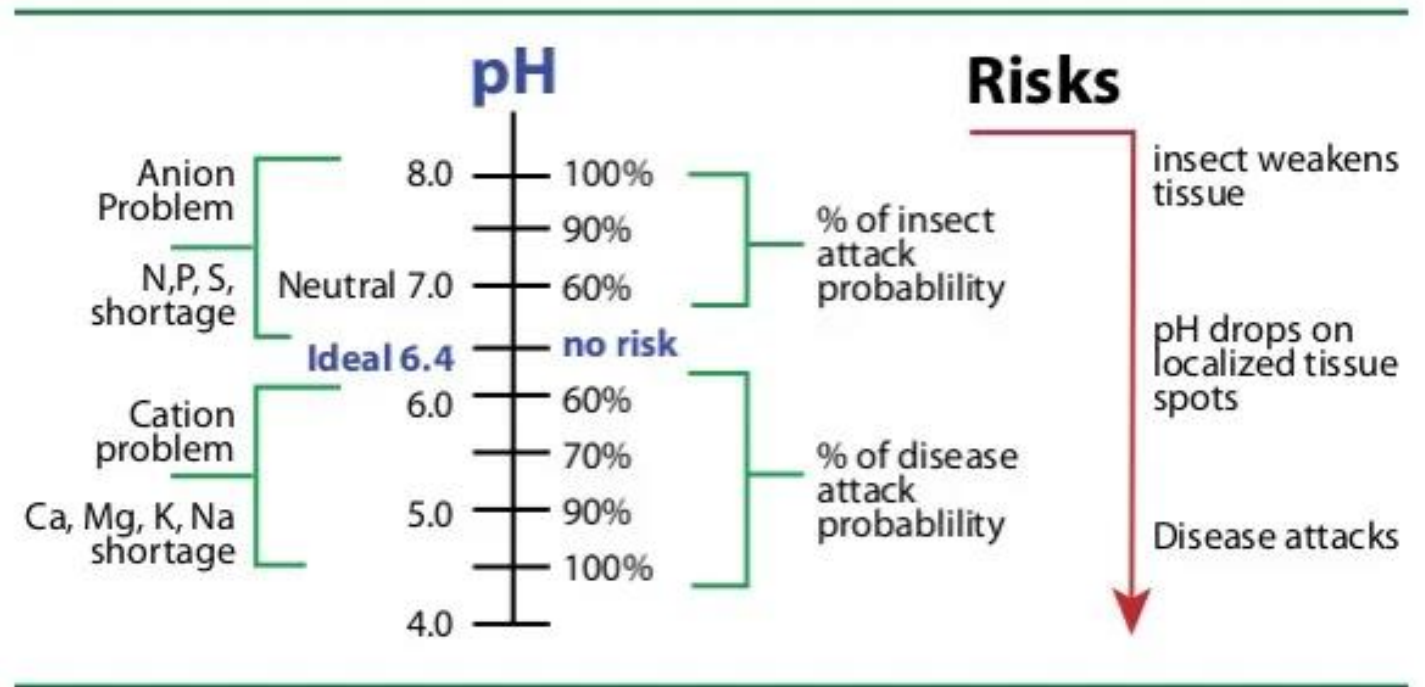
Additional Info

to be able to correctly interpret data, we need to pay attention to more details.

In agriculture, it's crucial to recognize the interconnection of factors and their intertwined effects. To make informed decisions, one must consider the entire spectrum of influencing elements, as illustrated in this image. For instance, elevated pH levels can lead to deficiencies in nitrogen (N), phosphorus (P), and sulfur (S), disrupting the balance of all cations. In such scenarios, addressing the root cause—namely, the pH imbalance—becomes critical. Simply adjusting fertilizer quantities won't help; a targeted approach to rectify the pH issue is essential.

Disease & Pests:

One of the main factors that alters the plant balance is a disease or pest attack. In this situation, the plant needs to uptake more nutrients to handle the stress, build resistance, manage the condition, and in the same time produce fruit. Therefore, considering the nutrient levels here is important. In this context, expecting a high level of nutrients in our readings is normal, and we shouldn't reduce it.



Disease Fighters

- Although a balanced nutrient supply is necessary, key 'disease fighting' nutrients can also be specifically and intentionally managed:
 - Silicon
 - Calcium
 - Potassium
 - Copper



Disease and Silicon

- Si is deposited in the cell wall.
- Physical barrier against disease (and insects).
- Si can also induce the plants immune response thereby improving the plants own capacity to fight off disease.



Overview of Nutrient Functions

Nitrogen

- Excess N limits the uptake of Ca, K, B and Cu.
- Highly leachable anion (-ve charge).
- Be careful of excess manure application – still high in NO_3^-
- Biologically active soils $\text{NH}_4^+ > \text{NO}_3^-$
- Very unstable so best to spoon feed.
- Combine with carbon.

Phosphorus

- Highly charged element – notorious for 'locking up' with other elements.
- Generally poor availability in low biologically active soils.
- Excess P limits the uptake of Ca, Zn, Fe, Cu, Mn.
- P and Mg are synergists.
- Balance fast and slow release inputs.
- AMF key to accessing soil reserves.

Potassium

- Excess Ca, Mg, Na, N and P limit uptake.
- High Mg soils trap K in clay layers.
- Na should never exceed K on base saturation.
- 5-7% on base saturation.
- $\text{pH} > 7$ soils are difficult to build K – add new exchange sites (OC and zeolite).

Overview of Nutrient Functions

Calcium

- Calcium flocculates soil - crucial for building soil structure.
- Consider overall base saturation, not just pH.
- 60-70% on base saturation.
- Be careful not to over apply.
- Excess Ca limits its own uptake and 7 other nutrients!
- Excess P and Mg limit Ca uptake.
- Always combine Ca applications with a fungal food.

Sodium

- Sodium disperses soil – breaks down soil structure.
- Surface seals, increased erosion potential.
- Excess Ca, Mg and K limit uptake.
- Ensure $Na < K$ on base saturation always.
- $< 2\%$ on base saturation.
- Buffer with humates and SOC.

Magnesium

- 10-20% on base saturation.
- Excess Ca, K and Na will antagonize uptake.
- Excess Mg limits its own uptake.
- High Mg soils are notoriously sticky – balance with calcium.
- N utilisation inefficient in high Mg soils.

Overview of Nutrient Functions

Copper

- Excess P, N, Ca, Fe and Mn limit uptake.
- High Cu limits Mn and Fe uptake.
- Peat soils tie up Cu.
- Humic acid helps to tie up excess Cu.

Sulphur

- Highly leachable (-ve charge) – monitor regularly.
- Great for leaching high Mg or Na soils.
- Building SOC is key to its long term retention.
- Excess S limits B and Mo uptake.

Manganese

- Excess Ca, P, Cu, Fe and Zn limit uptake.
- Excess Mn ties up Fe and P (\downarrow pH).
- When K+Na on base saturation exceed 10%, Mn uptake is limited.

Overview of Nutrient Functions

Silicon

- Silicon can improve the stress tolerance of plants against:
 - Heavy Metals
 - Salinity
 - Sodium
 - Insects and Disease
- No ideal levels determined, leaf analysis generally easier to monitor.
- Comparative measurements – good vs bad.

Zinc

- Ca, Mg, K and P limit uptake.
- High N inputs and a cold spring limit uptake.
- Excess Zn can tie up P and Fe.
- P:Zn = monitor in leaf.

Boron

- Most soil B remains in soil solution.
- Most leachable of all trace elements – regularly monitor soil levels.
- Building SOC is key to its long term retention.
- Always apply a carbon source with any B application.
- High Ca soils will require more B. Be careful not to overdo B in low Ca soils.