Nutrients in Kiwifruit and Kiwi Leaves

(Actinidia deliciosa and A. chinensis – green and gold types)

Introduction

Measuring leaf and fruit sap ions with meters such as the HORIBA LAQUAtwin is extremely important for kiwifruit production.

Sap measurements provide a snapshot of the actual nutrients moving in the vine, not just what is present in the soil. Soil tests alone are insufficient because nutrient availability in kiwifruit changes rapidly with spring growth, flowering, fruit set, canopy development, irrigation, and environmental stress.

The LAQUAtwin meters can measure K^+, NO_3^-, Ca^{2+}, Na^+, pH and EC in fruits, leaves, soil and water.

Why Ion, pH, and EC Meters Are Essential for Kiwifruit Farms

Modern kiwifruit production is no longer limited by fertilizer availability, but by nutrient balance, timing, and plant uptake efficiency. Disorders such as small fruit, uneven sizing, soft fruit, poor storage performance, low dry matter, internal breakdown, and reduced shelf life are almost always the result of nutrient imbalances that occur during the growing season—not at harvest. For this reason, real-time measurement tools—ion, pH, and EC meters—have become essential instruments for professional Kiwifruit orchards.

Why ion measurements matter

Ion-specific measurements (K^+, Ca^{2+}, NO_3^-, Na^+) provide direct insight into what the tree is actually absorbing and transporting at that moment. Unlike soil tests or traditional leaf tissue analysis, sap ion measurements reflect current physiological conditions, allowing growers to detect problems early—often weeks before visual symptoms or irreversible fruit damage occur.

Key advantages include:

- Early identification of K–Ca imbalance affecting fruit firmness and storage
- Improved control of nitrogen-driven vegetative vigor versus fruit development
- The ability to adjust fertigation and foliar programs proactively
- Reduced waste from unnecessary fertilizer applications

In high-value green and gold kiwifruit cultivars, these measurements directly affect export grade and storage performance.

Why pH and EC are equally important

While ion meters show what nutrients are present, pH and EC explain why uptake succeeds or fails.

- pH governs nutrient availability and ion competition at the root and leaf level. Even optimal Ca or K levels are ineffective if pH conditions restrict absorption.
- EC (Electrical Conductivity) provides a rapid indicator of total salt concentration and osmotic stress. Elevated EC reduces water uptake, suppresses calcium movement, and often precedes sodium or chloride toxicity.

Together, pH and EC measurements allow growers to:

- Detect salinity stress early
- Diagnose irrigation and fertigation problems
- Interpret ion readings correctly and avoid misinformed decisions

Without pH and EC context, ion data alone can be misleading.

Preparing Sap from Kiwifruit or Kiwi Leaves

Sample Collection

1. Select leaves or fruits

- For leaves: Choose healthy, fully expanded leaves from similar positions.
- For fruits: Peel and chop fruit. Crush or blend. Filter solids to collect clear juice

2. Extract the sap

- Leaves: Use a leaf petiole sap press (like a garlic press) or a small handheld sap press to squeeze out the sap.
- Kiwifruit: Crush or slice the Kiwi and collect the juice; filter out solids so the meter only contacts clear liquid.

- If needed, dilute samples with deionized or distilled water so that the ion concentration falls inside the calibrated range of the meter.

STEP-BY-STEP PROTOCOL

Kiwi Leaf Sap (Petiole Sap) — Recommended Method

1 Sampling

When: Morning (8–11 am), avoid drought or heat stress
Which leaves:

- Fully expanded leaves from mid-cane position
- Avoid diseased or shaded leaves

How many: 20–30 leaves per block or variety
Remove the petioles (leaf stems). The blades dilute sap and increase variability.

2 Sap Extraction

Equipment

- Garlic press or handheld sap press
- Clean plastic cup
- Coffee filter or syringe filter (optional)

Procedure

1. Chop petioles into 5–10 mm pieces
2. Press firmly to extract sap
3. Collect ≥0.5 mL total sap

Typical yield: 20 petioles → ~0.4–0.9 mL sap.



3 Dilution (IMPORTANT for Kiwifruit)

Kiwi sap is usually too concentrated for Ca and K meters.
Standard dilution (recommended starting point):

Meter	Dilution
NO_3^-	1:5
K^+	1:10
Ca^{2+}	1:10
Na^+	1:5

How to dilute (example 1:10)
Take 0.10 mL sap and add 0.90 mL distilled / deionized water.
Mix gently.
Use disposable pipettes or syringes for accuracy.

STEP-BY-STEP PROTOCOL

Kiwifruit Juice

1 Sampling

- 3–5 representative fruits
- Avoid damaged or overripe fruit

2 Juice Extraction

1. Peel and chop fruit
2. Crush or blend
3. Filter solids
4. Collect clear juice

3 Dilution

- K, Ca: usually 1:5 or 1:10
- NO_3^-, Na^+: often no dilution needed

Measurement

Before mesaurement the instrument must be calibrated.

1. Turn on the meter
2. Rinse the sensor with demineralized or normal tap water and dry carefully with a tissue
3. Place some of the 150ppm solution on the sensor and press the CAL button
4. Rinse the sensor with demineralized or normal tap water and dry carefully with a tissue
5. Place some of the 2000ppm solution on the sensor and press the CAL button
6. Rinse and dry the sensor
7. Place the extracted sap or juice onto the sensor
8. Wait for the reading to stablize (takes a couple of seconds)

EXPECTED VALUES

⚠️ These are typical working ranges, not absolute sufficiency standards. Kiwifruit sap varies strongly with:

- Cultivar (green vs gold)
- Crop load
- Irrigation
- Weather
- Growth stage

Kiwi Leaf Petiole Sap (ppm, mg/L)

Status	NO_3^-	K^+	Ca^{2+}	Na^+
Low	<300	<1600	<200	–
Adequate	300–700	1600–3200	200–500	<50
High	700–1200	3200–4800	500–800	50–150
Excessive	>1200	>4800	>800	>150

Kiwifruit requires moderate nitrogen—excess N drives canopy growth at the expense of fruit quality.
High K suppresses Ca uptake → soft fruit and poor storage.
Sodium should be very low.

Kiwifruit Juice (ppm, mg/L)

	Range	Note
NO_3^-	<30	High nitrate is undesirable
K^+	800–1200	Excess → soft fruit
Ca^{2+}	>30	Low Ca → poor firmness
Na^+	<20	Indicates saline stress

Note: Fruit Ca is much lower than leaf sap Ca.

Practical, Stage-specific Sap Ranges

Below are practical, stage-specific sap ranges tailored for Kiwis, using HORIBA LAQUAtwin NO_3^-, K^+, Ca^{2+}, and Na^+ meters, with cultivar adjustments where this really matters (especially for bitter-pit–prone varieties).
These are working target ranges, not textbook sufficiency levels. They're designed for decision-making in orchards, not lab diagnostics.

Leaf Petiole Sap (ppm, corrected for dilution)
STANDARD GREEN & GOLD KIWIFRUIT

	NO_3^-	K^+	Ca^{2+}	Na^+
Budbreak – Early Growth	500–900	2600–4200	300–600	<50
Flowering – Fruit Set	400–700	2300–3600	350–650	<50
Early Fruit Growth	350–600	2000–3200	400–700	<50
Mid-Season	300–550	1800–3000	450–750	<50
Pre-Harvest	<300	1500–2400	500–850	<50

KIWIFRUIT JUICE TARGETS (AT HARVEST)

	NO_3^-	K^+	Ca^{2+}	Na^+
Desired Range	<30	800–1100	>40	<20
K:Ca ratio		< 20:1		

K : Ca ratio (leaf sap)

The K : Ca (potassium : calcium) ratio in Kiwifruit leaf sap is important because it strongly influences fruit quality, storage life, and physiological disorder risk, especially bitter pit and soft fruit.

Stage	Target
Early season	< 8 : 1
Mid-season	< 6 : 1
Pre-harvest	< 4 : 1

Tips for Kiwifruit & Leaves

What to Measure

- Leaves (Petiole Sap): Best for rapid assessment of vine nutrient status during the growing season, especially for nitrate and potassium.
- Petiole sap reflects current uptake and transport and is the most useful tool for in-season management decisions.

Kiwifruit Juice: Suitable for quick quality checks (for example, potassium or calcium levels related to fruit firmness and storage potential), but juice values do not reflect plant physiological status as directly as sap measurements.

Consistency

- Sample at similar times of day and environmental conditions to reduce variability.
- Morning sampling (8–11 am) under non-stress conditions provides the most repeatable results

Dilution & Compensation

- If ion concentrations exceed the meter's range, dilute the sample and apply a correction factor. For example, diluted plant sap readings must be multiplied by the dilution ratio

What about pH and EC?

pH and EC are also important, but they serve a slightly different purpose than ion-specific measurements like K^+, Ca^{2+}, NO_3^-, and Na^+.

1 pH (Hydrogen ion concentration)

Why it matters:
pH affects nutrient availability. Even if you apply enough Ca or K, if the pH is too high or too low, the plant cannot take it up efficiently.

Typical ranges for Kiwi sap or irrigation water:
Sap: Usually 5.5–6.5
Irrigation / fertigation water: 6.0–7.0

Extreme pH can cause:
- Reduced uptake of Ca, Mg, Fe, Mn
- Nutrient imbalances, which can indirectly affect bitter pit and growth

Takeaway: pH is not an ion itself, but controls how well the plant can use other nutrients.

2 EC (Electrical Conductivity)

Why it matters:
EC measures total soluble salts in water or sap.

High EC in water or sap indicates salinity stress, which can:

- Reduce water uptake
- Increase Na^+ accumulation
- Interfere with K^+ and Ca^{2+} uptake

Typical target ranges:
Leaf sap EC: 1–3 mS/cm (varies by cultivar and growth stage)
Irrigation water: <0.75 mS/cm preferred for Kiwis

Use in practice:
- Monitor EC in irrigation water and sap together to detect salt stress early.
- If EC is high, foliar Ca sprays may be less effective — you may need adjustments in irrigation or fertigation.

3 How they complement ion measurements

Parameter	Use	Critical for
K^+, Ca^{2+}, NO_3^-, Na^+	Direct ion status	Nutrient balance, disorder prediction
pH	Nutrient availability	Ensures applied nutrients can be absorbed
EC	Total salts / salinity	Detects stress, Na^+ interference

In short:
- Always check pH and EC for irrigation water and sap.
- Ion meters + pH/EC = full picture of plant nutrient status and stress risk.

Advantages of LAQUAtwin instruments for Kiwifruit Orchards

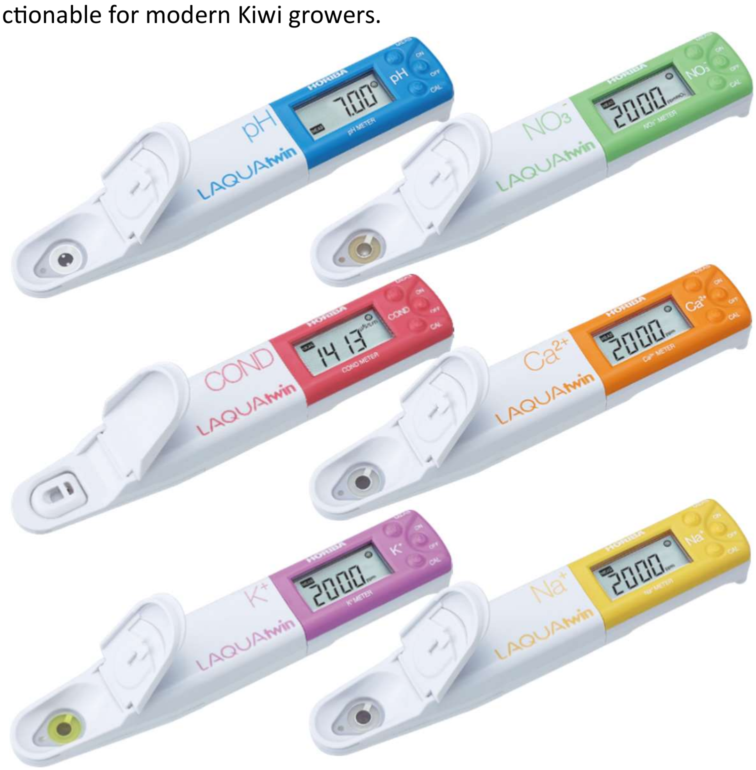
The HORIBA LAQUAtwin instruments are uniquely suited to orchard use because they combine laboratory-grade ion-selective technology with true field practicality.
Key advantages include:
- Direct measurement of plant sap and fruit juice with no complex preparation
  Extremely small sample volume requirements, ideal for petiole sap
- Fast, repeatable results that enable same-day management decisions
- Ion-specific accuracy, allowing precise tracking of K, Ca, NO_3^-, and Na
- Portable, durable design suitable for orchard and packhouse environments
- Proven reliability across agriculture, research, and advisory services worldwide

Importantly, LAQUAtwin meters make frequent monitoring realistic, which is critical because nutrient dynamics change rapidly during post-bloom, fruit expansion, and pre-harvest stages.

The practical bottom line
Kiwifruit orchards that integrate ion, pH, and EC monitoring move from calendar-based fertilization to data-driven nutrient management.

This leads to:
- Better canopy balance
- Improved fruit size and firmness
- Enhanced storage performance
- Lower input costs
- Reduced environmental impact
- Greater confidence in management decisions

In modern kiwifruit production, ion, pH, and EC meters are no longer optional—they are essential management instruments. In today's high-cost, high-risk Kiwi production systems, ion, pH, and EC meters are no longer optional diagnostic tools—they are essential management instruments. The LAQUAtwin platform makes this level of precision practical, affordable, and actionable for modern Kiwi growers.



Disclaimer: The sap value ranges and interpretations presented in this application note are **indicative guidelines only**. Actual optimal values may vary depending on cultivar, rootstock, orchard age, crop load, growth stage, climate, irrigation water quality, and management practices. Sap analysis should be used as a **decision-support tool**, not as a standalone diagnostic method. For critical nutrient management decisions, sap measurements should be interpreted together with visual assessment, soil analysis, irrigation water analysis, and periodic laboratory tissue testing.

HORIBA UK Limited
Kyoto Close, Moulton Park,
Northampton NN3 6FL, UK
Phone: +44 1604 542600
waterquality@horiba.com
www.horiba-water.com

HORIBA Instruments Pte. Ltd.
83 Science Park Drive, #02-02A, The Curie,
Singapore 118258
Phone: + 65 6908-9660
laqua@horiba.com
www.horiba-laqua.com

HORIBA Instruments Incorporated
9755 Research Drive, Irvine, California 92618
USA
Phone: +1 949 250 4811
labinfo@horiba.com
www.horiba.com/us/en