# Nutrients in Pears and Pear Leaves

**Introduction**

Measuring **leaf** and **fruit sap** ions with meters like the HORIBA LAQUAtwin is extremely important for pears.
Sap measurements give a snapshot of the actual nutrients moving in the plant, not just what's in the soil. Soil tests alone are insufficient because nutrient availability can change daily based on water uptake, growth stage, 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 Pear Farms

Modern pear production is no longer limited by fertilizer availability, but by nutrient balance, timing, and plant uptake efficiency. Disorders such as bitter pit, cork spot, poor storage life, excessive vegetative growth, and inconsistent fruit quality 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 pear farms.

**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, the primary driver of bitter pit and storage disorders
- Improved control of nitrogen-driven vigor, fruit size, and maturity timing
- The ability to adjust fertigation and foliar programs proactively, rather than reactively
- Reduced waste from unnecessary fertilizer applications

In high-value cultivars such as Honeycrisp, Golden Delicious, and Conference pears, these measurements can mean the difference between marketable fruit and significant storage losses.

**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 Pears or Pear Leaves

Sample Collection

1. Select leaves or fruits

- For leaves: Choose healthy, fully expanded leaves from similar positions. Typically 3rd–5th leaf from the shoot tip
- For fruits: Typically sample fruit juice rather than sap from the leaf veins; this works especially well for nitrate, potassium, sodium, and calcium since the meters are compatible with 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.

- Pears: Crush or slice the pear 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

**Pear 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-shoot 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 → ~0.6–1.0 mL sap.



### 3 Dilution (IMPORTANT for pears)

Pear 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

**Pear Fruit Juice**

### 1 Sampling

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

### 2 Juice Extraction

1. Chop fruit (with peel)
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. Pear sap varies strongly with:

- Rootstock
- Crop load
- Irrigation
- Weather
- Climate
- Growth stage

**Pear Leaf Petiole Sap (ppm, mg/L)**

| Status | $NO_3^-$ | $K^+$ | $Ca^{2+}$ | $Na^+$ |
|---|---|---|---|---|
| **Low** | < 300 | < 1500 | < 250 | – |
| **Adequate** | 300–700 | 1500–3000 | 250–600 | < 50 |
| **High** | 700–1000 | 3000–4500 | 600–900 | 50–150 |
| **Excessive** | > 1000 | > 4500 | > 900 | > 150 |

Pears generally run lower nitrate than apples.
High K strongly suppresses Ca → internal breakdown & poor storage.Sodium should remain very low, especially on quince rootstocks.

**Pear Fruit Juice (ppm, mg/L)**

| | Range | Note |
|---|---|---|
| **$NO_3^-$** | <30 | Elevated nitrate in fruit is undesirable |
| **$K^+$** | 700-1200 | High K → reduced storage life |
| **$Ca^{2+}$** | 15-60 | < 30 ppm → high breakdown risk |
| **$Na^+$** | <20 | Indicates salinity stress |

Note: Fruit Ca values in pears are lower than apples, but still critical.

## Practical, Stage-specific Sap Ranges

Below are practical, stage-specific sap ranges tailored for pears, 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 PEAR (MODERATE STORAGE RISK)
Examples: Conference, Williams, Packham's Triumph

| | $NO_3^-$ | $K^+$ | $Ca^{2+}$ | $Na^+$ |
|---|---|---|---|---|
| Post-Bloom (10–35 DAFB) | 400–700 | 2200–3500 | 300–600 | < 50 |
| Early Fruit Expansion (35–60 DAFB) | 300–600 | 2000–3200 | 350–650 | < 50 |
| Mid-Season (60–90 DAFB) | 200–450 | 1700–2800 | 400–700 | < 50 |
| Pre-Harvest (2–4 weeks before harvest) | < 200 | 1400–2300 | 450–800 | < 50 |

HIGH STORAGE-RISK PEARS
Examples: Abate Fetel, Comice, Forelle

| | $NO_3^-$ | $K^+$ | $Ca^{2+}$ | $Na^+$ |
|---|---|---|---|---|
| Post-Bloom (10–35 DAFB) | 350–600 | 2000–3000 | 400–700 | < 40 |
| Early Fruit Expansion (35–60 DAFB) | 250–500 | 1800–2600 | 450–750 | < 40 |
| Mid-Season (60–90 DAFB) | 180–400 | 1500–2400 | 500–800 | < 40 |
| Pre-Harvest (2–4 weeks before harvest) | < 180 | 1200–2000 | 550–900 | < 40 |

**PEAR FRUIT JUICE TARGETS (AT HARVEST)**

| | $NO_3^-$ | $K^+$ | $Ca^{2+}$ | $Na^+$ |
|---|---|---|---|---|
| Desired Range | <25 | 800–1100 | >35 | <20 |
| K:Ca ratio | | < 18:1 | | |

## K : Ca ratio (leaf sap)

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

| Stage | Target |
|---|---|
| Post-bloom | < 7 : 1 |
| Mid-season | < 5 : 1 |
| Pre-harvest | < 3.5 : 1 |

## Tips for Pears & Leaves

**What to Measure**
- Leaves (Petiole Sap): Good for rapid assessment of nutrient status (especially nitrate and potassium) during growing season.
- Pear Juice: Suitable for quick quality checks (e.g., potassium or calcium content that might relate to fruit quality), but values may not directly reflect plant physiological status like sap measurements do.

**Consistency**
- Sample at similar times of day and environmental conditions to reduce variability.

**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 pear 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 pears
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 pear farms

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**
Pear farms that integrate ion, pH, and EC monitoring move from calendar-based fertilization to data-driven nutrient management. This leads to:

- Better fruit quality and consistency
- Improved storage performance
- Lower input costs
- Reduced environmental impact
- Greater confidence in management decisions

In today's high-cost, high-risk pear 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 pear 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