



# NANOBUBBLES IMPROVE YIELD, ACCELERATE MATURITY, AND ENHANCE OIL DEVELOPMENT IN OLIVE TREES

**Customer: Aceite Artajo (Los Llanos Estate)**

<b>Dates:</b>	<b>Location:</b>	<b>Key Results:</b>
June - November 2025	Navarra, Spain	<ul style="list-style-type: none"> <li>• 13.6% increase in olive yield</li> <li>• 3-year Arbosana trees matched yield of untreated 6-year trees</li> <li>• 13-21% higher sap sugars during key growth stages</li> <li>• 32% increase in soil organic matter</li> </ul>

## The Challenge

### A High-Performance System Limited by Water Behavior

Aceite Artajo operates a super-intensive olive system in Navarra's Ebro Valley designed for high output and consistency. Performance in these systems is constrained by conditions in the root zone.

Young trees require multiple seasons to reach full production, while warm-climate irrigation water carries less dissolved oxygen during peak demand periods. Reduced root-zone oxygen limits water and nutrient uptake, slowing oil formation and extending the time required to reach mature yields. In super-intensive systems, this delay directly impacts return on investment.

Water quality adds an additional constraint. Irrigation water in the region trends saline, with sodium and chloride accumulation in plant tissue reducing vigor and contributing to *vecería*, the biennial yield cycle that disrupts production and quality consistency.

## The Solution

### Changing How Oxygen Moves Through Irrigation Water

In June 2025, nanobubble generators were installed at the irrigation headworks of the Los Llanos estate, treating drip irrigation water across two trial sectors: 2.72 hectares of 3-year-old Arróniz and 5.24 hectares of 3-year-old Arbosana. Untreated sectors of the same varieties served as controls. Sap, leaf, soil, fruit, and oil were monitored throughout the 2025 growing season through final harvest.

Nanobubbles change how oxygen behaves in water. Rather than dissipating, oxygen remains suspended as ~100-nanometer bubbles that move through drip systems and deliver oxygen directly into the root zone.

This creates a more consistent oxygen environment, supporting root activity, nutrient uptake, and plant energy production throughout the irrigation cycle.

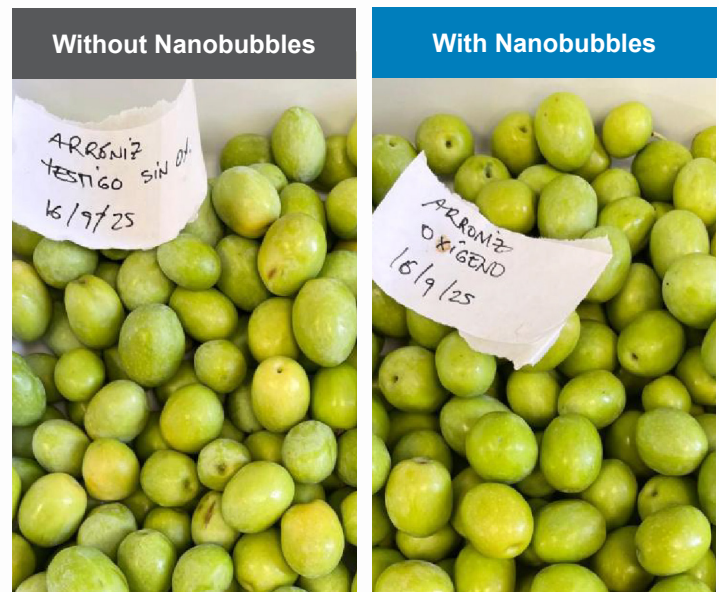
## Results

### Immediate Water Savings

The first changes appeared inside the plant. Sugar concentrations were 13–21% higher in treated trees through late summer, while nitrate levels decreased by 26–44%. Together, these shifts indicate earlier movement of nutrients from transport pathways into leaves and fruit. Earlier sugar accumulation supported earlier oil formation.

At the same time, plant stress was reduced. Sodium levels in sap declined by 33–39%, and chloride by 22–26%, lowering the plant's osmotic load and improving resource allocation toward fruit development and reserve accumulation.

These changes were reflected in the field. By mid-September, treated olives were rounder, more uniform in size, and a deeper green than untreated fruit, indicating more advanced and consistent development.



*Arróniz olives, September 16, 2025. Left: untreated control. Right: nanobubble-treated. Treated fruit shows tighter size distribution, more uniform shape, and deeper green color.*

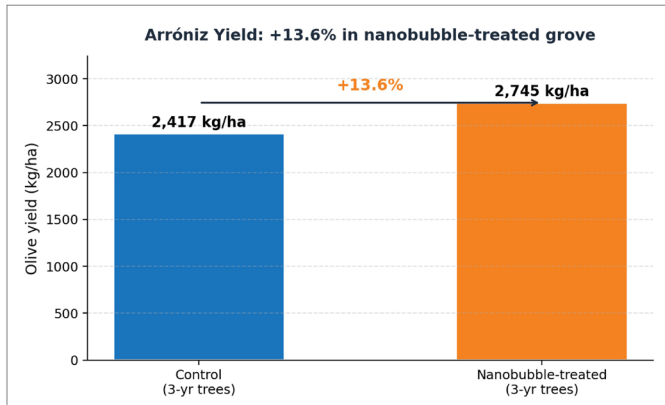


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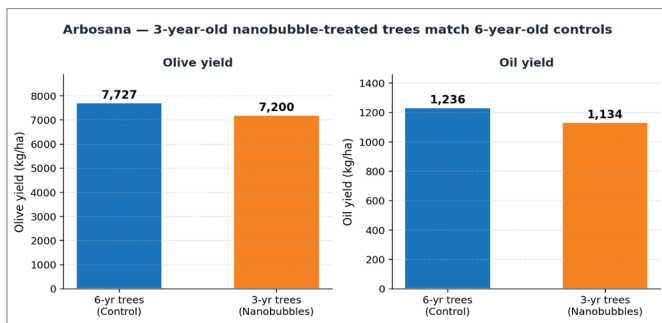
## Yield: 13.6% Increase in Arróniz, Three Years of Maturity Gained in Arbosana

In Arróniz, treated trees produced 13.6% more olives per hectare than untreated controls of the same age and management.

In Arbosana, treated 3-year-old trees produced at levels comparable to untreated 6-year-old trees, representing a maturity gain of roughly three growing seasons. For super-intensive growers, this compresses the time required to reach full production and materially improves the economics of new plantings.



Arróniz harvest, November 2025.



Arbosana yield comparison: 3-year-old trees on nanobubble-treated water vs. 6-year-old untreated controls.

## Soil and Oil Quality Held

After one season, the treated sector showed a 32% increase in soil organic matter, along with higher total organic carbon and improved cation exchange capacity, indicators of a more biologically active soil system. Field observation confirmed a looser, more friable soil structure in treated rows.

Critically, these gains came without tradeoffs in oil quality. Across both varieties, oil composition, including fatty acid profile, biophenols, oleocanthal, oleacein, and free acidity, remained consistent between treated and control sectors.

## Impact on Production Economics

For super-intensive growers, time to full production defines the economics of the operation.

Nanobubble-treated irrigation accelerated maturity, reduced salt stress in the trees, and improved consistency across the season, delivering 13.6% more olives in Arróniz and bringing 3-year-old Arbosana trees to production levels comparable to untreated 6-year-olds, while maintaining oil quality.



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