

Improving Lettuce Yield and Quality Using Oxygen Nanobubbles

Case Study: Water Technology Lab, Department Of Chemical Engineering, IIT Ropar.

Location	Unit Type	Results
Water Technology Lab, Department Of Chemical Engineering, IIT Ropar	NanoAqua N-5 Nanobubble generator	<ul style="list-style-type: none">Enhance GrowthShoot length increasedRoot Length EnhancementHigher Biomass AccumulationImproved Leaf Count
Application	Trial Dates:	
Hydroponic Growth of Lettuce	March to April 2024	

Nanobubble technology has emerged as an effective approach in hydroponics by enhancing oxygen availability and improving nutrient uptake. Unlike conventional aeration, nanobubbles are ultra-fine and remain stable in water for longer durations, allowing better penetration into the root zone.

Hydroponic systems rely heavily on dissolved oxygen and nutrient availability for optimal plant growth. This study evaluates the impact of oxygen nanobubble-enriched water on lettuce growth compared to a control system using standard water conditions.

The study utilized the NanoAqua N-5 Nanobubble Generator to introduce oxygen nanobubbles into the hydroponic system, aiming to improve plant growth efficiency and overall crop performance.

Objective

The primary objective of this study was to assess the influence of oxygen nanobubbles on key lettuce growth parameters, including leaf count, shoot length, root length, fresh weight, and dry weight.



with Oxygen Nanobubble without Oxygen Nanobubble

Experimental Setup

The study was conducted in a hydroponic system using nutrient-rich water reservoirs for lettuce cultivation. The NanoAqua N-5 nanobubble generator was integrated to oxygenate the water continuously. Treated water was circulated to ensure uniform distribution across the roots. Environmental conditions, including temperature, humidity, and light, were maintained consistently.

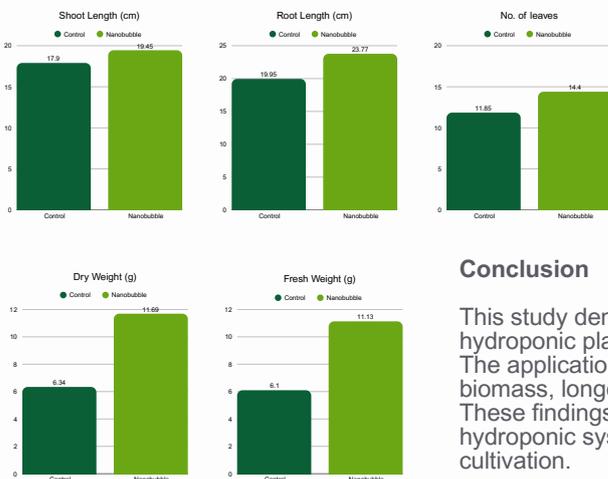


Figure: Control plant grown without treatment



Figure: Plant grown with O₂ Nb treatment

Key Observations:

Enhanced Growth Performance

Lettuce grown in nanobubble-enriched water showed a clear improvement across all growth parameters compared to the control system.

Shoot Development

An increase of approximately 9% in shoot length was observed, indicating improved above-ground growth.

Root Development

Root length improved by around 19%, suggesting better oxygen availability and enhanced nutrient absorption at the root level.

Biomass Accumulation

A significant increase in biomass was recorded, with fresh weight increasing by up to 82%, indicating higher productivity.

Leaf Development

An increase in the number of leaves was observed, contributing to improved photosynthetic activity and overall plant vigor.

Conclusion

This study demonstrates that nanobubble technology significantly enhances hydroponic plant growth by improving oxygenation and nutrient absorption. The application of oxygen-enriched nanobubbles resulted in increased biomass, longer shoot and root development, and greater leaf proliferation. These findings suggest that incorporating nanobubble technology in hydroponic systems can lead to more sustainable and productive crop cultivation.



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