

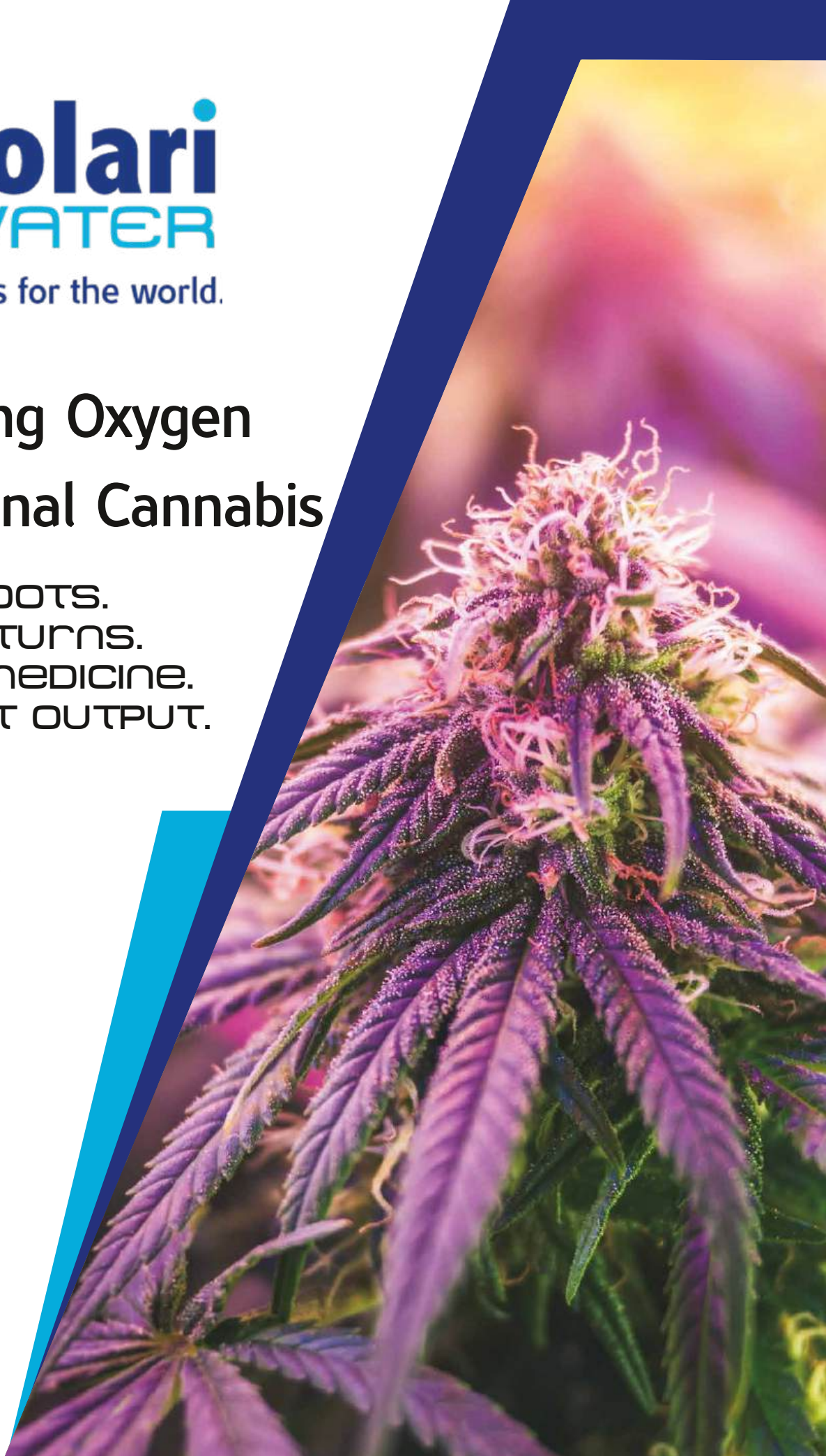


Water solutions for the world.

Engineering Oxygen for Medicinal Cannabis

HEALTHY ROOTS.
BETTER RETURNS.
RELIABLE MEDICINE.
CONSISTENT OUTPUT.

E BOOK



www.SolariWater.com.au

WELCOME

INTRODUCTION

OVERVIEW

Engineering oxygen as a controllable input for medicinal cannabis performance.

Medicinal cannabis cultivation operates under uniquely demanding conditions. Facilities must deliver consistent yields, predictable cannabinoid profiles, and repeatable quality outcomes while meeting strict regulatory, environmental, and cost constraints.

Oxygen is one of the most influential yet least actively engineered variables. While light, nutrients and climate are tightly controlled, oxygen delivery in irrigation water is often left to passive aeration that declines before reaching the root zone.

Solari engineers ultrafine oxygen nanobubbles directly into irrigation water so oxygen is stabilised, retained and delivered at the root interface. This supports strongly aerobic root environments, beneficial microbial activity and efficient nutrient uptake in high-density medicinal systems.

This ebook outlines how oxygen-engineered irrigation can improve root performance, enhance crop consistency and contribute to measurable commercial returns.

From Innovation to Application

Solari has developed proprietary IP in PSA oxygen nanobubble control and integration for high value crops and medicinal cannabis, and is recognised as a world leader in this emerging field.

This ebook is a starting point; the next step is a conversation about how this approach can be engineered into your facility.





Doug Fletcher

CEO Solari Energy and Solari Water

About The Author

Doug Fletcher

Through Solari's work in water oxygenation and nanobubble irrigation, the team has seen how engineered oxygen delivery can improve plant health, soil performance, and productivity. These consistent results underpin Solari's focus on making advanced water technology practical and accessible, helping growers improve yields, reduce reliance on chemical inputs, and support long-term commercial and environmental outcomes.



Mark Lobban

Field Specialist

Industry Contributor

Mark Lobban

Mark Lobban works with commercial growers across intensive and irrigated cropping systems, with experience spanning high-value horticulture and medicinal cannabis. Based in South Australia, he brings practical, on the ground insight into irrigation performance, root-zone management and system reliability in production environments where consistency and scale are critical.

With a Masters-level specialisation in medicinal cannabis cultivation and root-zone oxygen management, Mark translates academic insight and field experience into practical measurement, control and optimisation strategies for real production sites.





OXYGEN-POWERED Irrigation

Engineering Better
Cannabis Performance





THE POWER OF OXYGEN

THE HIDDEN CONSTRAINT IN MEDICINAL CANNABIS PRODUCTION

Medicinal cannabis is one of the most technically demanding crops grown today. Genetics, lighting, nutrition, climate and compliance all receive careful attention, yet oxygen delivery to the root zone often lags behind.

In intensive systems such as RDWC, drip-fed substrates and controlled soil, roots frequently operate close to oxygen limitation. High plant density, warm nutrient solutions, biological activity and recirculation rapidly reduce dissolved oxygen.

As oxygen availability declines, root respiration slows, nutrient uptake efficiency drops and the rhizosphere shifts away from strongly aerobic conditions. These changes are subtle but they limit root function, microbial balance and overall plant performance.

In high-value production, even small root-zone constraints translate into measurable losses in uniformity, resilience and yield potential. Oxygen becomes the hidden constraint that holds back an otherwise well-designed facility.

WHAT THIS MEANS IN PRACTICE

Most growers respond to performance limitations by adjusting nutrients, additives or environmental settings — treating symptoms rather than the underlying constraint.

Without sufficient, reliable oxygen at the root interface, even well-designed grow systems operate below their true performance ceiling. Water remains a delivery medium rather than an active performance input.

Solari's approach begins at this hidden bottleneck — engineering oxygen delivery so irrigation water actively supports root respiration, microbial balance and nutrient uptake, rather than limiting them.

By addressing oxygen directly, growers unlock performance that existing systems are already capable of delivering.





NANOUBBLE SOLUTION: OXYGEN ENGINEERED IN WATER

Medicinal cannabis facilities do an excellent job of controlling what goes into the air and the fertigation tanks, but much less attention is paid to how oxygen is managed in the water itself. Nanobubble systems recast dissolved oxygen as a tuneable input rather than a side effect of basic aeration.

In recirculating systems such as RDWC, drip-fed substrates and controlled soil, nanobubbles saturate the irrigation stream with extremely small, long-lasting gas bubbles that stay in suspension instead of racing to the surface and bursting. This creates a more even oxygen profile through tanks, lines and emitters, helping root zones stay aerobic even under warm, high-demand conditions.

With higher and more consistent dissolved oxygen, roots can respire efficiently, pull in nutrients faster and support a more favourable microbial community around the rhizosphere. Instead of oxygen quietly becoming an unrecognised brake on performance as plants mature, nanobubble oxygenations turns the irrigation system into a consistent driver of root health, crop resilience and yield potential in high value medicinal cannabis production.

OXYGEN IS CONSUMED FAST

In high-density medicinal cannabis systems, oxygen demand increases as plants mature.

Root respiration and microbia activity can deplete dissolved oxygen wihtin minutes of delivery. Without continuous replenishment, oxygen becomes a limiting input during peak growth phases.

This is why short-term aeration often fails to deliver lasting root-zone benefit.



ROOT-ZONE HEALTH & Pathogen Resistance

Why oxygen stability matters below the surface

Oxygen Availability Shapes Root Resilience

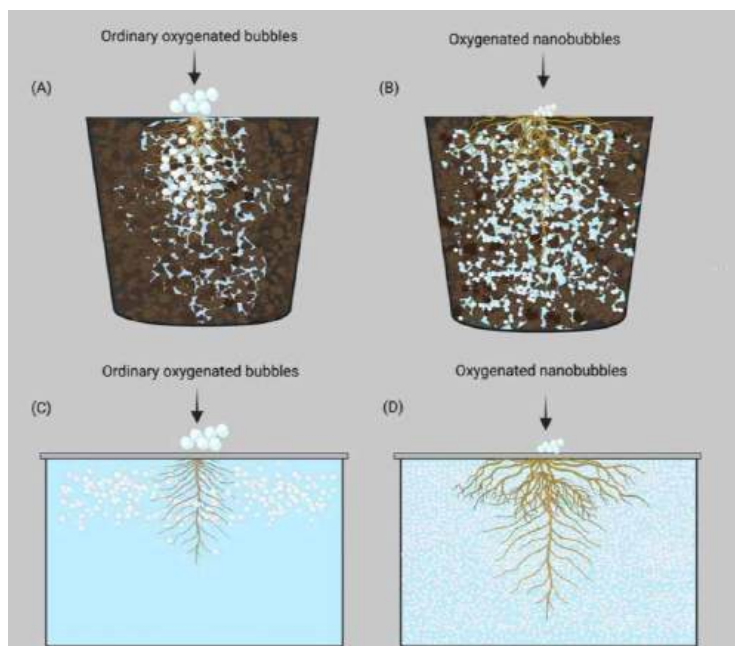
In medicinal cannabis, the root zone operates under sustained load, dense planting, warm nutrient solutions, rapid crop turns and frequent irrigation.

When oxygen is limited, anaerobic processes gain ground. Root metabolism slows, beneficial aerobic microbes lose dominance and conditions become more favourable for opportunistic pathogens.

Visible issues often emerge later as uneven canopies, inconsistent nutrient expression and increased corrective inputs.

More reliable oxygen delivery changes this equation. A consistently aerobic root zone supports stronger natural defences, shrinks anaerobic pockets and helps roots recover faster from stress events such as over-irrigation or temperature spikes.

Over time, the microbial community shifts toward aerobic dominance. Beneficial organisms occupy space and resources, reducing the ecological advantage pathogens rely on and making the root environment inherently less hospitable to disease.



Sustaining Aerobic Conditions at the Root Interface

Nanobubble-based oxygen delivery changes how oxygen behaves within irrigation water. Because ultrafine bubbles remain suspended rather than escaping immediately, oxygen stays available as water moves through pipes, emitters and substrates.

This sustained oxygen presence supports active root respiration and helps maintain aerobic conditions where roots and microbes interact. Rather than brief oxygen spikes followed by rapid depletion, the root zones experiences a more even oxygen environment throughout the irrigation cycle.

Growers operating RDWC, drip-fed substrates and controlled soil systems report steadier root activity, improved uniformity across plants and fewer periods of hidden stress when oxygen availability is designed in rather than left to chance.





PATHOGEN SUPPRESSION MECHANISMS

Why Oxygen Stability Changes the Disease Equation

A Defensive Root Environment Starts Below the Surface

In medicinal cannabis systems, disease pressure often develops when oxygen becomes limited in the root zone. The high plant density, warm nutrient solutions and frequent irrigation place continual demand on root respiration and microbial balance.

When oxygen availability drops, root metabolism slows and biological balance shifts. These changes may be subtle at first, but they weaken natural defences and create conditions where opportunistic pathogens are more likely to establish.

Restoring Microbial Balance After Stress Events

Events such as over-irrigation, temperature spikes or system load changes can disrupt root-zone biology. When oxygen levels fluctuate, beneficial aerobic organisms slow down and less favourable biology takes advantage.

Steady oxygen delivery supports faster recovery by maintaining aerobic activity and root respiration, helping systems stabilise more quickly after stress.

Building Resistance Into the Root Zone

Consistent long term oxygen availability changes how the root zone behaves over time. Water distribution becomes more even, anaerobic pockets shrink, and roots remain metabolically active across growth stages.

Rather than relying on reactive intervention, the root environment becomes inherently less favourable to pathogen development.

How Oxygen Stability Disrupts Pathogen Conditions

When oxygen remains available throughout the irrigation cycle, the root zone avoids the rapid oxygen crashes that pathogens exploit. Oxygen persists as water moves through pipes, emitters and substrates, supporting roots during peak metabolic demand.

This sustained aerobic environment slows the establishment of anaerobic organisms and smooths out root performance across intensive production systems

Biology That Works in Your Favour

As oxygen conditions stabilise, the microbial community shifts toward aerobic dominance. Beneficial organisms occupy physical space, compete for resources and reduce the ecological advantage pathogens rely on.

Over time, this creates a root zone that actively resists infection — not through intervention, but through biological balance that strengthens with every irrigation cycle.



OPERATIONAL ROI

& Predictability

Medicinal cannabis facilities operate within narrow tolerance windows. Variability in root health, irrigation performance or biological balance quickly shows up as extra labour, more corrective inputs and added compliance risk.

Yield is the visible metric, but much of the commercial impact lies in stability. When oxygen at the root zone remains steady, growers experience fewer stress events and less reactive intervention. Root systems behave more consistently and nutrient uptake becomes more predictable.

This reduces the frequency of actions such as nutrient rebalancing, emergency flushing and disease responses. Instead of constantly correcting issues, teams spend more time executing a planned production strategy.

For regulated operations, oxygen-driven stability supports more consistent batch performance and simplifies production management under audit and reporting pressure. It is a systems-level lever that quietly protects margins over time.

Pioneering an Emerging Application

While nanobubble technologies have been applied across crops such as strawberries, tomatoes, turf and broadacre systems, there is very limited published work on PSA-fed oxygen nanobubbles in medicinal cannabis production.

This ebook reflects Solari's pioneering role in that emerging field, outlining how oxygen-engineered nanobubble systems can be practically designed and integrated into real medicinal cannabis facilities.

Global Field Validation

 **Yield: +21%**
Marketable Flower Weight
(Greenhouse Cannabis Trial, Netherlands).

 **Potency: +12%**
Total Cannabinoid Content
(Due to reduced metabolic stress).

 **Root Health: +26%**
Root Mass Increase
(Turf/Grass Field Trials).

 **Sustainability: 50%**
Reduction in Water Waste
(Due to better infiltration).

Summary of performance improvements recorded across commercial and field trials using oxygenated nanobubble irrigation systems.

Measured Commercial Impact of Oxygenated Nanobubble Systems



Summary of performance improvements recorded across commercial and field trials using oxygenated nanobubble irrigation systems.



WHERE PERFORMANCE MEETS PRACTICAL APPLICATION

Cleaner Water | Healthier Plants | Bigger Returns

Solari Water systems are built for growers who need consistency, reliability and measurable outcomes — not theoretical solutions.

By engineering oxygen stability directly into irrigation water, Solari helps medicinal cannabis producers:

- Improve root-zone resilience
- Reduce variability across crops
- Support uniform growth and quality
- Lower reliance on corrective inputs
- Strengthen long-term operational performance

Whether operating indoor RDWC, substrate-based systems, or controlled soil environments, Solari's modular nanobubble technology integrates seamlessly into existing infrastructure.

Next Steps

If you're exploring oxygen-engineered irrigation for medicinal cannabis production, the Solari team can help assess suitability, scale and system configuration.

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