



NANO BUBBLE
TECHNOLOGIES

*Oxygen Nanobubbles
Results for Barley
Seeds in the Malting
Process
October 2021*

TRIAL INTRODUCTION AND SETUP

Trial Introduction

Oxygen nanobubbles have unique properties that promote the growth of living organisms. This trial was conducted to evaluate the performance of oxygen nanobubbles in the barley steeping process, the critical first step in malt production.

Nanobubbles are long-lasting, sub-micron gas-filled cavities in aqueous solution. They are smaller than 200 nm in diameter and possess a significantly larger surface area per unit volume than conventional bubbles. Due to their tiny size, nanobubbles lack natural buoyancy and remain suspended in solution for extended periods, allowing for the super-saturation of dissolved oxygen.

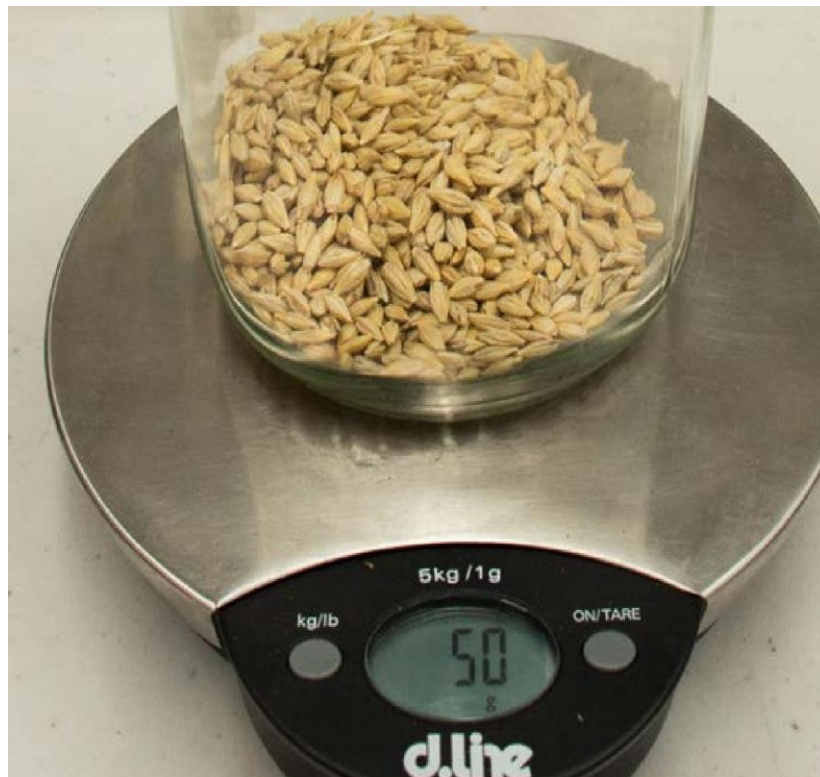
Nano Bubble Technologies' patent-pending nanobubble injector generates over 1.13 billion nanobubbles per millilitre, with each bubble measuring less than 75 nm. The technology is fully scalable and can oxygenate water up to 36 ppm in a single pass, compared to normal tap water, which typically contains no more than 10 ppm

Trial Setup

Fifty grams of Australian Certified Organic barley seeds (not a specific malting variety) were used for the trial. The seeds were divided into two equal batches and placed in clean, sterile glass jars. After rinsing and draining, the jars were filled with either:

- Oxygen Nanobubble (ONB) water: oxygenated to 36 ppm O_2 (pre-ozonated at 13 ppm for sterilisation and allowed to stand for 24 hours to eliminate residual ozone), or
- Control water: filtered bottled water with approximately 10 ppm dissolved oxygen.

Both jars were stirred every 1–2 hours to ensure adequate oxygen exposure. Dissolved oxygen levels were monitored using a Hanna HI98193 Dissolved Oxygen Meter. When levels in the nanobubble jar dropped below 20 ppm, the water in both jars was drained and replaced with a fresh solution. This process closely simulated a commercial steeping system. The jars were maintained at approximately 20°C throughout the trial.



After 48 hours, barley seeds steeped in oxygen nanobubble water showed **significantly greater chit development** compared to the control. The chits were noticeably larger and more advanced. At the 24-hour mark, seeds were sliced open to assess water absorption. The oxygen nanobubble-treated seeds exhibited substantially higher moisture uptake than the control seeds. Visual comparisons at 24, 36, 48, and 72 hours clearly demonstrated faster and more uniform germination in the nanobubble group. By day 3, the difference in chit development and overall seed vigour between the two groups was particularly evident.

Oxygen Nanobubble seeds on the top
Control sample seeds on the bottom



Oxygen Nanobubble

Regular Water



24 Hours



24 Hours



48 Hours



48 Hours



72 Hours



72 Hours



Control Sample Seeds @ 36 Hours





Control Sample Seeds @ 48 Hours





Control Sample Seeds @ 3 Days



DISCUSSION AND CONCLUSION

This trial clearly demonstrates that oxygen nanobubble water promotes faster and more robust development of barley seeds during the steeping stage of the malting process. The enhanced oxygen availability accelerates metabolic activity, resulting in improved chit formation and greater water absorption within the seed.

While germination rate was not rigorously quantified in this trial, visual observations strongly suggest that oxygen nanobubbles would also improve overall germination percentage. A larger follow-up trial using recognised malting barley varieties and precise seed counters is recommended.

The promising outcomes observed in this barley trial align with previous successes in hydroponic crops such as basil. This indicates that oxygen nanobubble technology has broad potential to enhance germination, growth, and efficiency across various agricultural and agro-processing applications.





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