



NANO BUBBLE
TECHNOLOGIES

*Oxygen Nanobubbles
Results on
Hydroponically
Grown Basil
September 2023*

This hydroponics trial was conducted to test whether increasing oxygen levels in the nutrient solution using nanobubbles would improve crop yield, shelf life, and plant resilience against pests and disease.

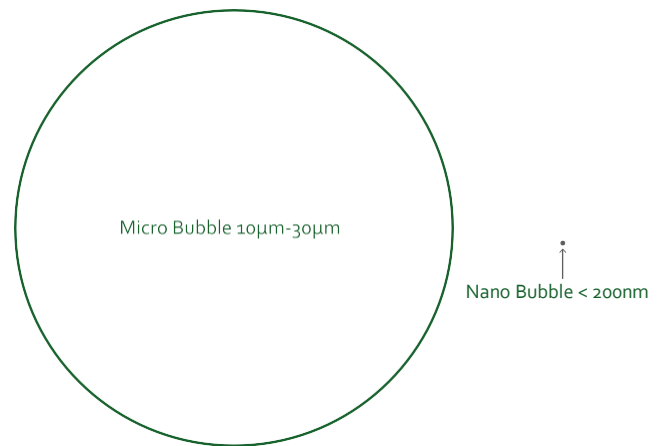
Nanobubbles are long-lasting, sub-micron gas-filled cavities in aqueous solution. They are approximately 1/400th the width of a human hair and have diameters smaller than the shortest wavelength of light, making them invisible to the naked eye and standard microscopes.

Due to their extremely small size, nanobubbles exhibit no natural buoyancy and do not rise and burst like larger bubbles. They remain suspended in solution for extended periods, enabling supersaturation of gases in liquid.

The gas that can be added to a liquid may vary depending on the application. To date, our technology has been successfully tested with Ozone and Oxygen, opening up a wide range of industrial and consumer applications.

Nano Bubble Technologies' (NBT) patented nanobubble injector produces bubbles with exceptional efficiency, with over 85% of bubbles measuring less than 100 nm in size.

A leading fresh herb supplier to major Australian supermarkets kindly hosted the trial at their advanced hydroponic facility



Micro & Nano Bubble Size Comparison - Drawn To Scale



*Pilot & Testing
Machine in place*

TRIAL SETUP

Our testing & pilot machine was set up at the partner plant to test oxygenated nano bubble water against a crop control using the Nutrient Film Technique (NFT) hydroponics technique. The trial commenced on the 8th of September 2023.

Bottled oxygen was used in place of a swing absorption oxygen concentrator; this would not have affected the results of the trial.

The system was set up to pump water from a catching reservoir, at the end of the hydroponics plant beds, back to a tank on the test machine. Nutrient water was pumped from this tank back onto the hydroponics plant bed.

A custom program and electronics were fitted to the test machine before installation, which allowed multiple programs and a programmable oxygen boost cycle to maintain dissolved oxygen concentrations during the day.

Both the control bench and the oxygen nanobubble bench had a water start time of 6:30 and ran for 12 hours daily.

The water was sanitised with Hydrogen Peroxide applied daily by the partner staff. The EC level used was 1.7-1.8 for both the control and nano bubble crops.

The test machine was programmed to maintain a dissolved oxygen level of between 20 and 25 mg/l (PPM) in the nanobubble nutrient water. At 6 am daily, the test machine was run for 30 minutes, recirculating water through the nano bubble injector to get the dissolved oxygen and nano bubble concentration up to desired levels.

Every 20 minutes, an oxygen boost cycle was run for 6 minutes to top up nanobubbles and oxygen consumed by the plants.

Oxygen Nanobubble Plants




Day 11: Root comparison

Oxygen nanobubble plants (top photo) show improved root development




Control Plants



Oxygen Nanobubble Plants

Day 16: Root comparison

The oxygen nanobubble plants in the top photo show noticeably improved root development



Control Plants

Day 19: Basil Plants Comparison

Oxygen nanobubble plants are shown on the left, showing denser roots and improved leaf development



Oxygen Nanobubble Plants

Control Plants



Oxygen Nanobubble Plant



Control Plant

Day 23 root comparison
The oxygen nanobubble plant (top photo) shows denser, more advanced root development.



Basil was harvested one week early on 13 October 2023 due to commercial demand. Twelve randomly selected plants from each group were analysed for foliage height, fresh foliage weight, and dry foliage weight.

Oxygen Nanobubble Advantages:

- **+27%** increase in foliage (fresh) weight
- **+13%** increase in dry foliage weight
- **+6%** increase in foliage height

Detailed Measurements:

- **- Foliage Weight:** Average 58 g (nanobubble) vs 45.8 g (control) — **27% increase**
- **- Dry Foliage Weight:** Average 5.6 g (nanobubble) vs 5.0 g (control) — **13% increase**
- **- Foliage Height:** Average 259 mm (nanobubble) vs 244 mm (control) — **6% increase**



+ 27%

Oxygen nanobubbles increased Basil foliage weight yield by 27% over the control crop.

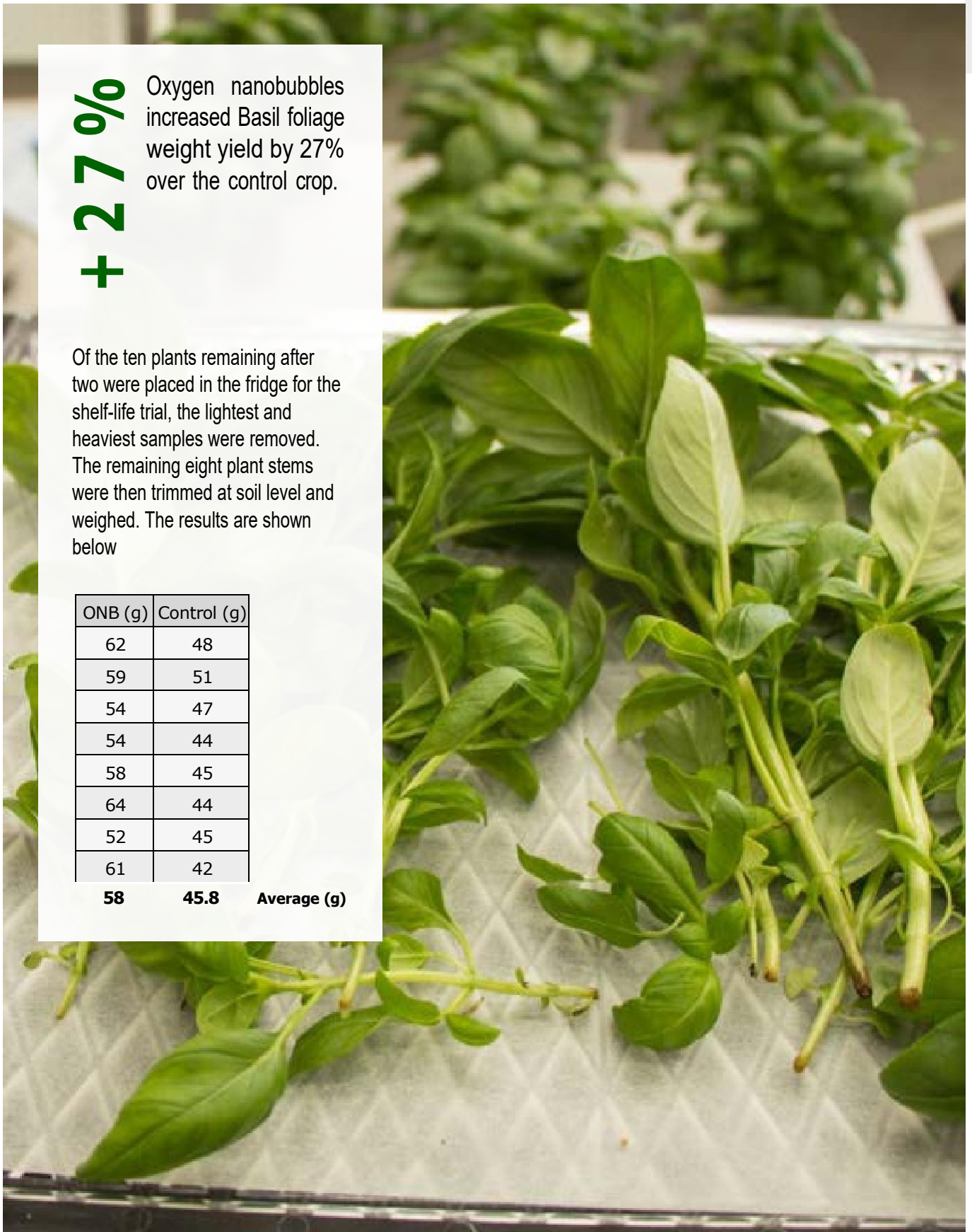
Of the ten plants remaining after two were placed in the fridge for the shelf-life trial, the lightest and heaviest samples were removed. The remaining eight plant stems were then trimmed at soil level and weighed. The results are shown below

ONB (g)	Control (g)
62	48
59	51
54	47
54	44
58	45
64	44
52	45
61	42

58

45.8

Average (g)



+13%

Oxygen Nanobubble plants had a 13% greater dry foliage weight than the control crop.

Of the ten plants remaining after two were placed in the fridge for the shelf-life trial, the lightest and heaviest fresh harvest samples were removed. The remaining eight plants were dried in a dehydrator for 24 hours and then weighed. The results are shown below.

ONB (g)	Control (g)
45	40

5.6 5 Average (g)



+ 6 %

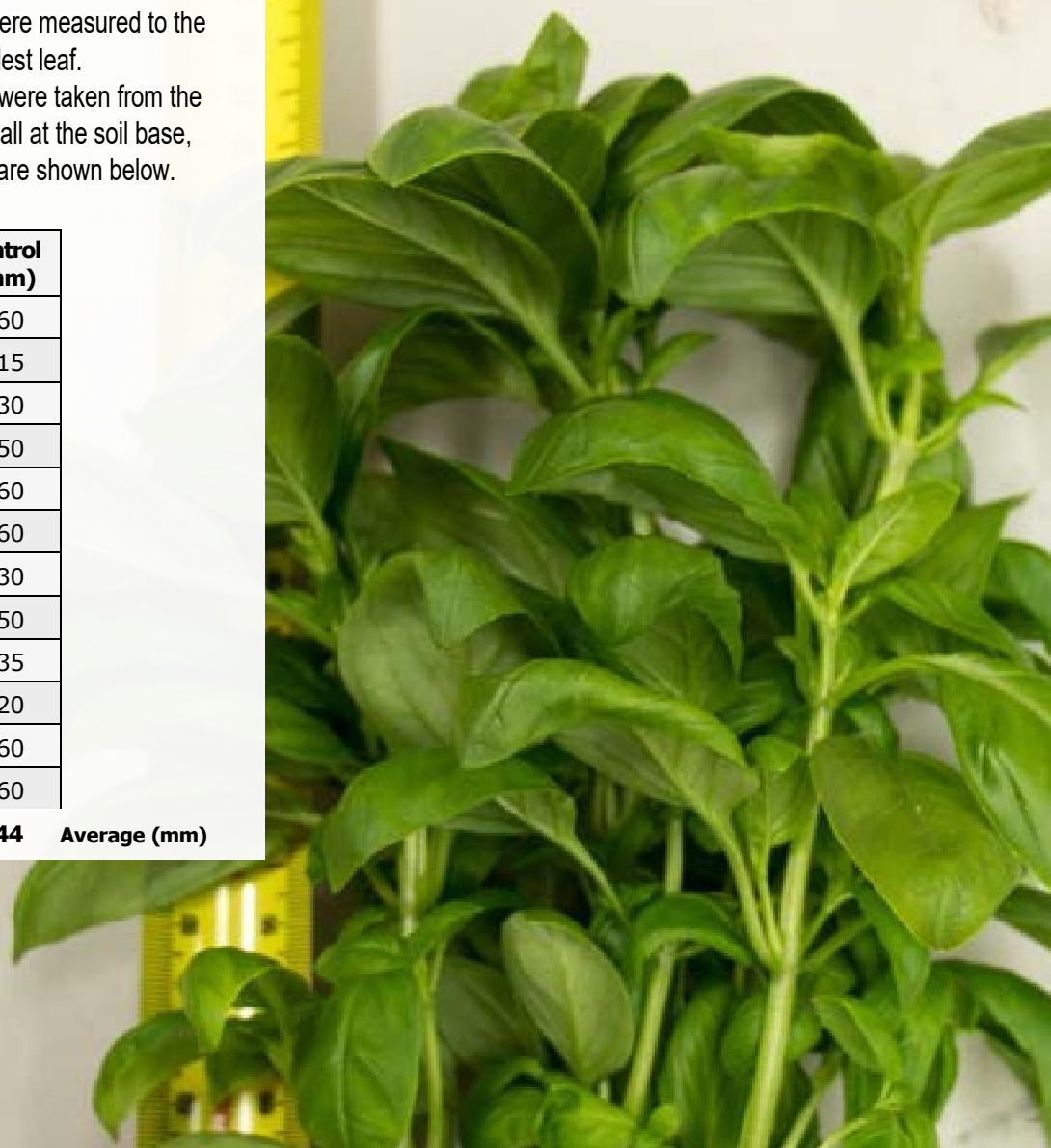
Oxygen nanobubbles increased the Basil foliage height from the top of the root system to the highest leaf by 6% over the control crop.

All twelve Oxygen Nanobubble and control plants were measured to the height of the tallest leaf.

Measurements were taken from the top of the root ball at the soil base, and the results are shown below.

ONB (mm)	Control (mm)
270	260
230	215
250	230
290	250
265	260
270	260
250	230
250	250
285	235
235	220
260	260
250	260

259 244 Average (mm)



Two plants from each group were placed in the refrigerator to evaluate shelf life. The results were outstanding. Basil grown with oxygen nanobubbles maintained significantly better visual quality and freshness compared to the control group over an extended period.

Photos clearly demonstrated that oxygen nanobubble-grown basil exhibited slower wilting and better leaf integrity at 72, 96, 120, and 168 hours in refrigerated storage.



Basil in the fridge for a shelf life trial - Day 1

Oxygen Nanobubble Plants



Control Plants



Oxygen Nanobubble Plants



Control Plants



Oxygen Nanobubble Plants



Control Plants



Oxygen Nanobubble Plants



Control Plants





CONCLUSION

Our technology has successfully demonstrated that oxygen nanobubble technology delivers substantial benefits for hydroponically grown basil. The trial results confirmed significant improvements in key growth parameters, with oxygen nanobubble-treated plants producing **27% more fresh foliage weight**, **13% more dry foliage weight**, and **6% greater plant height** compared to the control group using conventional oxygenation methods.

Beyond increased yield, the nanobubble-grown basil exhibited markedly superior shelf life, maintaining visual appeal and freshness for a much longer duration after harvest. These combined advantages, higher yield, stronger growth, and extended shelf life, offer hydroponic growers a powerful tool to boost productivity, improve product quality, and enhance profitability.

This trial adds to the growing body of evidence that nanobubble technology represents a breakthrough, chemical-free approach to optimising dissolved oxygen levels in hydroponic systems. By enabling super-saturation of oxygen and improving the root zone

Nanobubbles support healthier, more vigorous plant growth and improve nutrient utilisation efficiency. With further optimisation and larger-scale trials, oxygen nanobubble technology could become a standard enhancement in high-performance hydroponic systems, delivering both economic and environmental benefits to the industry.



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Nano Bubble Technologies

Unit 29/28 Barcoo
Street, Roseville, NSW
2069
AUSTRALIA

<http://www.nanobubble.com.au>