



Lettuce: Improved root health and development with oxygen nanobubbles from Moleaer

LOCATION

Proefstation for Vegetable Cultivation (PSKW), Belgium

DATE

July-August 2022

UNIT

Bloom 50 with external O₂ supply

RESULTS

- Increased Dissolved Oxygen
- Better Root Development
- Healthier Roots

Proefstation for Vegetable Cultivation (PSKW), an R&D institute in Belgium, conducted a trial on two varieties of lettuce, Fairly (Enza) and Alyssa (Rijk Zwaan), grown hydroponically. They compared three dissolved oxygen (DO) concentrations at 6, 13 and 15 ppm. The elevated oxygen concentrations of 13 and 15 ppm were obtained by enriching the water with pure oxygen (99.9% O₂) nanobubbles using a Moleaer nanobubble generator.

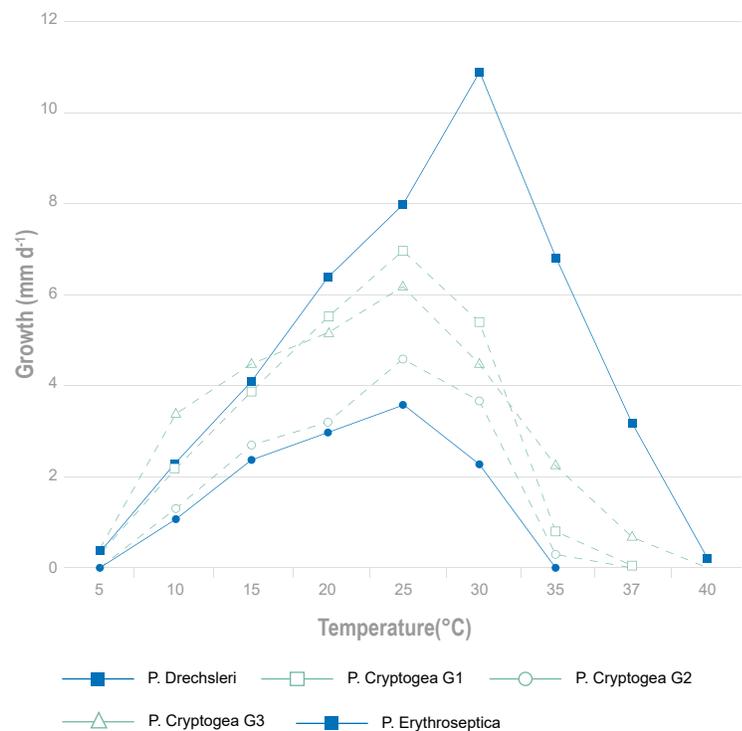
REDUCE DISEASE PRESSURE WITH OXYGEN NANOBUDDLES

Controlling root diseases caused by water-borne pathogens like *Pythium* and *Phytophthora* without chemicals is a challenge for many hydroponic growers. Once introduced into the water, the disease outbreak can be widespread and pervasive, causing damage to plant roots and crop loss.

Moleaer's nanobubble technology has been used by many growers worldwide to reduce disease pressure and improve root zone conditions by delivering optimal, efficient and economical dissolved oxygen (DO) levels and high concentrations of chemical-free nanobubbles. Oxygen creates an environment less conducive to pathogenic growth and nanobubbles create a natural oxidant that destroys pathogens and other contaminants in the water. The hard surface of the nanobubbles scours biofilm, which can harbor pathogens on irrigation piping walls, further reducing disease outbreaks. Better oxygenated root zones and reduced disease pressure leads to improved root development, better quality crops and reduced chemical and pesticide application for growers.

In an earlier study conducted by PSKW in lettuce (NFT) in 2020-2021, the suppressing effects of oxygen nanobubbles on pathogenic growth using Moleaer's patented nanobubble

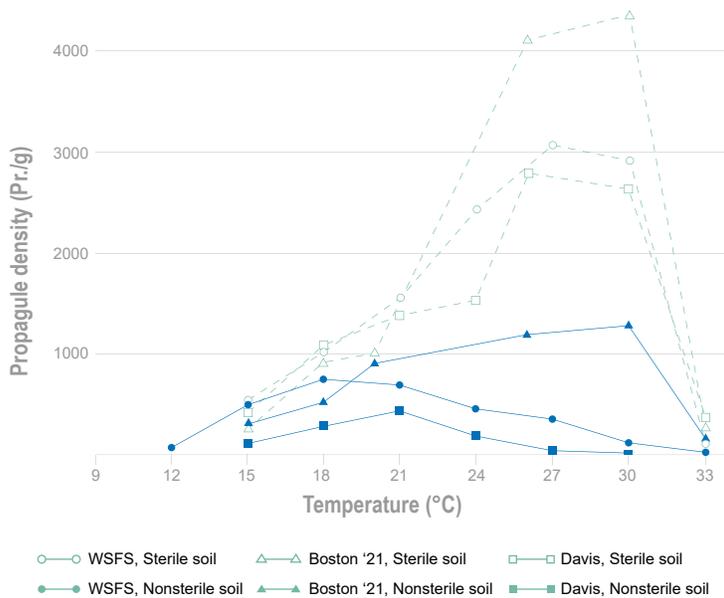
generator has already been established. Commercial leafy green growers like [Revol Greens](#), de Kruidenaer or Little Leaf Farms have since also reported significant pathogenic growth reductions based on before and after DNA sampling after deploying nanobubble technology in their hydroponic systems. Revol, for instance, was able to reduce *Pythium* levels by 80%. Additionally, researchers from [Delphy Research Institute](#) and [NovaCropControl](#) also reported reduced pathogen levels on other crops using nanobubble technology developed by Moleaer. Both studies resulted in better root development and higher yields.



Graph 1: Correlation between water temperature and Phytophthora infections. From Mostowfizadeh-Ghalamfarsa et al. Fungal Biology. 114:325-339

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Graph 2: Effects of oxygen and temperature on *Pythium* infections. From Lifschitz & Hancock. *Ecology & Epidemiology*, 73(2):257

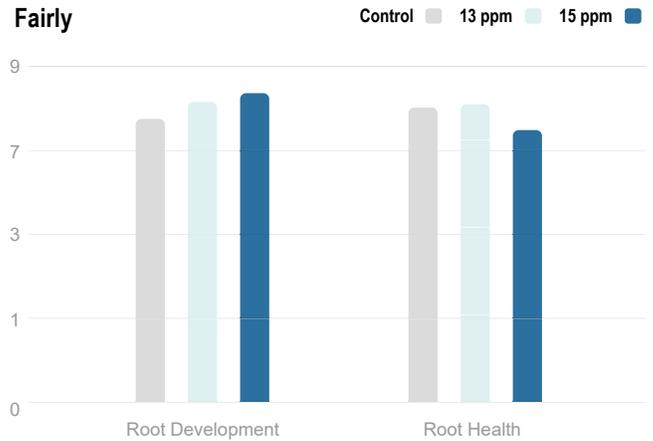
Literature studies¹ have studied the effect of oxygen and temperature on *Phytophthora* infections, concluding that a reduced concentration of oxygen promotes the formation of zoospores, and therefore, the spread of the pathogen. Optimal zoospore survival was observed between 5.3 - 5.6 mg/L and reduced survival under oxygenated and depleted conditions, hyperoxia and hypoxia, from 5.6 to > 16.7 mg/L. Elevated O₂ concentration (hyperoxia) results in less zoospore formation of *Phytophthora* spp.

Additionally, optimal growth has been observed at temperatures between 25 and 30 degrees Celcius both for *Pythium* and *Phytophthora* (See graph 1).

REDUCE DISEASE PRESSURE WITH OXYGEN NANOBUBBLES

After just ten days, PSKW reported a clearly visible increase in root development at the higher oxygen concentrations, with the best root growth and healthiest roots in the treatment with 13 ppm oxygen, for both varieties. The increased temperature in the clean tanks of the treatments with the highest oxygen concentration (15 ppm) affected the root development. Although root health and development were still better than in the non-oxygenated control, the root health not as good as in the medium oxygenated (13ppm) treatment. The increased temperature is expected to be the result of the over dimensioning of the Nanobubble Generator relative to the volume of treated

water. It is well documented that additional levels of oxygen in the water promote root growth and root health in lettuce and other crops. When the oxygen concentration of irrigation water is increased, the roots are healthier and grow faster. This makes the roots more resistant to infection from root diseases such as



Root development and Root health was measured on a scale of 1 to 9 based on number and length of the roots, and color of the roots, respectively.



Phytophthora cryptogea. In addition, a high oxygen concentration is also beneficial to limit distribution of *Phytophthora* cryptogea, as according to the literature, a high oxygen saturation inhibits spore formation in the water.

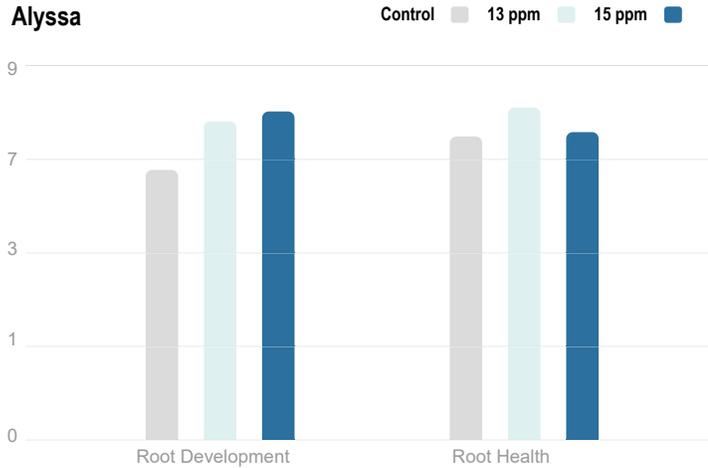
While it is normal that the levels of oxygen tend to decrease along the gutter, the plants located at the end of the gutter still had a higher O₂ concentration than those without oxygen nanobubbles added into the water. Besides that, there was no difference on the crop weight, so the plants located at the

¹ Mostowfizadeh-Ghalamfarsa et al. *Fungal Biology*, 114:325-339 - Kong & Hong. *BMC Microbiology*, 14:124 - Lifschitz & Hancock. *Ecology & Epidemiology*, 73(2):257

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Alyssa



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inlet and outlet had the same weight which is considered an improvement to standard conditions, when the plants located at the outlet tend to have a slightly lower weight than those at the inlet

BENEFITS THE GROWER COULD SEE

Ben Vanvoorden, a scientific researcher at the Research Station for Vegetable Cultivation (PSKW) in Belgium, says “the nanobubble technology is an efficient way of dissolving oxygen into the irrigation water and keeping it dissolved there. This is reflected in visibly more and healthier roots”.

When comparing different methods to transfer oxygen into water, oxygen measurements at ten different lettuce growers showed that Moleaer’s nanobubble technology is the most efficient way to introduce oxygen into the water and, in particular, to keep the oxygen dissolved in the water for as long as possible, as seen in several PSKW visits to lettuce growers that use Moleaer’s technology.

This effect of stabilizing DO levels with nanobubbles is also confirmed from Moleaer’s own R&D laboratory and offers additional benefits compared to other oxygenation technologies not based on generating nanobubbles, like an increased efficiency in the transfer of oxygen, decreasing waterborne pathogens, and the scouring effect of the nanobubbles, which helps keep the irrigation system cleaner by removing biofilm.



SCAN HERE

To learn more about how irrigation water infused with nanobubbles helps develop roots and control pathogens, download our eBook:

<https://www.moleaer.com/nanobubble-e-book>

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