

## The Role of Oxyfertiligation in High-Yield Agriculture



### Oxyfertiligation: why is there growing interest for high-yield sustainable farming?

Oxyfertiligation is a method used in advanced agricultural systems to promote a healthy root system. It delivers oxygen to the root of the plant to encourage absorption, microbial activity and root respiration. This can result in higher yields, while also maximising the efficient use of water and nutrients.<sup>1</sup>

The method has been used for growing plants in conditions where root aeration is restricted and oxygen levels in the soil are less than optimal. This includes vertical farms, hydroponic systems, and tropical and Mediterranean conditions where high temperatures mean oxygen levels in the soil drops. It is of particular interest to high value crops such as berries, tomatoes and greens that have been demonstrated to benefit from the method.<sup>2</sup>

In recent years there has been renewed interest from a sustainability perspective. Advances in technology have allowed it to become a more scalable option for vertical farming, an industry set to grow to US\$35 billion by 2032.<sup>3</sup> Meanwhile, amid growing interest in climate resilient food production, hydroponic systems are experiencing a growth in popularity.<sup>4</sup> Related processes, such as aerated irrigation are also being explored as a means of improving water and fertiliser use efficiency in more traditional farming.

### So, what does the latest research say and what do food producers need to know about the present landscape?

The significant yield increases in crops using oxyfertiligation have made it a commercially viable option for many farmers working in hot and arid conditions.<sup>5</sup> For example, roses grown in a greenhouse in a Mediterranean climate saw a 19% increase in yield when using oxyfertiligation methods. In soilless culture systems, oxyfertiligation has been demonstrated to return a 9% increase in yield for cucumbers while playing an important role in preventing hypoxic conditions in Mediterranean soils.<sup>6</sup>

<sup>1</sup> Surya P. Bhattarai, Ninghu Su, David J. Midmore. (2005), Oxygation unlocks yield potentials of crops in oxygen-limited soil environments, *Advances in Agronomy*. (V.88, p313 – 377)

<sup>2</sup> Palencia, P., Martínez, F., Padua, D. and Oliveira, J.A. (2019). Effects of oxyfertiligation on strawberry plant growth and fruit quality in a soilless growing system. *Acta Hort.* 1256, 511-518 DOI: 10.17660/ActaHortic.2019.1256.73 <https://doi.org/10.17660/ActaHortic.2019.1256.73>

<sup>3</sup> Projected vertical farming market worldwide from 2022 to 2032, Statista, April 2023

<sup>4</sup> Sasireka Rajendran, Tenzing Domalachenpa, Himanshu Arora, Pai Li, Abhishek Sharma, Gaurav Rajauria. (2024). Hydroponics: exploring innovative sustainable technologies and applications across crop production, with emphasis on potato mini-tuber cultivation. *Heliyon*, Volume 10, Issue 5. <https://doi.org/10.1016/j.heliyon.2024.e26823>.

<sup>5</sup> Guri; O. Marfà. (2002). Oxyfertiligation in soilless rose cultivation: preliminary results. *Plantflor.* 92, pp. 66 – 68.

<sup>6</sup> S. Guri; O. Marfà. (2001). Effect of oxygen application in irrigation water in soilless crops. *Agrícola Vergel.* 239, pp. 593 – 596.

Aerated irrigation is a related process that has also attracted growing interest in efficient use of farming resources, particularly in acidic, medium textured soils that receive high levels of irrigation. One 2018 meta-analysis found that this process increased water efficiency by 17.9% while resulting in a yield increase of 19.3% and was therefore an important process for the challenge of feeding more people on less arable land and scarce water.<sup>7</sup>

Other researchers are also starting to experiment with combining pure oxygen with nano-sized bubbles in commercial greenhouses. Early studies indicate that it can have a significant impact on the retention of fertilisers on crops growing in commercial greenhouses, whilst also significantly improving the quality of the produce.<sup>8</sup>

### Helping food producers overcome the technical challenge.

Oxyfertilisation systems offer numerous benefits and, with the right approach, can be effectively managed. Achieving and maintaining optimal dissolved oxygen levels in irrigation water with the relevant nutrients requires specialised systems that monitor pH levels and other variables. By adjusting oxygen levels to meet the specific needs of different crops and soil types growing conditions can be enhanced effectively. As research shows, optimising and maintaining these parameters in relation to your crop and soil type is the best way to achieve long term and consistent results.



Dr. Sonia Guri, Lead Agricultural Engineer at Air Products, has been involved in longstanding research involving oxyfertilisation in soilless crops and hydroponics systems. This experience, and our own ongoing understanding of the research from around the world have informed the way we offer the technology to an increasingly diverse base of users, from hydroponic systems to those looking for a sustainable method for intensive farming of high-quality products like berries.

Oxyfertilisation and other oxygen-based innovations in agriculture are poised to play a crucial role in the future of sustainable, high-yield farming. As vertical farming and soilless systems gain popularity, advancements in these technologies are making them more accessible to food producers worldwide. This increased accessibility will allow a range of food producers to leverage the technology as part of a high-yield, resource efficient future for agriculture.

<sup>7</sup> Ya-Dan Du, Wen-Quan Niu, Xiao-Bo Gu, Qian Zhang, Bing-Jing Cui, Ying Zhao. (2018). Crop yield and water use efficiency under aerated irrigation: a meta-analysis. *Agricultural Water Management*, Volume 210. Pages 158 – 164, ISSN 0378-3774, <https://doi.org/10.1016/j.agwat.2018.07.038>

<sup>8</sup> Towards a more sustainable cultivation of plants and berries with nano-oxygen water, HortiDaily, 7 May 2024

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