

Top tomatoes thanks to Mars missions

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Credit: M.Barel (CC BY-NC 2.0)

Next time you eat a tomato or sweet pepper, take a closer look, because there's a good chance that its healthy appearance is thanks to one of former US President Barack Obama's speeches and ESA research for sending people on long-duration space missions.



Inspired by an Obama speech in 2010 on human missions to Mars, Dutch company Groen Agro Control started investigating the best way to grow and fertilise plants in space, and whether that could also lead to improving the growth of vegetables on Earth.

"In space, you can fertilise plants only with the minerals you take with you, but you still want them to produce the best possible crops," explains the company's Lex de Boer.

"Ideally, you would also use the water that evaporates from the plants as a source of drinking water, with the minimum amount of purification. That means you have to apply doses of each mineral extremely carefully, so that as little as possible ends up unused in the drain water."

To study this, the company built an enclosed system in which tomato and pepper plants received doses of 16 different minerals, looking at how the uptake of each mineral correlated with growth.

In 2013, the company met an ESA team at the Space-MATCH event organised by Netherlands Organisation for Applied Scientific Research TNO and ESA's Technology Transfer Programme Office to bring ESA engineers and industry together to exchange knowhow. Here, the company was inspired to spin off a smart service helping horticulturalists to fertilise plants better on Earth.

Triggered by the requirement to provide for the needs of humans on long missions to the Moon and Mars, ESA's Micro-Ecological Life Support System Alternative (MELiSSA) project focuses on a 'closed' <u>life support</u> system, where all supplies are reused and recycled. So, for example, organic waste and carbon dioxide should be entirely converted into oxygen, water and food.

"MELiSSA recognises that we have to develop a self-supporting system



for long missions, as astronauts will not be able to rely on regular deliveries of supplies, especially as they move further from Earth," explains ESA's Christel Paille.



AlgoSolis. Credit: Université de Nantes

"One key issue is food and water supplies. Astronauts will need to grow their own food with limited resources, and reclaim as much water as possible from that growth cycle. Hence it's vital that we develop a scheme that tells them exactly the right amount of fertiliser to apply at every stage in the <u>plant growth</u>."

SPIN-OFF FROM RESEARCH AS IF IN SPACE

Based on its initial experiments, and the results it gained from growing



vegetables in closed and well-controlled environments conceptually as if in space, the company developed a scheme for horticulturists, this time with the goal of maximising plant growth and yield through very careful use of fertilisers.

In the service now offered to growers, samples are taken every week of both the fertiliser solution dripped into the plants – including tomatoes, peppers, cucumbers, eggplant, roses and gerbera – and the liquid that drains away.

These are analysed at the company's laboratory and the results sent back to the growers, with advice on any changes they should make to the amounts of each of the 16 minerals given to the plants.

"There is a separate approach for each mineral, but these are also linked with each other because the uptake of certain minerals – such as potassium, magnesium and calcium – are closely related," says Lex.

"The amount of each mineral that a plant needs also varies across its lifecycle. It will need a different combination when it is producing stalks and leaves early in its life compared with when it is producing flowers and fruit."

Horticulturalists also face challenges in altering fertiliser doses to match changing growing conditions. For example, rising energy prices have encouraged growers to keep greenhouse windows closed. However, this causes higher humidity, resulting in a fall in evaporation from plants.





Dosing of minerals for growing tomato and pepper plants. Credit: Groen Agro Control

That, in turn, makes it harder for tomato plants to transport calcium to the top of the plant, which can result in a condition that leaves and the plant top becomes necrotic".

The company's scheme shows growers how to compensate for this by altering not just the amount of calcium in the drop water, but also magnesium and potassium levels.

Production increase



In less than one season, Dutch customer Zwingrow has already started to see positive results from using the scheme for its crop of orange bell peppers.

"We're always trying to improve the health and quality of the plants we grow, but using this weekly analysis means we are acting proactively, delving deeper into the needs of the plants and getting better results," says Ted Zwinkels, co-owner of Zwingrow.

"Even though we started using it after the start of the season last year, the plants grew better and were healthier. I'd estimate that overall production increased by around 5%.

"It's impossible to know how much of this was due to the new regime, as variations in sunlight from year to year also play a part.

"However, already this season, using the service from the very start, we've seen stronger, better <u>plants</u>, and fewer vulnerable ones."

Groen Agro Control now has clients across the world. While it still has plans for experiments on crop growth in space, it is also widening its horizons on Earth, including a potential service for crops grown outside using drop water application of fertilisers, such as asparagus.

Provided by European Space Agency

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