Feeding a Mars mission: The challenges of growing plants in space

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Plants will play a critical role in the survival of human beings on long-duration space missions, such as a mission to Mars. However, as a paper published in *Botany Letters* shows, many challenges need to be addressed

if astronauts are to successfully grow enough food on board spacecraft and on other planets.

Lucie Poulet and colleagues from the University of Clermont-Ferrand, Auvergne outline in their review that while healthy plants can be grown in space, the long-term effects of the space environment on plant growth and reproduction are not yet well known.

Since the 1960s, experiments conducted in space stations and research rockets have shown that plants can grow normally in microgravity provided factors such as confinement, lack of ventilation and elevated radiation levels are taken into account.

However, microgravity can reduce cell growth, alter gene expression and change the pattern of root growth – all aspects which critically affect plant cultivation in space.

Seeds produced in orbit also seem to have different composition and developmental stages from seeds grown on Earth. As well as affecting the performance and nutritional content of space seeds, this could damage the flavour of plants produced in space, which might become a problem for crews reliant on plant-based diets during long space missions.

While there appears to be no major obstacle to plant growth in space, large-scale tests for food production in reduced gravity are still lacking, and a number of viable technologies for space agriculture need to be developed.

These include efficient watering and nutrient-delivery systems, precise atmospheric controls for temperature, humidity and air composition, and low-energy lighting which could include sun collection systems that take advantage of sunlight on the surface of planets and moons.

Selecting the right crops to grow in space is also essential. Given the limited amount of room available on board a spacecraft, plants with reduced size but high yields need to be developed: for example, dwarf varieties of wheat, cherry tomato, rice, pepper, soybean and pea have been successfully grown in orbit and in simulated planetary habitats.

Lucie Poulet said: "Challenges remain in terms of nutrient delivery, lighting and ventilation, but also in the choice of plant species and traits to favour. Additionally, significant effort must be made on mechanistic modelling of plant growth to reach a more thorough understanding of the intricate physical, biochemical and morphological phenomena involved if we are to accurately control and predict plant growth and development in a space environment."

More information: L. Poulet et al. Plant's response to space environment: a comprehensive review including mechanistic modelling for future space gardeners, *Botany Letters* (2016). DOI: 10.1080/23818107.2016.1194228

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