Growing Plants in Space: A Literature Review

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INTRODUCTION

- Space is a new frontier of exploration and scientific innovation. As space travel and interplanetary colonization increase, the growth of plants will become one of the most important challenges.
- Living plants provide food, oxygen, and may improve psychological well-being of astronauts.
- There are a variety of challenges: species selection, difficult light and nutrient, plant stress tolerance levels, and spontaneous changes in gene expression.

Test harvest of Arabidopsis at the Kennedy Space Station.
Credit: NASA/Leif Heimbold

Arabidopsis seeds grown on the ISS,
Credit: NASA

HYPOTHESIS

- Is there adequate information currently published to determine whether or not growing large-scale crops in space is feasible?

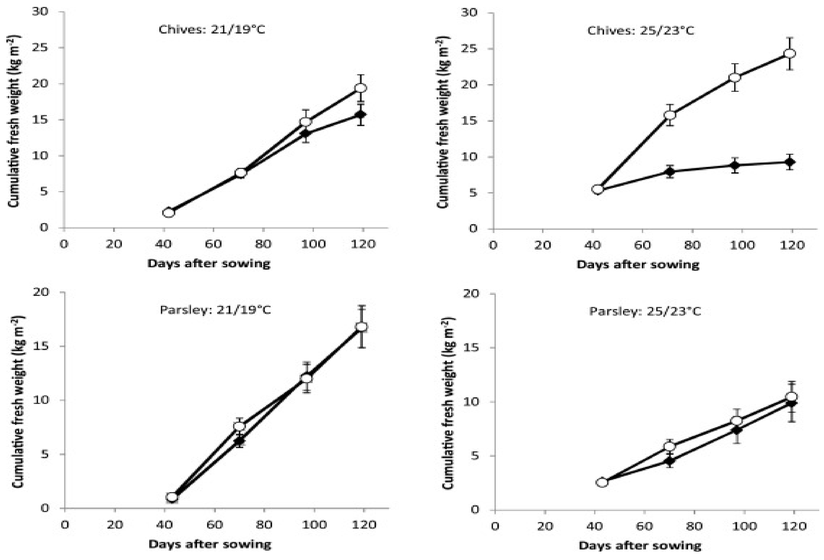
METHODS

- Peer-reviewed papers that have been published within the past five years were compiled and examined to create a comprehensive look at benefits, challenges, and methods that will be employed to grow crops outside of Earth.

NEXT STEPS

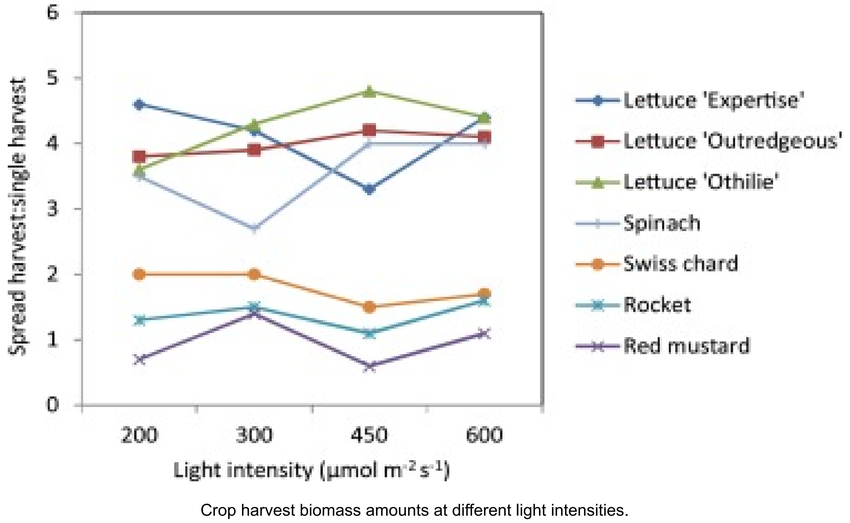
- Can artificial gravity prevent plant stress response and DNA methylation in space?

Graphs showing the biomass changes in chives and parsley at different temperatures.
Credit: **Meinen et al.**



CONCLUSIONS

- While there is a good amount of research on the topic currently, growing crops at a large enough scale to support more than a minimal population of people or short-term missions, is not quite within reach. There is still an extensive amount of research that needs to be conducted, mostly on the genetic and cellular level.



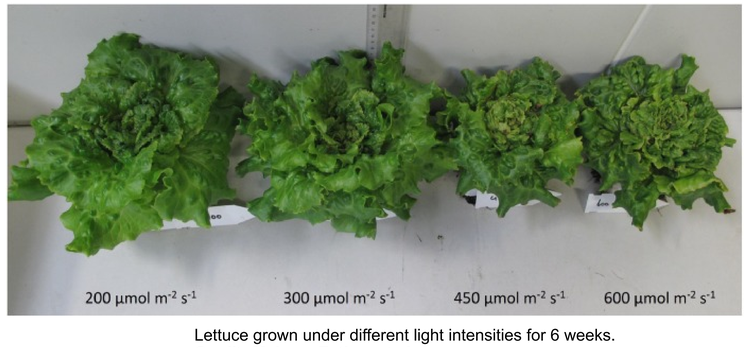
Crop harvest biomass amounts at different light intensities.
Credit: Meinen et al.

RESULTS

- Plants are largely grown on Earth in recreations of space-like environments. The list of species that have been grown in true space is limited.
- Light manipulation and small temperature fluctuations can have profound impacts on the growth rates of different crop species.
- Plants that have been to space experience higher levels of stress responses and spontaneous gene expression changes when compared to their Earthly counterparts.
- Oxygen production by certain species may also release toxic volatiles.

DISCUSSION

- Ultimately, it appears that lettuce, tomato, radish, and cucumber seem to be the best contenders for long term space missions.
- Minute environmental condition changes appear to have significant impact on the growth and production rates of common crops, which are not always favorable or predictable.
- Plant produced oxygen may not be usable for astronauts long-term.



Lettuce grown under different light intensities for 6 weeks.
Credit: Meinen, Esther, et al.

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