Evaluating Microgreens Crop Readiness for Space Production

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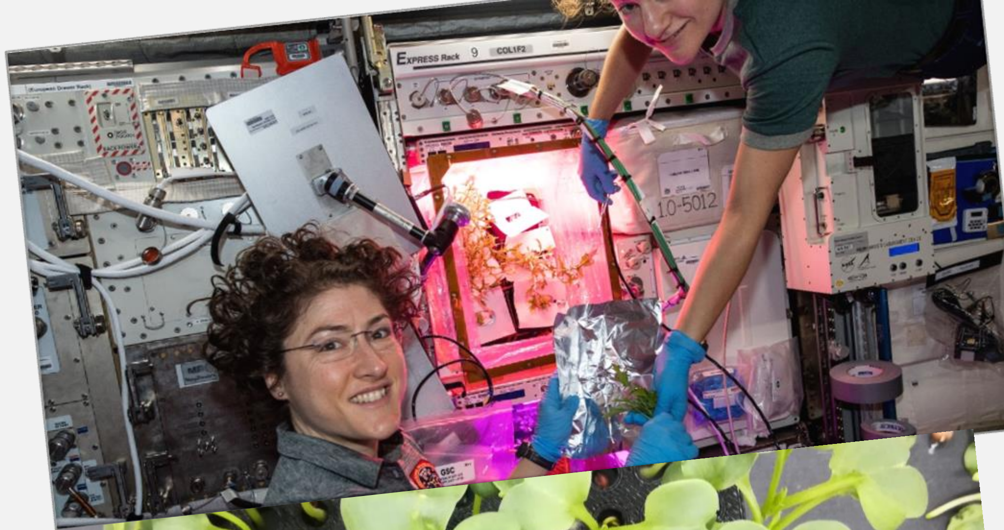
Background

Sustainable food production with plants

- Reduces mass and costs
- Provides necessary nutrients

Microgreens

- Good candidates for food supplements
  - Highly nutrient-dense
  - Excellent flavors
  - Fast growth
  - Easy cultivation
- Not yet grown in space
- Densely sown
  - Possible contamination by roots in low gravity
  - High microbial loads on roots



Selection of microgreens compatible species

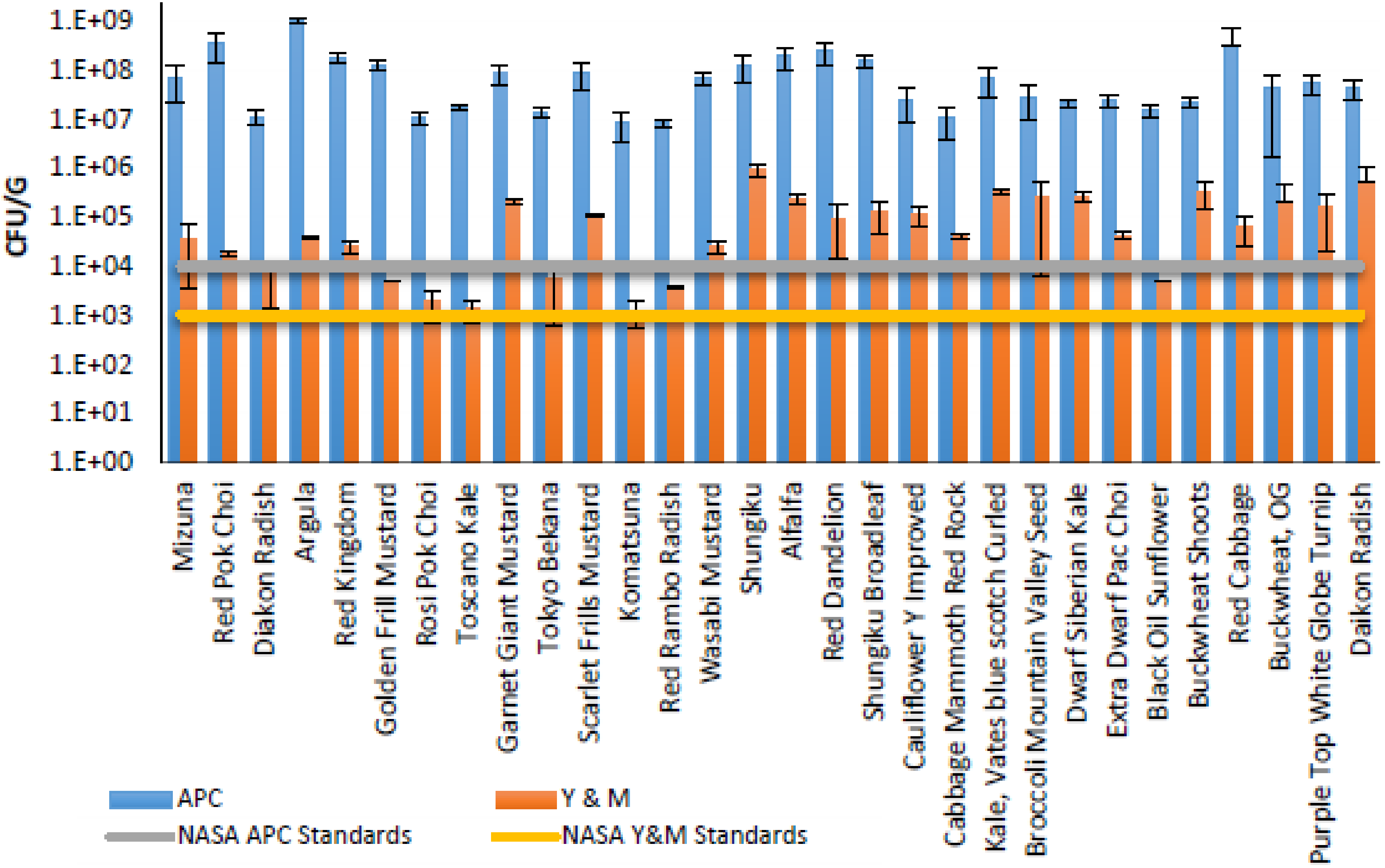
60 species tested – 18 down selected

- Morphology, yield, viability
- Organoleptic acceptability
- Nutritional value

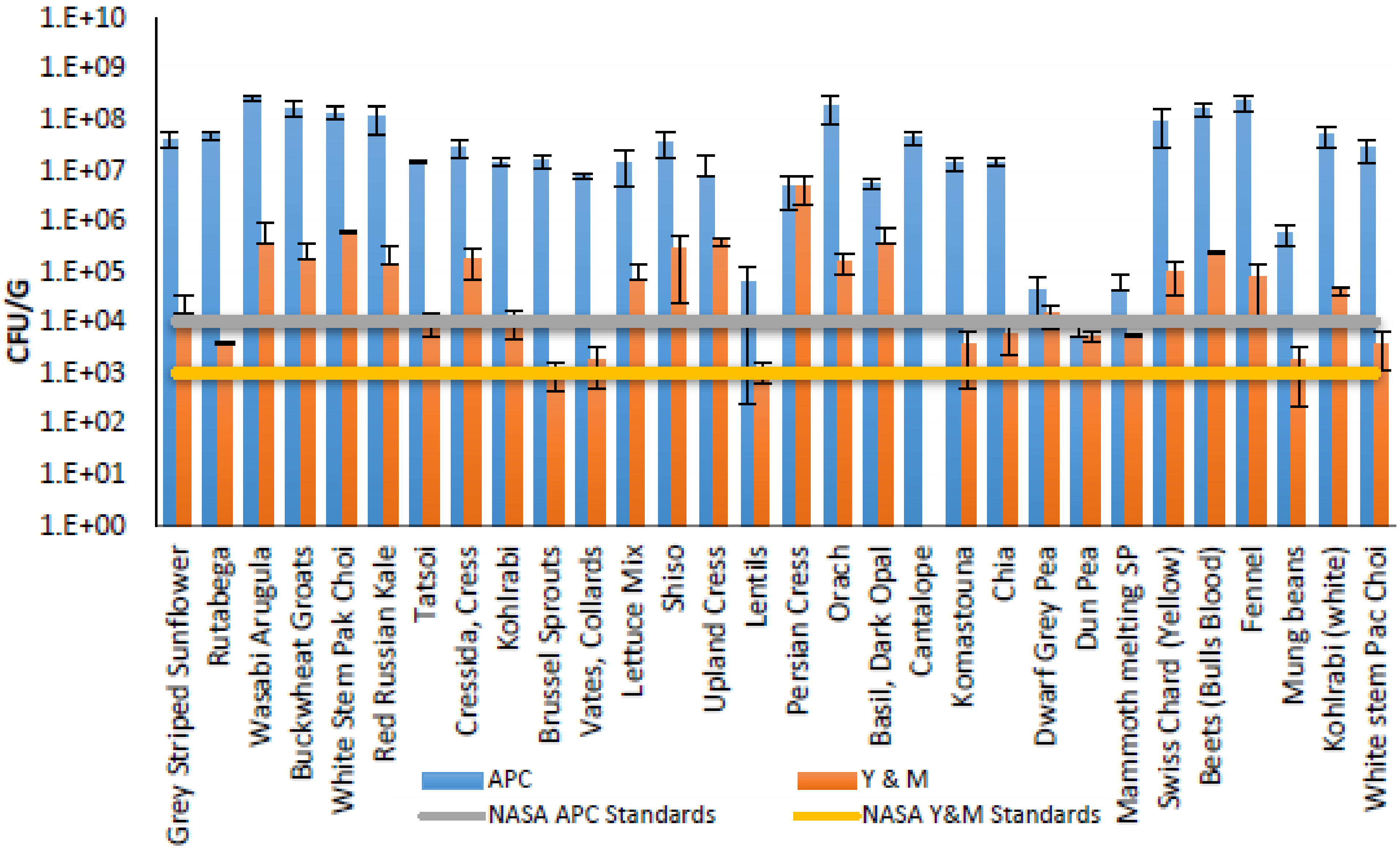
ISS- like conditions

10-14 days

Evaluation of microgreens food safety



Evaluation of microgreens food safety

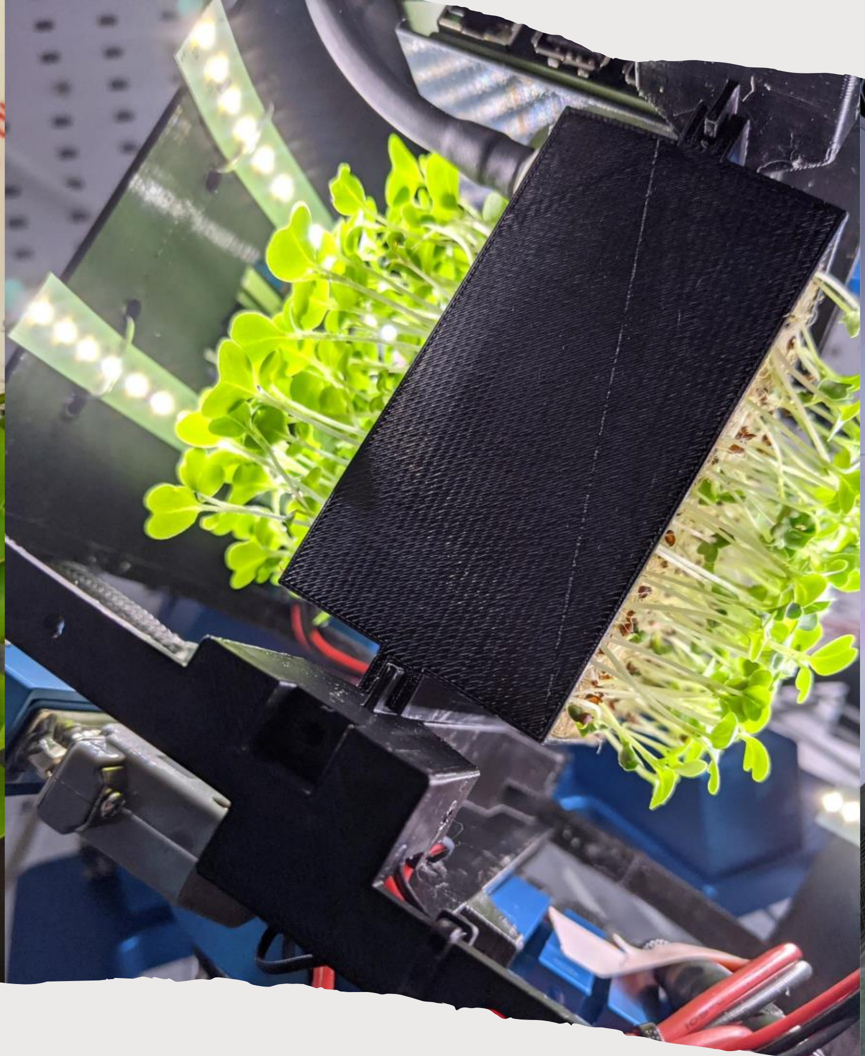
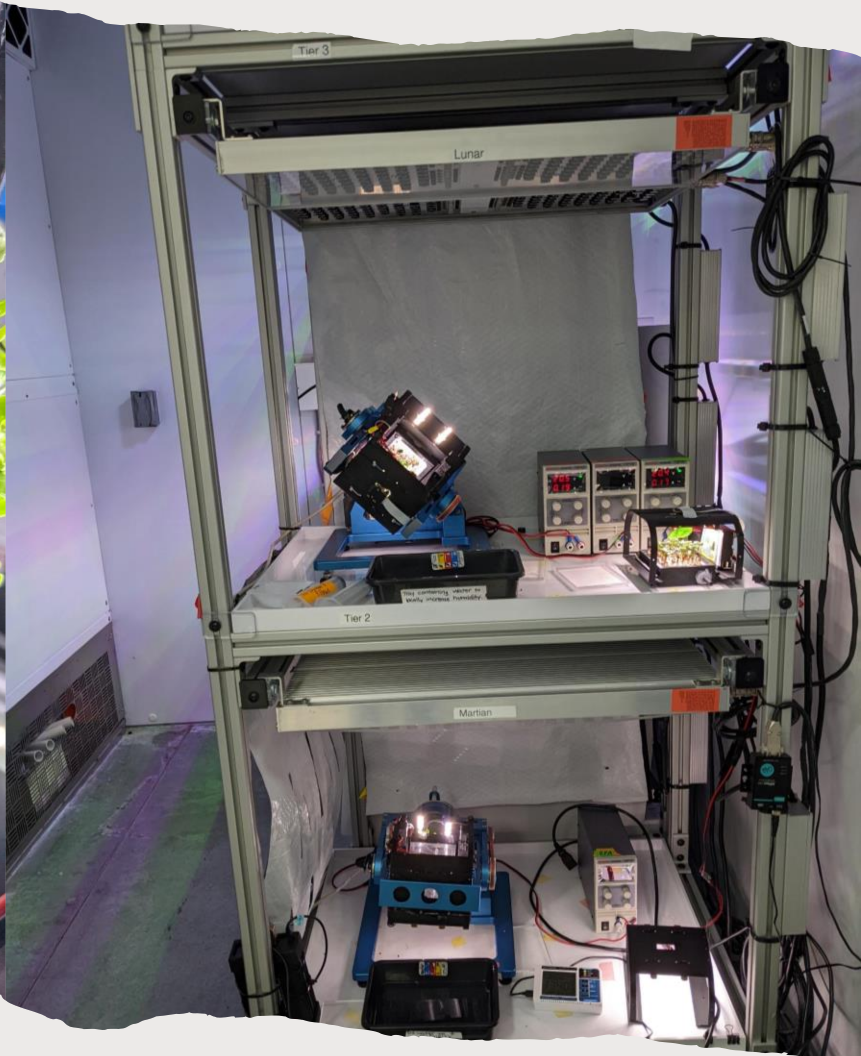


Ebb / flow hydroponics

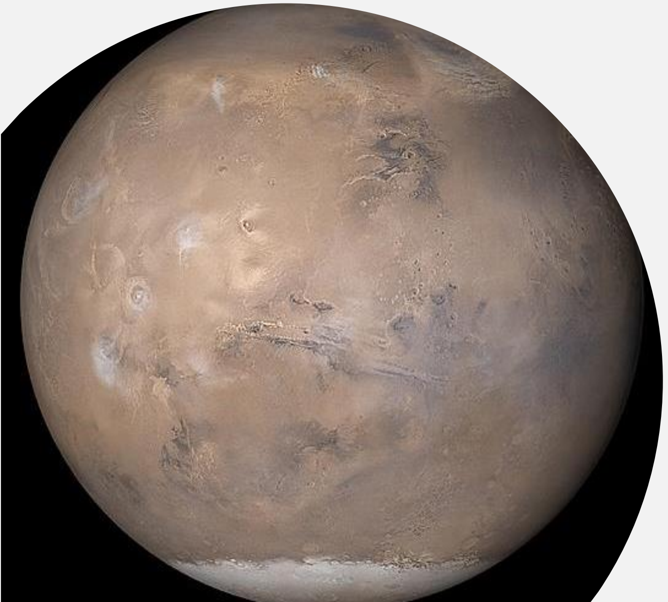
Developed and tested an ebb/flow hydroponics system for growing microgreens

- Microgreens grown in individual compartments
- Conducted tests using different media EC formulations
- Tested growth under higher light levels to observe effects on size and taste

Simulated microgravity growth

Experimental Development & Design



Developed and tested a reliable seed germination approach

- Worked with engineering team on microgreen holder and watering approach

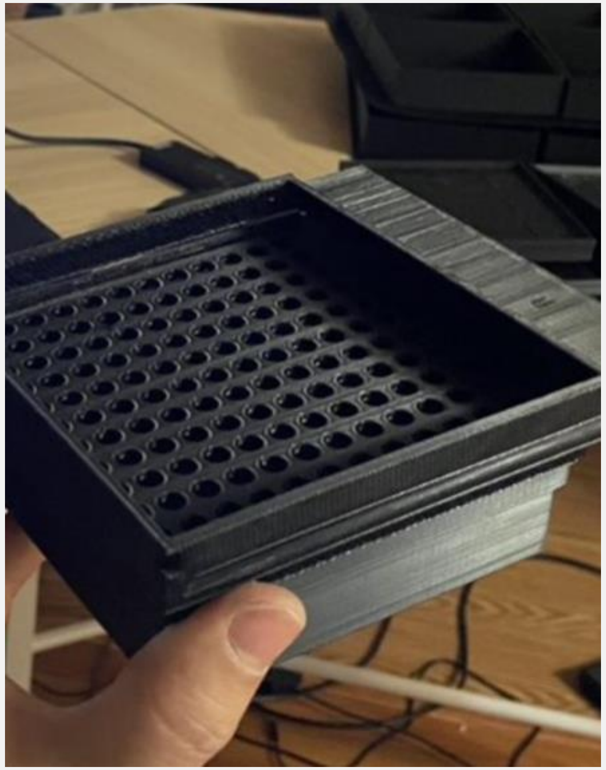
Treatments:

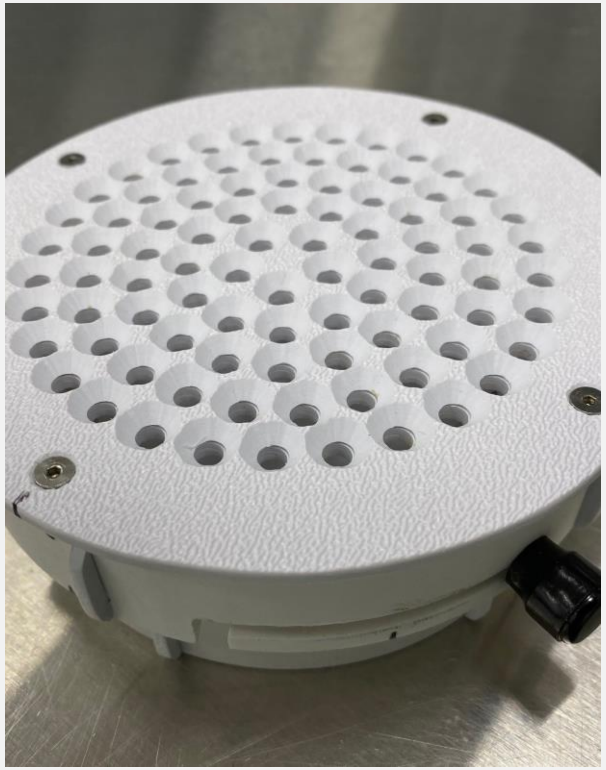
- μ-gravity (~ 0 g)
- 1/6 g (simulate Lunar gravity)
- 1/3 g (simulate Martian gravity)
- 1 g (as upright controls on Earth)

Measurements:

- Observations on shoot morphology under different simulated g's
- Shoot height, shoot fresh mass, shoot dry mass, transcriptome analysis
- Assess potential for different space settings like LEO, transit, Lunar and Mars surface

Harvesting techniques in microgravity





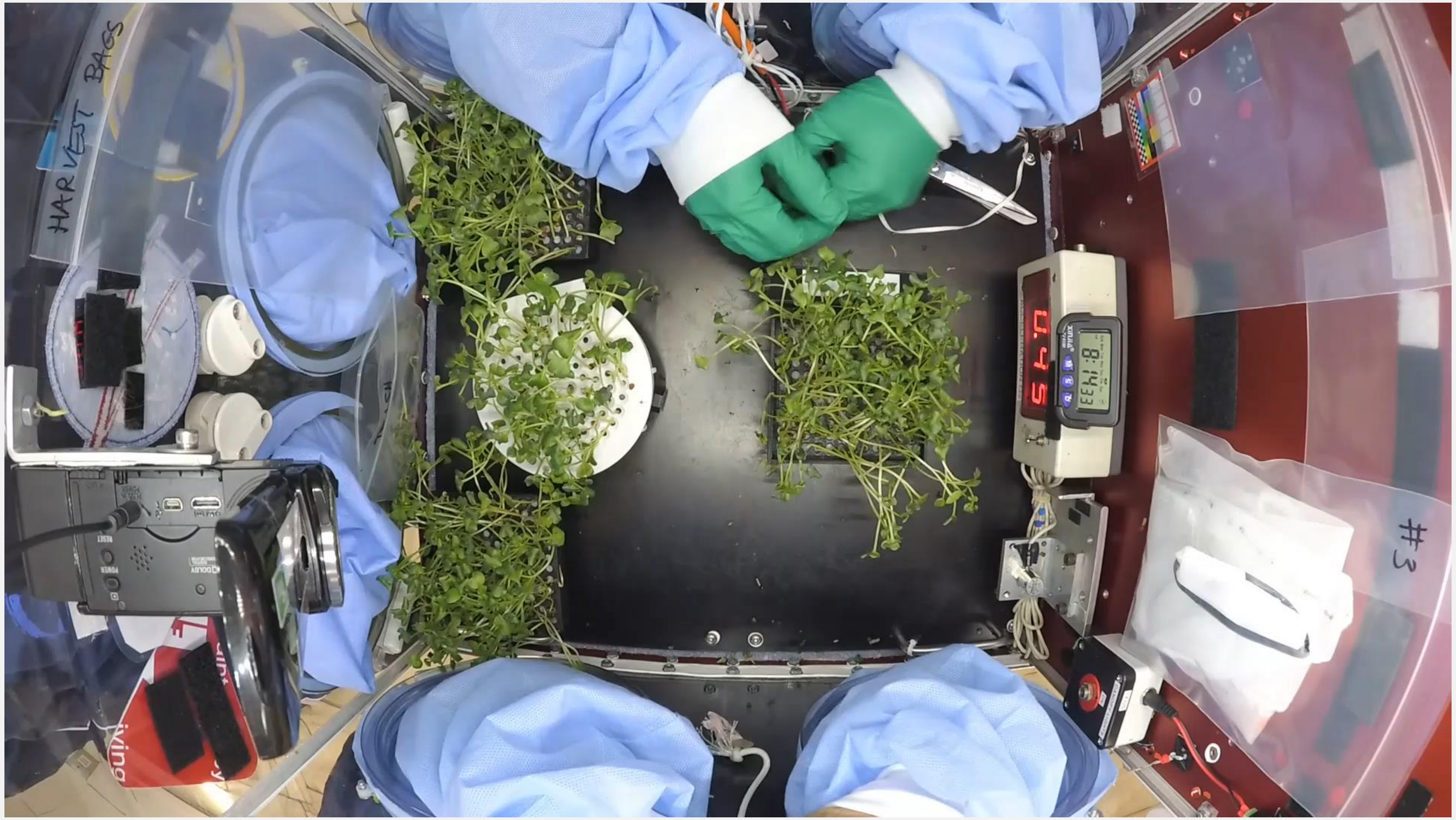
Identify suitable and unsuitable harvesting and bagging techniques

3 Cutting methods and 2 bagging methods to

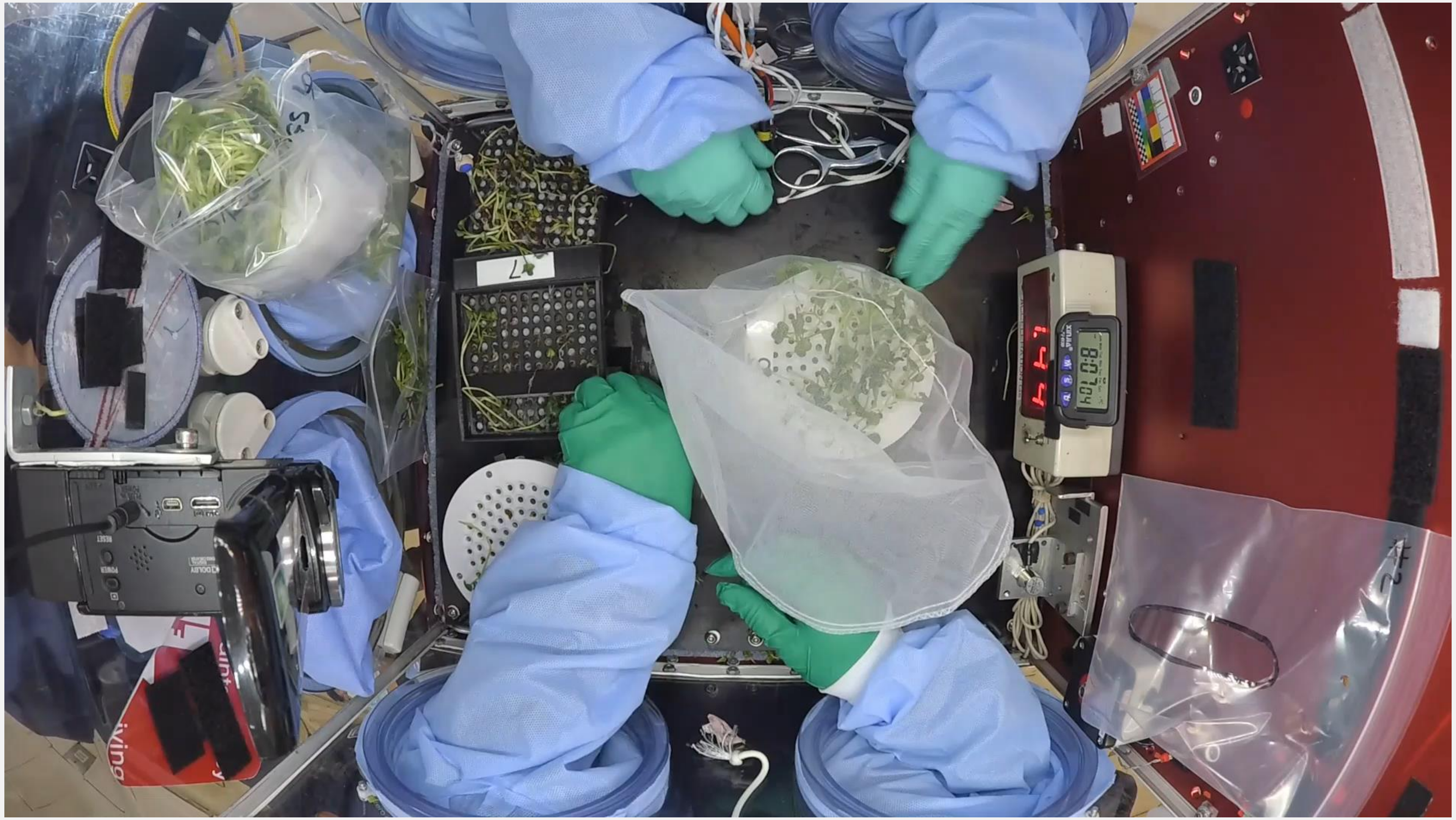
- Enable easier and safe microgreens harvesting low gravity
- Improve food safety, compared to conventional techniques
- Enable sustainable & safe nutrient production

Aboard ZeroG Corp modified Boeing 747 within a glovebox

Guillotine and manual bagging



Pepper Grinder and attached bag



Scissors and manual bagging

Factors and associated weights

1

Time of Execution

Perceived ease of use

1.5

Percentage of microgreens left on the hardware

Number of seedlings growing under the hardware lid

2

Cabin Debris

Yield (edible biomass)

Root debris

Percentage of no failures of the hardware

Trade analysis results

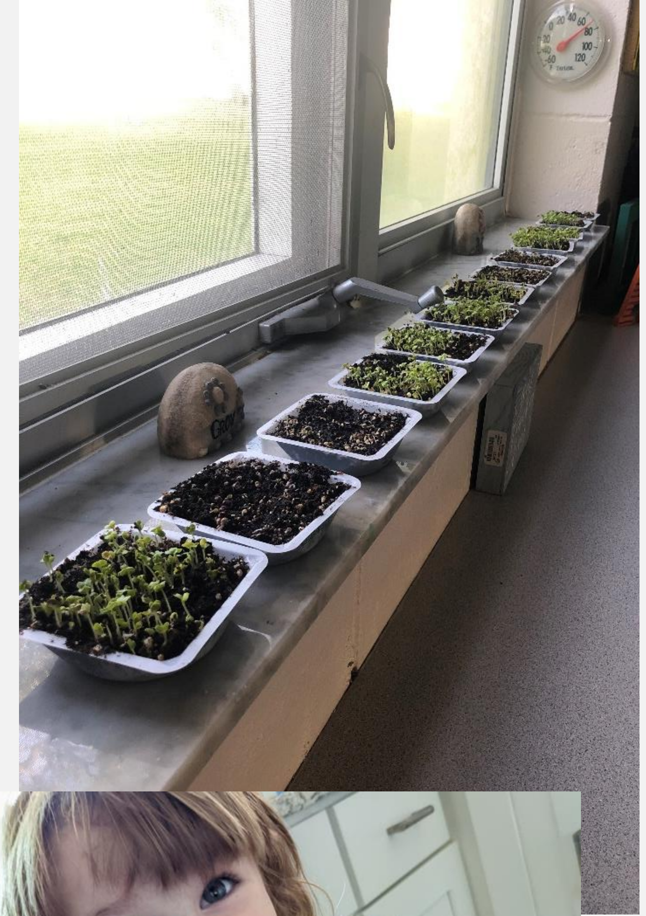
Guillotine Attached	9.05
Guillotine Manual	9.03
Pepper Grinder Attached	11.15
Pepper Grinder Manual	10.38
Scissors Attached	9.49
Scissors Manual	8.71

Perspective: microgreens gas exchange

Microgreens STEAM capability

Microgreens in your Classroom: Astrobotany International Research Initiative
www.astrobotany.com/AIRI

- Pre-K – university classrooms and clubs
- Curriculum developed with teachers and professors in USA, UK, and Japan



Space Crops in Your Classroom: NASA partnership with Fairchild Garden
https://fairchildgarden.org/gbe/

- Data directly impacts space crop selection
- Grades 6 – 12
- Started in Miami, Florida
- Now 400+ schools all over the USA

Artwork by Aubrie O'Rourke