



Space Plant Bioinformatics Aggregation and Visualization Matrix: Public Engagement Application

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Quick Background

Ph.D. Student, Aerospace Sciences, Space Studies, UND

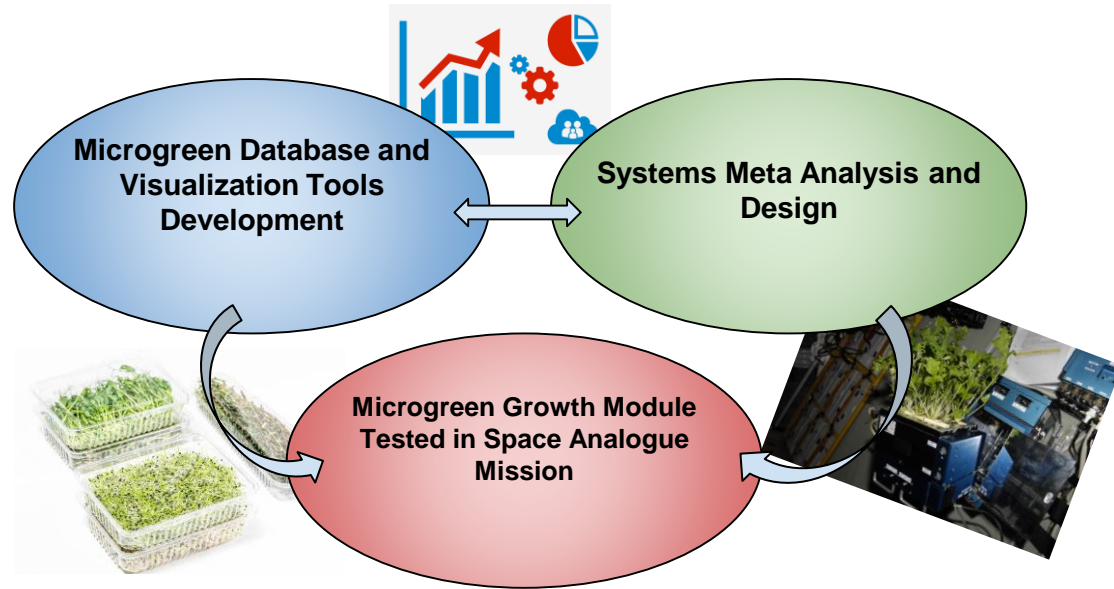
- M.S. Biology, Clemson University
- Mission Science Specialist; Magnitude.io
- Astrobotany Research Program Coordinator and Biology Teacher; Osaka Prefecture Suito Kokusai Senior School, Japan
- AIRI, Program Director
- NASA Genelab Plant Analysis Working Group



Ph.D. Research Focus

Plant Integration into bioregenerative life-support systems in space habitats

- **Particularly Microgreens**
- **Novel Growth Module**
- **Targeted Phenotypes**

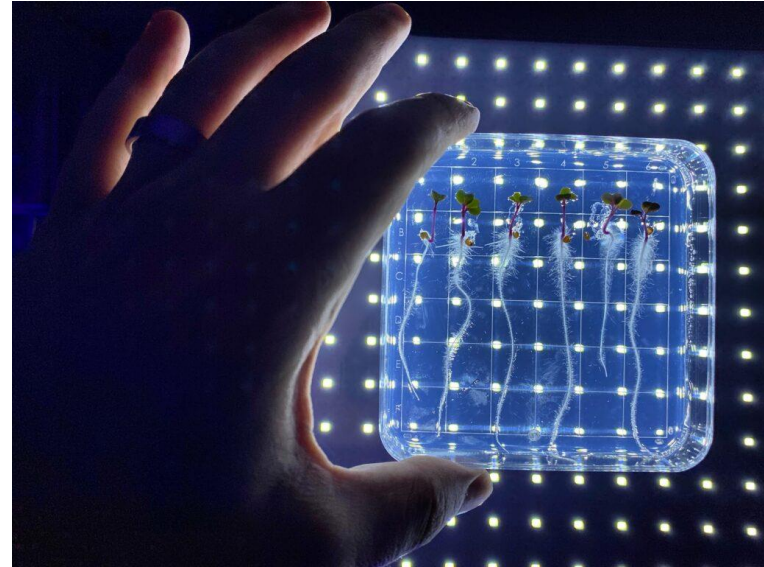


Space Plant Bioinformatics Aggregation and Visualization Matrix

Objective:

Development of an open-source baseline bioinformatics database and visualization pipeline designed to identify ideal cultivars and methods through the analysis of the following criteria:

- Biomass potential based on targeted light treatments
- Root architectural morphological variation
- Phenomic developmental gravitropic variability induced by simulated microgravity cultivation

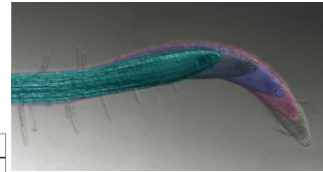
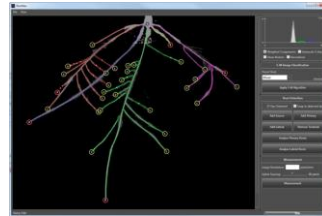
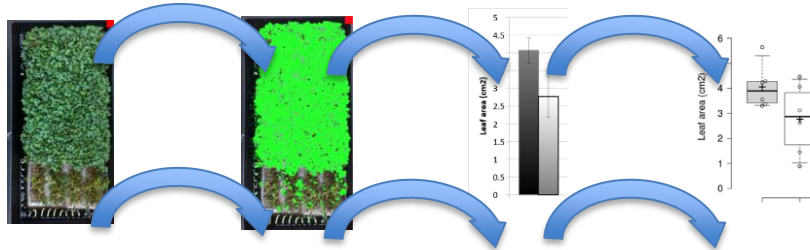


Step 1: Standardized Protocols

Protocols were developed and standardized in order to produce replicable investigations.

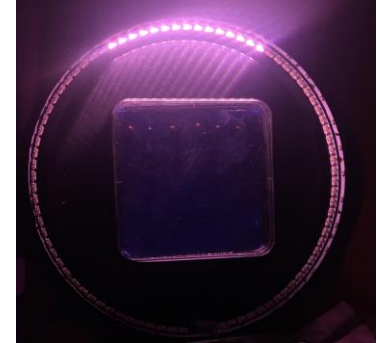
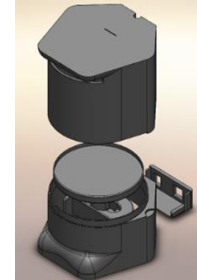
Stage 1: Biomass

Stage 2: Root Architectural Variation



Step 1: Standardized Protocols

Stage 3: Targeted Microgravity Cultivation



Step 2: Aggregation

A set of open-source, web-based data collecting forms were developed using epicollect5 associated with each protocol.



AIRI MICROGREEN ROOT ARCHITECTURE

This form is used to enter root architecture data associated with the AIRI STAGE II program


≈ 20 ENTRIES


LAST ON: 23 MAR 22

DETAILS

VIEW DATA



AIRI Microgreen R... AIRI Root Architecture Analysis

Download Table Map Exit

Add AIRI Root Archite... Total: 12, 1/1

Filter by title

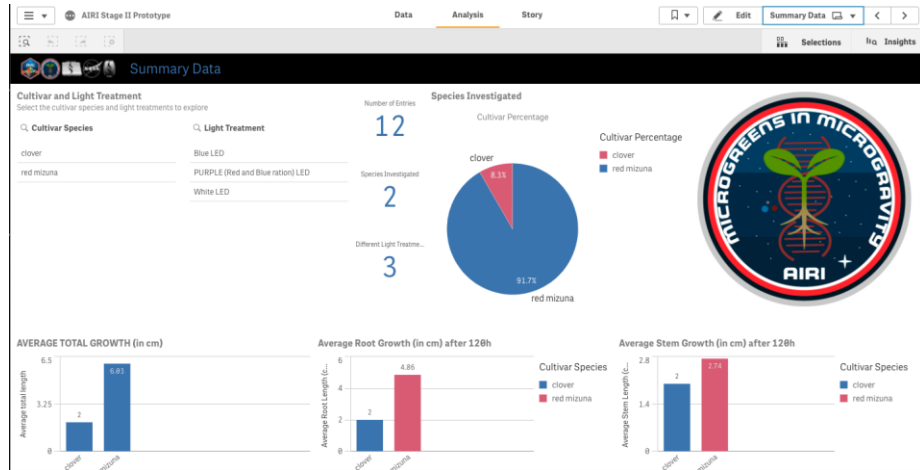
FROM: 22 MAR, 22 TO: 23 MAR, 22 NEWEST

| View | Delete | Edit | Title | Created At | What species of microgreen was... | What type of lighting was used... | Total length of cultivar 1 (in cm... | Total length of cultivar 2 (in cm... | Total length of cultivar 3 (in cm... | Total length of cultivar 4 (in cm... | Total length of cultivar 5 (in cm... |
|------|--------|------|------------------------|----------------|-----------------------------------|-----------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|
| | | | 9f00d0b-aa54-11ec-8... | 23rd Mar, 2022 | clover | PURPLE (red and blue rati... | 2 | 2 | 2 | 2 | 2 |
| | | | 92b4a40-aa54-11ec-... | 23rd Mar, 2022 | red mizuna | Blue LED | 0.16 | 6.61 | 1.55 | 9.1 | 2.26 |
| | | | 9e9fc90-aa49-11ec-... | 23rd Mar, 2022 | red mizuna | Blue LED | 7.79 | 0.25 | 4.02 | 6.62 | 6.71 |
| | | | e99a6d0-aa45-11ec-... | 23rd Mar, 2022 | red mizuna | Blue LED | 0.13 | 5.62 | 6.83 | 3.81 | 0.28 |
| | | | 83a3450-af82-11ec-... | 22nd Mar, 2022 | red mizuna | Blue LED | 4.83 | 6.99 | 3.37 | 0.1 | 0.58 |
| | | | d6b3090-af8a-11ec-... | 22nd Mar, 2022 | red mizuna | Blue LED | 4.15 | 5.42 | 7.75 | 5.97 | 5.16 |
| | | | 041a090-af8a-11ec-... | 22nd Mar, 2022 | red mizuna | White LED | 3.33 | 6.78 | 4.04 | 5.59 | 6.06 |
| | | | 651a7d0-af8d-11ec-... | 22nd Mar, 2022 | red mizuna | White LED | 8.75 | 9.77 | 6.15 | 2.27 | 7.58 |
| | | | 522a050-af8d-11ec-... | 22nd Mar, 2022 | red mizuna | White LED | 6.32 | 0.95 | 6.78 | 7.82 | 6.75 |
| | | | 667a760-af8d-11ec-... | 22nd Mar, 2022 | red mizuna | White LED | 5 | 6.11 | 6.7 | 5.13 | 9.46 |
| | | | 2129090-af8d-11ec-... | 22nd Mar, 2022 | red mizuna | White LED | 9.84 | 4.97 | 7.54 | 3.88 | 10.89 |
| | | | 0718840-af87-11ec-... | 22nd Mar, 2022 | red mizuna | White LED | 10.76 | 6.17 | 6.63 | 10.06 | 9.54 |

Step 3: Visualization

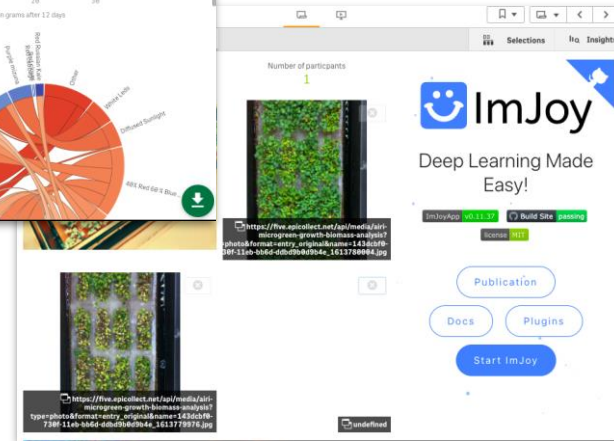
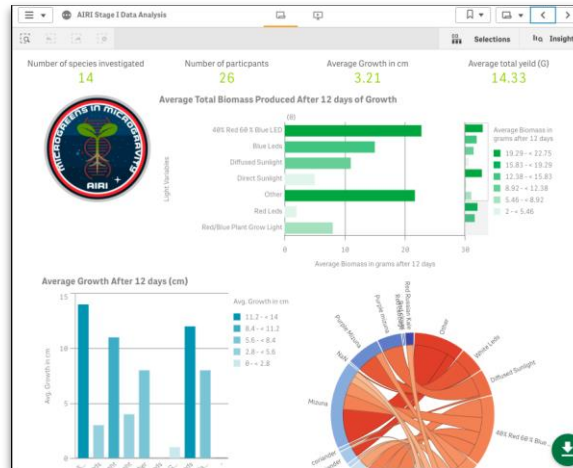
An interactive data analysis and visualization interface was developed using Qlik

- Variables in the data sets are able to be isolated in order to identify possible trends associated with the investigative data sets.
- All data sets and visualizations are able to be downloaded and shared.



Step 3: Visualization

- First step in machine learning pipeline able to identify various phenotypic variables autonomously through the association of data sets and images



AIRI: Astrobotany International Research Initiative

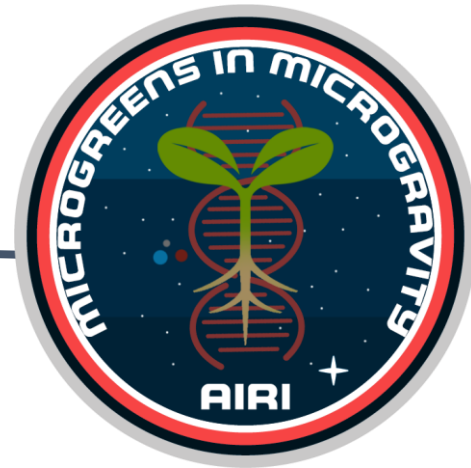
Open source astrobotany research platform that seeks to support ongoing space plant biology research through an interactive, collaborative space.

- AIRI aims to engage researchers, academics, citizen scientists, university students, and K-12 educators and students in authentic astrobiology research

www.astrobotany.com/AIRI



It all came together!



The program will go live in early summer 2022!

Next Steps

- **User Experience Trials utilizing the NASA TLX (Late April)**
- **Live launch online**
- **Publish**
- **Outreach**
- **Integration into future ILMAH missions at UND**
- ★ **STEM Curriculum Development**



Open Source Ethos

Goal for this program was to develop a tool to make space plant biology research...

- Accessible
- Applicable
- Scalable





Acknowledgments:

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