



Watermeal as a resilient nutrient source for space farming: Omics-based insights into gravity-driven adaptation for closed life support systems

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Mahidol University



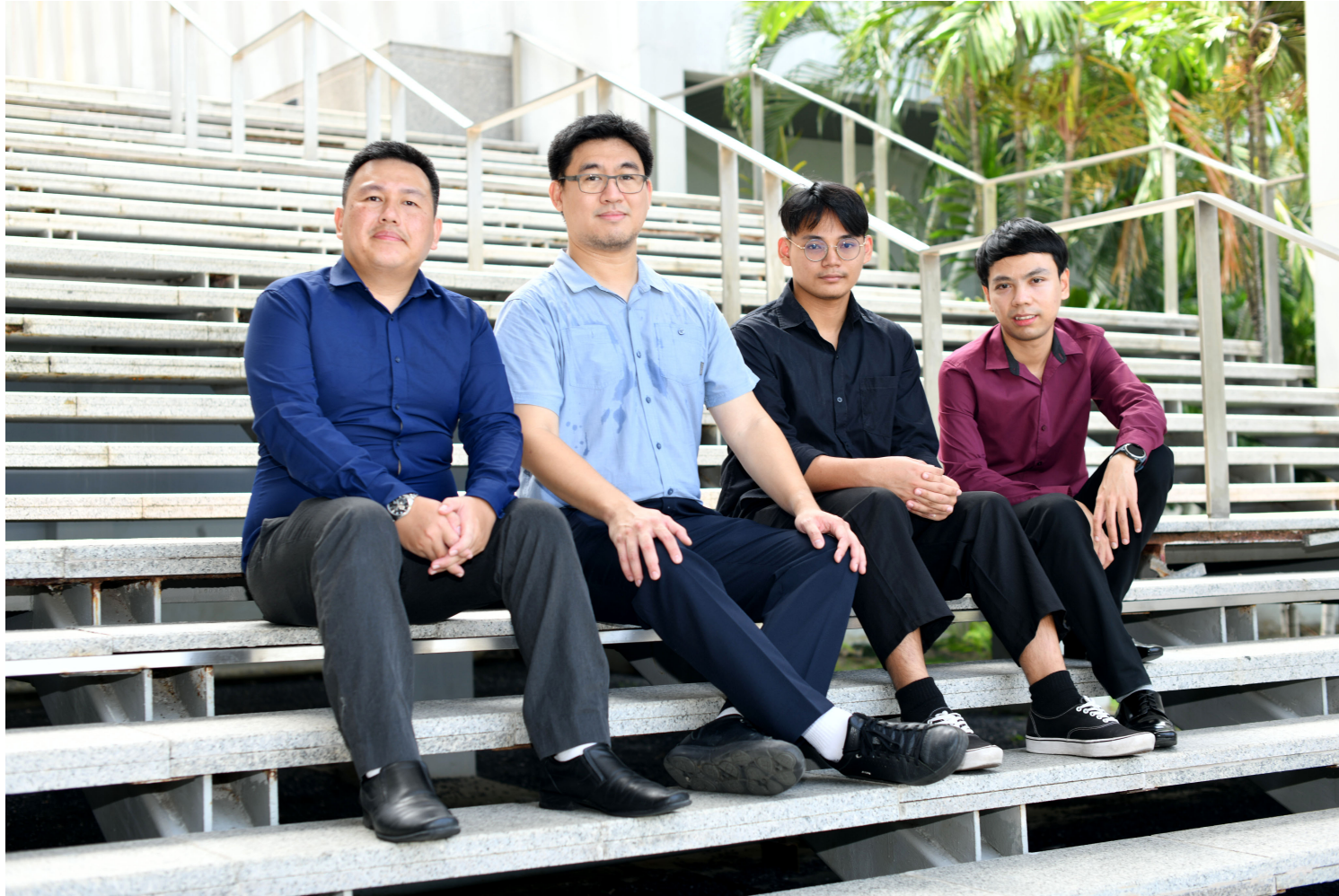
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Hello from Mahidol University!



About out group

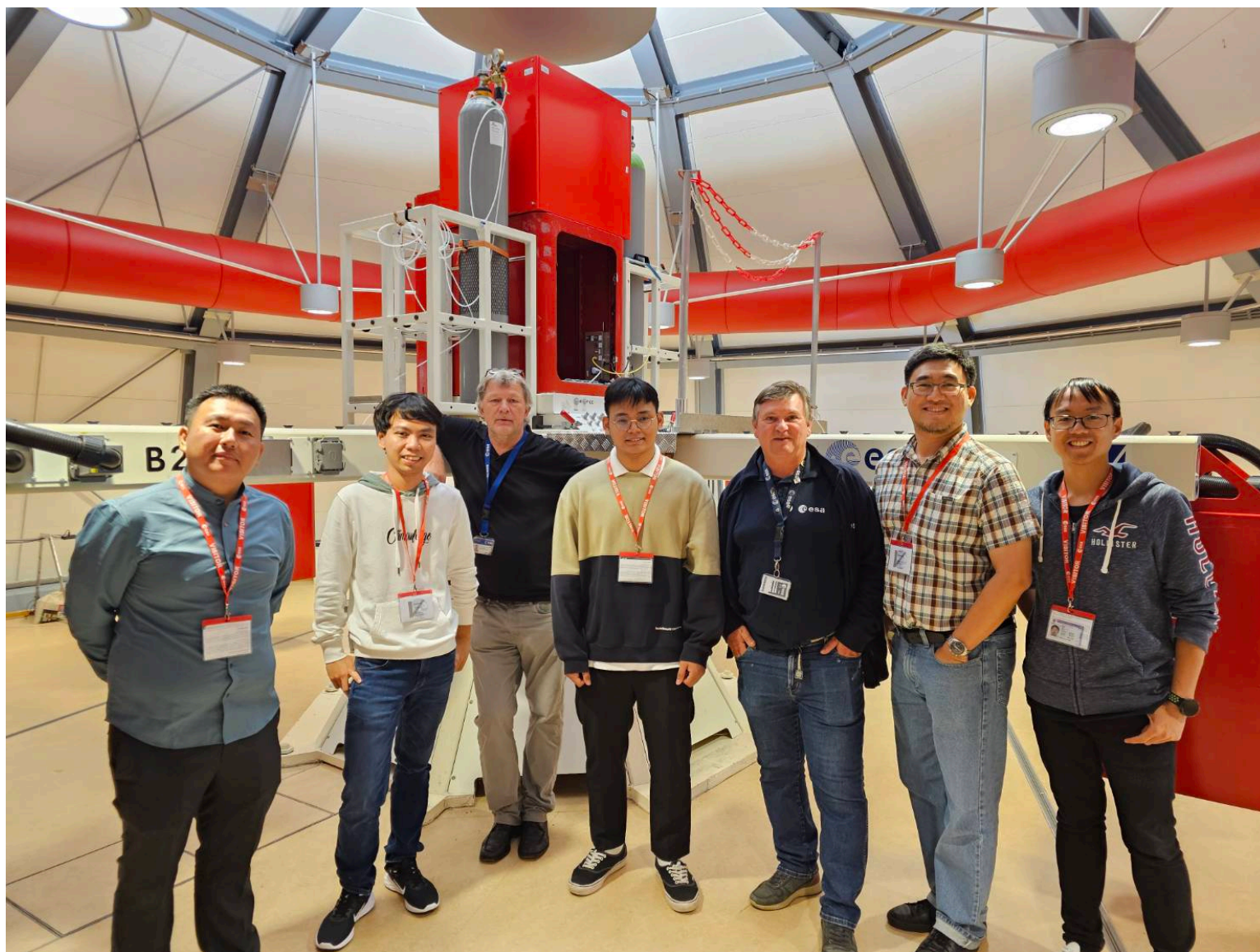


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United Nations/European Space Agency Fellowship Programme on the Large Diameter Centrifuge Hypergravity Experiment Series (HyperGES)

The First Announcement of Opportunity

Press release:

UNOOSA and ESA announce winner of opportunity to conduct hypergravity experiments at ESTEC

Winner for the 1st cycle:

The Team from Mahidol University, Thailand

Title of the winning project:

Watermeal, the Future Food Source for Space Exploration

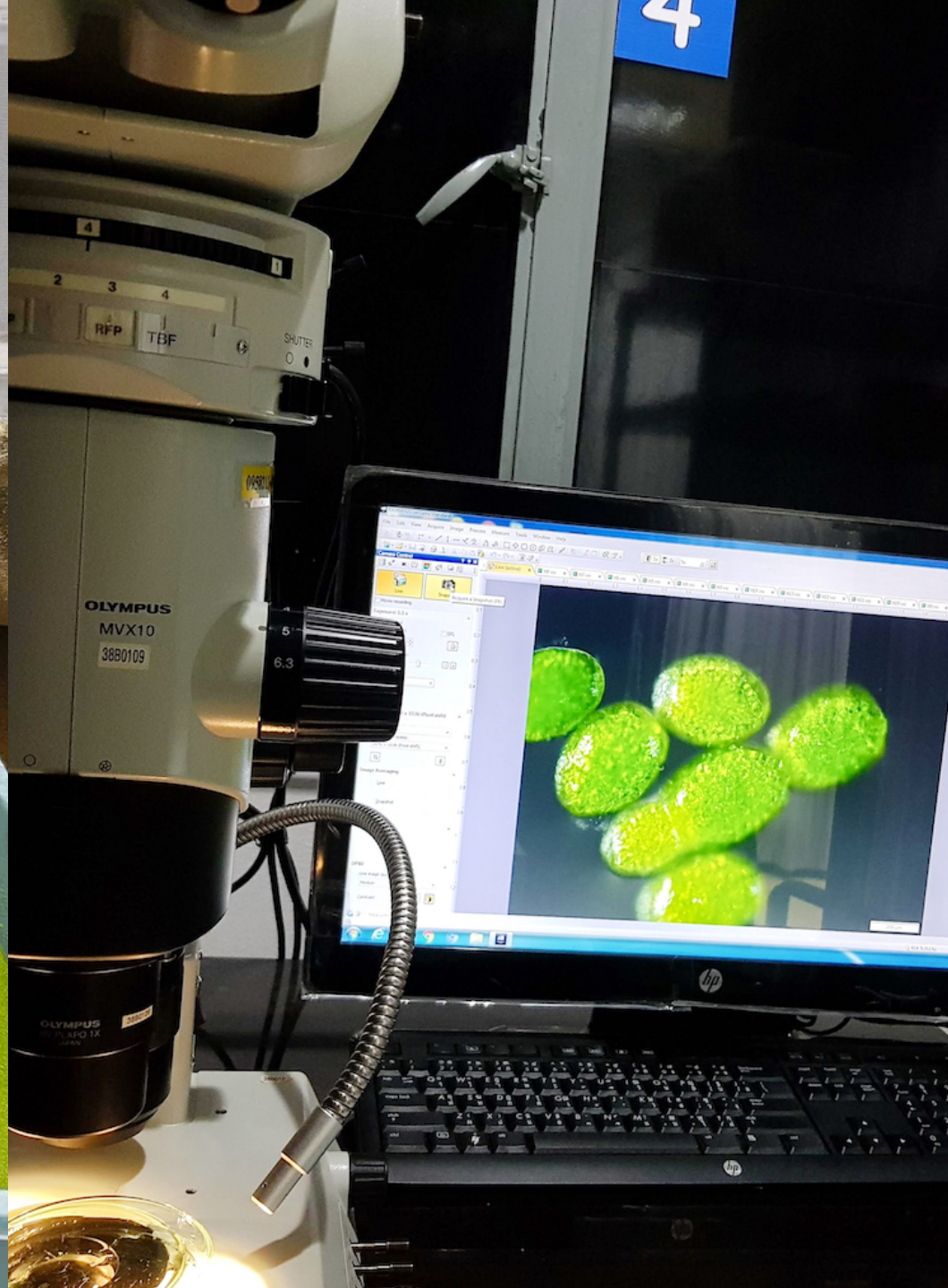
Objectives of the winning project:

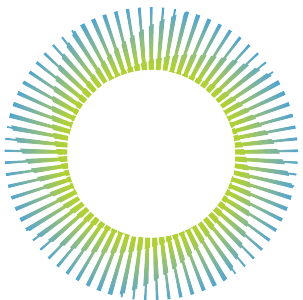
The experiment is to study effect of hypergravity on watermeal, the smallest and fastest growing flowering plant on Earth. It would help



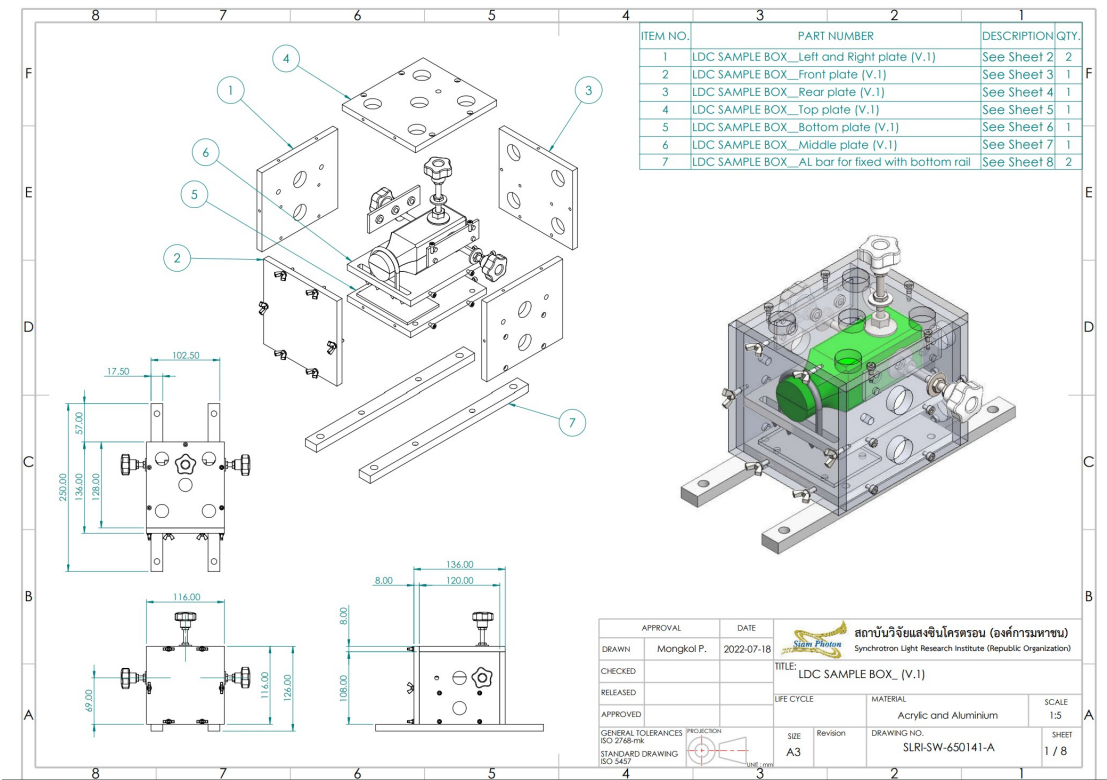
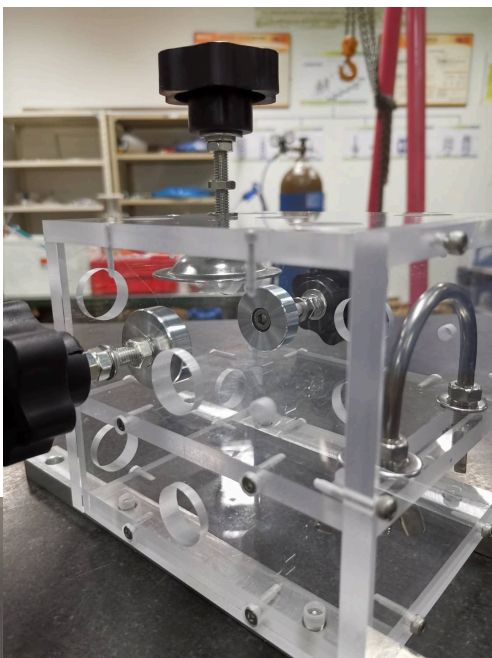
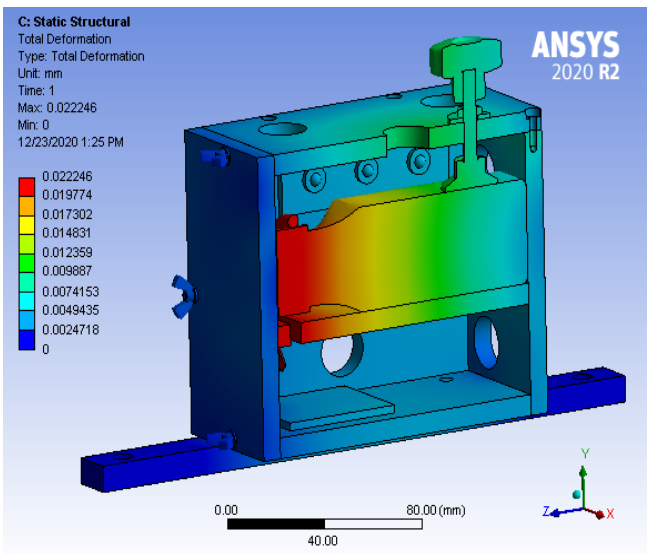
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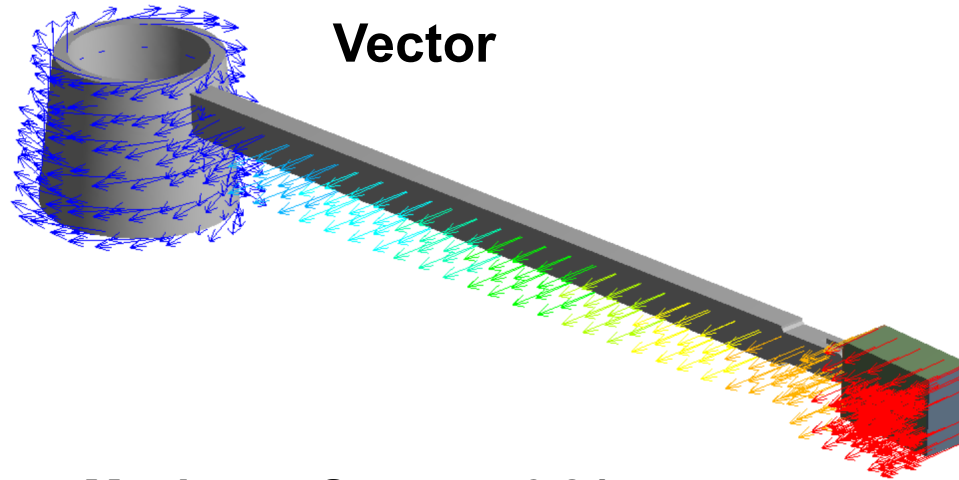






SYNCHROTRON THAILAND CENTRAL LAB



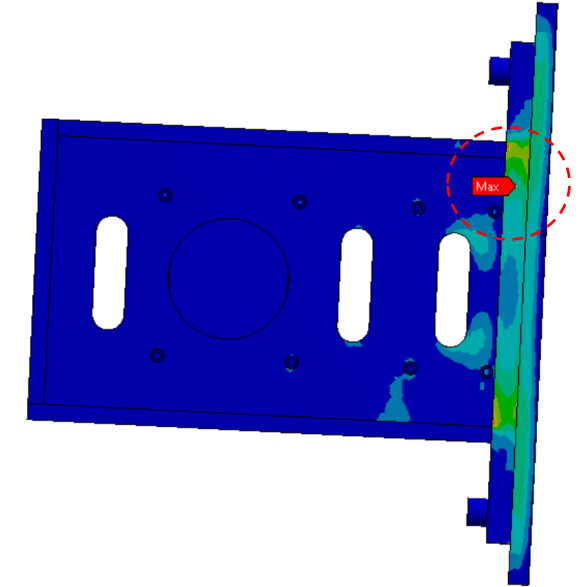
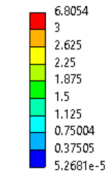


Vector

Maximum Stress = 6.81 MPa.

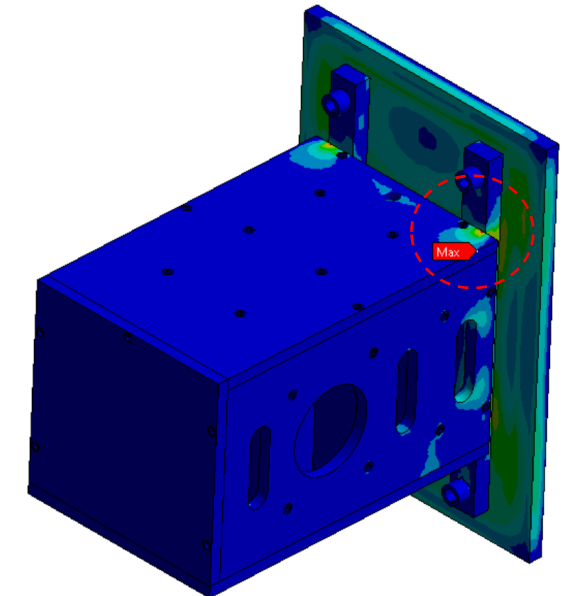
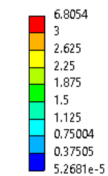
Maximum Stress = 6.81 MPa.

Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1
Custom
Max: 57.91
Min: 5.2681e-5

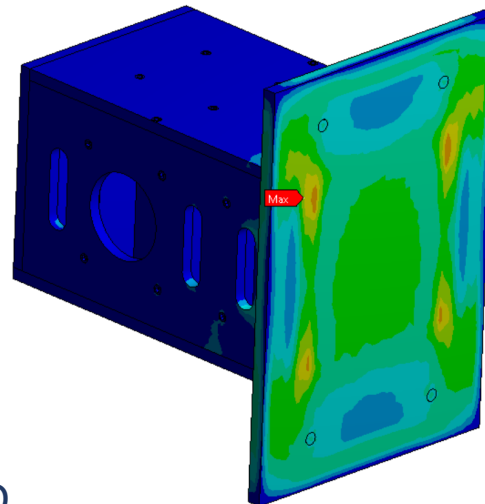
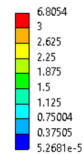


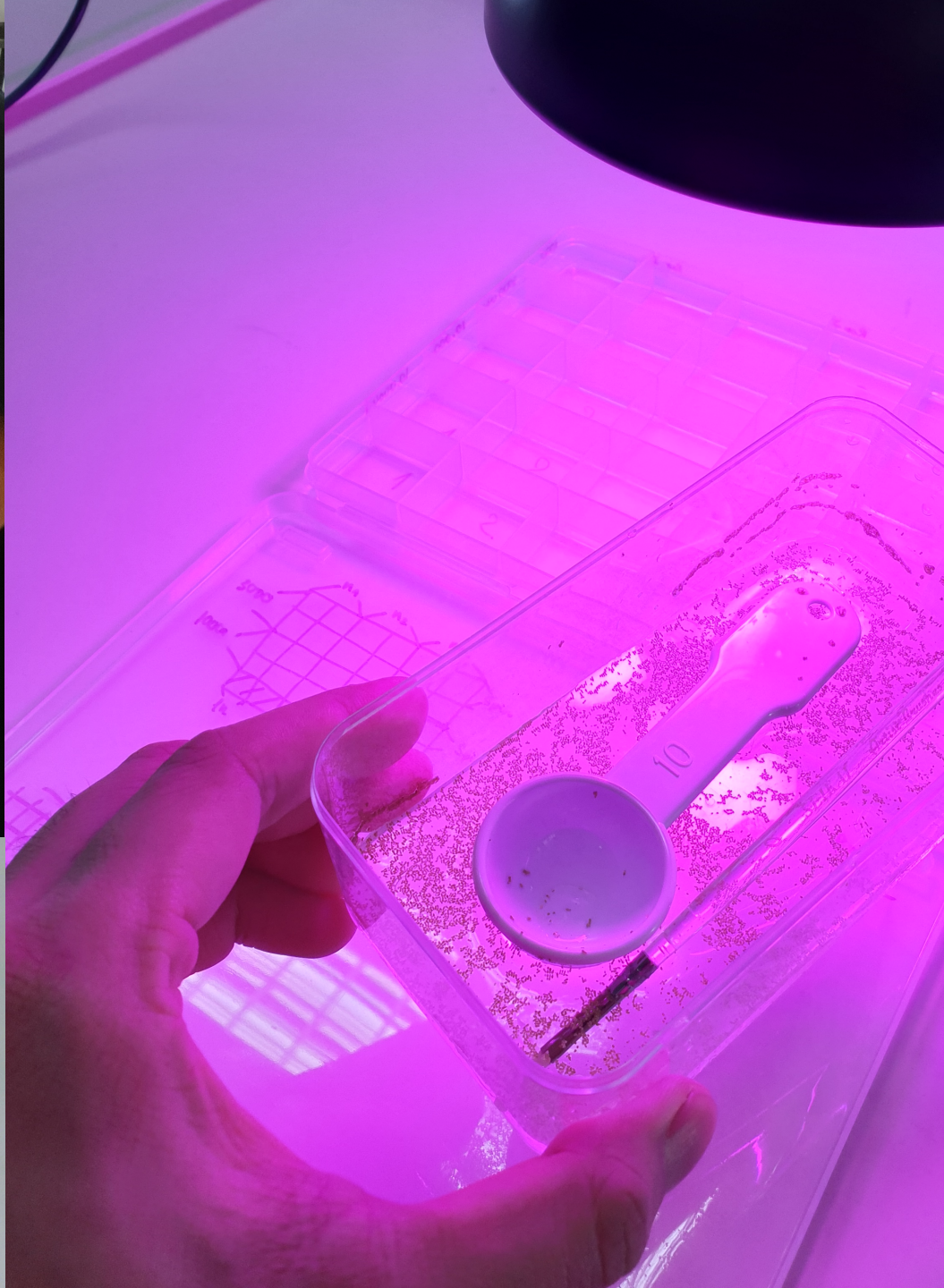
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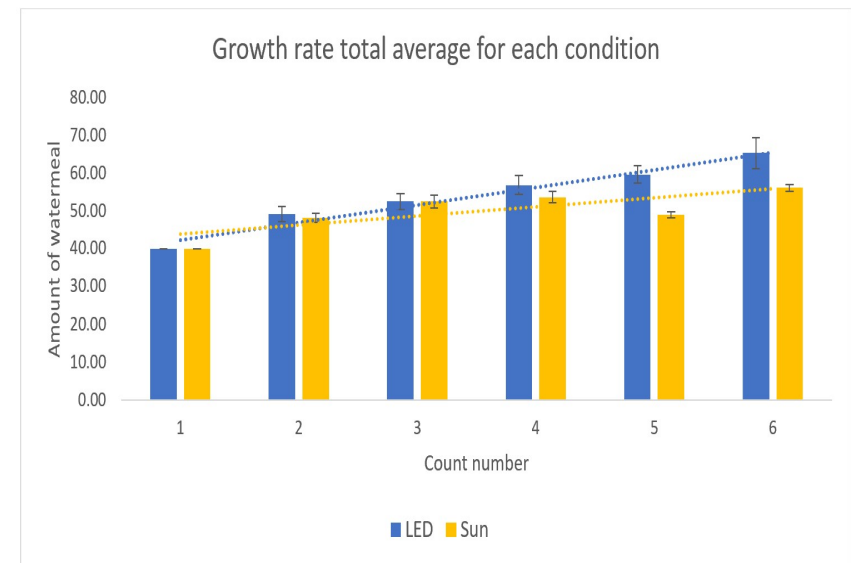
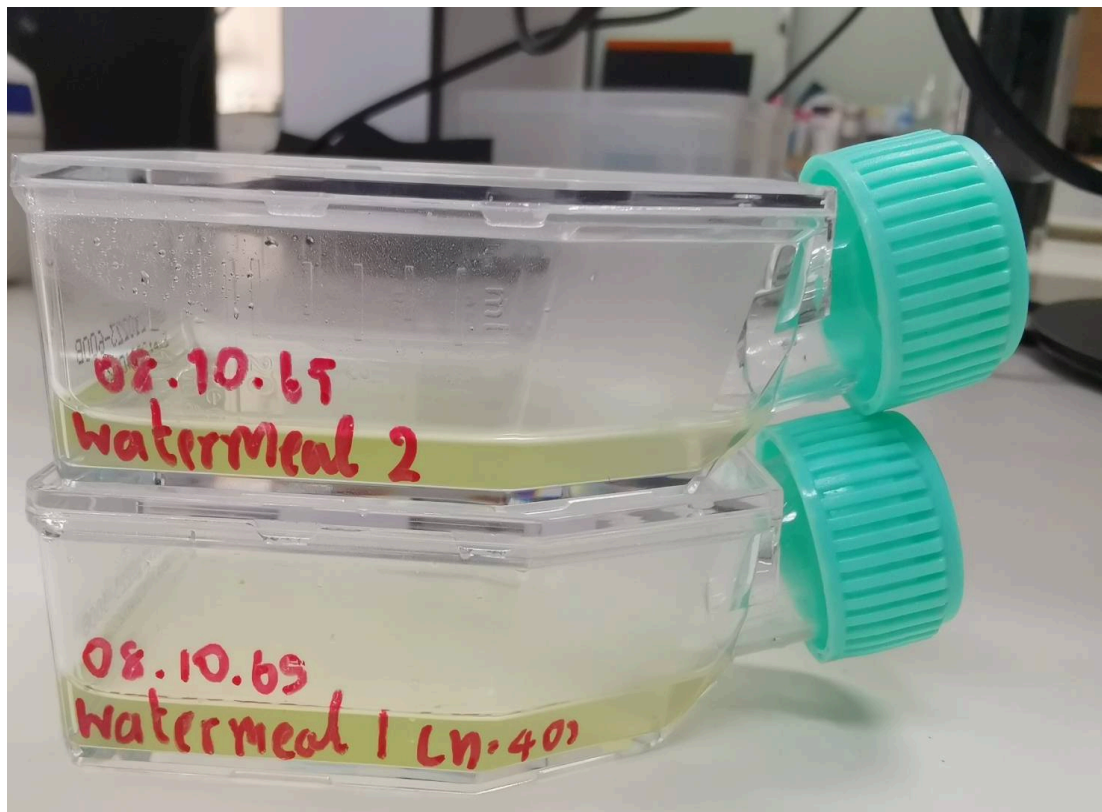
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1
Custom
Max: 57.91
Min: 5.2681e-5



Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1
Custom Obsolete
Max: 57.91
Min: 5.2681e-5

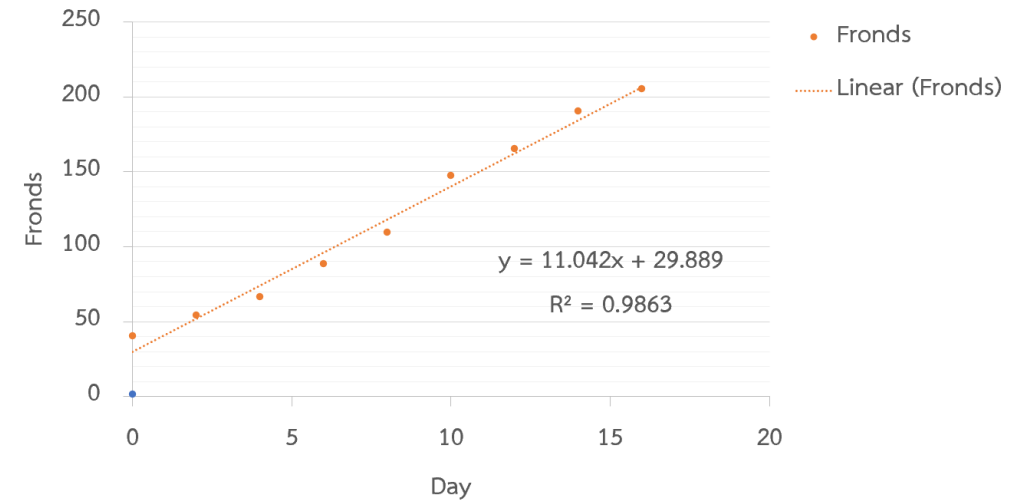


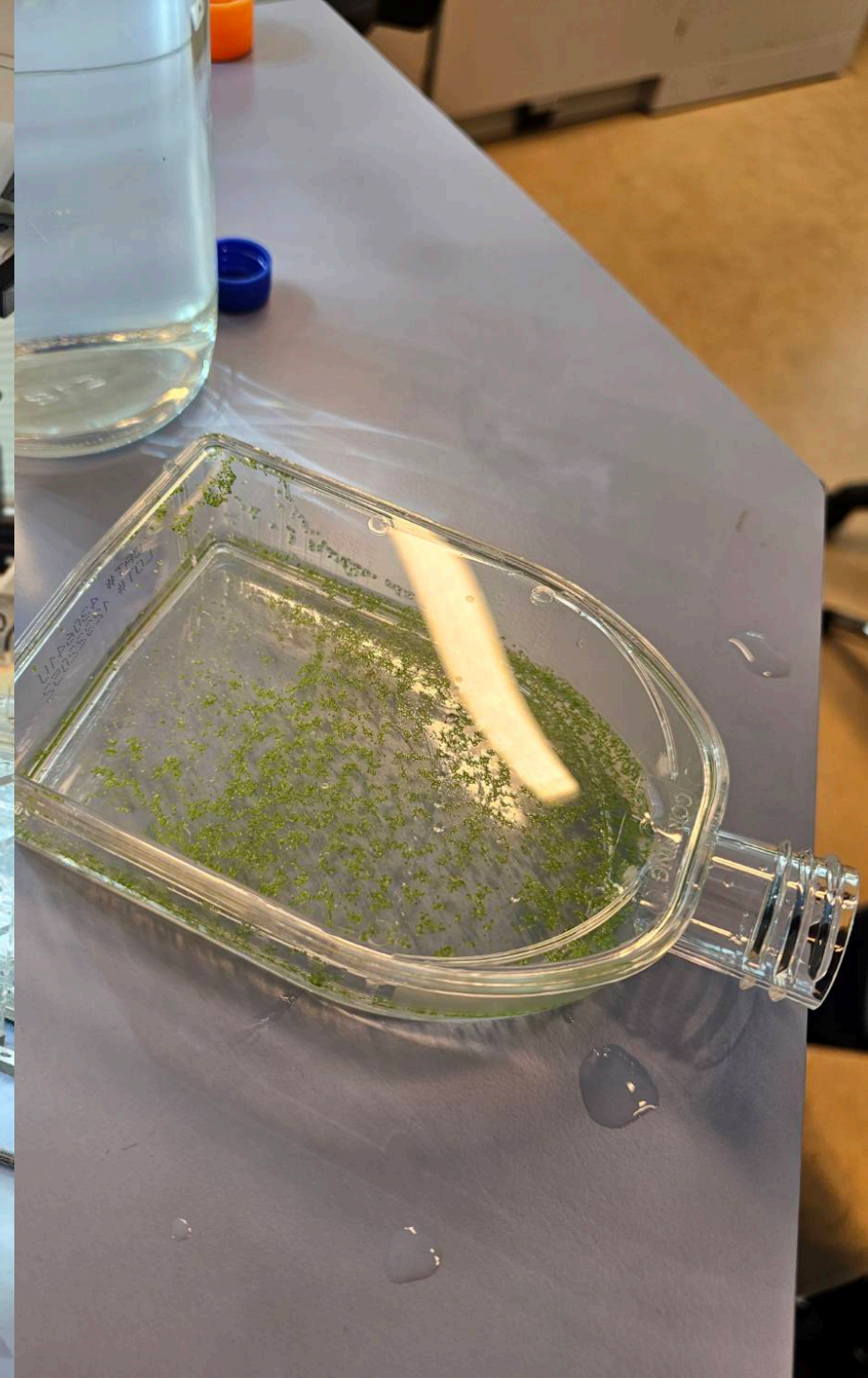




Mean± SD(LED)	40 ± 0	49.17 ± 5.42	52.5 ± 5.72	56.83 ± 6.82	59.67 ± 6.25	65.33 ± 11
Mean± SD(Sun)	40 ± 0	48.17 ± 3.31	52.5 ± 4.68	53.67 ± 4.08	49 ± 2.1	56.17 ± 2.48

Watermeal Grows in Light Box with T75

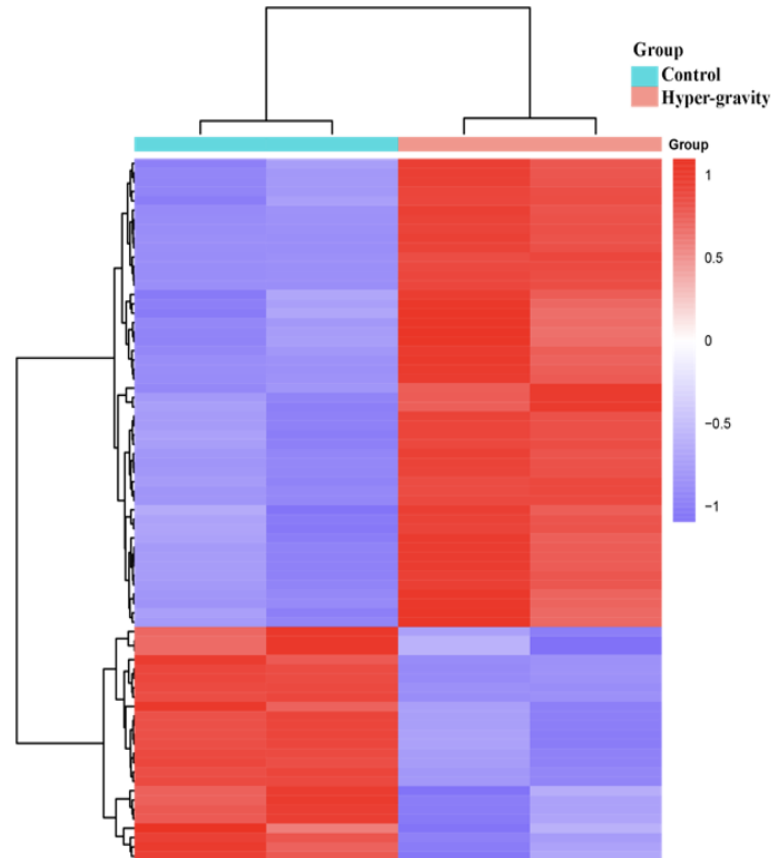
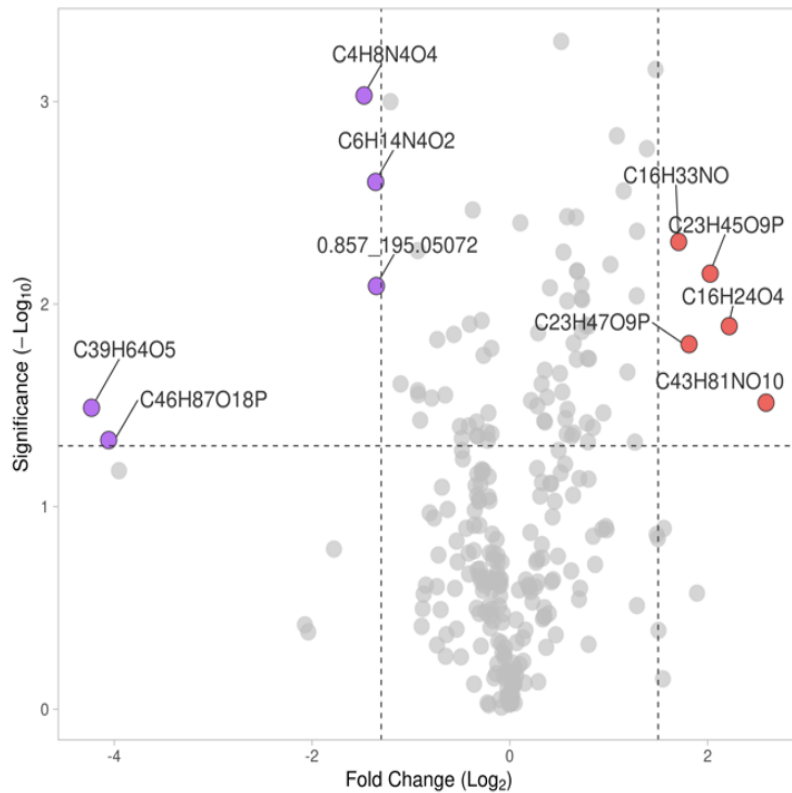






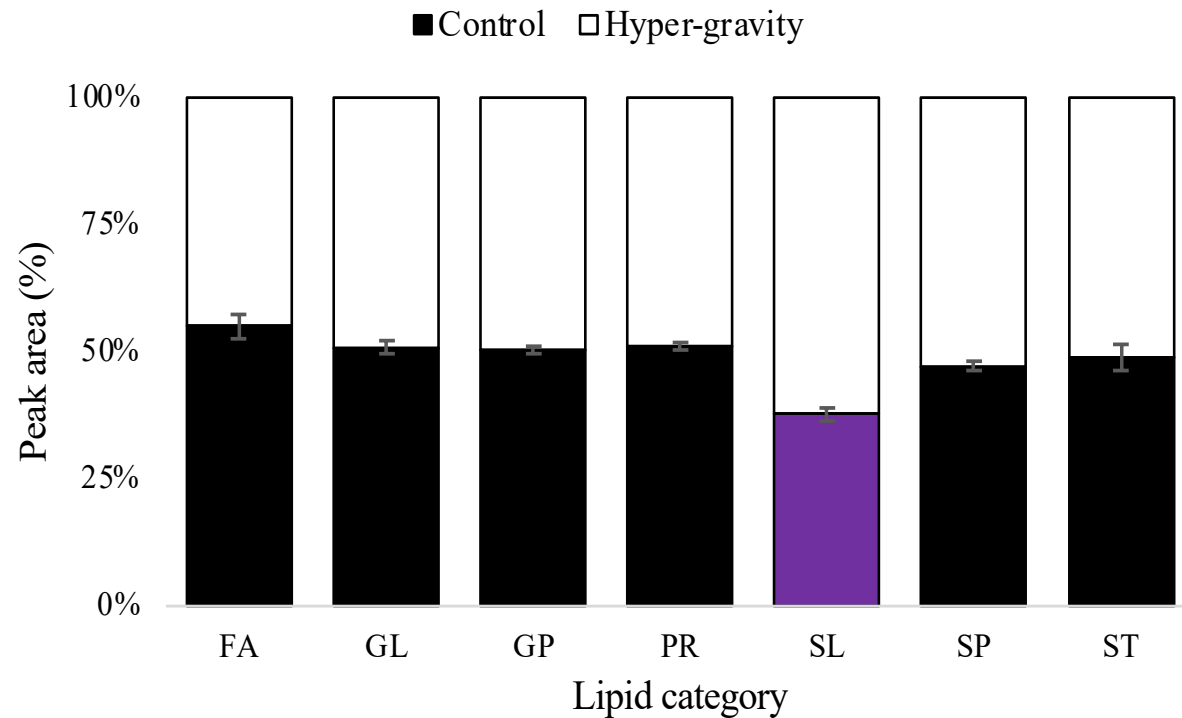


Omics Analysis



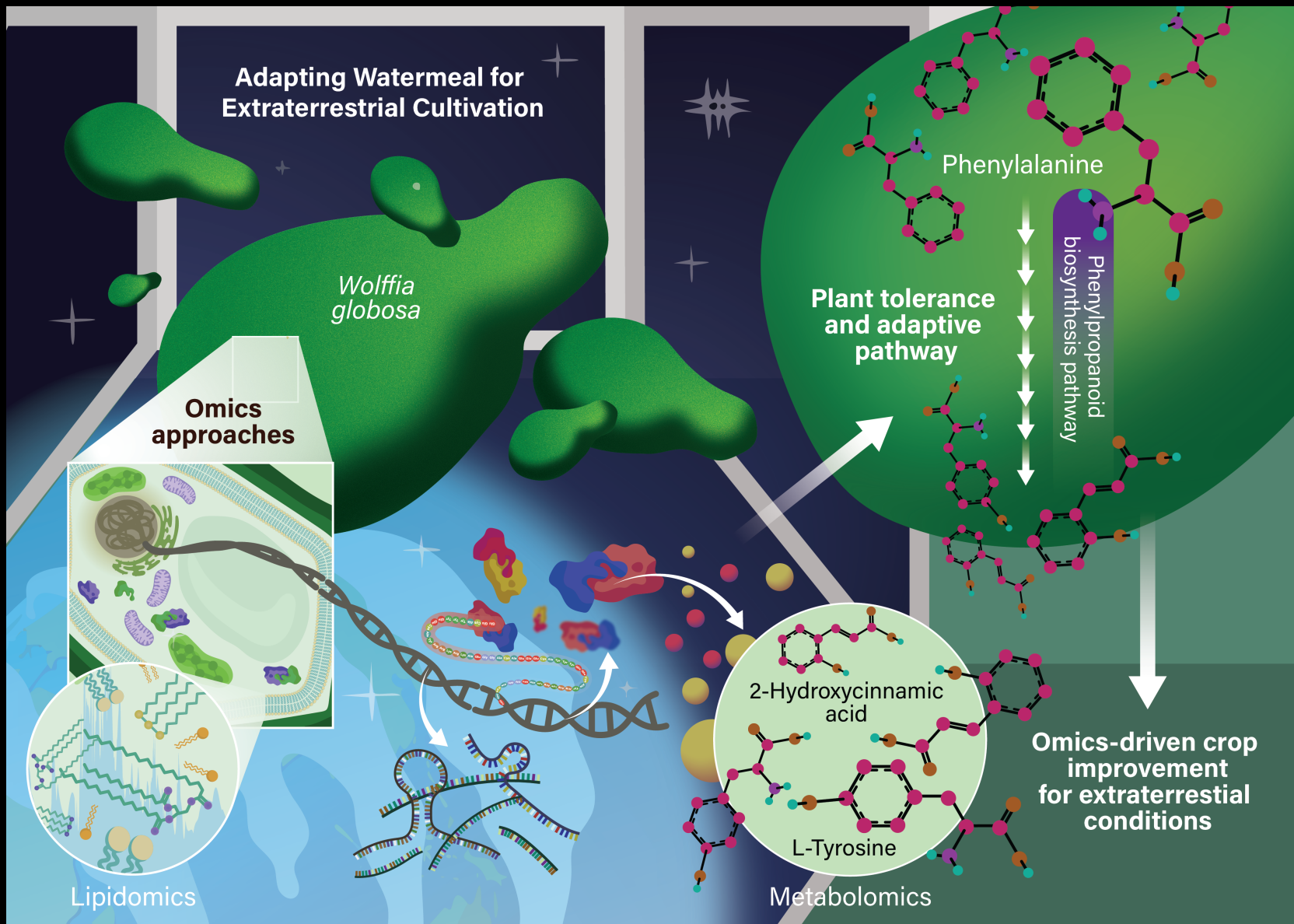
- **Metabolomics profiling** identified 359 metabolites (positive mode) and 242 (negative mode).
- **Hierarchical clustering** revealed clear separation between control and hyper-gravity groups.
- **Phenylpropanoid biosynthesis** was the most significantly altered pathway ($p = 3.4 \times 10^{-8}$).
- **Key metabolites** included 2-Hydroxycinnamic acid, L-Tyrosine, L-Phenylalanine, Sinapinic acid, 1-O-Sinapoyl- β -D-glucose, and 1-O-Sinapoyl- β -D-glucoside.

Omics Analysis



- **Lipidomics profiling identified 459 lipids across both ionization modes.**
- **Saccharolipids (SL) showed the most significant increase under hyper-gravity.**
- **SL abundance was 1.65-fold higher than control ($p < 0.001$).**

Summarize our finding





Future research

- Plant and seed storage for long-term transportation
- Rice cultivars selection for space agriculture
- Cosmic radiation on plant physiology and mutation



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