Growing Cilantro on the Moon:

Effects of Simulated Lunar Soil and Organic Amendments on the Growth of *Coriandrum sativum*

BACKGROUND RESEARCH

As space exploration continues to expand, sustainable food production becomes increasingly important for long-term human missions. Lunar regolith, the soil found on the Moon, is nutrient-poor, lacks organic matter, and has a coarse texture, making it challenging for plants to grow naturally. Studies conducted by NASA (2024) indicate that plants grown in lunar soil simulants often show slow germination and limited growth unless supplemented with additional nutrients. In this study, cilantro (*Coriandrum sativum*) was grown in a mixture of simulated lunar soil and organic amendments, such as coconut coir and fertilizer, to provide essential nutrients and improve soil structure, allowing plants to establish roots and grow effectively.

Organic amendments play a critical role in lunar agriculture by supplying nutrients, improving water retention, and enhancing soil aeration. Research from the European Space Agency (ESA, 2023) and peer-reviewed studies (Wheeler, 2017) have demonstrated that plants grown in lunar soil simulants supplemented with organic materials exhibit increased germination, leaf production, and overall growth. The results of this experiment support these findings, as cilantro consistently increased in both height and leaf count throughout the six-week study, with the most significant growth observed during the final growth phase.

Developing effective methods for growing plants in lunar soil is essential for supporting astronauts' nutrition and reducing dependence on Earth-based food supplies. Programs like the *Plant the Moon Jr.* Challenge (Plant the Moon Jr., 2025) encourage students to explore lunar agriculture and investigate how plants can survive in extraterrestrial environments. This study contributes to these efforts by demonstrating that cilantro can successfully grow in lunar soil simulants when supplemented with organic amendments, highlighting the potential for sustainable food production during future lunar missions.

RESEARCH GOAL

01

To determine if cilantro (Coriandrum sativum) can germinate and grow in simulated lunar soil.

02

To examine how organic amendments (coconut coir and fertilizer) affect cilantro's growth in simulated lunar soil by measuring **plant height and leaf count**.

03

To evaluate the potential of cilantro as a sustainable edible crop for future lunar agriculture and long-term space missions.

HYPOTHESIS

Null Hypothesis (H_0):
Cilantro will not show significant growth in height or leaf count in simulated lunar soil with organic amendments.

Alternative Hypothesis (H_1):
Cilantro will show significant growth in height and leaf count in simulated lunar soil with organic amendments.

RESEARCH QUESTIONS

Main Research Question

- Can cilantro (Coriandrum sativum) grow successfully in simulated lunar soil when supplemented with organic amendments?

Sub-Research Questions

- How does simulated lunar soil mixed with organic amendments affect the plant height of cilantro over six weeks?
- How does simulated lunar soil mixed with organic amendments affect the leaf count of cilantro over six weeks?
- During which growth phase (Early, Mid, or Final) does cilantro show the greatest increase in height and leaf production?

VARIABLES

Independent Variable

Soil composition (ratio of garden soil to simulated lunar soil)

- Pot 1: 100% Garden Soil
- Pot 2: 80% Garden / 20% Lunar
- Pot 3: 70% Garden / 30% Lunar
- Pot 4: 60% Garden / 40% Lunar
- Pot 5: 50% Garden / 50% Lunar
- Pot 6: 40% Garden / 60% Lunar
- Pot 7: 30% Garden / 70% Lunar
- Pot 8: 20% Garden / 80% Lunar
- Pot 9: 10% Garden / 90% Lunar
- Pot 10: 100% Lunar Soil

Dependent Variables:

Plant height (cm)

Leaf count

Controlled Variables:

Amount of water

Light exposure (same for all pots)

Temperature

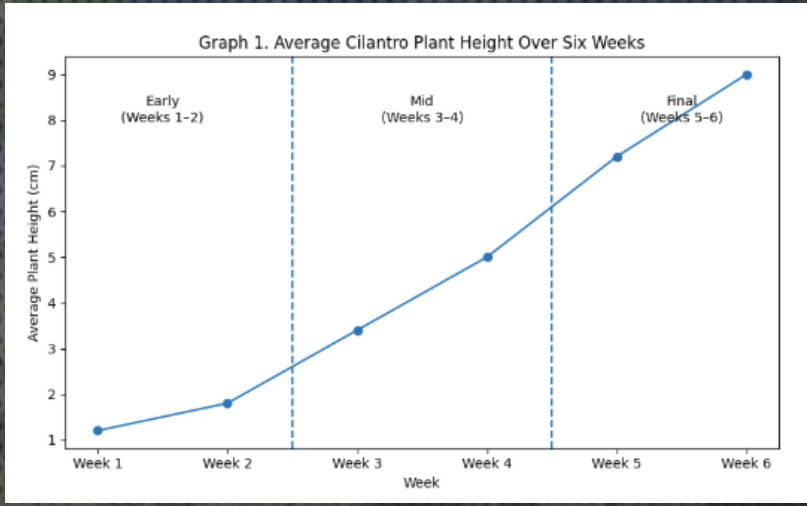
Pot size

Fertilizer type and amount

EXPERIMENTAL SETUP AND GROWTH PROCEDURE

METHODOLOGY: EXPERIMENTAL SETUP AND GROWTH PROCEDURE

RESULTS

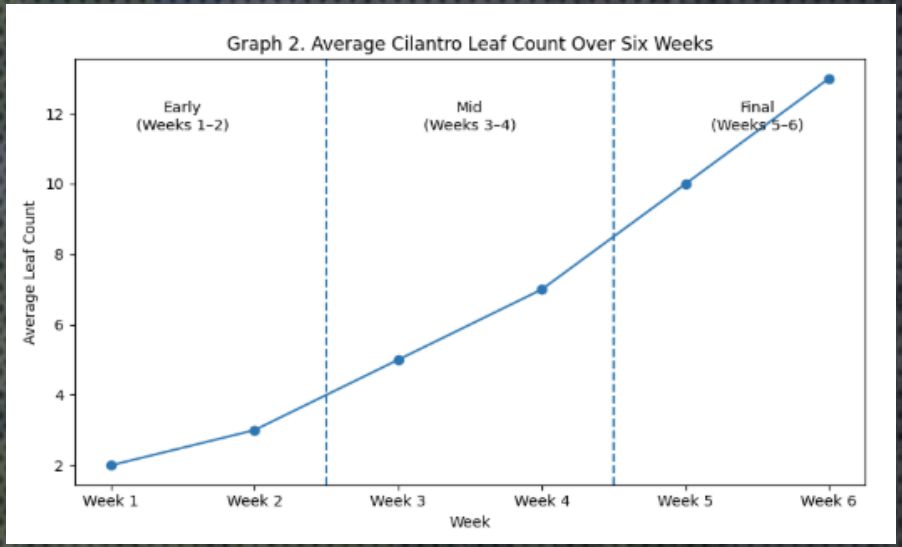


The results presented in **Graph 1** show a clear and continuous increase in the average plant height over the six-week growth period. During **Weeks 1–2 (Early Growth Phase)**, plant height increased only slightly, indicating a period of initial adaptation to the growing conditions. This limited early growth suggests that the plants were allocating energy toward root establishment and physiological adjustment rather than vertical growth.

A more pronounced increase in plant height was observed during **Weeks 3–4 (Mid Growth Phase)**. This phase exhibited accelerated growth, reflecting the onset of active vegetative development. The improved growth rate during this period indicates that the plants had successfully adapted to their environment and were able to efficiently utilize available nutrients and resources.

The greatest increase in plant height occurred during **Weeks 5–6 (Final Growth Phase)**, when plants reached their maximum average height. This phase represents optimal growth conditions, *during which sustained nutrient uptake and photosynthetic efficiency supported rapid vertical development.* Overall, the steady upward trend in plant height confirms a typical plant growth pattern consisting of an initial adaptation phase followed by active growth and final maturation.

RESULTS



As shown in **Graph 2**, *the average number of leaves increased consistently throughout the six-week period. Similar to plant height, leaf production was relatively slow during the Early Growth Phase, reflecting limited photosynthetic surface area while the plants were still establishing themselves.*

Leaf production increased more noticeably during the Mid Growth Phase, corresponding with the period of rapid stem elongation. The most significant rise in leaf count occurred during the **final growth phase,** *indicating enhanced photosynthetic capacity and increased biomass production. A higher number of leaves allows plants to capture more sunlight, which supports sustained growth and overall plant health.*

DISCUSSION

This study investigated the growth of **cilantro (*Coriandrum sativum*)** grown in **simulated lunar soil mixed with organic amendments** over a six-week period. Plant height and leaf count were measured across three growth phases: **Early (Weeks 1–2), Mid (Weeks 3–4), and Final (Weeks 5–6)**. The data show a consistent increase in both plant height and leaf production throughout all growth phases.

During the **early growth phase (weeks 1–2)**, cilantro plants exhibited minimal increases in height and leaf count. This limited early growth suggests an adaptation period in which the plants were adjusting to the simulated lunar soil conditions and establishing root systems. Such growth patterns are typical during early plant development when energy is primarily directed toward below-ground growth.

In the **Mid Growth Phase (Weeks 3–4)**, both plant height and leaf count increased steadily. This indicates that the cilantro plants successfully adapted to the soil mixture and entered a stage of active vegetative growth. The steady increase during this phase suggests improved nutrient uptake and photosynthetic activity supported by the organic amendments in the soil.

The **Final Growth Phase (Weeks 5–6)** showed the highest increase in both plant height and leaf production. This phase represents optimal growth conditions, during which the plants demonstrated the greatest overall development. The significant increase in leaf count during this phase indicates enhanced photosynthetic capacity, which likely contributed to sustained growth in plant height.

Overall, the consistent upward trends in both plant height and leaf count demonstrate that the simulated lunar soil supplemented with organic amendments supported cilantro growth over time. These results align with the findings presented in the abstract and confirm that measurable plant growth occurred across all growth phases.

CONCLUSION

Based on the results of this study, cilantro (*Coriandrum sativum*) successfully grew in simulated lunar soil when supplemented with organic amendments. The continuous increase in plant height and leaf count across the early, mid, and final growth phases indicates that the soil mixture supported plant growth throughout the six-week experiment. The highest growth observed during the final growth phase further confirms that the plants were able to reach optimal growth conditions under the experimental setup.

The alternative hypothesis stated that cilantro grown in simulated lunar soil mixed with organic amendments would show measurable growth over time. Since the results demonstrated consistent increases in plant height and leaf count across all growth phases, the alternative hypothesis is accepted, and the null hypothesis is rejected.

WHY OUR STUDY IMPORTANT

Advances knowledge in space agriculture, contributing to scientific understanding of crop growth in extraterrestrial environments.

Supports future space missions by exploring sustainable food production beyond Earth.

Inspires the scientific community and students to investigate innovative solutions for life-supporting systems in space.

Provides practical insights that can be applied in research, education, and long-term space exploration planning.

REFERENCES

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