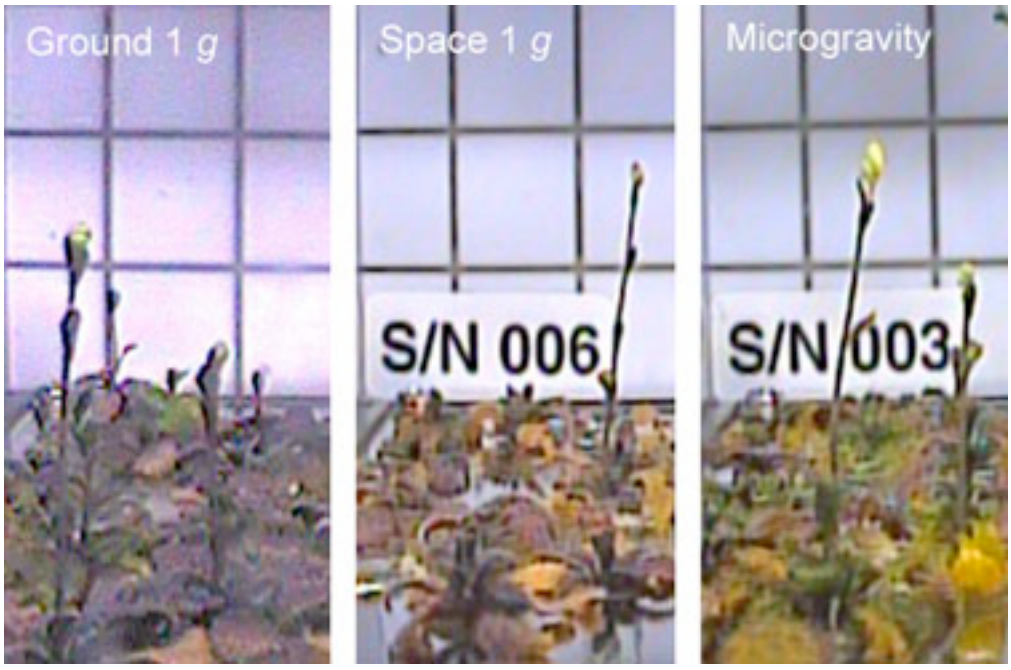

What does the figure show?

What was the objective of the study?

How was the study carried out?

What were the main findings?

Can you explain the findings?

Can you think of a suitable title for this article?

A. Give definitions/explanations to your partner for the following words.

Micro-gravity

Cortical microtubules

Growth stimulation

Dwarfism

B. Give definitions/explanations to your partner for the following words.

Inflorescences

Stems

Cell wall

Tubulin mutants

Here is the title of the article. Compare with your version.

Growth stimulation in inflorescences of an *Arabidopsis* tubulin mutant under microgravity conditions in space.

Now work with a partner to think of any questions you would like to find the answers to in the article. Write down your questions below.

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Look at the sentences below and decide from which section of the article they are taken: the Introduction (I), Materials and Methods (M), Results (R), or Discussion (D).

__ As the final step in gravity resistance, plants increase the rigidity of their cell walls via modifications to the cell wall metabolism as well as to the cell wall (apoplastic) environment.

__ Because no clear differences were detected in the length or the growth rate between ground and on-orbit 1 g controls, stimulation of inflorescence growth may be caused by microgravity, not by space flight.

__ The stems were 10–45% longer, depending on the day, under microgravity conditions than those at ground and on-orbit controls, and the differences were significant over wide range of growth phase.

__ The important role of cortical microtubules in plant resistance to hypergravity has been suggested, as mentioned above.

__ However, it is uncertain whether the hypothesis is applicable to gravity resistance of plants to 1 g gravity, as to the resistance to hypergravity.

__ These results support the hypothesis that cortical microtubules play an important role in plant resistance to the gravitational force.

__ To clarify this point, we conducted the space experiment using an Arabidopsis **a**-tubulin 6 mutant (tua6) in the Kibo Module on the International Space Station, as a part of the experiment termed Space Seed (PI, S. Kamisaka).

__ Watering was carried out 6–14 times a day and relative humidity was kept between 70 and 80%.

The Introduction

What we know already (generalisations, definitions, references to the literature).	Justifying the study, indicating a gap	Objective of the study, filling the gap.

Material and methods

How was the study done.	Materials	Methodology	Analyses

Results

What are the main findings	How are the findings substantiated

Discussion

Expected/unexpected findings
Tentative explanations
Comparison with other findings
Limitations
Implications
Conclusions for future research

Reorder the statements below to form the abstract of the article.

__ Growth of inflorescence stems was stimulated under microgravity conditions, as compared with ground and on-orbit 1 g conditions.

__ The degree of growth stimulation tended to be higher in the tua6 mutant than the wild-type Columbia.

__ To clarify this point, we cultivated anArabidopsis **a**-tubulin 6 mutant (tua6) in the Cell Biology Experiment Facility on the Kibo Module of the International Space Station, and analyzed growth and cell wall mechanical properties of inflorescences.

__ The stems were 10–45% longer and their growth rate 15–55% higher under microgravity conditions than those under both 1 g conditions.

__ Cortical microtubules are involved in plant resistance to hypergravity, but their rolesin resistance to 1 g gravity are still uncertain.

__ No clear differences were detected in any growth or cell wall property between ground and on-orbit 1 g controls.

__ These results support the hypothesis that cortical microtubules generally play an important role in plant resistance to the gravitational force.

__ Under microgravity conditions, the cell wall extensibility in elongating regions of inflorescences was significantly higher than the controls, suggesting that growth stimulation was caused by cell wall modifications.

KEY

Look at the sentences below and decide from which section of the article they are taken, the Introduction (I), Materials and Methods (M), Results (R), or Discussion (D).

I As the final step in gravity resistance, plants increase the rigidity of their cell walls via modifications to the cell wall metabolism as well as to the cell wall (apoplastic) environment. ***What we know already, generalisation, has been shown in the literature (simple present).***

D Because no clear differences were detected in the length or the growth rate between ground and on-orbit 1 g controls, stimulation of inflorescence growth may be caused by microgravity, not by space flight. ***Stating results and then commenting on findings, tentative explanations (modality/hedging).***

R The stems were 10–45% longer, depending on the day, under microgravity conditions than those at ground and on-orbit controls, and the differences were significant over a wide range of growth phases. ***Statement of results (simple past)***

I The important role of cortical microtubules in plant resistance to hypergravity has been suggested, as mentioned above. ***Reviewing the literature, what has been shown, present perfect.***

I However, it is uncertain whether the hypothesis is applicable to gravity resistance of plants to 1 g gravity, as to the resistance to hypergravity. ***Gap statement – what we don't know - leads to justification of study.***

D These results support the hypothesis that cortical microtubules play an important role in plant resistance to the gravitational force. ***Extrapolation from results.***

I To clarify this point, we conducted the space experiment using an Arabidopsis **a**-tubulin 6 mutant (tua6) in the Kibo Module on the International Space Station, as a part of the experiment termed Space Seed (PI, S. Kamisaka). ***Filling the gap, statement of objective.***

M Watering was carried out 6–14 times a day and relative humidity was kept between 70 and 80%.

Reorder the statements below to form the abstract of the article.

3 Growth of inflorescence stems was stimulated under microgravity conditions, as compared with ground and on-orbit 1 g conditions.

5 The degree of growth stimulation tended to be higher in the tua6 mutant than the wild-type Columbia.

2 To clarify this point, we cultivated anArabidopsis **a**-tubulin 6 mutant (tua6) in the Cell Biology Experiment Facility on the Kibo Module of the International Space Station, and analyzed growth and cell wall mechanical properties of inflorescences.

4 The stems were 10–45% longer and their growth rate 15–55% higher under microgravity conditions than those under both 1 g conditions.

1 Cortical microtubules are involved in plant resistance to hypergravity, but their roles in resistance to 1 g gravity are still uncertain.

7 No clear differences were detected in any growth or cell wall property between ground and on-orbit 1 g controls.

8 These results support the hypothesis that cortical microtubules generally play an important role in plant resistance to the gravitational force.

6 Under microgravity conditions, the cell wall extensibility in elongating regions of inflorescences was significantly higher than the controls, suggesting that growth stimulation was caused by cell wall modifications.

ABSTRACT

Cortical microtubules are involved in plant resistance to hypergravity, but their roles in resistance to 1 g gravity are still uncertain. To clarify this point, we cultivated anArabidopsis **a**-tubulin 6 mutant (tua6) in the Cell Biology Experiment Facility on the Kibo Module of the International Space Station, and analyzed growth and cell wall mechanical properties of inflorescences. Growth of inflorescence stems was stimulated under microgravity conditions, as compared with ground and on-orbit 1 g conditions. The stems were 10–45% longer and their growth rate 15–55% higher under microgravity conditions than those under both 1 g conditions. The degree of growth stimulation tended to be higher in the tua6 mutant than the wild-type Columbia. Under microgravity conditions, the cell wall extensibility in elongating regions of inflorescences was significantly higher than the controls, suggesting that growth stimulation was caused by cell wall modifications. No clear differences were detected in any growth or cell wall property between ground and on-orbit 1 g controls. These results support the hypothesis that cortical microtubules generally play an important role in plant resistance to the gravitational force