Overview of Kibo experiment candidates for around 2012

1. Experiment Title

Molecular mechanisms of differentiation and formation of the gravity sensing system in plant cells

2. Principal Investigator

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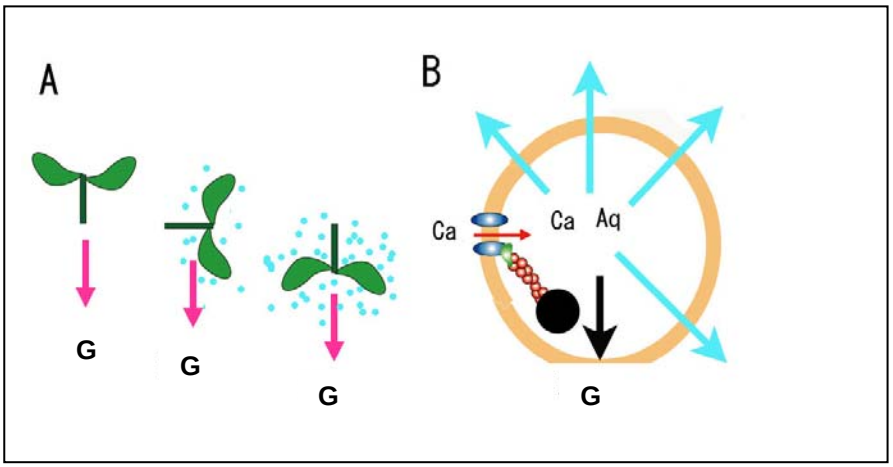
3. Outline of Experiment

Gravity is a critical environmental factor affecting the morphology and functions of organisms on Earth. Plants sense changes in the gravity vector (gravistimulation) and regulate their growth direction accordingly.

Plants exhibit cytoplasmic calcium concentration ([Ca2+]c) increases in response to a variety of endo- and exogenous signals such as phytohormones, temperature and touch, the mechanisms of which have been extensively investigated. However, few studies have assessed the relationship between [Ca2+]c increase and gravistimulation, because gravity is a ubiquitous force and difficult to control on Earth.

In Arabidopsis thaliana seedlings, gravistimulation, achieved by rotating the specimens, is known to induce a biphasic increase in cytoplasmic calcium concentration ([Ca2+]c). Based on kinetic and pharmacological analyses, the first and second [Ca2+]c increases appear to be related to rotation and gravistimulation, respectively, and are mediated by distinct molecular mechanisms. However, the molecular mechanism of the [Ca2+]c increase by gravistimulation has not been identified and its differentiation in seedling is totally unknown. Recent our preliminary experiments suggest that a certain putative mechanosensitive channel is involved partially in the [Ca2+]c increase by gravistimulation. It is most likely from our results that the channels are linked to the actin filament tethered with high and dense objects e.g., amyloplasts, the gravistimulation induces sedimentation of the amyloplasts mechanically, and activates the channels.

In the proposed research plan, Arabidopsis thaliana seeds are plated and sprouted in the Japanese Experiment Module (JEM, dubbed as KIBO) under the micro-gravity conditions. These seedlings are gravistimulated (0.1 g to 10 g) by centrifugation to test whether the gravisensing complex mechanism (i.e., amyloplasts-actin-filaments-the channels) is formed under micro-gravity conditions. The same gravistimulation will be applied to the channel knockout seedlings and the channel over-expressing seedlings to examine the role of the channel in the gravisensing process. If the channel is involved in the gravisensing processes, the [Ca2+]c increase will be diminished in the knock out seedlings, and by contrast the [Ca2+]c increase will be augmented in the over-expressing seedlings.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