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食糧作物の宇宙での栽培実証およびその成長への重力影響解析のための宇宙実験計画

Space experiment plan for demonstrating food crop culture in space and analyzing gravity effects on their growth characteristics

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Recently, there has been great interest in plant growth and reproduction in space with the increase in the possibility of realizing long-term manned space flight and habitation on Moon and Mars. The human life-support in long-term space missions is highly dependent on supplying food, O_2, and water. Space farming will play crucial roles in safe and systematic food production, CO_2/O_2 conversion, and water purification. In space farming, scheduling crop production, obtaining high yields with a rapid turnover rate must be established with the precise control of environmental variables with limited resources and energy for accurately grasping the behaviors of soundly growing plants.

In space farming, closed plant culture facilities like plant factories will be utilized. In such facilities, the influence of environmental conditions specific to space, such as micro- or low-gravity and common physical factors including the light intensity, light/dark cycle, light wavelength, temperature, humidity, CO_2 concentrations, and air movement that have combined effects with gravity must be considered for efficient plant production in space farming.

In this feasibility study project, sweetpotato [Ipomoea batatas (L.) Lam.] will be tested. Sweetpotato has a high yield of edible biomass with a little inedible part as waste, because it can be utilized for the leafy vegetable as well as the root crop and thus has been a candidate food crop in space. Sweetpotato can be cultured in recirculating hydroponic systems[1] which were recommended in space farming to allow efficient crop production and conservation of nutrients and water.[2]

Gravity effects on tuberous root (potato) formation will be analyzed from the viewpoints of allocation of photosynthetic assimilates, dynamics of cell development and biosynthesis of plant growth regulators, expression of genes especially in root formation, etc., while demonstrating food production in the ISS 'Kibo' laboratory using a plant culture system equipped with environmental control and plant growth information monitoring systems (Fig. 1).

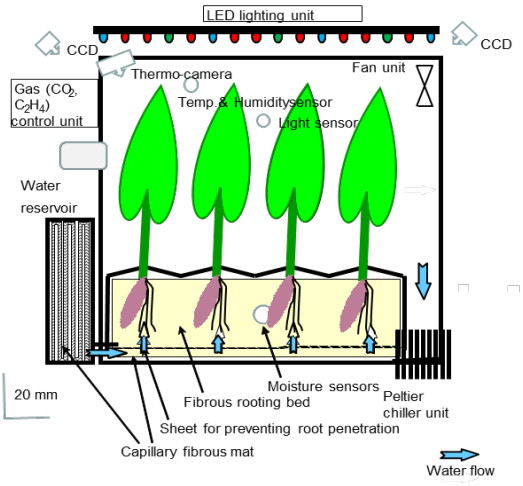

Fig. 1 Plant culture system for space experiment

References

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2) R. M. Wheeler, C. L. Mackowiak, W. L. Berry, G. W. Stutte, N. C. Yorio and J. C. Sager: Acta Hort., 481 (1999), 655.