JASMAC
Conference of the Japan Society of Microgravity Application

OS5-3

袋培養技術を活用した病害虫フリーでかつ緊急時バックアップも可能な農場システムの研究及び国際宇宙ステーションにおけるレタス栽培の実証的研究の実験計画

Diseases & insects-free farm system with potential of emergency backup, and an experimental design of empirical research on lettuce cultivation at the International Space Station

関光雄[1]，間宮幹士[2]，後藤英司[3]，寺島千晶[4]，布施哲人[5]，
Mitsuo SEKI[1], Kanji AMAMIYA[2], Eiji GOTO[3] , Chiaki TERASHIMA[4], Tetsuto FUSE[5]
1　（株）竹中工務店，Takenaka Corp.#1,
2　キリンホールディングス（株），Kirin Holdings Co., Ltd.#2,
3　千葉大学，Chiba Univ.#1,
4　東京理科大学，Tokyo Univ. of Science#1,
5　宇宙航空研究開発機構，Japan Aerospace Exploration Agency#1,

1. Introduction

The following items are required for space farms. They are prevention of diseases and pest damage, reduction of material for payload reduction, and operational energy reduction. As a solution, we focused on disease-free plants/somatic embryos/tubers supply utilizing bag-type culture vessel technology as Fig.1, and low pressure environment cultivation as shown in Fig.2-3. In this study, we confirmed the basics.

Fig.1 Bag-type culture vessel technology

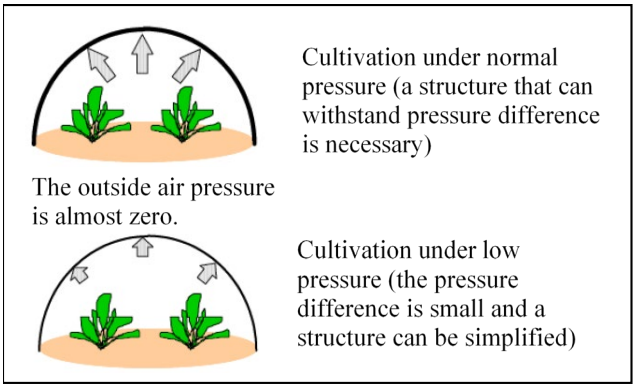

Fig.2 Concept of low pressure cultivation

Fig.3 Low pressure environment cultivation chamber

2. Methods

An empirical confirmation was made on lettuce plants as a source of vitamin C, seed potatoes as a carbohydrate source, and soybean somatic embryos as a protein source. We performed nutritional component evaluation and material balance evaluation. Based on these results, a lunar farm model was examined.

3. Results

It was confirmed that the edible part of lettuce can be grown by bag-type culture vessel technology. Similar growth was confirmed in low-pressure environmental cultivation. Seed potatoes and soybean somatic embryos were confirmed to grow in the same way as normal pressure in a low-pressure environment as shown in Fig.4. The farm model was examined assuming a food supply of 20 people as shown in Fig.5.

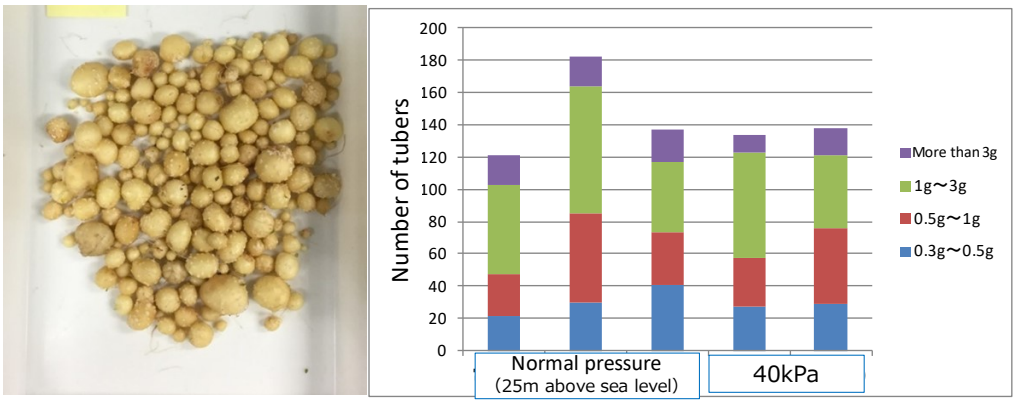

Fig.4 Potato micro tuber formation status

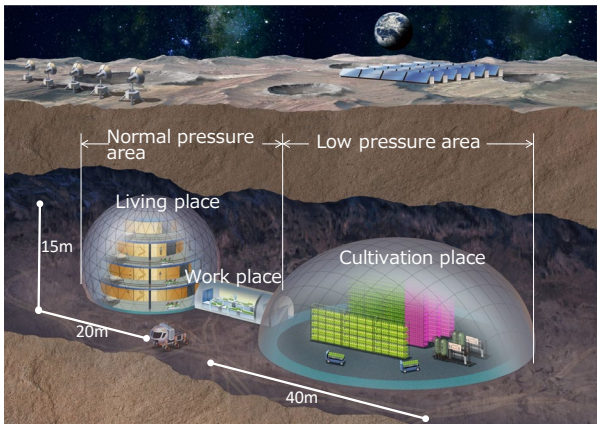

Fig.5 Image of farm system

4. Outline of experimental design on the ISS

Based on the research up to the previous section, we are currently planning to grow lettuce on the ISS as an empirical experiment in the space environment. To confirm the superiority over other cultivation methods, the food safety of the cultivated lettuce and the possibility of processing the culture-liquid on water circulation system will be evaluated.

The experimental equipment will be installed under the lighting inside the ISS and cultivated for about 45 days. During the period, a culture solution is prepared from ISS water and supplied to the culture bag. Cultivation is scheduled to end around October 2021. The grown lettuce and culture-liquid will be returned to the ground for analysis.

Fig.6 Experimental equipment

5. Conclusions

The feasibility of bag culture of lettuce, seed potatoes and soybean somatic embryos in low pressure environment was confirmed. This technology can be used in a micro-gravity environment because it can be sealed in a small lot. In addition, we are currently planning to grow lettuce on the ISS as an empirical experiment in the space environment.

This work was supported by TansaX, JAXA under Support Program for starting up Innovation Hub on the National Research and Development Agency promoted by JST.