

EUROPEAN MARS SOCIETY CONFERENCE

14-16th October 2016

Plant cultivation for Bioregenerative Life Support Systems (BLSSs) in Space

Roberta Paradiso, Youssef Rouphael, Antonio Pannico and Stefania De Pascale*

Department of Agricultural Sciences, University of Naples Federico II, Naples (Italy)

* Speaker

Human colonization of Space relies on the efficient realization of Bioregenerative Life Support Systems (BLSSs), for resources regeneration during long term missions or in planetary stations.

Higher plants play a key role in BLSSs, thank to their “complementary” interrelationship with humans: in a simplistic vision, plants recycle human waste and provide food to humans, while humans recycle plant waste and provide nutrients to plants. Specifically, plants are able to regenerate air through photosynthetic absorption of carbon dioxide and oxygen emission, to recover water through transpiration, and to convert waste products in biomass through mineral nutrition. In addition, they can provide fresh food to integrate the crew diet and help to preserve the astronauts' wellbeing.

However, realizing resource regeneration at high and continuous rate, and food production stable in quantity and quality, requires the proper choice of plant crops and varieties, which must be compliant with the specific growth environment and fulfil the astronauts needs, and of cultivation techniques, which must be feasible under the several constraints of Space vehicles and colonies (including reduced availability of crew-time, volume and energy, altered gravity).

Based on technical and dietary requirements, several plant species (e.g. tomato, lettuce, wheat, potato, soybean) are studied in Space research programs as candidates for cultivation in BLSSs. Experiments are conducted in growth chamber, mainly by using closed-loop hydroponic (soilless) cultivation systems, in order to design Space greenhouses where each environmental factor (e.g. light, temperature, air composition, water and nutrients availability) can be precisely modulated to optimize plant performance.

For long time our team has been realizing experiments aiming to investigate the adaptation of various crops to hydroponics in controlled environment, by considering both biological and agro-technological issues. Wide attention is dedicated to the influence of several parameters (e.g. hydroponic system, nitrogen source in the nutrient solution, influence of microbes in the rhizosphere) on plant behaviour, in order to identify cultivation protocols able to maximise the plant productivity and the resource use efficiency, even while reducing plant sensitivity to space stressors and enhancing the nutritional quality of products.

The lecture will present an overview on the achievements and the current research in agro-technology in controlled environment, and the related technical and scientific issues. Focus will be on our experience on plant cultivation for BLSSs.