Gardening on the Moon

Michael Stasiak, TechNote 001-2011

Living on the moon for any long period of time is impossible at the moment, but researchers here at the University of Guelph's Controlled Environment Systems Research Facility have set out to make it possible.

Currently, space mission vehicles are able to carry enough food, water, and air to keep crews alive for short missions. For extended durations, such as on the International Space Station, resupplying life support components is required at regular intervals. Because of the impending end to the US Space Shuttle program, on March 14, 2011, NASA bought 12 seats on the Russian Soyuz spacecraft at a cost of $753 million. Each seat is allowed 50 kg of cargo, resulting in a cargo transport cost of a staggering $1.25 million per kg. To put that in perspective, it would cost over $300,000 to send a single tomato into orbit. This makes resupply potentially unsustainable for longer duration space missions, as in a permanent Lunar base or a manned mission to Mars.

Luckily, the needs of the crew can be met by developing renewable life support systems based on plants and microorganisms. As the primary basis of life on earth, plants are uniquely capable of providing the most efficient means of sustaining life in space. They are able to provide food, water (through transpiration) and oxygen, while removing carbon dioxide and helping eliminate polluting byproducts and waste. In space you can't throw anything away, everything must be reused in one way or another, and biological systems (including plants and microbes) are uniquely capable of providing the primary means of waste management by utilizing (recycling) human waste products (urine and faeces) as fertilizer.

Which brings us to gardening on the Moon. The ability of the Canadian greenhouse industry to sustainably grow fresh produce throughout the year has spawned a research program that has set its sights on growing the first plant on the Moon. With the exception of air, the Moon isn't too different than Canada in February – it's really cold. The University of Guelph's Controlled Environment Systems Research Facility (CESRF) houses numerous plant growth systems and a myriad of state-of-the-art analytical equipment. Undergraduate, MSc and PhD students are involved in all aspects of the life support research process, from system engineering and construction to experimental design and implementation. A number of areas of importance to biological life support system design and function are

being explored, including: efficient energy supply for dense plant canopies, hydroponic nutrient cycling and remediation, maintenance of indoor air quality, selection of candidate plant species, evaluation and design of new lighting systems for plant growth, evaluation of plant growth under conditions of low atmospheric pressure and development of plant based biosensors. The CESRF has already spun off two technologies from its research: a plant-based biological filter for maintaining indoor air quality and fighting "sick building syndrome" (Nedlaw Living Walls Inc.) and a recyclable plant growth medium (EnviroGrow) for greenhouse food production systems.

That first plant on the Moon may not be one you know though. The lowly Arabidopsis, one of the most intensely studied flowering plants (actually a weed in the mustard family) because its entire genome has been mapped, is destined to be the pioneer plant on the Moon. With the addition of reporter genes that glow or fluoresce in response to stress, Arabidopsis is an ideal environment 'sensor'. Depending on conditions encountered such as cold, heat, drought, nutrient deficiencies, light quality, radiation or atmospheric gas, various genes would be activated or deactivated and this can be directly assessed through non-invasive imaging using specialized cameras and LEDs.

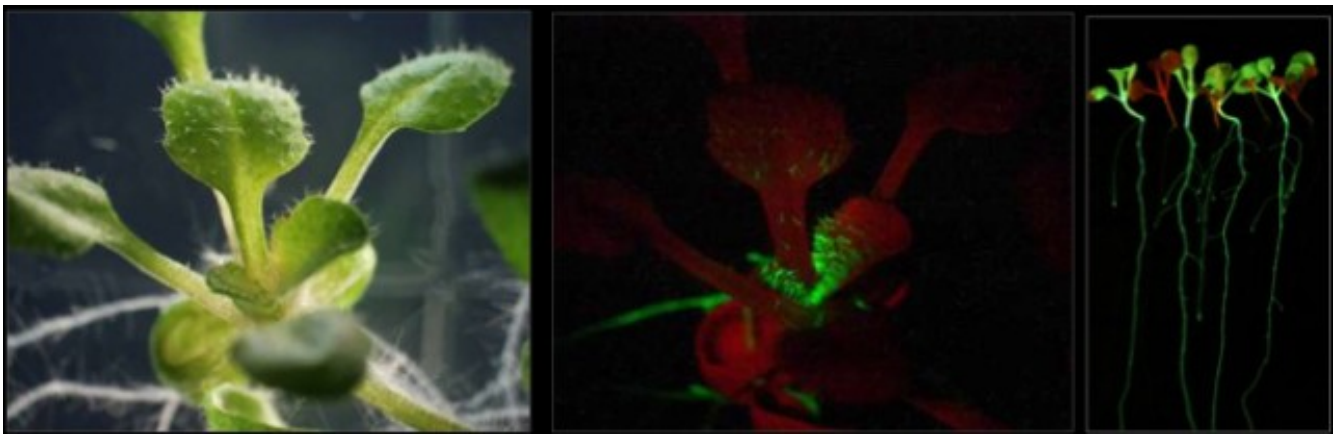

Photo credit: Anna-Lisa Paul and Rob Ferl, http://www.hos.ufl.edu/ferllab/

And if all goes according to plan, we should be putting down roots on the moon within the next 10 years.

This TechNote is also blogged on the Ontario Ministry of Research and Innovation website and you can find it here:

http://www.mri.gov.on.ca/blog/index.php/2011/04/michaelstasiak/

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