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Regolith as baseline to a future space farm †

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Abstract: Heavy pay attention and investment of resources attended to space colonization were shown in the last decade. Indeed many space agencies, first upon all NASA which have set programs to create a stable settlement on Moon (in the next years) looking at the future with a first manned mission to Mars. In this perspective, a key role going to be played by Bioregenerative Life-Support Systems (BLSS), because providing all consumables for the crew members life-support from Earth becomes un-realistic (high cost and planning time to keep). An alternative solution to reduce the payloads and the support delivery can be given by the implementation of BLSS through the in situ resource utilization (ISRU). Specifically, improving the use of moon' and martian's regolith (the "soil" of a planet or a satellite) and promoting the re-use of waste materials produced either during the journey than to live in the future colony such as human excreta and food residues. Nowadays few works have investigated the feasibility of use of these resources for crop productions and the effects on crop yield and nutritional quality. Our work aims to fill this gap, by using regolith simulants mixed at different rates with an amendment as plant growth substrates, to evaluate afterwards their effects on crop (lettuce) growth and quality. Furthermore, the physicochemical properties of each substrate, as affected by root exudation, are monitored over time. Our first surveys on lettuce showed significant differences in term of physiological parameters, mineral composition, and polyphenolic compound content; accordingly, the bioavailability of the main nutrients was quite dissimilar in the diverse substrates, in particular in the highly-dynamic rhizosphere.

Keywords: ISRU; lettuce; regolith simulant