FULL MOON: A Novel and Economical Method for Sustainable Agriculture on the Moon

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Lunar colonization will require sustainable agriculture using in-situ resources and minimal fostering materials from Earth. This study aimed to grow Raphanus sativus (radish) in a Lunar South Pole Regolith Simulant (LSP-2) substrate that yields plant biomass statistically non-inferior to Earth-soil control plants. Previous studies using augmented 75% lunar regolith simulant (not LSP-2) grew stressed plants. Research is needed to support full-growth, nutritious agriculture while reducing fostering materials from Earth. Analysis of LSP-2's chemical and physical properties indicated that augmentation is needed to support agriculture; including acidification, nitrogen fortification, microbe introduction, humus creation, and drainage. This experiment augmented LSP-2 with drainage, soil (15 mL per sample) and a substrate top-layer that was developed over each of four ten-week growth cycles integrating Lunar-grown Trifolium repens plant biomass as biofertilizer for the subsequent cycle. 100% LSP-2 plants did not sprout. After growth cycle 1 (G1, no biofertilizer), average radish biomass was significantly lower than control ($p<0.01$). After G2 (one cycle of biofertilizer worked into the top layer), average plant biomass increased (+17%), but was lower than control ($p<0.01$). After G3 (two biofertilizer cycles), average radish biomass increased 92%, inferior to control ($p<0.01$). After G4 (three biofertilizer cycles), the average dry biomass grew 48%, non-inferior to control ($p=.4151$). The null hypothesis is rejected. This approach, using just 4% Earth soil, a custom drainage system and three cycles of Lunar-grown biofertilizer, is the first method to successfully grow plant biomass in augmented LSP-2 non-inferior to Earth-grown crops.

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