



Exolith Lab | Plant Growth in Simulants

Soils on Earth have co-evolved with the biosphere for billions of years and are perfectly suited for plant growth. This is not the case for Mars or the Moon, and plants may have difficulty growing in martian or lunar soil without modifying it. Below is a guide on what we and other simulant users have learned from initial plant growth experiments. We will update the guide on an ongoing basis as new experiments are performed. If you have any interesting findings, email us: exolithlab@ucf.edu.

Particle size distribution. The best soils for growing plants on Earth are called loams: these are roughly equal mixtures of sand-sized, silt-sized and clay-sized particles. By default, martian soil is likely too coarse-grained, and lunar soil too fine-grained for many plants. *Recommendation: for martian simulants, try adding clay or other materials to increase the “fluffiness” of the soil (MGS-1C already contains abundant clay). For lunar simulants, experiment with sieving.*

Fertilizer. Soils on the Moon and Mars contain little to no carbon, nitrogen, or phosphorus, and have no bacteria, fungi or earthworms. *Recommendation: experiment with various organic and inorganic fertilizers, particularly those like biosolids and earthworm castings that could be produced inside a human habitat on Mars.*

Nutrient cycling and time. Rich soils on Earth take time to develop from bare rock, and successive cycles of plant growth and fertilization may improve the growing capacity of simulants over time. *Recommendation: use the same initial batch of simulant over multiple growth cycles to study changes in soil chemistry and growth potential.*

Enhanced realism. Our simulants are made from inorganic minerals but are not sterilized, and the Mars simulants do not contain perchlorate or chlorate salts. *Recommendation: for truly realistic experiments, consider sterilizing the simulants by heating to 120°C, and adding perchlorates, which may be detrimental to plants at high concentrations (DO NOT eat plants grown in perchlorate-bearing soils).*

Salt & acidity. Most plants prefer low-salinity, neutral-pH soils, but some species grow in more harsh conditions. Simulants, and presumably martian and lunar soils, usually tend to be somewhat basic (pH>7). Martian soils contain a variety of salts that may need to be removed. *Recommendation: Experiment with leaching salts out of the martian simulants, and with various buffering agents for plants that require a specific pH range.*

Experiment! Simulants are made based on incomplete knowledge and they aren't perfect copies of extraterrestrial soils. Future astronauts will almost surely encounter surprises when they try to grow plants on the Moon or Mars. If certain plant species don't grow well in the simulants, get creative and come up with a strategy to achieve better results.

