Summary of: Biomass Production of the EDEN ISS Space Greenhouse in Antarctica During the 2018 Experiment Phase

Summary:

The EDEN ISS greenhouse, a space-analog facility located near the German Neumayer III station in Antarctica, produced a significant amount of edible biomass during the 2018 experiment phase. Here are the key findings:

Methodology: - The facility was designed and built starting from March 2015 and deployed in Antarctica in January 2018. - The greenhouse operated from February 7th to November 20th, 2018. - The facility was subdivided into three sections: Cold-Porch, Service Section, and Future Exploration Greenhouse (FEG). - The FEG, the main plant cultivation space, included multi-level plant growth racks operating in a controlled environment. - The greenhouse utilized a nutrient delivery subsystem, atmosphere management subsystem, thermal control subsystem, and illumination control subsystem.

Results: - A total of 268 kg of fresh edible biomass was produced, with most of it coming from cucumbers (67 kg), lettuces (56 kg), leafy greens (49 kg), and tomatoes (50 kg). - The majority of the harvest was from lettuce, leafy greens, and fresh vegetables, with a focus on crops like lettuce, leafy greens, and fresh vegetables. - The environmental set points for the crops were 330–600 µmol/(m²·s) LED light, 21°C, ~65% relative humidity, 1000 ppm CO2, and a photoperiod of 17 h per day. - The overall yearly productivity of the EDEN ISS greenhouse was 27.4 kg/m², equivalent to 0.075 kg/(m²·d).

Discussion: - The production rate was 21.44 kg/m², resulting in a time-normalized production rate of 0.075 kg/(m²·d). - The EDEN ISS MTF produced more edible biomass than the South Pole Food Growth Chamber (SPFGC) in 2006. - The yield of cucumber was higher compared to experiments in Lunar Palace 1. - The production of lettuce was better than some other experiments but only half as good as the results from the Biomass Production Chamber (BPC).

Conclusions: - The EDEN ISS MTF produced a significant amount of edible biomass, demonstrating the potential for controlled environment agriculture in space. - The dataset can be valuable for improving simulation models for space greenhouses and for cultivar selection. - The unique aspect of growing all crops simultaneously under the same conditions, while not optimal for each cultivar, is closer to how future space greenhouses might operate.