

Abstract:

Future food production system development pulling from space biology crop growth testing in Veggie

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Preliminary crop testing using Veggie indicates the environmental conditions provided by the ISS are generally suitable for food crop production. When plant samples were returned to Earth for analysis, their levels of nutrients were comparable to Earth-grown ground controls. Veggie-grown produce food safety microbiology analysis indicated that space-grown crops are safe to consume. Produce sanitizing wipes were used on-orbit to further reduce risk of foodborne illness. Validation growth tests indicated abiotic challenges of insufficient or excess fluid delivery, potentially reduced air flow leading to excess water, elevated CO₂ leading to physiological responses, and microorganisms that became opportunistic pathogens.

As NASA works to develop future space food production, several areas of research to define these systems pull from the Veggie technology validation tests. Research into effective, reusable water delivery and water recovery methods for future food production systems arises from abiotic challenges observed. Additionally, impacts of elevated CO₂ and refinement of fertilizer and light recipes for crops needs to be assessed. Biotic pulls include methods or technologies to effectively sanitize produce with few consumables and low inputs; work to understand the phytomicrobiome and potentially use it to protect crops or enhance growth; selection of crops with high harvest index and desirable flavors for supplemental nutrition; crops that provide psychosocial benefits, and custom space crop development. Planning for future food production in a deep space gateway or a deep space transit vehicle requires methods of handling and storing seeds, and ensuring space seeds are free of contaminants and long-lived. Space food production systems may require mechanization and autonomous operation, with preliminary testing initiated to identify operations and capabilities that are candidates for automation. Food production design is also pulling from Veggie logistics lessons, as we learn about growing at different scales and move toward developing systems that require less launch mass. Veggie will be used as a test bed for novel food production technologies. Veggie is a relatively simple precursor food production system but the knowledge gained from space biology validation tests in Veggie will have far reaching repercussions on future exploration food production.