

Water Use and Requirements of PtFT1 Plums for Long Duration Space Missions

Active Technology Project (2016 - 2017)



Project Introduction

Early applications of bioregenerative life support technologies for space exploration will likely start with supplemental food production for the crew. This could include fresh, perishable foods that cannot be stored for long and but have a high impact on the diet acceptability bioavailable nutrients. Because of the limited working volume in spacecraft, these plants must be small in size.

A combination of CIF and NASA Post Doctoral funding was used in FY 15 develop horticultural approaches for propagation, production and fruiting of several dwarf plum lines and evaluate their suitability as candidates for long duration space missions. Collaborators at the USDA/Agricultural Research Service transformed *Prunus domestica* with the FT1 flowering gene from *Populus trichocarpa* (PtFT1), which resulted in early flowering, driving the plant out of its juvenile growth phase and into reproductive development years earlier than would normally occur. The result is a plum line that has potential as component of food production system on long duration space missions since it completes complete generation (seed to seed) within in less than a year and maintains a dwarf bush or vine-like growth habit. Further, there appears to be no obligate requirement for a dormancy period resulting in continuous fruit production on a given plant. This potential is described in Graham et al (2015, in press).

Objective of proposed research

We propose to establish the water use requirements of 4 lines of dwarf PtFT1 transformed plums, and develop automated method for controlling water content in the root zone.

End Product

The project will advance both technical and scientific knowledge on the production of PtFT1 dwarf plums and provide approach for the management of soil moisture content in microgravity. This will be achieved by determining the baseline water demands of the candidate plum lines (NASA 5, NASA 10, NASA 11 and NASA 12), determining the optimal range of soil moisture contents, and establishing feedback irrigation system based on plant water demand. Off the shelf soil moisture probes will be used to monitor root moisture conditions and integrated into an irrigation control system. This technology has wide application to near and long-term space flight experiment with plants, as well as direct applicability to terrestrial horticulture industry.



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Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Center Independent Research & Development: KSC IRAD



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Anticipated Benefits

This proposal aligns with OCT Technology Area Roadmaps TA 06 and TA 07 for Human health, life support & habitation systems and Human exploration destination systems.

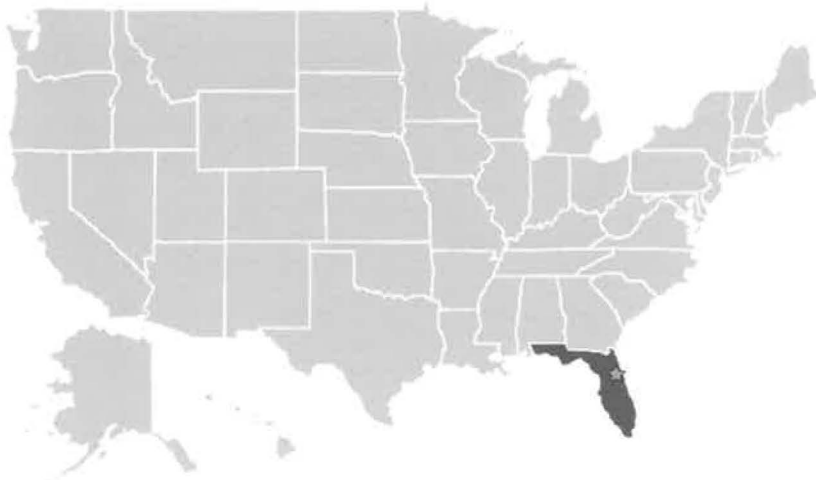
This project also aligns itself with both KSC's Technology Capability Areas (Life Sciences, Habitation Systems, and Human Research), with expertise in microbial food safety and food production.

NASA's Grand Challenge of "Space Colonization." Sustainable systems for long-duration space colonization that provide healthy, nutritious, acceptable food.

The National Office of Science and Technology Policy, in the categories of 1) Science and 2) Technology.

In addition, this technology addresses an improvement in the challenge area of "Long duration Health Effects" (level 2 TAB) alignment in the NASA Strategic Space Technology Investment Plan.

Primary U.S. Work Locations and Key Partners



Project Management

Project Manager:

Raymond Wheeler

Principal Investigator:

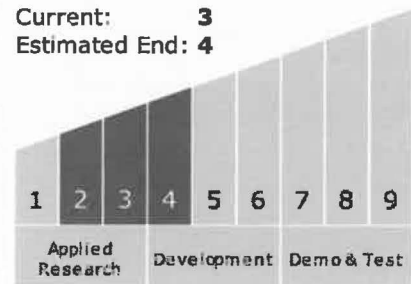
Raymond Wheeler

Technology Maturity (TRL)

Start: 2

Current: 3

Estimated End: 4



Technology Areas

Primary:

- Human Health, Life Support, and Habitation Systems (TA 6)

Other/Cross-cutting:

- Human Exploration Destination Systems (TA 7)

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Organizations Performing Work	Role	Type	Location
★ Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, FL

Primary U.S. Work Locations

Florida