Fiscal Year:	FY 2020	**Task Last Updated:**	FY 09/11/2019
PI Name:	Lewis, Norman G Ph.D.		
Project Title:	Dissecting Beneficial Plant-Microbe Interactions and Their Efficacy in the ISS Spaceflight Environment, a Model Study		
Division Name:	Space Biology		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	None		
Human Research Program Risks:	None		
Space Biology Element:	(1) Cell & Molecular Biology (2) Microbiology (3) Plant Biology		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	lewisn@wsu.edu	**Fax:**	FY 509-335-8206
PI Organization Type:	UNIVERSITY	**Phone:**	509-335-2682
Organization Name:	Washington State University		
PI Address 1:	Institute of Biological Chemistry		
PI Address 2:	299 Clark Hall		
PI Web Page:	http://ibc.wsu.edu/		
City:	Pullman	**State:**	WA
Zip Code:	99164-6340	**Congressional District:**	5
Comments:			
Project Type:	Flight	**Solicitation / Funding Source:**	2018 Space Biology (ROSBio) NNH18ZTT001N-FG. App B: Flight and Ground Space Biology Research
Start Date:	01/01/2020	**End Date:**	12/31/2022
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA KSC
Contact Monitor:	Mickens, Matthew	**Contact Phone:**	
Contact Email:	Matthew.A.Mickens@nasa.gov		
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Davin, Laurence Ph.D. (Washington State University, Pullman) Kahn, Michael Ph.D. (Washington State University, Pullman)		
Grant/Contract No.:	80NSSC19K1484		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Significance of objectives to NASA and this Solicitation: Deep space exploration or extraterrestrial colonization (e.g., Moon or Mars) will require the ability to sustainably produce plants for human/animal consumption, as well as providing aesthetic benefits of plant life to future crews and personnel in extra-terrestrial colonies. One key challenge in spaceflight/microgravity is in overcoming long-standing difficulties in efficaciously providing water and nutrients to germinating and maturing plants. Another important research challenge that has seen little attention is in productively exploiting beneficial plant-microbe interactions in spaceflight/microgravity, particularly for nitrogen (N) fixation. When both challenges are resolved for optimal, productive, and efficacious plant growth in space, this will provide the exciting opportunity to recycle organically bound carbon (C) and N that was sequestered in these plants. Through subsequent recycling of those organics (e.g., derived from human and animal consumption waste and from unused plant parts), this will help enable sustainable plant growth over multiple generations. Another benefit of studying beneficial plant microbe interactions is at the fundamental science level, i.e., by gaining much improved understanding of how the spaceflight/microgravity environment affects this important physiological process. Central objectives of proposed research: Complementary purposes of our 2 Specific Aims are to initially dissect, understand, and optimize plant growth/development in spaceflight/microgravity via exploiting beneficial plant-microbe interactions. Then to ultimately recycle organic C and N from them suitable for subsequent multiple plant generations. To do this, we will use model Medicago plant species (e.g., alfalfa), and its beneficial bacterial symbiont, which together can potentially displace the need for N-containing fertilizer in spaceflight/microgravity. Specific Aims: 1. Comprehensively compare and contrast efficacy of beneficial symbiotic plant-microbe interactions between Medicago and Sinorhizobium growing on International Space Station (ISS) and on Earth (NASA Kennedy Space Center/KSC), including understanding changes occurring at the molecular level; 2. Compare and contrast ease of biodegradation of ISS and Earth grown Medicago plant material, in order to assess whether there are any differences in the ability to recycle C, N, etc. for multiple generations of plant growth/development. Justification for this work is threefold: The first is to demonstrate that beneficial plant microbe interactions during N-fixation can be efficaciously achieved in spaceflight/microgravity. The second is to gain a fundamental understanding of spaceflight/microgravity environment effects on these beneficial plant microbe interactions, and their potential usage for deep space exploration and colonization. The third is to demonstrate that organic C and N can be facilely recycled to support multiple generations of plant growth in Space. Methods/techniques: During growth in Advanced Plant Habitat (APH), FluorPen and plant size measurements will be carried out to assess comparative N-fixation efficacy for each condition, both on ISS and Earth. Tissues (leaf, stem, and root) from ISS and Earth control will be collected after ca. 6-8 weeks growth, frozen (-160°C). They will be subjected to transcriptomic, proteomic, and metabolomic (including amino acid) analyses; the microbiomes present in aerial/underground tissues will be determined. The multi-omics approaches employed are as for our Arabidopsis study. Medicago plant material, from ISS and ground control, will also be subjected to biodegradation to establish whether there are any differences in N-mineralization (for recycling) in spaceflight/microgravity or ground control tissues.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2020.
Bibliography Type:	Description: (Last Updated: 01/22/2025)