Plant cell wall adaptation to spaceflight in two successive generations

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Plant Molecular and Cellular Biology PROGRAM

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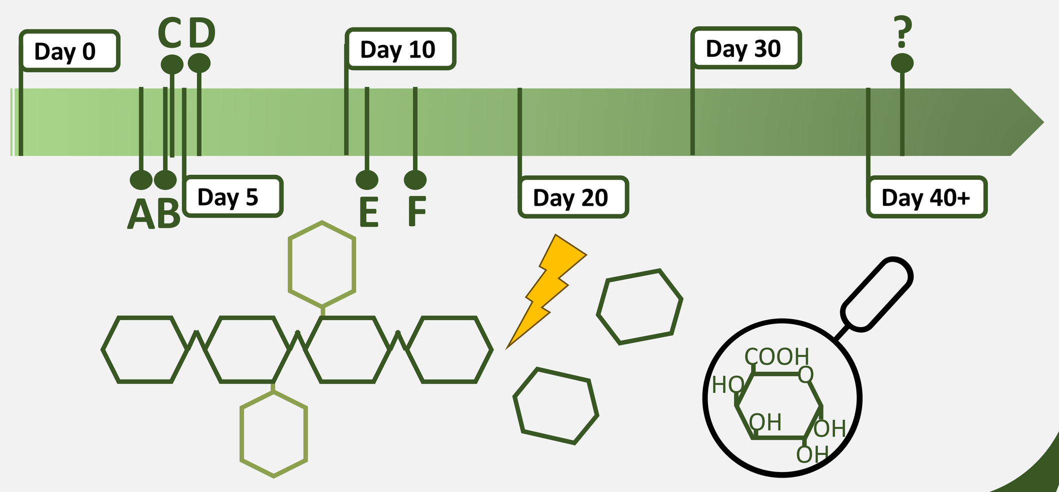
Plant Cell Walls in Spaceflight

Multiple studies have examined plant cell walls during or post-spaceflight in both monocots (*Oryza sativa*, Rice) and dicots (*Arabidopsis thaliana*, Arabidopsis) and discovered significant responses. These responses have included decreased abundance of both cellulosic and non-cellulosic components (A, B, C), differences in expression of cell wall-related enzymes and genes (D), and identification of certain polysaccharide linkages (E, F).

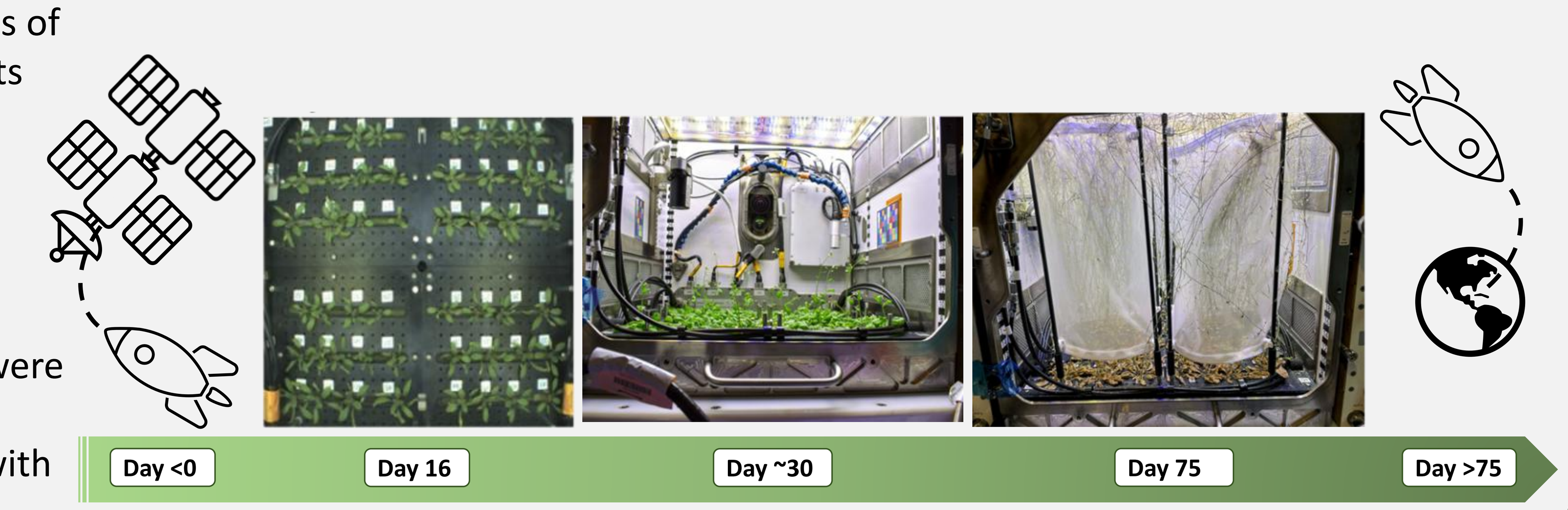
However, these studies have not examined the chronic (long-term) effects of spaceflight stress on plant cell walls, since many do not go beyond 14 days of microgravity exposure. These studies have also largely been limited to the types of possible analyses due to small sample quantities.

Spaceflight Cell Wall Experimental Durations:



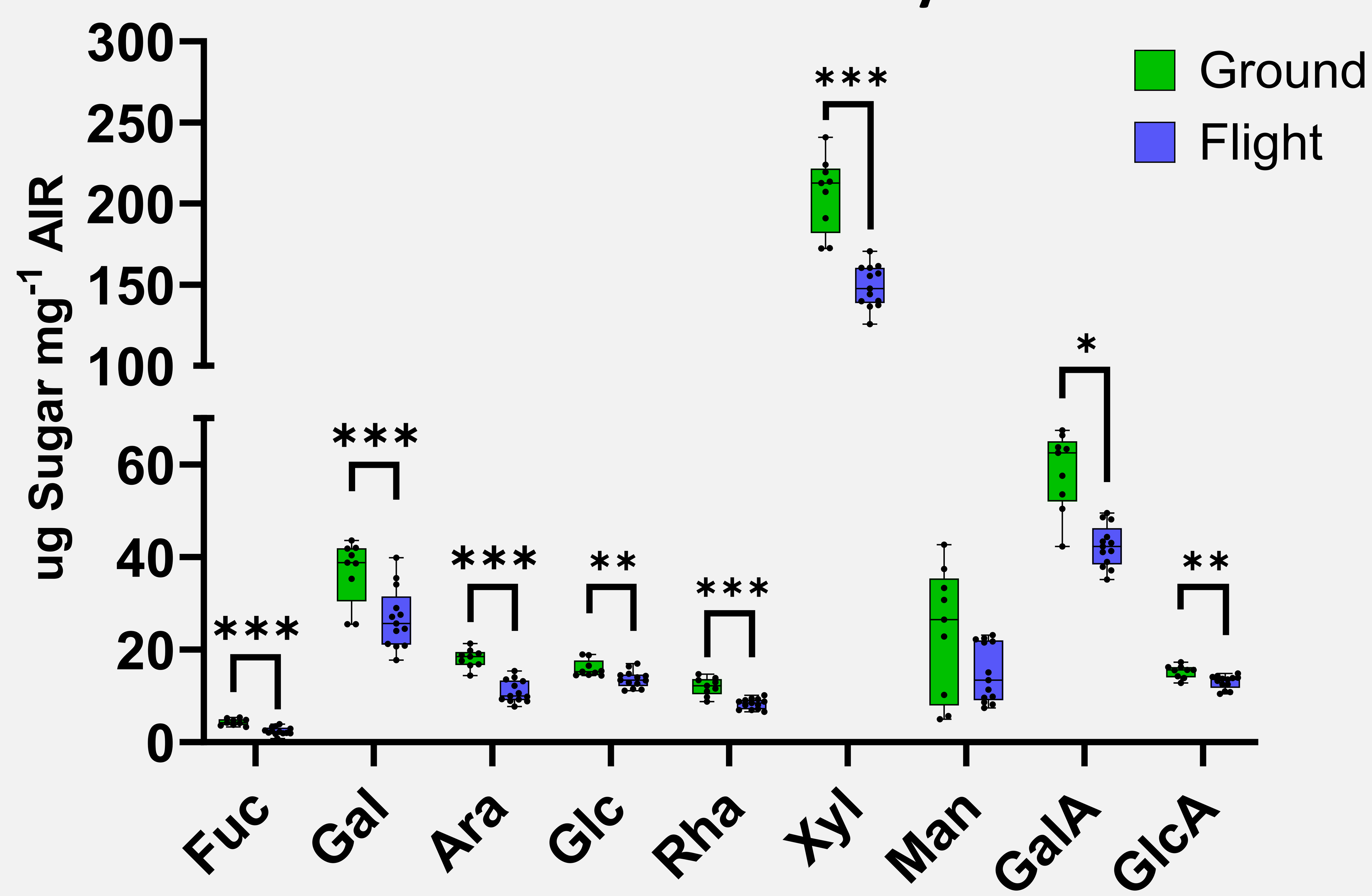
Experimental Design

- Stem sections from two generations of spaceflight and ground grown plants had their cell wall matrix polysaccharides hydrolyzed and quantified
- 4 cm stem sections from the basal portion of the inflorescence stem were analyzed using High Performance Anion Exchange Chromatography with Pulsed Amperometric Detection (HPAEC-PAD)



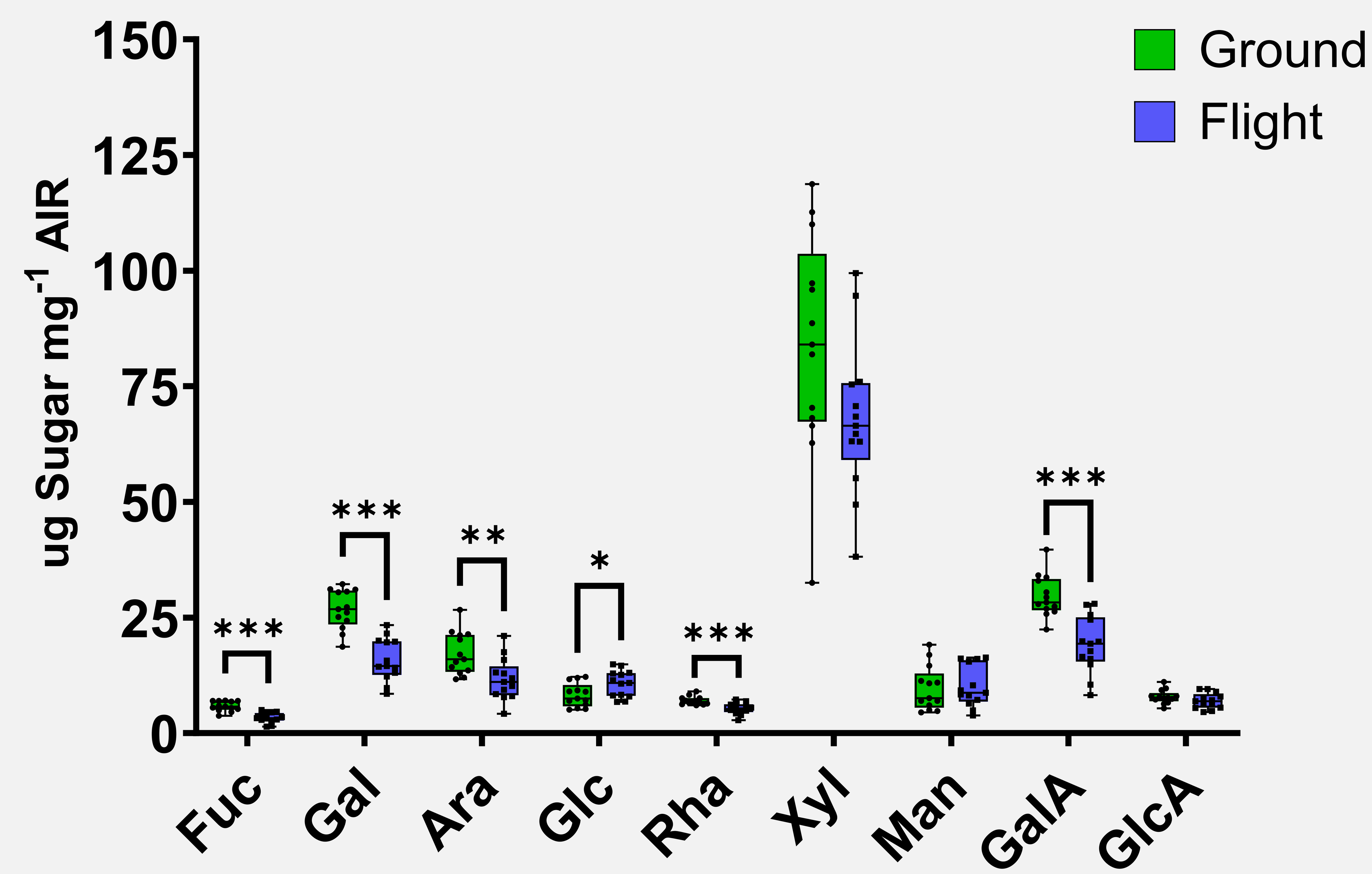
Learn more about the plant cell wall

Generation 1 Stem Matrix Polysaccharides



Sample pools were a total 13 and 9 for flight and ground respectively, asterisk denote p-values as follows *<0.05, **<0.01, and ***<0.001

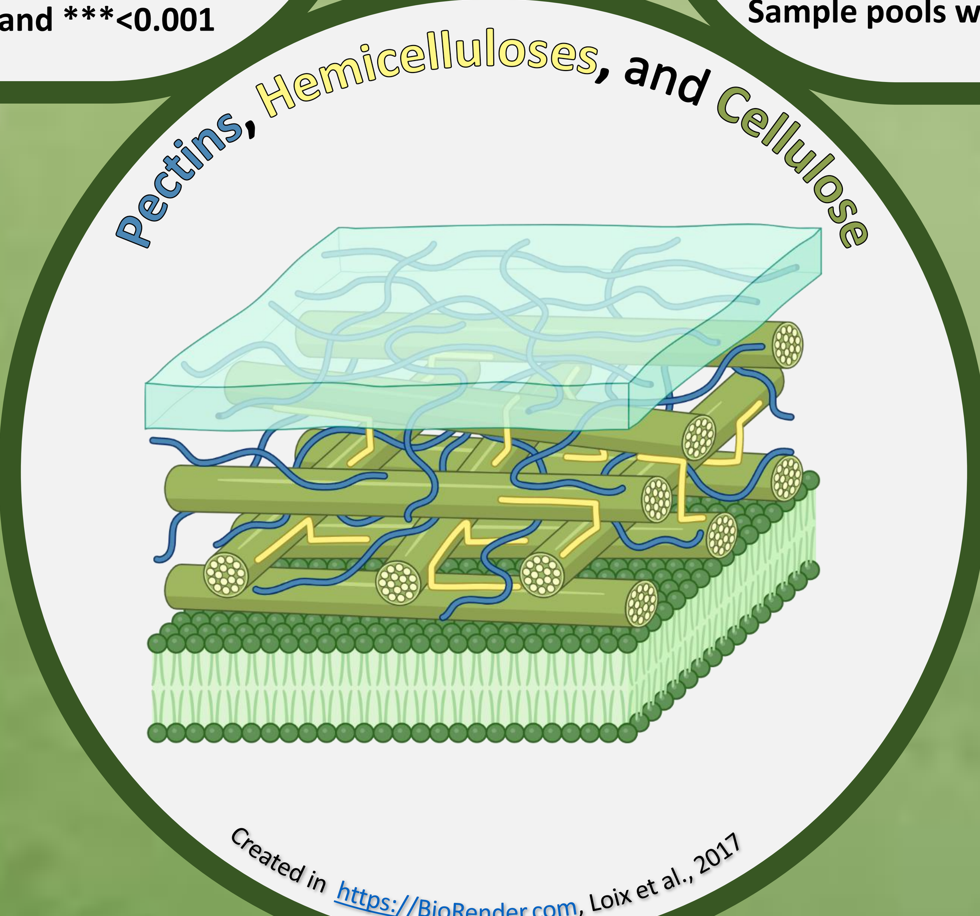
Generation 2 Stem Matrix Polysaccharides



Sample pools were a total of 13 and 13 for flight and ground respectively, asterisk denote p-values as follows *<0.05, **<0.01, and ***<0.001

Conclusions

The data presented not only corroborates previous reports of perturbations to the plant cell wall during spaceflight but also increases the resolution of this analysis beyond that of previous studies. In previous experiments, only 3-6 polysaccharide fractions could be quantified and here we have illustrated the abundance of 9 monosaccharides, some of which remain relatively unaffected by the spaceflight environment. **Based on these data we have hypothesized that the primary matrix polysaccharide affected by spaceflight is pectin**, due to reductions in the abundance of galactose (Gal), rhamnose (Rha),arabinose (Ara), and galacturonic acid (GalA), which are the primary sugars which make up pectin. **It is also possible that select types of hemicellulose could also be affected** based on changes in glucose (Glc) and glucuronic acid (GlcA). To confirm this, we will be conducting an ELIZA-based glycomics assay to determine what glycosidic linkages are present within the cell wall to determine which polysaccharides, rather than monosaccharides are more or less abundant.



Acknowledgments

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