A Flexible Architecture for Plant Functional Geonomics in Space Environments

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Plants will play an essential role in providing life support for any long-term space exploration or habitation. This proposal describes a revolutionary concept for a flexible architecture for measuring the response of plants to any unique space condition and then determining the function of genes that can be used to optimize plant performance under those conditions. The proposed architecture is based on combining the recent and forthcoming rapid advances in the field of plant genomics with the power of homologous recombination to determine gene function via gene alterations or knockouts. Discoveries made in this manner can be used to allow the engineering or selection of plants optimized to thrive in specific space environments.

Testing the feasibility of the proposed plant functional genomics architecture for space has only recently become possible with the availability of the first complete genome sequence for a plant (*Arabidopsis*), the development of micro array technology for measuring gene expression, and the demonstration of efficient homologous recombination in a model green land plant, a moss (*Physcomitrella*). The novel combination of these three technologies will allow us to validate the viability of the proposed concept and define the major feasibility issues during Phase I. Eventually, as more plant genomes are sequenced and homologous recombination techniques are expanded to other species, it should become possible to use this architecture to optimize the performance of any plant in any space environment. Future additions to the architecture will include the technical advances necessary for remote collection and evaluation of data. The proposed concept will advance NASA's mission of human exploration, use, and development of space, both in the near- to mid-term on the International Space Station and in the far-term and beyond for longer duration missions (i.e. to Mars) and eventual space habitation.