

Challenges of Life Support - Medical Support for Manned Space Exploration (9)  
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## THE STUDY ON SPACE-FLIGHT INDUCED DNA DAMAGE IN ARABIDOPSIS THALIANA USING THE RELATED HOMOLOGOUS RECOMBINATION REPORTER SYSTEM

### Abstract

Usually, phenotype changes of plants were used to analyze the responding genetic damages. However, this method is time-consuming, laborious and needs a long period. Here, we developed an Arabidopsis thaliana homologous recombination reporter system, in which HR frequency and HR-related AtRAD54 gene expression level were used as mutagenic end points. Based on the system, effect of DNA damage by space-flight during the Shenzhou-9 mission was investigated. In this study, an Arabidopsis thaliana-line transgenic for GUS recombination substrates (R3L66, AtRAD54promoter:: GFP + GUS) was used to study the mutagenicity of space-flight, and the results showed that 13 days space-flight exposure of seedlings induced a significant increase in HRF compared with its ground-base three-dimensional clinostat (generally called a random positioning machine or RPM, an effective simulator of microgravity) controls and ground 1g controls. We also observed three-dimensional clinostat induced a significant increase in HRF and HR-related AtRAD54 gene expression level compared with ground 1g controls. Treatment with the ROS scavenger DMSO dramatically reduced the effects of simulated microgravity on the induction of HR and expression of the AtRAD54 gene, suggesting that ROS play a critical role in mediating the simulated microgravity mutagenic effects in plants. In order to understand the combined effects of radiation and microgravity (the main factors in space environment) on DNA damage, we further investigated the effects of modeled microgravity on radiation-induced bystander effects (RIBE) *in vivo* in *A. thaliana* plants using the expression level of the HR-related AtRAD54 gene as mutagenic end points. The results showed that the modeled microgravity significantly inhibited the up-regulated expression of the AtRAD54 gene in bystander aerial plants after root irradiation, suggesting a repressive effect of microgravity on RIBE.