

Effect of Microgravity on *Sinorhizobium meliloti*: Initial results from the SyNRGE experiment.

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SyNRGE (Symbiotic Nodulation in a Reduced Gravity Environment) was a sortie mission on STS-135 in the Biological Research in Canisters (BRIC) hardware to study the effect of microgravity on a plant-microbe symbiosis resulting in biological nitrogen fixation. *Medicago truncatula*, a model species of the legume family, was inoculated with its bacterial symbiont, *Sinorhizobium meliloti*, to observe early events associated with infection and nodulation in Petri Dish Fixation Units (PDFUs). Two sets of experiments were conducted in orbit and in 24-hour delayed ground controls. Experiment one was designed to determine if *S. meliloti* infect *M. truncatula* and initiate physiological changes associated with nodule formation. Roots of five-day-old *M. truncatula* cultivar Jemalong A17 (*Enod11::gus*) were inoculated 24 hr before launch with either *S. meliloti* strain 1021 or strain ABS7 and integrated into BRIC-PDFU hardware placed in a 4°C Cold Bag for launch on *Atlantis*. Inoculated plants and uninoculated controls were maintained in the dark at ambient temperature in the middeck of STS-135 for 11 days before fixation in RNA<sup>later</sup>™ by crew activation of the PDFU. Experiment two was designed to determine if microgravity altered the process of bacterial infection and host plant nodule formation. Seeds of two *M. truncatula* cultivar Jemalong A17 lines, the *Enod11::gus* used in experiment 1, and SUNN, a super-nodulating mutant of A17, were germinated on orbit for 11 days in the middeck cabin and returned to Earth alive inside of BRIC-PDFU's at 4°C. *S. meliloti* strains 1021 and ABS7 were cultivated separately in broth culture on orbit and also returned to Earth alive. After landing, flight- and ground-grown plants and bacteria were transferred from BRIC-PDFU's into Nunc™ 4-well plates for reciprocity crosses. Rates of plant growth and nodule development on Buffered Nodulation Medium (lacking nitrogen) were measured for 14 days. Bacteria cultivated in microgravity in the presence or absence of *M. truncatula* were characterized by phenotype microarray (PM) analysis of over 1,000 phenotypes including the utilization of carbon, nitrogen, phosphate, and sulfur sources; growth stimulation/inhibition by nutrients, osmolytes, and metabolic inhibitors; and antibiotic susceptibility. (Research supported by NASA ESMD/Advance Capabilities Division grant NNX10AR09A).