Regional

SIUE plant growth research returns to earth

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College Talk

A research project conducted by professors at Southern Illinois University Edwardsville and Ohio University recently returned to earth aboard the SpaceX Dragon Capsule after spending a month in earth orbit on the International Space Station.

Darron Luesse, an associate professor in the department of biological sciences at SIUE, together with Sarah Wyatt, professor in the department of environmental and plant biology at Ohio University designed the study to find out how zero gravity affects plant growth and development.

This research, Luesse said, could provide new and exciting insights into how plants respond to a zero gravity environment. Like any organism, plants interact with their environment by responding to predictable sensory input. In a plant's world, light indicates "up" and gravity indicates "down." So what happens when these environmental cues are no longer available? Funded by a nearly $400,000 NASA grant, and access to the International Space Station research facilities, Luesse and Wyatt are about to find out.

"It's important to them because they are interested in figuring out how we can live in space, basically," said Luesse. "NASA spends a lot of time and money figuring out how organisms exist in space, what's different for them and how they adapt to those challenges."

From the time a seed germinates, Luesse explained, until the end of a plant's life, it uses gravity to make decisions about which direction to grow and how to position its branches and leaves.

"When plants are grown on the space station they have basically no information, so they end of being kind of confused," he said.

But zero gravity is not the only challenge space presents. Gasses do not move as well as they do on earth. Plant cells use oxygen the same way animal cells do, to produce energy. In space, when the area around the roots becomes depleted of oxygen, the cells are in a very stressful situation.

Luesse's work focuses primarily on pre-launch activities. "My main job was to figure out how to get enough protein out of a tiny petri dish of plant seedlings to do the complicated molecular biology that we want to do with it," he said. This type of research, he added, has only recently been possible thanks to new technologies that allow data to be collected from very small seedling samples.

To test the collected data, Luesse said that he plans to use a technique called proteomics. This involves grinding up the plants and analyzing which proteins are present and then counting how many of each is there. By comparing the protein content of spaceflight plants to an identical set grown on earth, he hopes to gain insight into plant growth in microgravity.

"What we're trying to do is figure out what the plants think is happening to them and how they are responding to the stress," he explained. "We can then help them along by changing growth conditions or using genetic engineering."

The study began nearly a year ago. In the first six months of the study, Luesse and Wyatt and their students spent several weeks at the Kennedy Space Center in Cape Canaveral, Fla., working directly with NASA engineers to plan the trip for the approximately 18,000 plant seeds that went to the space station. The lucky plant, Arabidopsis thaliana, doesn't get much love in gardens or on dinner tables, but is a popular organism for research because of its small size and short life cycle.

The experiment finally launched into space aboard the SpaceX Dragon on Jan. 10. After docking with the space station, the seeds were transferred to room temperature and allowed to grow for three days while orbiting earth. After the third day, astronauts placed the petri dishes into a freezer where they remained until they returned to earth on Feb 10.

At the same time that the plant seeds were germinating in outer space, an identical package of seeds was germinated at the Kennedy Space Center. The seeds were treated identically in every way, except for the removal of gravity. This set of plants will offer a comparison to the spaceflight group, allowing researchers to differentiate the proteins plants use on a daily basis from the ones that they specially employed in space.

Now that the plants have returned to earth, the real fun begins, Luesse said. He and Wyatt will complete the proteomic analysis and then begin to analyze the most interesting plant candidates. The results of their experiment will inform plant researchers about how plants sense and respond to gravity, and could provide new insights into how plants can be grown during space flight in the future.

"I'm really excited to get back the results of the analysis," Luesse said. "There are a lot of cool things that could come out of this. The most obvious is that it may help us do a better job of growing plants in space, which will be a critical component of any long-term manned space flight. However, we also hope to see some earth-based benefits. By understanding how plants use gravity to determine their body plan, it's possible we could use this information to alter agricultural practices. If we can get plants to grow up instead of out, it may be possible to increase the total output per acre."

Howard Ash/SIUE

Dr. Darron Luesse in his lab.