University of Manitoba

Research News

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Plant scientists make breakthrough discovery

By Frank Nolan, Research Promotion Officer

A team of University of Manitoba plant scientists is the first in the world to discover a receptor for a plant hormone called abscisic acid (ABA). The discovery, published in the January 19, 2006 edition of the scientific journal *Nature*, represents a major leap forward in our understanding of plant growth and development.

The team, led by Robert Hill, includes postdoctoral fellows Fawzi Razem and Ashraf El-Kereamy. They have found that a protein called FCA is a receptor for abscisic acid (ABA), a hormone that plays an important role in the timing of seed germination and a plant's transition to flowering.

"ABA is essentially a survival hormone that is involved in a plant's response to many environmental stresses," Hill said. "The hormone is particularly important for plant survival in our Canadian climate where the response to cold, drought, salt and the timing of germination and flowering are all regulated by this hormone."

Knowing what the hormone does is only half of the puzzle, since ABA can only have an effect when it has a specific receptor site to bind to.

"There are two ways you can have an effect with ABA," Hill said. "You can have high levels of the hormone receptor, so that small amounts of ABA have an immediate effect, or you can have a higher amount of ABA with a lower number of receptors. If there are no receptors for the hormone, you don't get any effect."

While scientists have known about ABA for many years, nobody had previously been able to isolate a receptor. The discovery of FCA as a receptor is particularly important in understanding how and when a plant becomes reproductive.

A plant's reproductive organs develop when the transition to flowering occurs, and FCA is involved in the flowering response. When FCA and another protein are both present, this transition to flowering can take place.

"This process is already known," Hill said. "But what wasn't previously known is that the hormone, ABA, interferes with this process. We have shown that FCA has a receptor site for ABA, and when ABA is present, it prevents the two proteins from coming together, which means that the plant will not flower."

The paper in Nature describes the steps involved in the discovery by Hill and his team that FCA is an ABA receptor. It provides proof that FCA binds ABA and that this binding has an effect on the action of the protein at the molecular, cellular and whole plant level.

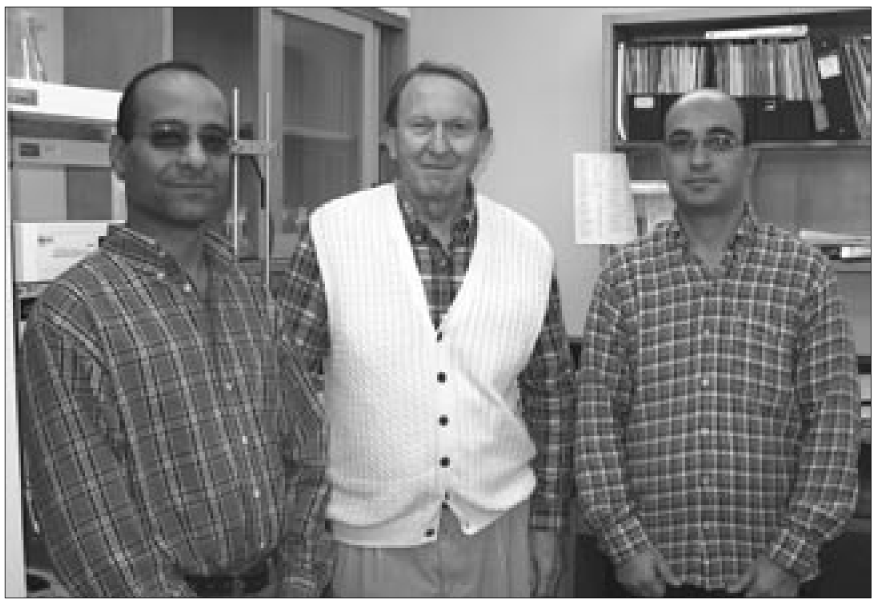

Photo by Frank Nolan

Robert Hill, plant science (centre), with post-doctoral fellows Ashraf El Kereamy (left) and Fawzi Razem.

"The downstream actions of ABA have been known for many years" Hill said. "This is the first description of the receptor part of the process. We were standing with a key at a door, knowing what was happening on the other side, but unable to find the lock. We have now found the lock"

For more information, please visit the *Nature* Web site to hear a podcast interview with Robert Hill: **www.nature.com/podcast**

Finding better ways to repair high-tech alloys

By Frank Nolan, Research Promotion Officer

The nickel-based "superalloys" used to construct modern aircraft engines are much stronger than traditional alloys, and they operate at temperatures that would have been inconceivable 30 or 40 years ago.

Unfortunately, these advanced materials are also very expensive. A typical high bypass turbofan engine can cost upwards of $4 million, and replacing the blades and nozzle guide vanes in an existing engine costs more than $1 million. Understandably, the aerospace industry is very interested in finding effective ways to repair, rather than replace, components made of these high-tech alloys.

"The newer alloys are much more difficult to repair than the traditional materials," said Norman Richards, mechanical and manufacturing engineering. "Current repair techniques like gas tungsten arc welding or vacuum brazing don't bring the repaired parts back to the original drawing requirements. We're looking at new technology that will make repairs that are more cost-effective and have a much longer life."

Richards leads a team of researchers investigating new ways to repair both nickel and titanium-based superalloys. The team includes department colleagues Jack Cahoon and Mahesh Chaturvedi, who holds a Canada Research Chair in aerospace materials.

Over the next three years, the project will receive $519,150 in funding from the Natural Sciences and Engineering Research Council of Canada (NSERC). Richards' team is working closely with industry partners, including Standard Aero and Bristol Aerospace, to examine the mechanical properties of repairs made using newer techniques, like laser processing and electron beam welding.

"With laser processing, for example, people have already looked at the micro-structure of these materials before and after repairing," Richards said. "We're going to do that as well, but we're also looking at the mechanical properties of the repairs themselves. In a gas turbine, these materials operate under extreme conditions of high stress, alternating stress, low cycle fatigue, high cycle fatigue, thermal fatigue, you name it. We want to know how well the repaired material performs under these conditions compared with the baseline material."

Richards will use a piece of equipment called a Gleeble Thermal Simulator that can simulate the extreme temperature conditions gas turbine parts would be subjected to in normal operation. This thermal cycling, Richards said, is very important in determining how well repairs made with the new technology will perform.

"It's a very tough test of the material," he said. "It's heating up and cooling down over and over, and different parts of the material are cooling at different rates. There's a lot of stress on both the material and the repair itself."

By studying the mechanical properties of repairs made by laser processing, electron beam welding, and other emerging technologies, Richards hopes to be able to tell his aerospace industry partners which repair method works best for specific applications. The other major goal of the project is to train students in these advanced technologies.

Photo by Frank Nolan

Norman Richards, mechanical and manufacturing engineering, and the Gleeble Thermal Simulator, which measures the performance of repaired superalloys under extreme temperature conditions.

"We'll be including graduate students and postdoctoral fellows, as well as third and fourth-year engineering students," he said. "We'll be training a lot of people."

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