Researchers find long awaited key to creating drought resistant crops

December 3 2009

Van Andel Research Institute (VARI) researchers have determined precisely how the plant hormone abscisic acid (ABA) works at the molecular level to help plants respond to environmental stresses such as drought and cold. Their findings, published in the journal *Nature*, could help engineer crops that thrive in harsh environments around the world and combat global food shortages. The findings could also have implications for stress disorders in humans.

VARI scientists have determined the structure of the receptors that plants use to sense ABA, a hormone that keeps seeds dormant and keeps buds from sprouting until the climate is right. Locating these receptors and understanding how they work is a key finding — one that has eluded researchers for nearly a half-century. This discovery is crucial to understanding how plants respond when they are under stress from extreme temperatures or lack of water.

"The plant community has been waiting for this discovery for many years," said VARI Research Scientist Karsten Melcher, Ph.D., one of the lead authors of the study. "It could have major effects on nutrition and crop yields, especially as fresh water sources become scarcer."

"The work by Dr. Xu and his colleagues, published in one of the most prestigious science journals in the world, will undoubtedly become known as an historic defining moment in our understanding of the mode of action of the important plant hormone abscisic acid," said Grand Valley State University Plant Development Biologist Sheila A.

Blackman, Ph.D. "They show how the signaling molecule and its receptor initiate a cascade of events that ultimately affects the expression of genes that are critical for a plant's survival under harsh conditions. This work has enormous implications for global food supply."

Melcher works in the VARI Laboratory of Structural Biology led by Distinguished Scientific Investigator H. Eric Xu, Ph.D. The lab began studying abscisic acid signaling in March this year because a proposed ABA receptor was reported to be a member of G-protein coupled receptors, a group of proteins that the lab studies. More than 50% of all drugs on the market target these proteins, but it has been extremely difficult to determine their atomic structure.

Xu's laboratory uses a technique known as X-ray crystallography to determine exactly how and why the drug compounds work in molecular detail, which can then help drug developers engineer more potent drugs that have fewer unwanted side effects.

Although it later resulted that the abscisic acid receptors were found to be members of another protein family, Xu's lab continued their studies on the newly identified ABA receptors. Their findings could help to develop crops that grow in drought, cold, salt water environments, and other harsh conditions, perhaps aiding in stemming or reversing food shortages around the world. Additionally, proteins central to ABA sensing are related to human proteins involved in cellular stress responses and may have implications for stress disorders in humans.

"Proteins with similarities to plant ABA receptors are also found in humans," said Xu. "Further studies in this area could reveal important implications for people with stress disorders."

The lab worked with specialists in plant biology at other institutions to

validate the data, including the National Center for Plant Gene Research in Beijing, China, the Department of Botany and Plant Sciences at the University of California at Riverside, the Center for Plant Stress Genomics and Technology at the King Abdullah University of Science and Technology in Thuwal, Saudi Arabia, and the Department of Biochemistry at the Medical College of Wisconsin.

"A finding of this importance helps demonstrate how discoveries at the molecular level in plants can have profound implications for the diseases of humans." said VARI President and Research Director Dr. Jeffrey Trent. "Remarkably Dr. Xu's findings (made in only a few short months) will open a decade of research on both plants and man. From a key role in the ripening of fruit through increased understanding of how stress affects a myriad of diseases in man - this finding starts a new chapter in plant and animal biology."

Source: Van Andel Research Institute