Plants that Earn their Keep

Written by Kirk Johnson on 1/26/2011 for <u>The New York Times</u>

DENVER – Could airport security gardens be the wave of the future? ("Please have photo ID and boarding pass ready and walk past the rhododenrons.") How about a defensive line of bomb-sniffing tulips in Central Park in New York, or at the local shopping mall's indoor waterfall, or lining the streets of Baghdad?

Researchers at Colorado State University said Wednesday that they had created the platform for just such a plant-kingdom early warning system: plants that subtly change color when exposed to minute amounts of TNT in the air. They are redesigned to drain off chlorophyll — the stuff that makes them green — from leaves, blanching to white when bomb materials are detected. "It had to be simple, something your mom could recognize," said June Medford, a professor of biology at Colorado State, referring to the idea of linking a plant's chemical response to its color, visible to the naked eye.

The research, published in the peer-reviewed online science journal PLoS One, and financed mostly by the Departments of Defense and Homeland Security, said that plants are uniquely suited by evolution to chemical analysis of their environment, in detecting pests, for example. Plants in the lab, when modified to sense TNT, the most commonly used explosive, reacted to levels one one-hundredth of anything a bomb-sniffing dog could muster, the paper said.
The trick, still in refinement, is how to make sure the plant's signal is clear enough and fast enough to be of use.

"Right now, response time is in the order of hours," said Linda Chrisey, a program manager at the Office of Naval Research, which hopes to use the technology to help protect troops from improvised explosive devices. Practical application, she said, requires a signal within minutes, and a natural reset system back to healthy green in fairly short order.

Professor Medford said she thought both goals were attainable, perhaps within three years — the goal that military backers are pushing for, she said — but more likely in five to seven years. One scientist who read the scientific paper on Wednesday and was not involved in the project said he was concerned that the difference between all-clear green and TNT-detected white might be too subtle or subject to false inputs.

"What you want is something that is extreme on-and-off and reliable, and I don't think they're there yet," said Sean R. Cutler, an associate professor of plant cell biology at the University of California, Riverside. "It's a very interesting work-in-progress."

Colorado State University Biologist Produces Plant Sentinels
that Detect Environmental Contaminants, Explosives
Written by The Dept of Public Relations on 1/26/2011 for Colorado State University

FORT COLLINS – A Colorado State University biologist has shown that plants can serve as highly specific detectors for environmental pollutants and explosives. Professor June Medford and her team in the Department of Biology enabled a computer-designed detection trait to work in a plant by rewiring its natural signaling process so the plant turns from green to white when chemicals are detected in air or soil. This work – an important step in a long process – could eventually be used for a wide range of applications such as security in airports or shopping malls, or monitoring for pollutants such as radon in a home.

"The idea to make detector plants comes directly from nature," Medford said. "Plants can't run or hide from threats, so they've developed sophisticated systems to detect and respond to their environment. We've 'taught' plants how to detect things we're interested in and respond in a way anyone can see, to tell us there is something nasty around." The research appears today in the peer-reviewed journal PLoS ONE.

"Plant sentinels engineered to detect explosives may ultimately help us protect our troops from improvised explosive devices (IED's)," said Linda Chrisey, program officer for the Naval Biosciences and Biocentric Technology Program at the Office of Naval Research.

Medford and her team also recently received a three-year, $7.9 million grant from the Defense Threat Reduction Agency in the U.S. Department of Defense to take the discovery described in PLoS ONE from her CSU research laboratory to the "real-world."

Based on research so far, detection abilities of these plants are similar to or better than those of dogs, Medford said. The detection traits could be used in any plant and could detect multiple pollutants at once – changes that can also be detected by satellite.

"Dr. Medford's research illustrates that basic changes in scientific understanding can be applied to important problems such as environmental protection and homeland security," said Bill Farland, vice president for Research at Colorado State and formerly top scientist at the Environmental Protection Agency.

Computational design of Medford's detection trait was initially done in collaboration with Professor Homme Hellinga at Duke University and more recently with Professor David Baker at the University of Washington. The Baker and Hellinga laboratories used a computer program to redesign naturally occurring proteins called receptors. These re-designed receptors specifically recognize a pollutant or explosive. Medford's lab then modifies these computer-redesigned receptors to function in plants, and targets them to the plant cell wall where they can recognize pollutants or explosives in the air or soil near the plant. The plant detects the substance and activates an internal signal that causes the plant to lose its green color, turning the plants white.

Moving forward, Medford will use her team of some 30 undergraduate and graduate students and post-doctoral fellows to focus on such factors as speeding up detection time. The initial or first-generation plants respond to an explosive in hours, but improvements are underway to reduce the response time to a few minutes.