NEWS RELEASE

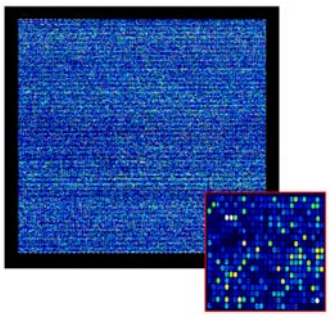
Media Contacts: Dr. Heike Winter Sederoff, 919/513-0076 or
heike_winter@ncsu.edu
Mick Kulikowski, News Services, 919/515-3470 or
mick_kulikowski@ncsu.edu

Oct. 5, 2004

Study: Plants Respond Quickly to Changes in Gravity, Environment

FOR IMMEDIATE RELEASE

When a plant is blown by the wind, flipped over, or has its roots disturbed by an animal or a rock, specific genes responsible for keeping the plant stable and its roots and shoots growing respond very quickly, many within one minute of the stimulus.



A sample microarray. Lighter colored genes are being expressed and darker colored genes are not being expressed in this snapshot in time.

Those are the findings of a research team from North Carolina State University studying the effects of both mechanical stimulation – forces like wind, temperature, and water – and gravitational stimulation to the root tips of the plant model *Arabidopsis*, or mustard weed.

The team – consisting of botany graduate student Jeffery M. Kimbrough; Dr. Heike Winter Sederoff, research assistant professor of botany; Dr. Christopher Brown, director of the North Carolina Space Initiative; Dr. Wendy Boss, professor of botany; and post-doctoral researcher Dr. Raul Salinas-Mondragon – also discovered the specific genes that responded to the different types of stimulation.

The research, which was funded by NASA, was published in the September issue of *Plant Physiology*.

The research team used a technique called whole-genome microarray analysis to take multiple snapshots of all the plant's genes during different time points – 2 minutes, 5 minutes, 15 minutes, 30 minutes and 60 minutes – after both gravitational and mechanical stimulation.

Gravitational stimulation was applied by rotating *Arabidopsis* seedlings 135 degrees from a vertical orientation, or essentially flipping the seedling over so the shoot would face down toward the ground on an angle and the root would face up to the sky on an angle.

The research showed that 65 of the plant's roughly 24,000 genes responded specifically to gravitational stimulation.

To reproduce mechanical stimulation, the researchers moved the *Arabidopsis* seedlings in a back and forth motion for five seconds, similar to what a strong gust of wind might do.

The results showed that 26 genes responded specifically to mechanical stimulation.

The team also discovered that about 7 percent of the plant's genes responded to both mechanical and gravitational stimulation. Sederoff says these were mostly general plant growth genes that respond to many different stimuli.

"The rapidity of the response of some of the plant genes was a surprise to us," Sederoff says. "This research shows plants can quickly distinguish between mechanical and gravitational stimulation."

***Arabidopsis* seedlings like this one are used to study the effects of mechanical and gravitational stimulation on plants.**

That's important, she says, because it could lead to more clues about how crops survive in different climates on Earth. Also, agencies like NASA want to learn more about how plants would grow on planets with different gravitational forces than Earth's.

The researchers plan to continue their work in this area, examining the effects of other types of stimulation and different varieties of plants.

- kulikowski -

Note to editors: An abstract of the paper follows.

"The Fast and Transient Transcriptional Network of Gravity and Mechanical Stimulation in the *Arabidopsis* Root Apex"

Authors: Jeffery M. Kimbrough, Raul Salinas-Mondragon, Wendy F. Boss, Christopher S. Brown and Heike Winter Sederoff, North Carolina State University
Published: September 2004 in *Plant Physiology*

Abstract: Plant root growth is affected by both gravity and mechanical stimulation (Massa GD, Gilroy S [2003] Plant J 33: 435–445). A coordinated response to both stimuli requires specific and common elements. To delineate the transcriptional response mechanisms, we carried out whole-genome microarray analysis of *Arabidopsis* root apices after gravity stimulation (reorientation) and mechanical stimulation and monitored transcript levels of 22,744 genes in a time course during the first hour after either stimulus. Rapid, transient changes in the relative abundance of specific transcripts occurred in response to gravity or mechanical stimulation, and these transcript level changes reveal clusters of coordinated events. Transcriptional regulation occurs in the root apices within less than 2 minutes after either stimulus. We identified genes responding specifically to each stimulus as well as transcripts regulated in both signal transduction pathways. Several unknown genes were specifically induced only during gravitropic stimulation (gravity induced genes). We also analyzed the network of transcriptional regulation during the early stages of gravitropism and mechanical stimulation.