UNL research shows plans change responses to survive

Plants subjected to a previous period of drought learn to deal with the stress thanks to their memories of the previous experience, University of Nebraska-Lincoln research has found.

The findings could lead to development of crops better able to withstand drought.

The research also confirms, for the first time, the scientific basis for what home gardeners and nursery professionals have learned, often through hard experience: Transplants do better when water is withheld for a few days to drought harden them before the move.

“This phenomenon of drought hardening is in the common literature but not really in the academic literature,” said Michael Fromm, a UNL plant scientist who was part of the research team. “The mechanisms involved in this process seem to be what we found.”

The work is the subject of an article this week in the online journal Nature Communications.

Working with Arabidopsis, a member of the mustard family considered an excellent model for plant research, the team of Fromm, plant molecular biologist Zoya Avramova and post-doctoral fellow Yong Ding compared the reaction of plants that had been previously stressed by withholding water to those not previously stressed. The pre-stressed plants bounced back more quickly the next time they were dehydrated. Specifically, the nontrained plants wilted faster than trained plants and their leaves lost water at a faster rate than trained plants.

“The plants ‘remember’ dehydration stress. It will condition them to survive future drought stress and transplanting,” Fromm said.

The team found that the trained plants responded to subsequent dehydration by increasing

transcription of a certain subset of genes. During recovery periods when water is available, transcription of these genes returns to normal levels, but following subsequent drought periods the plants remember their transcriptional response to stress and induce these genes to higher levels in this subsequent drought stress.

“All of this is driven by events at the molecular level,” Avramova said. “We demonstrate that this transcriptional memory is associated with chromatin changes that seem to be involved in maintaining this memory.”

Arabidopsis forgets this previous stress after five days of watering, though other plants may differ in that memory time.

This is the first instance of transcriptional memory found in any life form above yeasts.

This discovery may lead to breeding or engineering of crops that would better withstand drought, although practical applications of these findings in agriculture are years away, Fromm said.

“We’re a long way off. We’re just starting to get a basic understanding,” Fromm said. “It’s possible plants overreact to a first drought stress. They panic, they slow down more than they need to.”

Perhaps scientists can modify those instincts in plants to help maintain or improve productivity during times of drought, he added.

But home gardeners can make immediate use of these findings.

“If I was transplanting something, I would deprive it of water for a couple of days, then water overnight, then transplant,” Fromm said.

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