Regulating those raging (plant) hormones

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The Biblical book of Amos describes the 8th-century BC prophet as a "gatherer" of sycomore figs. Some now think a more correct translation would be "piercer," because that's how ancient farmers got that type of fig to ripen. Centuries later, the Greek philosopher and botanist Theophrastus (371-286 BC) described this method: "It cannot ripen unless it is scraped, but they scrape it with iron claws; the fruit thus scraped ripens in four days."

Biologists now know that the substance at play in those early horticultural practices was ethylene, a gaseous hormone that dictates changes throughout the life cycle of the plant. Ethylene tells plants when to germinate, bear fruit, drop their leaves and petals, and wither and die. Plants synthesize and release ethylene in response to changes in light and air temperature, and during the course of normal growth and development—as well as in response to pathogens or wounds, as in the case of the ancient farmers.

Recent research led by a Dartmouth biologist helps explain how plants regulate those all-important responses to ethylene, a body of knowledge that could help the food and cut-flower industries better control ripening and decay, said the researcher, Dartmouth Associate Professor of Biological Sciences G. Eric Schaller.

In a paper published this month in *The Journal of Biological Chemistry*, Schaller and colleagues from Dartmouth and the University of New Hampshire studied the plant Arabidopsis, a small flowering plant related to the cabbage and mustard plants. While Arabidopsis itself is of no commercial value, it is widely used for research because it has a short life cycle, is a prolific seed-producer, and has a relatively small genome, covering 125 million base pairs, about one-twentieth the size of the genome of corn, Schaller said.

The team focused on the ethylene receptor ETR2, one of a family of proteins that bind to that hormone. The group found that once ETR2 had bound to an ethylene molecule and sent a chemical message saying ethylene was present, the protein degraded and no longer functioned. This suggests that the plant cell somehow destroys the ETR2 receptors as a means of regulating the receptor's signal, rather than waiting for the hormone molecule to diffuse away from the receptor.

The paper, titled "Ligand-Induced Degradation of the Ethylene Receptor ETR2 through a Proteasome-Dependent Pathway in Arabidopsis," was co-authored by Dartmouth researchers Yi-Feng Chen and Samina Shakeel, as well as former Dartmouth researcher Naomi Etheridge, and former University of New Hampshire researchers Julie Bowers and Xue-Chu Zhao.

Plants also respond to ethylene from outside sources, such as the form of air pollution that hastened the hormone's discovery a century ago, Schaller said. Leaks from pipelines used to transport gas used for illumination began to be associated with premature aging in nearby trees and greenhouse plants. In 1901, Dimitry Neljubov, a young researcher at the Botanical Institute of St Petersburg, published results identifying ethylene as the active component in the gas. Within a few decades, external ethylene was being used to ripen fruit, and researchers had demonstrated that plants themselves produced the hormone.

Source: Dartmouth College