Adoption of advanced techniques could propel crop improvement

June 28 2012, by Brian Wallheimer

(Phys.org) -- Scientists could take greater strides toward crop improvement if there were wider adoption of advanced techniques used to understand the mechanisms that allow plants to adapt to their environments, current and former Purdue University researchers say.

In a perspective for the journal *Science*, Brian Dilkes, a Purdue assistant professor of genetics, and Ivan Baxter, a research computational biologist for the U.S. Department of Agriculture's Agricultural Research Service, argue that today's technology could allow scientists to match physiological and genetic characteristics of plants with the soil characteristics that promote or inhibit their growth. Making those connections could reduce the time necessary to improve plants that are coping with changing environmental and climatic conditions.

"Evolution has solved the problems that we face in terms of adapting plants to grow in a multitude of environments," Dilkes said. "If we understand these processes, we'll be able to apply that knowledge to maintaining diversity in natural systems and improving and maintaining crop yield."

The majority of a plant's makeup, besides carbon dioxide, comes from elements and minerals absorbed from the soil as the plant grows. The physiological and genetic mechanisms that allow plants to obtain iron from the soil, for instance, can also cause the plant to accumulate other elements. Understanding how those changes interact is an important piece of improving plants, Baxter said.

"This is just a hint of the complexity that's out there," said Baxter, a former post-doctoral researcher at Purdue who works for the USDA at the Donald Danforth Plant Science Center in St. Louis. "If we're going to make the necessary improvements in agricultural productivity, we will have to move forward with these techniques."

Much of the work done to understand how plants have adapted to their environments focuses on one gene and one element it controls at a time. Pinpointing one or more genes responsible for a particular trait can take years, even decades.

Dilkes and Baxter believe a wider adoption of molecular phenotyping techniques, such as ionomics and genome-wide association mapping, could allow scientists to work with multiple elements and genes at once.

"By focusing on one gene or one element at a time, you miss out on the other physiological mechanisms occurring in the plant," Dilkes said. "The potential to broaden our understanding of these complex interactions and have a dramatic effect on agriculture is there."

Genome-wide association mapping allows scientists to find genetic associations among multiple phenotypes, or physical traits. The process quickly shows which genes may be responsible for the physical characteristics.

Ionomics studies the elemental composition of plants and how those compositions change in response to environmental or genetic changes.

"Experiments with thousands of samples are now possible," Baxter said. "We've just started to put these things together."

More information: Elemental Profiles Reflect Plant Adaptations to the Environment, Ivan Baxter, Brian P. Dilkes, *Science*, 2012.

ABSTRACT
Most mineral elements found in plant tissues come exclusively from the soil, necessitating that plants adapt to highly variable soil compositions to survive and thrive. Profiling element concentrations in genetically diverse plant populations is providing insights into the plant-environment interactions that control elemental accumulation as well as identifying the underlying genes. The resulting molecular understanding of plant adaptation to the environment both demonstrates how soils can shape genetic diversity and provides solutions to important agricultural challenges.

Provided by Purdue University

Citation: Adoption of advanced techniques could propel crop improvement (2012, June 28) retrieved 26 June 2024 from https://phys.org/news/2012-06-advanced-techniques-propel-crop.html