Research pinpoints region of plant genome where rising CO2 controls flowering time

February 12 2013

Henry David Thoreau obsessively recorded the flowering time of plants around Concord, Mass., in the 1850s, while Japanese naturalists took keen note of the flowering time of cherry blossom trees for centuries before that. For hundreds of years, naturalists and scientists have tracked flowering time, because it marks the transition between vegetative and reproductive growth, and it is highly influenced by climate change.

"The timing of when flowering is induced is incredibly important to the reproductive success of any plant," said Joy Ward, associate professor of ecology and evolutionary biology at the University of Kansas. "If it occurs too early, then not enough resources may be accumulated to maximize reproduction. If it occurs too late, then plants may not have finished or even started producing seeds before the growing season ends. So this timing is absolutely critical."

Today, in response to climate change, many plant species seem to be flowering earlier than in the past — and scientists have assumed this was due to increasing global temperatures. But Ward's recent research has shown that higher concentrations of carbon dioxide (CO_2) in the atmosphere might play a direct role in influencing flowering times, and this may be as large or larger than the warming effect.

Now, Ward and colleague John Kelly, professor of ecology and evolutionary biology, have pinpointed the region of a plant's genome that drives changes in flowering time in response to atmospheric levels of CO_2—a breakthrough finding that shows the genetic architecture behind changes in flowering time in response to CO_2 in Arabidopsis thaliana, a model species whose genome has been completely sequenced.

"It's a model system for understanding how other plants respond to the environment," Ward said. "We now know from a large survey study (published in New Phytologist) that I did that carbon dioxide has large effects on flowering time. My lab identified a specific gene whose expression was effected by carbon dioxide, and we were the first lab to identify genes in the flowering pathways whose expression was sensitive to carbon dioxide."

To build on that work, Ward and Kelly wanted to understand at the DNA level what areas of the genome might be driving a plant's response to carbon dioxide for flowering. They cross-bred two parental plant species and let the progeny self-replicate, then genotyped those offspring to determine the location in the genome that controls changes in flowering time in response to rising atmospheric CO_2.

"We now know in the whole genome where the gene or genes may be located that are causing a shift in flowering time as related to CO_2," Ward said.

The esteemed and open-access journal *PLOS ONE* recently published the KU researchers' findings. Prior to this work, little was known about the "underlying genetic architecture that controls flowering time in response to CO_2 at the genomic level, which may impact both wild and crop species."

Ward said that such basic science could lead to more successful agriculture in ahigh CO_2 world of the future, as is predicted by her work and that of other scientists.

"Rising CO_2 is occurring across the planet," Ward said. "So this work is highly relevant to changes in flowering time across all ecosystems. It has the potential to improve crops responses to a changing environment, and to help us better prepare for change. In addition, CO_2 is an under-appreciated environmental factor that influences flowering time. We have heard a lot of studies mention that temperature affects flowering time, but carbon dioxide, which plants use as a carbon source for photosynthesis, also drives flowering time even when temperatures are not changed in controlled experiments. It's key that we understand such changes now through basic research and experimentation, before they start occurring in reality in our crop and natural systems."

Provided by University of Kansas

Citation: Research pinpoints region of plant genome where rising CO2 controls flowering time (2013, February 12) retrieved 23 April 2024 from https://phys.org/news/2013-02-region-genome-co2.html