

Early bud-break gene discovered in *Populus* species

*The function of a **gene** that controls the awakening of trees from winter dormancy has been discovered by scientists. This is a crucial factor in controlling the ability of trees to regulate the fluctuating climates. While earlier researchers had identified genes involved in producing the first green leaves of spring, the discovery of a master regulator in **poplar trees** (*Populus* species) could eventually lead to breeding plants with better adaptation to warmer climates. Findings of the decade-old research at Oregon State University were published in the Proceedings of the National Academy of Sciences, by scientists from Michigan Technological University and Oregon State University (OSU).*

"This is the first time a gene that controls the timing of bud break in trees has been identified outside of *Arabidopsis*, a small flowering plant related to mustard and cabbage," said Steve Strauss, co-author and distinguished professor of forest biotechnology at OSU. "The timings of annual cycles - when trees open their leaves, when they produce flowers, when they go dormant - help trees adapt to changes in environmental signals like those associated with climate, but the genetics have to keep up, Strauss said.

While trees harbour genetic diversity to adjust to current conditions, climate models predict that an adverse temperature and precipitation patterns may expose trees to more stress in future. As a consequence, trees may find difficult to survive either by adaptation or migration. Finally, the forest health may decline, trees may disappear from places they are currently found, and some species may even go extinct. Strauss called the confirmation of the bud-break gene - which scientists named EBB1 for short - a "first step" in developing the ability to engineer adaptability into trees in the future.



An inflorescence of *P. alba*



An inflorescence of *P. tremula*

Yordan Yordanov and Victor Busov at Michigan Tech worked with Cathleen Ma and Strauss at Oregon State to trace the function of EBB1 in buds and other plant tissues responsible for setting forth the first green shoots of spring season. The experiments were

conducted in a hybrid of *Populus* species WT-717 (*Populus tremula* X *P. alba*) and its transgenic lines. They developed modified trees that overproduced EBB1 genes and emerged from dormancy earlier in the year. They also showed that trees with less EBB1 activity emerged from dormancy later. "The absence of EBB1 during dormancy allows the tree to progress through the physiological, developmental and adaptive changes leading to dormancy," said Busov, "while the expression of EBB1 in specific cell layers prior to bud-break enables reactivation of growth in the cells that develop into shoots and leaves, and re-entry into the active growth phase of the tree."



A plantation of *Populus tremula*

Strauss and Busov, a former post-doctoral researcher at Oregon State led efforts to identify the genes responsible. The idea sparked when they noticed four seedling trees in a 2.5-acre test plot were putting forth leaves at least a week before all the other trees. They found that EBB1 codes for a protein that helps to restart cell division in meristem. EBB1 also plays a role in suppressing genes that prepare trees for dormancy in the fall and in other processes such as nutrient cycling and root growth that are critical for survival. Altogether, they found nearly 1,000 other poplar genes whose activity is affected by EBB1. It's unlikely that plant breeders will use the finding any time soon, Strauss said. Breeders tend to rely on large clusters of genes that are associated with specific traits such as hardiness, tree shape or flowering. However, as more genes of this kind are identified, the opportunity to breed or engineer trees adapted to extreme conditions will grow.

Source:

<http://oregonstate.edu>

Yordan S. Yordanov *et al.* **EARLY BUD-BREAK 1 (EBB1) is a regulator of release from seasonal dormancy in poplar trees.** *PNAS*, June 2014 DOI: 10.1073/pnas.1405621111