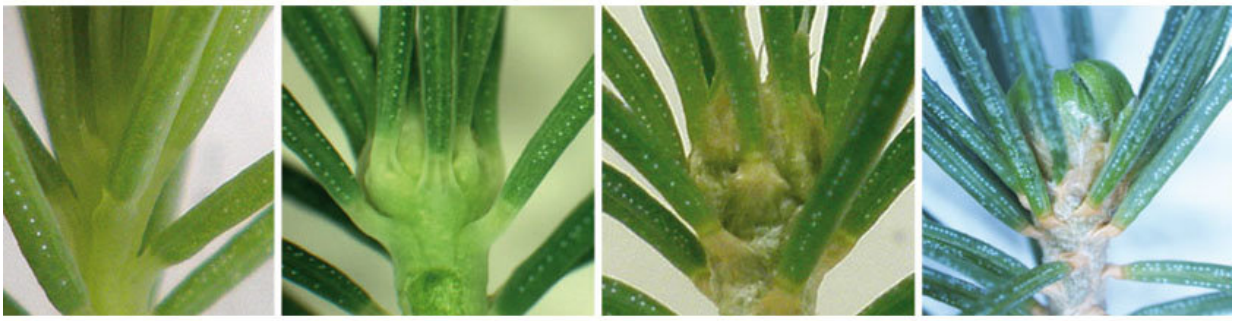
Study reveals mechanism in spruce tree that causes growth

February 19 2018, by Pippa Wysong



Shoot tip of a growing plant under long days; plant with terminal winter bud after short day exposure for three weeks; plant with brown bud scales after short day exposure for eight weeks; plant showing bud break and new growth three weeks after re-transfer to long days following eight weeks under short days. Credit: Canadian Light Source

While it's common knowledge that trees grow when days start to become longer in the springtime and stop growing when days become shorter in the fall, exactly how this happens has not been well understood.

Now, scientists using the Canadian Light Source are offering insights

into the mechanisms of how certain cells in the winter buds of Norway spruce respond to changes in seasonal light, affecting growth. The research was published in *Frontiers in Plant Science*.

Such knowledge allows for better predictions of how trees might respond to climate change, which could bring freezing temperatures while daylight is still long or warmer temperatures when daylight is short.

Professor Jorunn E. Olsen and YeonKyeong Lee, plant scientists at the Norwegian University of Life Sciences, along with colleagues from the University of Saskatchewan investigated winter bud cells from Norway spruce and how they differ with respect to the amount of daylight to which they were exposed.

Norway spruce was used because it is an ecologically and economically important conifer tree in Northern Europe, says Olsen. The scientists' findings could provide essential information for researchers seeking ways to improve frost and cold tolerance of a wide range of plants from trees to crops.

The bud cell samples used in the study were from tree seedlings grown in several controlled lighting conditions. Some were from plants exposed to up to 24 hours of light per day (as happens in the summer months in countries in the Far North) for eight weeks. Some samples were from a subset of trees that were then exposed to shorter amounts of daylight for eight weeks, and some of these were then exposed to longer days again. Bud cell samples were taken for study for each pattern of daylight.

The samples were from the crown, which is a plate of thick-walled cells at the base of the dormant winter bud.

After analyzing the CLS data and images of the crown cells, researchers were able to identify specific differences associated with the daily

amount of light to which each bud had been exposed.

Young seedlings growing under long days have no crown structure, but during short days, the crown develops and becomes less permeable, which blocks water flow, and causes the buds to stop growing and become dormant. Blocking water flow also prevents the bud from freezing in winter. Subsequent exposure to long days makes the crown permeable to water, which allows water and nutrients to get to the bud to help it grow.

"We have shown that the plate of crown cells serves as a barrier ensuring that there is no water transport into the dormant bud. In this way, freezing of the cells of the dormant bud can be avoided," said Olsen, adding that this crown structure is found only in specific groups of conifers.

"There may be similar barriers also in other species, but not such a distinct cell plate at the base of the bud."

The study helps with understanding how climatic factors control the annual growth-dormancy cycling in trees. The primary factor affecting when a tree will enter a dormant state is the length of day. If trees do not become dormant by the time freezing temperatures start, they will be subjected to frost damage and possibly die, she said.

More information: YeonKyeong Lee et al. Photoperiodic Regulation of Growth-Dormancy Cycling through Induction of Multiple Bud–Shoot Barriers Preventing Water Transport into the Winter Buds of Norway Spruce, *Frontiers in Plant Science* (2017). DOI: 10.3389/fpls.2017.02109

Provided by Canadian Light Source