From Forest Nursery Notes, Winter 2011

138. © Light and temperature sensing and signaling in induction of bud dormancy in woody plants. Olsen, J. E. Plant Molecular Biology 73:37-47. 2010.

Plant Mol Biol (2010) 73:37–47
DOI 10.1007/s11103-010-9620-9

Light and temperature sensing and signaling in induction of bud dormancy in woody plants

Jorunn E. Olsen

Received: 9 September 2009 / Accepted: 23 February 2010 / Published online: 8 March 2010

Abstract In woody species cycling between growth and dormancy must be precisely synchronized with the seasonal climatic variations. Cessation of apical growth, resulting from exposure to short photoperiod (SD) and altered light quality, is gating the chain of events resulting in bud dormancy and cold hardiness. The relative importance of these light parameters, sensed by phytochromes and possibly a blue light receptor, varies with latitude. Early in SD, changes in expression of light signaling components dominate. In *Populus* active shoot elongation is linked to high expression of *FLOWERING LOCUS T* (*FT*) resulting from coincidence of high levels of CONSTANS and light at the end of days longer than a critical one. In *Picea*, *PaFT4* expression increases substantially in response to SD. Thus, in contrast to *Populus-FT, PaFT4* appears to function in inhibition of shoot elongation or promotion of growth cessation. Accordingly, different *FT*-genes appear to have opposite effects in photoperiodic control of shoot elongation. Reduction in gibberellin under SD is involved in control of growth cessation and bud formation, but not further dormancy development. Coinciding with formation of a closed bud, abscisic acid activity increases and cell-proliferation genes are down-regulated. When dormancy is established very few changes in gene expression occur. Thus, maintenance of dormancy is not dependent on comprehensive transcriptional regulation. In some species low temperature induces growth cessation and dormancy, in others temperature affects photoperiod requirement. The temperature under SD affects both the rate of growth cessation, bud formation and depth of dormancy. As yet, information on the molecular basis of these responses to temperature is scarce.

Keywords CO-FT regulon · Hormones · Light receptor · Light quality · Photoperiod · Temperature

Introduction: dormancy is a meristem state

Survival and competitive success of woody and other perennial plants in the temperate and boreal zone depend on a precise timing of growth, winter dormancy and frost hardiness in synchrony with seasonal changes in temperature. The duration of the winter dormancy is important in determining the growth season and thus productivity. According to the definition of Lang (1987) dormancy is a developmental process involving a temporal suspension of growth of any plant structure containing a meristem. Rohde and Bhalerao (2007) recently proposed an improved definition of dormancy as the inability to initiate growth from meristems or other organs and cells with the capacity to resume growth, under favourable conditions. Such a definition better distinguishes between events in the meristem and surrounding tissues such as bud scales and leaf initials, and is certainly more functional for a mechanistic point of view. Here the discussion will be limited to seasonal bud dormancy in woody species, emphasizing light sensing and signaling and effects of temperature in dormancy induction.

Photoperiodic control of shoot elongation

It is well established that the photoperiod, or rather night length, is of prime importance regulating the transition between active growth and terminal bud formation, as well

J. E. Olsen (✉)
Department of Plant and Environmental Sciences, Norwegian University of Life Sciences, 1432 Aas, Norway
e-mail: jorunn.olsen@umb.no