From Forest Nursery Notes, Winter 2010

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Trees (2009) 23:971–979
DOI 10.1007/s00468-009-0339-7

ORIGINAL PAPER

Warm temperature accelerates short photoperiod-induced growth cessation and dormancy induction in hybrid poplar (*Populus* × spp.)

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Received: 10 November 2008 / Revised: 17 March 2009 / Accepted: 15 April 2009 / Published online: 5 May 2009

Abstract There is increasing evidence that temperature, in addition to photoperiod, may be an important factor regulating bud dormancy. The impact of temperature during growth cessation, dormancy development, and subsequent cold acclimation was examined in four hybrid poplar clones with contrasting acclimation patterns: 'Okanese'—EARLY, 'Walker'—INT1, 'Katepwa'—INT2, and 'Prairie Sky'—LATE. Four day–night temperature treatments (13.5/8.5, 18.5/13.5, 23.5/8.5, and 18.5/3.5°C) were applied during a 60-day induction period to reflect current and predicted future annual variation in autumn temperature for Saskatoon, SK. Warm night temperature (18.5/13.5°C) strongly accelerated growth cessation, dormancy development, and cold acclimation in all four clones. Day temperature had the opposite effect of night temperature. Day and night temperatures appeared to act antagonistically against each other during growth cessation and subsequent dormancy development and cold acclimation. Growth cessation, dormancy development, and cold acclimation in EARLY and LATE were less affected by induction temperature than INT1 and INT2 suggesting that genotypic variations exist in response to temperature. Separating specific phenological stages and the impact by temperature on each clone revealed the complexity of fall phenological changes and their interaction with temperature. Most importantly, future changes in temperature may affect time to growth cessation, subsequently altering the depth of dormancy and cold hardiness in hybrid poplar.

Keywords Bud dormancy · Temperature · Adaptation · Climate change

Communicated by O. Junttila.

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Introduction

Temperate woody plants annually cycle through a period of active growth and a period of growth cessation and dormancy. In early autumn, the transition from active growth to the dormant phase occurs. This transition is a necessary step for winter survival of woody plants in temperate regions. Over the next 75 years, the global annual mean temperature is forecast to increase between 1.1 and 6.4°C (IPCC 2007). The impact of this temperature increase on phenological processes associated with the growth cessation, the induction of dormancy, and cold hardiness in temperate woody plants is relatively unknown. Temperature increases will be more pronounced at northern latitudes, including the Great Plains region of North America. In autumn, when dormancy levels and cold hardiness normally increase in temperate woody plants, temperatures are forecast to elevate by 3–5°C (Wheaton 2001) in the Great Plains region, thereby extending the growing season (Motha and Baier 2005). It is generally assumed that woody plants will be able to take advantage of the increase in length of growing season.

Growth, growth cessation, and dormancy (induction, maintenance, and release) are sequential and interconnected processes in the annual life cycle of plants. Growth cessation is important for winter survival of woody plants