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► **To cite this version:**

Maurizio Sabatti, Francesco Fabbrini, Muriel Gaudet, Catherine Bastien, Justine Guet, et al.. QTL mapping and genomic characterization of phenology in black poplar. Final Conference Noveltree. Tree Breeding, Genomics and Evolutionary Biology, Oct 2012, Helsinki, Finland. 69 p. <hal-02746499>

HAL Id: hal-02746499

<https://hal.inrae.fr/hal-02746499v1>

Submitted on 3 Jun 2020

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Final Conference Noveltree

Tree Breeding, Genomics and Evolutionary Biology: New synergies to tackle the impact of climate change in the 21st century



16-17 October 2012
House of Science and Letters
Helsinki, Finland

Organised
by



QTL mapping and genomic characterization of phenology in black poplar

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The genetic control of important adaptive traits, such as phenology, is still poorly understood in most forest trees species. Poplar is an ideal model tree to study phenology because of its indeterminate shoot growth. Thus, a full-sib family derived from an intraspecific cross of *P. nigra* with 162 clonally replicated progeny was used to assess genetic variation of bud set in two sites of contrasting environmental conditions.

Six crucial phenological stages of bud set were scored. Night length appeared to be the most important signal triggering the onset of growth cessation. Nevertheless, the effect of other environmental factors, such as temperature, increased during the process. Descriptors of growth cessation and bud onset explained the largest part of phenotypic variation of the entire process. Quantitative trait loci (QTL) for these traits were detected. For the four selected traits (the onset of growth cessation (date2.5), the transition from shoot to bud (date1.5), the duration of bud formation (subproc1) and bud maturation (subproc2)) eight and sixteen QTL were mapped on the maternal and paternal map, respectively. The identified QTL, each one characterized by small or modest effect, highlighted the complex nature of traits involved in bud set process. Comparison between map location of QTL and *P. trichocarpa* genome sequence allowed the identification of 13 gene models, 67 bud set-related expressional and six functional candidate genes (CGs). These CGs are functionally related to relevant biological processes, environmental sensing, signaling, and cell growth and development. Some strong QTL had no obvious CGs, and hold great promise to identify unknown genes that affect bud set.

This study provides a better understanding of the physiological and genetic dissection of bud set in poplar. The putative QTL identified will be tested for associations in *P. nigra* natural populations. The identified QTL and CGs will also serve as useful targets for poplar breeding.

Keywords:

Bud set, Populus nigra, quantitative trait loci, candidate genes, seasonal growth cycle.

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/ 2007-2013) under the grant agreement n° 211868 (Project Noveltree)