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Ecotypic mode of regional differentiation of black cottonwood (*Populus trichocarpa*) due to restricted gene migration: further evidence from a field test on the northern coast of British Columbia

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Abstract: A previous common-garden test located in southern British Columbia revealed that black cottonwood (*Populus trichocarpa* Torr. & A. Gray) sources from the southern region were distinctly superior in growth and health conditions than their northern counterparts, and restricted gene migration between the two regions was proposed as the main cause of the observed ecotypic mode of regional differentiation. Confirmation of the observed pattern of regional differentiation and the proposed underlying mechanism is very important as it will not only enhance our understanding of the evolution of the species, but also have substantial practical implications. In this study, we examined the performance of 483 clones from 30 populations (drainages) across the entire range in British Columbia in a field trial on the northern coast. Three-year test results confirmed the ecotypic mode of genetic differentiation between the two regions as previously observed in the south, providing further evidence supporting the proposition of restricted gene migration as the underlying mechanism. The southern populations were 87% taller than and twice as healthy as their northern counterparts. Regional differences accounted for most of the detected nonrandom variation, with over 80% in both height and health condition. Of the 30 fastest growing clones that were free of any damages, 27 were from the southern region, whereas only three were from the northern region. Performance was very consistent between sites in the two regions at both population and clonal levels.

Résumé : Une étude antérieure en plantation comparative située dans le sud de la Colombie-Britannique a permis de découvrir que les provenances de peuplier de l'Ouest (*Populus trichocarpa* Torr. & A. Gray) de la région méridionale étaient nettement supérieures à leurs contreparties plus septentrionales du point de vue de la croissance et de l'état de santé. Une migration restreinte des gènes a été proposée comme cause principale de ce mode écotypique de différenciation régionale. La confirmation de ce patron de différenciation régionale et du mécanisme sous-jacent qui a été proposé apparaît très importante puisqu'elle améliorera non seulement notre compréhension de l'évolution de cette espèce mais aura également d'importantes répercussions pratiques. Dans la présente étude, nous avons examiné la performance de 483 clones provenant de 30 populations (bassins versants) réparties sur l'ensemble de l'aire de répartition de l'espèce en Colombie-Britannique à l'aide d'un essai au champ localisé dans la région côtière nordique. Après trois ans, les résultats confirment le mode écotypique de différenciation génétique entre les deux régions, tel qu'il a été observé antérieurement dans le sud, fournissant une preuve additionnelle que la migration restreinte des gènes est le mécanisme sous-jacent. Les populations méridionales étaient 87 % plus hautes et deux fois plus en santé que leurs contreparties septentrionales. Les différences régionales expliquaient la plus grande partie de la variation non aléatoire dont plus de 80 % était due à la hauteur et à l'état de santé. Parmi les 30 clones dont la croissance était la plus rapide tout en n'ayant aucun dommage, 27 provenaient de la région sud alors que seulement trois provenaient de la région nord. La performance était très cohérente entre les stations dans les deux régions à la fois pour les populations et les clones.

[Traduit par la Rédaction]

Introduction

The natural distribution of black cottonwood (*Populus trichocarpa* Torr. & A. Gray) along the coast of British Columbia (BC) is not continuous but is divided into two, namely northern and southern, regions by a "no-cottonwood" belt in the central coast (Fig. 1; Peterson et al. 1996). Geographic

patterns of genetic variation revealed from a common-garden test located in the south (Fig. 1) demonstrated that populations from the two regions were genetically distinct in various adaptive traits including growth, phenology, and disease susceptibility (Xie et al. 2009). Black cottonwood from the northern region suffered much higher mortality, grew significantly slower, was extremely susceptible to the conifer-

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