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ORIGINAL PAPER

Factors influencing direct shoot regeneration from leaves, petioles, and plantlet roots of triploid hybrid *Populus* sect. *Tacamahaca*

Yan Zhang[1] · Beibei Wang[1] · Liqin Guo[1] · Wenting Xu[1] · Zewei Wang[1] · Bailian Li[1,2] · Jinfeng Zhang[1]

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Abstract Since the generation of full-sib artificial triploid families, rapid clone establishment and genetic improvements have been needed. Here, we report an in vitro method of direct shoot regeneration of a triploid hybrid poplar [(*Populus simonii* × *P. nigra* 'Italica') × (*P.* × '*popularis*')]. Using different randomized block designs, we selected one triploid to evaluate the explant type, optimal concentrations of plant growth regulators and agar, and culture time under light or dark conditions over 60 days. The highest rate of shoot induction, 80.0%, was obtained using Murashige and Skoog (MS) medium supplemented with 0.2 mg/L benzyladenine, 0.04 mg/L naphthaleneacetic acid (NAA), and 5.5 g/L agar for the first 30 days in the dark, then 3 g/L agar for the next 30 days in light. This last medium yielded the best rate of shoot induction (6.32 shoots/explant). These three media were also used to evaluate the influence of the genotypes of the parents and hybrid triploids on regeneration. Two parents and three of the four full-sib triploids were regenerated successfully; different genotypes and explant types significantly affected the rate of shoot induction and average number of shoots. Leaves but not petioles were a suitable explant. One genotype produced the highest rate of shoot induction of 96.67%. Half-strength MS medium supplemented with 0.2 mg/L indole butyric acid and 0.04 mg/L NAA was the most effective for rooting; rooting rate was 96.67%, survival rate of transplants was 73.33%, and rooting frequency surpassed 85% for each genotype. Overall, this in vitro regeneration system will be useful for the propagation and genetic modification of triploid poplars.

Keywords Direct organogenesis · Dark incubation · Two-step culture

Yan Zhang and Beibei Wang have contributed equally to this work.

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✉ Jinfeng Zhang
zjf@bjfu.edu.cn

[1] Beijing Advanced Innovation Center for Tree Breeding by Molecular Design, National Engineering Laboratory for Tree Breeding, Key Laboratory of Genetics and Breeding in Forest Trees and Ornamental Plants of Ministry of Education, Key Laboratory of Forest Trees and Ornamental Plants Biological Engineering of State Forestry Administration, College of Biological Sciences and Technology, Beijing Forestry University, Beijing 100083, China

[2] Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC 27695, USA

Introduction

Populus belongs to the *Salicaceae* family and is found throughout the Northern Hemisphere. Because it provides many useful products, such as wood, fibre, fuelwood, and other forestry products and can contribute to sustainable development, poplars are recognized internationally, especially in developing countries (Isebrands and Richardson 2014). As a result of its small genome, short rotation cycle, rapid growth rate, and easy vegetative propagation, poplar has become a model system in forest

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