From Forest Nursery Notes Winter 2013

120. © Ectomycorrhizal networks of *Pseudotsuga menziesii* var. *glauca* trees facilitate establishment of conspecific seedlings under drought. Bingham, M. A. and Simard, S. Ecosystems 15:188-199. 2012.

Ecosystems (2012) 15: 188–199
DOI: 10.1007/s10021-011-9502-2

ECOSYSTEMS

Ectomycorrhizal Networks of *Pseudotsuga menziesii* var. *glauca* Trees Facilitate Establishment of Conspecific Seedlings Under Drought

Marcus A. Bingham* and Suzanne Simard

Department of Forest Sciences, The University of British Columbia, Vancouver, British Columbia V6T 1Z4, Canada

Abstract

Ectomycorrhizal (EM) networks are hypothesized to facilitate regeneration under abiotic stress. We tested the role of networks in interactions between *P. menziesii* var. *glauca* trees and conspecific seedlings along a climatic moisture gradient to: (1) determine the effects of climatic factors on network facilitation of *Pseudotsuga menziesii* (Mirb.) Franco var. *glauca* (Mayr) seedling establishment, (2) infer the changing importance of *P. menziesii* var. *glauca* parent trees in conspecific regeneration with climate, and (3) parse the competitive from facilitative effects of *P. menziesii* var. *glauca* trees on seedlings. When drought conditions were greatest, seedling growth increased when seedlings could form a network with trees in the absence of root competition, but was reduced when unable to form a network. Survival was maximized when seedlings were able to form a network in the absence of root competition. Seedling stem natural abundance $\delta^{13}C$ increased with drought due to increasing water use efficiency, but was unaffected by distance from tree or network potential. We conclude that *P. menziesii* seedlings may benefit from the presence of established *P. menziesii* trees when growing under climatic drought, but that this benefit is contingent upon the establishment of an EM network prior to the onset of summer drought. These results suggest that networks are an important mechanism for EM plants establishing in a pattern consistent with the stress-gradient hypothesis, and therefore the importance of EM networks to facilitation in regeneration of EM trees is expected to increase with drought.

Key words: climate change; climatic gradients; competition; Douglas-fir; ecophysiology; facilitation; mycorrhizal networks; plant water relations; reforestation; stress-gradient hypothesis.

Introduction

Ectomycorrhizas have been demonstrated to link the root systems of different plant individuals, forming ectomycorrhizal (EM) networks (Newman 1988), and recent studies have shown that they can influence establishment of *Pseudotsuga menziesii* (Teste and others 2010). Some basic tenets of plant community ecology were challenged in 1997 when net carbon (C) transfer between *P. menziesii* and paper birch (*Betula papyrifera*) was demonstrated in

Received 31 May 2011; accepted 21 October 2011;
published online 22 November 2011

Electronic supplementary material: The online version of this article (doi:10.1007/s10021-011-9502-2) contains supplementary material, which is available to authorized users.

Author Contributions: Bingham had the principal role of designing the study, writing and interpreting, analyzing data, and coordinating and conducting field and laboratory analyses. Simard coordinated funding for the project and assisted in designing the study, as well as contributing to the writing and interpretation.

**Corresponding author; e-mail:* binghm93@gmail.com