From Forest Nursery Notes, Summer 2009

103, © Ecophysiology of species with distinct leaf morphologies: effects of plastic and shadecloth tree guards. Close, D. C., Ruthrof, K. X., Turner, S., Rokich, D. PO., and Dixon, K. W. Restoration Ecology 17(1):33-41. 2009.

Restoration Ecology
THE JOURNAL OF THE SOCIETY FOR ECOLOGICAL RESTORATION INTERNATIONAL

Ecophysiology of Species with Distinct Leaf Morphologies: Effects of Plastic and Shadecloth Tree Guards

Dugald C. Close,[1,2,3,4] Katinka X. Ruthrof,[1,2,5] Shane Turner,[1,2] Deanna P. Rokich,[1,2,6] and Kingsley W. Dixon[1,2]

Abstract

Ecological restoration using seedling tubestock is challenging under a Mediterranean-type climate of hot, dry summers. We investigated the ecophysiological effects of plastic tree guards and shadecloth tree guards during seedling establishment of four co-occurring tree species that differ in leaf morphology. Average temperature was 6.7°C higher in plastic guards than controls over a summer, with a maximum of 53.5°C compared to 47.9°C in controls. Light levels were 2-fold lower in both tree guard treatments relative to control. In spring, photosynthesis and specific leaf area were significantly elevated in shadecloth tree guards relative to other treatments. In summer, photosynthetic rate was significantly lower, and midday photochemical efficiency was significantly higher, in both tree guard treatments relative to controls. The effect of elevated temperature in plastic tree guards may partially explain our results of higher mortality of seedling in plastic tree guards. The relatively elevated spring photosynthesis of seedlings in shadecloth tree guards may partially explain the result of reduced mortality and increased growth in this treatment. We conclude that shadecloth tree guards create a microclimate more favorable for seedling establishment in a Mediterranean-type environment than plastic tree guards and control treatments. Our results may have wide applicability to the range of restoration settings where seedling tubestock is planted, except in environments where low temperature is limiting to plant growth.

Key words: eucalypt, leaf morphology, photosynthesis, seedling establishment, tree guard.

Introduction

Seedling establishment is one of the most limiting processes in the perpetuation of plant populations, particularly in disturbed environments (Schemske et al. 1994; Hobbs & Yates 2003). Urban bushland remnants are often characterized by significant weed infestation, high browsing pressure, altered edaphic and hydrological regimes, and altered vegetation structure due to the increased frequency of fire. For these reasons, native vegetation in urban bushland remnants can fail to recruit and regenerate, necessitating ecological restoration. A favored method for restoration is the use of direct seeding following weed control and sometimes soil scarification (Turner et al. 2006). However, preference for use of local provenance seed to avoid genetic pollution of indigenous genotypes (Krauss et al. 2005) often results in limited seed resources, particularly when bushland is fragmented and where remnant populations are small and old and/or where stressed plants set limited seed numbers per plant. Thus, limited seed resources combined with the inherent variability of climate can preclude the practice of direct seeding and result in ecological restoration of urban bushland by planting nursery-raised seedlings.

In Mediterranean-type environments, different strategies for coping with low soil water and high atmospheric evaporative demand may contribute to differences in the competitive ability and the distribution of species (Damesin et al. 1998). Stomatal closure, which minimizes water loss through transpiration (Jones 1998), is a common plant strategy although different species may have different stomatal responses and the net effect of this on transpiration is affected by leaf morphology and leaf angle. Conversely, stomatal closure limits transpirational cooling and leads to carbon dioxide limitation to photosynthesis and thus reduced competitive ability. In order to maximize early growth, seedlings can have higher stomatal conductance and photosynthesis than mature plants during the wet season of a Mediterranean-type climate year (Kolb & Stone 2000).

Plant water availability can alter specific leaf area (SLA) that affects leaf transpiration and photosynthesis

[1] Science Directorate, Botanic Gardens and Parks Authority, Kings Park and Botanic Garden, Fraser Avenue, West Perth 6005, Australia
[2] School of Plant Biology, University of Western Australia, Crawley 6005, Australia
[3] School of Plant Science, University of Tasmania, Private Bag 55, Hobart, Tasmania 7001, Australia
[4] Address correspondence to D. C. Close, email dugald.close@utas.edu.au
[5] Present address: School of Biological Sciences and Biotechnology, Murdoch University, South Street, Murdoch, Perth 6150, Australia
[6] School of Environmental Science, Murdoch University, South Street, Murdoch, Perth 6150, Australia

doi: 10.1111/j.1526-100X.2007.00330.x