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Short communication

Measuring water stress in *Eucalyptus grandis* Hill ex Maiden seedlings planted into pots

C.A. Rolando *, K.M. Little

Institute for Commercial Forestry Research, PO Box 100281, Scottsville 3209, South Africa

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Abstract

A pot trial incorporating various watering regimes was initiated to assess: 1) water stress in *Eucalyptus grandis* seedlings, and 2) the efficacy of different types of research equipment in quantifying these levels of water stress for applied research. There were two dry soil treatments differing in terms of seedling root plug moisture at transplanting, dry (DD) and wet (WD), respectively, and three treatments consisting of well watered seedlings transplanted into wet soil (WWD, WWW and control). Treatment WWW was re-watered when seedlings were water stressed. The control was maintained at field capacity for the entire trial period. Seedling physiology was assessed by shoot water potential, stomatal conductance and chlorophyll fluorescence. Seedlings with dry root plugs, planted into dry soil were dead one to two days after planting. A wet root plug at the time of transplanting increased seedling shoot water potential and survival for up to three days in dry soil. Planting into wet soil increased shoot water potential for the duration of the trial and was also associated with new root growth. This study indicated that both the pressure chamber and the porometer provided simple and easy to interpret measures of water stress in *E. grandis* seedlings. Measurements of chlorophyll fluorescence did not significantly reflect treatment effects.

Keywords: Chlorophyll fluorescence; *Eucalyptus grandis*; Re-establishment; Shoot water potential; Stomatal conductance

1. Introduction

In South Africa hardwoods are grown primarily for pulpwood over an eight to twelve year rotation. Most hardwoods are planted along the eastern seaboard and adjacent escarpment where rainfall ranges from approximately 600 to 1100 mm (Smith et al., 2005). To optimise productivity on a site specific basis, a variety of eucalypt species and hybrids are planted including: *Eucalyptus grandis*, *E. nitens*, *E. smithii*, *E dunnii*, *E. grandis* × *E. camaldulensis* and *E. grandis* × *E. urophylla* (Smith et al., 2005). Even when planted on highly productive sites mortality following planting can exceed 10%, resulting in sub-optimal stocking which affects final yield in a pulpwood stand (Morris, 1995; Chambers and Borralho, 1997). Survival and initial growth can be associated with one or a combination of the following factors: silvicultural practices (Turvey, 1996; Little and Van Staden, 2003), seedling quality and age (Zwolinski et al., 1995; Bayley and Kietzka, 1997) and incorrect site-species matching (Darrow, 1995). These factors may become more critical if plants are grown under adverse environmental conditions that negatively affect the ability of the seedling to utilize the site's resources.

Worldwide, water deficits are one of the major causes of failure during re-establishment, and a seedlings ability to use water efficiently is crucial to post-planting survival (Burdett, 1990; Margolis and Brand, 1990). If the seedling does not receive water during the period of new root development, its internal water deficits will increase considerably (Burdett, 1990). The natural distribution of *Eucalyptus* species in Australia is strongly influenced by their ability to manage water stress, either as seedlings, or as they continue to grow (Myers and Landsberg, 1989). Water stress following planting is considered one of the major causes of eucalypt seedling death in South Africa (Viero and Little, 2006) and Ethiopia (Gindaba et al., 2004). The availability of soil water as a function of rainfall is thus important when planting eucalypts in South Africa and most planting is confined to the summer months

* Corresponding author.
E-mail addresses: carol@icfr.unp.ac.za (C.A. Rolando), keith@icfr.unp.ac.za (K.M. Little).

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