Root growth capacity of *Cupressus macrocarpa* and *Pinus radiata* seedlings

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ABSTRACT

Nursery seedlings of macrocarpa and radiata pine were lifted at about four-weekly intervals during winter, and their roots were exposed for 0, 30, or 60 minutes. Seedling water potential and root growth capacity were then assessed. The root growth capacity of macrocarpa seedlings was greater than that of radiata pine, particularly later in the lifting season. Radiata pine seedlings lifted early in the winter (May 30) showed maximum root growth capacity, and this decreased for all subsequent liftings. Root exposure decreased seedling water potential and subsequent root growth capacity. In macrocarpa seedlings water potential declined significantly, but root growth capacity declined only slightly. In radiata pine both water potential and root growth capacity declined after root exposure.

Cupressus macrocarpa (macrocarpa) is recognized as a potentially valuable timber species (NZ Forest Research Institute 1984). However, attempts to establish plantations have often been thwarted by inadequate or poor site selection, site preparation, weed control, and quality of tree stocks.

Seedling quality has traditionally been measured by morphological characteristics, including height, diameter at root collar, sturdiness, and root: shoot ratio. Although some of these characteristics give an indication of seedling quality they are not ideal for predicting potential survival and growth. Seedling water potential (ΨW) (Ritchie and Hinckley 1975) and root growth capacity (RGC) (Burdett 1979) have been used as measures of seedling quality in some species, but have not been assessed in macrocarpa seedlings.

In 1982 a programme was set up to improve quality of nursery stock and to evaluate methods of processing and storing macrocarpa seedlings. This note describes how lifting dates and exposure of seedling roots after lifting affect ΨW and RGC. Radiata pine seedlings are used for comparison because nursery practices for macrocarpa usually follow those designed for radiata pine.

Method

Seedlings of macrocarpa and radiata pine were raised as bare-root 1/0 planting stock by sowing seed in drills 12.5 cm apart and hand thinning the seedlings to 10 cm spacing within the drills. Seedlings were undercut at a depth of 10 cm in late summer, then root wrenched and lateral-root pruned in autumn (through till mid-May).

Seedlings of both species were lifted at approximately four-weekly intervals throughout the winter, starting on May 30, 1983. Roots were exposed for 0, 30, or 60 minutes. For exposure of 30 or 60 minutes, seedlings were laid out on a suspended wire mesh in a glasshouse maintained at 21 °C, 60% relative humidity, and a 2 km/hour wind speed (provided by a fan). Lifting time was constant (8.30 am), and all exposures were completed by 9.45 am. Shoot water potential was then measured in a pressure chamber (Ritchie and Hinckley 1975) for 10 seedlings from each treatment.

Root regeneration capacity was measured for 45 seedlings from each treatment. Root volumes were measured by the displacement technique described by Burdett (1970). Seedlings were then placed with their roots in an aerated water bath maintained at 19 °C ± 1 ° for three weeks before root volumes were remeasured. The gain in root volume (cm^3) was used as a measure for RGC. The water baths were kept in a glasshouse maintained at 12 °C for 16 hours and 12 °C for eight hours in each 24-hour period. Relative humidity was maintained at 60% and incandescent lighting gave a controlled photoperiod length of 16 hours.

Differences in ΨW and RGC were tested by two-way analysis of variance with interaction for lifting date and exposure time.

RESULTS AND DISCUSSION

Shoot water potential

Water potential in both species declined with increased periods of

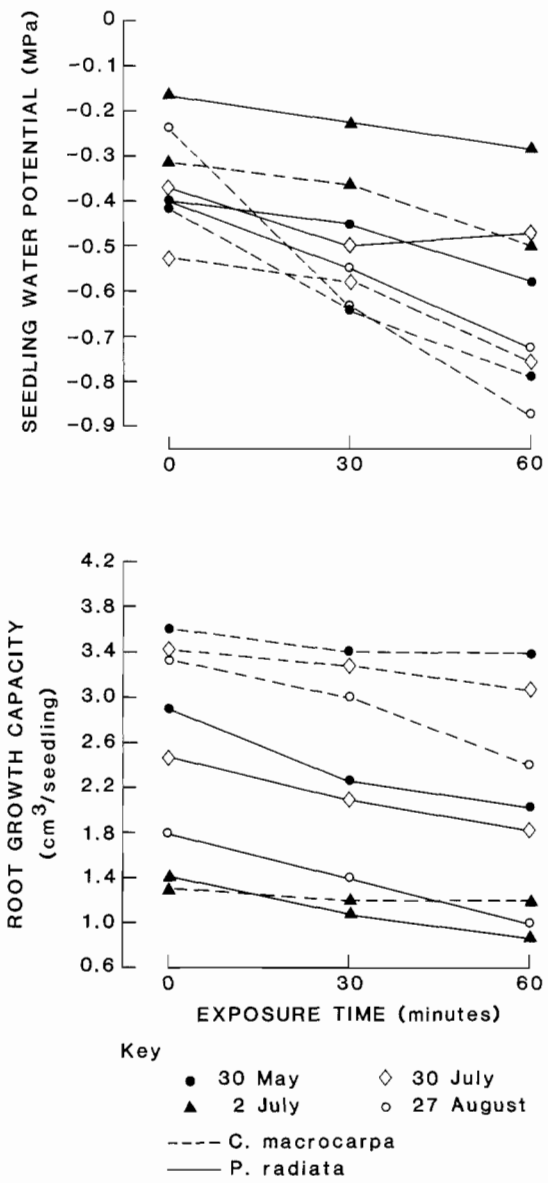

Fig. 1. Seedling Water Potential (a) and Root Growth Capacity (b) for different lifting dates and root exposures.

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root exposure, and after 60 minutes macrocarpa had consistently lower water potential than radiata pine (Fig. 1). The decline was significant ($P \leq 0.001$).

Differences in ΨW between the July 2 lifting date and the other three dates was significant ($P \leq 0.001$). However ΨW remained satisfactory at lifting (not worse than -0.5 MPa).

Root growth capacity

Unexposed seedlings of macrocarpa had high RGC, except for those seedlings lifted on July 2. The difference between the July 2 lifting date and the other three dates was significant ($P \leq 0.001$). Root growth decreased slightly with exposure but this was not significant.

RGC in radiata pine generally decreased through the winter ($P \leq 0.001$), with the exception of seedlings lifted on July 2, which had the lowest RGC. Root growth in the radiata pine seedlings declined significantly ($P \leq 0.005$) with increasing exposure.

Low RGC was noted for both species on July 2, when ΨW were relatively high. The reason for the anomalous results for July 2 was not clear.

RGC of macrocarpa seedlings was affected by lifting dates, but not by length of root exposure, which affected only ΨW. However RGC of radiata pine showed a marked response to both lifting dates and length of root exposure. Macrocarpa seedlings had consistently higher RGC than radiata pine seedlings after all lifting dates and after each period of root exposure (Fig. 2).

This note highlights several points worthy of further investigation.

* Macrocarpa seedlings proved to be more resistant to handling stress than radiata pine. Is this a general rule? If so, can the better performance be related to the more fibrous nature of the macrocarpa root systems?

* What factors cause the variability in seedling performance between lifting in late May and the end of August? Is it related to the time between 'conditioning' and lifting? Or are there other seasonal or climatic factors operating?

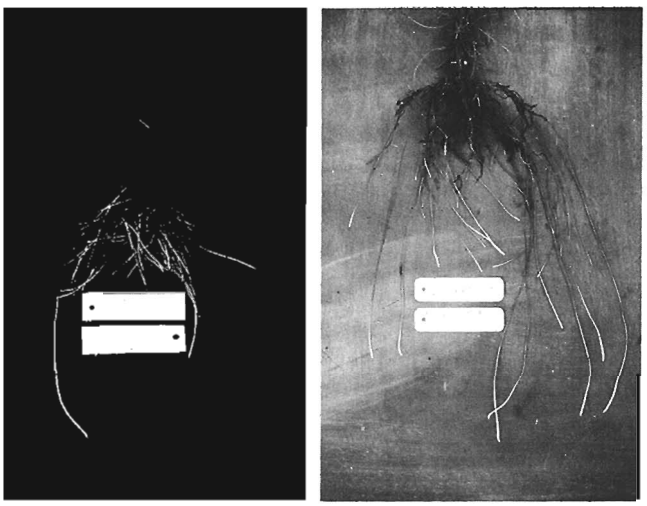

Fig. 2 New root growth of *C. macrocarpa* (left) and *P. radiata* (right) seedlings, lifted on July 2, exposed for 30 minutes and placed in the water bath for 21 days (photos: B. Cosslett).

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CONFERENCE PAPER

DOES MULTIPLE USE FORESTRY HAVE A FUTURE?

An overview of the Keynote speakers, NZIF Conference, Greymouth, May 1987

C. Anstey

Mike Orchard must be congratulated on his choice of speakers. A very diverse range of views were expressed and each speaker approached the question from a quite distinctive viewpoint. Priestley Thomson tended to reflect on the past performance of foresters in the practice of multiple use, as did Guy Salmon. John Gilbert explored the concept, its evolution and its future, tending to dwell on the social processes involved in achieving balanced decisions. Andy Kirkland reflected on the Forest Service's difficulties with the concept and, in his usual lucid way, explained the inevitability of changed administrative arrangements. Ken Piddington accepted the concept and outlined the values his department would be considering, and how these values were to be integrated into management. Ken was the only speaker who talked about integration and this seemed somehow significant. John Gilbert, in speaking about conservation land management, did concede a compatibility in non extractive uses.

The reviewer, Clive Anstey, was chairperson of this session.

Both John Gilbert and Priestley Thomson made reference to a common definition of multiple use. The definition is that adopted by the US Forest Service who modified Professor B.L. Orell's version given at the 5th World Forestry Conference in 1960.

"Multiple-use forestry is simply the accommodation of a maximum of other compatible uses with the highest single beneficial use of the land."

John Gilbert explored some of the difficulties with the concept and made reference to historic debate. The notion of