Propagation of the Tree Waratah, *Alloxylon flammeum* P. H. Weston and Crisp

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Alloxylon flammeum P. Weston and Crisp (family Proteaceae) is a native Australian rain forest plant which is classified as a rare and threatened species (Briggs and Leigh, 1996). It is not widely cultivated, but has attracted the interest of the cut flower industry and may also be a good rootstock for the more sensitive *A. pinnatum*. Both are showy flowering trees with large spectacular flowers ranging in colour from pink to red. There is limited published material on *Alloxylon* species and little is known with regards to their propagation. There is also a lack of availability of propagation material which prevents commercial production and makes research difficult. The purpose of this study was to determine the best procedures for the propagation of *A. flammeum*.

Alloxylon flammeum, also known as a tree waratah, is closely related to the NSW waratah (*Telopea speciosissima* R. Br.). The primary horticultural use of waratah is for cut flower production, with blooms being highly sought after on both local and export markets (Worrall, 1994). A great deal of work has been conducted with regard to the cultivation and propagation of the waratah in recent years, leading to a steady increase in the number of waratah plants in cultivation and the number of blooms available. These are more consistent in quality and quantity than the bush-picked blooms that were relied upon in the past (Offord and Campbell, 1994).

Waratah, banksia, and protea blooms belong to the feature flower market, but there is a definite shortage of Australian native feature flowers (Gollnow et al., 1995). Australian native cut flowers are attractive to overseas buyers because they are different. New species that would be suitable as cut flowers need to be developed to maintain the interest of export markets, and to expand the choice available on both the domestic and export scene. Recently there has been considerable interest in developing *Alloxylon* spp. as a feature flower to fill this niche.

The main limitation to waratah production is the restricted marketing period. Blooms are only available from September to October (Moody, 1993) with supply dropping off before the pre-Christmas market peak. *Alloxylon* species have a long flowering period from spring to early summer (Wrigley and Fagg, 1989), therefore the blooms are still available once the supply of waratah has finished. The spectacular red blooms of *Alloxylon* are similar to those of the NSW Waratah, but more importantly they possess the red-green colour combination that is highly sought after in the pre-Christmas market. This suggests that *Alloxylon*, in particular *A. flammeum*, has the potential to complement *Telopea* production and expand the native cut flower industry.

The development of a successful propagation system for *Alloxylon* is not only motivated by potential commercial gain, but also for conservation purposes. *Alloxylon* *flammeum* is classified as a rare species (Briggs and Leigh, 1996) which is not widely cultivated. The biology of the species is not well understood. Widespread cultivation would help to increase our knowledge base and alleviate the threat of exploitation of remaining stands of the species. In addition, *A. flammeum* may be a good rootstock for the more sensitive *A. pinnatum* (P. Weston pers. comm.), another rare but beautiful species which also has commercial potential. The latter will be the subject of subsequent investigations.

The purpose of this study was to investigate whether *A. flammeum* may be propagated vegetatively by cuttings and micropropagation, and if so, what are the best procedures. Since little was known about the cultivation and propagation of *Alloxylon*, the techniques used were largely adapted from those employed in the propagation of *Telopea* species. Seed propagation was not investigated. *Alloxylon flammeum* seed is difficult to obtain due to their limited distribution in the wild and cultivated sources cannot supply sufficient seed for possible commercial plantations. It is also likely that *Alloxylon* populations grown from seed would show a great deal of variation, as has been documented in seedling populations of *Telopea* (Burnett and Mullins, 1985; Worrall, 1983). The development of an effective clonal propagation system for *A. flammeum* would allow selected genotypes to be propagated and commercial plantations to be established.

CUTTING PROPAGATION

Two basic experiments were performed looking at the effect of environmental conditions and rooting hormones on propagation by cuttings. A root zone temperature of 24±2C gave superior rooting of *A. flammeum* cuttings compared to 18±2C, and there was no difference found between mist and fog, with mist being the most commercially viable alternative. *Telopea* waratahs are generally propagated using similar root zone temperatures, although no information is available comparing the rooting of waratah under mist and fog.

Clonex® Red (8000 ppm IBA gel) gave significantly better rooting of mature *A. flammeum* cuttings than the other hormones tested, which were Clonex® Green (1500 ppm IBA gel), Clonex® Purple (3000 ppm IBA gel), and a 5-sec dip in 500 ppm IBA/500 ppm NAA in 50% ethanol. However, less woody material may respond to lower auxin concentrations since *Telopea* may be struck at more moderate IBA levels of 2000 to 3000 ppm with toxicity occurring above 4000 ppm (Worrall, 1976).

MICROPROPAGATION

Two experiments were performed concentrating on the stages of initiation and multiplication. It was found that pre-treatment of *A. flammeum* material with gibberellins (GA_{4+7}) prior to initiation into culture improved the success of initiation. It was also established that a higher quality of explant is achieved using stem segments taken from the tip and a few centimetres below for initiation, and 1% bleach for 15 minutes is adequate for surface disinfestation of material. These results are similar to those for *Telopea* (Offord et al., 1992) and there is potential to use growth regulator pre-treatment for preparation of many other woody species.

The value of BA (6-benzyladenine), 2iP (6-dimethylallyaminopurine), and TDZ (thidiazuron) as growth regulators for shoot multiplication in vitro was investigated. BA at 0.6 μM produced the best results for *A. flammeum* explants. This concentration of BA is lower than the 1.25 μM used for *Telopea* (Offord et al., 1992), but is closer to that used for some other Proteaceous species such as *Stirlingia latifolia* which prefers 0.5 μM BA (Bunn and Dixon, 1992). 2iP produced good elongation and quality of shoots, but the shoot number was not as high as for BA. TDZ, even at the lowest end of the accepted working concentration (0.035 μM) produced very bushy explants with many short unusable shoots. Preliminary studies suggest that rooting conditions for *A. flammeum* explants are similar to those required by *Telopea* (Offord and Campbell, 1994).

Propagation of *A. flammeum* was achieved in this study by cuttings and tissue culture. Basic parameters for propagation by these techniques have now been established and the system chosen by plant propagators will depend on the number of plants required and the facilities available. Studies on postharvest and cultivation across a range of environment and cultural regimes should be the next stage in the development of tree waratahs.

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LITERATURE CITED

Briggs, J.D. and **J.H Leigh.** 1996. Rare and threatened Australian plants. (rev. ed. 1995) CSIRO Australia.

Bunn, E. and **K.W. Dixon.** 1992. Micropropagation of *Stirlingia latifolia* (Proteaceae), an important cut flower from Western Australia. HortScience 27(4):368.

Burnett, J. and **M.G. Mullins.** 1985. Cultivation of the waratah as a commercial flower crop. Proc. Aust. Flora Found. Nat. Symp., Canberra.

Gollnow, B., R. Worrall, and **G. Ireland.** 1995. Development of Australian Eastern coast species for floriculture in both domestic and export markets. NSW Agriculture.

Offord, C.A., L.C. Campbell, and **M.G. Mullins.** 1992. Micropropagation of *Telopea speciosissima* R.Br.(Proteaceae) 1: Explant Establishment and Proliferation. Plant Cell, Tissue and Organ Culture 29:215-221.

Offord, C.A. and **L.C. Campbell. 1994.** The Waratah: Taming of an emblem. Aust. Hort. 92(9):52-57.

Worrall, R.J. 1976. Effects of time of collection, growing conditions, and growth regulators on rooting of cuttings of *Telopea speciosissima*. Scientia Hort. 5:153-160.

Worrall, R.J. 1983. Growing waratahs commercially. Aust. Hort. 81(8):9-103.

Worrall, R.J. 1994. Growing waratahs. Aust. Plants 81:17-21.

Wrigley, J.W. and **M. Fagg.** 1988. Australian native plants. Collins, Sydney.