Chapter 1
Introduction

The New South Wales (NSW) waratah *Telopea speciosissima* is an Australian native species cultivated for domestic and export cut flower markets. The waratah inflorescence is subtended by showy floral bracts, which often suffer from browning or 'burn' prior to harvest, significantly reducing flower quality. The total value of lost production due to bract browning is likely to increase in the future, with increasing numbers of waratahs planted in NSW in the last five years. International and domestic markets demand high quality blooms, therefore, reducing bract browning and improving flower quality is a high priority. Cultivation of waratahs also reduces pressure on wild populations, which continue to be harvested in spite of legislation prohibiting bush picking.

The agronomic requirements for commercial waratah production have become increasingly better defined in the last ten to fifteen years (Mackenzie, 1987; Offord, 1996). However, practices to maximise waratah flower quality and increase the duration of the flowering season require further refinement (Gollnow, 1996; Gollnow and Worrall, 2000; Criley, 2001). Waratahs are generally grown as field crops, although some plantations are protected with shade cloth or natural or artificial windbreaks. While anecdotal evidence suggests better waratah quality with protection and shading (Offord, 1996; Nixon, 1997), the physiological cause of this response is unknown and the increase in quality has not been quantified.

Bracts are modified leaves, although some characteristics are likely to be shared with sepals and petals. Leaves and bracts have morphological similarities, but differences in pigmentation, photosynthetic yield and light requirements for saturation of photosynthesis have been recorded in comparisons of leaf, bract and floral tissues in other species (Bondada, 1994; Khoo *et al.,* 1997; Wissemeier and Marienfeld, 1998). Bract morphology in waratahs requires further description, as differences in bract form within an inflorescence and between cultivars have been reported (Nixon, 1997).

Waratah bracts are vulnerable to damage over a long period of time, as they protect the developing flower head for seven to eight months between late summer and early spring. However, information on the timing, severity and appearance of bract browning is lacking and will be studied during this project. The trigger for bract browning has not been identified, although many environmental factors have been implicated in its development. These factors include heat, water stress, wind, and frost followed by strong sunlight (Worrall, 1983 and 1994; Mullins, 1987; Burnett and Nixon, 1990; Offord, 1996; Nixon, 1997). Browning and necrosis in other flower and fruit crops, caused by similar phenomena, is often linked to localised calcium deficiency or photoinhibition. Photoinhibition often affects shade-adapted plants (Powles, 1984; Osmond, 1994) and floral tissues more severely than leaf tissues (He *et al.* 1998). Chronic photoinhibition is caused by high light alone, or in combinations with other stresses (Powles, 1984), and can cause a cascade of reactions leading to cell damage and browning (Chow, 2001).

Literature on browning in other crops will be used as a basis to further examine the physiology of waratah bract browning. The calcium content of waratah bracts will be measured, to determine whether localised calcium deficiency may trigger browning.

Bract pigmentation during flower development will also be investigated, to characterise the pigments present in bracts and determine whether changes in chlorophyll or anthocyanin content are linked to possible photoinhibition and browning. Photoinhibition will be measured using chlorophyll fluorescence techniques, as described by Maxwell and Johnson (2000).

Waratahs are perennial shrubs with one main flowering period each year, peaking in September and October. These seasonal limitations meant that only one experiment at each study site was possible each year, except in 2001, when calcium experiments and factorial light and irrigation frequency experiments were conducted simultaneously.