Grafting Australian Native Plants

This paper reviews published information and records from the Australian National Botanic Gardens on grafting Australian native plants. Potential implications for ornamental horticulture and the cut flower industry are discussed. The domestication and improvement of native plants for the cut flower and nursery industries have emphasised the selection and development of new species, propagation, disease resistance, and agronomy. A major concern for growers is minimising costs by increasing productivity per square metre per annum. This involves faster growth, and reduced losses from disease or poor propagation. Maximising prices by improving plant quality and matching production to demand are also of major importance. In addition in the production of cut flowers there are problems with the longevity of some crops (eg *Boronia*), and long term survival and plant hardiness also influence purchasers of landscaping plants.

Grafting of desirable forms or species on to different rootstock has been used for centuries to address these problems for other crops. Careful selection of rootstock has been demonstrated to confer pest and disease resistance, increased cold, soil type and pH tolerance (extended geographic range), greater productivity (more vigorous growth) and increased life span (see Hartmann and Kester, 1975). Many species that do not root well from cuttings may be vegetatively propagated by grafting. Some species can be made to flower earlier (eg Wisteria), and it is also possible to dwarf plants with appropriate rootstock (eg apples).

In view of these potential benefits, which have often been canvassed (eg Wrigley, 1973; McCredie et al, 1985; Lewis, 1986; Boorman, 1991), it is surprising that more use has not been made of the technique for Australian plants, particularly as so many of them appear to have very specific soil requirements or are susceptible to Phytophthora and other root pathogens. Generally grafting has been most successful with plants which are very important horticulturally (eg roses, apples), which have a dormant period, and where there has been a long term commitment to trials. The relative neglect of most Australian species may therefore be because of the relatively small market for so many species, the predominance of evergreen species, and the relative youth of an industry that requires mass production of a single species. Other factors that may have contributed to the relative neglect of grafting are the skill level required, the cost and time required for production, problems of re-shooting of rootstock, and the lack of good information on suitability of rootstock. Propagation benefits have also been overshadowed by tissue culture, which has been more fashionable in recent years, and smoke stimulated seed germination.

Some nurseries have been quite successful in grafting Australian plants but this is still on a small scale and for only a limited number of genera (eg *Boronia* and *Darwinia*). Commercial flower growing has so far made little use of the technique but there appears to be demand for more grafted plants as many growers have complained that grafted stock is in short supply.. The Sapphire Coast flower growers group in NSW is trialling a number of species (mainly *Boronia*, *Hakea* and *Eremophila*), and there have been attempts to graft *Chamelaucium* on to Phytophthora resistant rootstock at Gatton (Qld).

Research into grafting Australian plants has usually been small scale, piecemeal, often poorly controlled from the scientific standpoint, and poorly communicated. For example, only one of the papers listed in the bibliography below is from a refereed journal. In addition most projects have not been followed up over a sufficiently long period of time to judge the success of grafts properly. Most published papers only describe initial successes with grafting and do not revisit plants some years later. In this era of quality assurance it should be essential for sellers of plant material to indicate the expected performance of their products, but perhaps fear of litigation works against this! Table 1 summarises the published information on survival

beyond 2 years, but that is only part of the story. For example, the general tone of most published information on Banksia grafting might lead one to expect that it had been extremely successful. However, despite surviving for over 20 years, several banksias in the ANBG collection have not been vigorous growers and there are signs of incompatibility. McKenzie (pers. comm., 1996) also only claims *Banksia solandri* as a complete success from all the species of *Banksia* he reported in 1984.

Experience at ANBG from the late 1960s to the present serves as a good example of the benefits of grafting, and we are fortunate to have an excellent record keeping system to study the long term survival of our plants. Grafting was a response to the difficult climatic and soil conditions at Canberra which are generally not ideal for a national collection. Canberra has hot summers and cold winters. The mean absolute maximum is 37C, which is not very different to most other cities in Australia, but the mean absolute minimum is less than -6C, which is by far the coldest for a capital city. There are over 90 frosts per annum. Annual rainfall is 638mm and is evenly distributed, however potential evaporation exceeds rainfall by a factor of 3 (1720mm p.a.) so irrigation is needed for plant growth in summer. The site is on the eastern side of Black Mountain and has a range of aspects from northerly to south - westerly. It is sheltered from prevailing winds from the west and north west. This, and an altitudinal range of 520 to 706 m allowing cold air drainage, makes the site warmer than most other locations in Canberra and gives a good range of microclimates, but it is still cold in comparison to many parts of Australia.

The natural soils are red/yellow earths and red earth/ red podzolic soils with associated lithosols and some siliceous sands (Lester Firth and Associates, 1984). The upper horizons tend to be coarse textured and allow rapid infiltration of rain water despite the steep slope. However, many areas remain waterlogged for several days after rain because of impermeable subsoils. *Phytophthora cinnamoni* and *Alternaria* sp. are common pathogens.

Under these environmental conditions grafting allows the cultivation of species that otherwise would not grow on the site. For example, many Western Australian banksias will not survive in Canberra on their own roots but will on those of eastern *Banksia* species such as *B. ericifolia* and *B. spinulosa* . However, as mentioned previously, despite survival of some species for up to 24 years further work is needed to better match the growth rates of rootstock and scions.

Much of the *Prostanthera* collection is also grafted. *Prostanthera* species are usually short lived. However by grafting *Prostanthera nivea*, for example, on to *Westringia fruticosa* some plants have survived 24 years so far. ANBG also has an excellent collection of 'difficult' *Eremophila* species which are invariably grafted onto *Myoporum insulare*.

Apart from allowing the cultivation of plants that either will not survive at all or are short lived, another major reason for grafting at ANBG has been to propagate and conserve rare or threatened species. Several examples are listed in Table 1.

Propagation by grafting of desirable forms that can not be propagated any other way is an important commercial application for this technique. For example we have grafted an *Angophora costata* with variegated leaves on to the roots of the common form of *Angophora costata*. We were unable to root this species from cutting and seed was not appropriate to conserve the character. Another application has been to create a standard form of*Grevillea* x *gaudichaudii* by grafting it on to *G. robusta* (see Burke, 1983).

In future I expect that grafted stock will become more common in the flower industry, particularly as advances in seed germination will greatly increase the variety and number of scions and rootstock available, especially for some types of micrografting where seedlings are grafted onto seedlings. However, the current quality of published work in this area is inadequate for the needs of the industry. I hope that the data presented in Table 1 can be improved and expanded to incorporate details of compatibility and plant performance as well as include the records of other institutions and individuals. It would then be a valuable resource for the entire ornamental plant industry. Research in Israel and South Africa on grafting proteaceous plants (including *Banksia*) indicates that grafting is seen in those countries as a promising tool for the development their flower industries (Malan, 1992; Ben-Jaacov et al, 1989). It is time that Australia

also took grafting seriously, rather than leaving it to often talented and industrious but, usually, amateur scientists. This will not happen unless the industry makes a long term commitment to research in this area.

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