

A Review of Factors Affecting the Establishment of Magnolias in New Zealand

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INTRODUCTION

It was noticed that several grafted plants within the Lincoln University magnolia collection had performed poorly or died. It was decided to examine the possible reasons for this and to evaluate other plantings with the objective of explaining why these problems of establishment have occurred, so that recommendations can be made to help improve the success in establishing magnolias in the future.

PROPAGATION METHODS

A wide range of magnolias are commonly grafted (mostly by chip budding) onto rootstocks in New Zealand. Hooper (1990) discussed the grafting of magnolias and reported on the growth of several understock/scion combinations at one nursery. Up to the early 1950s most deciduous magnolias were grown from layering (Hillier, 1950) but Johnstone (1955) records how grafting was also becoming an important method of propagation. One experienced nursery person commented that the "early" layered magnolias, like *Magnolia campbellii*, had established really well; however later grafted plants of this species, have suffered several losses during establishment (Hughes, pers. comm.). Clones of *M. grandiflora*, *M. sieboldii*, *M. ×soulangiana*, and *M. stellata* (syn. *M. kobus* var. *stellata*), as well as Gresham hybrids, are now commonly grown from cuttings. Callaway (1994) states "today propagation by cuttings is the most common form of vegetative propagation, though some *Magnolia* species and cultivars, such as, *M. denudata* still remain difficult to root by this means." Early methods of commercial production by grafting, which began about 40 years ago, were approach and veneer grafting (Hillier, 1950). Chip budding has now become a very popular and successful means of propagation for the grafted species (Callaway, 1994; Itaya, 1981; Knuckey, 1969; Lane, 1993; Tubesing, 1987).

SURVEY RESULTS

A survey was carried out whereby a range of magnolia growers were asked for their observations on problems in establishing these plants. In addition the Lincoln University and Trott's Nursery plantings were visited and plants measured and evaluated (only conclusions from this are included generally within this article).

Legend: C indicates species or hybrids of *M. campbellii*.

- Auckland Botanic Gardens, Auckland.
Generally good establishment of *M. campbellii* hybrids particularly if open-ground stock planted in good soils with shelter (Hobbs, pers. comm.).
- Blue Mountain Nurseries, Otago. Magnolias that have died:

<i>M. campbellii</i> ssp. <i>mollicomata</i>	C
<i>M. campbellii</i> ssp. <i>mollicomata</i> 'Strybing White'	C
<i>M.</i> 'Mark Jury'	C

All these plants appeared to establish but then experienced scion death after 2 years with the rootstock remaining alive.

- Dunedin Botanical Gardens, Otago. Magnolias (examples only) that have died:

<i>M.</i> 'Athene'	C	
<i>M. campbellii</i> ssp. <i>mollicomata</i> 'Lanarth'	C	*
<i>M.</i> 'Serene'	C	

* This cultivar has failed three times, with the fourth plant currently growing well (Matchett, pers. comm.).

- Elliott's Nursery, Canterbury. Magnolias (examples only) that have died:

<i>M.</i> <i>xbrooklynensis</i> 'Woodsman'
<i>M.</i> 'Susan'

Both plants were planted on a moist bank (Elliott, pers. comm.).

- Lincoln University, Canterbury. This collection consists of 80 plants which were mostly planted between 1990 and 1992. Magnolias that have died:

<i>M. acuminata</i> 'Golden Glow'		**	#
<i>M.</i> 'Atlas'	C		
<i>M.</i> 'Caerhays Belle'			
<i>M. campbellii</i> ssp. <i>mollicomata</i>	C		
<i>M. campbellii</i> ssp. <i>mollicomata</i> 'Lanarth'	C		#
<i>M. campbellii</i> ssp. <i>mollicomata</i> 'Strybing White'	C		#
<i>M.</i> 'Lotus'	C		
<i>M.</i> 'Mark Jury'	C		#
<i>M.</i> 'Milky Way'	C		
<i>M.</i> 'Spectrum'			
<i>M. sprengeri</i> 'Diva'			
<i>M. xsuishoren</i>			

** This plant flowered in its 2nd and 3rd years but the scion (only) died the following winter with the scion height at 2.06 m.

These plants later sent up suckers indicating scion death only. Most graft unions were measured and assessed for growth characteristics. Unions were generally smooth and in most cases the diameter of the stock was greater than that of the scion. One exception to this was the marked overgrowth of 'Mark Jury' compared to the stock.

- Tikitere Gardens, Rotorua. Magnolias (example only) that have died:

<i>M.</i> 'Vulcan'	C
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There had been several failures with container-grown stock, especially plants with *M. campbellii* "blood", particularly *M.* 'Vulcan'. Open-ground plants were found to establish more successfully (Robinson, pers. comm.).

- Trotts Nursery, Canterbury. Magnolias that have died:

M. acuminata

Mostly container-grown stock which have all established well, including *M. campbellii* hybrids (Trott, pers. comm.). About 30 plants were measured to compare the diameter of stocks and scions close to the graft union. Matching was generally excellent with little overgrowth and smooth unions.

REASONS FOR FAILURES

Species and Cultivars. There was a very high proportion of magnolia losses that were *M. campbellii* or cultivars directly related to this species, as indicated in the survey list. *Magnolia campbellii* ssp. *mollicomata* 'Lanarth' is an example of a cultivar that has proved particularly difficult to establish. At the Dunedin Botanic Gardens they are currently attempting to grow their fourth plant of this cultivar having failed with the previous three (Matchett, pers. comm.). It was also noted, in the survey, that *M.* 'Vulcan' had given repeated failures and this hybrid has 'Lanarth' as one of its parents. *Magnolia campbellii* ssp. *mollicomata* 'Strybing White' is another cultivar that has been noted to often give problems in establishment (Rumbal, pers. comm.). Further comment on individual species can be found under subsequent sections.

Soil and Climate Effects. Several plants that died were grafted ones where the scion died but the rootstock remained alive. Frost killing the top of the plant is a possibility. Harrison (1967) comments that there are several forms of *M. campbellii* grown in New Zealand and that the one most propagated in nurseries is the more tender Yunnan form. He states that the previous season's young growths can be badly damaged by frost. Hillier's Manual of Trees and Shrubs (Anon, 1977) also states that there is a considerable variation in the degree of hardiness. However, Fleming (1989) pointed out the value of grafted plants compared to cutting-grown plants of identical clone and grown in the same area were observed to be much less hardy than those that had been grafted. One would expect that planted magnolias would establish more readily in the warmer and more favourable climates of the North Island of New Zealand than in the South Island, although the climate in the latter is still a good deal more favourable than situations in the British Isles where so many species have been successfully established. The dry summer conditions in Canterbury are also a big contrast to the natural habitats of species like *M. campbellii* which comes from conifer-clad mountain slopes of southern China to a height of 3000 m or more (Treseder, 1978) but this should not result in death. There are very suitable conditions in autumn in Canterbury for the ripening of wood, a factor which has proved important for plants to avoid frost injury in England (Millais, 1927).

In the magnolia collection (over 100 plants) at the Auckland Botanic Gardens it has been noted that soil type and shelter are major factors in the establishment and successful growth of plants (Hobbs, pers. comm.). Plants grown in deep open soils tend to do well while those plants in sheltered areas have a much greater chance of success. It had been noted that magnolias on good soils, but exposed to the wind, would usually sulk and often die. This clearly concurs with Millais's (1927) statement that the rate of growth of magnolias depends entirely on their cultivation, situation, and climate.

Graft Incompatibility. The recorded evidence in the literature concerning incompatibility problems in magnolias does not appear to be strong or widespread. However, Humphrey (1966) reported that Hillier's nursery in England needed to grow five different stocks of magnolia in order to avoid incompatibility. Also Nelson's (1968) summary of incompatibility in grafted horticultural plants does record several instances. This review specifically states that *M. acuminata* and *M. campbellii* have been recorded as showing incompatibility with *M. ×soulangiana*

stocks. In contrast, and only a year later, there was a report on the ease of budding magnolias in which there was no mention of incompatibility even between evergreen and deciduous species, citing the example of *M. grandiflora* budded onto the deciduous stock, *M. kobus* (Knuckey, 1969). More recently Tubesing (1987) stated that he knew of no cases of intraspecific graft incompatibility in the genus *Magnolia*, such as occurs in *Acer rubrum*. Unsightly unions formed when *M. campbellii*, *M. sprengeri*, etc, were grafted onto *M. kobus* or *M. ×soulangiana*, but were not seen as a sign of incompatibility. In a recent report on chip budding of magnolias, Lane (1993) commented on the desirability of having stocks and scions of close genetical affinity, but again there was no information on actual problems. This was also the case for a New Zealand study recording the use of different magnolia clonal rootstocks (Hooper, 1990).

It appears that there is general acceptance of the fact that graft incompatibility in magnolias is seldom a problem and the genus has high affinity even between widely differing species. *Magnolia campbellii* is readily grafted onto *M. ×soulangiana* as reported by Hooper (1990) and there are also many other successful combinations, even between deciduous and evergreen species. Treseder (1978) also states that even though some people surmise that there are problems, "there is no evidence of graft incompatibility". Callaway (1994) in her recent book on magnolias summarises this situation by stating that some graft incompatibilities do arise where there are differences in growth between stock and scion which may result in a weak union. Also, the comment was made that graft incompatibilities are not as common with magnolias as with other genera, such as maples, so grafted magnolias are usually successful if the process is carried out correctly. It is noteworthy that of the many recent articles on magnolia grafting there is little or no emphasis on the danger or risk of graft incompatibility in magnolias.

However, there are some losses that are hard to explain other than incompatibility since only the scions died up to 3 years after planting, while often extensive suckering occurred from the rootstock. For example, *M. acuminata* 'Golden Glow' was planted at Lincoln University in 1990 (Edwards, 1994) and recorded as having flowered in 1991 and 1992. The scion died in 1993 when at a height of 2 m while the regrowth of the rootstock is now almost 2 m high and growing strongly. The cultivars 'Lanarth' and 'Strybing White', which are both selections of *M. campbellii* ssp. *mollicomata*, also showed scion death at Lincoln University and have since produced basal shoots from the stock. The latter cultivar had flowered in its second growing season but failed to grow after that. Sectioning of graft unions of some plants indicated that in the case of 'Lanarth' and 'Golden Glow' there is a strong indication of graft incompatibility due to the distinct dark colouring in the tissues shown in Fig. 1. This darkened area appears to indicate graft incompatibility and was completely absent in the section taken from *M. 'Caerhays Belle'*. There is, therefore, some evidence that graft incompatibility is a factor in the early death of some plants, particularly 'Lanarth' and 'Golden Glow'. Callaway (1994) has also stated that delayed incompatibility does occur and that cutting propagation, where possible, has the advantage of avoiding this problem.

Disease Losses. Magnolias are subject to a range of diseases, many of which are leaf spots and die-back disorders (Callaway, 1994; Pirone, 1978). Severe losses occurred with a planting of *M. grandiflora* in recent years in Canterbury (Morgan, pers. comm.). This was identified in the laboratory as *Verticillium* wilt, a disease that

has been noted on magnolias overseas (Pirone, 1978). However, no wilt symptoms were noted as occurring on any of the deciduous plants included in the survey, also there were no *M. grandiflora* losses. Some plants at Lincoln University have shown scion death followed by regrowth of the rootstock and as stated above there is some evidence to link this with graft incompatibility. Other possibilities are that disease could have entered the top part of the plant resulting in scion death but not root death. *Magnolia campbellii* (and others) may have greater susceptibility to this type of disease attack. Several plants at Lincoln University show tip die-back which results in dead wood for 10 to 15 cm from the ends of shoots. Growers (Blumhardt, pers. comm.; Hooper, pers. comm.) have noted major die-back on well-grown species of *M. campbellii* which was thought to be *Verticillium* wilt. Blast (bacterial wilt, *Pseudomonas syringae*) has been identified and recorded as a pathogen on magnolias in New Zealand and is a possible reason for scion death, however, Callaway (1994) only records this as causing leaf spots. A further consideration may be that systemic diseases like *Verticillium* wilt could readily be transmitted on budwood.

Transplanting Loss. Millais (1927) begins this topic in his book by saying: "Practically the only difficulty with magnolias is to get them established after planting." The roots are thick, fibrous, and fleshy, and it is important to avoid damaging the soft and fragile roots of young seedlings when potting (Bean, 1973; Treseder, 1978). Damage could be done by rough handling or excessive firming. It is most important to avoid planting too deeply and to plant sensitive species preferably in late winter to early spring (Huxley et al., 1992; Millais, 1927; Treseder, 1978). Several authors also recommended deep cultivation in the planting hole, incorporation of organic matter, and the value of mulching. The Royal Horticultural Society Dictionary of Gardening (Huxley et al., 1992) states that planting too deep is one of the most common causes of poor growth or even subsequent death in newly

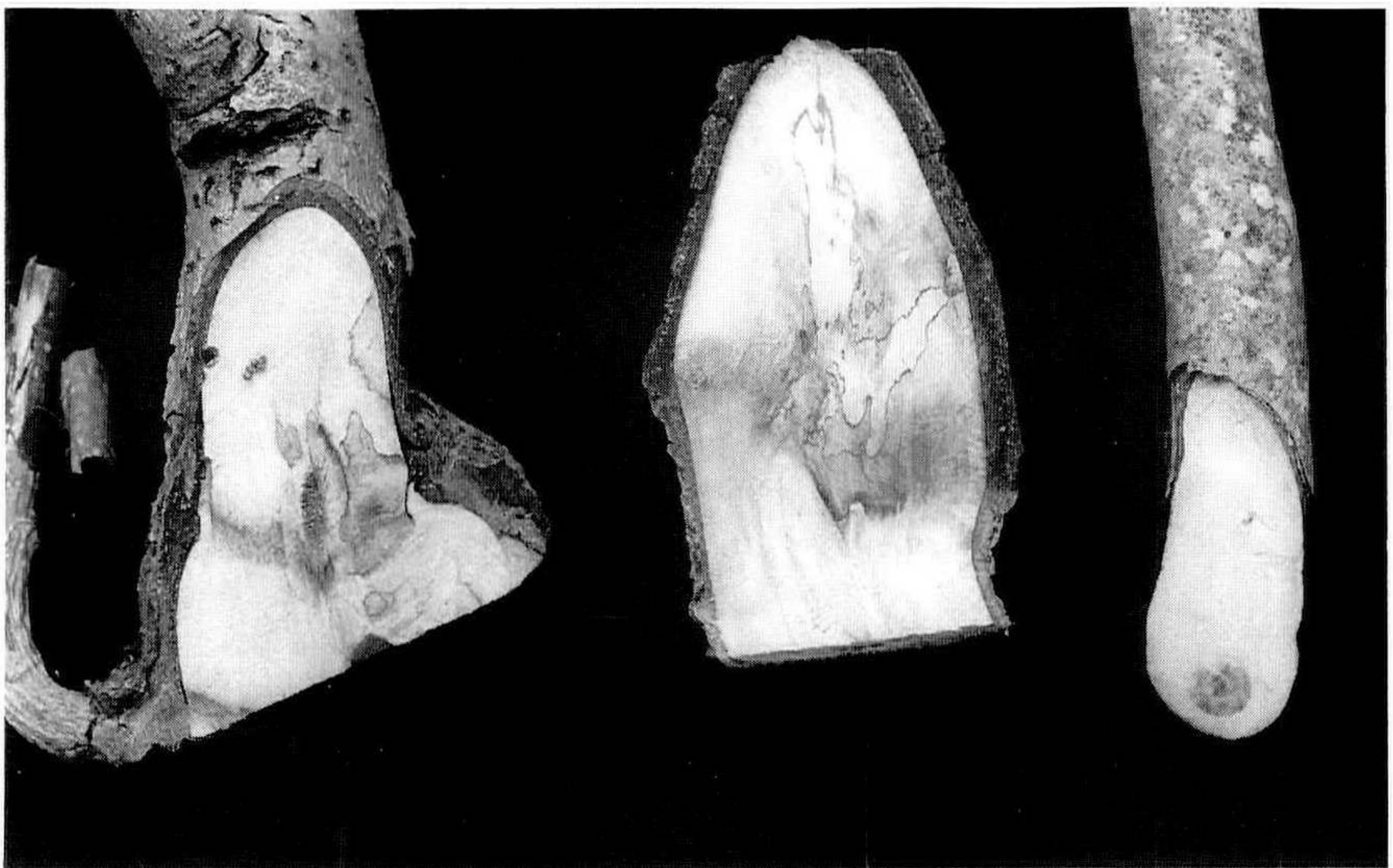


Figure 1. Cross sections of the graft unions of three cultivars of magnolias. Left to right: 'Lanarth', 'Strybing White', 'Caerhays Belle'.

planted magnolias. Young plants are probably more prone to loss than large plants since there are accounts of moving large specimens, for example a 10-metre-high specimen of *M. campbellii* was successfully moved from England to Ireland on a truck (Treseder, 1978).

Harrison's (1967) comments on transplanting and establishment of magnolias are worthy of special attention as they link several factors together. He states that these plants are quite easy to grow in any good free-draining soil but in districts with very cold and wet winters, losses often occur during transplanting. This is due to the fact that the fleshy roots, damaged by lifting and handling, die back from the cut and bruised portions, and under such conditions spring planting is best. Huxley et al. (1992) suggest that to leave the planting until the sap begins to rise, as is sometimes advocated, is doubtful advice. Harrison (1967) also states that *M. campbellii* and the *M. stellata* forms are particularly subject to root collapse under such conditions.

CONCLUSIONS AND RECOMMENDATIONS

The difficulty of assessing the cause of losses is compounded by the fact that certain species are sensitive to transplanting shock, so that although genotype is probably the key factor in incompatibility problems, the genetic constitution is also very significant in being the cause behind many failures to establish magnolias. Based on this review it was noted that a large proportion of the losses involved species and hybrids of *M. campbellii* and clearly the "blood" of this species does confer a weakness in the establishment phase.

It is probable that graft incompatibility was the cause of the death of the scions in those cases where the rootstock remained alive and sent up suckers. In the majority of cases, where the whole plant died, causes other than graft incompatibility are likely. Disease infection of the scions is considered another possibility (disease attacking the scion of a grafted plant is not strictly graft incompatibility unless the graft union is affected). It is suggested that this again indicates the sensitivity of *M. campbellii* and that in this case it is disease susceptibility. Graft incompatibility and disease susceptibility would appear to warrant further study to establish their relative significance.

It is recommended that nurseries take special care with the production of magnolias, and especially grafted *M. campbellii*, so that they are produced with healthy compatible root systems and not allowed to become pot bound or lacking in vigour in the nursery. Growing advice needs to be passed on to customers to help minimise losses, especially on *M. campbellii* plant labels, etc. Such aspects as site selection, shelter, soil preparation, and planting depth, need to be publicised through educational pamphlets and labels.

Finally, the authors acknowledge that some conclusions and evaluations of factors causing losses have been rather speculative given the lack of conclusive evidence. Clearly more research is needed. We **would greatly appreciate receiving comments** and observations from magnolia growers around the world so that we can continue to "seek and share" and fulfill this noble aspiration of our society, for the establishing of magnolias is clearly one of the most dominant problems which stand in the way of more widespread use of these magnificent plants.

Epilogue: A valuable comment was made after the conference paper by Phil Carson. He pointed out that he had looked on *M. campbellii* as a plant with a root system that never seemed to really go dormant. This means that the fleshy roots are

very subject to damage when transplanting is carried out, since the roots always have some degree of activity.

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