

11. Garner, R.J. and Hatcher, E.S.J. 1955. The Interplay of factors influencing rooting behaviour of shoot cuttings. *Inter. Hort. Congress* 1:204-214.
12. Gorst, J.R., Bourne, R.A., Hardaker, S.E., Richards, A.E., Dircks, S., and de Fossard, R.A. 1978. Tissue culture propagation of two *Grevillea* hybrids. *Proc. Inter. Plant. Prop. Soc.* 28:435-446.
13. Hartmann, H.T. and Kester, D.E. 1975. *Plant Propagation: Principles and Practices*. 3rd ed. Prentice Hall, Englewood Cliffs, New Jersey.
14. Ivey, I.D. 1979. Feijoas: selection and propagation, *Proc. Inter. Plant Prop. Soc.* 29:161-168.
15. Larkin, P.J. and Scowcroft, W.R. 1981. Somaclonal variation — a novel source of variability from cell cultures for plant improvement. *Theor. & App. Genetics* 60:197-214.
16. Mosse, B. and Labern, M.V. 1960. The structure and development of vascular nodules in apple bud unions. *Ann. Bot.* 24:500-507.
17. Ooishi, A., Machida, H., Hosoi, T., Komatsu, H. 1978. Root formation and respiration of cuttings under different temperatures. *J. Japan Soc. Hort. Sci.* 47(2):243-247.
18. Shippy, W.B. 1930. Influence of environment on the callusing of apple cuttings and grafts. *Amer. Jour. Bot.*, 17:290-327.
19. Skirvin, R.M. and Janick, J. 1976. A tissue culture induced variation in scented *Pelargonium* spp. *J. Amer. Soc. Hort. Sci.* 101:281-290.
20. Skirvin, R.M. and Janick, J. 1976b. 'Velvet Rose' *Pelargonium*, a scented geranium. *HortScience*, 11:61-62.
21. Wells, J.S. 1962. Wounding cuttings as a commercial practice. *Proc. Inter. Plant Prop. Soc.* 12:47-55.

PROPAGATION OF PIN OAK (*QUERCUS PALUSTRIS*) TO PREVENT WINTER LEAF RETENTION

R. BODEN, J.H. FRYER, AND G. KING

*Department of the Capital Territory
Canberra, A.C.T.*

INTRODUCTION

The pin oak (*Quercus palustris*) is a tree of considerable amenity value in the cooler areas of southeast Australia. It is vigorous and hardy on most soils, it is quite drought tolerant and gives heavy summer shade and brilliant autumn colours. To date it has shown only a low susceptibility to the oak leaf miner.

However pin oak has one obviously unattractive habit. In mature trees the upper crown loses its leaves in late autumn but most of the dead leaves on the lower crown persist and are shed gradually during winter and spring, giving the tree a rather tattered appearance for much of this period. This gradual loss of leaves necessitates a number of winter clean-ups by residents or park authorities, rather than one concerted effort in autumn.

The habit of winter leaf persistence was investigated by Scaffalitzky de Muckadell (1) in the European beech (*Fagus sylvatica*). He showed that growth from scions taken from the upper part of the tree of this species, when grafted onto seedling rootstocks shed all their leaves in autumn, while growth from scions taken from the lower part of the tree retained their foliage throughout the winter. These differences were attributed to the different physiological ages of the scion material. Scions from the lower crown had apparently retained the juvenile characteristic of winter leaf-retention.

AIM OF STUDY

A trial was established in 1965 by the Research Unit of Canberra's City Parks Administration to determine whether winter leaf persistence in pin oak is a function of physiological age and, if so, whether this phenomenon could be used to improve the habit of the species as an amenity specimen.

METHODS AND MATERIALS

In 1965, 1966, and 1967 a total of six large pin oak trees were selected in Canberra on the basis of health, shape, and autumn colour. Scions from the upper and lower levels of the crowns of each tree were collected from October to January (spring to mid-summer) each year and grafted onto open-rooted seedling stock. Tip cleft grafts, side cleft grafts, and budding were used. The plants were lined out in nursery beds for observation and in 1970 all surviving stock was planted out with a seedling control on an unwatered site in Canberra for long term study.

By autumn 1968, differences in leaf fall pattern were noticeable between grafts taken from the different parts of the crown. Thorough assessments were made in 1972, 1973 and 1976, recording height, autumn colour, and percentage defoliation throughout the winter period.

RESULTS

The success of budding and grafting was only 29% for 1965, the only year for which records of losses were kept.

The results of height growth and defoliation habit of each clone, as well as the control, for 1973 and 1976 are summarized in Table 1.

Table 1. The effect of origin of scion material on height growth and defoliation habit of grafted pin oak trees.

Clone No.	Origin of scion within crown of parent tree	Mean Height (meters)		Mean percent of leaf loss per tree by 1st June (early winter)		Percent of trees totally defoliated by 1st June (early winter)	
		1973	1976	1973	1976	1973	1976
		101	Upper	4.1	5.0	100	100
101	Lower	4.0	5.2	20	56	11	11
102	Upper	3.4	4.6	100	100	100	100
102	Lower	3.5	5.2	85	96	71	49
103	Upper	3.3	5.0	100	100	100	100
103	Lower	3.6	5.2	22	40	11	0
104	Upper	3.7	5.0	100	100	100	100
104	Lower	3.6	4.8	62	54	25	0
105	Upper	3.3	4.4	100	100	100	100
105	Lower	3.0	5.3	66	63	33	0
106	Upper	3.3	5.3	100	100	100	100
106	Lower	3.0	4.7	50	30	0	0
Seedlings		2.2	4.0	93	30	85	0

DISCUSSION

The poor survival of grafts in 1965 may be attributed to the late season of grafting. Recent communication with nursery propagators indicate that propagation of pin oaks by budding usually gives close to 100% success.

The defoliation habit of grafts from the upper crown was most encouraging. Without exception these grafts have shed all their foliage by late autumn, in a similar fashion to most deciduous trees. This has been the case for as long as observations have been recorded (since 1970). Grafts from the lower crown have consistently shown the juvenile characteristic of varying degrees of leaf retention over the winter. The contrast in the two habits is shown in Figure 1.

Other characteristics of the grafts are not significantly different from seedlings. The form of grafts from both upper and lower crown levels appears to be less pyramidal than seedlings but the difference is not marked. There is a tendency for grafts to form low multiple leaders and heavy lower branches, a habit that can be corrected with simple tree surgery at an early age. To date there has been no evidence of intraspecific graft incompatibility.

Since 1980 the Government Nursery at Yarralumla, A.C.T. has been producing a proportion of their pin oak stock by budding tissue collected from the upper crown levels of select-



Figure 1. Ten year old grafted pin oak trees showing defoliation habit of upper crown scion wood (left row) and lower crown scion wood (right row), in mid-winter.

ed trees. The success rate from budding has been very high and it has been reported that budded stock has a first year growth rate far higher than that of seedlings.

CONCLUSIONS

The habit of winter leaf retention in pin oaks can be effectively eliminated by propagating adult tissue from the upper crown of mature trees onto seedling rootstocks. The technique appears to be technically and economically feasible as a routine nursery procedure. It is possible to produce both persistent and early deciduous leaf types to allow landscapers the choice of both forms, as well as allowing selection for other attributes, such as autumn colour.

LITERATURE CITED

1. Scaffalitzky de Muckadell, M., 1954. Juvenile stages of woody plants. *Physiol. Plant.* 7:782-786.