

then placed the tubes in an incubator with a 16-hour/day illumination.

No contamination occurred but unfortunately no growth either. This was possibly due to the procedure not being attempted at the correct time. It may be better to use plants which have overwintered outside, and to attempt the method in the spring. We hope to continue with this by contacting the U.S.A. speaker.

4) *Leaves*. As this plant is a member of the Liliaceae it was decided to try the individual leaves in a manner similar to lily scales. Some leaves stayed alive for several weeks but no sign of regeneration occurred.

5) *Roots*. These were made into root cuttings but again no success.

In Conclusion. Until we can be successful with *in vitro* culture we concluded that by very thorough washing of the lifted plants which revealed many more buds than first apparent, it is possible to use a single bud + roots which did make reasonable sized plants and in fact were sold in July. The plants in the frame also developed well but would have to be left for a season before being lifted and potted up or planted out.

LITERATURE CITED

1. Dictionary of Gardening. Royal Horticultural Society, London. 1951.

PRODUCTION OF EUCALYPTUS

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The eucalyptus embody many of the desirable characteristics that a diligent plant breeder would endeavor to collect into one plant, if set the task of breeding a modern tree. They are evergreen, fast growing and virtually without pests and diseases in this country and have both amenity and forestry values. Nevertheless eucalyptus are not as widely planted as they should be. A popular misconception is that they are soft and will not grow in the greater area of the British Isles. Our experience suggest that with the proper seed provenance and exact cultural programme, excellent results can be obtained with eucalyptus.

Eucalyptus have many modern potential uses because of their rapid growth and evergreen canopy. They must be considered as a serious contender as a quick temporary replacement in areas ravaged by Dutch Elm Disease, or as a screen for indus-

trial and mining sites, and in our parks where vandalism would only improve their growth. Species such as *Eucalyptus viminalis* will stand some oil around their roots.

The table below shows the growth rates achieved by various species in Great Britain and Ireland (1).

Species	Measurement (ft.)	Location
<i>Eucalyptus aggregata</i>	59' × 2'4" in 15 years	Cornwall
<i>coccifera</i>	105 × 6'9"	Avondale, Co. Wicklow
<i>dalrympleana</i>	80' × 6'4" in 30 years	Mt. Usher, Co. Wicklow
<i>glaucescens</i>	52' × 2'6" in 12 years	Devon
<i>globulus</i>	47' × 1'9" in 5 years	Co. Kerry
<i>gunnii</i>	35' × 1'3" in 6 years	Oxford
<i>johnstonii</i>	111' × 9'2" in 65 years	Mt. Usher, Co. Wicklow
	62' × 2'2" in 14 years	Co. Down
<i>mitchelliana</i>	25' × 1'4" in 8 years	Surrey
<i>nitens</i>	37' × - in 4 years	Argyll
<i>perriniana</i>	70' × 4' in 32 years	Co. Down
	44' × 1'8" in 11 years	Hampshire
<i>pulverulenta</i>	31' × 1'0" in 10 years	Devon
<i>simmonsii</i>	55' × 2'11" in 21 years	Edinburgh
<i>viminalis</i>	35' × 1'5" in 9 years	Devon
	118' × 14'7" in 65 years	Mt. Usher, Co. Wicklow

Botanical. Over 500 species have now been recorded and the work continues (2). Of these over 150 species have been grown or assessed for hardiness in Ireland (2). They are members of *Myrtaceae* family. Most have simple straightforward leaves, untoothed and unlobed. They have well marked stages in the two year growth of their evergreen leaves. These stages are commercially important for some enterprises. The juvenile foliage is very often round shaped, and leaves appear opposite each other in pairs. The adult foliage is alternate and isobilateral. They are totally different in shape, usually being long, narrow and willow-like. Grey green is the most common foliage colour. Leaves of some species are apple green, silver grey, blue grey and even purple or pink tinged in the young stages. The juvenile foliage, which is often used for floristry, can be maintained by annual cutting.

Most of the hardier species have the typical strong eucalyptus oil fragrance. Leaves of most quiver continuously in the wind, a feature rare in evergreen trees. The bark peels on many species, to reveal smooth trunks of great beauty; white in *F. dalrympleana*, *E. niphophila* and *E. viminalis*, orange in *E. johnstonii* or salmon pink in *E. rubida*. The bark shedding species are the main types grown in Ireland.

Hardiness. The eucalyptus are more associated with Australia than any tree is with any country. No other single genus of tree dominate so vast and climatically so diverse an area. According to the F.A.O., there are 512 million acres of forest in Australia. Broadleaves dominate 97% of these forests and in these broadleaf forests, 94% are dominated by eucalyptus (3).

Their ecological range is therefore enormous from the tropical forests at Darwin to the snowy mountain passes in Tasmania. The genus does not occur naturally in New Zealand. Within this enormous range of ecological niches, surely many provenances of species exist which when properly grown and systematically tested should be suitable for our climate.

Seed Provenance. The name of a species is no guide to its hardiness. The natural occurrences of most of the 500 species found in Australia are localized. However within the locality of natural occurrence of a species there may be a great range in altitude - over 1200 m in some cases. Thus trees at the lower level rarely encounter frost whilst at the higher reaches the same species may be surviving frequent and severe frosts.

Table 1. Lowest temperatures eucalyptus species are known to survive.

- 12°C		- 14°C		- 16°C		- 18°C or more	
<i>E. cordata</i>	<i>E. glaucescens</i>	<i>E. johnstonii</i>	<i>E. coccifera</i>				
<i>E. dalrympleana</i>	<i>E. parvifolia</i>	<i>E. perriniana</i>	<i>E. gunnii</i>				
<i>E. mitchelliana</i>		<i>E. urnigera</i>	<i>E. nitens</i>				
<i>E. rubida</i>			<i>E. niphophila</i>				
<i>E. stellulata</i>							

Minimum temperatures are in any case a poor guide but they are only simple facts readily available. Other factors which influence hardiness depend on:

1. The rate of freezing.
2. The age of the plant.
3. Exposure to the wind.
4. Time of planting.
5. Seed provenance.
6. Cultural treatment in raising the plants.

The older the plant the more certain it is of surviving severe cold. For trees with substantial stems even if cut back they will invariably grow away from the live bark at the bottom and become within 12 months even more handsome and better furnished specimens. Thus in 1971 there were some notable recoveries on tender species damaged by an unusually severe frost of - 16°C in the Dublin area.

Hard, cold, incessant winds do more damage than frost. Young plants should be unstaked in order that the plant develop a strong sturdy stem. We plant out in the summer and early autumn and cut back the resultant growth to 45cm the following May and to 150cm the following year. This we find gives us a sturdy, windfirm tree well furnished and minus stakes.

Seed Sources. Altitude is the most important factor, when looking for a seed source. Seed from New South Wales should

be from an altitude higher than 1200m and higher than 900m in Tasmania (4). Throughout the world eucalyptus is raised from seed, as no worthwhile method of vegetative propagation has yet been found. In our climate selection of clones for special purposes has not taken place. Consequently there has not been a pressing need to develop vegetative propagation methods. We have succeeded in rooting some juvenile stems of *E. globulus* while some success in grafting red flowered species has been made in California (5).

Seed Treatment. Eucalyptus seed is extremely small, as shown in the table below.

Seeds of various species of Eucalyptus (6).

Species	No. of seeds per gram
<i>Eucalyptus dalrympleana</i>	450
<i>Eucalyptus delegatensis</i>	360
<i>Eucalyptus globulus</i>	90
<i>Eucalyptus regnans</i>	350

Seeds of alpine species can be erratic in germination. A cold, wet treatment improves germination of *E. perriniana* and *E. johnstonii*. We mix the seed with water, shake well, seal the vessel and place it in the bottom of a domestic refrigerator as per the method outlined by Barnard (4,6). Watch the seed for germination after 3-4 weeks.

Germination. We produce 20,000 seedlings per year at present. We mix a compost of 2 parts peat to 1 part of sand and fill the seed trays. We put 0.5 cm of granite sand on top of this mixture and we sow the seed uncovered on top of the sand. The seed trays are placed in a heated propagation house at a temperature + 18°C in March, and the trays are covered with 50 gauge clear polythene.

Germination starts in 6 to 14 days. As the cotyledons emerge, the plastic is gradually cut and eventually removed within 7 days as the seedlings harden off. No water is given until there is a good stand of seedlings. As soon as the first true leaves emerge the plants are pricked off into 8 cm peat pots. The young plants are established in these pots on true capillary beds (where the water is controlled by a ball-cock) in an opaque polythene tunnel which prevents sun scorch. If necessary we seal the doors of 30 × 5 m plastic houses to get even more rapid establishment. When the roots start emerging through the peat pots the plants are 15-20 cm tall, we pot on again into 15 or 17.5 cm polythene containers.

We use pure peat for all our potting composts. At the pricking out stage we use Osmocote at one quarter of the recom-

mended rate (0.6 Kg/M³). For the final potting we use 1.4 Kg/M³. These rates give excellent growth on capillary beds.

Eucalyptus roots. Eucalyptus have a rapid growing tap root system. The plants are very sensitive to root damage and are intolerant of any root restriction. A nurseryman's natural inclination is to pot on a small seedling into a 10-12 cm pot. However a 17 cm holds twice as much compost as a 12 cm pot. When we place this size container on a capillary bed not only do we not get any rooting through but the adequate supply of water seems to retard the development of a coarse and fangy root system.

For subsequent establishment, a young vigorous root system is preferable to a coarse root. For these reasons we find that 17 cm container is ideal for the production of quality plants provided watering is by automatic capillary beds.

Worldwide research indicates that young plants not more than 4 months old and 45 cm tall give best establishment. Our production system offers a good compromise between what is the ideal plant and planting time for eucalyptus and popular prejudices favoring traditional tree planting practices.

LITERATURE CITED

1. Mitchell, A., private communication.
2. Official Yearbook of the Commonwealth of Australia, 1973.
3. Australian Forests and Forest Industries, Forestry and Timber Bureau, Canberra A.C.T., 1966.
4. Barnard, R.M., R.H.S. Journal, 1963.
5. Batchellor, O.M., I.P.P.S. Proceedings 1973, pp.195-201.
6. Raising Eucalyptus Seedlings. Commonwealth of Australia, Forestry and Timber Bureau.

SOME OBSERVATIONS OF THE NURSERY INDUSTRY IN AUSTRALIA

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The initiative for my six months visit to Australia came from the Queensland Nurserymen's Association; the reason was their concern about the absence of adequate training facilities for the nursery industry and the opportunity was provided by a temporary vacancy at the Queensland Agricultural College. The objective was to encourage and advise on setting up courses — particularly technical and technological courses — directed towards the needs of the nursery industry. Horticulture has a very low status in Australia — and the ornamental section is quite