Although the bulk of Mr. Eberts' production consisted of cuttings, a wide range of plants were also grafted. Miniature roses were grafted in December using dormant buds. The understock used was 8/12 mm. *Rosa multiflora*. A "T" incision was made at the top of the stock, and a single-eyed scion was then inserted in the same way as in summer budding. The grafts were not tied, and were plunged into beds of moist peat which was heated to 65°F. The bed was covered with a polythene tent and after about six weeks the young shoots produced from the dormant eyes were used for 'green-leaf' scions; so the process was repeated. The first batch of grafts were potted into 9 x9 cm. square pots making saleable plants within fifteen weeks. A production line was set up when we grafted the roses, in which one man collected and cut the scions and two others made the incisions and inserted the scions into the stocks. *Cedrus*, *Hammamelis*, *Picea*, *Pinus*, *Syringa* and *Parthenocisus tricuspidata* 'Veitchii' were also grafted. I was interested to note that two, three and five-needled pines were *all* grafted onto the common rootstock, *Pinus montana* (syn. P *montana mugo*) (i.e. reverse)

I hope in this very general paper to have summarised the highlights of the time I spent working on the Continent. I felt, as is usual in similar cases that the time spent on the Continent was all too short but the memories and horticultural experience gained will always be of value to me.

It is encouraging to know that our products are in great demand throughout Europe, and I see great futures for progressive companies within the now enlarged Common Market.

INITIATING A PROPAGATION PROGRAMME AT KINSEALY

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The considerations that prompted the initiation of a research programme on hardy nursery stock at Kinsealy in 1967 included a rising import bill, the possibility of building up an export trade, and consideration of the very favourable conditions of soil and climatic factors as evidenced by the existence of famous gardens in all parts of the island. These gardens are of international repute for the extent of their collections and for the size and luxuriance of growth of many of the trees and shrubs cultivated in them. Another positive factor was the comparative freedom from

pests and diseases of plants and animals which hinder trade in trees and shrubs in other countries.

Yet despite this obviously favourable background Irish nurseries are mostly small scale family businesses, catering for a local trade; few are large enough to become companies. Here then was an identifiable opportunity to encourage growth from a small base with, in the short term, a home market and further ahead, a large export potential.

The immediate question was the type of research to be undertaken at the start of the programme. One possibility was to undertake fundamental investigations into such problems as the identification and manipulation of factors of the environment which control rooting in cuttings with a view to a better understanding and hence to improvement in techniques. Other fundamental studies such as photoperiodic responses of various species, nutritional requirements and so on were considered. It was recognised that such studies are highly desirable, indeed essential, but they were deferred in favour of questions of more immediate urgency as judged by the criteria of national need and likelihood of results that would quickly stimulate expansion of the nursery industry.

Visits to nurseries, and a survey carried out in 1968 with the co-operation of the advisory services of the Department of Agriculture, showed that while garden centres were multiplying near the larger areas of population, these centres depended to a large degree on greater imports to meet the demand for trees and shrubs which was growing yearly with the increasing number of new houses, parks and factories. The existing nurseries were not geared to rapid expansion of production and there was little realisation on the newer techniques of plant propagation. A few nurseries had installed mist units, but there were no data tested under conditions in Ireland and little information was available on which to organise a planned production programme.

The basic problem, therefore, was one of the improvement of existing practices, especially the introduction and testing of newer techniques. During the first six years of our programme the work has been along three main lines:

A) The propagation requirements of individual species and cultivars, including vegetative propagation and production from seed

B) The testing of new systems of propagation

C) The synthesis of (A) and (B) into production programmes for the nurseryman

A] The propagation requirements of individual species and cultivars

i) **Influence of cultivar.** It is well known that with many genera, some cultivars are more easily rooted from cuttings than are others. However, such knowledge is generally acquired on a trial and error basis by individual propagators and is not recorded for the benefit of a wider public. Experience at Kinsealy with *Chamaecyparis* cultivars has been quoted in the Proceedings of this Society (1). Other examples which could be given include *Acer palmatum* where the cvs. Atropurpureum, Osakazuki and Vitifolium have, over several seasons proved relatively easy to root and to grow on. Others, like A p. 'Dissectum Paucum' and A *japonicum* 'Aureum' have proved either more difficult to root or to grow on afterwards. The Exbury azaleas 'Gibralter', 'Gold Dust' and 'Kathleen' are among those found relatively easy to root. Examples of more difficult cultivars include 'Golden Girl', 'Ballerina', and 'Cecile'. Similarly the rhododendrons, 'Pink Pearl', 'Purple Splendour' and 'Gomer Waterer' root readily at Kinsealy, but 'Britannia', 'Doncaster' and 'Cynthia' are more exacting.

ii) **Timing.** The date at which the cuttings are taken can be important in several contexts. At the species level, *Betula lutea* has rooted well from cuttings taken at intervals from May to July, whereas those of *B. jacquemontii* only rooted from mid-August on. Cherries, too, can be divided into two groups, those which come readily from softwood cuttings in spring, (e.g. *Prunus incisa, P subhirtella* 'Autumnalis') in contrast to the Japanese cherries which have rooted better from late summer cuttings. At Kinsealy a few junipers have rooted as well from October cuttings as from April cuttings but, in general, better and quicker rooting has resulted from the latter, using the cold frame and plastic method.

The influence of timing over a period of two months on rooting and the effect on subsequent development has been described for *Chamaecyparis* (1). Another aspect of this question is whether cuttings taken early, rooted quickly, and then grown on surpass in subsequent development those allowed to grow to a larger size before being removed from the parent plant. Two contrasting examples are *Prunus incisa* and *Pyracantha coccinea*. With the former, May cuttings not only rooted in higher percentage but were larger plants by autumn than those taken in July. With *Pyracantha*, to the contrary, May cuttings never caught up with larger cuttings struck in September. Furthermore, the May cuttings did not flower the following season, whereas the September cuttings could be sold as berried specimens one year later.

With some trees and shrubs, e.g. Japanese maples and deciduous azaleas, while rooting is feasible over a period of

weeks, only early struck cuttings will give plants which will survive their first winter without heavy losses. This has led to the development of techniques for the production of early cuttings, as will be described presently.

iii) **Time taken to root.** In planning a production programme it is necessary to know which species and cultivars can be grouped together to vacate propagating space simultaneously. While speed of rooting is usually associated with ease of rooting, the propagator will frequently wish to know, in addition, which species, often quite unrelated, require the same rooting time. For example, when filling frames with soft cuttings in June, subsequent operations are much simplified if it is known that *Viburnum tinus*, *Weigela*, *Ulex*, *Lavandula*, *Kolkwitzia*, *Escallonia* and many others can be rooted in 3 weeks, whereas *Senecio compactus*, *Skimmia*, *Ligustrum ovalifolium* 'Aureum', *Cotoneaster adpressus* and others require 5-8 weeks under conditions at Kinsealy.

iv) **Type of cutting.** Taking cuttings with a heel of older wood is a long established practice amongst propagators. Trials at Kinsealy with four cultivars of *Chamaecyparis lawsoniana* (2) and with five species and eight cultivars of *Juniperus* (2) gave better results from cuttings of the current year's shoots clipped off with a secateurs than from prepared heeled cuttings. With *Chamaecyparis* the results from the heeled cuttings were at least as good or substantially better whether propagated under mist, in a cold frame with double glass, or by the cold frame and plastic method. With *Juniperus* also, the stem cuttings were, in almost all instances, superior in numbers rooted and size of root system.

'Mallet' cuttings are side shoots taken with a short section of the parent shoot attached. In a trial at Kinsealy with *Berberis x lologensis* such cuttings gave 65% rooted as compared with 35% for basal cuttings (i.e. cut through the swollen base of the shoot just above the parent branch) and 15% for the nodal type. Material for nodal cuttings is not, however, abundant in this barberry, so pruning trials to investigate the possibility of increasing side shoot production would be desirable. With the more readily propagated *B. verruculosa* no significant differences resulted in a trial comparing mallet, basal and nodal cuttings.

v) **Use of root promoting substances.** The usefulness of root promoting substances was, in the absence of published information based on trials under local conditions, regarded as a matter for trial and error for the individual nurseryman, resulting in opinion rather than documented information. Experience at Kinsealy has shown that even easily-rooted subjects, e.g. *Euonymus*, *Hebe* and *Cytisus* can react positively to treatment (Table 1). Examples of genera rather more difficult to root which have also given improved results with IBA are *Magnolia*, *Hamamelis* and *Viburnum* (Table 1). Species and cultivars which did

not give a marked response included some of the Exbury azalea cultivars, *Caryopteris* x *clandonensis*, *Ceratostigma wilmottianum*, *Cotoneaster congestus* and others. Just because a species or cultivar shows a definite response to root promoting substances when propagated one way, it does not follow that it will do so when propagated under an alternative system.

With leaf-bud cuttings, e.g Camellia and *Mahonia japonica*, the use of IBA is not recommended owing to the delay in bud break that follows application of this substance so close to a single bud.

Table 1. Response of some easy and some difficult rooting species to IBA

Species and cultivar	Treatment	Percentage rooted
Euonymus radicans	0 4% IBA	98%
" 'Silver Queen'	Control	11%
Hebe pinquifolia	08% IBA	60%
'Pagei (*H pageana*)		
"	Control	40%
Hebe 'Simon Delaux'	08% IBA	90%
"	Control	55%
Cytisus scoparius 'Dragonfly'	.08% IBA	70%
"	Control	35%
Magnolia stellata	08% IBA	90%
"	Control	63%
Hammamelis mollis	08% IBA	100%
"	Control	75%
Viburnum carlesii	08% IBA	95%
"	Control	67%
V x carlcephalum	08% IBA	85%
"	Control	30%

vi) **Wounding.** is often an aid to better rooting. Apart from participation in the IPPS experiment reported by Howard (2) in most cases wounding of the cutting has been carried out on cuttings of subjects for which it has been recommended by various authorities. In general, it has been observed to be beneficial, but more experimental work is needed in this field.

vii) **Medium for rooting.** For most subjects we use 2 parts granitic sand to 1 part moss peat. Trials on a limited scale and wider experience indicate that generally this mixture gives better results than peat only, sand only, or 2 parts sand to 1 of peat. Where there is little difference in rooting, we favour the mixture containing the greater proportion of peat, since this material is obtainable as a standardised product. Current investigations at Kinsealy indicate that the origin and grade of sand will have to be considered in relation to the subject being propagated. For *Ericaceae* we recommend peat only.

B) **Systems of Propagation.** Since mist propagation was already practised in nurseries, our initial work on the requirements of individual species and cultivars was carried out in a mist unit. Though considerable information has since been built up under cheaper alternative techniques, where the nurseryman has a mist system already installed it is essential for him to have the information to enable efficient utilisation of the system. Hence the information that has been compiled on date of insertion, time taken to root, and the other details described above will enable him to plan maximum throughput. Systems involving plastic sheeting in the place of mist are being recommended for more and more species in the light of further experience. Nevertheless, it is useful to know which species are quick and easy to root under mist, so that they can be utilised as catch crops should there be vacant space on the bench.

This substitution of thin (80-100) gauge, clear plastic sheeting for the mist to provide the necessary humidity is the first step in simplification. Successive steps are the cold frame and plastic system, and then the low tunnel of white plastic out-of-doors. These latter systems are well adapted to the mass production of quickly-rooted subjects such as *Ribes*, *Deutzia*, *Philadelphus* and many others. To complete the range of systems, the plain cold frame and open ground rooting of cuttings are included in our tests.

C) **Production Programme.** Our experience at Kinsealy on the individual treatments of different species and cultivars and the results from different systems have been tabulated in our publication 'Propagation of Trees and Shrubs at Kinsealy' (3). A sample page is quoted below:

WARM BENCH AND PLASTIC

The results in Table 2 (below) refer to the method whereby light plastic sheeting (100 gauge) is placed closely over the cuttings and sealed down at the edges. This plastic sheet is lifted every 10 days for 10 minutes, any fallen or unhealthy leaves being removed before replacing the sheet.

Undoubtedly, many more species than are listed can be propagated by this method. Those included merely represent results to date at Kinsealy.

This information enables the propagator to consider the alternative means of propagating the plants in which he is interested, to decide what equipment he needs, and to plan his throughput to a degree to which would have been impossible without these guidelines before him. It is not claimed that these are final recommendations, but are to be improved on or modified in the light of further experience.

Table 2 Warm bench and plastic. results from work at Kinsealy

Species, cultivar	Percentage rooted	Period	Wound + No wound -	Hormone	Medium
February					
Calluna vulgaris cvs.	92-100	3 weeks	—	None	P
Daboecia cantabrica 'Alba'	96	9 weeks	—	"	P
Erica carnea cvs.	85-100	6 weeks	—	"	P
Erica ciliaris 'Wych'	68	6 weeks	—	"	P
Erica stricta	92	6 weeks	—	"	P
Erica vagans 'Lyonesse'	48	6 weeks	—	"	P
Rhododendron 'Blue Tit'	88	8 weeks	+	Seradix 3	P
Rhododendron campylogynum	78	8 weeks	—	"	P
Rhododendron fastigiatum	44	8 weeks	—	"	P
Rhododendron hanceanum	100	8 weeks	+	"	P
Rhododendron macrostemon	90	8 weeks	+	"	P
Rhododendron mucronatum	77	8 weeks	+	"	P
April					
Azalea — Exbury (forced under plastic)					
'Gold Dust'	98	10 weeks		None	P
'Balzac'	95	9 weeks	—	"	P
'Hotspur'	85	12 weeks	—	Seradix 3	P
'Marconi'	100	12 weeks	—	"	P
'Strawberry Ice'	75	10 weeks	—	None	P
July					
Azalea — Evergreen hybrids					
'Armada'	100	5 weeks	—	Seradix 3	P
'Buccaneer'	80	5 weeks	—	"	P
'Hino-crimson'	80	5 weeks	—	"	P

LITERATURE CITED

1. Lamb, J. G. D. 1970. Trials on propagation of *Chamaecyparis* at Kinsealy. *Proc Inter Plant Prop Soc* 20:334-338.
2. Howard, B.H. 1971. Nursery experiment report: The response of cuttings to basal wounding in relation to time of auxin treatment. *Proc Inter Plant Prop. Soc* 21:267-274.
3 Lamb, J. G D , Propagation of Trees and Shrubs at Kinsealy, 5th ed

Discussion

In answer to a request from John Gaggini, Dr. Lamb supplied the following details concerning the rooting of cherries from stem cuttings:

Group 1 — (*Prunus incisa*, *P. subhirtella* and cvs., *P. 'Accolade'*, *P* x *hillieri* 'Spire' etc.) were taken in spring as softwood cuttings when large enough to handle, treated with Seradix 3 and

placed under intermittent mist, in 2 peat/1 sand mixture with a bottom heat of 70°-75°fi. These rooted well and made good growth in the first year

Group 2 — (Japanese cherries 'Kanzan, 'Tai-Haku-Zakura', etc.) — taken in July as semi-ripe cuttings; the cuttings were wounded, treated with Seradix 3 and inserted as above. Rooting was good but extension growth didn't occur until the following year.

Andy Leiser asked why cuttings were used rather than budding, to which the speaker replied that in Ireland there was no expertise for tree budding, it saved purchasing stocks and, in practice, the time scale to tree production was no greater. Dr. Lamb also indicated that he had not yet worked with virus-free material.

Peter Vermeulen observed that he had taken *P.* 'Kanzan' cuttings in June, used the Propacon system and achieved 18-21" plants by the end of the season.

PRODUCTION OF GARRYA ELLIPTICA

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With increasing demand for this plant within the trade, it was decided to adjust our production programme so that a saleable plant of acceptable size could be produced in one season instead of the traditional time of 18 months. To do this, we analysed the plant from the first principles; its propagation, subsequent production, and growth behaviours.

PROPAGATION

There seems to be no difficulty in rooting this subject if normal procedures and precautions are taken.

Preparation of Cuttings. Cuttings are collected, prepared and inserted from late summer through November. Tip nodal cuttings, 3-4 inches long, or strong side shoots with a heel are used, ensuring, with both types, that the terminal bud has developed. Avoid thick, vigorous "water shoots." Wounding is optional; if carried out then a light wound should be made, 1 inch long. Deep wounding will often result in loss of the cutting due to fungal infection. Seradix No. 3 (0.8% I.B.A.) is applied to the base of the cuttings. Bottom heat (68°F - 70°F) was given and within six to eight weeks rooting should take place.