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Project 4079

**COLLECTION AND REJUVENATION OF
RARE/SCARCE PLANTS FOR THE NURSERY
STOCK INDUSTRY**

PHOTO

Kinsealy Research Centre
Horticulture and Farm Forestry

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**COLLECTION AND REJUVENATION OF RARE/SCARCE
PLANTS FOR THE NURSERY STOCK INDUSTRY**

Project 4079

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SUMMARY

The main objectives of this project were:

- Location of scarce/rare or new plants of high garden merit with tolerance to disease and pests
- Rejuvenation.
- Conservation of rejuvenated plants in the original gardens from which they were collected, at the Kinsealy Research Centre and in other selected locations.
- Evaluation of the collection for a variety of uses – foliage, patio etc. over a range of different conditions and locations.
- Plant identification.
- Commercialisation of these plants by the trade to extend their range of plants.

To date over 200 species/cultivars of rare woody, shrubby, alpine and herbaceous plants has been successfully collected and rejuvenated. The project has been fortunate to have been able to secure several outstanding plants which have since perished in their original gardens, such as *Calceolaria*, *Crataegus*, *Geranium*, *Dianthus*, *Cistus* and *Rhododendron* species. Several of these plants were under threat from senescence and old age and had not been rejuvenated while others have been the victims of recent storm damage. Some of these plants are new cultivars of *Chamaecyparis*, *Acer*, *Ilex*, *Azara*, *Eucalyptus*, *Geranium* and *Dianthus* having arisen as sports or seedlings.

Cultivars of *Ilex*, *Azara microphylla* ‘Variegata’, *Pittosporum eugenioides* and *P. tobira* ‘Variegata’, *Pseudowintera colorata*, *Buxus* and *Elaeagnus angustifolia* collected are highly prized foliage plants in demand for the expanding cut foliage industry.

Several plants are proving suitable for growing as container plants for both patio & formal situations. These include fastigate and other forms of *Ilex*, *Pittosporum tobira*, *Buxus microphylla*, *Myrtus* and *Echium fastuosum*.

A range of ornamental trees ranging from small to large size has been saved. The most outstanding are *Acer pseudoplatanus* cv. Brilliantissimum – a highly coloured slow growing clone, several dwarf cultivars of *Crataegus*, a medium size *Malus robusta*, *Betula ermanii*-var. *sub-cordata*, and a weeping *larix kaempferi* cv. Hanan.

About 80 woody shrubby cultivars ranging from low prostate to medium size were also collected. Among the most outstanding are *Calceolaria* 'Kentish Hero', *Cistus x corbariensis* (both original plants have since perished in their original gardens) a highly fragrant weeping *Daphna odora*, *Pittosporum tobira* and *P. tobira* 'Variegata' and an outstanding form of *Sequoiadendron* cv. Prostrata.

The collection also includes alpine and herbaceous plants. These plants are currently in increasing demand. This section has a large number of excellent cultivars of *Dianthus*, *Geranium* (alpine and herbaceous) *Campanula* and rare cultivars of *Trachelium*, *Teucrium*, *Erysimum*, *Ajuga* and *Lithodora*. Several *Osteospermums* were also located, suitable for ground cover as well as floral display.

Micropropagation methods were developed for *Daphne bhuloa* cvs. Jacqueline Postill and Ghurka as well as for *D. collina*. Shoot cultures and rooted plants were also established for the foliage plant *Eucalyptus glaucescens*, the native plant *Ajuga pyramidalis* as well as for *Garrya elliptica*, and *Arbutus x andrachnoides* and *Prunus x incisa* cv Woodfield Cluster.

The Nursery Stock Association has recently requested investigation of methods of propagation to enable rapid multiplication of eighty cultivars of this collection to extend their plant range to satisfy current consumer demand both at home and in Europe.

INTRODUCTION

With the rapid increase in nursery stock production to an estimated value of IR£24 million, the industry is responding to consumer demand to expand its range of plants. In recent years there has been a surge in demand for new and in particular plants of Irish origin and for material which is tolerant to pests and diseases which do not have to be sprayed with pesticides. The larger outlets in addition are responding to this demand by issuing new growing protocols to further reduce overall pesticide usage. These factors taken together suggested that Irish gardens should be sourced for plant material which could be brought into commerce to expand the range of 'new plants' and satisfy these new demands of consumers both at home and in export markets particularly in the UK and Europe. With this objective in mind Irish gardens with important collections of rare plants were contacted with a view to collecting and rejuvenating so that an important genetic resource would not be lost and could be made available for the Irish Nursery Industry.

Materials and Methods

The project targeted the most important gardens in Ireland. Access was gained from a number of sources such as R.H.S., Bord Failte and from personal contacts built up within the industry – the latter being the most important source. The project was very fortunate to have gained access to several of Irelands top gardens with valuable rare plant collections. Several of these recently changed ownership during the course the project. It is often at this stage that the plant collections were most vulnerable.

The plants were initially assessed for garden worthiness – form, shape, flower, length of flowering season and above all disease and pest tolerance. All evergreen plants selected were propagated from autumn to late winter. Cuttings were prepared from current seasons growth 10-14cm long and dipped in standard hormone rooting powder (IBA). They were then transferred to rooting trays with 50% sand/peat mix under a mist unit with bottom heat of 18°C. Woody alpiners and some herbaceous plants were successfully propagated from May to August. Woody trees were invariably rejuvenated by grafting on to respective root stocks usually in the beginning of February, but *Quercus coccinea* was successfully budded in late August. Spectacular success was achieved however by soft wood cuttings taken after the first flush of growth in early June in the case of *Acer pseudoplatanus* ‘Brilliantissimum’ and *Prunus* ‘Ukon’.

After rooting, plants were weaned off and repotted into containers of varying sizes up to 0.5 litre capacity to grow on in a shaded-protected environment.

After reaching suitable size, plants were repotted and returned to their original gardens and at the same time evaluation commenced at Kinsealy Research Centre on the plants for a variety of potential uses.

For micropropagation, shoots were surface sterilised by washing them in running water initially followed by 10 minutes in mercuric chloride (0.1% w/v) and then in calcium hypochlorite (7% w/v) for 20 minutes followed by three washes in sterile water. Culturing was in 170 ml glass jars at 22°C in a 16 hr photoperiod of $32\mu\text{E.M}^{-2}.\text{sec}^{-1}$ and transfers to fresh medium was made every 4-6 wks. The optimal concentrations of growth regulators are given under each species; they were: BA, benzylaminopurine; NAA, naphthaleneacetic acid; IBA, indolebutyric acid ; 2iP, isopentenyladenine; PBA, benzyltetrapyranyladenine; GA gibberellic acid. Basal media sources are in the references.

Results

The plant collection is divided into alpine, herbaceous and woody categories. The results of the collection are summarised in tables 1-3.

The alpine and herbaceous plants comprise about 50% of the collection. After propagation in the mist unit, most cultivars were weaned successfully into 4cm pots for further repotting. Some alpine plants however required very dry regimes to over-winter successfully and this particularly applied to *Lithodora oleifolia* and *Lithodora intermedia*. Apart from these, no major problems at propagation or weaning were encountered. Several plants of all alpines are now successfully established as stock plants in the open ground and in containers at Kinsealy.

The main criterion for garden worthiness were habit of growth, compactness, length of flowering period, flower quality, leaf texture and tolerance to relevant diseases and pests. The plants have been evaluated for performance in several locations under a range of growing conditions to test their growing requirements. The main points of interest for several of the most important genera collected are given below.

ALPINES & HERBACEOUS

Ajuga pyramidalis is a native species to Ireland which is threatened in the wild. It has ornamental value and forms a creeping carpet of spoon-shaped deep green leaves, above which appear spikes of whorled blue flowers and it is less invasive than the more common *Ajuga reptans*. Cultures were established using leaves and the micropropagation method was by the induction of adventitious shoots directly on leaves. Adventitious buds were produced using MS medium containing BA (2.5 mg/L), NAA (0.1 mg/L) and 3 g/L sucrose in both *Ajuga pyramidalis* and the large leaved variety *Ajuga reptans* cv. Catlin's Giant. After 3 months of culturing the buds developed into shoots and spontaneously rooted on the same medium. 1.4 rooted plants per cultured leaf and 2.5 rooted plants per shoot cluster was obtained every 6-8 weeks. Subculturing was by excising leaves and by dividing up the clusters of shoots/buds. Entire leaves could be bisected and used as explants. Bisected leaves gave 3.6 rooted plants per leaf cultivated at a density of three per jar and 2.5 rooted plants at a culture density of 2.5 per jar. All rooted plantlets were successfully transferred to the glasshouse and they made good growth in Jiffy 7 pots. Saleable plants were available within one year of the start of culture.

Dianthus

Fourteen exciting and rare cultivars were successfully located and propagated. Of these, six are exceptionally outstanding having a very long flowering season, fragrance and neat form. They have proved to be hardy survivors over a range of adverse growing conditions encountered in the past three seasons varying from very high rainfall over the winter period to severe air frosts at the beginning of the growing season. The flowers of these cultivars cover a wide range of hues mostly in shades of pink with many having a very attractive darker 'eye'. Some of these are double flowered and they range from vigorous to slow growing.

Geranium

Twelve important cultivars have been located including three new distinct cultivars which have arisen from seedlings. These include both herbaceous and alpine cultivars. The outstanding herbaceous cultivars are the recently introduced hybrid 'Mavis Simpson' and a new dwarf form of *G. endressi* 'Wargrave Pink'. The remainder are mainly dwarf cultivars suitable for frontal positions in herbaceous borders and for alpine culture. The alpine cultivars are proving to be both reliable and hardy but are not as easy to propagate as the larger flowered herbaceous cultivars. Stock plants of some cultivars are still very scarce and more intensive propagation will take place when they set seed or grow sufficiently large. Like the *Dianthus* collection they are not difficult in cultivation.

Campanula

Stock plants of several alpine and herbaceous cultivars have been established. The herbaceous plants are slow to bulk up for propagation purposes in contrast to the alpine cultivars which bulk up fairly rapidly. All the cultivars located are free of campanula rust and have proved adaptable to a range of different growing soils and aspects i.e. to be of easy culture – an important requirement of today's market.

Erysimum

This genus is making a welcome comeback in commerce and eight cultivars are now in the collection. It includes several outstanding cultivars – ranging from pale primrose alpine types to taller wine/orange flowering and variegated cultivars.

The alpine collection has in addition several exceptionally rare alpine cultivars as yet not fully named

SHRUBS

The most spectacular plant in this section is probably the choice *Calceolaria*. 'Kentish Hero' (the original sole surviving plant perished in the winter of 97) which has proved to have an unrivalled flowering period of over 3 months during the last 3 years at Kinsealy Research Centre. Other outstanding dwarf shrubs include *Coronilla valentina* 'Citrina', which flowers from November to April and is richly scented. Two *Cistus* cultivars, *Fuchsia corralina*, *Cystissus* 'Porlock', *Hebe* 'Hagley hybrid' and *Phildaelphus* 'Sybille' are also proving to be excellent 'new' plants of easy culture. Two excellent weeping forms of *Sequoiadendron* and *Daphne* have been recently acquired.

Garrya elliptica

Shoot cultures of *Garrya elliptica* were successfully initiated and established using WPM containing 0.2mg/L BA with 2% sucrose, giving a micropropagation rate of 2.5 explants per explant initially cultured. After 6-8 months of subculturing shoot vigour declined so the cytokinin concentration was increased from 0.2 to 0.3 mg/L BA and IBA was added at 0.05 mg/L (G4 medium). A culture period on G4 medium with activated charcoal (3.0 g/l) increased shoot length significantly from 19mm to 36 mm although this was accompanied by a decline in propagation rate. Several rooting trials showed that auxin (IBA) was necessary to stimulate rooting in the range of 0.5 to 1.0 mg/l. Rooting ranged from 78 to 100% and 94% of plantlets were successfully weaned to soil. Weaned plants grew normally under glass producing a single shoot. Studies on the timing and method of pruning are needed to give an optimal method to produce multi stemmed saleable plants.

Eucalyptus glaucescens is grown as a coppiced shrub for the production of juvenile foliage. Shoot cultures of a selected clone were established and maintained on MS medium containing BA (0.1 mg/L) NAA (0.001 mg/L) and 2% sucrose. Cultures consisted of a cluster of shoot buds with some elongated and developed shoots. The effect of lowering the concentration of BA on the production of shoots >1 cm in length was tested in the range 0.001, 0.005, 0.01, 0.05, and 0.1 mg/L. The mean shoot yield was 1.8, 2.6, 3.7, 14.7 and 24.6 respectively, indicating the superiority of the standard medium with 0.1 mg/L BA. Kinetin Zeatin and 2iP could be substituted for BA as the main cytokinin but shoot yield was reduced four to five fold at the concentration ranges tested (0.1 to 0.5 mg/L). For rooting experiments, selected shoots were at least 1.0 cm in length. The auxin NAA gave variable rooting rates ranging from 4 to 40% with concentrations ranging from 0.1 to 0.5 mg/L and pre-treating the shoot cultures for 3 days in darkness before auxin treatment did not increase the percentage rooting.

Rooting was significantly reduced in shoots which were derived from half strength MS medium in the propagation stage. The rooting response of shoots cultured with either kinetin or zeatin were similar to those cultured with BA. In the absence of auxin, rooting was poor and 80-95% rooting was achieved with 0.5 mg/L IBA. The anti-oxidant quercetin depressed rooting when applied together with IBA for all cultures. Weaning of *Eucalyptus* was generally difficult with a maximum of 72% of shoots viable upon transfer to compost over several experiments.

Daphne

Shoot cultures of the following *Daphne* species and cultivars were established: *D. collina*, *D. bhuloa* 'Jacqueline Postill', *D. bhuloa* 'Ghurka'. Surface sterilisation of young shoots was as described above for *Arbutus*. All cultivars grew well on WPM containing BA (0.2 Mg/L), NAA (0.001 mg/L) with 2% glucose and agar (0.8% w/v) (Fig 1) *Daphne collina* produced approximately 15-20 shoots per jar per month (Fig 2), however a satisfactory rooting method has not been developed so far. Shoot production for both species of *D. bhuloa* required over a year to establish and shoot yields from cv. Jacqueline Postill were greater than from cv. Ghurka (Fig 3). Rooting rates of 75%-90% was achieved for "Jacqueline Postill" using WPM at one fifth strength containing sucrose 15% (w/v), activated charcoal (3.0 k) and IBA(5.0 mg/L). Survival of unrooted plants during weaning was 10-20% and ranged from 50% to 85% for rooted plants (Fig 4) .

PHOTO

Fig. 1: Shoot Cultures of *Daphne Bhuloa* cv. Jacqueline Postill.

Fig. 2: Micropropagation rate for *Daphne bhuloa* 'Ghurka'

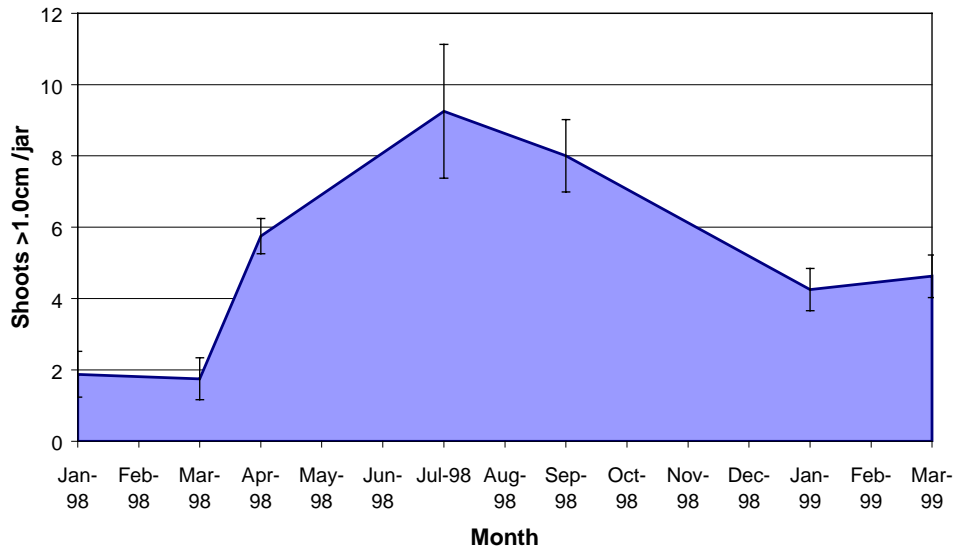
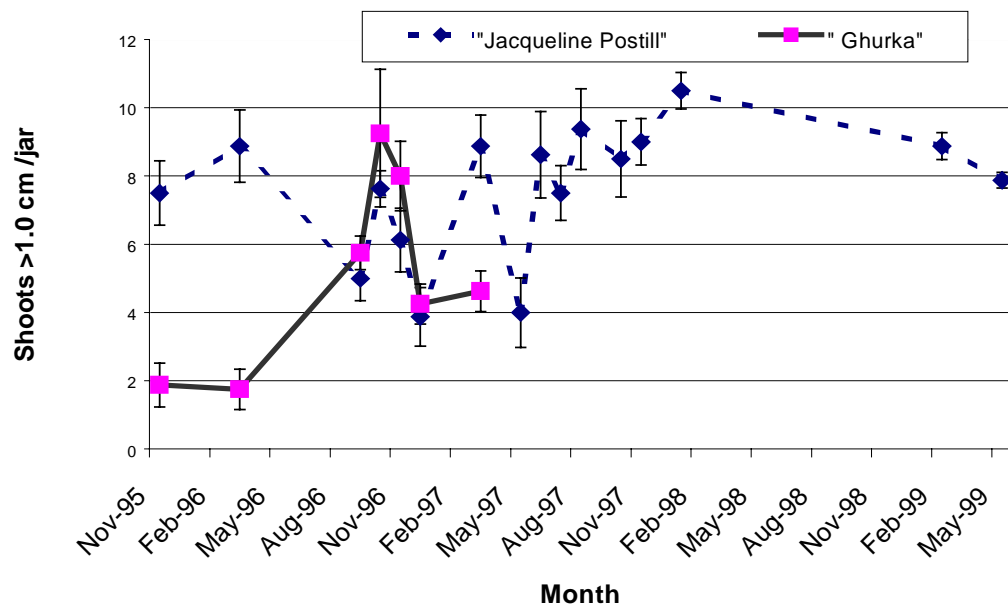


Fig. 3: Micropropagation of *Daphne bhuloa* cvs.



PHOTO

Fig. 4: Micropro gated plantlets of *Daphne bhulon* cv Jacqueline Postill

TREES

A number of very dwarf *Crataegus laevigata* cultivars were rescued and rejuvenated. The smallest is a picturesque dome shaped tree about 1.7m high which is well suited to today's requirements of small gardens. This cultivar together with six other small growing *crataegus* cultivars were propagated by grafting on to *crataegus monogyna* rootstocks in February. These clones are particularly attractive in the autumn –carrying large crops of berries. In addition two of the clones have attractive grey foliage.

An outstanding dwarf clone of *Acer pseudoplatanus* 'Brilliantissimum' was successfully propagated by both grafting to *Acer pseudoplatanus* and also using cuttings of current years growth under mist in early June.

In the medium-large range trees a particularly good form of *Betula ermanii sub-cordata* was located and successfully grafted on to *Betula pendula*. The outstanding features of this tree are its imposing branch structure with cream bark and its tolerance to rust where several important *Betula* cultivars are succumbing to this serious disease in recent years. Two other beautiful clones of *Betula albo-sinensis* var. *Septentrionalis* were located but were unsuccessful in propagation either by grafting or cuttings.

The other outstanding trees successfully propagated by grafting at Kinsealy were a *Malus robusta* cultivar and *Pyrus ussuriensis*. Both clones have proved very tolerant to scab. These are both medium growing trees of graceful habit and are particularly good in early summer and autumn with floral and berry displays.

A weeping form of Japanese larch (*Larix leptolepis*) was discovered in a shelterbelt in John F. Kennedy Arboretum New Ross. The cultivar is registered. It is notable in having branches which are pendulous from the main trunk and it has potential for small and medium gardens because of its slim and elegant form. Thirty scions were grafted in 1996 and 11 were viable. under greenhouse conditions these plants reached 1.0m in one season. In February 1997 77% viable grafts was obtained using the "tube " method of grafting (End of project Report No. 4330) whereas conventional grafting with elastic gave 40% viable grafts .

Arbutus x andrachnoides

This is a notable evergreen which is hardy and has attractive red bark. Shoot cultures were initiated from mature trees of *Arbutus x andrachnoides* in October. By using our standard sterilization procedure we obtained 55% of explants free from contamination. Cultures became established on Anderson's medium and shoot growth was obtained using 2iP (30.0 mg/L) in combination with IAA (4.0 mg/L) and sucrose 3%. The micropropagation rate ranged from 1.5 to 3.3 explants obtained per original explant cultured. Cultures were strongly apically dominant with only about half of the cultures producing more than one shoot. The production of additional shoots by whole shoot explants was not stimulated by doubling 2iP concentration to 60.0 mg/L or supplementing media with BA (0.01 to 0.1 mg/L). Similarly, PBA had no stimulatory effect on the number of secondary shoots produced per culture though there was a slight stimulation in the length of shoots obtained when used in the range 0.1 to 5.0 mg/L in combination with 2iP (30 mg/L). Removal of the apical bud stimulated the outgrowth of axillary shoots. The presence of 2iP was essential for shoot production by each type of explant and shoot tips and nodal explants were superior to shoot bases. PBA stimulated the production of shoots by shoot tip and nodal explants in the range 0.1 to 0.5 mg/L and by basal explants at a concentration of 0.5 to 1.0 mg/L.

Shoots of 1.0 to 2.0 cm in length were selected for rooting. In the absence of auxin rooting was 4-26% using WPM at one fifth strength and 1.5% w/v sucrose. The optimal range of IBA concentration was 0.5 to 5.0 mg/L giving a maximum of 71% rooted shoots. After transfer to the greenhouse 91% of the shoots remained viable and became established in compost where they grew approximately 3 cms in the first two months.

Prunus x incisa 'Woodfield Cluster'

This cherry is notable in flowering profusely early in the life of the tree. It flowers on short spurs in March-April with two flowers per bud and we observed flowering in one year old plants which had been micropropagated (Lamb and Nelson 1987). Micropropagation was successful on MS medium containing BA (1.0mg/L), IBA (1.0 mg/L) and GA (0.1mg/L) which gave an average, over 7 months of eight shoots per jar which were competent to root. Rooting was 73-100% using quarter strength MS medium and 0.5 to 5.0 mg/L IBA and weaning was not difficult.

Table 1: Alpine plant collection

Cultivar	Propagation	Characteristics
<i>Ajuga pyramidalis</i>	cuttings	Attractive ground cover with 20-25cm flowering spikes, not invasive
<i>Antennaria montana</i>	cuttings	Grey foliage, long flowering period. For sunny sandy/gravelly poor soils.
<i>Campanula jenkinsae</i>	root division	Superb dwarf flowering cultivar with large display of white bells held upright on 20-24cm stems. Hardy and adaptable
<i>Campanula</i> cv.1	root division	Hardy and robust member of the harebell group with 24-30cm flowering stems.
<i>Campanula</i> cv.2	root division	As above but shorter (12-15cm) flowering stems.
<i>Campanula planipes</i>	cuttings	Dwarf cv. With 10-14cm flowering stems (white).
<i>Dianthus</i> cv.1 A.S.	cuttings in summer	Superb dwarf cultivar, flowers are pink with dark eye and highly fragrant. Blooms over an exceptionally long period from June to September. The original plant of this cultivar has since perished.
<i>Dianthus</i> cv.2	cuttings in summer	More vigorous cultivar. Flowers less refined, pink with a darker eye, hardy and robust.
<i>Dianthus</i> 'Innishriach Dazzler'	cuttings in summer	Dwarf cushion type plant. Magenta pink flowers.
<i>Dianthus</i> cv.3 A.G.	cuttings in summer	Neat dwarf cultivar, flowers are strong pink with a dark centre and edges frilled.
<i>Dianthus</i> 'Warden Hybrid'	cuttings in summer	Flowers are double, rich purple/pink and highly fragrant. Very hardy, robust and reliable.
<i>Dianthus</i> 'Betty Norton'	cuttings in summer	Recently acquired. Larger flowers and more vigorous than cv.1.
<i>Dianthus</i> cv.4 A.G.	cuttings in summer	Pink flowered cv. With dark eye. A good dwarf cultivar, flowering for a long period.

Table 1 (continued): Alpine plant collection

Cultivar	Propagation	Characteristics
<i>Dianthus</i> 'Constance Spinnis'	cuttings in summer	Choice cultivar for dry situations. Pale pink/white flowers with dark purple eye.
<i>Dianthus anatolicus</i>	cuttings in summer	Dwarf cushion type of growth. Tiny flowers.
<i>Dianthus</i> 'Queen of Henry'	cuttings in summer	Vigorous growing cultivar with 20-30 flowering stems.
<i>Dianthus</i> Dewdrop	cuttings in summer	Neat strong growing cultivar with large white flowers.
<i>Dianthus</i> cv.5 P.S.	cuttings in summer	Dwarf alpine with pink flowers.
<i>Dianthus</i> cv. 5	cuttings in summer	Dwarf alpine. Flowers early – apricot/pink.
<i>Dianthus lemsii</i>	cuttings in summer	Fragrant, dwarf flowering pink cv. Forms large mats.
<i>Dryas drummondii</i>	cuttings in late April	New cultivar to cultivation in Ireland, with yellow flowers.
<i>Erodium chrysanthum</i>	cuttings in summer	Dissected grey/green leaved cv. pale primrose coloured flowers.
<i>Erysimum</i> 'Moonlight'	cuttings in summer	Compact plant, yellow flowers.
<i>Erysimum</i> cv.2	cuttings in spring	Dwarf erysimum. Flower pale primrose with brown/purple buds for light free draining soils. Superb cultivar.
<i>Erysimum</i> 'Variegata'	cuttings in summer	Dwarf variegated form. Prone to reversion.
<i>Erysimum</i> cv.1	cuttings in summer	Vigorous plant, pink/wine coloured flowers with brown/orange buds. Very fragrant.
<i>Erysimum</i> cv's.3 & 4	cuttings in summer	New cvs recently acquired from old gardens about 36cm high.
<i>Geranium</i> cv.1	root division, seed	Low growing alpine with neat habit. Flowers (pink) continuously over a long period from June to September.
<i>Geranium</i> cv.2	root division, seed	As above but white flowers.
<i>Geranium</i> cv.3	root division, seed	As for cv.1 but larger flowered.

Table 1 (continued): Alpine plant collection

Cultivar	Propagation	Characteristics
<i>Geranium sub-caulescens</i>	seed	Outstanding cv, though only a small plant; for alpine culture.
<i>Geranium</i> cv.4	Root division	Very dwarf distinct cv. Flowers pale pink, large and only 3-4 cm high.
<i>Geranium argenteum</i>	Seed	Dwarf silver coloured foliage and pale pink flowers.
<i>Geranium cinerium</i>	Seed	Several dwarf forms with variable flower colours in shades of pink.
<i>Geranium lancastriense</i> 'Farrars Form'	Division	Recently acquired dwarfer form of <i>G. lancastriense</i>
<i>Geranium sanguineum</i> 'Minutum'	Seed	Dwarfer form of <i>G. sanguineum</i>
<i>Geranium</i> 'Tim Wallace'	Seed	Recently acquired, dwarf geranium. Masses of small violet blue flowers over a very long season.
<i>Glaucium</i> cv.	Cuttings in summer	Spectacular orange flowers over grey foliage
<i>Helianthemum</i> 'Jubilee' <i>Helianthemum</i> 'Cerise Queen'	cuttings in summer	Both outstanding double flowered cultivars with long flowering seasons.
<i>Hypericum olisanthum</i>	Cuttings in summer	newly acquired alpine
<i>Helianthemum</i> cv.1	cuttings in summer	Newly acquired cv with pole primrose flowers.
<i>Hypericum olympicum</i> 'Citrinum'	Cuttings in summer & autumn	Lovely dwarf tufted alpine with lemon yellow flowers
<i>Lithodora intermedia</i>	cuttings in summer	Can grow on alkaline soils of light sandy texture in full sun. After propagation, plants must be kept dry. Violet blue flowers.
<i>Lithodora oleifolia</i>	cuttings in summer	Much sought after lithodora. Pale blue flowers over a long season. Soil aspects and comments as for <i>L. intermedia</i> .
<i>Mazus reptans</i>	division of plants	Prostate carpeting plants, blue flowered.
<i>Potentilla repens</i> cv.	cuttings and root division	Dwarf silver leaved form. Good foliage plant.
<i>Potentilla repens</i> cv.	cuttings and root division	Dwarf low growing form.
<i>Solidago alpina</i>	division of plants	Two forms collected both early and late following clones, with yellow flower.

Table 1 (continued): Alpine plant collection

Cultivar	Propagation	Characteristics
<i>Silene maritima</i> 'Rosea'	Seed & cuttings	Very neat cultivar. Pale pink flowers in mid-summer
<i>Teucrium ackermanii</i>	cuttings in summer	Low growing alpine. Flowers in mid summer on a grey leaved bushlet. Reliably hardy and a good performer.
<i>Veronica</i> cv.	cuttings in summer	Small shrublet. Pale lavender blue flowers.
<i>Zeloskyana</i>	-	New alpine recently acquired.

Table 2: Herbaceous plant collection

Cultivar	Propagation	Characteristics
<i>Aconitum</i> cv.	root division	Excellent herbaceous plant. Flower spikes, violet blue from 30-60 depending on moisture.
<i>Ajuga reptans</i> 'Catlins Giant'	cuttings	Superb large leaved <i>ajuga</i> ; excellent ground cover and 30 cm flowering spikes.
<i>Anemone</i> cv.1	root division in spring/autumn	Dwarf pink flowered cv
<i>Anemone</i> cv.2	root division in spring/autumn	Very floriferous cv. Good display of pink flowers on intermediate length stems in autumn.
<i>Campanula</i> cv.1	division of clump	Double blue flowered cv. on flowering stems 40-50cm.
<i>Campanula</i> cv.2	division of clump	White flowered cv. flowering stems 50cm.
<i>Campanula valdensis</i>	root division seed	Recently acquired cv.
<i>Campanula</i> cv.3	division of clump	Lilac/pink flowers on 40-50cm stems
<i>Epimedium</i> cv.	Cuttings in late summer	Newly acquired cv. Flower spikes of pale pink/lavender in early autumn on a compact plant.
<i>Erigeron</i> cv.	root division	Floriferous perennial 25cm tall.
<i>Geranium endressi</i> cv.	cuttings	New dwarf form of <i>G. endressi</i> 'Wargrave Pink'. Neater habit and flowers over a long period from early to late summer.
<i>Geranium</i> 'Coombeland'	-	Pale pink flowered.
<i>Geranium ibericum</i> 'Flore Plena'	root division	Double violet blue, flowers in July on stiff, erect stems (75cm).
<i>Geranium</i> 'Mavis Simpson'	division of crowns in autumn/early spring	Superb hybrid. Low growing in vigorous matts; soft pink flowers over a very long flowering season from June to end September.
<i>Geranium traversii</i> 'Elegans'	seed	Silver foliage, soft pink foliage, for milder areas only.
<i>Hieraceum waldstenii</i>	seed	Excellent grey leaved plants.
<i>Knautia macedonica</i>	cuttings in June	Knautia with exceptionally long flowering season from April to November.

Table 2 Continued: Herbaceous plant collection

Cultivar	Propagation	Characteristics
<i>Leucanthemum</i> cv.	root division cuttings	Dwarf cultivar. White flowers with yellow centres; 15cm tall.
<i>Leucanthemum</i> 'Whirral Supreme'	root division	Superb plant with double white flowers flowering in July.
<i>Nepeta</i> cv.	division	Distinct 'catmint' with broader leaves. Needs free draining light soils and sunny aspect.
<i>Osteospermum</i> cv.1	cuttings	Good ground cover plant with pale pink flowers, flowers over a long period; evergreen.
<i>Osteospermum</i> cv.2	cuttings	Dwarf plant. Stunningly large pink flowers.
<i>Papaver</i> 'Fireball'	root division	Perennial with underground stolons. Rich salmon/orange flowers 20cm high for semi-shade and woodland.
<i>Serratula seoanii</i>	division of plants	Late flowering cv of neat habit. Flower spike 35-40 cm.
<i>Sphaeralcea parviflora</i>	division of tubes cuttings	Very floriferous spreading cv; flowers salmon/orange

Table 3: Woody plant collection

Cultivar	Propagation	Characteristics
<i>Acer pseudoplatanus</i> 'Brilliantissum'	cuttings in early June, grafting Jan/Feb	Slow growing clone selected from seed. Colour of young leaves is shrimp pink which lasts for several weeks. Original tree is 3m high.
<i>Azara microphylla</i> Variegata	cuttings in early winter	Clone found in the south of the country with superior coloured foliage. Highly prized by the foliage industry.
<i>Aucuba japonica</i>	cuttings in early winter	Foliage plant
<i>Betula ermanii sub-cordata</i>	grafting in Jan/early Feb	Large birch, good bark colour. Tolerance to rust.
<i>Buddleja lindleyana</i>	cuttings in summer	Striking violet purplish flowers.
<i>Buxus</i> cv.	cuttings in summer	Foliage plant – large leaved.
<i>Buxus microphylla</i>	cuttings in summer	Dwarf shrub, round shape. For formal design and good in containers.
<i>Calceolaria</i> 'Kentish Hero'	cuttings in spring autumn	One of the outstanding plants in the collection. Flowers for a long period from late May to October in shades of orange/yellow. Makes a bush 30-40cm x 35cm. Original plant has perished.
<i>Cistus x corbariensis</i> cv.	cuttings	Superior clone with exceptionally large white flowers with yellow centre on a 1m x 1m wide bush. Original plant perished in 1997.
<i>Cistus</i> cv.	cuttings in summer	Recently acquired cultivar. Perpetual flowering white flowers on a compact bush 1.5m x 0.6m.
<i>Chamaecyparis</i> cv.	cuttings in Oct/March	Very columnar, medium sized conifer which does not scorch in full sun.
<i>Colletia armata</i>	cuttings in Feb	Excellent barrier plant.
<i>Colletia cruciata</i>	cuttings in Feb	As above, with fragrant flowers in the summer.

Table 3 Continued: Woody plant collection

Cultivar	Propagation	Characteristics
<i>Cornus</i> 'Butterfly'	cuttings in summer	Evergreen, cornus, attractive flower bracts. For milder areas only.
<i>Coronilla valentina</i> 'Critina'	cuttings in summer	Dwarf evergreen shrub with fragrant, pale lemon yellow flowers from Nov. to March
<i>Crataegus</i> cv.	grafting February	Large leafed cv.4mx4m
<i>Crataegus laevigata</i> cv.	grafting in February	Very dwarf tree only 1.7m high x 3m wide, profusely flowering with large crops of berries. New growth is variegated, probably virus infected.
<i>Crataegus laciniata</i> cv.1 <i>Crataegus laciniata</i> cv.2	grafting in February	Both attractive grey foliated, deeply cut leaves. They carry attractive crops of large orange berries. The two cultivars differ only in size, one being 5mx5m and the smaller one is approx 3m x 3m wide.
<i>Crataegus canbyi</i>	grafting	Small tree, good shape and carries berries – dark red like cherries.
<i>Crataegus</i> cv.	grafting	Small elegant tree 4,x3m wide. Both parent trees of this cv. and cv. Canbyi are decaying.
<i>Cytissus</i> 'Porlock'	cuttings	Fragrant bush to 2m high
<i>Cytissus</i> cv.	cuttings	Excellent flowering shrub for sunny dry banks in lieu of <i>ulex</i> . Accepts pruning. 1.3mx1.3m wide.
<i>Drimys lanceolata</i>	cuttings in June	Grown for foliage.
<i>Daphne</i> cv.	layering	Alpine cv., very compact may be a form of alpina.
<i>Daphne</i> 'Darjeeling Red'	grafting in February	Flowers dark purple and fragrant.
<i>Daphne</i> 'Pendula'	grafting in February	Beautiful small weeping daphne probably a cultivar od <i>D. odora</i> .
<i>Drimys</i> (Fota form)	cuttings in spring	Large structural shrub

Table 3 Continued: Woody plant collection

Cultivar	Propagation	Characteristics
<i>Elaeagnus angustifolia</i> 'Quicksilver'	cuttings in summer	Very attractive grey foliated plant, fast growing to 3-4m high. Good seaside plant. Fragrant flowers. Suckers.
<i>Echium fastuosum</i>	cuttings	Large spreading architectural shrub for milder areas. Grey leafed.
<i>Euonymus hamiltonianus</i>	cuttings in late summer	Magnificent crops of large berries and autumn colour. Grows to 4-5m high.
<i>Eucalyptus</i> 'Glaucescens'	micro-propagation	Superior clone located for juvenile foliage production.
<i>Eucryphia moorei</i>	cuttings in spring	Medium growing tree, white flowers
<i>Eupatorium</i> (A.G.)	cuttings in spring	Medium growing shrub
<i>Fagus</i> 'Birr zebra'	grafting in January	Golden variegated beech, slow growing.
<i>Genista pilosa</i> cv	cuttings in summer	Growing carpeting plant work.
<i>Fuchsia corallina</i>	cuttings in summer	Magnificent cv., flowering from July to November when pruned annually to ground level when it makes a dome shaped bush 0.5m x 1m wide.
<i>Hebe</i> cv.	cuttings in summer	Meeting sized shrub growing to 2m x 2m wide. Blue flowers continuously over summer.
<i>Hebe</i> cv. (dwarf)	cuttings in summer	Dwarf disease resistant cv.
<i>Hebe</i> 'Hagley hybrid'	cuttings in summer	Very dwarf shrub with pink flowers in early summer.
<i>Hebe</i> 'la Seduisante'	cuttings in summer	Slightly tender shrub 1m x 1m crimson flowers in late summer.
<i>Hydrangea villosa</i>	cuttings in summer	Slightly tender large shrub, very floriferous in late summer.
<i>Hypericum perforatum</i> cv.	cuttings in summer	May be rust tolerant.
<i>Hypericum</i> lancastriense	cuttings in summer	Grown for its flowers and berries. Unfortunately it is subject to rust.
<i>Hypericum perforatum</i>	cuttings in summer	Appears to have more rust tolerance compared with other H. cultivars.
<i>Halimocistus sahucii</i>	cuttings in summer	Narrow leaved dwarf cultivar flowering in early summer.

Table 3 Continued: Woody plant collection

Cultivar	Propagation	Characteristics
<i>Ilex-fastigiate forms</i>	cuttings in November	Two cultivars successfully propagated. Both are narrow and upright but one (a female) is very symmetrical and columnar, berrying profusely and is 10m x 2.5m wide. The second cultivar is, less columnar but propagates more readily
<i>Ilex-other forms including aquifolium augustifolium</i>	cuttings in November	Three other cultivars have been selected which produce berries late in the season and are being evaluated.
<i>Leptospermum cv</i>	cuttings in late spring	Choice 'tea plant' attaining 2m high. Flowers pale pink.
<i>Leptospermum cv..</i>	cuttings in winter	Choice grey foliated dwarf shrub.
<i>Ligustrum jap.</i> 'Rotundifolium'	cuttings in winter	Decorative shrub, rough textured leaves
<i>Malus – seedling cvs</i>	grafting in February	Profuse berrying cultivars. Two seedlings selected for shape and autumn display.
<i>Maytenus boaria</i>	layering	Small evergreen tree.
<i>Myrtus lechleriana</i>	cuttings in late winter	Beautiful fragrant flowering evergreen small trees 3mx2.5m wide with potential for several uses.
<i>Myrtus ugnii (mulinae)</i>	cuttings in late winter	Small shrub, fragrant flowers and masses of edible berries, suitable for roadside or general amenity planting.
<i>Malus c.v.</i>	grafting	Outstanding medium sized tree to 15m of elegant shape with large crops of fruit. Good tolerance to scab appears to be a cultivar of <i>M. robusta</i> .
Oyster bay pine (Fota)	cuttings in early spring	Choice large growing pine

Table 3 Continued: Woody plant collection

Cultivar	Propagation	Characteristics
<i>Philadelphus</i> 'Sybille'	cuttings in late summer	Superb dwarf shrub with arching branches bearing highly fragrant flowers over a very long period. 2m x 1.5m wide.
<i>Philadelphus coronarius</i> 'Variegata'	cuttings in late summer	Small elegant variegated shrub growing to 2mx1m wide.
<i>Philadelphus</i> cvs.	cuttings in late summer	Several other cultivars have been located and propagated.
<i>Pieris</i> sp	cuttings in February	Superior flowering cultivar found in the south; original plant perished in 1998.
<i>Pittosporum tobira</i>	cuttings in winter	Dwarf drought resistant shrub, potential for container/patio use. Fragrant flowers.
<i>Pittosporum tobira</i> 'Variegata'	cuttings in winter	Very rare cv. with creamy white margins. Highly prized for patios and city plantings, fragrant flowers as for the species.
<i>Pittosporum eugenoides</i> <i>Pittosporum eugenoides</i> 'Variegata'	cuttings in water	Foliage trees, both this and the variegated cultivar are in high demand by the foliage industry.
<i>Podocarpus</i>	cuttings in early spring	Distinct large growing conifer.
<i>Prunus</i> 'Ukon'	cuttings in June	Vigorous tree to 14m, yellow/green flowers in April and autumn colour.
<i>Prostanthera</i> cvs	cuttings in summer	Very dwarf and prostate forms.
<i>Pseudowintera colorata</i>	cuttings in late winter	Superior foliage clone
<i>Pyrus ussuriensis</i>	grafting in February	Very elegant shape to 10m high. High scab resistance. Good autumn colour.
<i>Rhododendron concatenens</i>	cuttings in September	Attractive glaucous foliage species from an original plant collection.
<i>Rhododendron cinnabarinum</i> <i>blandiflorum</i>	cuttings in September	Species from an original Kingdon Ward plant collection.

Table 3 Continued: Woody plant collection

Cultivar	Propagation	Characteristics
<i>Rhododendron augustini</i>	cuttings in September and February	Very floriferous species from an original plant collection of Kingdon Ward.
Roses (climbing) including cvs Phyllis Bide Stella Allister Gray Specks Yellow and other named cvs	cuttings in summer	Several outstanding old cultivars with good blackspot tolerance and are perpetual flowering.
Roses-Cabbage, burnet and other disease tolerant ground cover/shrubby cultivars	cuttings in summer	These have been located recently and successfully propagated at Kinsealy. All excellent shrubby disease resistant cultivars.
<i>Rosa roulettii</i>		Newly acquired very dwarf cv with exceptionally long flowering season an one of the outstanding cultivars in its collection.
<i>Sarcococca hookeriana var digna</i>	cuttings in late winter	Rare narrow leaved hardy cultivar for shade and dry situations
<i>Senecio heriteri</i>	cuttings	Profusely flowering over the summer time. For seaside areas.
<i>Sequoiadendron</i> 'Prostrata'	cuttings in autumn	Very distinct slow growing form of the species. Grows slowly to 6m in a semipendulous fashion. Can be kept prostrate.
<i>Skimmia japonica</i> 'Fructo-Albo'	cuttings in late winter	Compact dwarf shrub with white berries
<i>Skimmia japonica</i> 'Fragrans'	cuttings in late winter	Male clone evergreen with highly scented flowers. Medium sized shrub
<i>Syringa x laciniata</i>	cuttings	Small graceful shrub with dissected leaves
<i>Syringa</i> 'Sensation'		Superb cultivar with purplish florets edged white.
<i>Syringa meyeri</i> 'Palibin'		Slow growing medium sized shrub, violet/purple flowers.
<i>Sollya heterophylla</i>	cuttings in summer	Dwarf climber or container plant for conservatory, long flowering period.
<i>Vestia lycioides</i>	cuttings in summer	Tender shrub
<i>Veronica</i> cv.	cuttings in summer	Grey leaved bush, blue flowers
<i>Viburnum</i> 'Rowallane'	Cuttings in autumn	Resembling a slender form of <i>V. tomentosum</i> .

Conclusions

- Several important foliage plants and trees of outstanding garden merit were collected and successfully propagated by both grafting carried out in February and by cuttings under mist in early June. In several cases single surviving plants existed and the propagating material was from these sole surviving specimens. Eight of these original cultivars have since perished since they were first located and propagated.
- Most of the plants collected were from ageing stock in old gardens and with few exceptions have good tolerance to a wide range of relevant pests and diseases. This is probably why they have been good survivors where other cultivars have perished. Such plants will become more important in future years where disease tolerance will be important and new protocols are being developed to reduce pesticide usage to comply with increasing demand for less pesticide usage by the public.
- An outstanding clone of *Acer pseudoplatanus* 'Brilliantissum' was rejuvenated by both grafting on to *Acer pseudoplatanus* rootstocks in February and also from current soft wood cuttings in mist after growth extension was completed in early June. Cuttings were also successful with *Prunus* 'Ukon' at this time.
- A highly decorative *Betula ermanii sub-cordata* cultivar resistant to rust was successfully propagated by side grafts on to *Betula pendula* as well as a new weeping larch *larix kaempferi* cv. Hanan.
- Seven ornamental *crataegus* species comprising very dwarf cultivar clones were rejuvenated using grafting in February. Two of these cultivars have since perished in their original gardens of origin.
- Three ornamental *malus* cultivars including one large growing scab tolerant cultivar and *Pyrus ussuriensis* were also propagated by grafting in January.
- A large range of rare shrubs was located and successfully propagated using cutting material from current years growth taken from autumn to early spring. These include: *Elaeagnus angustifolia* 'Quicksilver', *Syringa meyeri* 'Palibin' and six *Philadelphus* including very fragrant dwarf cultivars. Evergreen small leaved *Rhododendron* species, *Pittosporum tobira*. *P. tobira* 'Variegata', *Myrtus mulinae*, and *M. lechleriana*, *Sarcococca*, *Hebes*, *Cistus*, *Fuchsia* and a very rare weeping form of *Daphne collina* are also in this collection. Several clones of different *Ilex* cultivars of diverse growth habits were likewise found and propagated. A highly prized Calceolaria and a highly prized foliage *Azara* were also added to the collection of woody shrubs for the amenity market.
- About 100 rare alpine and herbaceous plants were also located. Those successfully propagated were *Lithodora*, *Helianthemum*, *potentilla*, *Teucrium*, *Ajuga*, several

Campanulas, Geraniums, Erysimums, leucantheums, Ostoespermums and a large selection of *Dianthus* cultivars. These were all rejuvenated from current years cuttings.

- Plants successfully propagated have been returned to their original gardens. In addition Fota Arboretum and other selected gardens have specimens of the tree collections for safe keeping.
- The alpine, herbaceous and shrub collections are at the Teagasc Research Centre Kinsealy at present awaiting further rapid multiplication for the trade.
- Micropropagation methods were developed for *Daphne bhuloa*. 'Jacqueline Postill' and 'Ghurka' as well as for *D. collina*. Shoot cultures and rooted plants were also established for the foliage plant *Eucalyptus glaucescens*, the native plant *Ajuga pyramidalis* as well as for *Garrya elliptica*, *Arbutus x andrachnoides* and *Prunus x incisa* cvs Woodfield Cluster.

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