Where possible we give priority to later sowings that are prone to damage if the surface dries out e.g. finer seed, birch.

PEST AND DISEASE CONTROL

Growing plants on an intensive scale produces an unnatural environment which is suitable for the spread and development of pests and diseases. Because damage can result in loss of growth or even the saleability of the crop, regular spraying is carried out as a preventative measure rather than a cure. Spraying is done using a tractor-mounted spray with booms. Examples of pests and diseases sprayed are:

Powdery mildews — oak, field maple, *Euonymus*, sycamore (maple), thorn (hawthorn)

Aphids — birch, sycamore (maple), oaks, beech, alder

Caterpillars — *Sorbus aria*

Scab — *Pyrus*

UNDERCUTTING

At the end of the growing seasons all beds are undercut using an Egedal blade fixed behind the tractor. The depth of cutting varies from 4″ on small plants, to 9″ deep on two-year beds that were undercut the previous year.

THE PRODUCTION OF CONTAINER-GROWN TREES BY BENCH GRAFTING — SOME CRITERIA FOR SUCCESS

CLAIRE F. HOWE

Hadlow College of Agriculture and Horticulture
Hadlow, Tonbridge, Kent.

The purpose of this paper is to outline the work carried out in two group projects during our third year as students in the Ordinary National Diploma in Horticulture at Hadlow College. Besides benefitting our practical skills, our two main objectives were, firstly, to assess the suitability of the subsequent trees for garden centre sales after a one season's growing from winter bench grafting; secondly, to see how a range of genera, species and cultivars respond by being grown on under protection.

PROPAGATION

1. *Time of Year.* The great majority of the grafting process

was carried out over a two week period commencing 5th February 1976.

2. *Rootstocks.* The rootstocks were either one-year layers or one to two-year seedlings — the latter being bare root or pot-grown. (see Table 1 for details)

3. *Scion.* The scion materials came from the two year worked trees being grown on the College's tree nursery. The choicer cultivars were kindly donated by Hilliers Nurseries of Winchester. (See Table 1 for details).

Some of the material was cold stored until ready for use.

4. *Type of Graft.* The main types of grafts used were whip, side veneer and modified side veneer grafts (see Table 1 for details). Where possible 20 to 25 grafts for each cultivar were used.

5. *Grafting Process.* The pot-grown rootstocks were "dried off" in a heated glass house prior to grafting. The rootstocks were stem and root pruned as necessary and the area where the cuts were to be made were cleaned with a dry rag. Rapidex rubber strips were used to tie in the whip, side veneer and modified side veneer grafts after which they were then waxed over, using either Arbrex, paraffin wax or "red grafting wax". The complete scion and union were dipped into the liquid paraffin wax when applied to those subjects which were whip grafted.

6. *Aftercare.* The veneer grafts were plunged into a bed containing moist peat, leaving the union just above the surface. The grafts were then covered with a semi-circular Weldmesh hoop over which we laid film plastic. Basal heat of 65° to 70°F (18.3 to 21.1°C) was maintained. In order to harden-off the grafts after callusing, one side, then both sides, of the film plastic could be lifted back for a period during the day. Eventually it could be completely removed.

The majority of the bare-root whip grafts were again plunged into moist peat contained in a rigid open container which could easily be carried by one person. No basal heat was given as these containers were placed down onto the concrete floor of the propagation glasshouse. Initially polythene film was draped over the containers but was removed to be substituted by Rokolene shading material. Where possible the air temperature was kept at around 45°F (7.2°C).

With both propagation facilities, shading was important so as to avoid scorching of the foliage when vegetative growth started from the scion buds. Regular fungicidal applications were carried out in order to reduce loss from disease such as botrytis.

Generally the results from the grafting were successful; nevertheless three problems which were experienced are worth noting.

1. Despite the Arbrex being used successfully in past years, many of the grafts where this material was applied after tying-in failed. On closer examination, it was noted that the Arbrex had penetrated into the cut surfaces and stained both the tissues of the stock and scion. The Arbrex which was used was recently purchased and was less viscous compared with the same material used in previous years.

In a subsequent conversation with Mr. R.J. Garner of East Malling Research Station it was learned the losses with Arbrex compared with the paraffin wax was almost certainly due to their different properties. The paraffin wax has a low melting point and when applied over the union cools very quickly from "inside to outside" to seal the graft. The Arbrex requires no heating and solidifies "outside to inside" thus remaining in a liquid form at the union longer than the paraffin wax would. This time period, in particular if the stock and scion are not completely matched, allows the Arbrex to penetrate the tissues of the cut surfaces.

2. The premature breaking of the rubber ties during the callusing process which caused the stock and scion to partly separate, thus bringing about graft failure by drying out of the union.

3. The premature breaking of the scion bud after grafting by high air temperatures. Where practical, the air temperature — in particular for the whip grafts — must be kept as low as possible; slow callusing process for the latter seemed very beneficial. It was apparent that this premature bud break from the scion brought about both a lower percentage "take" and poorer establishment of the grafts after containerization.

GROWING ON

Generally the containerization of the grafts was carried out some six weeks from grafting. This time period did vary mainly due to the condition of the grafts. Besides being hardened off it was very important that there should be a very minimum of scion growth prior to containerization which, in turn, could have a direct effect on the establishment of the grafts. Genera where this condition was a particular problem were Prunus, *Malus*, *Aesculus* and *Robinia*.

The grafts were carefully removed from the peat so as to minimize the damage to the newly-formed roots. The compost used for the containerization was an Osmocote/peat-based formulation.

The two sizes of container used were a 6¼″ (15.5 cm) and 9″ (23.0 cm) in diameter; a container of good depth is particularly important with the latter size. A proportion of the grafts were containerized with the 6″ (15.5 cm) pots to aid establishment and then subsequently re-containerized in May into the 9″ (23.0 cm) size. The remainder were containerized straight into the 9″ (23.0 cm) selling container — the advantage here being that if the grafts successfully established, costs could be saved by omitting the necessity of using the 6¼″ (15.5 cm) container.

Next the containerized grafts were placed in an unheated dutch light structure and then well watered-in. To assist the establishment it is vital that shading and ventilation be given, in addition to careful watering so as to assist in retaining even temperature and moisture gradients.

Later the ties of those grafts were removed where they had not previously disintegrated. The veneer grafts were headed back in two stages — the first at four weeks after containerizing, while the second was carried out some four weeks later. Desuckering, pest and disease control, staking, tying and trimming were carried out as necessary.

CONCLUSIONS

Through observations taken from the grafting process to the stage of growth of the subsequent trees by mid-July, the following factors seem to be important criteria for success.

1. To achieve a high percentage take from the actual grafting process attention to detail is necessary, in particular with the aftercare of the grafts.

2. At the time of containerization following the grafting process a minimum of growth from the scion is important to reduce losses after containerization.

3. As to the size of container used for the growing on, some subjects such as *Sorbus sargentiana* and *Fagus* benefited from the intermediate 6¼″ (15.5 cm) container, but the majority of plants established as well in the 9″ (23.0 cm) container. Also by July, growth was generally better where the grafts had been containerized straight into 9″ (23.0 cm) selling container.

4. Cultural practices to ensure establishment of the grafts after containerization are important as it is at this stage of the production cycle that many losses can occur.

5. The growth response of different genera, species, and cultivars vary when grown in a glass or film plastic structure.

6. Time taken to produce a saleable tree varies. It was very apparent that the cultivars of *Prunus*, *Fraxinus*, *Betula*, *Malus*, *Robinia*, *Liriodendron*, *Sorbus aucuparia* would produce a qual-

ity tree by the end of one growing season. However, *Sorbus* × *hybrida 'Gibbsii'*, *Acer pseudoplatanus 'Leopoldii'* and *Acer platanoides 'Royal Red'* would taken two season's growth, while the cultivars of *Fagus* and *Quercus*, took three years.

Finally, it is important to point out that this project was carried out by students in their final year at College and many of our results were formed by observation. It by no means lays down a dogmatic procedure, but merely points out the successes and problems we experienced. Also many points that we came across have already been discovered by experienced growers. However to us they were new and, experiencing them first hand, taught us a great deal.

For the future, more detailed investigational work is required for certain genera. Also work on costs is needed so as to ensure this production system is commercially viable.

Table 1. The scion, rootstock, and type of graft used in the project work.

SCION	ROOTSTOCK	TYPE OF GRAFT
Acer negundo 'Variegatum' *A platanoides* 'Royal Red' *A. pseudoplatanus* 'Simon-Louis Freres'	*Acer negundo* *A. platanoides* *A. pseudoplatanus*	side veneer and whip.
Aesculus × *carnea* 'Briotii'	*Aesculus hippocastanum*	whip
Betula lutea, *B. nigra* *B. pendula* 'Fastigiata' *B.p* 'Purpurea'	*Betula pendula*	side veneer and modified side veneer
Carpinus betulus 'Columnaris'	*Carpinus betulus*	side veneer
Fagus sylvatica 'Purpurea' *F.S.* 'Roseo-marginata' *F.S.* 'Tortuosa'	*Fagus sylvatica*	side veneer and modified side veneer
Fraxinus oxycarpa 'Raywood'	*Fraxinus excelsior*	whip
Laburnum × *vosii*	*Laburnum anagyroides*	whip
Liriodendron tulipifera 'Aureomarginatum' *L.t* 'Fastigiatum'	*Liriodendron tulipifera*	whip
Malus 'Profusion', *M.* 'Cowichan,' *M.* 'John Downie', *M. toringoides*	*Malus sylvestris* M.M. III	whip
Prunus × *hilliera* 'Spire' *P. serrulata* 'Kanzan' (syn. *P.s.* 'Kwanzan')	Mazzard F 12/1	whip
Pyrus salicifolia 'Pendula'	*Pyrus communis*	whip
Quercus robur 'Fastigata' *Q. frainetto*	*Quercus robur*	side veneer
Robinia pseudoacacia 'Frisia' *R.p* 'Bessonia'	*Robinia pseudoacacia*	whip

Table 1. (Continued)

Sorbus × *hybrida* 'Gibbsii' *S. sargentiana*	*Sorbus aucuparia*	whip — retaining terminal bud for *S. sargentiana*
Sorbus aria 'Lutescens' *S.a* 'Magnifica'	*Sorbus intermedia*	whip

PRODUCTION OF NORWAY MAPLE CULTIVARS BY BENCH GRAFTING

CHRIS LANE

Oakover Nursery,
Ashford, Kent.

Why propagate Norway maple by grafting and not by the accepted practice of field budding?

a) because of poor bud takes in the field, due to spring planting and sometimes the poor quality of stocks available

b) to fit in with cropping programme on the nursery (i.e. at Oakover we are seed sowing or potting container plants at critical times for the field production)

c) labour profile, i.e. (because we have peaks at planting and budding time, it is convenient to graft these in the winter)

d) to produce a well-grown maiden whip of good size for field lining (i.e. 5-7′)

e) to be able to line out in the field at 100% crop

PRODUCTION METHODS

Understocks. Strong, well-grown, 1-year seedlings are lifted from the seed-bed during the winter. These should then be carefully graded by an experienced staff member and 5-7 mm sized stocks are selected, all having good fibrous root systems. Fangy or coarse-rooted seedlings are discarded. Cut all the stocks to 12-15″ in length to facilitate ease of potting.

They are then potted up into 4″ long tom polypropylene pots during January before the main potting season commences; they are then stood down in a frame outside. They should be potted with the hypocotyl just above soil level.
The compost used is: 80% peat, and 20% sand.

To this is added — per bale of medium Irish moss peat:

12 ozs Osmocote 18N:6P:12K
10 ozs Aldrin (for control of vine weevil)