were potted immediately and then taken to a cold greenhouse and watered in.

**Aftercare.** The grafted trees were watered regularly and any understock suckers rubbed off. After 4 to 6 weeks callus formation could be seen on the grafts, but I left the polythene bags on until I saw the scions bursting into growth — the polythene bags were then removed. The Rapidex ties were left tied around the graft as long as possible in order to create a good union and were finally removed three months after grafting. An overall grafting take of 85% was achieved. The young trees were left inside to form a good head; when this was achieved they were taken outside.

**Observations.** There seems to be no need to have established potted understocks as long as the understocks from outside are grafted and potted while fresh. The difference between heeled-in and fresh scions is insignificant, so fresh-cut scions can be used for *Acer pseudoplatanus* 'Brilliantissimum' as long as the timing of grafting is right. I have continued this basic grafting method in 1976 and 1977 with a few slight variations in that I have tried two-year-old stems and also inside scion material. The younger stems form a much better match with the scion material so forming a good graft union. Inside scion material has much stronger growth and the takes seem just as good with this material.

## HARDWOOD CUTTINGS — FIELD PRODUCTION

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**Production Lists.** These are made up bearing in mind what we think we can sell, what we need for growing on, and the amount of land available. Four lists are made — two for office records and one each for the propagator and planting foreman. There has been an increased demand for *Sambucus*, *Symphoricarpos*, bush *Salix*, and *Populus* over the last few years for screening and planting industrial sites. Land has now become our most limiting factor against increased production.

**Cuttings.** Cuttings are taken from stock hedges or any other source available. They are made approximately 6″ long of one year wood, the material being no thinner than a pencil. Thicker material makes the better plants eventually. We start with *Sambucus* as soon as possible in late October and November as these cuttings are from hedges which will be cut by a contractor as soon as the sugar beets have been harvested. The *Sambucus*

cuttings are the only ones cut deliberately to nodes as the inter-nodal length is so variable. The rest are just chopped off in 6" lengths. The *Sambucus* are followed by *Populus*, *Salix*, *Symphoricarpos*, *Ligustrum*, and smaller quantities of flowering shrubs, which are done last. The cuttings are tied into bundles of approximately 25 to 30 with either elastic bands or string. String is preferred on the machine at planting time as this is removed easier. The bundles are then laid in straight away in sand pits to the full depth of the cuttings, making sure everything is properly labelled.

The number of cuttings produced daily varies with cultivars from 700 *Sambucus* to 1200 *Salix* per person per day. We know that these figures can be improved upon but so far have not developed the right machine.

**Land.** A suitable area is selected as early as possible; the land must be clean and free from perennial weeds, old tree roots, etc. All our land is a light sandy loam. Sometimes, depending on the previous crop, a light dressing of F.Y.M., is given at 20 tons per acre and then ploughed and left until the February/March planting time. The land is rotovated twice and run up into beds using the tractor wheels to mark the beds; it is then left to settle. We plant four rows to the bed with rows at 12", with cuttings 3" apart in the rows, giving 90,000 cuttings per acre. The planting machine, which is homemade, cuts four slits with knife coulters which close up immediately, but they push stones, etc., out of the way so that there is a mark, and cuttings can be inserted easily to the depth of the coulter. The machine requires four persons — two abreast, and plants 6,000 cuttings per hour. Cuttings are lifted from sand beds into black Dale trays which can be carried on the machine. Cuttings are pushed in as deep as possible until only 1" is showing. Fluffiness of the soil does not seem to have any adverse effect and we have found no firming necessary. Labelling is done at the time of planting.

**Aftercare.** Cuttings are sprayed as soon as possible with 1-1/2 lbs Gesatop (3/4 lb active simazine). We sidehoe when necessary, usually about twice, then all that is needed is a walk over to take the odd weeds from the rows. We apply 3 cwt - (12.8.18) fertilizer in May when the cuttings have rooted and are growing away.

**Lifting.** An Egadal type bed-lifter behind a David Brown 995 tractor on high clearance is used for undercutting. We lift and grade as orders are required and, later, all the remaining plants are removed and replanted making good big plants the following year.

**Comments.** We are gradually increasing the number of shrubs propagated in this way as we find the cultivars which can root easily and the cutting material becomes available. We get a good plant in one year which is often up to and above the specification required for landscape contracting work and the smaller plants are much better liners than ones from soft or semi-hardwood cuttings. So far we are having success with cultivars from the following genera: *Cornus*, *Forsythia*, *Philadelphus*, *Ribes*, *Sambucus canadenis* (or *nigra*?) 'aurea' and *S. racemosa*, *Spirea*, *Weigela* and *Privet*.

**Economics.** The economics of nursery stock has always baffled us, as every cost assumed to be constant seems to change immediately it is used. No doubt this is why we are still in business, as those with true business acumen have found easier ways of making money. In deciding to expand the production of hardwood cuttings, we have made a comparison with other nursery crops, not only on the return per plant or per acre, but on the labour requirement, both in number of hours, and the time of year, the use of existing equipment, the present sales demand, and the sales potential.

However attractive a crop appears to be to grow, it cannot be an economic proposition if the labour requirements of the crop clash with other tasks already employing all available labour, and it is unlikely that mechanization can entirely overcome the problem.

The cultivars of cuttings being produced are based on three factors: will it root, does it sell, or can we make it sell? Secondary factors to consider have been the availability of stock plants, who should make the cuttings, the propagator as a routine, or should the work be saved as a bad weather job? Should the cuttings be made at the site of the stock plant or prepared indoors and how should they be bundled? Should they be layed in outdoors or indoors, in soil or in sand? All these points are labour intensive, and other work may suffer if production increases quickly.

It would appear from our own experience that mechanized planting is an advantage where more than 50,000 cuttings are to be lined out, though this figure may well be higher if a suitable machine has to be purchased. We have not considered that planting machines have been successful in the past, as the soil is left comparatively loose around the cutting and the base is not firmly in contact with the bottom of trench which, rightly or wrongly, we have considered to be of major importance.

Efficient use of labour is now essential, and it is interesting to consider that in 1976, cuttings were inserted at the rate of 10,000 per short day by three women and, in 1977, four women

and a tractor driver were planting 30,000 cuttings per short day and enjoying it!!

We have ignored ground preparation in comparative costings as this is similar for most crops, but it has become obvious that production from hardwoods is still the most economic way of producing many plants, and when we have improved the system of producing cutting material and improved the speed at which cuttings are made, by machine cutting, together with a change of attitude by the propagators so that they no longer look upon each cutting as an individual, then we can consider further expansion in cutting production with confidence.

We have seen increasing interest in tenders for shrubs in the 45 to 60 cm size and, by selecting cuttings, it should be quite possible to supply strong sturdy shrubs of this size in one year. We have not yet overcome the difficulty of producing two-year transplants of willows, poplars, etc., with a central leader but only 45 to 60 cm high, which is a specification often quoted in the North, and any suggestions would be appreciated.

## EFFECT OF SPACING ON THE ROOTING OF *CHAMAECYPARIS*

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**Abstract.** In an attempt to maximize production from a given area of heated propagation bench, it is common practice for plant propagators to space cuttings densely. The close spacing of cuttings of cultivars of *Chamaecyparis lawsoniana* reduced rooting and the results show that this was wasteful of labour and propagating material. Less densely placed cuttings showed satisfactory rooting and a lower death rate.

### MATERIALS AND METHODS

In two randomized factorial experiments carried out at Kinsealy Research Centre, the effect of spacing of *Chamaecyparis lawsoniana* cultivar cuttings in the propagation bench was studied. In 1969, basal cuttings (i.e. those removed from the parent plant by cutting through the junction of the new and older wood) of cultivars 'Fraseri' and 'Pottenii' were prepared for propagation. The cuttings were immersed in a solution of captan (3 gm per litre of water). After being allowed to dry, the bases of the cuttings were dipped in a proprietary powder containing 0.8% indolebutyric acid (IBA).

The cuttings were inserted in propagation trays containing a mixture of two parts moss peat to one of sand and placed in a mist unit. Heat was applied to the bases of the cuttings by