Feeding. Initially, the Osmocote in the compost provides adequate nutrition, but from early June liquid feeding is given via the irrigation system. We start from a concentrated solution which is injected in impulses into the pipes and diluted at 3 parts per 1000. The stock solution is adjusted according to the analysis of the water. The interesting thing about this system is that we can use any type of water; the pH is lowered with nitric acid. We generally cease feeding at the end of August to allow the plants to harden before winter.

Weeding. The weed problems are reduced by the use of our sterile compost. Herbicides we use are Simazine at ½ kg per hectare, Tenoran at 3½ kg per hectare, and Ronstar 2G (granular form) at 120 kg per hectare. In the last two years we have tried a new chemical called Boulherb, which is a mixture of lenacil and neburon. Used at a rate of 7 kg per hectare it lasts two months, and seems to be an efficient chemical. Most plants have tolerated it quite well up to now. An important aspect with herbicides is the method of application. To be effective it must be done very carefully. Overdosing causes accidents; too little avoids accidents but gives poor weed control. We spray with a boom which is the same width as the beds (3 m); the rate of application is controlled by the walking pace of the two operators at either side. The pressure is constant. For the last two years hand weeding has been reduced to 1 minute per 400 pots for the whole season.

Spraying. Pests and diseases are a constant problem so we spray all plants at 3-weekly intervals with a fungicide and insecticide. We use alternately Benlate, Aliette, Thiram, Captan, Decis, and Kilval.

In addition, plants are shaded, pruned and staked to make them saleable by the end of September.

THE PRODUCTION OF POT-GROWN LINERS IN DEVON

NIGEL JOHN TIMPSON

Hewton Trees and Shrubs

Bere Alston, Devon

The nursery at Hewton was established 14 years ago. Since I took over in 1976 we have considerably expanded the facilities and production output. On the 3½ hectare nursery, 1½ hectares are used for production and 2 for stock planting. Most of our facilities are under polythene and we have space for ½ million plants under cover. Our current production is

around 700,000 plants per annum, 90% of which are produced from cuttings; the remainder, apart from about 5,000 grafts, are from seed.

We specialise in liner production and are, therefore, able to give the attention to detail that is required to enable us to successfully propagate difficult plants. Our policy has always been to concentrate on propagating plants which other people find difficult, or which are in demand for some other reasons — perhaps there is a shortage of suitable stock material for propagation. Growing difficult plants has stood us in good stead in years when orders have been difficult to come by.

When people visit the nursery they often say how favoured we are in Devon since we have such a good climate with practically no frost. This is not really true. Although our average temperatures are higher than in many parts of the country, we must have had 12 to 15 nights last winter when the temperature reached −4°C or lower. However, the most significant weather factor is our relatively high rainfall, over 1000 mm a year; this makes it difficult to over-winter small plants outside.

Having said that we do not have a particularly good climate, I believe we do have certain natural advantages. Firstly, we are situated on the banks of the River Tamar which is up to 300 m wide at this point. The reflection from the water, or mud as it is at low tide, seems to give us very high light levels even on a relatively dull day. Secondly, we have a very good clean water supply from Dartmoor. This comes from a granite area and the pH is quite suitable for the sort of plants we grow. It means that we have no deposits on our cuttings even after a long period under mist and that a blocked mist nozzle is a rare occurrence. The third asset which we have is the availability of the well-known Cornish grit. Our grit actually comes from Devon from the china clay workings north of Plymouth. These three advantages, plus reasonable facilities, combined with our experience, mean that we are more successful than many nurseries with the propagation of difficult plants from cuttings.

We use several different facilities for our propagation. For instance, we use unheated frames for early cutting of dwarf rhododendrons, the frames being covered with Dutch lights and shaded as necessary. However, the bulk of our propagation is carried out using mist under glass or polythene. In our main propagation house we have benches fitted with heating cables and mist facilities. The house is completely unshaded to allow maximum light levels; this causes no problems and, indeed, is essential for successful propagation of many decidu-

ous species such as magnolias, parrotias and azaleas. For artificial lighting we have fluorescent tubes fitted which are used to extend daylight on these deciduous cuttings from dusk until about 11 p.m. These will be used from the end of the first week in August until early November. In this way we are able to get sufficient growth and root establishment on otherwise difficult plants to enable them to over-winter successfully.

Apart from one trial solar control unit, we are using wet leaves to control the mist operation. We have found the solar control to be more satisfactory and, in due course, I expect to convert all our mist to this type of operation. We use the mist as little as possible, and from October until March on most days it will be manually controlled. On many days during the winter it will only be used for two or three short mistings. This has the dual advantage of keeping the cuttings dry and thereby requiring less bottom heat. For summer propagation we maintain a minimum of 20°C bottom heat, but for most species this is progressively reduced during the autumn and during the coldest weather in December and January, may be as low as 12° to 13°C. There are some exceptions; for instance, *Magnolia grandiflora* cultivars require around 18°C to enable them to callus, and hardwood cuttings of vines and figs will tend to rot if the bottom heat is below this figure.

Most of our propagation is done in trays with a depth of 2½ in. but for some species such as magnolias with large root systems, we use 3 in. deep trays. Some plants, which do not tolerate root disturbance, are propagated in individual pots; for example: *Vitis*, *Fremontodendron* and *Embothrium*.

We use a 3:1 sand/peat mixture for much of our propagation but for many species which are susceptible to decay or are otherwise difficult, we use pure sand. These include, for example, *Garrya*, *Daphne*, and *Ceanothus*. All our cuttings are wounded when they are prepared and we use Seradix 2 or 3 mixed with various proportions of Captan. During their time in propagation cuttings are regularly fed with a weak solution of Bio Number 5.

As propagators specialising in difficult to root plants, we have to be more successful than the next person. A combination of the techniques previously outlined plus attention to detail, particularly in relation to hygiene enables us to achieve good rooting percentages.

We also propagate during late summer and winter under polythene tunnels, 58 ft long by 14 ft wide and 6½ ft high. The environment in the tunnels is not suitable for all plants; for instance, garryas and daphnes we would only propagate under glass.

In one of these tunnels we have heating cables with a misting system. This works well but is expensive to run since it is not properly insulated. A further five tunnels are used for winter propagation, this time on benches which have warm air ducted underneath them. This system works extremely well and even in the coldest weather we are able to maintain a bottom heat of 10° to 12°C at night — sufficient for propagation of many species. There are lights available in two of these tunnels so that we can keep plants or rooted cuttings growing during the autumn period if this is required.

Following rooting, cuttings are held in tunnels prior to potting. Having tried carefully controlled machine potting we have for several reasons returned to potting everything by hand. We can achieve a much more uniform product in terms of depth of potting, centralisation in the pots, and degree of firmness of the compost, the latter being particularly important when trying to establish a batch of difficult plants. In addition, we find that we can achieve a higher output by hand, although there is still room for improvement, perhaps by incorporation of some of the features of the ADAS hand potting method. Potting starts in the middle of February and continues until the end of summer.

The most difficult aspect of our production process is the establishment of the young plants after potting. To ensure continuity one person is solely responsible, apart from weekend cover, for watering and looking after plants in the tunnels. She has no other responsibilities so can devote all her time to this without distraction and give the attention to detail which is so important. It is not sufficient to turn on a spray line to water batches of difficult plants, so a lot of our watering is done by hand, with the sprinklers being available as a backup in hot weather. Where difficult plants are being grown in large numbers I regard establishing and looking after them as being the most demanding job on the nursery. Propagation becomes relatively simple once the techniques have been worked out, whereas the factors affecting young plants vary all the time.

Our principal pest problems are red spider, aphids, and tortrix caterpillars. These are controlled by two or three overall sprays during the season with spot treatment where there is a particular problem.

Weed control is all by hand. Where chemical methods have been tried, for instance Ronstar granules, we have experienced an unacceptable level of damage to freshly potted plants. Our main problem, accentuated by our lime-free water, is liverworts and this we live with until it reaches an unacceptable level, when it is controlled by top dressing the pots.

The final part of our production process is the selecting of the plants for despatch. We always aim to provide plants which have been carefully graded, so that our customers will be able to produce an even batch of container plants.

Looking to the future, I have been keeping a close watch on developments in the micropropagation field. I have considered the setting up of a small unit but have now decided that the way forward for us is to take micropropagated plants from an existing unit and establish them in small pots — a process which we should have the right techniques to do successfully. During the next 6 to 12 months we shall be gaining some experience in this field so that we will be in a position to take advantage of future developments.

Finally, I would like to comment on the position of the liner producer in the industry today. It seems to me that the future is very promising, certainly where more difficult plants are concerned. A container grower wishing to produce 200 saleable plants of a species such as *Magnolia grandiflora* may need to start with twice as many cuttings to enable him to produce a well graded batch of plants for potting on. The liner producer, on the other hand, will be able to give the attention to detail which is required to obtain 90% of the plants suitable for potting on. This same argument applies to many plants and I believe that, for economic reasons, the trend should be to more specialisation of production, with liner producers and container growers concentrating on what they are able to do well.

DIRECT ROOTING OF DORMANT CUTTINGS

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For many years we have used the procedure of taking cuttings and sticking them directly in a pot filled with growing medium. The cuttings then root and continue to develop into mature liners without interruption until harvest.

The basic system of direct rooting and procedures for handling cuttings is explained in detail by Sidney B. Meadows (1) in a paper presented to the IPPS Southern Region in 1981.