R. MILLER: In small quantities, the Allibert trays cost £3 each, and the similar Dutch tray £1.39.

B. RIGBY: Did you make your own trolleys, or were they made by an engineer who could supply to the industry?

R. MILLER: Most roller conveyors clog with peat, so we consulted an engineer when we decided to build a system around the Empot carrier. It is too expensive to patent the idea, but I am prepared to sell the drawings. The handling time to unload the trailer is 20 minutes for 2000 plants; this is impossible to do by hand.

R. EVISON: Do you overwinter young plants in the trays, and do they get starved?

R. MILLER: We use no fertilizer in the compost, but we now top dress Q4 as soon as the cuttings are rooted and water it well in. Most get one application before they are potted.

R. EVISON: We are using smaller but deeper trays with a potting compost in the base and a normal cutting compost on the top. It has been very successful, but we shall have to see how they overwinter.

COST EFFECTIVE PROPAGATION USING POLYTHENE STRUCTURES

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When I left college some 13 years, or so, ago; with ambitious plans to turn a small family retail firm into a production orientated wholesale business, there were three factors which determined our propagation set-up:

Firstly, large amounts of money were not available;

Secondly, the lack of any existing conventional propagation systems, which allowed me to start from scratch with a fresh approach. People are reluctant to change what they already have!

Thirdly, the reluctant realisation by horticulturists that polythene did have applications other than wrapping sliced bread, and that it might even be used as a glass substitute.

Using this magical substance it became apparent that not only did it work, it enabled one to erect large areas of propagation covering, simply and with a low initial expense.

I say initial because, over a period of time, re-cladding

labour and material costs mean that there must be a point where the cost of glass versus polythene evens out. But it is the low initial cost which was important.

With the high capital outlay and high running costs with glass, concrete paths, raised beds, mist and timers (I never could understand the concept of heating a bed and at the same time drenching it with cold water), and all the other electronic paraphernalia, which always seems to break down during the hottest day of the year, leading to "propagator's palsy".

Simplicity is the key; nothing could be simpler than going with the seasons, using the sun as free heat with polythene as the uncomplicated tool.

Now with the high capital outlay in misted glass, bench space is at a premium. There must be a constant flow of rooted material through the propagation house to justify the high costs.

Grouping of plants with similar rooting times becomes critical, making the use of trays essential. Trays are costly; they need sterilizing and filling. The labour costs in handling the trays from propagation room to propagation house, and then from rooting to the weaning or over-wintering house are considerable. Trays also take up space.

With "poly-houses", without mist or heat, one can afford to root one crop per year and leave it sitting there undisturbed over the winter, ready for spring potting when teams of part-time workers lift the crop en masse for the potting team. (Autumn potting can be discounted as being too risky, and there's no point in doing this with us, anyway.) This eliminates trays (although we do use trays for about 10% of our production, which I'll explain later).

Having large areas of propagating space at one's disposal is a definite asset. For example, the majority of evergreens under polythene root best without bottom heat, from mid-August to the end of October. This major peak in propagation can be met by employing more part-time cutters, and production can really be achieved in a big way, without the worry of having to find more space.

I won't go into the importance of having large stock beds on a hedgerow system, or time and motion in the cutting room. I'm sure this has been covered adequately before.

Our propagation year starts after potting, which is the last week of June, and continues with fluctuations in the labour force, to the end of January, after which the potting cycle commences once again.

We have two 28′×100′ wide Filclair houses with vents for

propagation extremes. By "extreme" it is meant that one is used for mid-summer propagation where the hottest temperatures are achieved; the other in the depths of winter when one experiences the coldest temperatures. Both houses are designed to deal with these extremes and they account for about 30% of our total propagation.

From mid-August to December we have a series of 14′ to 16′ wide polyhouses. In all houses, with the exception of the winter house, cuttings are stuck into a 10cm peat/grit layer, which is laid directly on black polythene. All beds are at ground level. The peat/grit ratio varies according to season. (Osmocote, frit, and dolomite are incorporated in the mix at ½ potting compost rates). Rockwool and other multi-pot aids are also being used.

A trolley for the "sticker" is used to cut out most of the arduous bending work involved, and to increase production.

SUMMER PROPAGATION

The greatest hazard of propagation under polythene between June and August is the excessive heat build-up. There are several ways to deal with this. When we start in July with deciduous softwood cuttings, our vented Filclair house is used. A 60% shade plastic netting is suspended across the eaves and along the sides. Under this at ground level are low tunnels covered with 150 gauge white polythene. Each low tunnel is fitted with a series of high pressure nozzles which are used either manually, or on a time-clock at week-ends. These high pressure nozzles are only used on warm clear days, giving an 8 second burst every hour between 9 am and 5 pm. They are used purely as cooling devices but they also ensure that 100% humidity is achieved. This is our only concession to the "mist" principle and the actual volume of water used is minute; it is turned off completely during dull weather.

We aim to experiment with fine sprays actually directed over the top of the tunnels, which would induce cooling without over-saturation of the compost.

In mid-August we move into the 16′ wide polythene house clad in white film. As an additional precaution in hot weather, a 20′ wide Nicofence is draped over the house, which can be removed or erected in minutes, as the weather dictates. In the houses themselves the low polythene tunnels are now dispensed with and white 150 gauge polythene is laid directly on top of the cuttings.

We believe direct polythene gives better results at this time of the year and into the winter months, especially with evergreens and small-leaved subjects.

One word about shading: at one time netting was laid directly on top of the polythene clad inner tunnels. We found very little, if any, reduction in heat inside these. There must be at least a 1' gap between the netting and the polythene.

We are now looking at lathe type shading — like Paraweb, which breaks the light into parallel bars of deep shade and bright light. As the sun moves these bars of light and shade move steadily across the house giving each strip no more than 10 minutes before heavy shade, thus giving a boost to the food production in the leaves of the cuttings, but without scorch.

In September/October, whilst still using the white out-covers, the 150 gauge white is replaced by a light opaque 75 gauge film directly on the cuttings and then by November, a clear 75 gauge polythene is used.

From late November through to mid-December we use a clear polythene house with the clear 75 gauge inner covering. During November and December all the easy ground-cover types are rooted, i.e. *Hypericum*, *Vinca*, ivies, etc. We find that even in mid-winter there is still enough heat in the sun to promote slow rooting without heat.

So we are having a flexible shading routine which varies according to the light throughout the different seasons.

From mid-December to the end of January we move into our winter Filclair, where cuttings of × *Cupressocyparis leylandii*, *Ilex*, and certain conifers do require some bottom heat. The beds are heavily insulated with styrofoam using Nobel probes.

We also, reluctantly, have to use trays because of unequal rooting times to make best use of the house.

Low polythene clear tunnels are hooped over the crop with Pillasol laid directly over this, and on clear sunny days white polythene is placed over this, creating a sandwich.

The bed temperature is kept at between 60° and 65°F; we have found higher temperatures unnecessary.

No air heating is used in any of our houses during the winter. During cold spells we do cover rooted cuttings with bubble glaze and polythene laid directly on top.

Last winter we recorded −20°C inside our tunnels and had very few losses, even with tender species whose mother plants were killed outside.

B. LOCKWOOD: Could you tell us more about the use of Osmocote, and nutrients in general in the rooting media?

R. TACCHI: We have tried for two to three years using long release Osmocote with trace elements (Micromax) and

dolomite limestone on summer-rooted cuttings, and they are left until the following spring.

M. SCOTT: Don't you run into problems with release of nutrients in hot summer weather?

R. TACCHI: No, not really.

A. WOOD: Initially you chose polythene houses for your nursery, but during the long term these incur high replacement costs for polythene. If you started again, would you choose glass or polythene?

R. TACCHI: It would be a difficult decision; I haven't done any definitive costs and examined the grant position.

W. MATTHEWS: I chose glass and built ¾ acre. There are breakage and washing problems, but I would stay with it. It is easier to control temperature and there are no drip problems. With the increasing cost of oil polythene replacement will get more expensive.

SIMPLE BUT EFFECTIVE PROPAGATION IN NORTH AMERICAN NURSERIES

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Last summer, I toured the United States and Canada as a Nuffield Scholar fully funded by the Studley Trust. My prime interest was in the production and marketing of container plants but, as I visited over forty container producing nurseries, I gained an insight into their propagation methods.

One cannot fail to be impressed by the vast open-air mist units of the South and Southwestern states. The progressiveness of the growers in the Pacific Northwest with tissue culture of ornamentals is equally impressive.

However, the humbler propagation techniques used by some growers set me wondering whether we in Europe are employing over-complicated and unnecessarily sophisticated methods for the propagation of easy subjects.

For instance, in the Midwest, millions of *Taxus* and *Juniper* cuttings are produced annually employing a technique which is really no more than an adaption of the old coldframe. Instead of frames, walk-in polytunnels are used to enclose the cuttings stuck in raised ground beds. No bottom heat is provided at all and the only air heating that is done is to prevent irrigation lines from freezing in winter. Large cuttings are