The Role and Performance of Tissue-Cultured Plants at FitzGerald Nurseries©

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INTRODUCTION

FitzGerald Nurseries has been weaning and growing plants propagated by tissue culture for the last 4 years and in this paper we aim to share our working knowledge of the facilities, staff, handling, and growing methods and overall philosophy required. Using tissue-cultured plants is a challenge but we have learned enough to lead us to believe there is a long-term future for them in our business.

REASONS FOR GROWING TISSUE-CULTURED PLANTS

The following are the main reasons why tissue-cultured plants are in use at FitzGerald Nurseries:

- To produce plants, which cannot be grown commercially in the numbers required through any other method, e.g., *Cordyline australis* 'Red Star'.
- To supply us with superior mother stock material to reduce the overall cost of production, for example in ornamental grass species.
- To produce clean mother stock material for enhanced conventional propagation. This generally invigorates the stock line allowing for a reduction in the use of chemical crop protection and a more uniform cutting crop, for example with *Buddleja davidii* cultivars.
- To bulk up new and novel plant taxa. This is one of the more recent uses but is becoming the most important.

FACILITY

To date we have operated a small, simple but effective facility, which takes 128,000 plants in one turnover. It can manage between 500,000 and 600,000 plants per year. Thin-gauge polythene tents create a microclimate of the right humidity around the plants within the glasshouse. Bottom heat, from under-floor hot-water pipes, is maintained at 21 °C. This can be achieved with a water temperature maximum of 40 °C and minimum of 35 °C. Actual root zone temperature is 18 to 25 °C. For weaning, the air temperature is maintained at around 15 °C day and 10 °C night. Sodium lamps between January and April provide supplementary lighting.

To improve handling efficiency, we have commissioned a new rooting and weaning unit based on container benching in a larger glasshouse area on the nursery. It will have the capacity to produce 350,000 plants per rotation and we plan to bring our rotations down to 4-week cycles all year round. This will be achieved by using two other zones within the same greenhouse complex to move the plants on after initial rooting in has been developed.

It has been a good learning curve for us to be able to understand this discipline of managing humidity and temperature within a modest facility before investing in much more costly and technically demanding equipment.

STAFF REQUIREMENTS AND LABOUR EFFICIENCY

Working with tissue-cultured plants demands a high degree of attention to detail so it is important that the nursery employs staff who can work in such a demanding environment. For the last 2 years we have been recording the day-to-day time sheets for all of our staff on a simple software program called Timelink. This enables us to assess how much labour is being spent on the various processes. We have already found that plants from tissue culture cost more in management time to produce than our conventionally propagated plants. We also find that unless we specialise within our range staff have a much slower output rate. We therefore aim to have the same people work on the same plants each week.

MANAGING THE LABORATORY—NURSERY RELATIONSHIP

This relationship is crucial to the ultimate success of growing tissue-cultured plants on a nursery. However the gap in understanding between the laboratory scientist and the grower has proved to be very difficult for the majority of people involved to bridge. On the one hand there are still some very unreasonable expectations from the market about what to expect from tissue culture. On the other, scientists can give very misleading and somewhat over optimistic predictions about what they have the ability to do.

In our experience, and the experience of most other growers I have spoken to, the supply of ornamental plants from tissue culture is generally unpredictable. This can prove expensive in lost sales and lack of customer confidence for the future. It is very important that the channels of information are clear between the laboratory and the grower but sadly this rarely happens.

Having seen how many growers around the world work with their supplier laboratory, I have come to the conclusion that our business must develop a proper blend of traditional and tissue-culture production. Planning must be in conjunction with the laboratory and reviewed on a regular basis throughout the production cycle of each plant line being worked.

Geographic proximity of laboratory and nursery is an advantage — but don't choose one of a poor standard just because it is close. We work with a small number of laboratories and in particular with Plant Technology Ltd of Enniscorthy, Co. Wexford. We have learned that deciding on the range of plants that we will grow through tissue culture requires a lot of care and constant reviewing. The laboratory and its scientists are vital partners for nursery growers of the future.

DELIVERY OF PLANTS TO THE NURSERY

Import permits must be applied for, customs clearance agents and agricultural inspectors informed of arrival dates, and paperwork must be obtained in advance from the supplier.

We have had experiences where plants have been delayed in transport from abroad and suffered the consequences. But some species are more sensitive than others — delays are not always a disaster if the transport conditions are maintained appropriately. For example, *Cordyline* needs as short a delivery period as possible while *Ophiopogon* can do very well over a long period. We always prefer to have our plants delivered in agar. This helps maintain their condition but is bulky which makes air transport expensive. Many suppliers are now randomly including

temperature-recording devices in shipments so that there is a verified record of the temperature maintained in transit.

Transport issues rarely if ever arise with our home suppliers. Unfortunately competition makes life difficult for suppliers in high cost countries. Mass movement of plants is relatively recent and I am not convinced we can rely on it in the future for all species of plants. We should be aware of the dangers of loosing our homegrown technology in plant production.

TREATMENT OF PLANTS ON ARRIVAL

If plants have deteriorated in transit make photographic records and contact the supplier immediately. Good suppliers will want to know and help devise a solution. We store incoming plants at 5 °C but try to have all plants packed out of their agar on the day of arrival. All tubs and boxes are checked by the weaning supervisor and quality is assessed. The time of arrival is recorded and the supplier notified of the shipment's condition. If stressed, some plants may require remedial treatment before sticking.

SUBSTRATE

Plants going for direct potting or sale as plugs are inserted into Elle-pots, which make it easy for individual sorting and grading before potting or shipment. Plants grown on for further subdivision, such as *Phormium*, are inserted into trays of 3 medium grade Irish moss peat : 1 Silvaperl vermiculite coarse grade (v/v) medium. We have been using this substrate in most of our propagation with great success. However we are currently reviewing our mixes and are testing a blend of Baltic and Irish peat. We are also planning trials of a coir-based medium.

We use a base dressing of Osmocote-mini controlled-release fertiliser at 1 $kg \cdot m^{-3}$. Supplementary feed is applied as required once plants are rooted through.

DELIVERY SCHEDULING

Most of the waste in growing tissue culture plants is caused by poor coordination of timing between supply and demand.

We must start with the assumption that deliveries from the laboratory are planned to coincide with the known schedule to finish the young plants in time for the customer in turn to finish their stage in the supply chain. They in turn will have a schedule to meet for specific sales periods. All timings should be researched and agreed with the laboratory when the order is made.

Even so, in our experience growers cannot assume agreed timings will always be met. For quite a lot of the species nurseries work with we might be naïve to expect they can be. It does work a lot of the time on many subjects but it is rarely as easily achieved in practice as it is to plan.

This is not meant as a criticism of laboratories, simply a statement of our experience. Once you know the potential pitfalls you can put strategies in place to overcome them. These must involve your customer as well as your supplying laboratory. We aim to deliver in the week that the customer specifies. It is therefore important not to take on unrealistic orders. If we suspect we cannot meet the requirement we alert the customer at the earliest opportunity.

FACTORS AFFECTING PROFITABILITY

Unless the market is prepared to pay a realistic price for the plant, or the process itself delivers significant cost savings, it is unwise to use tissue culture for that particular plant.

One of the main factors to consider is wastage in both the laboratory stage and the nursery stage of production. We have found wastage can be as much as 50% on some subjects at the initial development stage and even more when problems such as bacterial infection occur. The amount of wastage one can afford is obviously dependant on the price the finished crop can achieve. I would suggest that on difficult subjects 75% rooting could be tolerated but on the majority we must aim for 95% to 100% in the commercial interests both of the laboratory and the nursery.

The main benefits of consistent high volume production of otherwise difficult-to-produce plants; clean disease-free and vigorous crops; rapid number bulking of new and innovative plants and sales opportunities in markets outside of E.U., have to be set against the disadvantages of expensive equipment and labour; susceptibility to large-scale crop failure; unpredictability of supply; the need to grow large numbers; and the unsuitability for many crops due to tissue-culture-induced clonal instability.

THE FUTURE ROLE OF TISSUE CULTURE

The main benefit to our nursery has been in creating opportunities as a young plant producer to supply a global market. This is significant enough for us to cautiously increase our use of tissue-cultured plants.

This will help us develop many more new and exciting plant selections and to reach a larger market. We will be able to maximise the design, imagination, and breeding capabilities of our customers, employees, suppliers, and breeder partners.

Tissue culture could also help us reduce our dependency on the chemical control of pests and diseases by providing clean mother plants. It also has the potential to help increase efficiencies in the production of many of our standard taxa, through the use of clean mother-stock raised through tissue culture.