an insecticide is included, usually Attack (pirimiphos-methyl, plus permethrin).

WEED CONTROL

All weed control is done chemically using Ronstar (oxadiazon) applied with a small garden sprayer as a basal spray. Ronstar is applied as soon after potting up as possible, but after plants have been placed in the standing out area. The rate used is 30 ml per 100 litres of water, which is ⅓rd the normal application. This has been found to give effective weed control for up to six months.

CONCLUSION

Because revegetation plants are required in large numbers for any one project, it is essential that cost be kept to a minimum. The techniques outlined have been developed to keep labour input low and thus keep the cost per unit down. However, quality cannot be sacrificed for quantity and it is important that the plants be sturdy enough to meet the rigorous demands of harsh planting sites.

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TISSUE CULTURE: IS IT THE ULTIMATE IN ASEXUAL PROPAGATION?

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The New Zealand's locality and consequently its climatic conditions make it idealy suited to grow a large range of plants. With the added advantage of having an out-of-season market in the Northern Hemisphere, the horticultural industry has grown rapidly in the last few years. Typical "Kiwi ingenuity" has prompted the successful production of many different

vegetables, fruits, and more lately new cut flower crops.

With the fast growth in horticulture, plant tissue culture has emerged as an alternate way of propagating new plant material and the industry is well serviced by a number of competent commercial laboratories.

It has been my experience as one closely involved in commercial tissue culture, that many potential users of this technique neither appreciate the basic mechanisms involved nor understand the relative advantages or disadvantages. I welcome the opportunity to try to explain in practical terms what is involved in commercially producing plants by using tissue culture and to then discuss some of the factors relating to producing an economically viable product.

What is plant tissue culture? For the purposes of my talk we will define plant tissue culture as micropropagation, although the term can embrace a much wider range of potential uses. What we are able to achieve is an asexual propagation in a controlled laboratory environment with the potential for producing thousands of genetically indentical off-spring. Steps involved are shown in Figure 1.

Plant selection. To justify the expense of using plant tissue culture, the original "mother plant" must have special attributes.

The consequences of producing large numbers of inferior off-spring must be fully understood prior to commencing the propagation.

Also the requirement for relatively large numbers of plants must be determined for the project to be considered economic.

Plant preparation. This is an often neglected part of the tissue culture process. Education is required to show customers that material supplied for tissue culture propagation is properly prepared prior to culture initiation.

Pre-conditioning of the plant under a still air environment away from other plants, the absence of overhead watering, optimum nutrients, light and heat, and the selection of the correct season of the year will ensure that new soft growth with a minimum of biological contamination is available for the initiation of cultures.

Culture media. Before any actual tissue culturing takes place artificial culture media must be prepared in a laboratory. Normally for the initial stage a very basic media formulation is used.

Macro and micro nutrients, vitamins and an iron source, sugar, and other essential growth factors must be accurately

mixed together and sterilised in the optimum proportions to support plant growth. The addition of agar as a gelling agent is normally used.

Culture initiation. This is a potentially very difficult area in plant tissue culture and many different methods are in commercial use.

Basically the aim is to surface sterilise the plant material without killing the plant itself. From this point onwards the culture must remain completely sterile as microbes would overwhelm the cultures and prevent growth.

The use of a range of chemical sterilants together with various physical methods will normally achieve the desired results.

Once the pieces of tissue (called explants) are sterilised they are transferred aseptically to the sterile culture media. All the transfer operations take place in a specially designed laminar flow work station which provides a clean air work environment.

Culture multiplication. Having achieved sterile cultures and with the emergence of new shoot growth from the explants, a multiplication of the cultures must now take place.

This is achieved by sub-culturing the plants onto a more complex culture medium containing plant hormones. This stage is really the heart of the whole process and the multiplication rate largely dictates the economics of the whole project.

There may often be very long and expensive periods of time before an optimum multiplication medium can be determined, a factor which many customers cannot fully appreciate. Once the multiplication rate is known production scheduling can begin.

Rooting. Shoots resulting from the multiplication need to be rooted. This is often achieved in culture by changing the plant hormones in the medium.

Wherever possible the rooting should take place in the nursery rather than in the laboratory where shoots are normally dipped in rooting hormones prior to hardening off. Rooting of tissue culture plants can be very difficult particularly with some of the woody species.

Weaning and hardening off. Tissue culture plants are succulant with very little cuticle layer on their leaves. It is important that they are weaned with gradual exposure to dry air. Specially designed nurseries are required to handle tissue cultured plants with equipment such as humidity tents, misting, fogging, hot beds, etc. being required to handle the plants from the laboratory.

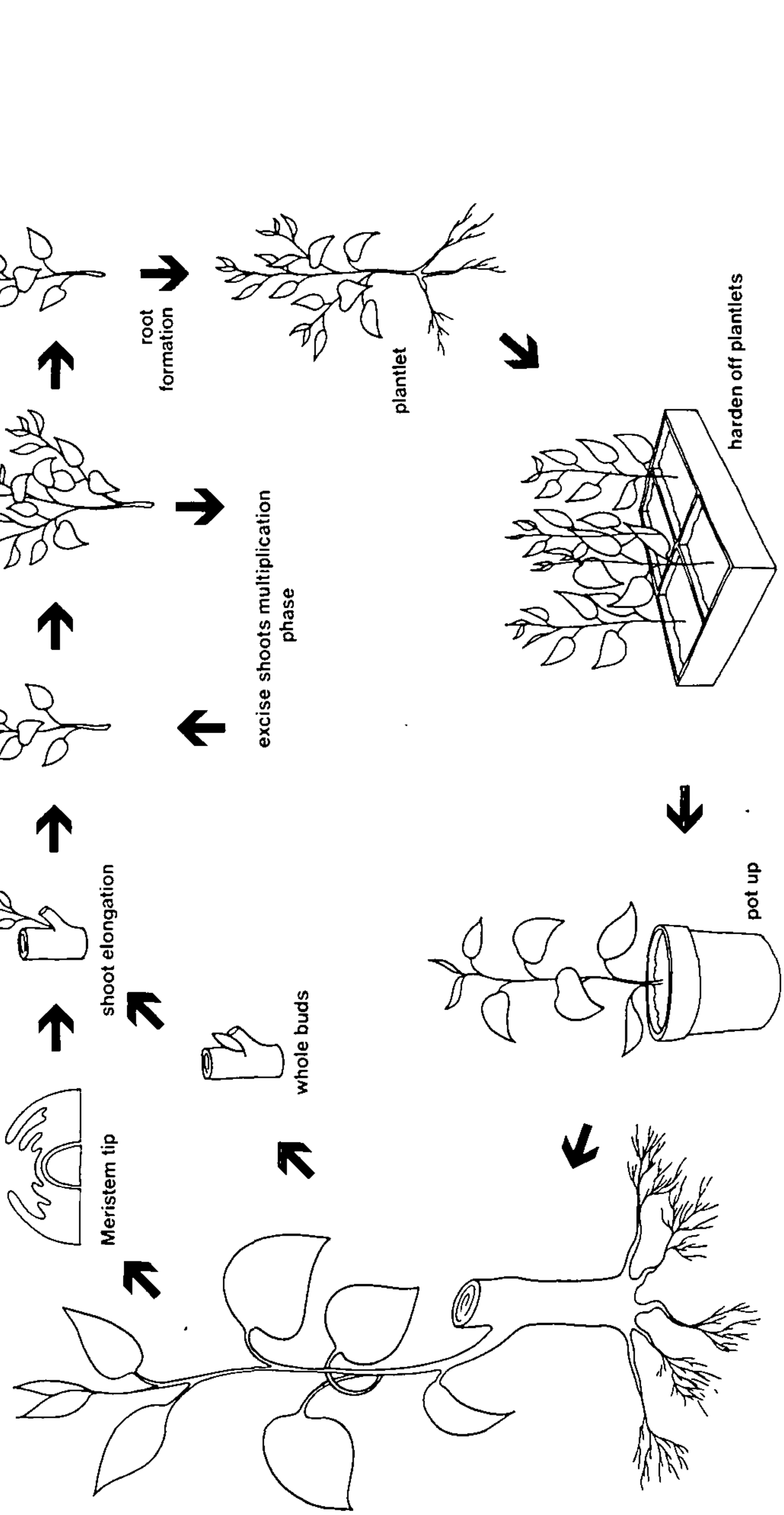

Figure 1. Steps involved in a typical tissue culture micropropagation process.

Growing on. Once the plants are fully hardened off and rooted they can be potted up like conventional plants. Tissue culture is often used to produce a uniform line of plants, e.g. squat multi-branched syngoniums.

What costs are involved? The requirement for expensive facilities and the need for trained personnel means that tissue culture is a more expensive form of propagation than the usual conventional methods. Some factors influencing costs include:

. . . is the species easy or difficult to establish in culture?
. . . multiplication rate.
. . . do the plants need to be rooted in culture?
. . . ease and success rate of hardening off the plants.
. . . the final number of plants required?

Advantages of using tissue culture:

. . . rapid clonal multiplication of valuable selections of plants
. . . multiplication of difficult-to-propagate cultivars
. . . availability all through the year
. . . elimination of viruses from infected plants
. . . maintenance of a nuclear stock of high health material
. . . reduction in a number of nursery stock plants
. . . importation and exportation of plant material
. . . production of new cultivars

Disadvantages:

. . . expensive setting up costs
. . . requirement for skilled staff
. . . the large numbers of plants required
. . . often lengthy research and development
. . . potential for some mutation to take place

So, to answer the question I orginally posed:- Is tissue culture the ultimate in asexual propagation? I believe that definitely it is not. It should not be considered as a replacement for the more traditional forms of propagation but, after considering a number of the points I have made, and understanding the basic principles of the process, it may be a realistic option when considering the propagation of a particular plant.