D. CLARKE: How do you see this propagation method in hardy nursery stock during the next 5 years?

M. STOKES: I think it will depend on co-operation among growers and research stations in establishing which cultivars could be employed economically.

VOICE: What is the time limit between the growing *in vitro* and purchasing smaller rhododendrons?

M. STOKES: Between 1 year and 18 months.

D. CLARKE: Does that include the development time as well? Would that time be from when you have the first plant from the nursery to the point when you receive 10,000 back?

M. STOKES. Providing there were no hiccups and the cultivar responded well — yes, but if there were any hiccups it could be longer.

TEACHING MICROPROPAGATION

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Teaching micropropagation can come into various categories. It is listed in the syllabus for Higher Grade Horticultural Science in the Scottish Certificate of Education for Schools.

At the West of Scotland College it is taught to all Ordinary National Diploma students in their first year in a laboratory class and, in the third year, students from time to time have chosen some aspect of micropropagation for their third year individual projects. It also comes into the crop option of the M.I. Biology course, the B.Sc. students have a laboratory class to introduce the subject to them and as a group may tackle a micropropagation problem. When it comes to the Honours year thesis, two students have chosen some aspect of micropropagation as their remit.

At universities and polytechnics, where post-graduate courses are available, micropropagation can be part, if not all, of the investigations carried out. Under these circumstances more time is available to devote to the culture and the problems which can arise

At the West College we are fortunate in having in the Biology building, equipment available to carry out micropropagation work, i.e *laminar flow benches* (bench with sterile air coming from the back and flowing over the work area), *autoclaves* (pressure cookers to kill bacteria, etc.), *incubators* (heated cabinets

with lights — or *growth cabinets*) and facilities for making up *media* (to grow the cultures on — these can be either solid or liquid).

Before introducing the student to the laboratory, it is necessary to give them some insight into the cleanliness needed and to "scrub up". Fortunately hospital films on the T.V. have made this easier to instill and it is carried out in a light-hearted manner! Terms too are new; *aseptic culture* (free from bacteria, etc.), *contamination* (growths of fungus or bacteria), *differentiation* (growth showing recognisable shoots and roots), *sub-divide* (putting pieces of original culture in new flasks), etc. etc.

With the OND class the method for carnation culture is used. The reasons being: 1) carnation material is easily obtained, a crop being grown in the department; 2) the small tips in the axis of the leaves are easily removed and seen; and 3) the tips already come "sterile wrapped" by the leaves. This cuts down the need to surface sterilise and although this is an important aspect it can be introduced later.

Procedures. The medium (1,000 ml of Knop's solution, 1 ml of NAA, 1 ml vit B_1 (thiamine), and 0.5 ml of Berthelot's solution. No need to adjust the pH which is about 5.5. In addition 40 gms of glucose are added (to provide carbohydrates) has already been prepared and is 20 ml amounts in flasks. The students are told that the medium has to correspond to the plant foods which would be available if the growth was in conventional soil or substrate and are made aware that the glucose will add to risk of contamination.

As well as the medium, all the instruments for use have been autoclaved, and are wrapped in greaseproof paper ready to use. We also buy pre-wrapped small sterile blades which can be used. A white tile has to be swabbed down with methylated spirit and, if necessary, instruments can be flamed after use too. All this again helps the student to realise the need for a sterile working environment.

The plant material has already been washed in distilled water and the students will isolate the small tips and put them into flasks as fast as possible. The flasks contain either solid medium (agar added) 10 or 20 ml, or the plant tissue is placed in a liquid medium on a filter bridge. Plastic flasks can be purchased sterile wrapped and are disposable or, if pyrex or monax glassware is used, they can be autoclaved.

After placing the tips in the flasks these are placed in an incubator at 20 to 23°C with continuous illumination and the students are encouraged to see the progress, or otherwise (!) of the flasks when they wish. In a few days time it is evident how much contamination has occurred and this more than anything

else gets the message across about being careful about conditions. Carnations do not take long to root and the students get the satisfaction of seeing some results from their efforts.

Individual Project - OND. This year (1980) an OND student who had previously worked at Rochfords (house plant firm) was anxious to try growing a batch of *Saintpaulias* using different sized pieces of leaf petioles 2 mm to 6 mm in a Murashige and Skoog medium, keeping it liquid and placing the pieces on a filter bridge. In this instance the student prepared the medium, made the bridges, pipetted the medium into the flasks and carried out the work at a laminar flow bench. The student learned a lot about the preparation necessary to carry out micropropagation and, although there was not any growth on the petiole segments before he left College, he did manage to get some of the flasks free of contamination.

B.Sc. involvement in micropropagation. In the third year of their course, a class of B.Sc. students (1976) carried out micropropagation techniques in *Hostas* and, although the technique was not perfected until the following year with the next group of students, they were made aware of the procedures.

Theses, 1978 and 1980. Both were under the guidance of the Botany Department of the West College and were concerned with problems connected with the production of apple rootstock 'M26' and tuberous-rooted begonias.

1978 — Walter Stewart Reid, with reference to work carried out by Jones and co-workers at East Malling Research Station on apple rootstock production looked at —

1) The potential increase rate which could be obtained *in vitro.*
2) Bacteria on or in the plant material and, if it was present, how it could be eliminated by using antibiotics, and
3) If antibiotics would prohibit or inhibit plant growth in the cultures.

As time is a limiting factor (the experimental work can only be carried out between October-March after which it has to be written up), it may be that some recommendations are arrived at for future work.

1980 — Maria dos Santos. As the culture of tuberous-rooted begonias was already in progress in the Botany Department, and with the Horticulture Department involved initially, and as a local grower had built a small laboratory on his nursery, the student was able to study certain problems in relation to this, namely:

1) the best type of ex-plant to use; bud, micro-leaf, flower peduncle or petiole segments (the latter giving the most consistent and uniform success rate).
2) Surface sterilization, using three strengths of Chloros, solutions — 2%, 5% and 10%.
3) The use of shoot and root promoting substances to get balanced growth of the petiole segments. These segments proved to be the best plant material for surface sterilization, 10% Chloros, being the suitable strength. No conclusions were drawn about 3) and further study would be needed.

To sum up. Micropropagation has such a wide and varied application in horticulture today that the necessity for methods to be taught at all levels is important. At school or college the basics are given and, if the student wishes to continue this work further, training on the job would be provided and certainly a basic knowledge of laboratory methods is necessary to begin with. A few days ago, notification of a M.A.F.F. Post-graduate studentship (University of Nottingham, Department of Agriculture and Horticulture) on "The rapid clonal propagation of tulips — (tissue culture)" came in, leading to a Ph.D. degree. The educational opportunities for micropropagation are there.

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B. RIGBY: You mentioned carnation and a particular recipe which you use. You buy a basic medium and then you add various millilitres of this and that.

L. DICK: With carnations, the solution was made up from scratch but you can buy the particular product. A lot of the time it is a basic Murashige and Skoog medium and then you add other things to it. A lot of the problems in making up the media have been taken away by the availability of products in packets.

A. CARTER: Can I just clear up this Chlorine/Domestos question? I think the advice was 10% Chloros — were you meaning 1% chlorine when you diluted it or are you actually using 1%?

M. STOKES: A 10% solution of the retail product

HANDLING PLANTS AT EGGERT PEDERSEN'S PLANTESKOLE, NYKOBING, DENMARK

ROGER PLATTS

Perryhill Nurseries
Hartfield, Sussex

During 1977/1978 I worked for Eggert Pedersen's nurseries on the island of Lolland in Southern Denmark doing a variety of tasks, mainly concerned with plant handling. A lack of knowledge of the Danish language obviously limited the jobs I could be asked to do.

I was interested in their system of plant handling because of the vast area covered with container plants. Approximately 80% of the staff of up to 200 were employed to move plants, and this meant that a very efficient handling system was necessary.

The plants were potted into rigid pots in a large potting shed housing four large potting benches for 16 people. During the winter the potting was done by hand; in the summer a potting machine was used.

As the plants were potted they were placed in small wooden boxes; eight 3½ litre pots were put in each box and the boxes were then loaded onto four-wheeled trailers, 33 boxes per trailer.